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REPORT

Withernsea Wastewater Treatment Works Long Sea Outfall (LSO) Replacement

Appendices

Client: Yorkshire Water Services

Reference: I&BPB5063R100F01
Status: Final/01
Date: 15 February 2019

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Document title: Withernsea Wastewater Treatment Works Long Sea Outfall (LSO) Replacement

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Date / initials:	14/02/19 / WH

Classification
Project related

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Appendix A – ERYC Screening Response

EAST RIDING
OF YORKSHIRE COUNCIL

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78 East Street
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Our Ref: 18/00207/EIASCR
Contact: Mr Matthew Sunman
Direct Line: 01482 393735
Email: matthew.sunman@eastriding.gov.uk

Date: 25.01.2018

Screening Opinion for Environmental Impact Assessment (EIA):

Proposal – Construction of a new Withernsea Wastewater Treatment Works and associated infrastructure, including Rising Main and Long Sea Outfall following the demolition of the existing Wastewater Treatment Works

At – Waste Water Treatment Works, Holmpton Road, Hollym, East Riding of Yorkshire

I refer to your email dated 17 January 2018. I am writing to provide you with a screening opinion of the Local Planning Authority (LPA) under S.5 of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2017 for the above proposal (see attached).

Given its understanding of the site environment and the development proposal at the time of writing, the LPA considers that the development proposal would not comprise EIA development. As such, the LPA cannot ask you to undertake an EIA of the development proposal or submit an Environmental Statement (ES) with the application for planning permission.

Yours Sincerely

Andy Wainwright
Strategic Development Services Manager

Enc: Screening Opinion

Screening Opinion for Environmental Impact Assessment (EIA):

Proposal – Construction of a new Withernsea Wastewater Treatment Works and associated infrastructure, including Rising Main and Long Sea Outfall following the demolition of the existing Wastewater Treatment Works

At – Waste Water Treatment Works, Holmpton Road, Hollym, East Riding of Yorkshire

Introduction

The purpose of this document is to provide a Screening Opinion on the need for an EIA in relation to the above development proposal. It therefore provides an outline of relevant legislation and guidance, as well as the Local Planning Authority's (LPA's) interpretation and application of this legislation and guidance in the case concerned.

Relevant Legislation and Guidance

The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2017 require the submission of an Environmental Statement (ES) with applications for planning permission for "EIA development".

The 2017 Regulations differentiate two types of EIA development - Schedule 1 and Schedule 2. Schedule 1 development (and changes/extensions thereto) is EIA development and therefore requires an EIA. Schedule 2 development (and changes/extensions thereto) is only EIA development if - in the opinion of the LPA - it is likely to have significant effects on the environment by virtue of factors such as size, nature or location.

In seeking to determine whether the Schedule 2 development comprises EIA development, the LPA is required by the Regulations to take into account the criteria as set out in Schedule 3 (i.e. selection criteria for screening Schedule 2 development):

1. Characteristics of development (e.g. size, cumulation, use of natural resources, waste production, pollution and nuisances, risk of accidents);

2. Location of development (i.e. environmental sensitivity with regard to existing land use, relative abundance and regenerative capacity of natural resources in area, absorption capacity of the natural environment - and in particular areas such as wetlands, coastal zones, nature resources, densely populated areas etc);

3. Characteristics of the potential impact (i.e. the potential significant effects of development in relation to the extent, magnitude, complexity, probability, duration, frequency and reversibility of the impact concerned).

Statutory Guidance

The National Planning Practice Guidance (NPPG) provides guidance to LPA's on the interpretation and implementation of the 2017 Regulations.

In order to help LPA's determine the need for EIA of a development proposal, the NPPG (Paragraph 030) provides a flow chart with five tests ("the fivefold test") as follows:-

1. Is the development type listed in Schedule 1?

2. Is the development type listed in Schedule 2?

3. If Schedule 2 development, is it in a sensitive area?

4. If Schedule 2 development, but is not in a sensitive area, does it meet any of the relevant thresholds and criteria in Schedule 2?

5. If Schedule 2 development (and is either in a sensitive area or meets one of the relevant thresholds and criteria in Schedule), is it likely to have a significant adverse effect on the environment?

The NPPG includes, at paragraph 058, an Annex on Indicative Screening Thresholds, to aid the LPA in assessing whether a project is likely to have significant environmental effects. The table also gives an indication of the types of impact that are most likely to be significant for particular types of development.

Application of Legislation and Guidance to the Development Proposal Concerned

Applying this "fivefold test" to the development proposal concerned, it is possible to state the following:-

a. The development is not a Schedule 1 development.

b. The development is Schedule 2 development because it falls into the category defined by section 11(c) waste water treatment plants.

c. The development is not in a sensitive area as defined within the 2017 regulations.

d. The development does meet the relevant applicable thresholds due to the fact that the area of the development exceeds the applicable threshold of 1000 square metres.

e. The proposed development would not give rise to any significant effects on the environment within the meaning of the 2017 Regulations and the associated guidance.

Conclusion

The proposal is for the construction of a new Waste Water Treatment Plant.

The proposal falls within Category 11 (c) of Schedule 2 and exceeds the relevant applicable threshold due to the area of the development exceeding 1,000 square metres (0.1 ha).

The site is not situated within a sensitive area.

Due to the fact the site meets the relevant applicable thresholds in schedule 2, the selection criteria in schedule 3 requires consideration.

Characteristics of development – The proposal would be sited adjacent to the south of Hollym village. The existing WWTW would be removed which is closer to the settlements of Withernsea and Hollymn as well as the fast eroding Holderness coastline. There would not be a significant use of natural resources or production of waste. Pollution, nuisance and the risk of accidents is controlled under separate legislation.

Location of development – The existing land use is arable (not of the highest grade). There are resources in the area which the development requires to be effective including connection to the Grid for power and foul water drainage infrastructure to receive foul water. The immediate area is not densely populated.

Characteristics of the potential impact – The geographical area and size of population affected are very small. There is no transfrontier impact. The impact would be most significant during construction. Impacts during operation (e.g. noise, odour etc) can be mitigated through appropriate design and conditions.

Taking into the account the selection criteria at Schedule 3 of the 2017 Regulations and the advice at Paragraph 58 of the NPPG, the Screening Opinion of the LPA is that the proposal does not comprise EIA development.

This opinion is based on information submitted with screening opinion request reference 18/00207/EIASCR. Any changes to this scheme may materially change the outcome of the Local Planning Authority's Opinion.

Appendix B – Planning Permission for Withernsea WwTW

EAST RIDING
OF YORKSHIRE COUNCIL

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www.eastriding.gov.uk
Stephen Hunt Head of Planning and Development Management

Ove Arup And Partners Limited
FAO - Mrs Laura Marchant
Rose Wharf
78 East Street
Leeds
LS9 8EE

Application No: **DC/18/02089/CM/STRAT**
PP-06885672

Case Officer: **Mr Matthew Sunman**

NOTICE OF DECISION

TOWN AND COUNTRY PLANNING ACT 1990

Application Type: **County Matter**

Proposal: **Construction of a new wastewater treatment works for Withernsea comprising two open treatment cells approximately 1.9ha each, associated works and improvements to the access with Myers Lane and A1033**

Location: **Land South Of Happy Landings Patrington Road Hollym East Riding Of Yorkshire HU19 2QJ**

Applicant: **Yorkshire Water**

The above application has been considered by the Council in pursuance of their powers under the above mentioned Act and has been **APPROVED**, in accordance with the terms and details as submitted, subject to the following conditions:

1. The development hereby permitted shall be begun before the expiration of three years from the date of this permission.

   This condition is imposed in order to comply with the provisions of Section 91 of the Town and Country Planning Act 1990, as amended by Section 51 of the Planning and Compulsory Purchase Act 2004 and in order to ensure that the Local Planning Authority retains the right to review unimplemented permissions.

2. The development hereby permitted shall be carried out in accordance with the following approved plans:

Drawing No.	Description	Date Received
Untitled	High Level Landscaping Plan	26.06.2018
1.1 P1	Topographical Survey	26.06.2018
41522050/01/G/0701 REV A	Location Plan	26.06.2018
41522050/01/G/0702 REV A	Site Elevations and Overview Plan	26.06.2018
41522050/01/G/0703 REV A	Proposed Sections Plan	26.06.2018
WTS-ARP-CH-001 REV P02	Junction Layout Plan	25.09.2018
WTS-ARP-CH-005 REV P01	Haul Road Layout Plan	25.09.2018

This condition is imposed in accordance with policy ENV1 of the East Riding Local Plan and for the avoidance of doubt and to ensure that the development hereby permitted is carried out in accordance with the approved details in the interests of the character and amenity of the area and the provisions of the development plan.

3. No development shall take place on site until:

o a scheme for the discharge of surface water from the site, incorporating a sustainable drainage system and associated management and maintenance plan;
o full survey of the field drain running through the eastern cell and adjacent watercourses to determine flow and confirmation if any diversions are required; and
o drainage ditch pollution prevention measures during construction;

Have been submitted to and approved in writing by the Local Planning Authority. Development shall proceed in accordance with the approved details, unless otherwise agreed in writing with the Local Planning Authority, and shall not be brought into use until surface water drainage has been constructed in accordance with the approved scheme, and shall be managed and maintained in accordance with the approved plan.

This pre-commencement condition, as agreed with the applicants agent, is imposed in accordance with policy ENV6 of the East Riding Local Plan and to prevent the increased risk of flooding and to prevent pollution of controlled waters by ensuring the provision of a satisfactory means of surface water disposal.

4. A) No demolition/development shall commence until a Written Scheme of Investigation has been submitted to and approved by the Local Planning Authority. The scheme shall include an assessment of significance and research questions; and:

1) The programme and methodology of site investigation and recording.
2) The proper identification and evaluation of the extent, character and significance of archaeological remains within the application area.
3) Community involvement and/or outreach proposals.
4) The programme of post investigation assessment.
5) Provisions to be made for analysis of the site investigation and recording.
6) Provisions to be made for publication and dissemination of the analysis and records of the site investigation.
7) Provisions to be made for the archive deposition of the analysis and records of the site investigation.
8) Nomination of a competent person or persons/organisation to undertake the works set out within the Written Scheme of Investigation.

B) No demolition. Development shall take place other than in accordance with the Written Scheme of Investigation approved under part (A).

C) Unless otherwise agreed beforehand in writing with the Local Planning Authority, the development shall not be occupied until the site investigation and post investigation has been completed in accordance with the programme set out in the Written Scheme of Investigation approved under part (A) and the provisions made for analysis, publication and dissemination of results and archive deposition has been secured.

The programme shall be carried out as approved, unless otherwise agreed in writing beforehand with the Local Planning Authority (to protect archaeological interests) and to comply with policy ENV3 of the East Riding Local Plan Strategy Document as well as section 16 of the National Planning Policy Framework.

This pre-commencement condition, as agreed with the applicant's agent, is imposed to ensure adequate archaeological recording and mitigation measures can be identified and incorporated into the scheme.

5. Development shall not commence until a Construction Traffic Management Plan (CTMP) incorporating details of deflectograph and/or visual/video surveys (To be agreed with Streetscene Services) of the haul and delivery route to the site, including a programme and methodology for improvements and repairs and the funding provision for improvements/repairs has been submitted to and approved in writing by the Local Planning Authority. In addition during the construction period any improvement or repair works on the approved routes shall be completed in accordance with the approved programme and methodology and the CTMP shall be up-dated in consultation with the Local Planning Authority. The CTMP must include details of reinstatement of Myers Lane to its more natural appearance at the end of the construction works.

   This pre-commencement condition, as agreed with the applicant's agent, is imposed in order to ensure that highway safety and any necessary improvements and repairs to the highway network as a consequence of the development is carried out in accordance with an approved Construction Traffic Management Plan in the interests of highway safety.

6. Prior to the commencement of the development details shall be submitted to and approved in writing by the Planning Authority showing of the improvement works to Myers Lane. Development shall be carried out in accordance with the approved details before the development hereby approved becomes operational unless otherwise agreed in writing with the Local Planning Authority.

   This pre-commencement condition, as agreed with the applicant's agent, is imposed in the interest of highway efficiency and safety to ensure safe access and egress from

7. No development shall take place on site until a Construction Method Statement (CMS) has been submitted to, and approved in writing by, the local planning authority. The approved Statement shall be adhered to throughout the construction period.

   The Statement shall provide for:

   i) the parking of vehicles of site operatives and visitors
   ii) loading and unloading of plant and materials
   iii) storage of plant and materials used in constructing the development
   iv) the erection and maintenance of security hoarding including decorative displays and facilities for public viewing, where appropriate
   v) measures to reduce mud deposition offsite from vehicles leaving the site including wheel washing facilities
   vi) measures to control the emission of dust and dirt during construction including arrangements to monitor dust emissions from the development site during the construction phase
   vii) a scheme for recycling/disposing of waste resulting from demolition and construction works
   vii) measures for the protection of the natural environment
   viii) the control of noise and vibration emissions from construction activities including groundwork's and the formation of infrastructure including arrangements to monitor noise emissions from the development site during the construction phase.

   This pre-commencement condition, as agreed with the applicant's agent, is imposed in accordance with policies ENV1 and EC4 of the East Riding Local Plan and in order to minimise detrimental effects to the neighbouring amenities, the amenities of the area in general, detriment to the natural environment through the risks of pollution and dangers to highway safety, during the construction phase.

8. In the event that contamination is found at any time when carrying out the approved development, that was not previously identified, it must be reported immediately to the local planning authority. An appropriate investigation and risk assessment must be undertaken, and where remediation is necessary, a remediation scheme must be prepared by competent persons and submitted to the local planning authority for approval. Following completion of measures identified in the approved remediation scheme, a verification report that demonstrates the effectiveness of the remediation carried out must be submitted to and approved in writing by the local planning authority.

   This condition is imposed to ensure that risks from land contamination to the future users of the land

and neighbouring land are minimised, together with those to controlled waters, property and ecological systems, and to ensure that the development can be carried out safely without unacceptable risks to workers, neighbours and other receptors.

9. Within six months of the commencement of development, a landscaping scheme shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall be based on measures detailed in the submitted 'High Level Landscape Plan' (drawing no. 258408). The plan shall be prepared by a suitably qualified specialist, and include a timetable for implementation. This shall include planting details, including planting plans, specifications of the planting to be undertaken including details of the species, size, number/density of plants, shrubs, hedgerows and trees; and a programme of implementation, maintenance and aftercare.

   The scheme shall be implemented as approved in writing by the Local Planning Authority.

   This condition is imposed to ensure the provision, implementation and maintenance of an appropriate landscape scheme, in the interests of conservation and enhancement of landscape character and public visual amenity.

10. The hedgerows established by condition 9 shall thereafter be allowed to grow to a minimum height of 4m and subsequently retained at a minimum height of no less than 4m.

    This condition is imposed to ensure the maintenance of an appropriate soft landscape provision, in the interests of the conservation and enhancement of landscape character and public visual amenity.

11. In this condition "retained tree" means an existing tree which is to be retained in accordance with the approved plans and particulars; and paragraphs (a) and (b) below shall have effect until the expiration of 5 years from the date of the occupation of the building for its permitted use, or occupation of the final dwelling on the site to be occupied.

    (a) No retained tree shall be cut down, uprooted or destroyed, nor shall any retained tree be topped or lopped other than in accordance with the approved plans and particulars, without the written approval of the Local Planning Authority. Any topping or lopping approved shall be carried out in accordance with British Standard (3998 Tree Work).

    (b) If any retained tree is removed, uprooted or destroyed or dies, another tree shall be planted at the same place and that tree shall be of such size, species and maturity, and shall be planted at such time, as may be specified in writing by the Local Planning Authority.

    This condition is imposed as the Council is under a statutory obligation when considering planning applications to consider whether it is necessary to take steps to preserve existing trees. There are trees within or near the site and these contribute to the character and appearance of the area. If these trees are to be retained it is important that they are protected from accidental damage during construction work. It is considered that the above details are required in accordance with policy ENV1of the East Riding Local Plan and are necessary to enable the Council to consider the effect of the proposed development on these trees.

12. The development hereby permitted shall be implemented in strict accordance with the ecological avoidance and mitigation measures detailed in section 6 of the Preliminary Ecological Appraisal (ARUP, June 2018), section 5 of the Breeding Bird Survey Report (ARUP, July 2018), and section 5 of the Water Vole Report (ARUP, June 2018), any variation thereto shall be agreed in writing by the local planning authority before such change is made.

    This condition is imposed to ensure that all species are protected having regard to the Wildlife and Countryside Act 1981 (as amended) and The Conservation of Habitats and Species Regulations 2017.

13. During construction no machinery shall be operated, no process shall be carried out and no construction traffic shall enter or leave the site outside the hours of 0700 to 1800 hours Monday to Friday nor at any time on Saturdays, Sundays or Bank Holidays unless previously approved in writing by the Local

Planning Authority.

This condition is imposed to protect the amenity of local residents from noise.

14. The rating level of noise from the development hereby approved and/or all plant associated with the site collectively shall not exceed the background noise level by more than 5 dB(A) at any time. Noise levels shall be taken at the boundary of the nearest noise sensitive premises. Measurements and assessment shall be made according to BS 4142:2014.

    This condition is imposed in accordance with policy ENV1 of the East Riding Local Plan and in order to protect the amenities of nearby properties from adverse effects due to noise nuisance.

Notes for Applicant/Agent

Natural England

Greater Wash SPA - Should timescale slip with regards work on the inshore area potentially affecting Red Throated Diver Natural England recommends the applicant and contractor follow code of practice with regards to work on the inshore area as follows:

o Avoiding and minimising traffic where possible during the most sensitive times
o Existing shipping lanes or vessel transit routes should be used where at all possible to avoid additional disturbance
o Developers should make vessel operators aware of the importance of the species (tool box talk) avoiding rafting birds either en-route to pipe-lay or from operational port and where possible avoid disturbance to areas with high diver density.

Highway Development Management

1/ The Applicant/Agent must contact the East Riding of Yorkshire Council's Streetscene Services (Highways), Grovehill Depot, Annie Reed Road, Off Grovehill Road, Beverley, HU17 0LF, tel: 01482 395739 regards the construction and specification of any permanent or temporary works at the junction of Myers Lane/A1033 and the works along Myers Lane before any works are commenced on the public highway. Details will also be required for the reinstatement of the temporary works. This will include the assessment of the culvert on Myers Lane with respect to its capacity to facilitate the movement of construction traffic.

This will entail entering into a Section 62 agreement under the Highways Act 1980 in order to ensure that any improvement works carried out within the existing public highway are constructed to the required adoptable standard. There is normally a three month period associated with traffic management act notifications therefore contact with D. Richards 01482 393939 is advised to discuss your proposals.

2/ A joint dilapidation survey will be carried by the Streetscene Area Engineer and the Applicant's Representative out prior to the works, with the extent to be agreed although anticipated Include Myers Lane and a section of the A1033. At this meeting the methodology for carrying out regular inspections and the agreement of the mechanisms for any required maintenance works resulting from any damage by construction traffic. Details for the Area Engineer (Area 5) are Mike Peeke 01482 395739 and a minimum notice period of 5 working days required to set up this meeting.

3/ The extent of the Public Highway on Myers Lane should be agreed with East Riding of Yorkshire Council Council's Streetscene Services (Highways), Grovehill Depot, Annie Reed Road, Off Grovehill Road, Beverley, HU17 0LF, tel: 01482 395739. Any work proposed on land adjacent to the public highway need to be agreed with the land owner.

Lead Local Flood Authority

Flood Risk Management Consent.
Consent will be required from the Flood Risk Management Section of the Council for any proposed

diversion, culverting or proposed discharge into the watercourse, prior to any works commencing on the site. The applicant should contact the Flood Risk Management Section on 01482 395810 for further information.

Public Rights of Way

The scale of the Definitive Map and the information contained within the accompanying statement make precise determination of the PROW lines extremely difficult. Applicants should satisfy themselves that they have determined this first prior to submitting an application. Applicants should not use the planning process to determine the width, status or precise route of a public right of way. It may be from time to time that during the application process, during construction, or post construction that evidence is presented to the authority that would suggest that any route incorporated within a development, or adjacent to a development site, is not on the correct line, even though the line on the Definitive Map might appear to be protected. The authority is legally bound to consider this evidence and it could lead to a situation, through no fault of the Planning or Highway Authority that a route is built upon, or obstructed by gardens or boundary walls. Applicants should be aware of this, and make all reasonable attempts to seek clarification of this prior to commencing development.

The granting of planning permission does not grant permission to obstruct a public right of way, and applicants should ensure that they have protected the line shown on the Definitive Map.

Interference or improvement of the surface of a public right of way requires the specific permission of the PROW section of the East Riding Council. Interference without permission constitutes an offence under the Highways Act.

Applicants should ensure that they have the necessary private vehicular rights to use the public right of way as driving a motor vehicle on a footpath, bridleway or restricted byway may constitute a criminal offence. The rights of way section reserves the right to have sight of this documentary evidence.

Relevant Planning Policies

Joint Waste Local Plan (JWLP) (2004)

Policy W2 Detailed planning considerations
Policy W4 Sequential approach for site selection
Policy W11 Waste management development will not be allowed if it harms groundwater source protection, aquifers or surface waters
Policy W12 Coastal erosion
Policy W14 Trees, hedgerows and woodland
Policy W17 Waste development on agricultural land
Policy W19 Archaeology
Policy W22 Transport - Alternative transport methods
Policy W23 Adequacy of local road network
Policy W24 Transport Improvements
Policy W26 Self sufficiency
Policy W36 Waste Water Treatment

East Riding Local Plan Strategy Document (ERLP SD) (April 2016)

Policy S1 Presumption in favour of sustainable development
Policy S2 Addressing climate change
Policy S3 Focusing development
Policy S4 Supporting development in Villages and the Countryside
Policy EC1 Supporting the growth and diversification of the East Riding economy
Policy EC4 Enhancing sustainable transport
Policy EC6 Protecting mineral resources
Policy ENV1 Integrating high quality design
Policy ENV2 Promoting high quality landscape

Policy ENV3 Valuing our heritage
Policy ENV4 Conserving and enhancing biodiversity and geodiversity
Policy ENV5 Strengthening green infrastructure
Policy ENV6 Managing environmental hazards
Policy A5 Holderness and Coastal sub area

National Planning Policy

National Planning Policy Framework (NPPF) (2018)
National Planning Practice Guidance (PPG) (2014)
National Planning Policy for Waste (NPPFW) (2014)
Waste Management Plan for England (2013)

Other Documents

East Riding of Yorkshire Landscape Character Assessment (2005)

In making this decision the Council has followed the requirements in paragraph 38 of the National Planning Policy Framework.

Signed ..... Date : 31 October 2018

Alan Menzies, Director of Planning and Economic Regeneration.

Notes to accompany application no DC/18/02089/CM/STRAT

1. **Town and Country Planning Act**
Any approval given by this notice of decision refers only to that required under the Town and Country Planning Acts and does not include any consent or approval under other legislation, e.g. Building Regulations.

2. **Duration of Permission**
The Town and Country Planning Act 1990 (as amended by the Planning and Compulsory Purchase Act 2004) provides that every permission shall be granted subject to a condition that the development must be begun within a specified time period. This period of time can vary depending on the type of application and the circumstances of the particular case. Usually there will be a specific condition on the notice of decision itself specifying the relevant period but if this has not been imposed, please refer to the provisions of Section 51 of the Planning and Compensation Act 2004 for a definition of the relevant period. Further guidance on this is also available in Circular 8/2005.

3. **Appeals to Planning Inspectorate**
If you are aggrieved by this decision you can appeal to the Planning Inspectorate within six months of the date of this decision (longer in special circumstances) The Secretary of State need not consider an appeal if it seems to him that the Local Planning Authority could not have granted planning permission for the proposed development or could not have granted it without the conditions they imposed, having regard to the statutory requirements, to the provision of any development order and to any directions given under a development order. The Planning Inspectorate have introduced an online appeals service which you can use to make your appeal online. You can find the service through the Appeals area of the Planning Portal – see http://www.planningportal.gov.uk/planning/appeals/online/makeanappeal. If you are unable to access the online appeal form, please contact the Planning Inspectorate to obtain a paper copy of the appeal form on telephone number: 0303 444 5000. The Inspectorate will publish details of your appeal on the internet (on the Appeals area of the Planning Portal). This may include a copy of the original planning application form and relevant supporting documents supplied to the local authority by you or your agent, together with the completed appeal form and information you submit to the Planning Inspectorate. Please ensure that you only provide information, including personal information belonging to you that you are happy will be made available to others in this way. If you supply personal information belonging to a third party please ensure you have their permission to do so. More detailed information about data protection and privacy matters is available on the Planning Portal.

4. **Purchase Notice**
If either the Local Planning Authority or the Secretary for the Environment refuses permission to develop land or grants it subject to conditions, the owner may claim that he can neither put the land to a reasonably beneficial use in its existing state nor render the land capable of a reasonable use by the carrying out of any development which has been or would be permitted. In these circumstances, the owner may serve a purchase notice on the Council in whose area the land is situated. This notice will require the Council to purchase his interest in the land in accordance with the provisions of Part VI of the Town and Country Planning Act 1990.

5. **Disabled Persons**
Where permission is granted and relates to development resulting in the provision of buildings or premises to which the public are to be admitted (on payment or otherwise) or of premises being office, shop, railway or factory premises in which persons are employed to work, your attention is directed to Section 4, 7 and 8a of the Chronically Sick and Disabled Persons Act 1970 and to the Code of Practice for Access for the Disabled to Buildings: being the British Standards Institution Code of Practice BS 5810: 1979.

6. **Fire Brigade Access**
If planning permission is granted and relates to the erection or extension of a building, your attention is drawn to the provisions of Section 14 of the Humberside Act 1982 whereby the Council are required to reject plans submitted for building regulations approval if the plans do not show adequate means of access for the fire brigade to the building or if the erection of the building or extension would render inadequate the means of access for the fire brigade to a neighbouring building.

7. **Affects Public Right of Way**
A grant of planning permission does not entitle a developer to obstruct a public right of way. Development, in so far as it affects a public right of way, should not be commenced, and the right of way should be kept open for public use, until the necessary order under Section 247 or Section 257 of the Town and Country Planning Act 1990 for the diversion or extinguishment of the right of way has been made and confirmed.

8. **Approval of Details Required by Condition**
Please note that there is now a fee payable for the submission of any matters required to be submitted for approval by any conditions attached to this permission. The fee is payable for each submission, not for each condition, so you may wish to minimise the fee payable by submitting all of the outstanding details required by all of the conditions at the same time. Relevant forms for the submission of such details are available on the Planning Portal www.planningportal.gov.uk together with details of the fee payable. Please be aware that conditions which require correspondence between the Local Planning Authority and outside bodies could take approximately four weeks, to agree on the suitability of the details submitted. It is therefore in your own interests to submit such information at the earliest opportunity.

9. **Amendment to Plans**
If you are proposing to alter the plans hereby approved you should first consult the Local Planning Department.

Appendix C – MMO Screening Response

Marine Management Organisation

Lancaster House
Hampshire Court
Newcastle upon Tyne
NE4 7YH

T 0300 123 1032
F 0191 376 2681
www.gov.uk/mmo

Emma Jose
Project Manager, YORKSHIRE WATER SERVICES LTD
LIVINGSTONE HOUSE
CHADWICK STREET
LEEDS
LS10 1LJ

Case reference: EIA/2018/00001

28th February 2018

Dear Ms Emma Jose,

The Marine Works (Environmental Impact Assessment) Regulations 2007, as amended ("the Regulations")
Request for a screening opinion - Withernsea Wastewater Treatment Works

Thank you for your application dated 17 January 2018, requesting a formal screening opinion from the Marine Management Organisation (MMO) in respect to the proposed scheme to replace the Withernsea Wastewater Treatment works.

Background

It is our normal procedure to consider such applications in compliance with our obligations under the Regulations.

In considering these Regulations, the MMO must determine whether the works envisaged are a project listed in Schedule A1 (for which an Environmental Impact Assessment (EIA) is mandatory) or a Schedule A2 project within the Directive.

If the works are determined to be a Schedule A2 project, consideration should be given to the nature of the project, having regard to its size, the scope of the works and its location. This will assess the potential for it to have a significant effect on the environment and take account of a range of factors including, the materials to be used; the likelihood that the works could bring about short or longer-term changes to marine environment, natural process or interactions with existing activities; the generation of wastes or release of pollutants and cumulative effects.

MMO Screening Opinion

On reviewing the information you supplied, I am of the opinion that the works proposed would require an EIA under the Regulations. Please see the attached document for the MMO screening opinion.

Your feedback

Marine Management Organisation

Lancaster House
Hampshire Court
Newcastle upon Tyne
NE4 7YH

T 0300 123 1032
F 0191 376 2681
www.gov.uk/mmo

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Finally, If you have any queries or require clarification on any of the above, then please do not hesitate to contact me.

Yours sincerely

Miss Kath Saunders
+44 (0)20 8026 1366
kath.saunders@marinemanagement.org.uk

Marine Management Organisation

Screening Opinion

Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) ("the Regulations")

Title: Withernsea Wastewater Treatment Works (WwTW)

Applicant: Yorkshire Water Services Ltd

MMO Reference: EIA/2018/00001

Contents

1. Proposal

Withernsea Wastewater Treatment Works (WwTW)

1.1 Project Background

The existing Withernsea Waste Water Treatment Works (WwTW) serves the local community of Withernsea and surrounding area. The facility comprises the WwTW itself, which is located approximately 1.5km south of Withernsea, and the Long Sea Outfall (LSO), which originates on the coast near Hollym and extends approximately 1km offshore. Yorkshire Water Services (YWS) has identified the asset as at risk from ongoing coastal erosion with an estimated remaining operational life of 2 to 10 years.

To address the urgent need for a replacement WwTW, YWS has proposed a scheme to replace the existing asset, giving a projected operational life of 100 years. The scheme comprises four main components:

1. Main Site: Construction of a new WwTW further inland.
2. Rising Mains: Two rising mains to be constructed to service the local residential areas.
3. Long Sea Outfall: Construction of a new LSO to service the proposed new WwTW. To be built as close as practicable to the existing LSO and extend approximately 1km from the current shoreline.
4. Upon completion of the proposed works to demolish the existing WwTW and partial demolition of the existing LSO.

YWS has therefore requested an Environmental Impact Assessment (EIA) Screening Opinion from the MMO in respect of the above described works.

2. Location

The Withernsea Waste Water Treatment Works proposed scheme is located at Withernsea and Hollym, East Riding of Yorkshore. The terrestrial aspect of the scheme is spread over approximately 8km^2, from Withernsea in the north to Hollym in the south, and extends approximately 2km inland from the coast. The offshore aspect of the scheme extends approximately 1km offshore from the coast. The footprint of the scheme is displayed in Figure 1 below.

Figure 1: Withernsea Waste Water Treatment Works Scheme Location

3. Environmental Impact Assessment (EIA)

Council Directive 2011/92/EU (as amended) on the assessment of the effects of certain public and private projects on the environment ("the EIA Directive") aims to protect the environment and the quality of life by ensuring that projects which are likely to have significant environmental effects by virtue of their nature, size or location are subject to an EIA before permission is granted.

The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) ("the Regulations") transpose the EIA Directive into UK law for marine licence applications.

The Marine Management Organisation (MMO) considers that the proposed works are capable of falling under Schedule A2 of the Regulations, specifically:

Article 75*; "Waste-water treatment plant (unless included in Schedule A1)."*

In accordance with Regulation 8 of The Regulations, the MMO must determine that an Environmental Impact Assessment is required in relation to the proposed works, if it is concluded that the project in question is likely because of its size, nature or location, to have significant effects on the environment; an assessment of the potential impacts is set out below:

3.1 EIA Screening Opinion

Areas have been identified which are protected under international and national legislation which could be directly affected by the development. These are; The Greater Wash potential Special Protection area (pSPA) and Holderness Inshore Marine Conservation Zone (MCZ).

The qualifying features and conservation objectives of the pSPA are outlined below:

Qualifying features:

- Red-throated diver (non-breeding)
- Common scoter (non-breeding)
- Litte gull (non-breeding)
- Sandwich tern (Breeding)
- Common tern (Breeding)
- Little tern (Breeding)

Conservation objectives:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

The works, particularly the coastal and nearshore aspects, may have the potential to disturb the species during breeding, foraging, overwintering and passage. The works may also have the potential for temporary, and locally permanent destruction of the habitats on which the qualifying features rely.

The protected features and management approach of the MCZ are outlined below:

Protected features:

- Intertidal sand and muddy sand
- Moderate energy circalittoral rock
- Subtidal coarse sediments
- Subtidal mixed sediment
- Subtidal sand
- Subtidal mud
- Spurn Head.

The management approach is to maintain in favourable condition.

The works, particularly the coastal and nearshore works may have the potential for temporary, and locally permanent destruction of the protected habitats of the MCZ.

It has been deemed that the development has the potential to directly impact both the Greater Wash pSPA and the Holderness Inshore MCZ.

The Humber Estuary Ramsar, SPA and Site of Special Scientific Interest (SSSI) site has also been identified within 5km of the works. At this time, due to the distance of the works from these sites, no significant direct impacts have been identified. However, there is the possibility for functional linkage of impacts, particularly to mobile species.

In addition, several physical changes to the environment have been identified as a result of the works. The changes identified are based on this initial assessment at screening, and therefore the list may not be exhaustive. In summary these relate to:

- Temporary changes of land use from insertion of access roads through both agricultural land and the cliff to allow access to the foreshore.
- Temporary construction compound and HDD works east of Hollym.
- Permanent change of land use where the proposed WwTW is placed and from installation of the new LSO and rising mains.
- Clearance of land for; main site, HDD compound, trench operations (onshore), cut and fill works, and directional drilling (off and onshore).
- Intrusive ground investigations (off and onshore).
- Dredging and shallow trenching for LSO (offshore).
- Additional terrestrial and marine traffic.

In conclusion, the proposed activities and physical changes to the environment have the potential to impact on a local and regional scale. Should the scheme undermine the conservation objectives of the European designated areas, and impact on qualifying features, this may impact the Natura 2000 network as a whole. The scheme may also contravene the management approach of the MCZ to maintain in a favourable condition.

Not with-standing the major significance criteria identified, there are also several significance impact criteria of moderate identified from the works. In summary these relate to; permanent loss of green belt land, permanent loss of habitat and resource of the agricultural land, the potential for pollution of controlled waters and the terrestrial environment, risks to human health, nuisance and disturbance to local populations.

It is therefore the opinion of the MMO that the proposed activity as described will have significant effects on the environment and is thereby **screened into** requiring an Environmental Impact Assessment under the Regulations. Regard to the above points must be given when producing the subsequent Environmental Statement.

It must also be noted that the works, as described will also require a marine licence under Part 4 of the Marine and Coastal Access Act 2009.

It must be noted however that the works, as described will also require a marine licence under Part 4 of the Marine and Coastal Access Act 2009 and sufficient regard must be given to the above points when submitting any application for a marine licence.

Kath Saunders

Marine Licensing Case Officer

27th February 2018

Appendix D – Environment Agency Discharge Permit

MODIFICATION OF CONSENT TO DISCHARGE

ENVIRONMENT AGENCY

WATER RESOURCES ACT 1991

(AS AMENDED BY THE ENVIRONMENT ACT 1995)

TO: Yorkshire Water Services Limited
Western House
Halifax Road
Bradford
West Yorkshire
BD6 2SZ

Company Registration Number
2366682

The Environment Agency, exercising its powers under paragraph 7 of Schedule 10 to the Water Resources Act 1991, hereby modifies the discharge consent conditions for the discharges listed in the attached Schedule 2 by substitution of the conditions as set out in the attached Schedule 1.

Subject to the provisions of paragraphs 7 and 8 of Schedule 10 to the Water Resources Act 1991 (as amended), no notice shall be served by the Environment Agency altering the effect of this modification without the agreement of the Consent Holder during a period of 4 years from the date this modification notice is served.

This modification notice is served and takes effect on the 1st day of April 2010

Signed Carl Sweeney

Carl Sweeney
Permitting Team Leader

Schedule 1 – Substitution of conditions

Delete all current conditions specifying the numeric limit for Dry Weather Flow and flow measurement, and substitute the following conditions:

(1) The Dry Weather Flow of the discharge shall not exceed *[x]* cubic metres per day. The consented Dry Weather Flow limit is set at the Consent Holder's planned annual 80%-exceeded flow.

NOTE ***For [x] in each consent, insert the numeric Dry Weather Flow limit for that discharge as shown in the current consent.***

(2) In determining compliance with this consent, the measured Dry Weather Flow is that total daily volume that is exceeded by 90% of the recorded measured total daily volume values in any period of 12 months.

(3) The numeric value of the measured Dry Weather Flow shall not exceed the numeric value of the consented Dry Weather Flow limit.

If the measured Dry Weather Flow exceeds the consented Dry Weather Flow limit then the Consent Holder shall as soon as is practicable investigate the reasons for the exceedance. The Consent Holder shall report the reasons for the exceedance to the Environment Agency and the steps that it proposes to take to restore compliance. An exceedance of the Dry Weather Flow limit shall not be recorded as a failure if the Consent Holder takes appropriate steps to restore compliance.

If the measured Dry Weather Flow exceeds the consented Dry Weather limit because of unusual rainfall during the 12-month period, then it will not be recorded as a failure of the Dry Weather Flow limit. For the purposes of this condition, unusual rainfall shall mean rainfall that causes significantly higher sewage flows during the three-month period that normally records the lowest flows.

For unusual rainfall to be considered, the Consent Holder shall notify the Agency and provide supporting evidence as part of the normal specified data returns.

(4) A continuous flow measurement and recording system ("the flow system") that complies with the MCERTS Flow Monitoring scheme, shall be provided and operated to record the total daily volume of sewage through the treatment works.

The flow system shall also measure and record either the instantaneous flow at least every 15 minutes or the 15-minute averaged flow every 15 minutes. The Consent Holder shall provide and operate an on-site visual display from which the Environment Agency can readily obtain the instantaneous or 15-minute averaged flow readings.

The Consent Holder shall hold records of the total daily volume and the 15-minute flow readings.

(5) As soon as reasonably practicable after installation of the flow system and before the expiry of any certificate issued, the Consent Holder shall

employ an independent expert to certify that the flow system complies with the MCERTS Flow Monitoring scheme.

The Consent Holder shall immediately on issue provide a copy of the MCERTS certificate to the Environment Agency and shall provide a copy of the independent expert's report to the Environment Agency on request.

The Consent Holder shall ensure that the flow system is always subject to a current MCERTS certificate."

(6) The Consent Holder shall produce and maintain documented procedures for the calibration, operation and maintenance of the flow system ("maintenance procedures").

The Consent Holder shall employ an MCERTS inspector to certify that the maintenance procedures comply with the MCERTS requirements.

The Consent Holder shall calibrate, operate and maintain the flow system in accordance with the maintenance procedures. The Consent Holder shall keep a record of the maintenance procedures and maintenance records available for inspection by the Agency and provide a copy to the Agency on request.

To meet the MCERTS scheme requirement the Consent Holder shall produce and maintain a formal Quality Management System ("QMS") for the management of the flow system and the implementation of the maintenance procedures. An appropriate independent certifier shall certify the QMS.

(7) The Consent Holder shall record all failures of the flow system and any other breaks in the flow record. The reasons for all failures and breaks that lead to missing or suspect total daily volume records and all steps taken to prevent a re-occurrence shall be recorded.

The Consent Holder shall ensure that the flow system remains fully operational at all times and shall remedy any failures as soon as reasonably practicable.

The Consent Holder shall provide records of the flow readings and the reasons for any significant breaks in the record when requested, in a format specified by the Agency.

27/27/0063	Thornton Dale STW
27/20/0068	Thorp Arch STW
27/21/0159	Tockwith STW
27/24/0321	Tollerton STW
3139(SS)	Tupton STW
E744	Upton Wrangbrook STW
2172	Wath on Dearne STW
27/22/0079	Wath Ripon STW
2704	Watton STW
27/20/0129	Weeton STW
27/27/0062	Welburn STW
C5412	West Bretton No. 1 STW
27/23/0301	West Rounton STW
27/22/0122	West Tanfield STW
27/20/0054	Wetherby STW
E704(SS)	Wharncliffe Side STW
27/28/0193	Wheldrake STW
27/28/0080	Wilberfoss STW
2941	Williamthorpe STW
27/24/0228	Wistow STW
WA6192	Withernsea No. 2 STW
H238	Withernwick STW
WA6273	Wombwell STW
1798	Woodall STW
2776	Woolley Village STW
WRA7404	Worsbrough STW
27/24/0124	York Naburn STW

CONSENT NO. List 1	Mod Notice 14th October 2008

Environment Agency

WATER RESOURCES ACT 1991

SECTION 88 - SCHEDULE 10

(AS AMENDED BY THE ENVIRONMENT ACT 1995)

NOTICE OF MODIFICATION OF CONSENT TO DISCHARGE

TO: Yorkshire Water Services Ltd ("the Consent Holder")
Western House
Western Way
Buttershaw
Bradford BD6 2SZ

Company Registration Number
2366682

Following a review of the conditions of its Consent, the **ENVIRONMENT AGENCY** ("the Agency") exercising its powers under paragraph 7(2)(b) of Schedule 10 to the Water Resources Act 1991 (as amended by the Environment Act 1995), **HEREBY MODIFIES ITS CONSENT** for making a discharge(s) **OF:**
Treated Sewage Effluent

with respect to the attached list of consents, (List 1)

FROM the date upon which this Notice of Modification takes effect, each of the Consents in the attached List 1 is modified as follows:

A. **Addition of the following new conditions** OSM 1 – OSM 13 and Annexes OSM1 and LUT1 as specified in this Notice of Modification

NOTE. All other conditions of the Consents in List 1 remain unaltered and in force. This Notice of Modification should be read in conjunction with, and attached to each Consent as specified in the attached list of Consents or Schedules to Consents.

Where a discharge is regulated by a Schedule to a Consent, then the wording in these conditions shall be taken as referring to that Schedule in place of the term 'Consent'.

Under the provisions of Paragraphs 7 and 8 of Schedule 10 to the Water Resources Act 1991 (as amended by the Environment Act 1995), no Notice shall be served by the Agency, which alters the effect of modifications made by this Notice, without the agreement in writing of the Consent Holder, during a period of 4 years from the date this Notice is served.

This Modification is served on 14th day of October 2008

This Modification takes effect on 1st day of April 2009 or a later date agreed in writing by the Agency but no later than 1st day of January 2010

Signed R. Street

Permitting Team Leader

New conditions added: Operator Self Monitoring (OSM) conditions

OSM Monitoring programme

OSM 1 The Consent Holder shall, unless otherwise agreed in writing by the Agency, undertake a monitoring programme for the parameters specified by this consent which control the effluent quality by numeric limits, at not less than the frequencies specified in Annex OSM 1 to this permit.
This does not include List 1 substances included within a consent in the General Standards Table.

OSM 2 The monitoring programme referred to in condition OSM1 shall:

(a) cover a calendar year, and

(b) be recorded and referred to in a Quality Management System before the commencement of a calendar year sample period.

QMS and MCERTS

OSM 3 The Consent Holder shall have an appropriate Quality Management System covering Operator Self Monitoring.

OSM 4 The Consent Holder shall ensure that appropriate actions and activities carried out to fulfil the requirements of condition OSM1 are recorded.

OSM 5 Any sampling or analysis carried out to fulfil the requirements of condition OSM 1 shall be managed and operated by the Consent Holder or its appointed organisation or organisations in accordance with ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part1) to the reasonable satisfaction of the Agency.

OSM 6 (a) For the period up to 1July 2010, any organisation undertaking sampling and analysis to fulfil the requirements of condition OSM1 shall have applied for accreditation to ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part1), unless otherwise agreed in writing by the Agency, and

(b) From 1 July 2010, any organisation undertaking sampling and analysis to fulfil the requirements of condition OSM1 shall have gained accreditation to ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part1), unless otherwise agreed in writing by the Agency.

OSM7 The Consent Holder shall ensure that all required records of compliance and accreditation with ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part 1) are maintained.

Records

OSM 8 All records required to be made by this consent shall:

(a) be legible, and

(b) be made as soon as reasonably practicable, and

(c) if amended, be amended in such a way that the original and any subsequent amendments remain legible, or are capable of retrieval and

(d) be retained, unless otherwise agreed in writing by the Agency, for at least 6 years from the date when the records were made, and

(e) where the records have been requested in writing by the Agency, copies shall be supplied to the Agency within 14 days, unless otherwise agreed in writing by the Agency,

Reporting routine analysis

OSM 9 The analytical results from the monitoring programme required by condition OSM 1 must be supplied to the Agency in an electronic format defined by the Agency, as soon as is reasonably practical for each result, and at least on a quarterly basis.

Reporting exceedances

OSM 10 When the Consent Holder becomes aware that a sample result has exceeded a numeric water quality limit specified within this Consent, (including those covered by the Look-up Table) the Consent Holder shall, unless prior agreement has been given in writing by the Agency, notify the Agency as soon as is reasonably practicable by a reporting system and format specified by the Agency.

OSM 11 When the Consent Holder becomes aware that the Discharge is not compliant with the Look-up Table (as set out in Annex LUT1) for a numeric water quality limit specified within this Consent, the Consent Holder shall, unless prior agreement has been given in writing by the Agency, notify the Agency as soon as is reasonably practicable by a reporting system and format specified by the Agency.

Reporting sample missed or lost

OSM 12 After becoming aware, or following notification that, a sample has not been taken on the Monitoring Programme pre-scheduled date, or is lost, or a result for that sample can not be reported, the Consent Holder shall record the details and reschedule the sample.

Annual monitoring summary compliance report

OSM 13 A summary report :

(a) of compliance with the monitoring programme referred to in condition OSM1 shall be made for each calendar year, and

(b) shall be submitted to the Agency within two months following the end of the year and shall have the data summarised and shall be in the format required by the Agency.

Annex OSM1 – Opra Tier 3 Sampling Frequency

Determinand	`Normal frequency` of samples per year	Reduced Sampling frequency after 12 consecutive months of numeric consent compliance, samples per year or pro rata over the remainder of a year	On consent failure return to Normal frequency as soon as reasonably practicable, samples per 12 months	Out of hours samples
Sanitary	24	12	24	For 24 samples 2 out of hours samples per annum
Non sanitary	12	12	12	For 12 samples 1 out of hours sample per annum

Annex OSM1 relates to spot samples which must be collected at approximately equal intervals during the year, but should include samples from different days of the week and different times. Approximately 10% of samples should be outside of the normal sampling window which is 9am - 3pm, Monday to Friday.

Annex LUT 1

Series of Samples Taken in any Year	Maximum Permitted Number of Samples which Fail to Conform to Numerical Limits
4 – 7	1
8 – 16	2
17 – 28	3
29 – 40	4
41 – 53	5
54 – 67	6
68 – 81	7
82 – 95	8
96 – 110	9
111 – 125	10
126 – 140	11
141 – 155	12
156 – 171	13
172 – 187	14
188 – 203	15
204 – 219	16
220 – 235	17
236 – 251	18
252 – 268	19
269 – 284	20
285 – 300	21
301 – 317	22
318 – 334	23
335 – 350	24
351 – 365	25

C5412	WEST BRETTON STW	BRETTON BROOK
WRA8296	WEST LUTTON STW	LAND
27/23/0301	WEST ROUNTON STW	RIVER WISKE
27/22/0122	WEST TANFIELD STW	RIVER URE
27/20/0054	WETHERBY SEWAGE TREATMENT WORKS	RIVER WHARFE
WRA8295	WETWANG STW	LAND
E704(SS)	WHARNCLIFFE SIDE STW	RIVER DON
WRA6659	WHELDALE (CASTLEFORD) STW	RIVER AIRE
27/28/0193	WHELDRAKE SEWAGE TREATMENT WORKS	RIVER DERWENT
27/29/0046	WHITBY WASTE WATER TREATMENT WORKS	NORTH SEA
27/28/0080	WILBERFOSS WPC WORKS	FOSS BECK
2941	WILLIAMTHORPE WWTW	WILLIAMTHORPE RESERVOIR
WA6192	WITHERNSEA OUTFALL	NORTH SEA
H238	WITHERNWICK WWTW	LAMBWATH STREAM
WA 6273	WOMBWELL WWTW	RIVER DOVE AND BULLING DYKE
1798	WOODALL STW	TRIBUTARY OF THE RIVER ROTHER
3334(SS)	WOODHOUSE MILL WWTW	RIVER ROTHER
WRA7404	WORSBROUGH WWTW	RIVER DOVE
E744	WRANGBROOK STW	THE SKELL (WRANGBROOK DYKE)

CONSENT NO. WA6192

ENVIRONMENT AGENCY

THE WATER RESOURCES ACT 1991 - SCHEDULE 10(6)
(As amended by the Environment Act 1995)

MODIFICATION OF CONSENT TO DISCHARGE

NOTICE IS HEREBY GIVEN TO **YORKSHIRE WATER SERVICES LIMITED**, of Western House, Halifax Road, BRADFORD, BD6 2SZ, that **Consent No. WA6192** issued on 8 October 1990 and Varied on 18 February 2005, in respect of a **DISCHARGE OF SEWAGE EFFLUENT** from **WITHERNSEA WASTE WATER TREATMENT WORKS, WITHERNSEA, EAST YORKSHIRE** is hereby Modified as specified below:-

Condition 2.4.2c shall now read:

2.4.2c The Consent Holder shall supply to the Agency, 1 month in arrears, in a format specified by the Agency, on a three monthly basis, the records of the readings specified in condition **2.4.2a**.

NOTES

i) All other conditions, pages, schedules, and annexes as included in Consent No. WA6192 dated 8 October 1990 and Variation dated 18 February 2005, remain unaltered.

ii) If the Applicant or Consent Holder considers that the conditions imposed by this Modification are unreasonable they may, within three months of the date given below, appeal to the Secretary of State DEFRA, Environment Appeals Administration, The Planning Inspectorate, Environment Appeals Team, Room 215, Regus Building, 1 Friary, Temple Quay, Bristol, BS1 6EA.

iii) Subject to the provisions of Paragraphs 7. & 8. of Schedule 10 of the Water Resources Act 1991 (as amended by the Environment Act 1995), no notice shall be served by the Agency, altering this Modification without the agreement in writing of the Consent Holder, during a period of four years from the date this Modification takes effect.

Signed ..... **Date** 17 October 2005

PETER BAKER, Team Leader Regulatory Water Quality
on behalf of the Environment Agency, North East Region

ENVIRONMENT AGENCY

Notice of Variation of Consent to Discharge

Water Resources Act 1991
(As amended by the Environment Act 1995)

YORKSHIRE WATER SERVICES LIMITED
Western House, Halifax Road,
BRADFORD, BD6 2SZ

[f.a.o. Mr Bob France]
[Consents Manager]

Consent to Discharge from
WITHERNSEA SEWAGE TREATMENT WORKS
HOLMPTON ROAD,
WITHERNSEA,
EAST YORKSHIRE,
HU19 2QG

Consent Number WA6192 issued on 8 October 1990 is hereby varied and all conditions, pages, schedules, and annexes are replaced by the attached document.

Consent Number
WA6192

Contents

Introduction

This note does not form part of the Consent.

This Variation does not exempt the Consent Holder from obtaining any Consent required by, or from complying with, any other statutory provisions, statutory instruments or byelaws.

If the Applicant or Consent Holder considers that the conditions of this Variation are unreasonable they may within three months from the giving of the Variation, appeal to the Secretary of State for the Environment, c/o Environmental Appeals Administration, The Planning Inspectorate, Room 4/19, Eagle Wing, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 6PN.

Consent History

Detail	Date	Comment
Consent WA6192	Issued 8 October 1990	
Consent Variation WA6192	Issued 18 February 2005	Effective 31 March 2005

Variation of Consent to Discharge

Water Resources Act 1991
Section 88, Schedule 10
(as amended by the
Environment Act 1995)

ENVIRONMENT AGENCY

Variation of Consent to Discharge

Consent Number **WA6192**

To:

YORKSHIRE WATER SERVICES LIMITED

Western House, Halifax Road,

BRADFORD BD6 2SZ

The Environment Agency ("the Agency") in pursuance of its powers under the Water Resources Act 1991(as amended by the Environment Act 1995) hereby consents to the making of a Discharge of:

Secondary Treated and UV Disinfected Sewage Effluent - (WA6192.01)

UV Disinfection - (WA6192.02)

UV Code of Practice for Measured Applied UV Dose Systems - (WA6192.03)

Calculation of UV Dose - (WA6192.04)

Storm Sewage Effluent - (WA6192.05)

From: **Withernsea Sewage Treatment Works**

At: Holmpton Road, Withernsea, East Yorkshire HU19 2QG

To: North Sea

Subject to the conditions set out in this Consent.

Subject to the provisions of Paragraphs 7 and 8 of Schedule 10 of the Water Resources Act 1991, as amended by the Environment Act 1995, no notice shall be served by the Agency, altering this Variation, without the agreement in writing of the Consent Holder, during a period of 4 years from the date this Variation takes effect.

This Variation is issued on..... 18 February 2005.....

and takes effect on..... **31 March 2005**.....

Signed.....

PETER BAKER, TEAM LEADER REGULATORY WATER QUALITY

On behalf of the Environment Agency, North East Region

Conditions of Consent

1 # SECONDARY TREATED AND UV DISINFECTED SEWAGE EFFLUENT (WA6192.01)

1.1 **Works Operation**

1.1.1

a The works shall be operated and effluent shall be treated in a manner which, so far as reasonably practicable, minimises the polluting effects of the Discharge made from the works on controlled waters.

b This condition does not require;

i any higher standard to be achieved in relation to any characteristic of the Discharge which is specifically regulated by Condition ***1.8.1 and 2.3.1*** than is required by those conditions.

ii any alteration of the works or a change in the type of treatment used.

1.2 **Substantial Change**

1.2.1

a A Discharge shall not be made from the works if it would cause a significant increase in the polluting effects of the Discharge on controlled waters as a result of a new or altered discharge of trade effluent into the works.

b A discharge of trade effluent into the works is new if:

i it is made by the sewerage undertaker and is of a kind not made into the works by the undertaker immediately before the date of effect of this Consent; or

ii it is made by a third party and the Discharge is authorised on or after that date.

c A discharge of trade effluent into the works is altered if:

i it is made by the sewerage undertaker and its composition or quantity changes significantly on or after the date of effect of this Consent; or

ii it is made by a third party and the alteration of the Discharge is authorised on or after that date.

d An increase in the polluting effects of the Discharge on controlled waters is not significant for the purposes of this condition if it relates to any characteristic of the Discharge which is specifically regulated by Condition ***1.8.1 and 2.3.1*** of this Consent but it may be significant if it is caused by a change in some other characteristic of the Discharge.

e For the purposes of this condition, "trade effluent" means:-

i any discharge by the sewerage undertaker other than surface water run-off, or domestic sewage from premises connected directly or indirectly to the works,

ii any discharge by a third party which is authorised under Chapter III of Part IV of the Water Industry Act 1991 or which is only accepted as a result of a contract with the sewerage undertaker.

1.3 Unauthorised Discharges

1.3.1

a A discharge made from the works shall not contain any poisonous, noxious or polluting matter or solid waste matter which is attributable to any unauthorised discharge into the works.

b A discharge into the works is unauthorised if it is made by a third party and either there is no obligation to receive it or conditions subject to which there is an obligation to receive it are not observed.

c Nothing in this, or any other, condition of this Consent prevents anyone from relying on any defence available to them under section 87 of the Water Resources Act 1991.

1.4 Nature

1.4.1 The Discharge shall consist solely of secondary treated sewage that has been disinfected by means of Ultra-Violet (UV) irradiation. (see Section 02 of this Consent).

For the purpose of this consent, "disinfection" is defined as the use of a process designed specifically to reduce the number of viable, potentially infectious micro-organisms in the effluent.

1.5 Location

1.5.1 The Discharge shall be made in the manner and at the place specified as:

a discharging from the Withernsea Sewage Treatment Works at Holmpton Road, Withernsea, East Yorkshire via a 400 millimetre nominal diameter pipe fitted with a diffuser consisting of a single riser pipe with four 125 millimetre nominal bore outlet ports.

b discharging to The North Sea;

c at National Grid Reference TA 3679 2629;

d shown marked 'Discharge Point' on the Plan included in this Consent.

1.6 **Listed Substances**

1.6.1 The Consent Holder shall notify the Agency in writing if any known introduction or material change, in respect of discharges from trade premises to the sewerage system, occurs that may increase or introduce in to the effluent any "dangerous substance" as set out in the list of Dangerous Substances included in this Consent (as updated by the Agency from time to time, and notified to the Consent Holder in writing), or any other substance considered by the Consent Holder as having or likely to have a significant effect on the receiving waters.

1.7 **Volume**

1.7.1 The volume of the Discharge shall not exceed five thousand eight hundred and ninety six cubic metres per day (5896m^3/day).

1.7.2 The Dry Weather Flow of the Discharge shall not exceed two thousand four hundred and eight cubic metres per day (2408m^3/day).

For the purpose of this condition Dry Weather Flow shall mean the average daily flow to the treatment works during seven consecutive days without rain (excluding a period which includes public holidays) following seven days during which the rainfall did not exceed 0.25 millimetres on any one day.

1.8 **Composition**

1.8.1 The Discharge shall not contain more than:

a 250 milligrammes per litre of biochemical oxygen demand (measured after 5 days at 20°C with nitrification suppressed by the addition of allyl-thiourea);

b 250 milligrammes per litre of suspended solids (measured after drying at 105°C).

1.9 **Dangerous Substances List II**

1.9.1 The quantity of List II Substances (specifically Copper and Zinc) (as defined in the Dangerous Substances Directive 76/464/EEC) in the Discharge shall not increase above the levels in the Discharge on the date of effect of this consent where no specific level is authorised; and

1.9.2 notwithstanding ***1.9.1*** above, the Discharge shall not contain quantities of any List II Substance (specifically Copper and Zinc) such as to cause or contribute to the concentration of that substance in the receiving water exceeding the relevant Environmental Quality Standard (EQS).

1.10 Flow Measurement

1.10.1 A continuous flow measurement and recording system, to a specification provided by the Agency, shall be provided and operated to record the total daily volume and 15-minute instantaneous or integrated flow of sewage passed for full treatment. An on-site visual display from which 15-minute integrated instantaneous or flow readings can be readily obtained by the Agency shall be provided and operated. The Consent Holder shall hold records of the flow readings.

1.10.2 As soon as practicable after completion of the flow system installation and subsequently on the expiry of any certificate issued, the Consent Holder shall employ an independent expert to certify that the installation and its quality management system complies with the Agency's specification. The independent expert shall be accredited to a competency scheme approved by the Agency. A copy of the certificate shall be sent to the Agency and the certifier's report shall be provided to the Agency on request. If a certificate issued for a flow system has no expiry date included then the certificate shall be deemed to expire five years after the issue date of the certificate.

1.10.3 The Consent Holder shall produce and maintain a documented quality management system, approved by the independent expert and to the satisfaction of the Agency, specifying procedures for the calibration, operation and maintenance of the flow measurement equipment. The flow measurement equipment shall be calibrated, operated and maintained by the Consent Holder in accordance with the provisions of the QMS. The Consent Holder shall keep a record of these procedures available for inspection by the Agency and provide a copy to the Agency on request.

1.10.4 The Consent Holder shall record all failures of the continuous flow measurement system and any other breaks in the flow record. The reasons for all significant failures and breaks, which lead to missing or suspect data, and all steps taken to prevent a re-occurrence shall be recorded and details shall be provided to the Agency on request. A failure or break is significant for the purposes of this condition if it prevents the calculation of the total daily volume to the required level of uncertainty. The Consent Holder shall ensure that as far as possible the recorder remains fully operational at all times. Any failures shall be remedied as soon as possible.

1.10.5 Records of the flow readings or the reasons for any breaks in the record, as described in condition ***1.10.4*** above, shall be provided to the Agency when requested, in a format specified by the Agency.

1.10.6 Flows of sewage passed for full treatment shall be measured at the inlet or at a point(s) as is/are agreed by the Agency.

1.11 Unusual Weather

1.11.1 No sample of the Discharge, taken at a time when unusual weather conditions are adversely affecting the operation of the sewage treatment works, shall be taken into account in deciding whether or not the conditions contained in conditions ***1.1.1, 1.8.1, and 2.3.1*** of this Consent have been complied with.

1.11.2 For the purpose of this condition "unusual weather conditions" shall include:

- **a** low ambient temperatures as evidenced by effluent temperatures of 5°C or less, or by the freezing of mechanical equipment in the works;
- **b** significant snow deposits;
- **c** tidal or fluvial flooding;
- **d** weather conditions causing unforeseen loss of power supply to the sewage treatment which could not be ameliorated by the reasonable provision and operation of standby generation facilities.

1.11.3 On any occasion where unusual weather conditions adversely affect the operation of the sewage treatment works, the Consent Holder shall use its best endeavours to mitigate that adverse effect.

1.11.4 For a sample of the Discharge to be considered for the purposes of paragraph ***1.11.1*** above, the Consent Holder shall notify the Agency by fax or telephone as soon as unusual weather conditions are known to have adversely affected operations and shall confirm the circumstances in writing as soon as possible thereafter (and in any event within 14 days of the occurrence of such conditions). That notification shall include a full description of the unusual weather conditions and their impact on the operation of the works.

1.12 Sample Point

1.12.1 An appropriately labelled sample point shall be provided and maintained at National Grid Reference TA 3588 2554 as shown marked 'Final Effluent Sample Point' on the Plans included in this Consent, so that a representative sample of the Discharge may be obtained. The Consent Holder shall ensure that all constituents of the Discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown that any sample of the Discharge taken at the said sampling point is a sample of what was discharging into controlled waters.

1.13 Urban Waste Water Treatment Regulations

1.13.1

- **a** The Consent Holder shall comply with the Urban Waste Water Treatment (England and Wales) Regulations 1994 ('the Regulations')
- **b** For the purpose of condition[s] ***1.13.2*** and ***1.13.3*** below, interpretations and references to a numbered regulation or Schedule shall have the meaning as in the Regulations, unless otherwise indicated.

1.13.2

- **a** The Discharge derives from an agglomeration with a population equivalent between 10,000 and 150,000 discharging to coastal waters.

b The Consent Holder shall inform the Agency in writing of any change, or proposed change, to the population equivalent such as would make a material change to the application of the Regulations and shall, on request, inform the Agency in writing of the actual population equivalent.

c The Discharge shall be subject to Regulation 5(1) and shall satisfy the relevant requirements of Part I of Schedule 3.

1.13.3

a The Consent Holder shall provide apparatus for the purpose of:

i measuring or recording the volume, rate of flow, nature, composition or temperature, and

ii collecting samples of any waste water,

as is necessary to ensure compliance with paragraph **b** below.

b The Consent Holder shall monitor the Discharge to verify compliance with the requirements of paragraph ***1.13.2c*** above in accordance with control procedures as set out in Part II of Schedule 3.

c The Consent Holder shall provide to the Agency any information collected in complying with paragraph **b** above in a manner agreed with the Agency.

1.13.4 Condition ***1.13.3*** above shall apply for the purpose of verifying compliance with the Directive from the date as specified in the relevant paragraph of Regulation 5 as incorporated in this Consent under condition ***1.13.2c***.

1.13.5 Condition ***1.13.3*** above shall apply for the purpose of verifying compliance with the requirements of the Directive from **31 March 2005**.

1.13.6 An appropriately labelled sample point shall be provided and maintained at National Grid Reference TA 3581 2554, as shown marked "Influent Sample Point" on the plans, or at other points as agreed in writing with the Agency, so that representative samples of the Influent may be obtained.

1.13.7 An appropriately labelled sample point shall be provided and maintained at National Grid Reference TA 3588 2554, as shown marked "Final Effluent Sample Point" on the plans, or at other points as agreed in writing with the Agency, so that representative samples of the Discharge may be obtained.

1-13-6
1-13-7 } Unnecessary duplicates

Conditions of Consent

2 UV DISINFECTION (WA6192.02)

2.1 Nature

2.1.1 The Discharge shall consist solely of secondary treated sewage effluent which has been disinfected by means of ultra violet (UV) irradiation. For the purpose of this consent, "disinfection" is defined as the use of a process designed specifically to reduce the number of viable, potentially infectious micro-organisms in the effluent.

2.1.2 The Discharge shall be disinfected by means of UV irradiation from an artificial source with at least 85% of the available UV radiation emitted in the wavelength range 250-260nm. A measured applied dose of **30.1** mJ/cm^2 must be exceeded subject to condition ***2.1.3*** and ***2.1.4*** below.

2.1.3 The measured applied UV dose must exceed the limit set out in condition ***2.1.2*** above for at least 99% of the measurements, (as required by condition ***2.4.2***), in any period of 12 consecutive months.

2.1.4 No more than 10% of measurements taken consecutively during any 24 hour period from midnight to midnight should fall below **15.05** mJ/cm^2.

2.1.5 The period(s) when the measured applied UV dose limit is less than the limit set out in condition ***2.1.2*** shall not be used by the Consent Holder for the maintenance of the UV plant. Maintenance is defined in the UV Code of Practice attached to this Consent.

2.2 Failure of UV measurement systems

2.2.1 In the event of failure of the flow monitor or UV transmittance meter used in the control of the UV dosing system:

a the maximum available number of duty banks of UV lamps shall be automatically activated;

b the minimum measured applied UV dose, at maximum effluent flow rates shall not be less than **30.1** mJ/cm^2.

2.3 Composition

2.3.1 Subject to paragraph **b** below, the Discharge shall not contain more than:

a 60 milligrammes per litre of suspended solids (measured after drying at 105°C).

b The limit for any of the relevant parameters set out in paragraph (a) above may be exceeded where, in any series of samples of the Discharge taken at regular but randomised intervals in any period of twelve consecutive months as listed in Column 1 of the 'Look-up table' attached to this consent, no more than the relevant number of samples, as listed in Column 2 of the said table, exceed the applicable limit for that relevant parameter.

2.4 Recording and Reporting

2.4.1 Maintenance Programme:

a The Consent Holder shall establish and operate a documented maintenance programme including the method and frequency of cleaning and replacement of UV lamps, transmittance meters, and flow meters, and record all non-routine actions undertaken that may have adversely affected effluent quality. Details of the maintenance programme shall be provided to the Agency for agreement. Copies of the programme shall be made available for inspection by the Agency's officers at all reasonable times.

b The Consent Holder shall keep records of the maintenance undertaken (both routine and non-routine). Copies of these records shall be maintained by the Consent Holder and kept available for inspection by the Agency's officers at all reasonable times.

c On request, the Consent Holder shall supply the Agency with a written report on the maintenance, and all non-routine actions that may have adversely affected effluent quality.

2.4.2 UV Process Monitoring and Reporting

a Continuous recorders, with on-site visual display from which readings may be readily obtained, shall be provided and maintained by the Consent Holder enabling the following to be measured and recorded at 15 minute intervals or more frequently:

i the instantaneous flow rate through each UV irradiation channel;

ii the instantaneous measured applied UV dose for each UV irradiation channel;

iii the number of operational lamps for each UV irradiation channel;

iv the instantaneous measured UV transmittance at the inlet to the UV irradiation plant;

v any other parameters, as agreed with the Company, used in calculating the UV dose.

b Copies of the records shall be maintained by the Consent Holder for a minimum of 2 years or such longer time as the Agency may from time to time specify and be kept at a nominated place available for inspection by the Agency's officers at all reasonable times.

c The Consent Holder shall supply to the Agency, 1 month in arrears, in a format specified by the Agency, on a monthly basis (or at a frequency as agreed with the Agency), the records of the readings specified in condition ***2.4.2.a***.

2.4.3 Exception Reports

a The Consent Holder shall supply to the Agency at 3 monthly intervals or upon request, a written report, detailing all occurrences where :

i there were any failures of any measurement system used to control the UV dosing system;

ii the external power supply to the UV disinfection system was interrupted;

iii a discharge of sewage effluent was made which had not been subjected to the required UV dose as specified in conditions ***2.1.4*** and ***2.2.1*** of this consent.

iv The report shall detail the reasons why the situation occurred, and the actions taken by the Consent Holder. The report shall include an assessment of what measures can be adopted in the future to minimise such occurrences.

v The Agency, if satisfied that the cause is an emergency and outside the control of the Consent Holder, and that all possible measures were taken to minimise the impact of the discharge on controlled waters, shall exclude the measurements for the period for compliance purposes with condition **2.1.4**.

2.4.4 Disinfection Efficacy Monitoring

The Consent Holder shall carry out the monitoring programme as detailed below, unless otherwise notified in writing by the Agency. The results of the monitoring programme are to be supplied to the Agency in a format specified by the Agency, on a three monthly basis, two months in arrears.

a Sample points as shown on the attached plan:

i **A** - Crude influent to the sewage treatment works at National Grid Reference TA 3581 2554

ii **B** - Secondary treated sewage effluent before UV disinfection at National Grid Reference TA 3587 2554

iii **C** - Secondary treated sewage effluent after UV disinfection at National Grid Reference TA 3588 2554

b Microbiological determinands and frequencies (Agency Standard Analytical Methods to be employed, including AQC):

i Faecal Coliforms – fortnightly, at sample points **A**, **B** and **C**;

ii Total Coliforms – fortnightly, at sample points **A**, **B** and **C**;

iii Faecal Streptococci – fortnightly, at sample points **A**, **B** and **C**;

iv Salmonella – fortnightly, at sample points **B** and **C**;

v Representative enteroviruses – fortnightly, at sample points **B** and **C**;

vi F-specific bacteriophage – fortnightly, at sample points **B** and **C**.

Following two consecutive years of full consent compliance, the Agency will review the data annually and notify in writing the Consent Holder of any resulting change to the monitoring regime.

c Other determinands and frequencies

The measurement of all determinands below shall coincide with the measurement of microbial determinands. At each sample point, samples for analysis should be sub-sampled from a single bulk sample. Where this cannot be achieved, the sampling regime shall be clearly recorded.

i The flow through each UV irradiation channel shall be measured.

ii The measured applied dose shall be recorded in each UV irradiation channel.

iii The measured UV transmittance at 254nm at the inlet shall be measured by both insitu meter and by laboratory analysis of samples collected from sample point **B**.

iv Suspended solids shall be measured at sample point **B** or **C**.

v Biochemical Oxygen Demand (measured after 5 days at 20°C with nitrification suppressed by the addition of allyl-thiourea) shall be measured at sample point **B** or **C**.

2.5 Telemetry

2.5.1 A telemetry alarm system connected to a 24 hour manned station shall be provided and maintained to provide a warning in the event that:

a the external power supply to the UV disinfection system has been interrupted;

b failure of any measurement system used to control the UV dosing system has occurred;

c a Discharge of sewage effluent has occurred which had not been subjected to the required UV dose as specified in conditions ***2.1.4*** and ***2.2.1*** of this Consent.

2.6 Emergency Notification

2.6.1 The Consent Holder shall notify the Agency in the event of a Discharge of sewage effluent which has not been subjected to the required UV dose as specified in Conditions ***2.1.4*** and ***2.2.1*** of this Consent. Such notification must be made as soon as practicable and no later than 24 hours after the event, and shall detail the reasons why the situation occurred, and the actions taken by the Consent Holder.

2.7 **Power**

2.7.1 Full stand-by power generation facilities shall be provided and maintained by the Consent Holder in good working order to enable automatic resumption of power to the UV disinfection system in the event of external power supply failure.

Conditions of Consent

3 # UV CODE OF PRACTICE FOR MEASURED APPLIED DOSE SYSTEMS (WA6192.03)

3.1 **Code of Practice**

3.1.1 The UV disinfection system shall be provided and maintained to ensure that its hydraulic characteristics and the path length of UV irradiation are such that, during the required period of disinfection, the effluent is subjected to the UV dose rate as specified in this Consent.

3.1.2 The UV disinfection system and stand-by power facilities shall be operated so as to minimise the frequency and duration of an emergency discharge of sewage effluent which has not been subjected to the required UV dose (as specified in this Consent).

3.1.3 The measured applied UV dose (as defined in the Calculation of UV dose) shall be determined from:

- **a** the flow rate of the effluent through the UV disinfection system (l/s);
- **b** the reactor volume;
- **c** the measured UV transmittance for the effluent (at 254nm);
- **d** the number of operational UV lamps.

3.2 **Maintenance**

3.2.1 A maintenance programme, including the method and frequency of cleaning and replacement of the UV lamps/ UV radiation monitors, shall be undertaken by the Consent Holder as agreed in writing with the Agency.

3.2.2 Any failure to meet the requirements of the agreed maintenance programme shall be advised to the Agency as soon as practicable and a report providing an explanation of the circumstances provided to the Agency within 2 weeks.

3.2.3 The Consent Holder shall keep records of the maintenance undertaken (both programmed and un-programmed). Copies of these records shall be maintained by the Consent Holder and kept available for inspection by the Agency's officers at all reasonable times.

Conditions of Consent

4 CALCULATION OF UV DOSE (WA6192.04)

4.1 Dose measurement System

4.1.1 The Consent Holder shall provide a dose measurement system that allows a relationship between measured applied dose and microbial performance to be established.

4.2 Definitions

4.2.1 For each bank of UV lamps, UV dose is defined as the product of UV light intensity (impacting on wastewater passing through the bank) and the retention time (of wastewater passing through the bank).

4.2.2 For the purposes of consent, the following terms are defined for each UV irradiation bank:

a **"Reactor Volume"** is the volume of wastewater in the bank at any given time;

b **"Adjusted Retention Time"**is the reactor volume divided by the measured rate of flow through the UV bank;

c **"UV Intensity with Measured UV Transmittance"** is the UV intensity across the reactor volumes, predicted from the rated output (mW) of the UV lamps at end of lamp life (cleaned) which are energised and the measured UV transmittance for the effluent (at 254nm), taking into account the lamp array configuration;

4.3 Calculations

4.3.1

i. Measured Applied UV Dose (mJ/cm^2) = UV intensity with measured UV transmittance (mW/cm^2) X Adjusted retention time (s) X $\frac{\text{Number of lamps in bank confirmed as operating}}{\text{Total number of lamps in bank}}$

The Measured Applied UV dose for each channel is the sum of the UV doses for each operational bank in the channel.

Conditions of Consent

5 # STORM SEWAGE EFFLUENT (WA6192.05)

5.1 **Nature**

5.1.1 The Discharge shall consist solely of storm sewage.

5.2 **Location**

5.2.1 The Discharge shall be made in the manner and at the place specified as:

a discharging from the Withernsea Sewage Treatment Works, Holmpton Road, Withernsea;

b discharging to the North Sea via an existing combined outlet located at a point corresponding to National Grid Reference TA 3679 2629;

c shown marked 'Discharge Point' in the plans included in this Consent.

5.3 **Occurrence**

5.3.1 The Discharge shall occur only when the rate of flow at the storm overflow chamber is in excess of sixty eight point two (68.2) litres per second due to rainfall and/or snowmelt and shall consist only of flows in excess of this figure.

5.4 **Solids Separation**

5.4.1

a The Discharge shall have passed, without prior comminution or maceration, through a screening device having apertures no greater than 6 millimetres in two dimension(s).

b The screening device shall be maintained in an efficient operational condition.

c All screenings must be removed and disposed of in a manner such as to prevent entry to the Discharge.

5.5 **Maintenance**

5.5.1 The overflow shall be maintained in an efficient operational condition.

5.6 **Sample Point**

5.6.1 An appropriately labelled sample point shall be provided and maintained at National Grid Reference TA 3586 2550 as shown marked 'Storm Sewage Effluent Sample Point' on attached Plan, so that a representative sample of the Discharge may be obtained. The Consent Holder shall ensure that all constituents of the Discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown that any sample of the Discharge taken at the said sampling point is a sample of what was discharging into controlled waters.

List of dangerous substances

Mercury and its compounds	Cadmium and its compounds	Hexachlorocyclohexane (lindane and related compounds)
Carbon tetrachloride	DDT (the isomers of 1,1,1-trichloro-2,2 bis{p-chlorophenyl} ethane)	Pentachlorophenol (PCP)
Aldrin	Dieldrin	Endrin
Isodrin	Hexachlorobenzene (HCB)	Hexachlorobutadiene (HCBD)
Chloroform	Polychlorinated biphenyls	Dichlorvos
1,2-Dichloroethane	Trichlorobenzene	Atrazine
Simazine	Tributyltin compounds	Triphenyltin compounds
Trifluralin	Fenitrothion	Azinphos-methyl
Malathion	Endosulfan	Lead
Chromium	Zinc	Copper
Nickel	Arsenic	*Iron
*pH outside range 5.5 to 9.0	*Boron	Vanadium
PCSD'S	Cyfluthrin	Sulcofuron
Flucofuron	Permethrin	4-Chloro-3-methyl-phenol
2-Chlorophenol	2,4-Dichlorophenol	2,4-D (ester)
2,4-D (non ester)	1,1,1-Trichloroethane	1,1,2-Trichloroethane
Bentazone	Benzene	Biphenyl
Chloronitrotoluenes	Demeton	Dimethoate
Linuron	MCPA	Mecoprop
Mevinphos	Napthalene	Omethoate
Toluene	Triazophos	Xylene
Cyanide	Azinphos-ethyl	Fenthion
Parathion	Parathion-methyl	Trichloroethylene
Tetrachloroethylene	Dioxins	PAHs
Nonyl phenol	Nonyl phenyl ethoxylate	Di-ethylhexyl phthalate
Bisphenol-A	Diazinon	Chlorfenvinphos
Chlorotoluron	Isoproturon	Diuron
Propetamphos	Flumethrin	Amitraz
High-Cis Cypermethrin	Cyromazine	Deltamethrin
Cypermethrin		

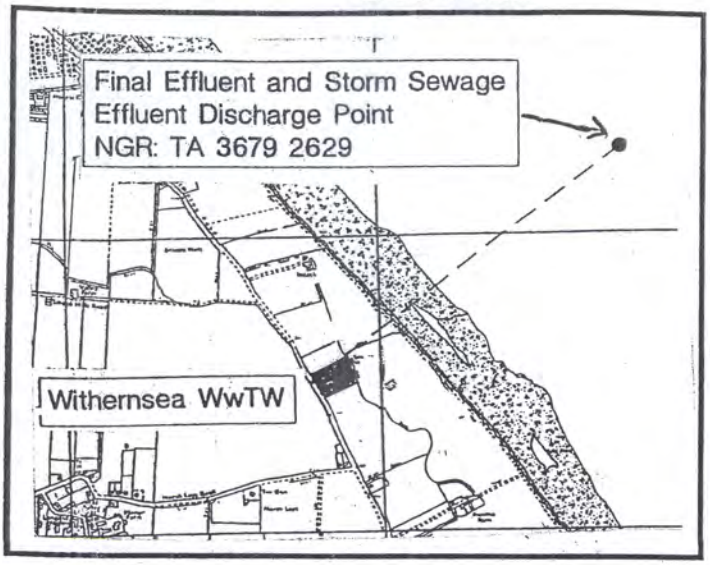
This list is applicable as at 1 December 1998 and will be updated as and when changes to the relevant legislative requirements occur.

*Notification to the Agency by the Consent Holder is only required in respect of changes to Trade Effluents likely to cause significant changes to the pH value, and/or iron or boron concentrations, of the crude sewage.

Look up table

Look-up table	
Number of samples taken in any period of 12 months	Maximum number of samples permitted to exceed limit for given determinand
4–7	1
8–16	2
17–28	3
29–40	4
41–53	5
54–67	6
68–81	7
82–95	8
96–110	9
111–125	10
126–140	11
141–155	12
156–171	13
172–187	14
188–203	15
204–219	16
220–235	17
236–251	18
252–268	19
269–284	20
285–300	21
301–317	22
318–334	23
335–350	24
351–365	25

Site Plan



CONSENT NO. WA6192

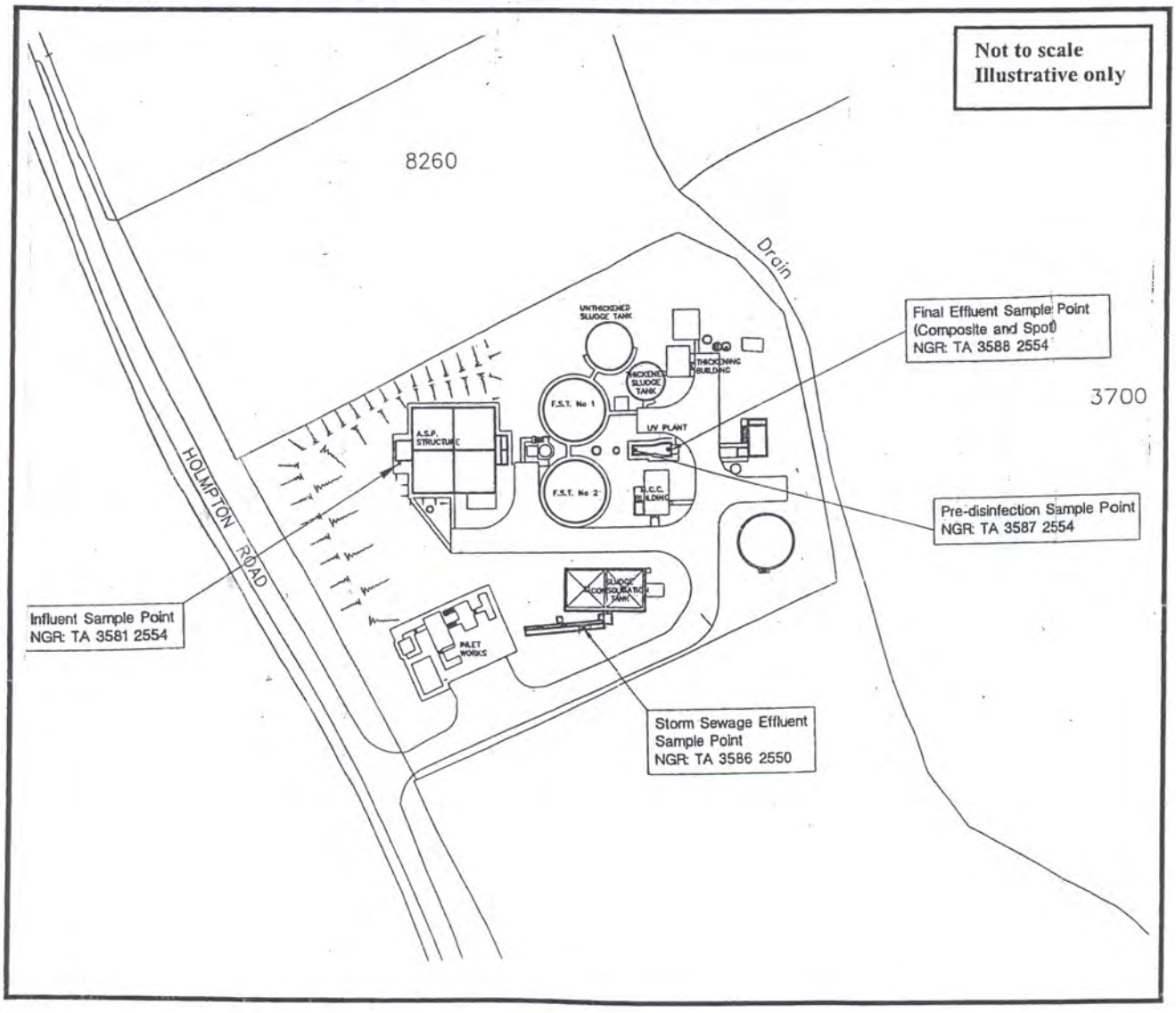
PLAN 1

PLANS ANNEXED TO CONSENT

WITHERNSEA STW

HOLMPTON ROAD

WITHERNSEA



Appendix E – MMO Scoping Response and Update

Marine Management Organisation

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Emma Jose
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Registered No.: 02366682

Case reference: EIA/2018/00036

5th November 2018

Dear Miss Jose,

The Marine Works (Environmental Impact Assessment) Regulations 2007, as amended (""the Regulations"")
Request for a scoping opinion - Withernsea Wastewater Treatment Works and Long Sea Outfall replacement

Thank you for your application dated 13 June 2018, requesting a scoping opinion from the Marine Management Organisation (MMO) in respect to the replacement of the Withernsea Wastewater Treatment Works and Long Sea Outfall.

In accordance with the regulations listed above, before reaching our scoping opinion, we have consulted such bodies that we considered likely to have an interest in the project by reason of their environmental responsibilities.

Details of the scoping opinion can be found in the attached Report. The items set out in the Report are those that have been highlighted by consultees and which we would expect to be fully considered within the environmental statement. However, we would not see this as a definitive list and other subsequent work may prove necessary following further discussion.

If you have any queries or require clarification on any of the above, then please do not hesitate to contact me.

Yours sincerely,

Dr Jamie Johnson

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Marine Management Organisation

Scoping Opinion

Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) ("the Regulations")

Title: Withernsea Wastewater Treatment Works and Long Sea Outfall replacement

Applicant: Yorkshire Water Services Ltd

MMO Reference: EIA/2018/00036

Contents

1 Proposal

Withernsea Wastewater Treatment Works and Long Sea Outfall replacement.

1.1 Project Background

The existing Withernsea Waste Water Treatment Works (WwTW) serves the local community of Withernsea and surrounding area. The facility comprises the WwTW itself, which is located approximately 1.5km south of Withernsea, and the Long Sea Outfall (LSO), which originates on the coast near Hollym and extends approximately 1km offshore. Yorkshire Water Services (YWS) has identified the asset as at risk from ongoing coastal erosion with an estimated remaining operational life of 2 to 10 years.

To address the urgent need for a replacement WwTW, YWS has proposed a scheme to replace the existing asset, giving a projected operational life of 100 years. The scheme comprises four main components:

1. Main Site: Construction of a new WwTW further inland.

2. Rising Mains: Two rising mains to be constructed to service the local residential areas.

3. Long Sea Outfall: Construction of a new LSO to service the proposed new WwTW. To be built as close as practicable to the existing LSO and extend approximately 1km from the current shoreline.

4. Upon completion of the proposed works to demolish the existing WwTW and partial demolition of the existing LSO.

2 Location

The Withernsea Wastewater Treatment Works and Long Sea Outfall replacement works is located at Withernsea and Hollym, East Riding of Yorkshire (**Figure 1**).

Figure 1. Site map showing the location of the proposed Withernsea Wastewater Treatment development. (b) Aerial image of the area within which the development is proposed. The location of the proposed works is indicated by the red shaded area in both figures, with the approximate position of mean high water springs (MHWS) delineated by the orange line

3 Environmental Impact Assessment (EIA)

Council Directive 2011/92/EU (as amended) on the assessment of the effects of certain public and private projects on the environment ("the EIA Directive") aims to protect the environment and the quality of life by ensuring that projects which are likely to have significant environmental effects by virtue of their nature, size or location are subject to an EIA before permission is granted.

The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) ("the Regulations") transpose the EIA Directive into UK law for marine licence applications.

Pursuant of Regulation 8 of the Regulations, The Marine Management Organisation (MMO) considered under **EIA/2018/00001** that the proposed works fell under Schedule A2 of the Regulations on the assessment of the effects of the project on the environment, specifically:

Schedule A2, paragraph 75: "Waste-water treatment plants (unless included in Schedule A1)."

Therefore, the application required for the proposed works for a marine licence under Part 4 of the Marine and Coastal Access Act 2009 ("the Act") will be accompanied by an Environmental Statement ("ES").

4 Scoping Opinion

Pursuant of regulation 13 of the Regulations, Yorkshire Water Services Ltd have requested a Scoping Opinion from the MMO. In so doing a Scoping Report entitled "EIA_2018_00036-Withernsea WwTW_Scoping Report_Final combined 120618_reduced-1.pdf" has been submitted to the MMO for review.

4.1 Structure of the EIA Scoping Report

4.1.1 Whilst the topics outlined within the Scoping Report are considered to be appropriate, the MMO advises that all subject headings be included within the 'Contents' pages of the ES.

4.2 Habitats Directive / Wild Birds Directive

4.2.1 The MMO confirms that the proposed development is located within the Greater Wash Special Protection Area (SPA), and adjacent to the Humber Estuary Special Area of Conservation (SAC), SPA, Ramsar site designations, and an underpinning Site of Special Scientific Interest (SSSI). The MMO welcomes consideration of both physical disturbance and noise to the associated qualifying features of the affected sites. However, in order to fully assess the likely impact of the project on Natura 2000 and Ramsar site designations, the MMO advise that the ES and shadow HRA (Appendix D of the Scoping report) must fully consider the points detailed below.

4.2.2 The MMO note that the Habitats Regulations Assessment (HRA) provided in support of the Scoping Report (Appendix D) states that the subtidal components of the work will be completed during the summer of 2020 and that the intertidal component of work will be carried out at low water, therefore avoiding sensitive timings for Red Throated Divers. The MMO advise that the recent People Over Wind Ruling by the Court of Justice of the European Union has determined that measures intended to avoid or reduce the likely adverse effects cannot be taken into account when determining whether a plan or a project is likely to have a significant effect on a site. Based on the information provided within the shadow HRA, without mitigation, it cannot be concluded that the works will not have a likely significant effect. Consequently, the MMO advise that information to inform an Appropriate Assessment is provided within a section of the ES.

4.2.3 Based upon the information provided within the Scoping Report and the shadow HRA (Appendix D), it is not clear whether the works associated with the decommissioning of the existing long sea outfall (LSO) works have been included and assessed accordingly. The MMO therefore advise that a detailed method statement concerning the decommissioning of the existing LSO be provided within the ES and used to fully inform the shadow HRA. Where there is uncertainty regarding the methods to be employed as part of the LSO decommissioning process, the MMO consider that a realistic Rochdale Envelope, or worst case scenario, to be appropriate for the assessment of the likely impacts of the licensable activities.

4.2.4 The MMO note that the shadow HRA provided in support of the Scoping Report (Appendix D) states that there will be little or no operational activities required to maintain the LSO, once installed. However, from the information provided, it is not clear whether activities associated with the maintenance and operation of the works have been included and assessed within the HRA (Appendix D). The MMO therefore advise that any maintenance and operation works be fully considered within the shadow HRA. However, it is acknowledged that it is difficult to quantify the necessity for maintenance. Consequently, the MMO consider a realistic Rochdale Envelope, or worst case scenario, to be appropriate for the assessment of the likely impacts of maintenance and operation works within the shadow HRA.

4.2.5 The MMO note that a temporary cofferdam structure is required to facilitate connection of the Horizontal Directional Drilling (HDD), to the subtidal trench. However, from the information provided in the shadow HRA (Appendix D), it does not appear that the likely effects of the works associated with the cofferdam structure (including piling) have been assessed. The MMO therefore advise that all works associated with the cofferdam be included within the ES and shadow HRA and used to fully inform the assessment. The ES and shadow HRA must also demonstrate full consideration of the likely timings and durations over which the works associated with the cofferdam are to occur.

4.2.6 The MMO note that a temporary ramp will be constructed to allow access from the cliff to the foreshore in order to carry out the works. From the information provided, it is not clear whether the works associated with the temporary access ramp have been considered within the Scoping Report and the shadow HRA (Appendix D). The MMO therefore advise that all works associated with the access ramp be included within the ES and shadow HRA and used to fully inform assessment. The shadow HRA must also fully consider the duration over which the works associated with the access ramp are to occur and their potential influence on physical processes.

4.2.7 The MMO considers that the proposed development is likely to have a significant effect on protected bird species, such as the Red throated diver during the overwintering period (i.e. 1 October and 31 March, inclusive). If works are to be undertaken during the overwintering period, the MMO advise that mitigation measures are required to reduce the likelihood of significantly effecting protected overwintering bird species. Any mitigation measures must be included and fully considered within the ES and shadow HRA to ensure that there will be no adverse impact to site integrity.

4.2.8 Further to the comments provided **in paragraphs 4.2.2** to **4.2.7**, the MMO advise that consultation advice be obtained from Natural England with respect to the assessment of the likely impact of the proposed development on sites designated for nature conservation and to ensure that the shadow HRA is both appropriate and fit for purpose.

4.3 Other Nature Conservation

Holderness Inshore Marine Conservation Zone (MCZ)

4.3.1 The MMO confirms that the proposed development is located within the Holderness Inshore MCZ and welcomes consideration of likely impacts of the proposed development to the associated qualifying features of the affected site. However, in order to fully assess the likely impact of the project on the conservation objectives of the MCZ, the MMO advise that the ES fully considers the points detailed below.

4.3.2 The MMO notes that the total area of habitat loss within the MCZ as a result of the works has been calculated at 255 m^2 (0.000825% of the total area of the site designation). However, from the information provided it is not clear as to what habitats will be affected by the proposed development. The MMO therefore advise that estimates of habitat loss within the MCZ be considered at the feature level. Such estimates should be informed by both available primary (e.g. sidescan sonar, sub-bottom sonar, and sediment samples) and secondary data sources (e.g. desk-based surveys). This will enable the MMO to appropriately consider the likely impacts of the works on the conservation objectives of Holderness Inshore MCZ.

4.3.3 Similar to the comments detailed under **paragraph 4.2.5**, from the information provided it does not appear that the likely effects of the works associated with the cofferdam structure (including piling) have been assessed within the shadow MCZ Assessment (Appendix E). The MMO therefore advise that all works associated with the cofferdam be included within, and used to fully inform the, the shadow MCZ assessment.

4.3.4 The MMO note that a temporary ramp will be constructed to allow access from the cliff to the foreshore in order to carry out the works. From the information provided, it is not clear whether the works associated with the temporary access ramp have been considered within the Scoping Report and the supporting MCZ assessment (Appendix E). The MMO therefore advise that all works associated with the access ramp be included within, and used to fully inform the shadow MCZ assessment. The MCZ assessment must also fully consider the duration over which the works associated with the access ramp are to occur and their potential influence on physical processes.

4.3.5 Similar to the comments detailed under **paragraph 4.2.8**, the MMO advise that consultation advice be obtained from Natural England with respect to the shadow MCZ assessment to ensure that it is both appropriate and fit for purpose.

Marine Mammals

4.3.5 The MMO note that the Scoping Report proposes to 'scope out' impacts to marine mammals on the basis that any potential impacts are expected to be both short-term and temporary, and will only affect transiting mammals, with no known haul out areas at this location. However, given anecdotal evidence of seal sightings on Withernsea beach itself, the MMO advise that impacts to

marine mammals (particularly to grey seals, a feature of the Humber Estuary Ramsar, SAC, and SSSI) should be 'scoped in' for further assessment. In particular, the MMO consider that the potential impacts to marine mammals from underwater noise must be considered within the ES.

4.3.6 As stated in **paragraph 4.2.5**, the MMO note that a temporary cofferdam structure is required to facilitate connection of the Horizontal Directional Drilling (HDD), to the subtidal trench. However, from the information provided in the ES, it does not appear that the likely effects of the works associated with the cofferdam structure (including piling) have been assessed. The MMO therefore advise that all works associated with the cofferdam be included within the ES and shadow HRA and used to fully inform the assessment. In particular, the MMO consider that the potential impacts to marine mammals from underwater noise must be considered within the ES.

4.4 Benthic Ecology

4.4.1 The MMO note that *Sabellaria spinulosa* was recorded during the benthic survey, but that there was no evidence of 'reef-like aggregations' within the footprint of the proposed development (Appendix H; Sections 3.9 and 4.3). As sidescan and multibeam data were collected at the site (Appendix G) these data could be used to investigate the possible presence of *S. Sabellaria* reef (an Annex 1 habitat) within the footprint of the proposed development. However, based on the information provided within the Scoping Report, it is unclear whether sidescan and multibeam data were used to investigate the occurrence of *S. Sabellaria* reef within the footprint of the proposed development and to inform the placement of the drop-down camera stations. The MMO therefore advise that the available sidescan and multibeam data must be considered within the ES for the identification of *S. Sabellaria* reef within the footprint of the works with a clear description of the investigation methods provided.

4.4.2 From the details provided within the Technical Report for the subtidal benthic survey (Appendix H) it is unclear where the four successful drop-camera stations were located. Moreover, the maps showing the positions of the grab sample stations (e.g. Fig. 3.1. of Appendix H) do not indicate the positions relative to the proposed LSO route. It is also stated that the grab stations 5 and 6 were located off the proposed LSO route (Appendix H; Section 2.7). However, in the aforementioned map all 6 stations appear to be positioned close together. To confirm whether the samples grabs and drop-down station were appropriately placed, the MMO consider that maps showing the positions of grab stations and drop-down camera stations in relation to the LSO route must be provided within the ES.

4.4.3 The MMO consider that the pathways to impact the benthic environment have been correctly identified with Section 5.2.3 of the Scoping Report. Specifically, the MMO agrees with the identification of "direct disturbance to benthic habitats" and "potential loss/smothering of associated species" during LSO installation as likely pathways to impact. However, the MMO consider that the ES must also fully consider the likely effects of resuspended sediment by construction works.

4.4.4 Whilst it is considered that the operational phase of the development works are unlikely to adversely affect the benthic environment, the MMO advise that the ES must fully consider the likely impact to benthic organisms during the decommissioning phase of the project, including impacts to benthic organisms that have colonised the diffuser and associated scour protection structures.

4.5 Coastal Processes and geomorphology

4.5.1 The MMO note that Section 5.2.1 of the Scoping Reports concludes that there are no expected impacts on the coastal configuration as a result of proposed development. Whilst the MMO agree that the impact of the project, as described, is unlikely to have a significant impact on coastal processes and geomorphology during the operational phase, given the nature of the site, which is experiencing coastal retreat, further consideration of the likely impacts of the construction phase of the project to coastal processes and geomorphology must be considered within the ES.

4.5.2 The MMO note that hydrodynamic and sedimentary modelling has yet to be undertaken with regards to informing an impact assessment of the proposed development. The MMO therefore advise that hydrodynamic and sedimentary modelling must be undertaken and used to fully inform the impact assessment of the development on coastal and sedimentary processes within the ES. To this end, it is imperative that coastal erosion and sediment movement processes are allowed to continue. Specifically, the ES must demonstrate that the proposed development will not have a significant impact on coastal processes.

4.5.3 The MMO consider that the appropriate data sources have been identified with regards to the impact assessment of the proposed development to local hydrodynamic and coastal processes and welcome the use of LIDAR data to inform the assessment. To ensure that the beach profile has not been significantly affected by the proposed development, the MMO recommends that additional LIDAR surveys be undertaken following completion of the works.

4.5.4 From the information provided within the Scoping Report, it is unclear as to what the main mechanisms and processes responsible for the erosion of the existing LSO are. The MMO advise that the physical processes responsible for the erosion of the existing LSO must be clearly presented within the ES and accompanied by appropriate measures to be taken to ensure that the replacement LSO is not compromised by the same processes in the future. To this end, the ES must also detail how the 3 m LSO burial depth will be achieved along the entire length of the outfall and demonstrate that the burial depth it will be sufficient to ensure that additional protection (e.g. rock armour) will not be required under the influence of present and future coastal processes.

4.5.5 The MMO support the proposal for beach profile monitoring and advise that that, at a minimum, monitoring be undertaken 100 metres up drift and down drift of the works.

4.5.4 When reinstating the beach profile, the MMO advise that consideration be given to the time of year to ensure that a natural profile is achieved. The ES must also

consider the possibility of sediment transport as the result of storm events and detail any activities required to relocate sediment deposits, if necessary.

4.6 Fish Ecology and Fisheries

4.6.1 The MMO notes and welcomes the inclusion of impacts to the local inshore commercial fishing fleet within the ES and support the proposal to appoint of a Fisheries Liaison Officer (FLO).

4.6.2 The MMO note that the Scoping Report correctly acknowledges that the development is situated within a herring spawning ground. However, based on the information provided, it is unclear as to whether impacts to herring will be assessed at the species level. The MMO therefore advise that impact assessments to herring at the species level be considered within the ES. Impact assessments to herring species must be informed by habitat requirements and available stock statistics for herring at the species level.

4.6.3 Herring are acoustically sensitive to noise and vibration and are therefore vulnerable to the impacts of construction activities (e.g. piling and dredging). The spawning season for Central North Sea herring is between August and October. If the works are likely to overlap with the herring spawning season, the MMO advise that the ES must demonstrate that underwater noise and vibration will not propagate into herring spawning grounds. Such considerations must be supported by suitable underwater noise assessments or modelling.

4.6.4 Further to the points raised in **paragraphs 4.6.2** and **4.6.3**, the MMO advise that impacts to other fish species with sensitivities to construction activities (e.g. piling and dredging) must also be considered within the ES.

4.7 Shellfish

4.7.1 The MMO note that the North Eastern Inshore Fisheries and Conservation Authority (IFCA) have already been consulted. However, the MMO consider that further consultation with local shell-fishers/fisherman must be undertaken and used to fully inform the ES with regard to understanding fleet behaviours and stock dynamics. Specifically, the MMO advise that consultation with local shellfisheries be undertaken to provide the best evidence base for establishing accurate environmental baselines and to reduce uncertainty in the impact assessment of the proposed development on shellfish.

4.8 Archaeology / Cultural Heritage

4.8.1 Under Section 6.3.2 of the Scoping Report, impacts to the marine historic environment have been ‘scoped out’. However, the MMO consider that the there is a high potential for geoarchaeological evidence to be preserved within offshore deposits and therefore advise that impacts to the marine historic environment be ‘scoped in’ under the ES. To this end, it is noted that Appendix N recognises that dredging activities may impact submerged archaeology but that the impact is not considered further. In assessing the impact to the historic marine environment the MMO advise that primary data sources (e.g. sidescan sonar, sub-bottom sonar, magnetometry, bathymetry, boreholes, and sediment

samples) be considered alongside desk-based surveys to fully inform the impact assessment of the works on the historic marine environment. Specifically, the MMO consider that any boreholes recovered must be made available to a geoarchaeologist for review and palaeoenvironmental sampling. The MMO also consider that a deposit model of the subsurface sediments must also be included within the ES. This model must be informed by existing and new borehole data, and considered within an geoarchaeological desk-based assessment of likely impacts of the works to the Doggerland area.

4.8.2 In order to fully assess the likely impacts of the development on the historic terrestrial environment, the MMO advise that a geoarchaeologist be consulted on the likely impacts to areas with deep superficial deposits related to Holocene lacustrine or alluvial sediments.

4.8.3 The MMO advise that consultation advice be obtained from Historic England to ensure that an appropriate assessment is undertaken with respect to the likely impacts to the historic environment, both marine and terrestrial, from the proposed development.

4.9 Navigation/Other users of the Sea

4.9.1 In principle, the MMO has no objection to the proposed development with regards to the likely impacts to navigational safety. However, the MMO consider that the ES must present a detailed method statement for the works and provide relevant measures to ensure navigational safety and the safety of other users of the marine environment, including beach users.

4.10 Water Quality

4.10.1 Given the nature of proposed development, the MMO considers that the removal and relocation of the existing LSO has the potential to elevate levels of bacteria (e.g. *Esherichia coli*) within the water environment. In light of this, the MMO considers that impacts to bathing water quality be included within the ES. Specifically, the ES should consider whether the works are likely to mobilise micro-organisms in sufficient numbers to adversely affect the water quality within designated bathing waters and subsequently have an impact users of the marine and water environment. If required, advice on impacts to water quality can be obtained from the Environment Agency.

4.10.2 Where it is not possible to conclude no significant adverse impact to water quality within designated bathing waters, the MMO advise the works must be completed outside of the bathing season in order to reduce the likely impact to water users.

4.10.3 In Section 5.2.2 of the Scoping Report it is stated that no impacts on water quality are predicted to result from contaminant release during construction or decommissioning because no contaminants were recorded above CEFAS Action Level 2. Whilst the MMO recognise and welcome the inclusion of sediment analyses, in accordance with an agreed sampling plan (Appendix H), we advise that unless the effect of contaminant release on water quality can be

specifically 'scoped out', then the impact of contaminant release on the benthos must be assessed within the ES.

4.11 Cumulative Impacts & In-Combination Impacts

4.11.1 The MMO notes that the information on the cumulative and inter-related impact assessment within the Scoping Report is very high-level. It is also unclear what will be included and considered within the ES. The MMO therefore advise that any developments within the area of influence (including those in planning, construction and operational stages), be included in the assessment of cumulative and inter-related impacts. This assessment must consider activities and development occurring within both the marine and terrestrial environments. Examples of marine-based developments might include: ports and harbours, offshore wind farms, aggregate dredging, oil/gas pipelines and subsea cables. The Crown Estate's Asset Map may be a useful tool for consideration of marine developments near to project site: https://www.thecrownestate.co.uk/en-gb/our-places/asset-map/

4.12 Risk of Major Accidents and Disasters Relevant to the Project (including those caused by Climate Change)

4.12.1 Regarding flood risk and wave action, the MMO note that there have been a number of notable winter events since 2015 (e.g. January 2017 and March 2018). The MMO therefore advise that the ES considers more up-to-date wave climate data when assessing the risk to the proposed development from major accidents and disasters.

4.12.2 As detailed in **paragraph 4.5.4**, when reinstating the beach profile, the MMO advise that consideration be given to the time of year to ensure that a natural profile is achieved. The ES must also consider the possibility of sediment transport as the result of storm events and detail any activities required to relocate sediment deposits, if necessary.

4.13 Mitigation

4.13.1 Based upon the issues raised in this EIA Scoping Opinion, the MMO advise that the ES fully considers the following points with regards to mitigation. Please note that the points considered below do not constituent an exhaustive list and other subsequent work may prove necessary following further discussion.

4.13.2 As detailed within **paragraph 4.2.2**, the recent People Over Wind Ruling by the Court of Justice of the European Union has determined that measures intended to avoid or reduce the likely adverse effects cannot be taken into account when determining whether a plan or a project is likely to have a significant effect on a site. Based on the information provided within the shadow HRA, without mitigation, it cannot be concluded that the works will not have a likely significant effect. Based on the information provided within the shadow HRA, without mitigation, it cannot be concluded that the works will not have a likely significant effect. Consequently, the MMO advise that information to inform an Appropriate Assessment is provided within a section of the ES.

4.13.3 As detailed in **paragraph 4.2.5**, the MMO note that a temporary cofferdam structure is required to facilitate connection of the Horizontal Directional Drilling (HDD) to the subtidal trench. The MMO considers that the effects of underwater noise generated by the works (including piling) to marine mammals and other sensitive species may be mitigated through the use of soft-start procedures and vibro-piling methods.

4.13.4 As detailed within **paragraph 4.2.7**, the MMO considers that the proposed development is likely to have a significant effect on protected bird species, such as the Red throated diver during the overwintering period (i.e. 1 October and 31 March, inclusive). If works are to be undertaken during the overwintering period, the MMO advise that mitigation measures are required to reduce the likelihood of significantly effecting protected overwintering bird species. Any mitigation measures must be included and fully considered within the ES and shadow HRA to ensure that there will be no adverse impact to site integrity.

4.13.5 As detailed in **paragraph 4.6.3**, herring are acoustically sensitive to noise and vibration and are therefore vulnerable to the impacts of construction activities (e.g. piling and dredging). The spawning season for Central North Sea herring is between August and October. The MMO therefore considers that one suitable mitigation measure would be to restrict the timings of construction activities (e.g. piling and dredging) to avoid the spawning season.

4.13.6 As detailed in **paragraph 4.10.2**, where it is not possible to conclude no significant adverse impact to water quality within designated bathing waters, the MMO advise the works must be completed outside of the bathing season in order to reduce the likely impact to water users.

5 Conclusion

The topics highlighted in this scoping opinion must be assessed during the EIA process and the outcome of these assessments **must** be documented in the ES in support of the marine licence application and any associated planning application(s). This statement, however, should not necessarily be seen as a definitive list of all EIA requirements. Given the scale and programme of these planned works other work may prove necessary.

Dr Jamie Johnson
Marine Licensing Case Officer

05/11/2018

Marine Management Organisation

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Case reference:
EIA/2018/00036

[By Email only]

09 November 2018

Dear Ms Gilchrist,

Re: EIA Scoping Opinion for Withernsea Wastewater Treatment Works and Long Sea Outfall replacement

Thank you for your response to the Environmental Impact Assessment (EIA) Scoping Opinion issued by Marine Management Organisation (MMO) on 5 November 2018 under **EIA/2018/00036**.

Having reviewed your response (email dated: 06 November 2018), it is our understanding that your concerns relate, specifically, to **paragraph 4.5.2** of the MMO's Scoping Opinion:

4.5.2 *The MMO note that hydrodynamic and sedimentary modelling has yet to be undertaken with regards to informing an impact assessment of the proposed development. The MMO therefore advise that hydrodynamic and sedimentary modelling must be undertaken and used to fully inform the impact assessment of the development on coastal and sedimentary processes within the ES. To this end, it is imperative that coastal erosion and sediment movement processes are allowed to continue. Specifically, the ES must demonstrate that the proposed development will not have a significant impact on coastal processes.*

Based on the information provided within your response, it is our understanding that you do not consider it to be appropriate to undertake hydrodynamic or sedimentary modelling to inform the Environmental Statement (ES) for the following reasons:

- The Long Sea Outfall (LSO) replacement will be completed using Horizontal Directional Drilling (HDD) within the intertidal zone and burial within the subtidal zone.
- The Scoping Report concludes a non-significant increase in suspended sediment levels during the construction phase of the proposed development.

In drafting our Scoping Opinion, the MMO carefully considered the information provided within the Scoping Report, as well as advice received from both statutory and non-statutory consultees. Copies of all consultation advice received in relation to your Scoping Report and the proposed development were made available to you via email on 17 and 19 September 2018.

With regards to the proposed development, the MMO considers that it is imperative that coastal erosion and sediment movement processes within the area are allowed to continue. Therefore, the ES must fully demonstrate that the proposed development will not have a significant impact on coastal processes. If it is considered that hydrodynamic and sedimentary modelling is not required, the MMO advises that the ES must fully consider and justify the reasons why.

I hope that this letter satisfactorily addresses the concerns raised in your recent response to our EIA Scoping Opinion.

Yours sincerely,

Dr Jamie Johnson
Marine Licensing Case Officer

Direct line: 0208 225 8951

Email: jamie.johnson@marinemanagement.org.uk

Your feedback

We are committed to providing excellent customer service and continually improving our standards and we would be delighted to know what you thought of the service you have received from us. Please help us by taking a few minutes to complete the following short survey (https://www.surveymonkey.com/r/MMOMLcustomer).

Appendix F – Natural England DAS Responses

Date: 06 October 2016
Our ref: DAS/11138/197263
Your ref: DAS/11138/197263

Andrew Auld
Senior Project Manager
Yorkshire Water Services
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Natural England
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Kings Pool,
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BY EMAIL ONLY

Dear Andrew,

Discretionary Advice Service (Charged Advice)
DAS/11138/197263
Development proposal and location: Withernsea Long Sea Outfall Pipe Replacement, Withernsea, East Yorkshire.

Thank you for your consultation on the above dated 12/09/16, which was received on **12 September 2016**.

This advice is being provided as part of Natural England's Discretionary Advice Service. Yorkshire Water Services has asked Natural England to provide advice upon:

- The potential impacts on designated sites and proposed designated sites
- Advice on whether a biological survey is necessary.
- Advice as to whether an EIA is required

This advice is provided in accordance with the Quotation and Agreement dated 12/09/2016.

The following advice is based upon the information within:

- Royal Haskoning DHV document: Appendix B: Ground Investigation Location Plan (02/06/2016) PB3148/TN06/303162/Newc

Natural England are providing comments based on limited information and this is reflected by the high level comments provided. NE also note that the pipeline location has yet to be decided and that Appendix B outlines two options, neither of the options follow the existing LSO pipeline. NE advises that careful consideration be given to using the original pipeline route, to minimise potential for habitat loss and damage beyond the existing footprint.

Protected sites

Holderness Inshore Marine Conservation Zone (MCZ)

Feature	General Management Approach (GMA)
Intertidal sand and muddy sand	Maintain in favourable condition
Moderate energy circalittoral rock	Maintain in favourable condition

High energy circalittoral rock	Maintain in favourable condition
Subtidal coarse sediment	Maintain in favourable condition
Subtidal mixed sediment	Maintain in favourable condition
Subtidal sand	Maintain in favourable condition
Subtidal mud	Maintain in favourable condition
Spurn head (subtidal)	Maintain in favourable condition

Potential impacts on Intertidal features (intertidal sand and muddy sand)

Where activities are proposed to occur through and over the intertidal features of Holderness Inshore MCZ, we advise that an assessment of impacts on the MCZ should consider the impacts of permanent and temporary habitat loss along and adjacent to the pipeline, and the recoverability of the features and their benthic communities after the installation operation is complete.

Where intertidal works are proposed, any preferred engineering option should consider impacts on net sediment movement and where possible designs should allow for a minimum impact to sediment movement. NE advise that beach profile data is obtained to allow for the intertidal area to be reinstated post works: as well as ensuring that damage to the MCZ feature is minimised, this is because the supply of sediment to and beyond the Humber Estuary from the Holderness coast is of direct importance to the Humber Estuary. See later comments on this site.

Potential Impacts on High and Moderate Energy Circalittoral Rock

Rock features (High and Moderate Energy Circalittoral Rock) within the MCZ should be considered to include areas of boulder clay exposures, areas of cobble and scattered boulders as well as more traditional stony reef. Routing of the pipeline should be selected to avoid and minimise the impact of the activities on these features, particularly through direct habitat loss but also indirect impacts such as smothering. Measures to secure the recoverability of any disturbed biotope present prior to the proposed work should also be identified and assessed.

Potential impacts on Subtidal sediments (subtidal coarse, mixed, sand and mud)

Where activities are proposed to occur through and over the subtidal sediment features of Holderness Inshore MCZ, we advise that an assessment of impacts on the MCZ should consider the impacts of permanent and temporary habitat loss along and adjacent to the pipeline, and the recoverability of the features and their benthic communities after the installation operation is complete.

Additional Impacts on Intertidal and Subtidal Features

Natural England advise that the impacts of the activities associated with construction of the pipeline are also considered and assessed. These could include abrasion and penetration resulting from vehicle movements and vessel anchoring.

The impacts of discharged material from the current LSO on MCZ features is not known. In addition it is unclear from the submitted information whether the proposals will result in an increase in the volume of material entering the MCZ. The likely implications of the existing outfall and the effects of any increase in discharges on MCZ features would need to be assessed.

Guidance on assessments of impacts on MCZ features

The existing designation maps produced by Defra display the spatial distribution of the broad scale habitats these can be found at https://www.gov.uk/government/publications/marine-conservation-zones-holderness-inshore. It is worth noting that the representation is based on numerous data sources, including significant areas where only modelled data is available.

Natural England therefore advises that the benthic habitats along and adjacent to the proposed

development should be surveyed in order to inform an MCZ assessment. In the subtidal environment, this could be achieved by the use of Drop Down Video footage, Grab Sampling, Acoustic Ground Discrimination (multi beam/side scan) or a suite of the above. The gathering of robust data that allows for accurate extent of the broad scale habitats to be quantified (within areas adjacent to the development) will assist in building confidence in the potential impact of the works and their associated footprint within the designated site, and would inform avoidance and mitigation measures. Natural England would be pleased to provide DAS advice on a draft survey methodology if that would be useful.

The MMO have produced guidance on assessing impacts on MCZs which can be found at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/410273/Marine_conservation_zones_and_marine_licensing.pdf

Humber Estuary Special Area of Conservation (SAC), Special Protection Area (SPA) Site of Specific Scientific Interest (SSSI) and Ramsar site.

As noted above, it is important that the sediment features of the estuary are not compromised by development on the Holderness Coast as a result of the interruption of sediment supply. The supply of sediment to and beyond the Humber Estuary from the Holderness coast is of direct importance to the designated sites including the Humber Estuary SPA, SAC, Ramsar site and underpinning SSSI. Any potential barrier to this in both the construction phase and post construction of the pipeline would need careful consideration.

In terms of the sub-tidal element it would likely be preferred that a sufficient burial depth was achieved for the pipeline, which would avoid any foreseeable intervention required to protect the pipeline, for example, rock armouring. Whilst this minimises impact upon the MCZ post construction, including the Spurn Head geological feature, it is also of importance for the nearby Humber Estuary SAC, SPA and Ramsar site. This is because changes to sediment movements along the Holderness Coast have the potential to impact features of these sites and the associated Sites of Special Scientific Interest (SSSI). Suitable geotechnical investigations along the pipeline corridor and existing commercially available ground condition reports should assist in identifying a suitable route.

Greater Wash draft Special Protection Area

Natural England is seeking permission from Defra to carry out a public consultation on the classification of a new Special Protection Area for birds named Greater Wash. We have had informal consultations about the draft boundary and features with stakeholders. If Defra approve Natural England to start a public consultation, the site will become a potential SPA (pSPA) and as such will be protected by the Habitats Regulations as a matter of policy. The site includes the Holderness Coast. It is being recommended for wintering red-throated diver, common scoter and little gull, and for marine foraging areas of importance to tern species (Sandwich, common and little) breeding at colonies already within terrestrial Special Protection Areas. More information on the proposals can be found at: http://publications.naturalengland.org.uk/publication/5741757132177408.

Red-throated diver use the Holderness coast in significant numbers and are present during the winter period (November to March inclusive). The species is sensitive to disturbance from human activities, particularly boat traffic. Natural England would suggest that the developer considers measures to minimise any potential impact upon the species. These may include, the use of a consistent vessel transit corridor, vessel based toolbox talks to raise awareness of the sensitivity of the species, and maintaining appropriate vessel transit speeds to avoid sudden disturbance by vessels operating in sensitive areas.

Natural England view regarding an Environmental Impact Assessment

The Marine Management Organisation would be the regulator in this case and therefore the decision as to whether an EIA is required would be made by them. However, Natural England would suggest

that due to the likely impacts of this project beyond the existing footprint of the LSO a statutory EIA under the Marine Works (Environmental Impact Assessment) Regulations 2007 may be required. We advise that should an EIA be required it encompass the project as a whole, assessing both the terrestrial and marine elements of the proposal. Further advice and confirmation should be sought from the Marine Management Organisation for clarification.

For clarification of any points in this letter, please contact Helen Devlin on 020 80266261.

This letter concludes Natural England's Advice within the Quotation and Agreement dated 12 September 2016.

As the Discretionary Advice Service is a new service, we would appreciate your feedback to help shape this service. We have attached a feedback form to this letter and would welcome any comments you might have about our service.

Senior adviser to QA letter and check box below

☒ The advice provided in this letter has been through Natural England's Quality Assurance process

The advice provided within the Discretionary Advice Service is the professional advice of the Natural England adviser named below. It is the best advice that can be given based on the information provided so far. Its quality and detail is dependent upon the quality and depth of the information which has been provided. It does not constitute a statutory response or decision, which will be made by Natural England acting corporately in its role as statutory consultee to the competent authority after an application has been submitted. The advice given is therefore not binding in any way and is provided without prejudice to the consideration of any statutory consultation response or decision which may be made by Natural England in due course. The final judgement on any proposals by Natural England is reserved until an application is made and will be made on the information then available, including any modifications to the proposal made after receipt of discretionary advice. All pre-application advice is subject to review and revision in the light of changes in relevant considerations, including changes in relation to the facts, scientific knowledge/evidence, policy, guidance or law. Natural England will not accept any liability for the accuracy, adequacy or completeness of, nor will any express or implied warranty be given for, the advice. This exclusion does not extend to any fraudulent misrepresentation made by or on behalf of Natural England.

Yours
Helen Devlin
Yorkshire and Northern Lincolnshire Team

Cc commercialservices@naturalengland.org.uk

Date: 21 April 2017
Our ref: DAS/11138/204391
Your ref: DAS 2563_Withernsea LSO

4th floor
Foss House
Kingspool
1-2 Peasholme Green
York
YO1 7PXAddress

T 020 802 66261

Ben Cornelly,
Yorkshire Water Services Ltd

BY EMAIL ONLY

Dear Ben,

Discretionary Advice Service (Charged Advice)
DAS/11138/204391

Development proposal and location: Yorkshire Water Services, Withernsea Long Sea Outfall, Withernsea

Thank you for your consultation which was received on 21 March 2017.

The following advice is being provided as part of Natural England's Discretionary Advice Service.

This advice relates to previous DAS advice provided to Yorkshire Water Services relating to the potential for impacts upon the Holderness Inshore MCZ from the installation of a new long sea outfall at Withernsea. Natural England advised that where there is a potential for impacts on the features of the designated sites the proposed development should be surveyed in order to gather robust data that would identify the extent of the broad scale habitats to be quantified in order to inform avoidance and mitigation measures which would in turn inform the MCZ assessment.

In response to this advice, Yorkshire Water Services have asked Natural England to provide further advice on:

- Draft biological survey methodology

This advice is provided in accordance with the Quotation and Agreement dated 21 March 2017.

The following advice is based upon the information provided within;

1. IBPB5063 SP001 F01_Environmental Investigation Specification_final draft (preferred option D)
2. PB5063-WSEA-GI-001-Rev0
3. PB3148-WSEA-GI-001-Rev0_bathy_geophys

Subtidal MCZ features (coarse, mixed, sand and mud)

Natural England can confirm that we agree that the subtidal proposed survey methodology would be sufficient to quantify the extent of the broad scale habitats associated with the outfall pipe. We note that the survey includes drop down video and grab samples which when used in conjunction with the geophysical survey data should be able to quantify the extent of the features within the surveyed area and inform a robust MCZ assessment.

Although verification surveys were conducted within the Holderness Inshore MCZ in 2012, the data captured was not considered not to be of a usable standard. Further surveys are planned for summer 2017 however it is unlikely that the data will be available for this project given the timescales.

It is also worth noting that the Holderness Inshore area is highly turbid with high levels of suspended sediment and this is exacerbated by weather conditions e.g. strong winds – this proved to be an issue with the verification surveys referred to above. The limited weather windows potentially available for good quality drop down video data to be collected should be considered when planning surveys, and extra flexibility factored into the survey campaign.

Intertidal features (sand and muddy sand)

NE's previous DAS advice suggested that where activities are proposed to occur through and over the intertidal features of Holderness Inshore MCZ, an assessment of impacts on the MCZ should consider permanent and temporary habitat loss along and adjacent to the pipeline, and the recoverability of the features and their benthic communities after the installation operation is complete.

It is unclear from the documents provided whether significant impacts from the works are anticipated in the intertidal area but if that is the case we would advise that standard survey techniques (e.g. biotope mapping, core samples) are used to gather the appropriate data to inform the MCZ assessment.

For clarification of any points in this letter, please contact Helen Devlin on 020 80266261.

This letter concludes Natural England's Advice within the Quotation and Agreement dated 20 March 2017.

As the Discretionary Advice Service is a new service, we would appreciate your feedback to help shape this service. We have attached a feedback form to this letter and would welcome any comments you might have about our service.

☒ The advice provided in this letter has been through Natural England's Quality Assurance process

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Yours sincerely,

Helen Devlin
Yorkshire and Northern Lincolnshire Team

Cc commercialservices@naturalengland.org.uk

Appendix G – MMO Sample Plan

Marine Management Organisation

Marine Licensing Team
Lancaster House
Hampshire Court
Newcastle upon Tyne
NE4 7YH

T +44(0)2080265334
F +44 (0)191 376 2681
www.gov.uk/mmo

Mr Andrew Auld
By email only

Our reference: SAM/2016/00063

13/10/2016

Dear Mr Auld,

RE: REQUEST FOR PRE-APPLICATION SAMPLING ADVICE FOR WITHERNSEA LONG SEA OUTFALL REPLACEMENT, YORKSHIRE.

Thank you for your request for a sample plan to inform a future dredge application. Please see the detailed response below and attached documents.

Should you wish to use the Cefas laboratory to analyse the sediment samples, please make a request to myself in writing. I will then provide a revised estimate in the online system.

Yours sincerely,

Heather Hamilton

Heather Hamilton
Marine Licensing Case Officer

D 02082557692
E heather.hamilton@marinemanagement.org.uk

1. Description of the project

1.1 The existing Withernsea Waste Water Treatment Works (WWTW) and associated Long Sea Outfall (LSO) are at risk from ongoing coastal erosion. Yorkshire Water Services are therefore proposing to build a new WWTW further inland, and install a replacement LSO approximately 100m to the south of the existing outfall. The proposed replacement outfall is approximately 1,000m in length, and would be located to the south of the existing outfall. The exact method for the construction works will be confirmed following completion of site investigation works. Two options are currently under consideration: 1. Burial of the laid pipe in a relatively shallow trench, using side-cast material as back-fill. Back-filling would also be supplemented by natural processes. 2. Installation using Horizontal Directional Drilling (HDD) techniques.

1.2 Should option 1 be selected, taking a conservative approach to the depth and width of trench required (using side slopes of 1:3), it is estimated that up to approximately 40,000m^3 of material along the entire length of the outfall may require side-casting and reuse as fill material. The trench width (bottom) is estimated to be 3.5m, trench depth 3.5m and trench width at the surface 15.6m.

1.3 It is anticipated that the construction phase will be undertaken from April 2017 to September 2017, and will require a marine licence from the Marine Management Organisation (MMO).

1.4 The project has been screened under the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended). With regard to the ground conditions over the marine portion of the site, existing boreholes and vibrocores mainly show firm to hard sandy gravelly clay (glacial till) with intermittent layers of sand and gravel existing to a depth of 6m below bed level. One near shore vibrocore indicated some possible soft clay within the upper 1m below bed level. Due to the predicted dominance of coarser grained sediments, the samples may be exempt from chemical analysis.

1.5 The site is located within the Holderness Inshore Marine Conservation Zone (MCZ). The MCZ was designated in January 2016 and covers an area of approximately 309km2.

2. Sampling required

2.1 In accordance with the recommendations of the OSPAR Guidelines for the Management of Dredged Material, samples should be taken to provide a good representation of the volume of material to be dredged. The distribution and depth of sampling should reflect the size and depth of the area to be dredged, the amount to be dredged and the expected variability in the horizontal and vertical distribution of contaminants. We also use the OSPAR guidelines to inform our advice on sampling requirements for other activities which are likely to lead to the mobilisation of sediments. Based on the information submitted (as described above), the MMO are of the opinion that the following sampling and analysis is required.

2.2 MMO request that a total of four representative samples are taken at four sites from across the dredge area to provide adequate spatial coverage. Samples must be taken at the surface (0 metres depth). MMO do not consider that given the physical nature of the material anticipated to arise and its location in a relatively open coastal environment that risk to the marine environment from use of the excavated material as backfill is likely to be vast. MMO therefore consider that detailed chemical analyses throughout the dredge depth are not required.

2.3 The following information must be included with any samples (irrespective of the laboratory to be used for analysis):

- Clearly labelled samples;
- Completed sample position sheet, including the latitude and longitude (decimal degrees and the projection i.e. WGS84) of each location;
- Details of the method of sampling;
- A map/chart detailing the sample locations.

2.4 Surface samples should be taken from the upper layer of in-situ sediment using a non-metallic / stainless steel scoop. To maintain the integrity of the samples please ensure that they are FROZEN and remain in the freezer until they can be dispatched. Please ensure the samples are dispatched in a cool box - the cool box should not be placed in any other packaging.

2.5 The protocol for the taking of samples is included in annex 1.

3. Analysis Required

3.1 The samples are recommended to be analysed for particle size analysis, trace metals, organotins and total hydrocarbons. The surface samples will be visually inspected on their receipt and if seen to be predominately sand/gravel will be analysed for PSA and documented to be the case. If some samples are able to be analysed for metals, tins and total hydrocarbons bulking will be carried out where possible.

3.2 Further details can be found on the sample plan form attached. Samples may be bulked into one lot of four samples depending on sediment composition and suitability for analysis. Details of methodologies used for bulking must be provided with analysis results.

3.3 To ensure consistency between laboratories it is expected that all analysis required will be undertaken from the same 250ml sample (unless bulking is undertaken).

4. Laboratories

4.1 If the analysis is to be undertaken by a laboratory other than Centre for Environment, Fisheries and Aquaculture Science (Cefas) or the National Laboratory Service (NLS), that laboratory must meet the qualifying criteria as set out in the MMO

guidance (https://www.gov.uk/apply-to-take-samples-analyse-sediment-and-make-minor- removals#sampling-and-sediment-analysis).

4.2 At present there are two laboratories validated to undertake sediment analysis to support a marine licence application:

a. Cefas - https://www.cefas.co.uk

b. National Laboratory Service - http://natlabs.co.uk

4.3 Whichever laboratory is chosen to undertake the analysis, the resultant analysis should be submitted with any future marine licence application.

4.4 It should be noted that Cefas are unable to accept any results from unvalidated laboratories in support of Marine Licence applications.

5. If analysis is to be undertaken by Cefas

5.1 On notification from MMO that the applicant wishes Cefas to undertake the analysis, CEFAS will send out the required number of sample jars. These must be clearly marked 'SAM/2016/00063' and numbered to identify the location of the sample within the dredge area/sampling area. The applicant must ensure that they follow the enclosed sampling instructions carefully.

5.2 The glass and plastic sample jars must be filled 3/4 full as per the indicated marker line to ensure sufficient material for analysis. Please note that if the jars are overfilled there is a risk that they could break and make the sample unusable additional samples may be required at the applicant's expense.

5.3 The samples, and all supporting information, should be sent to the Sustainable Environmental Assessment for Licensing Team at the address below:

Sustainable Environmental Assessment for Licensing Team
Cefas
Pakefield Road
Lowestoft
Suffolk
NR33 0HT

5.4 On returning samples to Cefas, please do **NOT** send samples on a Friday as Cefas is unmanned at the weekend. Any samples arriving over this period will defrost by the Monday and will not be suitable for chemical analysis. The samples will then have to be retaken.

5.5 **Samples must be returned within two weeks of receipt of the jars**. Please be aware that delays in providing the samples will inevitably increase the time required by Cefas to conduct the analysis. Excessive delay may result in the pre-application being cancelled and the pre-application fee reimbursed. Therefore, if you foresee a delay in returning their samples, we would ask that you let Cefas know as soon as possible.

5.6 MMO can provide an estimate of the cost of the analysis in the online system should you wish to use Cefas to undertake the sampling and analysis. Cefas will also charge for the sending of jars (not included in estimate).

6. Conclusion

6.1 This advice is based solely on the information provided in the pre-application request. The MMO considers that the sampling and analysis described will be adequate to inform a licence application that mirrors the information in this pre-application request, providing that no further issues come to light and an application is submitted in a suitable time-frame.

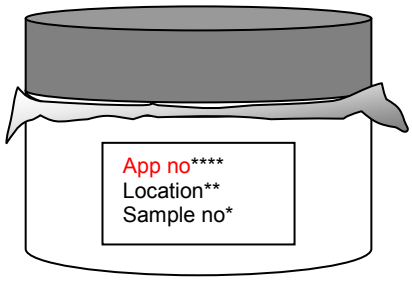
6.2 The MMO will take a pragmatic approach to the requirement of repeat samples in relation to projects where works have not commenced. Samples taken at depth will remain a valid consideration for decision-making from the time they are taken. However, due to the dynamic nature of the marine environment and the potential for changes in the quantity and quality of sediments, there may be a need for surface sediments to be re-sampled and analysed if the project has not commenced within two years of the time of sampling.

6.3 Where long term licences for maintenance dredging will be applied for, additional sampling and analysis will need to be undertaken throughout the duration of the proposed longer licence term in order to comply with the OSPAR guidelines.

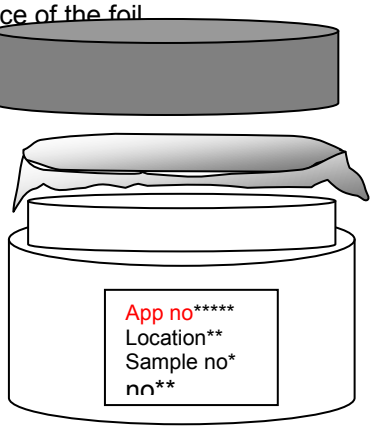
6.4 The MMO reserves the right to request further sampling/analysis should any submitted marine licence application differ from that information submitted here. Any future application must clearly state this pre-application reference number.

Annex 1. Procedure for taking samples of material to be dredged, using glass jars and metal scoops

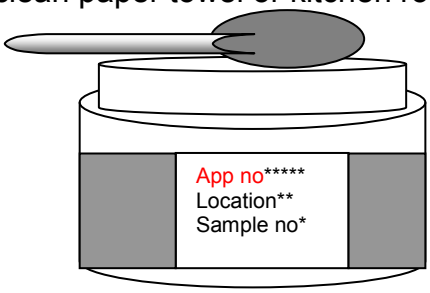
1. Take the correctly labelled sample jar for the location about to be sampled. The jars must have been treated to ensure that they are contaminant free (request new jars if any are broken – do not substitute).



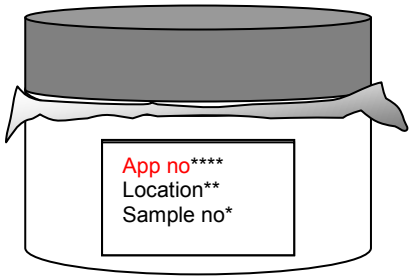
2. Remove the lid and the foil from the sample jar, being careful not to touch the internal surface of the foil



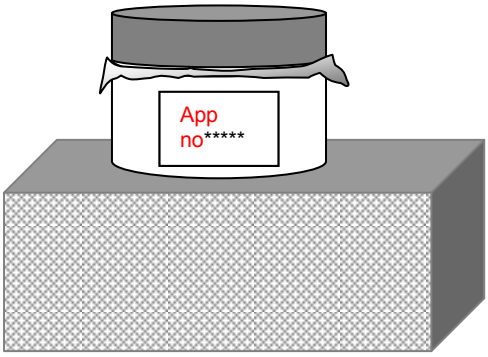
3. Use a stainless steel scoop to **fill the jar 3/4 full**. Do not smoke or eat whilst sampling. Wash the scoop thoroughly between samples, with a clean paper towel or kitchen roll



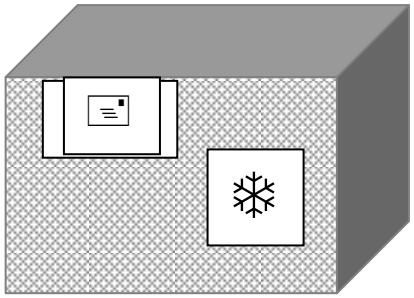
4. Replace the foil and lid



5. Pack carefully to minimise the risk of sample jar breakage.



6. Dispatch samples straight away ensuring they are frozen first, and put in a cool box with frozen ice packs. If this is not possible keep in a freezer until dispatch.



Please be aware that if you provide insufficient sample for all the analyses to be carried out, you may be asked to take all the samples again at your own cost.

Appendix H – ESG Geophysical Survey Results

Report No L7058-17

WITHERNSEA OUTFALL MARINE SITE INVESTIGATION

PHASE 1

HYDROGRAPHICAL AND GEOPHYSICAL SURVEY

Client: Ward and Burke for Yorkshire Water

October 2017

Environmental Scientifics Group
Unit 18-19, Deeside Industrial Park,
Deeside, Flintshire, CH5 2NY, UK
Tel: +44 (0) 1244 288200

Report No: - L7058-17

October 2017

Issue No Date	Status	Prepared by	Checked by	Approved by
0 Sept. 2017	Issued	NAME and QUALIFICATIONS Timothy Ellis (PhD) SIGNATURE 	NAME and QUALIFICATIONS Tony Greenwood (BSc) SIGNATURE AG	NAME and QUALIFICATIONS Tony Greenwood (BSc) SIGNATURE AG
1 Oct 2017		NAME and QUALIFICATIONS SIGNATURE	NAME and QUALIFICATIONS Tony Greenwood (BSc) SIGNATURE AG	NAME and QUALIFICATIONS Tony Greenwood (BSc) SIGNATURE AG
		NAME and QUALIFICATIONS SIGNATURE	NAME and QUALIFICATIONS SIGNATURE	NAME and QUALIFICATIONS SIGNATURE

CONTENTS

1 INTRODUCTION

In July 2017 ESG were commissioned by Ward and Burke for Yorkshire Water to carry out a marine site investigation to aid the design of a replacement outfall at the existing Withernsea outfall. The works were split into two separate phases: Phase 1 - a hydrographic and geophysical survey and Phase 2 - an optional follow-on intrusive investigation to provide further geotechnical information should it be required. This report deals with the requirements specified in WP2-Withernsea Marine GI Specification, Revision 01/Final (Dated 07 March 2017). Additionally an Ecological Survey was required in support of Yorkshire Water's application to MMO (Marine Management Organisation) for a licence (Ref: SAM/2016/00063) to conduct Marine Works in the area. This latter work is reported separately.

The survey objectives were to provide detailed information on the following:

- Ground conditions,bathymetry and sub seabed geological conditions at the site to enable the geotechnical design of the proposed works.
- Identification of the seabed features, obstructions and possible unexploded ordnance (UXO) at or below the level of the seabed.

This report details the Phase 1 hydrographic and geophysical survey investigation which was required to enable geotechnical design of the proposed works and to confirm whether sufficient detailed information has been obtained without the need for an intrusive investigation

This report describes the hydrographic and geophysical survey fieldwork undertaken and presents the results for the work carried out.

The scope of works for the operations was specified to include the following aspects:

- Swathe Bathymetric Survey
- Side Scan Sonar Survey
- Magnetometer Survey
- Single and Multi-channel Seismic Reflection Survey

The survey was carried out in accordance with the contract specification over a corridor 500 metres wide and extending some 1100 metres offshore.

Initial Survey works were completed between 13 July 2017 and 03 August 2017 with the follow up Multi Channel works conducted between 17 August 2017 and 19 August 2017.

2 THE SITE AND GEOLOGY

2.1 The Site

The Yorkshire Water Withernsea outfall and waste-water treatment works are located approximately 2.5 km south of Withernsea on the Holderness Coast in the East Riding of Yorkshire. The treatment works, which are situated within 100 m of the adjacent cliff top, will be at risk from coastal erosion in the near future. It has been proposed to relocate the treatment works further inland so that the life of the repositioned assets will be at least 100 years allowing for coastal erosion.

The site for the Marine Ground Investigation, Geophysical and Bathymetric Survey Work Package comprises the nearshore waters and intertidal zone in the vicinity of the existing outfall.

Seabed levels within the survey were expected (from Client's specification) to be no deeper than 10 m below Chart Datum (CD).

The project specified the following values to be used that were based on Immingham / Spurn Head. The tide is semi-diurnal in character with the following values:

Highest High Water	MHWS	6.9 mCD
Lowest High Water	MHWN	5.5 mCD
Mean Sea Level	MSL	4.1 mCD
Highest Low Water	MLWN	2.7 mCD
Lowest Low Water	MLWS	1.2 mCD

Chart Datum (CD) at Immingham is 3.9 m below Ordnance Datum (Newlyn) (OD(N)).

2.2 Geology

The geological map of the area describes the geology as Devensian glacial till overlying Upper Cretaceous Flamborough chalk (BGS map sheet 81).

3 FIELDWORK

3.1 Scope of works

The survey objectives were to provide information on the following within the proposed area:

- Seabed levels
- Bedrock level and any geomorphological features present e.g. buried channels
- The presence of any debris or obstructions on or in the seabed sediments
- Seabed characterisation
- The presence of any magnetic targets

In order to meet these objectives, the following techniques were employed during the survey

- Multi-beam Echo Sounding (MBES)
- Side Scan Sonar (SSS)
- Single Channel Seismic Reflection Profiling
- Multi-channel Seismic Reflection Profiling
- Magnetometery

3.2 Survey Plan

Technique	Line Plan
Bathymetric Survey	Minimum 100% seabed coverage. Programmed to include minimal 50% overlap between swathes.
Side Scan Sonar Survey	Minimum 100% seabed coverage. Data were collected along lines spaced at 30 metres.
Sub-Bottom Profiler	Data were collected along lines spaced at 20 metres. Cross lines spaced at 100 metres.
Magnetometer	Data were collected along lines spaced at 5 metres.
Sediment Sampling	6no. locations to be sampled

3.3 Fieldwork Activities

Daily progress reports for the duration of the project are presented in Appendix A. In summary, the following activities were completed.

On 12-13 July 2017 the equipment was subject to a final check and packed at the Deeside office. Vessel mobilisation, preparation for towing and travel to Grimsby was conducted arriving early evening 13 July 2017.

On 14 July 2017 the vessel was hoisted into the water at HCA Marina in Fish Docks, Grimsby. The MBES system was installed and a functionality check conducted.

The MBES survey commenced on 15 July 2017. Assessment of available water depths and locations of fishing pots was made on site before a calibration check was made and survey operations began. Wider line spacing in deeper water enabled 70% of the area to be collected.

MBES survey was completed on 16 July 2017 with High Water being used to achieve full coverage of the inshore area. SSS data collection commenced with 40% of data collected.

17 July 2017 the MBES data was processed quality and data coverage with the vessel then being reconfigured from bathymetric to geophysical survey as the MBES was demobilised and mobilisation of the single channel sub bottom profiler (SCSBP) commenced.

The SSS survey and mobilisation of SCSBP was completed on 18 July 2017.

On 19 July 2017 the weather was not suitable for surveying and a progress meeting in Partington was attended. Processing of SSS data commenced.

On 20 July 2017 the SCSBP survey was commenced and completed following an extended period on site ahead of forecast poor weather.

From 21 to 28 July 2017 mobilisation and calibration of Ultra Short Base Line system(USBL) and magnetometer was completed but a combination of poor weather, manpower availability and equipment failure meant that no surveying was conducted.

From 29 July to 01 August 2017 the UXO survey was completed.

The vessel was demobilised from Grimsby on 02 August 2017 and the processing of data commenced the following day.

On 17 August 2017, Multi Channel Sub Bottom Profiler (MCSBP) survey equipment was mobilised on board the *MV Humber Guardian*. All equipment verification checks were completed ready for survey.

On 18 August 2017 the MCSBP survey was commenced and completed.

The kit was demobilised form the vessel on 19 August 2017.

3.4 Survey Vessel

The majority of the marine survey works were undertaken from the *MV Pulsar*. The *MV Pulsar* is a Cheetah Marine 7.2 metre Catamaran with a beam of 2.55 metres and a maximum draught of less than 0.7 metres. The vessel is owned and operated by ESG Surveys.

The vessel was operated from Grimsby Fish Docks for the duration of the survey, approximately a two hour transit to the survey site a Withernsea.

An additional vessel, the *MV Humber Guardian* owned and operated by Briggs Marine, was chartered to conduct the Ecological and Multi-Channel Seismic surveys. This vessel, a 20 m catamaran, was skippered and crewed by Briggs Marine personnel and supplemented by ESG and specialist freelance staff for survey operations.

3.5 Equipment and Personnel

The following items of equipment were mobilised to site for use throughout the survey, technical information about the equipment can be found in Appendix E:

Portion of Survey	Type of Equipment	Item of Equipment
Surface Positioning	Marine Survey Navigation	Applanix POS-MV320 Inertia aided RTK Global Positioning System Leica GS14 RTK GPS
	Heading	Applanix POS-MV320 Inertia aided RTK Global Positioning System
	Navigation software	QPS QINSy
	Tidal data	Applanix POS-MV320 Inertia aided RTK Global Positioning System Applanix PosPAC software
Sub-Surface Positioning	USBL	Sonardyne Scout plus Sonardyne 8024 Transducer Sonardyne Omni transponder
Acoustic Survey	Multi Beam Echo Sounding	R2Sonic 2022 Multi-beam Echo sounder Valeport Mini SVS Valeport Soundbar
	Heave compensation	Applanix POS-MV320 Inertia aided RTK Global Positioning
	Side Scan Sonar	Klein system 3000 digital Side Scan Sonar system Coda DA4G Acquisition system
	Single Channel Sub-bottom Profiler	SES 2000 parametric sub bottom profiler

Portion of Survey	Type of Equipment	Item of Equipment
	Multi-Channel Sub-bottom Profiler	Applied Acoustics Triple Plate S-Boom Boomer Catamaran Applied Acoustics CSP N 1200 seismic energy source Geometrics Marine Geode 24 channel digital enhancement seismograph Geometrics MicroEel Analog Seismic Solid 24 Channel Streamer; 2.00 m. hydrophone spacing
UXO Survey	Magnetometer	Geometrics G882 Cs Vapour Marine Magnetometer
Sediment Sampling	Grab sampler	Half size Day grab Mini Hammon grab
Drop Down Video	Camera system	Fresh water lens system Sub marine camera
Computing facilities		Laptop & desktop computers, Printer
Others		Safety Equipment Generators Access to email, web and ESG Server available via 3G network connection on-board

The following personnel were mobilised to site to carry out the survey from the *MV Pulsar*:

Tony Greenwood	Party Chief/ Principal Surveyor
Timothy Ellis	Senior Surveyor/ Vessel Skipper
Alastair Blower	Geophysicist
Joe Milner	Senior Geophysicist

The following personnel carried out survey works on MV Humber Guardian:

Tony Greenwood	Party Chief
Alastair Blower	Geophysicist
Matt Guy	Senior Geophysicist and Engineer

3.6 Positioning and Navigation

3.6.1 Surface Positioning and Navigation

The primary positioning system during the survey was provided by an Applanix POS MV 320. This system provided position from the integrated inertial measurement unit (IMU) aided by a Global Navigation Satellite System (GNSS). The inertial capability of the POS MV allows vessel

positioning in areas of poor satellite visibility, however due to the requirement for RTK tides if satellite signal/ coverage was lost then surveying was temporarily suspended until reliable positioning returned. The POS MV also provided a vessel heading, real time tidal height and precision motion measurement.

The system comprises a processor, primary and secondary GNSS receiver cards and interface cards that allow it to communicate with and process the GNSS and IMU data. The GNSS received real time kinematic (RTK) corrections from Leica Smartnet via GSM. Leica SmartNet is a broadcast correction service introduced in 2006 as a partnership between Leica Geosystems and the Ordnance Survey. SmartNet is enabled by the network of Ordnance Survey base stations to create a high density, high redundancy network which is able to deliver corrections at the centimetre level in RTK mode.

The POS MV delivers a heading through the IMU that is accurate over short periods of time when rapid changes in direction occur. However, over long periods the heading will drift. This is compensated by using the GNSS azimuth measurement subsystem (GAMS) which calculates the baseline between the two GNSS antennas by measuring the phase difference of the received satellite signals. The POS MV calculates a vessel heading accurate to +/- 0.02° by combining the short term accuracy of the IMU with the long term stability of the GNSS.

The secondary vessel positioning system during the survey was provided by a Leica GS14 RTK GNSS.

The Primary and secondary positioning systems are operated in full RTK mode. This provided a vessel position to 2 to 3 centimetre accuracy in X and Y and around 10 centimetres in Z.

Details of the transformations and geodetic parameters used during the survey are presented below:

Ordnance Survey Great Britain 1936

Transformation	**OSTN02**
Geoid Model	**OSGM02**
Projection Type	Transverse Mercator
True Origin	49° North 2° West
False Easting	400000.00m
False Northing	-100000.00m
Scale Factor	0.9996012717
Ellipsoid	Geodetic reference system 1980
Units	International Meter
Vertical Datum	CD UKHO VORF

Prior to the system installation aboard the vessel, a position verification check was conducted over an Ordnance Survey bench mark. This mobile system was then installed aboard the vessel and a comparison completed against the PosMV system. This comparison demonstrated the PosMV position to be within acceptable variation limits (0.03m in X, Y and Z).

For survey operations QPS QINSy 8.16 was used to combine and log the position, attitude, heading, multi-beam echo sounder (MBES) and magnetometer data. QPS QINSy also provided a navigation display to allow the vessel helm to steer predefined survey lines.

The offsets for all of the survey equipment were positioned using a combination of a Leica 1205 Electronic Total Station (ETS) and a measuring tape. These offsets were entered into QINSy enabling the dynamic calculation of the position and orientation of all survey sensors. A vessel offset diagram is presented as Figure B2, Appendix B.

3.6.2 Sub-Surface Positioning

A Sonardyne Scout Ultra Short Base Line (USBL) acoustic positioning system was used to provide a position for the magnetometer tow fish when towed astern of the vessel. Dynamic calibrations were conducted by anchoring a beacon on the seabed and steering the vessel along a predetermined path. The Sonardyne Casius software then calculated a series of corrections to be applied to the positional data.

A Valeport Midas Sound Velocity Probe (SVP) was used to measure the acoustic velocity through the water column. An average value was input into the USBL system. The full velocity profile was used during processing of the bathymetry data.

The Sonardyne Scout USBL was interfaced with Trimble HydroPro software. This allowed the position of the magnetometer tow fish to be displayed on the navigation screens. A 2D constant velocity Kalman filter was applied to the fish position to correct for the small navigation jumps inherent in USBL positioning. The filtered magnetometer fish position was combined with the total magnetic field data during data storage.

3.7 Tidal Reduction

3.7.1 Real Time Tide Height

The RTK navigation provides accurate heights in the GPS datum ellipsoid it is necessary to shift the data to the survey vertical datum, this was achieved using the United Kingdom Hydrographic Office (UKHO) Vertical Offshore Reference Frame (VORF) model. Given the size of the survey areas a single offset has been used for the whole of the project based on the midpoint of the site. At this location the VORF Model states an ellipsoid to OD(N) separation of 45.10 metres. A further correction of 3.90 metres was then applied to reduce the data from OD(N) to the project specified CD.

3.8 Bathymetric Survey

3.8.1 Multi-beam Echo Sounding

The bathymetric surveys were conducted using an R2Sonic 2022 wideband high resolution multi-beam system. The R2Sonic has a selectable operating frequency (200 to 400 kHz) and beam variable swathe coverage between 10˚ and 160˚, although typically 140˚ was used providing optimal coverage without degrading the quality of data in the outer beams.

The following equipment was interfaced to the R2Sonic 2022: -

- GPS time tags and PPS (pulse per second).
- Applanix POS-MV320 for motion and heading compensation.
- Valeport MiniSVS to record and apply sound velocity at transducer face.

The calibration or patch test of the R2 sonic MBES system aboard the *MV Pulsar* was carried out over the survey area. The purpose of a patch test was to establish and correct for misalignments between the MBES reference frame and the reference frame of the vessel/motion reference unit. A suitable location was found containing the two prerequisites for a patch test, an area of relatively flat seabed and a distinct slope or seabed object. The patch test was processed using the software QPS Qimera V 1.5.

An extended single line was run twice in opposite directions over flat seabed and the diffuser. These lines were used to calculate roll and pitch offsets. A third line was run offset from the previous lines. This was used in conjunction with the previous offset line which had been run in the same direction to calculate the heading calibration value. The efficacy of the derived calibration offsets was assessed visually by inspecting cross sections of data chosen to highlight any errors.

Sound velocity profiles of the water column were measured using a Valeport 650 Sound Velocity Probe (SVP). These profiles were loaded into the QINSy software to allow real time and post processing correction for water column ray bending. Profiles were taken daily with further profiles not considered necessary due to the well mixed nature of the water column. The Valeport mini Sound Velocity Sensor (SVS) mounted on MBES head was used by the system to accurately resolve beam angles in real time and monitor for variations in near surface velocity in comparision to the latest SVP.

3.9 Side Scan Sonar Survey

A Klein system 3000 digital side sonar system was used for this aspect of the survey to map seabed texture and features.

For the purposes of the survey, both low and high frequency data (100 kHz/ 500 kHz) were recorded with the system set to maximum 38 meters per channel, providing a swath width of 76 meters.

During the survey, data were viewed and recorded by a Coda Octopus DA4G Geophysical Acquisition System. This allowed the quality of the data to be monitored and enhanced in real time whilst digitally recording all raw data. The data were recorded in Coda format to allow post processing, mosaic production and charting.

3.10 Single Channel Seismic Reflection Survey

An Innomar SES 2000 parametric sub-bottom profiling system was used for this aspect of the works. The system was rigidly mounted on a bespoke over the side mount.

The SES 2000 system was operated in a single frequency ‘Pinger’ mode with two frequencies logged of 4 and 10 kHz. Vessel motion (pitch and roll) provided by the PosMV was input into the system to provide heave and motion compensation to the acquired data.

A percentage of the acoustic energy is reflected from the sea floor. This percentage is dependent upon the composition of the seabed materials. The remaining energy penetrates the seabed and is reflected from layers of contrasting acoustic impedance. Acoustic impedance is the product of the density and seismic velocity of a material. The character of the sub-bottom records are therefore dependent upon the way in which the acoustic signal is reflected. This is used to interpret the conditions present.

The reflections are collected and processed by the Innomar *SESWIN* software which allows the data to be amplified, filtered, presented graphically and recorded to its internal HDD. The data was converted to SEG-Y format to allow post processing, picking and charting within the Coda Octopus software Suite.

The equipment was tuned on site using the existing outfall as a target. A balance between penetration and resolution was chosen to ensure maximum penetration without sacrificing feature identification.

3.11 Multi-Channel Seismic Reflection Survey

An Applied Acoustics Triple Plate S-Boom Boomer Catamaran was used as the seismic source. The source combines three AA252 boomer plates into a single source with the transmitted energy focused by the array geometry to improve the directivity and beam pattern. The source can operate at an energy output of 1000 Joules per pulse and firing at up to 3 pulses per second. The multi-plate boomer was towed 30 m astern of the vessel and 1.5 m to starboard relative to the vessel centreline.

Data were collected using a Geometrics MicroEel, a solid seismic streamer which is extremely lightweight and easily deployed by hand. The cable has a 2 metre hydrophone group interval to optimise the useable data available for stacking in the data set. Each of the groups is made up of three depth limited polymer hydrophones which are encased in a single solid continuous mould to minimise external noise affects and improve the ruggedness of the system.

The array was towed astern of the survey vessel with an offset between source and near trace group centre channel 1. During system trials the optimum position for the hydrophone streamer first receiver was determined to be 30 metres. Trials for the position of the seismic source catamaran showed that a position offset 0 metres forward and 2.5 metres laterally to starboard returned the best data quality and was subsequently adopted for the survey.

Source triggering, controlled by the navigation software, provided a command to the S-Boom power supply, an Applied Acoustic Engineering CSP-N, at 0.5 second intervals along the survey line. A record length of 0.125 seconds was recorded with a sample rate of 0.125 ms with high and low cut filters applied to enhance the data.

Data were recorded, using a Geometrics Geode seismograph and *Marine Multi Geode Operating Software* (Marine MGOS) software, in SEG-D format. Noise and trigger delays will be monitored during data acquisition using the software controlling the seismograph.

Any poor quality data identified during the above process was subject to resurvey.

3.12 Magnetometer Survey

A single Geometrics G-882 Caesium Vapour Marine Magnetometer was used for this aspect of the works. The magnetometer was towed astern a minimum of 25 metres to negate the effects of any magnetic influence of the vessel. The maximum towed length was 60 metres in the deeper areas. In the furthest inshore area, the magnetometer was towed at a reduced speed with a surface float to prevent grounding and to improve the quality of the data collected. Data, including USBL positioning were logged on the navigation computer running QPS software.

The following equipment was interfaced to the G882 Magnetometer: -

- Echo-sounding altimeter
- Depth pressure gauge

Interfaced equipment data were monitored in real time for system flight control and used during post processing. These logged parameters were used during processing as criteria against which magnetic field data were accepted or rejected.

3.13 Sediment Sampling for Chemical Analysis

In accordance with the recommendations of the OSPAR Guidelines for the Management of Dredged Material (OSPAR, 2014) and the specification of works *WP3 Environmental Investigation* (reference I&BPB5063R004F01), Sediment sampling was undertaken in two phases. Phase one consisted of sediment sample recovery using a 0.1 m^2 Day Grab deployed from the aft deck of the vessel *MV Humber Guardian*. Samples were obtained from as close as possible to the target locations; within 25 m. Where no or insufficient sample was recovered after a minimum of 3 attempts, a further one attempt 100 m from the specified location was made. No samples were successfully recovered during phase one of the sampling. Phase two of the sampling was conducted using a Mini-Hamon Grab. The above stated protocol was followed. Samples were successfully recovered during the second phase of the sampling campaign. The position and time of each grab sample was recorded in the Survey Log. Samples were stored ready for analysis at -20 °C and sent to CEFAS laboratories for relevant analysis.

4 RESULTS

4.1 General

The raw data acquired during the survey were processed as described in the following section to produce charts listed in the table below and presented in Appendix D.

Drawing Number	Description
L7058-17/01	Bathymetric Chart
L7058-17/02	Seabed Features Chart
L7058-17/03	Side Scan Sonar Mosaic
L7058-17/04a	Residual Magnetic Field Chart
L7058-17/04b	Analytic Signal Anomaly Chart
L7058-17/05	Isopachyte To Interpreted SC01 Reflector Chart
L7058-17/06	Isopachyte To Interpreted SC02 Reflector Chart
L7058-17/07	Isopachyte To Interpreted SC03 Reflector Chart
L7058-17/08	Isopachyte To Interpreted SC04 Reflector Chart
L7058-17/09	Reduced Level To Interpreted Reflector SC01 Chart
L7058-17/10	Reduced Level To Interpreted Reflector SC02 Chart
L7058-17/11	Reduced Level To Interpreted Reflector SC03 Chart
L7058-17/12	Reduced Level To Interpreted Reflector SC04 Chart
L7058-17/13	Isopachyte To Interpreted MC01 Reflector Chart
L7058-17/14	Isopachyte To Interpreted MC02 Reflector Chart
L7058-17/15	Isopachyte To Interpreted MC03 Reflector Chart
L7058-17/16	Isopachyte To Interpreted MC04 Reflector Chart
L7058-17/17	Isopachyte To Interpreted MC05 Reflector Chart
L7058-17/18	Reduced Level To Interpreted Reflector MC01 Chart
L7058-17/19	Reduced Level To Interpreted Reflector MC02 Chart
L7058-17/20	Reduced Level To Interpreted Reflector MC03 Chart
L7058-17/21	Reduced Level To Interpreted Reflector MC04 Chart
L7058-17/22	Reduced Level To Interpreted Reflector MC05 Chart
L7058-17/23	Geological Cross Sections – Assumed Centreline

4.2 Bathymetry

The bathymetric data are presented on a site drawing as a contoured image, shown in drawing L7058-17/01, Appendix D. The entire data set was used in the construction of the image but for clarity only selected soundings have been annotated.

Data were processed using the hydrographic processing package QPS Qimera. Position, motion and depth data (relative to the WGS 84 ellipsoid) were post processed in the Applanix POSPAC software. In using downloaded ephemeris data from ground stations the positioning solution was refined and a Smooth Best Estimate Trajectory (SBET) which combines all position, motion and height data was created. The SBET was checked for quality and outage times in POSPAC before being applied to the data in QPS Qimera.

Data were cleaned and validated via QPS Qimera software and patch test calibration and SBET applied. Data were only accepted that fell within acceptable accuracies as stated in the IHO Minimum Standards for hydrographic surveys. Any soundings not meeting this specification were flagged and rejected but not erased. Results of the patch test are shown in table 4.2 below.

Table 4.2. Patch test misalignment correction values.

	CO
Latency	0.00 s
Roll	1.68°
Pitch	1.01°
Yaw	-0.80°

A 0.5 metre binned dataset was produced based on the shoalest value of the soundings contained within the bin. The shoalest were used as there was a lot of deep sounding logged skewing the data in areas where there was a boundary between differing sediment types. The shoalest values are considered to provide the best representation of the bathymetry in the area.

Seabed levels in the surveyed area range between 3.6 metres above Chart Datum at the inshore end, to 11.3 metres below Chart Datum at the offshore extents. The seabed in the inshore area appears to be largely flat with few features and is probably sandy in nature. Approximately 200m offshore this changes with the seabed features becoming more prominent with a possible gravel bank evident in the data at this point. Further gravelly waves are evident in the deeper water. There is also evidence of a number of objects in the bathymetry that are indicative of cobbles and small boulders. These are too numerous to list individually but those exceeding 1.0m in any

dimension have been listed. This seabed type created a lot of noise in the data and some of these contacts are likely to be spurious but can't be disproved, and have therefore been left in the dataset. The outfall diffuser and redundant inshore concrete inspection hatch are visible in the data. Additionally there is an indication that the existing outfall is near the surface from approximately 500m to 800m offshore, as a linear feature is evident in the data.

4.3 Seabed Features

Side scan sonar data have been combined into a mosaic using the Coda GeoKit software and presented as a seabed features chart (drawing L7058-17/02) and side scan sonar mosaic (Drawing L7058-17/03) in Appendix D. Any significant bed features have been annotated on these charts and the positions of any side scan sonar contacts and magnetic anomalies are also indicated.

The seabed material and features have been interpreted based on the intensity and character of the side scan sonar returned signal. The seabed in the survey area is composed of two types:

- Areas where the seabed shows a smooth texture with low reflectivity and isolated high reflectivity areas are interpreted as sand with cobbles.
- Areas of seabed displaying a smooth, occasionally rippled or rough texture with moderate reflectivity are interpreted as sandy clay with gravel,cobbles and boulders.
- Areas of the seabed with relatively high reflectivity, a rough texture and moderate changes in relief have been interpreted as bed forms.

Example side scan sonar images are presented on Figure B4, Appendix B.

4.4 Shallow Geology

The sub-bottom data collected using both parametric sub-bottom profiling and the multichannel reflection data have been interpreted together to provide as full an appreciation of the shallow geology across the site as possible.

4.4.1 Single Channel Marine Seismic Survey Processing

The single channel data were processed and picked using Coda Octopus *Survey Engine Seismic+* software. The converted SESWIN SEG-Y data files were read into the Survey Engine Seismic+ software where the data were subject to addition of signal gains and band pass filtering to enhance the horizons of interest. Appropriate seismic velocities were assigned to the picked horizons to

convert the 'picks' from a travel time to depths below seabed. For this site, a seismic velocity of 1600 ms^{-1} was used as a representative velocity for the superficial materials.

The reduced level of the identified horizons was determined by calculation of isopachyte thickness below the bathymetric data terrain model using Trimble's *Terramodel* software.

4.4.2 Multi-channel Marine Seismic Survey Processing

During the fieldworks, initial data quality checks were completed by the shore based geophysicist. The multi-channel seismic data was subject to the following processing flow within Deco *Geophysical's RadExPro* software.

- **SEG-D data input** – reads the 24 channel data into RadExPro format.
- **Shot Display** – Displays the 24 channel data for each shot point.
- **Trace Displays** – Displays one of the near source traces (channel 3) and one of the far end traces (channel 22) to produce records similar to that of a single channel boomer record.
- **Direct Arrival Display** – Displays the first arrival of the closest hydrophone to the source which allows source to receiver changes to be displayed to allow checks of trigger variations or source receiver distance variations.
- **Dummy Geometry Assignment** – allows data to be binned as common mid-point (CMP) gathers.
- **CMP Display** Displays CMP gathers along the profile.
- **Brute Stack Display** – Displays traces in each CMP after correction for Normal Move Out (NMO) to produce profile similar to a near trace display but with improvements I signal to noise ratio of reflectors.

Any lines determined to be of insufficient quality were highlighted for re-survey.

Survey lines passing the initial quality checks were then further processed using the processing flow chain set out below with the objective of producing a processed SEG-Y format file which was read into Coda Survey Engine software for further minor processing, reflector picking and interpretation.

- **Geometry Assignment** – Correct offsets for shot point and receivers relative to the GPS position are read into each shot file to allow common mid-point (CMP) gathers.
- **Pre-Processing** – A Band Pass filter (400 to 2000 Hz) applied to raw data, data stored as pre-processed data files.
- **Velocity Analysis** – The pre-processed data is subject to super gathers which are then analysed interactively to produce a velocity profile for NMO corrections.
- **Stack** – The pre-processed data is subject to NMO corrections based on the derived velocity profile and the data is stacked into an ensemble for the survey profile.

- **Seabed Pick** – The seabed is identified and stored into the stacked data.
- **SGY Export** – The stacked data profile is exported as a SGY data file for reading into Coda Survey Engine Software.

The exported SEG-Y data files were read into the Survey Engine Seismic+ software where the data were subject to addition of signal gains and band pass filtering to enhance the horizons of interest. Appropriate seismic velocities were assigned to the picked horizons to convert the 'picks' from a travel time to depths below seabed. For this site, a seismic velocity of 1600 ms^{-1} was used as a representative velocity for the superficial materials.

4.4.3 Seismic Reflection Data quality

The parametric sub-bottom profiling data were reasonable throughout with good penetration being achieved typically to 7 or 8 metres below seabed. Less penetration was evident in areas of deeper water or where the superficial deposits were thinner. The data quality allowed good mapping of the superficial materials. The expected depth of rock means that determination of top of rock level has not been possible in the area. An example single-channel seismic record can be seen in Figure B5, Appendix B.

The multichannel data were reasonable throughout although considerable seabed multiple interference occurred, principally due to the shallow water depth across the inshore areas.

The rock interface has not been identified within the multi-channel data set. It is believed to be beyond the detectable range of the system given site conditions. This is despite the system being tuned for maximum depth penetration. An example multi-channel seismic record can be seen in Figure B6, Appendix B.

4.4.4 Marine Seismic Survey Results

A total of seven horizons have been identified and mapped over the area between the two seismic reflection techniques. Some of which have been interpreted to correspond to the same horizon. In these instances, greater reliance should be placed on the SCSBP data, due to its greater resolution. These are as follows:

1. Horizon 1 – Interpreted as the base of the reworked surface sediments / top of Glacial Till – Reflector SC01.
2. Horizon 2 – Interpreted as the base of a Glacial Till layer – Reflector SC02 / MC01 (less well defined in MC01).

3. Horizon 3 – Interpreted as the interface between Clay rich and Sand rich materials – Reflector SC03.

4. Horizon 4 – Interpreted as the top of a sand and gravel layer – SC04 / MC02 (less well defined than SC04 at off shore end).

5. Horizon 5 – Interpreted as a change in Glacial Till composition. – Reflector MC03.

6. Horizon 6 – Interpreted as a change in Glacial Till composition – Reflector MC04.

7. Horizon 7 – Interpreted as a change in Glacial Till composition – MC05.

Data from ESG'sSeptember 2017 borehole logs has been used to aid the seismic interpretation where possible. Addtionally the overwater boreholes from Alluvial Mining November 1990 report were compared. Below Horizon 4, there has been no intrusive investigation to act as a ground truth for the seismic interpretation. As such, the horizons have been categorised by how their displayed seismic character compares with those horizons identified at shallower depths.

The Glacial Till is believed to be comprised of varying quantities and compositions of sand, gravel and clay. With this in mind, it is possible that layers of sand or increased percentage of sand in the composition exist within the layers interpreted as Glacial Till. This is consistent with Aluvial Mining's BH7 which reported several alternating, thin layers of sand and clays within the top 6 meters of sediment, and "lenses of sand" being reported in nearly all other borehole reports.

Drawing L7058-17/05 presents the isopachyte thickness chart for reflector SC01 (Horizon 1), identified within the single-channel seismic reflection data. Horizon 1 has only been observed up to approximately Chainage (Ch.) 500. Isopachyte thickness above Horizon 1 is interpreted to reduce from 1 metre at Ch.50 to 0 metres at Ch.500. The materials lying above Horizon 1 are interpreted to be reworked surface sands.

Drawing L7058-17/06 presents the isopachyte thickness chart for reflector SC02 (Horizon 2), identified within the single-channel seismic reflection data. Horizon 2 has only been observed up to approximately Ch.750. Isopachyte thickness above Horizon 2 is interpreted to reduce from 6 metres at Ch.50 to less than 1 metre at Ch.750. The materials lying between Horizon 1 and Horizon 2 are interpreted to be Glacial Till.

Drawing L7058-17/07 presents the isopachyte thickness chart for reflector SC03 (Horizon 3), identified within the single-channel seismic reflection data. Horizon 3 has been observed across the majority of the site. It became more difficult to identify at the nearshore end of the site due to

being obscured by seabed multiples. Isopachyte thickness above Horizon 3 is interpreted to reduce from 7.2 metres at Ch.50 to around 1 metre at Ch.1100. Horizon 3 is interpreted to be the interface between Clay rich and Sand rich materials.

Drawing L7058-17/08 presents the isopachyte thickness chart for reflector SC04 (Horizon 4), identified within the single-channel seismic reflection data. Horizon 4 has only been observed between Ch.475 and Ch.1100. It became more difficult to identify at the nearshore end of the site due to the thickness of sediment exceeding the penetrative capabilities of the system. Isopachyte thickness above Horizon 4 is interpreted to reduce from 7.3 metres at Ch.475 to around 1.7 metres at Ch.1100. The materials lying below Horizon 4 are interpreted to consist of Sand and Gravel.

Drawing L7058-17/09 presents the level of reflector SC01 (Horizon 1) reduced to Chart Datum (CD), identified within the single-channel seismic reflection data. The reduced level of Horizon 1 is interpreted to decrease from 2.5 metres above CD at Ch.50 to 2.5 metres below CD at Ch.500.

Drawing L7058-17/10 presents the level of reflector SC02 (Horizon 2) reduced to CD, identified within the single-channel seismic reflection data. The reduced level of Horizon 2 is interpreted to decrease from 2.5 metres below CD) at Ch.50 to 8 metres below CD at Ch.750.

Drawing L7058-17/11 presents the level of reflector SC03 (Horizon 3) reduced to CD), identified within the single-channel seismic reflection data. The reduced level of Horizon 3 is interpreted to decrease from 4 metres below CD) at Ch.50 to 11.5 metres below CD at Ch.1100.

Drawing L7058-17/12 presents the level of reflector SC04 (Horizon 4) reduced to CD, identified within the single-channel seismic reflection data. The reduced level of Horizon 4 is interpreted to decrease from 9.4 metres below CD at Ch.475 to 12.1 metres below CD at Ch.1100.

Drawing L7058-17/013 presents the isopachyte thickness chart for reflector MC01 (Horizon 2), identified within the multi-channel seismic reflection data. Horizon 2 has only been observed from Ch.100 up to approximately Ch.350. Isopachyte thickness above Horizon 2 is interpreted to reduce from 5 metres at Ch.100 to 4 metres at Ch.350.

Drawing L7058-17/014 presents the isopachyte thickness chart for reflector MC02 (Horizon 4), identified within the multi-channel seismic reflection data. Horizon 4 has only been observed from Ch.100 up to approximately Ch.700. Isopachyte thickness above Horizon 4 is interpreted to reduce from 10 metres at Ch.100 to 3 metres at Ch.700.

Drawing L7058-17/015 presents the isopachyte thickness chart for reflector MC03 (Horizon 5), identified within the multi-channel seismic reflection data. Horizon 5 has been observed from Ch.100 across the majority of the survey area. Isopachyte thickness above Horizon 5 is interpreted to reduce from 15 metres at Ch.100 to 6 metres at Ch.1100.

Drawing L7058-17/016 presents the isopachyte thickness chart for reflector MC04 (Horizon 6), identified within the multi-channel seismic reflection data. Horizon 6 has been observed from Ch.100 across the majority of the survey area. Isopachyte thickness above Horizon 6 is interpreted to reduce from 19.5 metres at Ch.100 to 8.5 metres at Ch.1100.

Drawing L7058-17/017 presents the isopachyte thickness chart for reflector MC05 (Horizon 7), identified within the multi-channel seismic reflection data. Horizon 7 has been observed from Ch.100 to the offshore survey extents. Isopachyte thickness above Horizon 7 is interpreted to reduce from 24 metres at Ch.100 to 12.5 metres at Ch.1100.

Drawing L7058-17/18 presents the level of reflector MC01 (Horizon 2) reduced to CD, identified within the multi-channel seismic reflection data. The reduced level of Horizon 2 is interpreted to decrease from 3 metres below CD) at Ch.100 to 4 metres below CD at Ch.350.

Drawing L7058-17/19 presents the level of reflector MC02 (Horizon 4) reduced to CD, identified within the multi-channel seismic reflection data. The reduced level of Horizon 4 is interpreted to decrease from 8 metres below CD at Ch.100 to 10 metres below CD) at Ch.650.

Drawing L7058-17/20 presents the level of reflector MC03 (Horizon 5) reduced to CD identified within the multi-channel seismic reflection data. The reduced level of Horizon 5 is interpreted to decrease from 13 metres below CD at Ch.100 to 16.5 metres below CD at Ch.1100.

Drawing L7058-17/21 presents the level of reflector MC04 (Horizon 6) reduced to CD, identified within the multi-channel seismic reflection data. The reduced level of Horizon 6 is interpreted to decrease from 17 metres below CD at Ch.100 to 19 metres below CD at Ch.1100.

Drawing L7058-17/22 presents the level of reflector MC05 (Horizon 7) reduced to CD, identified within the multi-channel seismic reflection data. The reduced level of Horizon 7 is interpreted to decrease from 22 metres below CD at Ch.100 to 23 metres below CD at Ch.1100.

Drawing L7058-17/23 presents the geological cross-sections from both the single-channel and multi-channel sub-bottom profiling works. It displays each horizon identified reduced to a depth in metres above / below CD. The horizons have been displayed on separate plots for clarity.

The discrepancies in depth between the horizons identified by both seismic techniques are as a result of the reduced resolution of the multi-channel system. The multi-channel system offers greater depth of investigation but resolution of features is decreased.

4.5 Magnetometer / UXO Survey

4.5.1 Magnetic Field Survey Processing

The position of the data were checked and corrected for USBL jumps / layback where necessary before removing any spikes in the total magnetic field values.

Data were then cleaned of drop-outs, magnetic reading errors associated with tow cable length adjustment and upper and lower thresholds were applied to remove data spikes. Background noise in the majority of the data set was established as less than +4 nT. However a few lines exhibited increased noised associated with the towfish tumbling in the water due to the tide flow. The magnetic data are considered of high quality and sufficient to meet the needs of the project.

A median filter of 175 readings was applied to the data set on a line by line basis. This value was selected to provide a median filter over a distance of approximately 33 metres along the ground profile to remove the ambient magnetic field and those long wavelength anomalies more commonly associated with variations in geology. This process allowed anomalies to be compared relative to a null background field through the removal of background noise and environmental interference. The resultant residual data were gridded with a cell size of 0.5 to produce a residual chart.

The Oasis Montaj *UXO Detect* functions were used to calculate the dX, dY, dZ derivatives and produce an analytic grid. The analytic signal moderates any anomaly offsets due to magnetic field direction and remnant magnetism resulting in a distinctive positive peak over the centre of each potential target. This analytic field dataset was used in conjunction with the residual magnetic field dataset to complete the target identification.

Given the high quality and density of the magnetic field data, an automatic detection regime was considered appropriate as a starting point for target identification. This Blakely Test (Blakely & Simpson, 1986) is an automatic peak detection algorithm where each cell on the analytical grid is compared with the adjacent cells in 8 directions (Up, down, left, right and four diagonals). If the cell has a higher value than those surrounding it, it is identified as a peak. The test parameters can be altered to define what is identified as a peak based on the expected target and background noise.

The following Blakely Test parameters were applied to this data set:

No of passes of smoothing filter:	3
Level of peak detection:	4 (Normal)
Grid value cut off level:	6

Following completion of the automated selection process, the dataset was inspected by an experience geophysicist for targets that may have been missed or incorrectly selected by the automated regime. Targets characteristics were analysed to ensure no processing artefacts were included by the Blakely Test.

Clusters of targets were located and merged into single targets. This was undertaken by creating a TIN (Triangular Irregular Network) from the X, Y locations of the input targets. For each node in turn, adjacent nodes were located that were within the specified merge radius. If such targets were located, then they were replaced with a single target at the geometric centre of the original locations.

Target parameters were determined using a '2.7 Ordnance Target Type'. The Target Type represents a structural index used to express the degree of homogeneity in the calculation of apparent depth. An index of 2 would represent an infinitely long pipe where as an index of 3 would represent a sphere. Decimal values will approximate a shape somewhere between a sphere and a pipe. The apparent weight of a target is obtained from look up table contained within the software using the analytic value and calculated apparent depth for each target type.

4.5.2 Magnetic Field Survey Results

The resultant residual field data grid from the processing has been presented as false colour images on drawings L7058-17/04a and b. The calculated residual magnetic field following removal of the background magnetic field highlights the position of anomalies associated with short wavelength features which may represent the presence of shallow targets. The existing long sea and short seaoutfalls are clearly evident together with a number of isolated magnetic targets.

The results from the magnetometer survey have been successful in accurately and extensively mapping the magnetic field variations over the site. A total of 121 anomalies have been identified in the area surveyed. The positions of these have been presented on survey charts L7058-17/04a and b, together with a target ID which can be cross referenced to the target listing. The following parameters have been provided within the magnetic anomaly target listing, Table T2, Appendix B:

Target ID	OSGB East	OSGB North	Residual Analytic Field Grid Value	Background Field	Target Size	Apparent Weight	Calculated Depth	Depth Error

The false colour image highlights many further small anomalies above those that have been listed. Such features have been disregarded as possible targets following review of the data and are likely to be associated with for example; small errors in background field removal and local drift geology changes etc. which are not possible to remove from the dataset without removing valid data. Drawing L7058-17/04a shows the residual analytic field and anomalies produced using the majority of the valid data acquired. This chart has been included for clarity of visual analysis. Drawing L7058-17/04b shows the residual analytic field and anomalies identified from data filtered to remove the influence of the short wavelength anomalies identified due to the assumed influence of the drift geology / sediment overburden. The data illustrated in L7058-17/04b were used for the target analysis and identification.

As no UXO desk study information has been made available for the survey area it has not been possible to confirm the risk level and likely ordnance type to be expected. It should also be noted that it is not possible to confirm the identity of the causative body of a magnetic target and therefore we are unable to positively identify whether these may be associated with buried UXO.

The majority of the magnetic targets identified have little magnetic signature variation from that of the background field. 117 of the targets have been calculated to have a mass of greater than or equal to 14 kg. As such, it is anticipated that the majority of targets are likely to be associated with small items of debris from fishing and other sources. Typically the smallest items of UXO encountered in UK waters include 3.7" AAA shells and 50 kg air dropped German UXB. The ferrous mass of a 3.7" AAA when new was approximately 14 kg. The calculated depth (mean 2.63 m) from sensor for many of the targets identified would indicate that they are on the surface or shallowly buried.

Whilst it is believed that the majority of the anomalies are unlikely to be associated with UXO, it is considered important that they be considered as potential UXO during any future intrusive work and advice from a suitably qualified and experienced UXO specialist should be obtained.

5 SUMMARY

The results of the survey can be summarised as follows:

Bathymetry

- Levels encountered across the site range from 3.6 m above Chart Datum to 11.3 m below Chart Datum.
- The inshore portion of the survey area is characterised by a featureless sandy seabed with the seabed becoming gravelly with scattered boulders offshore, wave-like features likely to be gravely in nature are also evident.

Seabed Features and Obstruction

- Two distinct zones of sediment distribution across the site have been identified. These range from high reflectivity seabed interpreted as clay with gravel and cobbles and relatively low reflectivity sand with cobbles.
- The magnetometer clearly identifies the presence and route of the outfall pipeline.
- 121 magnetic targets have been identified during the survey and positions recorded.
- All targets identified by the side scan sonar and the magnetometer have been listed in Appendix B.

Details on Sub-bottom Geology

- The single channel reflection achieved good penetration to around 8 metres below the seabed in places. Four horizons have been identified from the data.
- The multi-channel seismic reflection provided reasonable penetration of up to 23 metres with three additional horizons been identified below the detectable range of the single channel system.
- A total of seven sub-bottom horizons have been mapped and existing boreholes have allowed four of these to be characterised.
- An interpreted depth to top of rock has not been possible in this case .

6 SAFETY

All staff were inducted on to site and briefed on the project requirements by the site safety and environmental supervisor (SSES). A record of the induction is kept in the following document; ESG Project Plan L7058-17.

All operations and procedures on site during the survey adhered to ESG Surveys method statement and control measures put in place as a result of carrying out a risk assessment.

7 REFERENCES

The British Geological Survey (BGS) 1:50,000 scale geological map Sheet 81 Patrington Solid and Drift Edition

APPENDIX A

DAILY OPERATION REPORTS

APPENDIX B

FIGURES AND TABLES

Description	Figure
Site Location Plan	B1
Vessel Offset Diagram	B2
Sound Velocity Profiles	B3
Side Scan Sonar Target Listing Images	B4
Example Seismogram	B5

Description	Table
B1 Sonar Contacts	B1
B2 Magnetic Contacts	B2

APPENDIX C
CALIBRATIONS

Description	Report
MBES Patch Test	C1

APPENDIX D

DRAWINGS

Drawing Number	Description
L7058-17/01	Bathymetric Chart
L7058-17/02	Seabed Features Chart
L7058-17/03	Side Scan Sonar Mosaic
L7058-17/04a	Residual Magnetic Field Chart
L7058-17/04b	Analytic Signal Anomaly Chart
L7058-17/05	Isopachyte To Interpreted SC01 Reflector Chart
L7058-17/06	Isopachyte To Interpreted SC02 Reflector Chart
L7058-17/07	Isopachyte To Interpreted SC03 Reflector Chart
L7058-17/08	Isopachyte To Interpreted SC04 Reflector Chart
L7058-17/09	Reduced Level To Interpreted Reflector SC01 Chart
L7058-17/10	Reduced Level To Interpreted Reflector SC02 Chart
L7058-17/11	Reduced Level To Interpreted Reflector SC03 Chart
L7058-17/12	Reduced Level To Interpreted Reflector SC04 Chart
L7058-17/13	Isopachyte To Interpreted MC01 Reflector Chart
L7058-17/14	Isopachyte To Interpreted MC02 Reflector Chart
L7058-17/15	Isopachyte To Interpreted MC03 Reflector Chart
L7058-17/16	Isopachyte To Interpreted MC04 Reflector Chart
L7058-17/17	Isopachyte To Interpreted MC05 Reflector Chart
L7058-17/18	Reduced Level To Interpreted Reflector MC01 Chart
L7058-17/19	Reduced Level To Interpreted Reflector MC02 Chart
L7058-17/20	Reduced Level To Interpreted Reflector MC03 Chart
L7058-17/21	Reduced Level To Interpreted Reflector MC04 Chart
L7058-17/22	Reduced Level To Interpreted Reflector MC05 Chart
L7058-17/23	Geological Cross Sections – Assumed Centreline

APPENDIX E

TECHNICAL INFORMATION

MV Pulsar

Applanix POS-MV320 Inertia aided RTK Global Positioning System

Leica GS14

Sonardyne 8024 Transducer

Sonardyne Omni Transponder

Knudsen 320M Dual frequency Hydrographic Echo Sounder

Valeport Mini SVS

R2Sonic 2022 Multi-beam Echo sounder

Valeport 650 SVP

Coda DA4G Acquisition system

Klein system 3100 digital Side Sonar system

SES 2000 parametric sub bottom profiler

Applied Acoustics Triple Plate S-Boom Boomer

Applied Acoustics CSP S1250 seismic energy source

Geometrics GEODE 24 channel seismic recorder

Geometrics MicroEel Analog Seismic Solid 24 Channel Streamer

Geometrics G882 Cs Vapour Marine Magnetometer

Applanix PosPAC PPK software

QPS QINSy

Sonardyne Scout plus

Coda GeoKit Seismic and Sidescan Interpretation Software

Trimble Terramodel

APPENDIX F

DIGITAL DATA

File name	Description
L7085-17_Withernsea_MBES_0.5m_CD.xyz	BATHYMETRIC SOUNDINGS
L7058-17 Withernsea Magnetometry data.csv	MAGNETOMETRY DATA
L7058-17 Withernsea UXO target list.csv	POTENTIAL-UXO TARGET LIST
L7058-17 Withernsea UXO Oasis.zip	OASIS MONTAJ PROJECT

Site Location Plan

Notes:

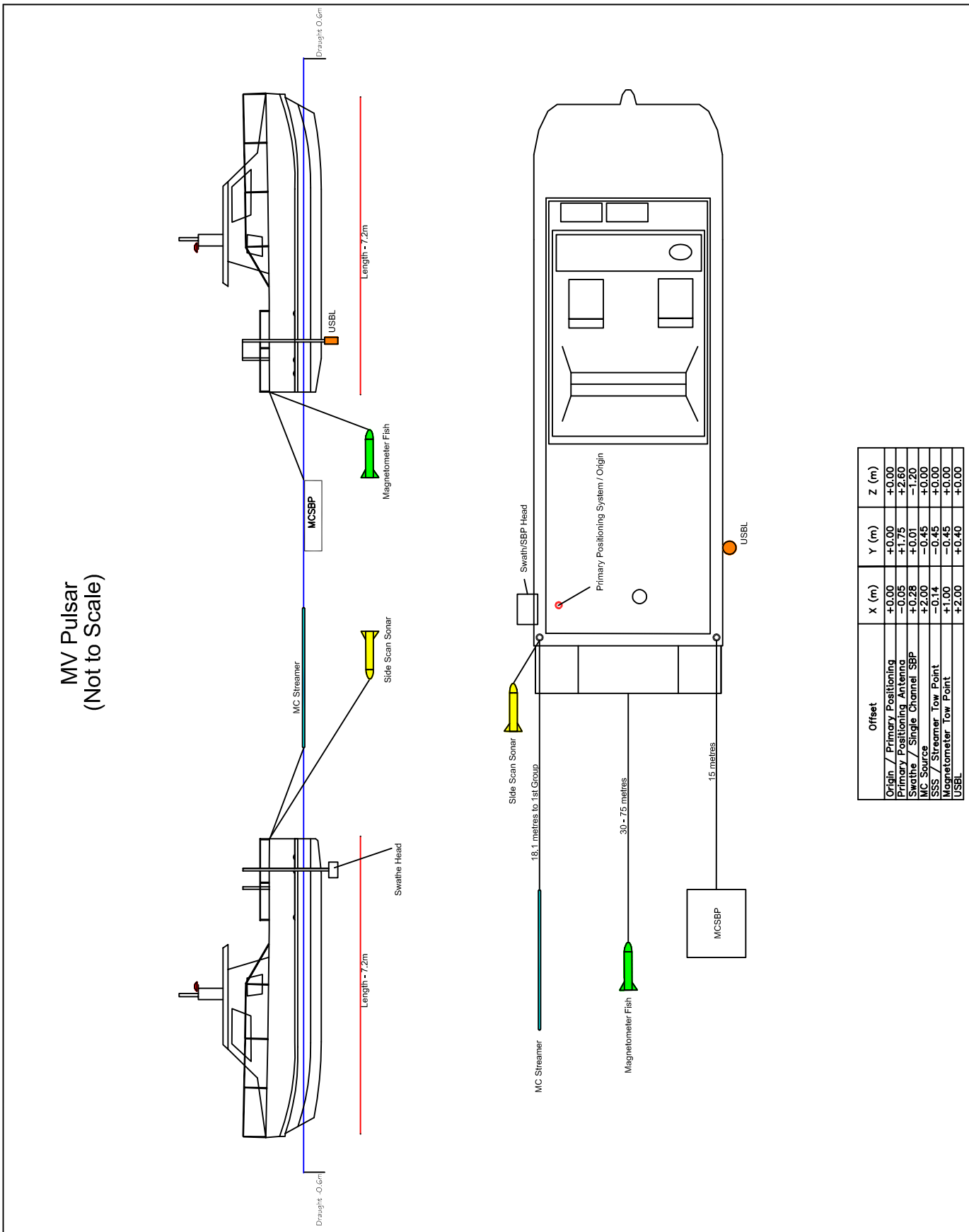
Reproduced from the Ordnance Survey Landranger map by permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office, © Crown copyright, Environmental Scientifics Group Limited. All rights reserved. Licence 100006060

Project	**YORKSHIRE WATER WITHERNSEA OUTFALL PHASE 1 - GEOPHYSICAL SITE INVESTIGATION**
Proiect No.	**L7058-17**
Carried out for	**Yorkshire Water**

Figure

B1

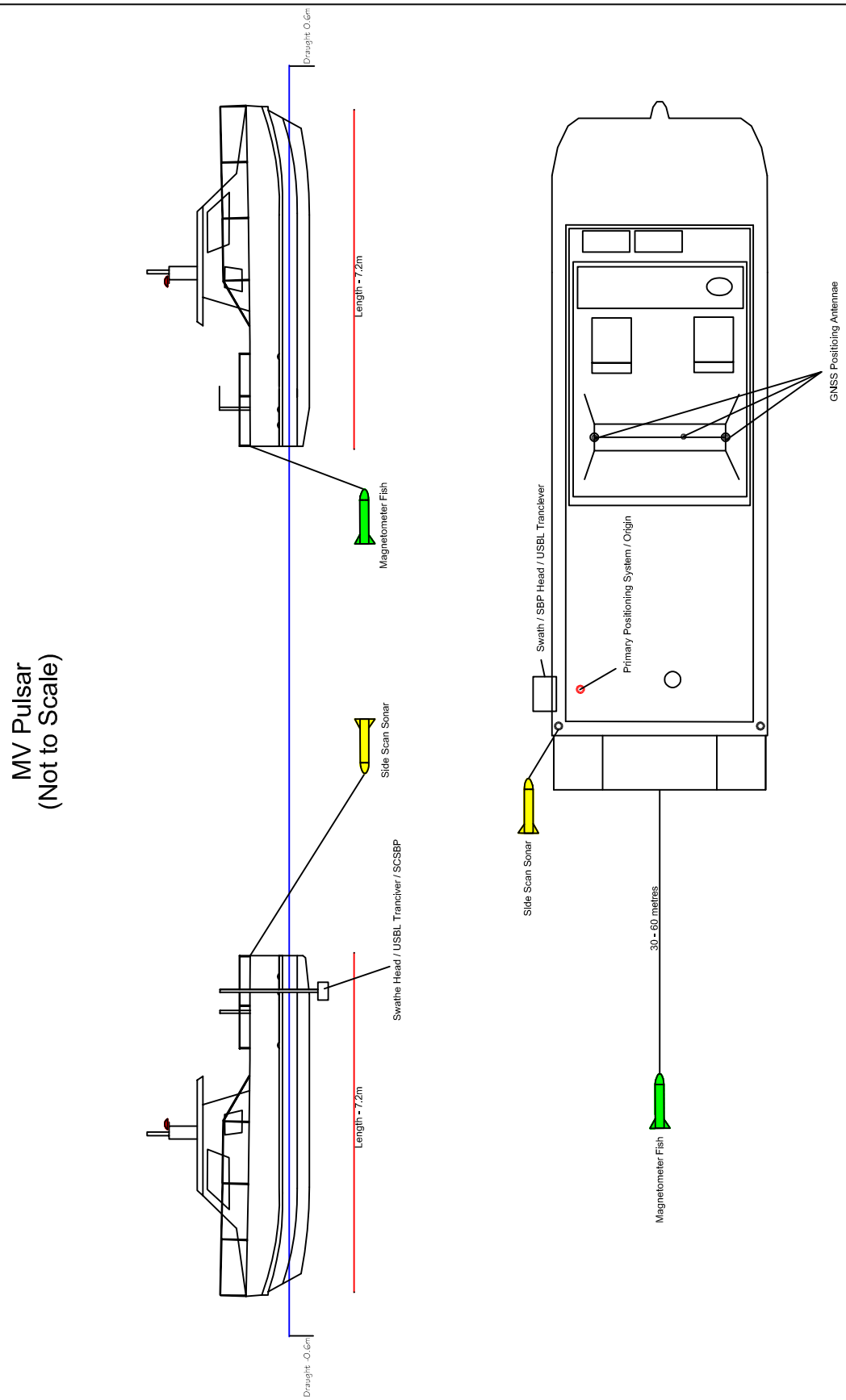
MV Pulsar Vessel Offsets



Offset	X (m)	Y (m)	Z (m)
Origin / Primary Positioning	+0.00	+0.00	+0.00
Primary Positioning Antenna	−0.05	+1.75	+2.60
Swathe / Single Channel SBP	+0.28	+0.01	−1.20
MC Source	+2.00	−0.45	+0.00
SSS / Streamer Tow Point	−0.14	−0.45	+0.00
Magnetometer Tow Point	+1.00	−0.45	+0.00
USBL	+2.00	+0.40	+0.00

Notes: NOT TO SCALE	Project: YORKSHIRE WATER WHEATCROFT OUTFALL PHASE 1 - GEOPHYSICAL SITE INVESTIGATION Project No.: L5232-15 Carried out for: Yorkshire Water Services Ltd	Figure B2

MV Pulsar Vessel Offsets



Offset	X (m)	Y (m)	Z (m)
Origin / Primary Positioning	+0.00	+0.00	+0.00
Primary Positioning Antenna	−0.05	+1.75	+2.60
Swathe / Single Channel SBP	+0.28	+0.01	−1.20
USBL Tranclever	+0.28	+0.01	−1.20
SSS Tow Point	−0.14	−0.45	+0.00
Magnetometer Tow Point	+1.00	−0.45	+0.00

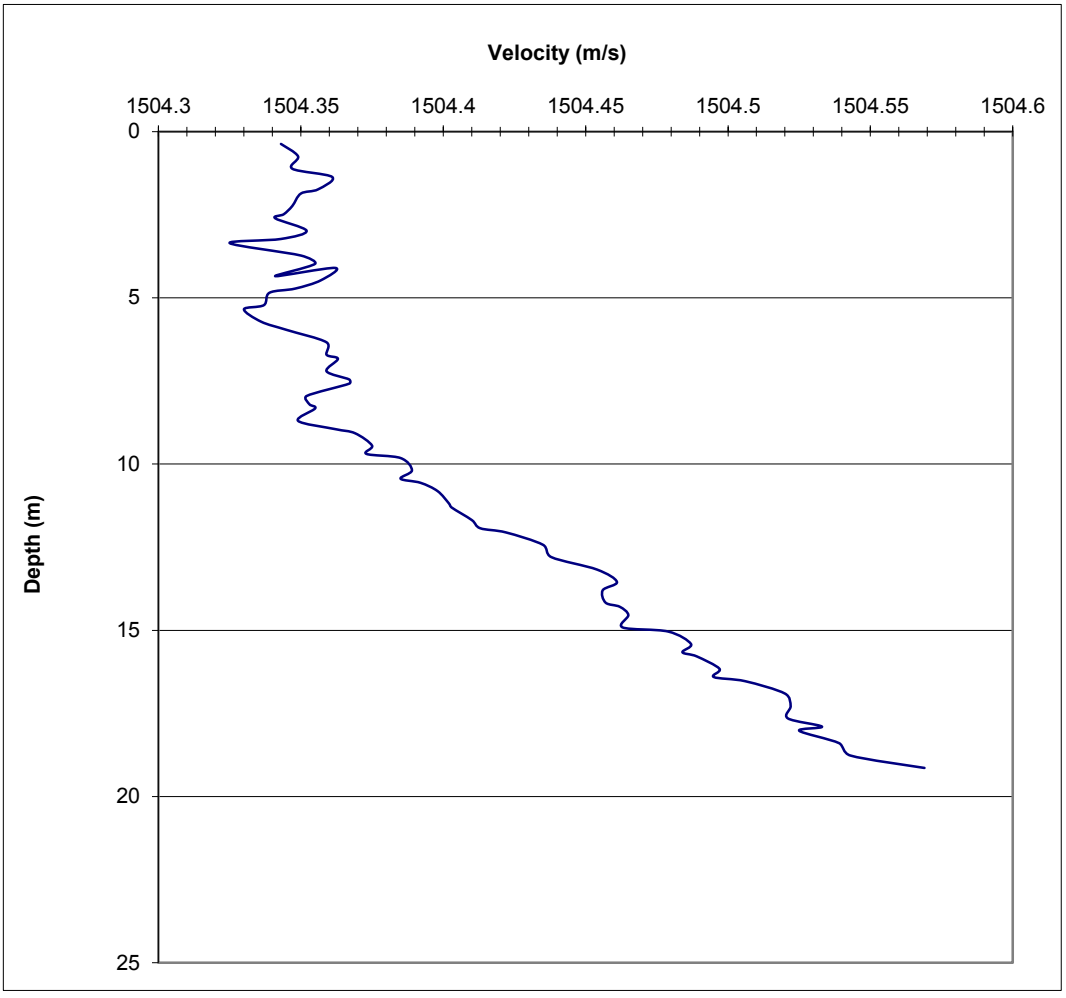
Notes: NOT TO SCALE	Project: YORKSHIRE WATER WITHERNSEA OUTFALL PHASE 1 - GEOPHYSICAL SITE INVESTIGATION Project No. L7058-17 Carried out for Yorkshire Water	Figure B2

Example Sound Velocity Profile

Client:	Yorkshire Water
Job Number:	L7058-17
Job Description:	YORKSHIRE WATER WITHERNSEA OUTFALL
Date & Time:	15 July 2017
Location:	WITHERNSEA
Vessel:	MV Pulsar
Probe type:	Valeport SVP Midas Serial No. 21712

Summary Statistics

Mean	1504.41
Minimum	1504.33
Maximum	1504.57
Count	71.00

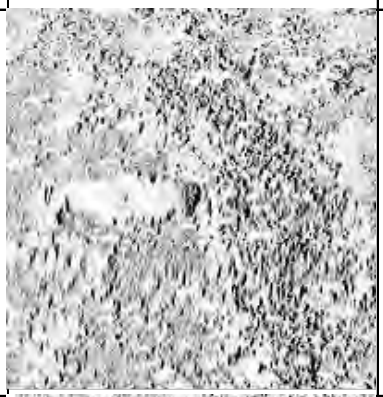
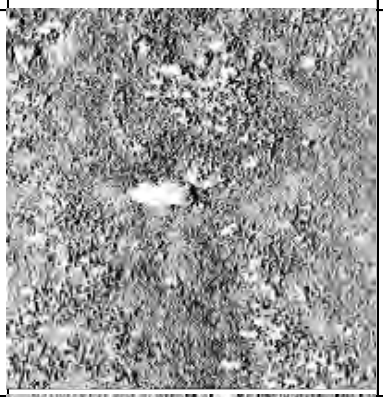
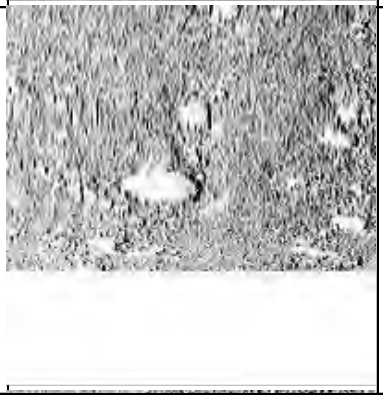


Notes:

Project	YORKSHIRE WATER WITHERNSEA OUTFALL PHASE 1 - GEOPHYSICAL SITE INVESTIGATION
Proiect No.	L7058-17
Carried out for	Yorkshire Water

Figure B3

Side Scan Sonar Target Listing

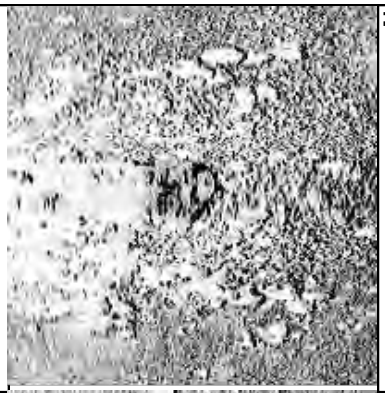
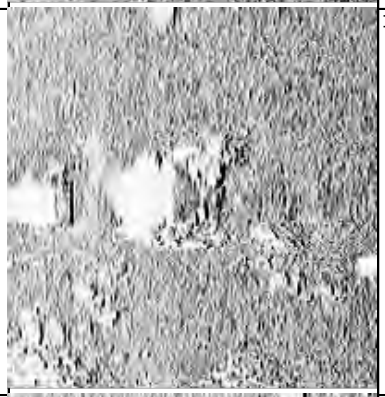
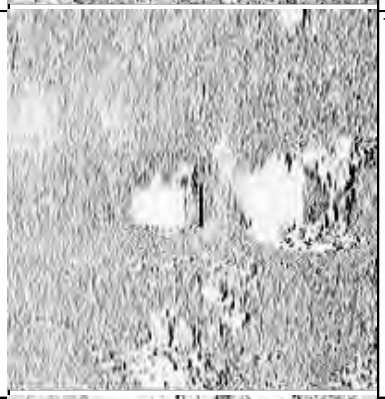
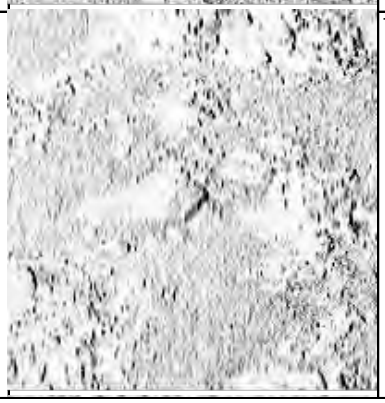
Type Name	Anomaly Number	Snap Shot	Length (m)	Width (m)	Height (m)	Easting (m)	Northing (m)
Debris	1		1.4	0.4	0.8	536621.3	426258.4
Exposed Pipeline	2					536669.3	426202.3
Linear Debris	3		5.4	0.2	0.2	536784.7	426034.2
Linear Debris			5.4	0.2	0.2	536787.4	426029.7
Debris	4		1.3	0.6	0.6	536852.7	425923.4
Debris	5		1.0	0.4	0.4	536714.6	426409.7

Notes:

Project	Withernsea Outfall Geophysical Site Survey
Project No.	L7058-17
Carried out for	Yorkshire Water

Figure **B4**

Side Scan Sonar Target Listing

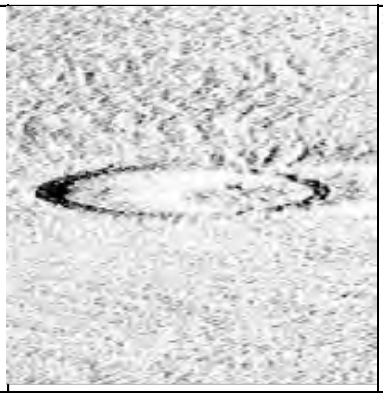
Debris	6		2.2	1.5	2.6	536794.0	426295.9
Debris	7		3.8	1.1	0.4	536815.6	426273.2
Debris	8		1.6	0.3	0.3	536818.2	426275.2
Debris	9		1.8	0.7	0.4	536893.0	426183.8

Notes:

Project	Withernsea Outfall Geophysical Site Survey
Proiect No.	L7058-17
Carried out for	Yorkshire Water

Figure **B4**

Side Scan Sonar Target Listing

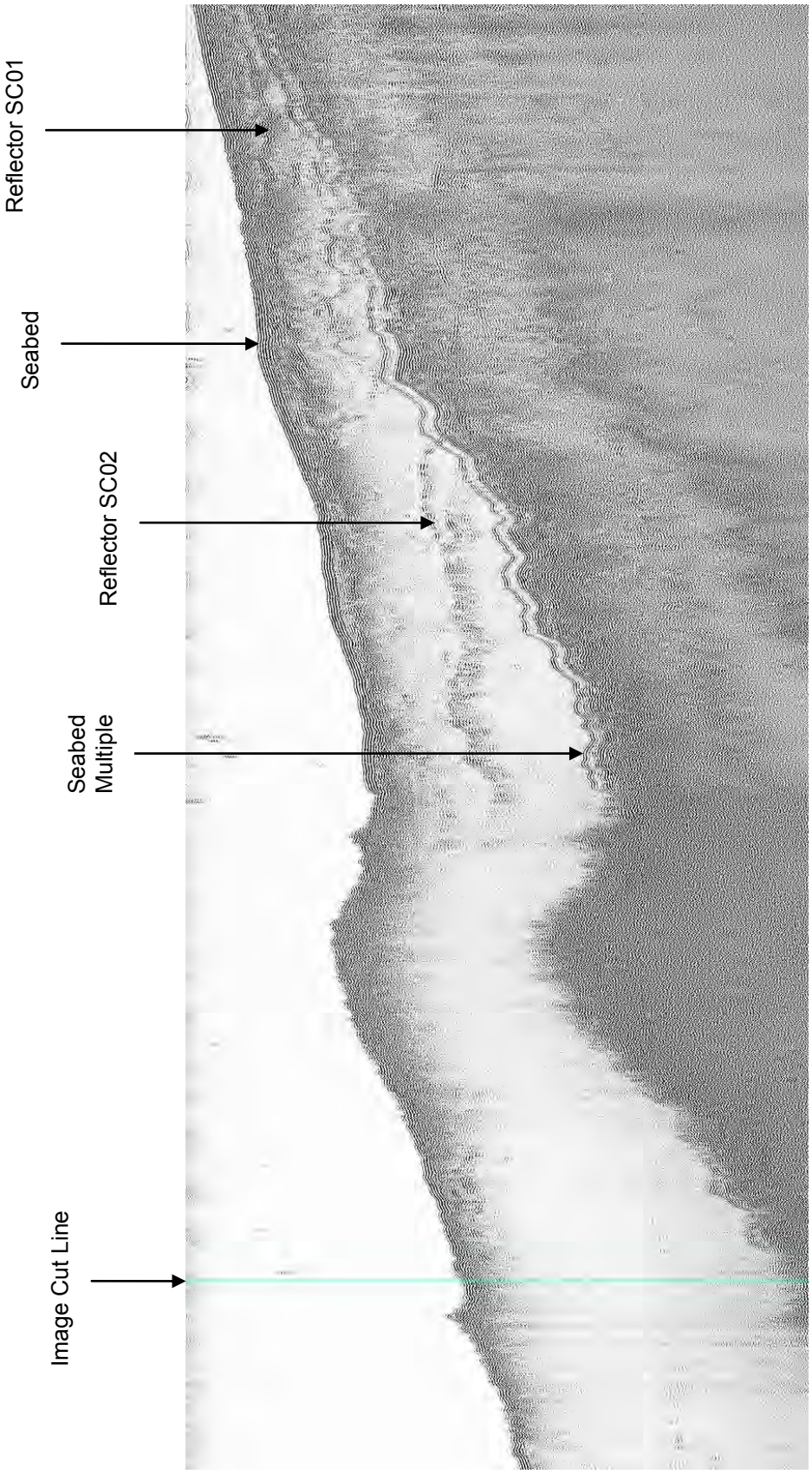
Diffuser	10		3.5	3.4	0.7	536017.3	425704.5

Notes:

Project	Withernsea Outfall Geophysical Site Survey
Proiect No.	L7058-17
Carried out for	Yorkshire Water

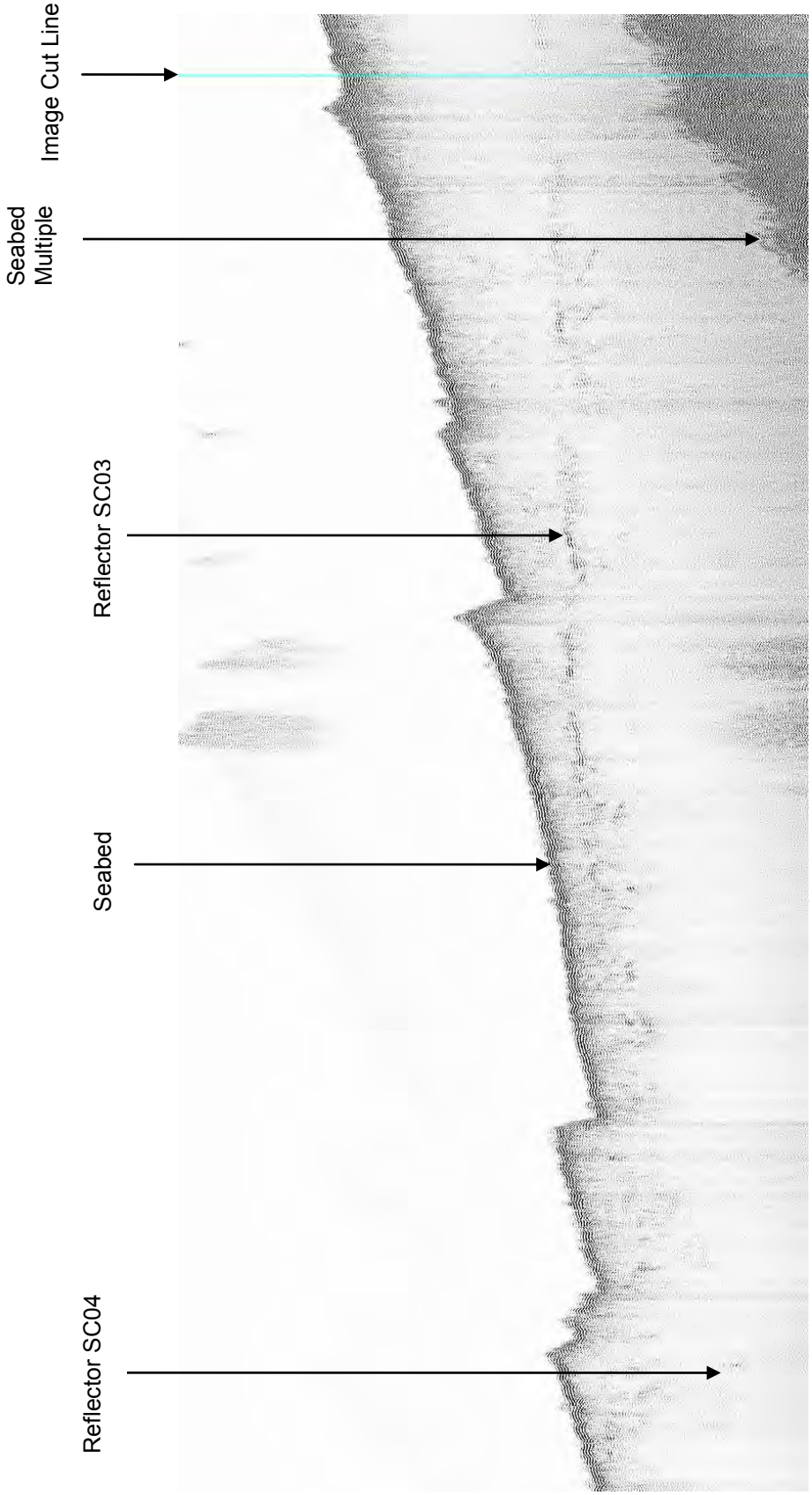
Figure **B4**

Example Seismogram – Single-channel



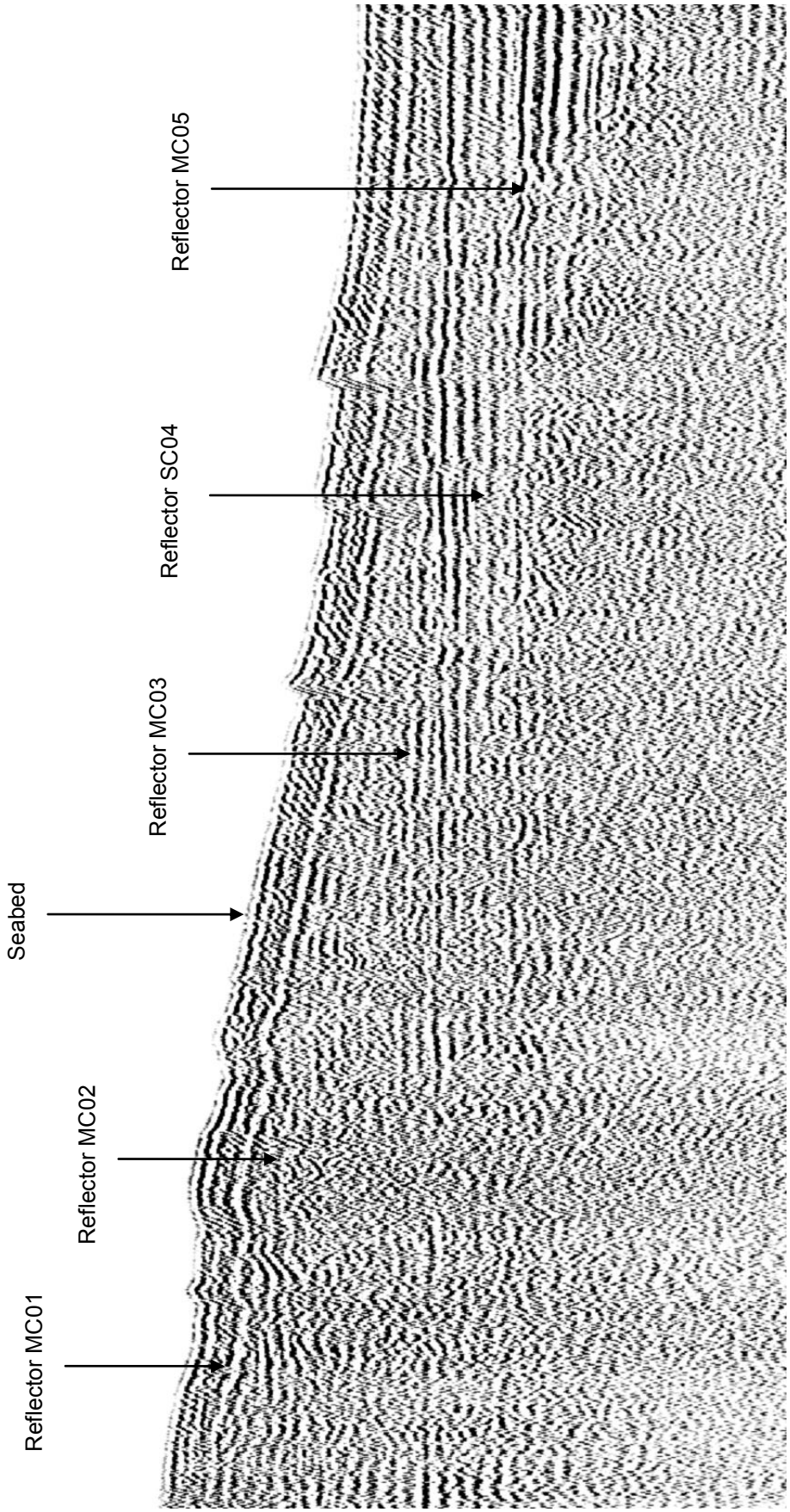
Notes:			Figure
	Project	Withernsea Outfall Geophysical Site Survey	B5a
	Proiect No.	L7058-17	
	Carried out for	Yorkshire Water	

Example Seismogram – Single-channel



Notes:	Project	Withernsea Outfall Geophysical Site Survey	Figure
	Project No.	L7058-17	B5a
	Carried out for	Yorkshire Water	

Example Seismogram – Multi-channel



Notes:	Project	Withernsea Outfall Geophysical Site Survey	Figure
	Proiect No.	L7058-17	B5b
	Carried out for	Yorkshire Water	

Side Scan Sonar Target Listing

Type Name	Anomaly Number	Length (m)	Width (m)	Height (m)	Easting (m)	Northing (m)
Debris/Suspected Debris	1	1.4	0.4	0.8	536621.3	426258.4
PipeLine	2				536669.3	426202.3
Linear Debris Start	3	5.4	0.2	0.2	536784.7	426034.2
Linear Debris End	3	5.4	0.2	0.2	536787.4	426029.7
Debris/Suspected Debris	4	1.3	0.6	0.6	536852.7	425923.4
Debris/Suspected Debris	5	1	0.4	0.4	536714.6	426409.7
Debris/Suspected Debris	6	2.2	1.5	2.6	536794	426295.9
Debris/Suspected Debris	7	3.8	1.1	0.4	536815.6	426273.2
Debris/Suspected Debris	8	1.6	0.3	0.3	536818.2	426275.2
Debris/Suspected Debris	9	1.8	0.7	0.4	536893	426183.8
Debris/Suspected Debris	10	3.5	3.4	0.6	536017.2	425704.6
Debris/Suspected Debris	11	3.3	3.1	0.7	536017.5	425704.4

Magnetometer Contact Listing

Target ID	OSGB East	OSGB North	Residual Analytic Field Grid Value	Background Field	Target Size	Apparent Weight	Calculated Depth	Depth Error
1	536016.7	425829.9	123.3	-3.77	4.10	317.15	2.69	1.56
2	536020.9	425837.1	11.8	12.23	3.22	155.2	4.33	5.75
3	536024.5	425842.0	20.8	4.76	1.80	92.55	2.97	1.71
4	536058.2	425856.9	4.4	-1.34	3.50	5.89	1.54	4.92
5	536062.4	425873.4	13.7	-4.66	3.33	54.04	2.76	1.78
6	536064.8	425868.5	14.7	0.93	2.10	73.53	3.06	2.52
7	536070.3	425764.4	6.9	-2.19	3.47	60.99	3.64	2.84
8	536072.1	425866.1	10.3	-1.46	1.66	66.93	3.31	2.38
9	536119.2	425664.7	40.5	-7.55	1.75	144.34	2.81	2.00
10	536121.2	425823.4	12.3	-3.09	1.85	41.09	2.55	4.97
11	536127.3	425630.4	50.4	-12.73	5.07	674.39	5.62	6.10
12	536131.7	425687.3	13.8	1.61	2.04	37.81	2.36	3.27
13	536135.3	425622.4	10.1	-1.05	1.65	549.58	7.19	26.59
14	536136.9	425670.7	20.9	1.97	1.97	79.64	2.80	5.40
15	536155.1	425653.0	17.2	2.45	2.18	64.31	2.74	4.06
16	536159.5	425656.2	35.2	-1.94	1.89	109.22	2.64	3.10
17	536169.2	425641.3	13.8	1.54	1.78	44.03	2.52	2.96
18	536179.7	425619.6	11.2	-3.90	2.27	52.93	2.93	4.62
19	536189.9	425611.5	5.7	7.16	4.99	9.97	1.81	6.89
20	536196.2	425573.6	10.7	1.37	1.97	37.08	2.57	9.13
21	536196.6	425942.7	11.9	0.03	1.80	32.56	2.33	2.21
22	536220.3	425560.5	12.9	-1.10	5.27	58.56	2.91	2.27
23	536232.4	425546.6	11.2	-1.32	1.90	35.04	2.47	1.68
24	536267.1	425800.9	20.5	-3.06	1.64	55.57	2.42	3.01
25	536267.5	425580.3	72.3	24.71	5.04	73.75	1.71	4.75
26	536286.0	425738.0	12.1	-1.40	1.58	29.38	2.21	9.34
27	536293.1	425782.3	41.5	-1.01	2.56	63.21	1.98	1.78
28	536295.3	425655.6	31.0	61.48	3.79	233.97	3.77	10.69
29	536295.3	425645.8	823.0	100.44	2.48	674.39	2.38	1.99
30	536310.6	425618.0	14.9	-2.05	1.60	38.22	2.31	5.91
31	536310.6	425664.7	47.5	-5.02	3.37	467.55	4.28	2.25
32	536324.7	425719.1	20.4	-3.41	1.93	155.71	3.65	4.03
33	536325.1	425510.8	16.5	-1.70	1.94	55.1	2.60	4.30
34	536333.6	425707.8	1302.3	2.05	2.24	674.39	2.86	5.73
35	536336.4	425630.0	15.9	-1.73	1.79	36	2.19	2.68
36	536339.2	425825.8	10.3	5.88	2.74	10.67	1.47	6.55
37	536342.6	425579.7	28.2	92.75	4.98	158.6	3.31	4.06
38	536343.6	425590.6	1136.5	67.37	2.13	674.39	2.57	2.92

Notes:

Project	YORKSHIRE WATER Withernsea OUTFALL PHASE 1 - GEOPHYSICAL SITE INVESTIGATION
Proiect No.	L7058-17
Carried out for	Yorkshire Water Services Ltd

Table B2

Magnetometer Contact Listing

39	536361.8	425719.9	33.6	3.23	1.51	93.36	2.53	6.75
40	536363.0	425714.2	101.2	-20.78	1.91	157.94	2.11	1.38
41	536375.9	426122.8	10.3	-2.29	1.80	20.73	1.99	3.98
42	536386.7	425742.8	11.7	6.85	2.00	55.52	2.94	4.45
43	536408.1	426043.4	11.4	-4.37	1.25	105.64	3.81	14.55
44	536414.9	425696.9	1686.1	143.43	1.69	674.39	2.34	2.19
45	536422.2	425684.4	42.5	47.68	1.91	351.57	3.98	27.99
46	536431.5	426062.7	17.4	3.90	2.77	61.6	2.68	3.70
47	536437.1	425932.2	21.9	-3.29	1.71	44.58	2.14	2.08
48	536440.3	425795.6	20.6	-1.74	2.72	54.1	2.39	1.83
49	536456.0	426134.9	30.3	-5.30	1.74	95.18	2.64	6.97
50	536467.5	426064.1	13.6	-2.29	5.38	67.75	3.03	2.92
51	536474.2	425918.9	15.9	1.89	1.77	38.19	2.25	5.30
52	536480.6	425842.8	13.1	-3.74	2.42	40.89	2.49	5.00
53	536485.4	426097.4	19.9	0.19	2.08	76.13	2.79	4.51
54	536489.5	426106.2	23.7	2.10	3.31	47.54	2.15	1.33
55	536493.5	425889.9	17.0	1.54	2.66	43.44	2.33	2.09
56	536501.2	426109.5	10.0	0.63	2.09	24.02	2.16	2.72
57	536501.6	425903.2	24.1	0.94	1.99	68.49	2.50	3.54
58	536509.2	425919.7	11.6	-0.29	1.76	25.86	2.12	3.60
59	536529.0	426142.9	23.2	4.01	1.90	65.04	2.48	5.70
60	536588.2	426201.7	15.4	-1.45	2.69	63.35	2.83	6.52
61	536597.8	426190.9	13.4	-0.24	2.12	41.21	2.48	2.36
62	536598.6	426287.9	15.8	3.85	1.70	47.39	2.48	5.59
63	536603.9	426285.5	13.3	0.31	1.66	29.75	2.15	2.82
64	536605.5	425790.0	16.0	10.66	2.67	144.15	3.82	5.11
65	536609.5	426078.4	13.3	1.90	2.58	25.89	2.02	8.64
66	536610.3	425796.8	203.4	-10.30	1.50	396.08	2.48	10.56
67	536614.4	426082.5	39.9	-4.12	1.93	142.98	2.81	1.32
68	536624.0	426263.4	13.0	-1.27	1.69	30.3	2.18	3.80
69	536638.3	425979.3	26.9	-2.79	2.98	62.86	2.31	1.20
70	536638.5	425692.1	12.3	-3.08	1.54	39.2	2.50	5.14
71	536644.0	426012.8	15.1	-0.81	2.80	37.73	2.28	1.24
72	536650.0	426317.0	9.6	-0.70	3.02	22.75	2.14	1.26
73	536661.1	426000.7	19.8	-0.13	2.02	68.02	2.67	4.86
74	536668.7	425918.5	25.4	-0.40	2.16	99.15	2.86	3.49
75	536674.8	426327.4	53.2	-10.55	1.52	244.7	3.22	9.34
76	536680.8	426267.8	22.5	-0.37	2.59	99.28	2.97	2.76
77	536692.1	425817.0	12.6	3.62	1.94	44.17	2.61	5.20
78	536693.7	425748.9	11.2	1.51	1.64	34.9	2.46	3.88

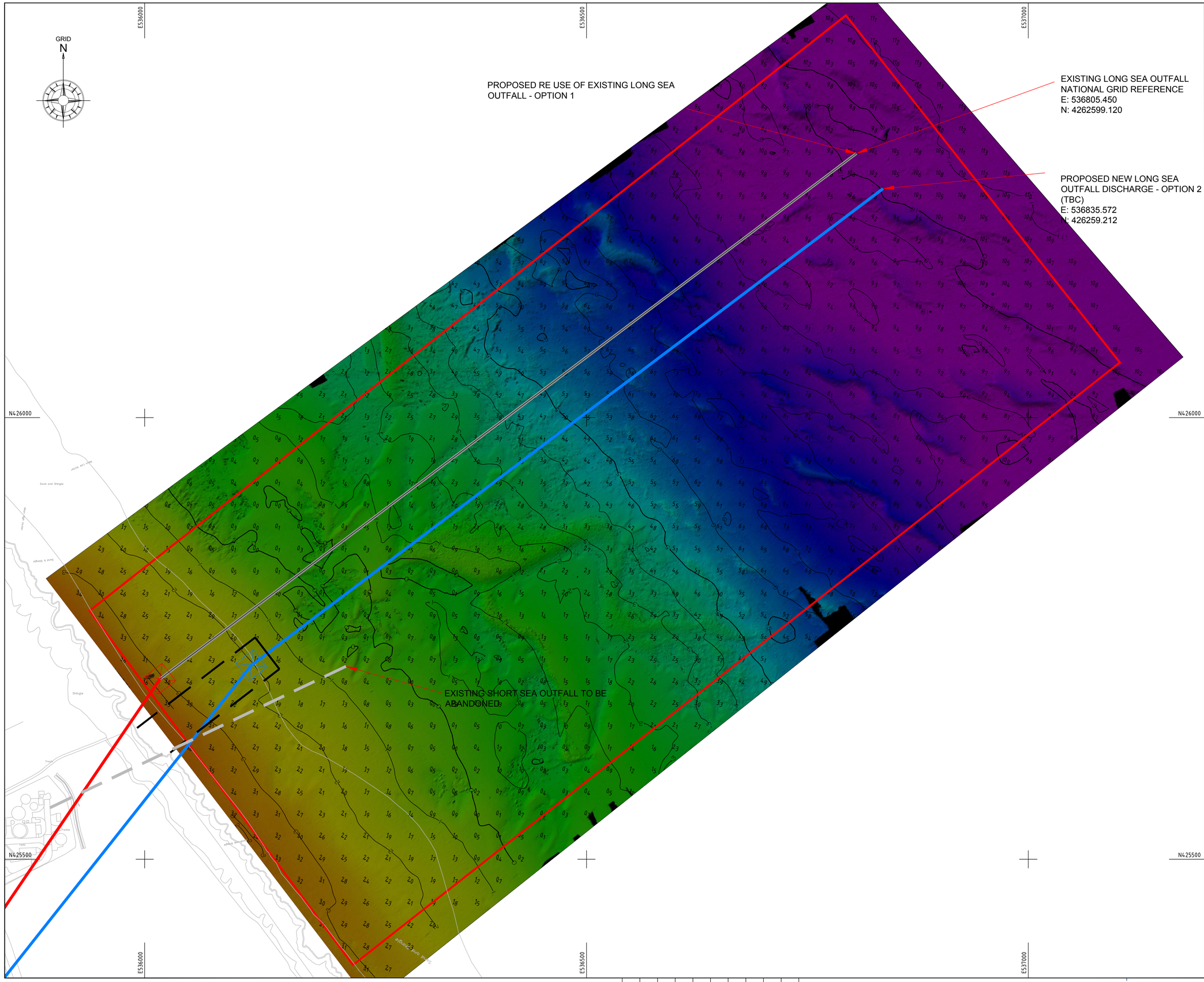
Magnetometer Contact Listing

79	536696.7	426327.6	17.2	7.53	3.59	49.06	2.44	8.08
80	536707.0	425913.3	50.5	-1.30	1.78	95.63	2.20	8.06
81	536707.4	425893.1	12.6	4.00	1.87	35.49	2.37	4.24
82	536715.9	425898.0	11.5	2.59	2.33	47.78	2.79	3.36
83	536721.1	425834.3	28.1	3.83	1.74	45.32	1.97	4.26
84	536721.7	426133.8	6.1	1.76	3.15	10.49	1.80	6.73
85	536727.2	426022.0	13.3	5.48	2.15	54	2.78	4.94
86	536730.4	426153.4	22.5	-2.78	1.98	55.97	2.35	6.21
87	536735.2	425891.9	11.5	1.34	2.28	26.91	2.17	5.70
88	536742.9	426387.1	48.4	-15.88	1.93	173.51	2.87	10.21
89	536743.7	426020.8	23.0	5.70	2.02	63.56	2.46	1.96
90	536753.0	425893.5	20.9	-2.94	2.42	62.93	2.53	5.23
91	536757.8	425895.1	40.8	-1.72	1.96	134.98	2.73	3.05
92	536762.2	425975.7	11.7	-2.14	2.00	26.21	2.13	2.88
93	536762.6	426386.2	25.7	-2.80	1.64	50.07	2.13	4.37
94	536767.3	425789.2	16.9	1.39	5.49	98.72	3.26	2.39
95	536767.1	426402.8	14.9	-2.92	1.73	33.69	2.18	5.96
96	536768.7	426188.4	13.3	-2.16	1.47	31.24	2.20	21.41
97	536774.3	426361.7	11.7	0.82	1.96	28.67	2.22	2.46
98	536799.7	426336.7	14.1	3.29	2.08	41.53	2.44	3.50
99	536811.8	426421.3	19.7	-0.29	1.84	54.47	2.44	3.53
100	536812.2	426285.1	21.5	0.44	1.60	87.75	2.88	6.25
101	536821.8	426178.0	11.4	-1.03	1.59	34.03	2.41	4.36
102	536828.3	426060.7	13.8	3.20	1.79	65.01	2.97	3.30
103	536828.3	426426.5	24.0	0.93	2.14	98.89	2.92	5.51
104	536833.5	426122.4	12.0	-1.45	2.06	28.53	2.19	5.35
105	536849.2	426257.3	21.5	-0.74	2.07	89.49	2.90	5.29
106	536860.5	426239.6	21.2	-0.81	1.94	66.43	2.58	3.41
107	536863.3	426373.8	185.7	18.93	2.13	303.62	2.28	2.31
108	536878.2	426050.2	13.7	-1.79	1.53	34.09	2.26	15.80
109	536879.5	425877.8	13.7	0.82	2.23	64.4	2.97	3.92
110	536888.3	425862.1	14.6	1.84	2.07	58.39	2.79	3.25
111	536918.5	426053.9	54.2	-8.91	1.77	114.09	2.31	6.09
112	536924.6	426202.9	21.7	3.70	2.62	54.2	2.34	5.73
113	536942.7	425976.5	14.3	3.53	1.89	26.56	1.99	11.58
114	536947.9	426195.7	13.4	2.72	1.63	53.32	2.76	3.94
115	536970.5	426173.9	16.4	-5.02	1.83	74.93	2.97	7.30
116	536995.1	426210.2	12.2	0.52	1.94	27.07	2.13	3.06
117	537008.8	426110.7	10.3	1.10	1.94	28.86	2.33	3.60
118	537062.8	426026.9	37.7	-5.46	1.69	58.65	1.98	7.02

Magnetometer Contact Listing

119	537074.9	426011.2	51.6	0.90	3.12	73.57	1.95	1.39
120	537083.3	426041.0	17.6	-0.87	2.06	36.5	2.13	5.10
121	537087.7	426008.3	14.5	0.26	1.61	26.7	1.99	14.99

Target identification completed within Oasis Montaj using UX Detect functions including a Blakely Test (Blakely & Simpson, 1986) and visual inspection by experienced geophysicist. Above target sizes determined using a 2.7 Ordnance target type.



Legend:

- SITE BOUNDARY
- CONTOUR
- INDEX CONTOUR
- 31 DEPTH (Below Chart Datum)
- 23 DRYING HEIGHT (Above Chart Datum)

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TE	Revised Issued
0	BS	Sep '17	TE	TG	Issued

Survey Date:	Surveyor:	Drawn By:
13/07/17 - 18/07/17	TE	TG

Client:

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Contractor:

ESG

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Deeside, Flintshire
CH5 2NY
United Kingdom

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Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

Bathymetry
Withernsea Outfall
L7058-17/01

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID
N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

Sand and Shingle
Shingle
Sand and Shingle
Sand and Shingle

Legend:

- Seabed interpreted as Sandy Clay with Gravel, Cobbles and Boulders
- Seabed interpreted as Sand with Cobbles
- Seabed interpreted as Bedforms
- Survey Boundary
- 4 Side Scan Sonar Target / Target (with ID)
- 103 Magnetic Anomaly (with ID)

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	
0	TE	Sep '17	TE	TG	Issued

Survey Date:	Surveyor:	Drawn By:
13/07/17 - 18/07/17	ASB	ASB

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Contractor:

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CH5 2NY
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geo.surveys@esg.co.uk
Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

Seabed Features Chart
Withernsea Outfall
L7058-17/02

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID
N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

Legend:

- Survey Boundary
- Seabed Character Change
- 4 Side Scan Sonar Target / Target (with ID)
- I03 Magnetic Anomaly (with ID)

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	TE	Sep '17	TE	TG	Issued

Survey Date:	Surveyor:	Drawn By:
13/07/17 - 18/07/17	ASB	ASB

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
Marlborough House
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Newcastle upon Tyne
NE1 4EE

Contractor:

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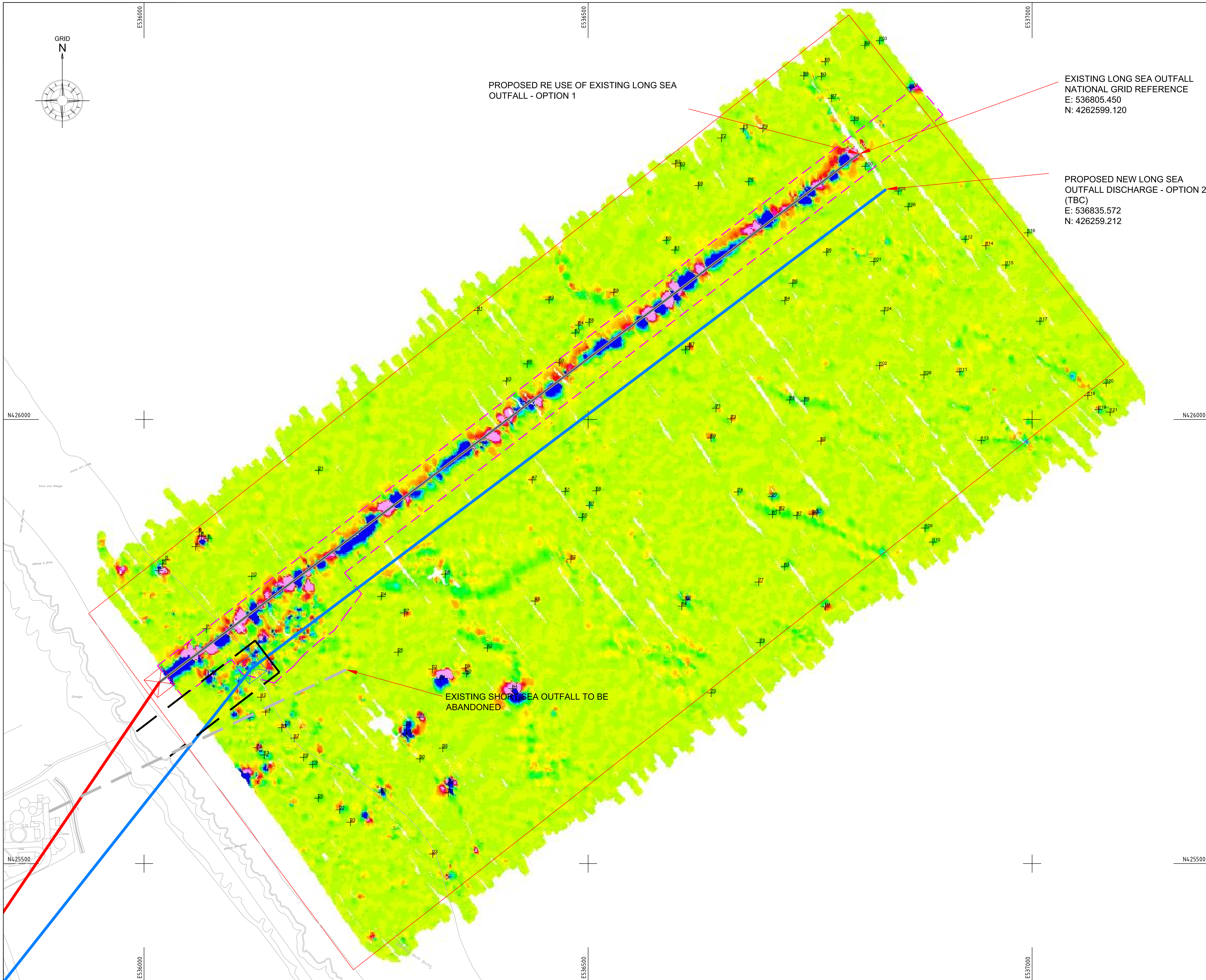
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

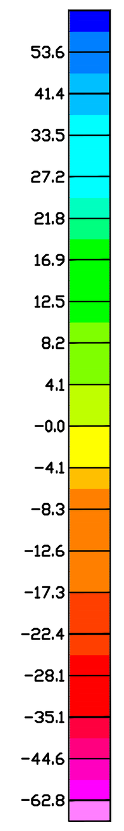
Side Scan Sonar Mosaic
Withernsea Outfall
L7058-17/03

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Survey Boundary
- Existing Pipeline: Targets Not Shown
- Side Scan Sonar Target / Target (with ID)
- Magnetic Anomaly (with ID)



Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	TE	Sep '17	TE	TG	Issued

Survey Date:	Surveyor:	Drawn By:
13/07/17 - 18/07/17	TE	TE

Client:

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Marlborough House
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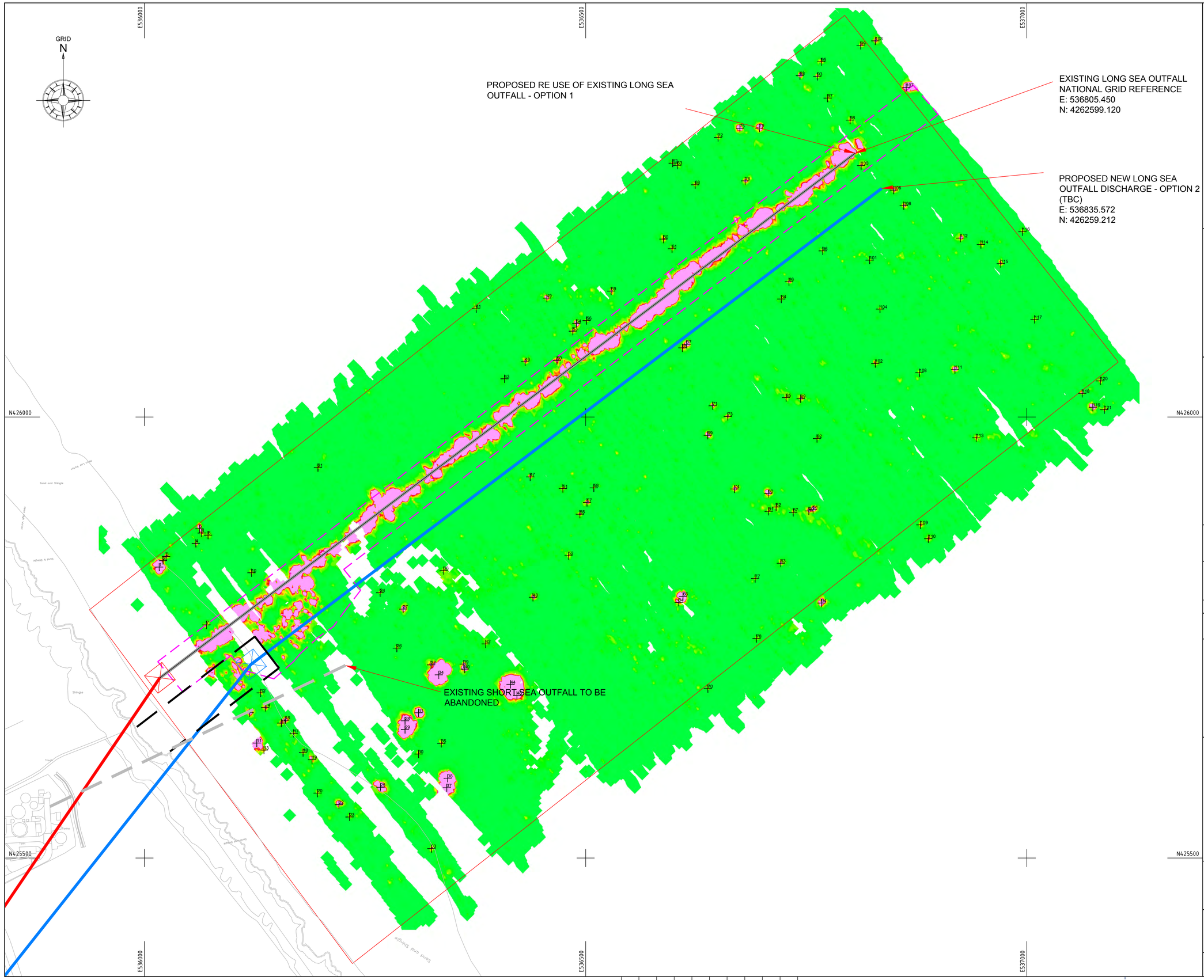
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

Residual Magnetic Field Chart
Withernsea Outfall
L7058-17/04a

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Survey Boundary
- Existing Pipeline: Targets Not Shown
- Side Scan Sonar Target / Target (with ID) — e.g. 4
- Magnetic Anomaly (with ID) — e.g. I03

Residual Magnetic Field (nT): 14.6, 14.2, 13.8, 13.5, 13.1, 12.7, 12.3, 11.9, 11.5, 11.2, 10.8, 10.4, 10.0, 9.6, 9.2, 8.8, 8.5, 8.1, 7.7, 7.3, 6.9, 6.5, 6.2, 5.8, 5.4, 5.0, 4.6, 4.2, 3.8, 3.5, 3.1, 2.7, 2.3, 1.9, 1.5, 1.2, 0.8, 0.4

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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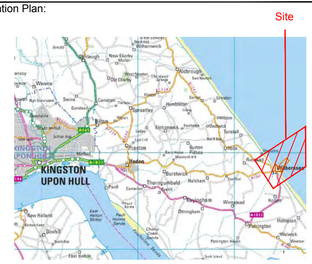
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:



Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	TE	Sep '17	TE	TG	Draft

Survey Date:	Surveyor:	Drawn By:
13/07/17 - 18/07/17	TE	TE

Client:

YorkshireWater

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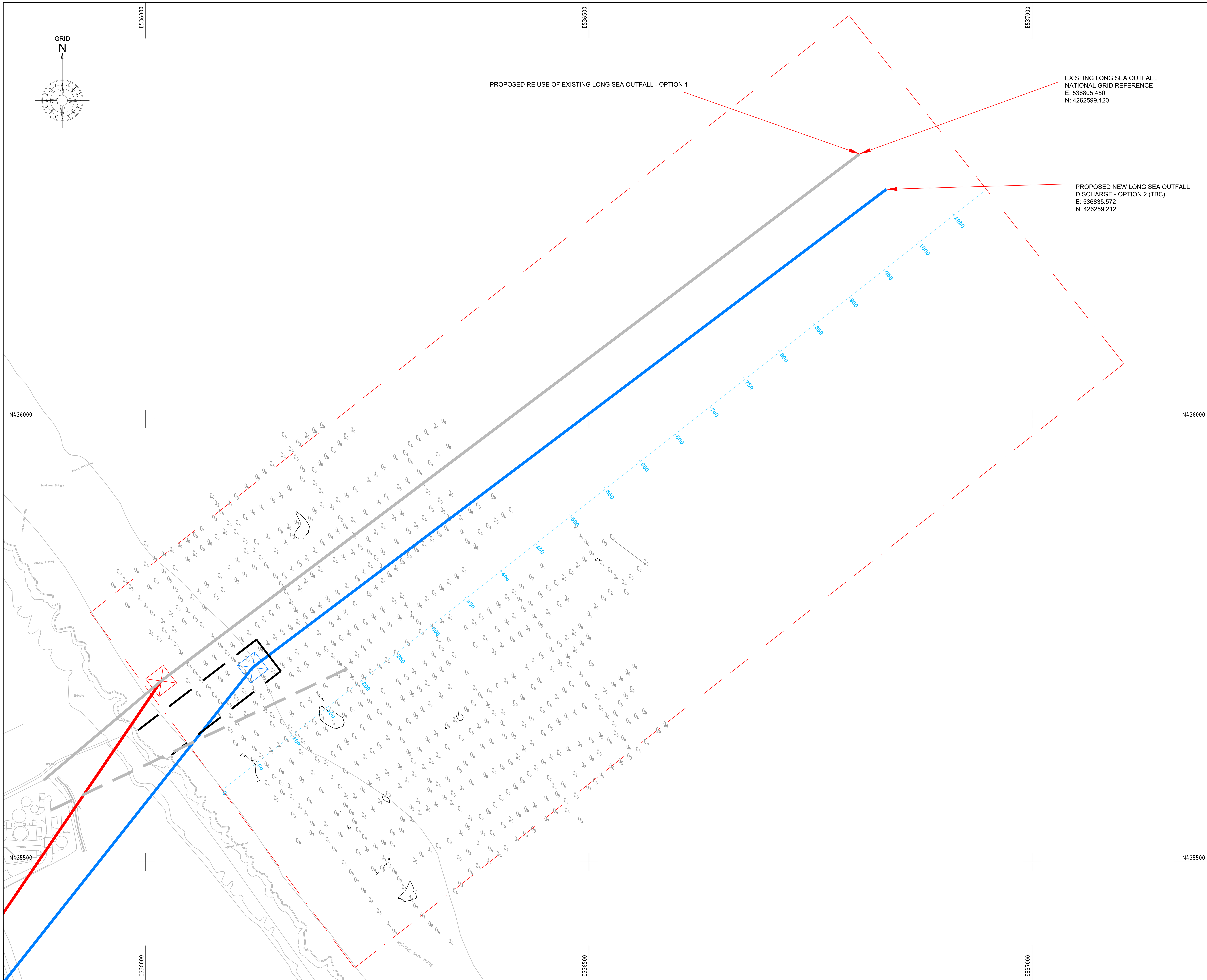
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

Analytic Signal Anomaly Chart
Withernsea Outfall
L7058-17/04b

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- Isopachyte Sounding Value
- Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Contractor:

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Unit 18 & 19
Drome Road
Deeside Industrial Estate
Deeside, Flintshire
CH5 2NY
United Kingdom

www.esg.co.uk

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Tel: +44(0)1244 288200

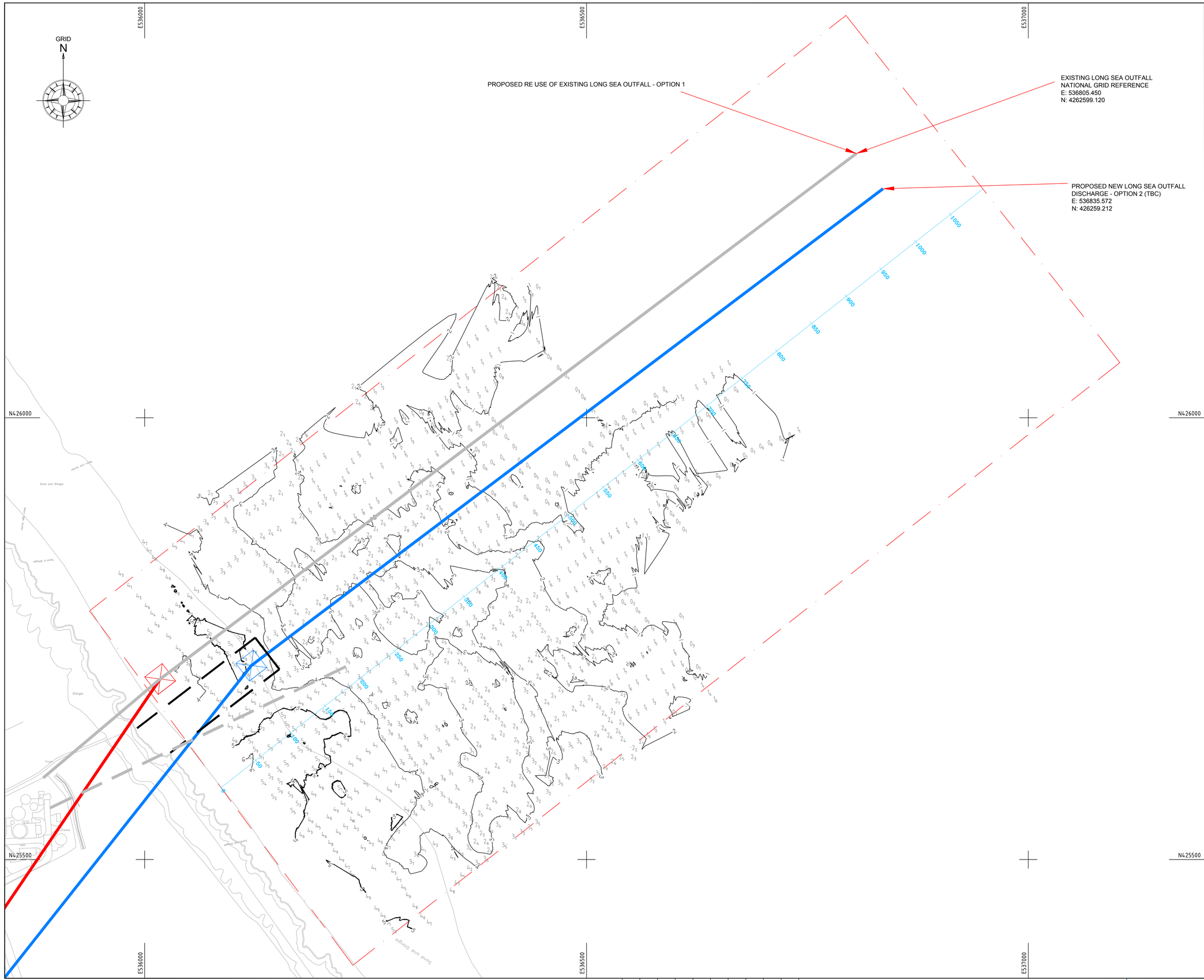
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED SC01 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/05

Original Sheet Size:	Scale:	Rev.:
A1	Horiz. 1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 — Isopachyte Sounding Value
- 50 — Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
Marlborough House
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NE1 4EE

Contractor:

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Deeside, Flintshire
CH5 2NY
United Kingdom

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Tel: +44(0)1244 288200

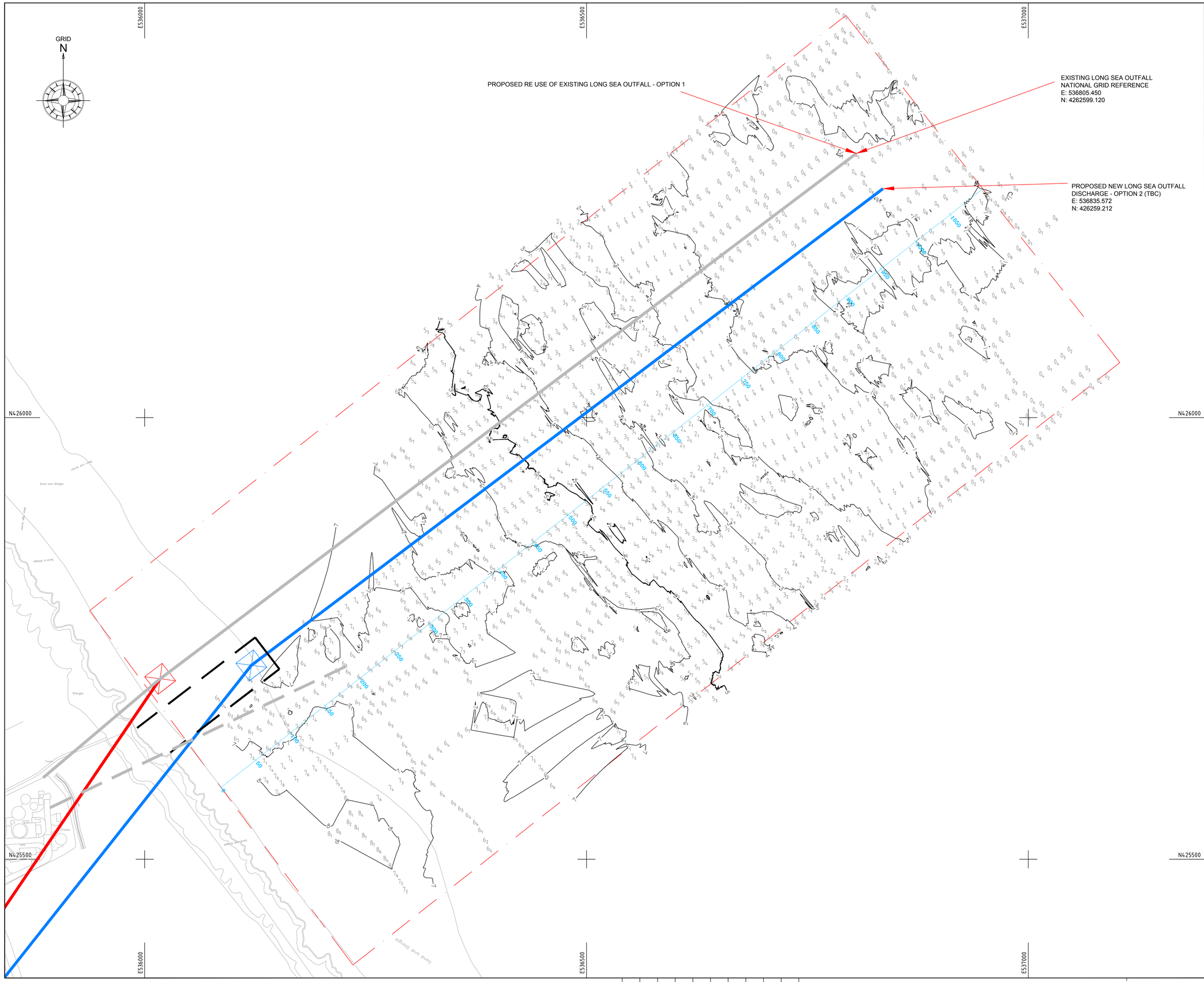
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED SC02 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/06

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 — Isopachyte Sounding Value
- 50 — Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Contractor:

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Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED SC03 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/07

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL
DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

0 50 100 150 200 250 300 350 400 450 500 600 700 800 900 1000 1200 1400 1600

Sand and Shingle

Shingle

Sand and Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 Isopachyte Sounding Value
- 50 Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

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Enhancing Society Together

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Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED SC04 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/08

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID
N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL
DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050

Sand and Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- Isopachyte Sounding Value
- Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED SC01 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/09

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000 E536500 E537000

N426000 N425500

GRID N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL
DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

Sand and Shingle

Shingle

Sand and Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 Isopachyte Sounding Value
- 50 Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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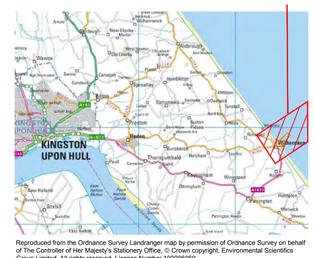
Location Plan:



Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Contractor:

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Deeside, Flintshire
CH5 2NY
United Kingdom

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Tel: +44(0)1244 288200

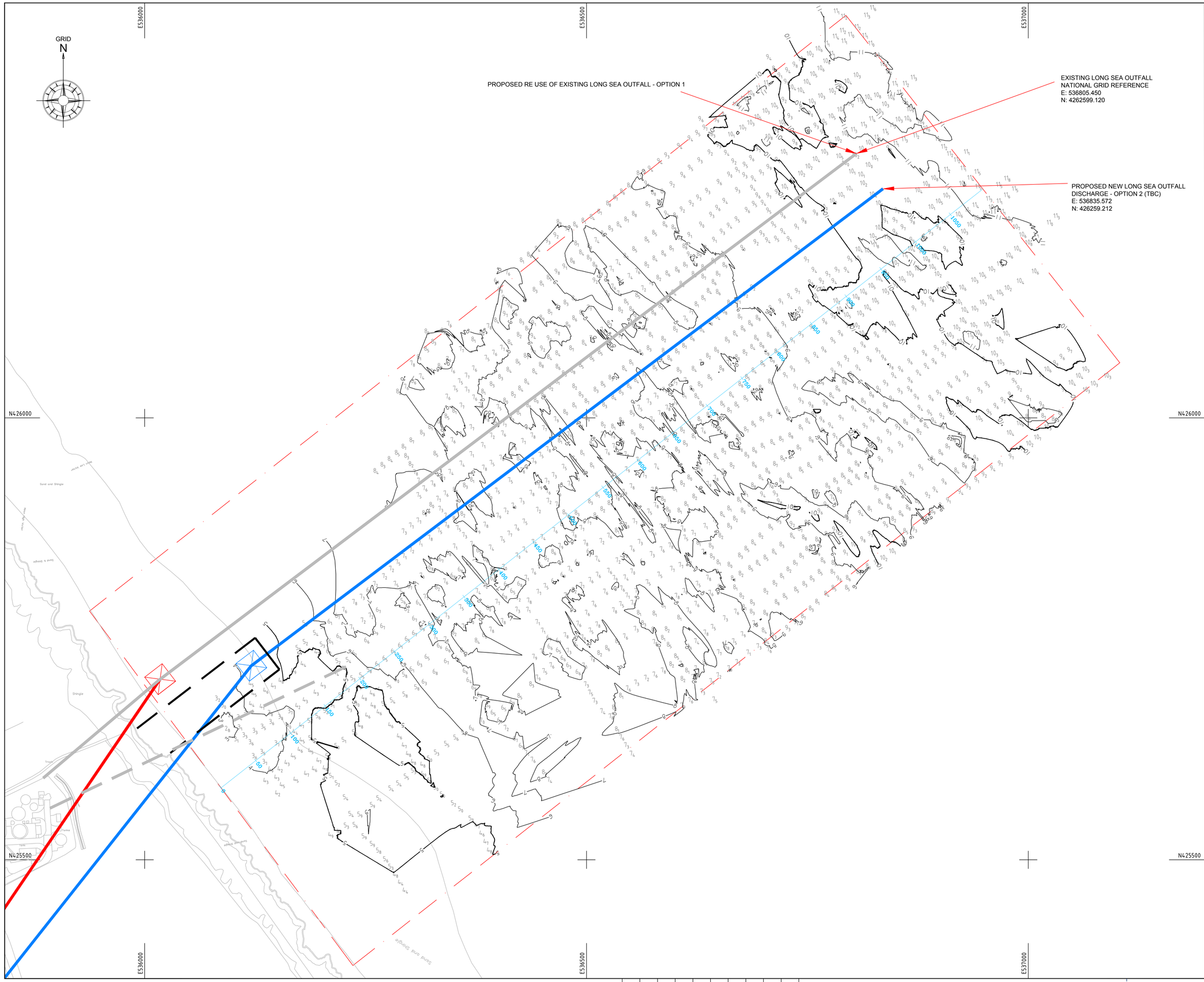
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED SC02 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/10

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 — Isopachyte Sounding Value
- 50 — Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
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Engineer:

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Enhancing Society Together

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Tel: +44(0)1244 288200

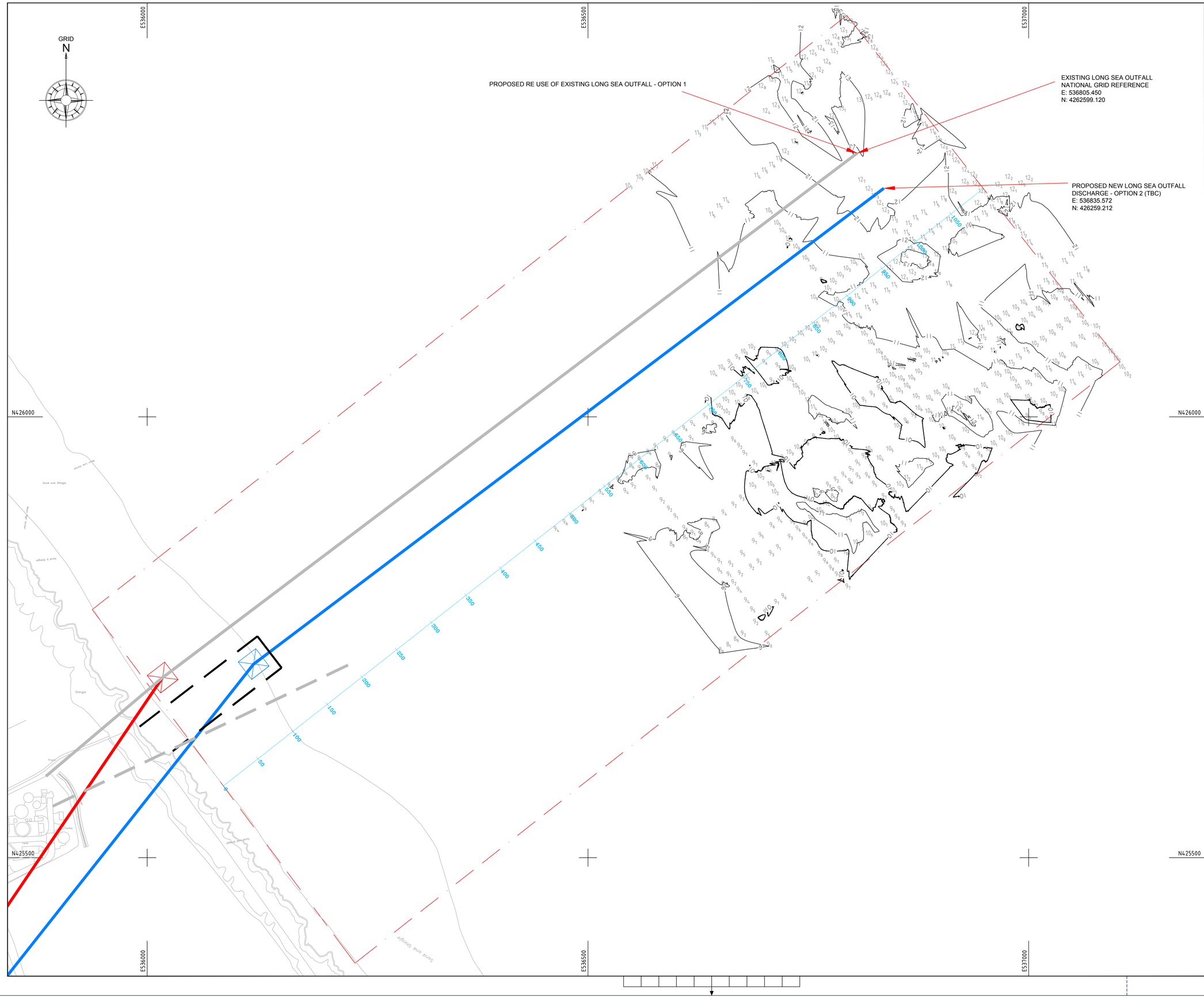
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED SC03 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/11

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 — Isopachyte Sounding Value
- 50 — Center Line with Chainage

Notes:

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Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TE	TG	Comments Addressed
0	ASB	Sep '17	ASB	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

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Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED SC04 REFLECTOR
Withernsea Outfall Single-Channel Sub-bottom Investigation
L7058-17/12

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID
N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

Sand and Shingle
Shingle
Sand & Shingle
Sand and Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- 42 Isopachyte Sounding Value
- 50 Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

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Western House
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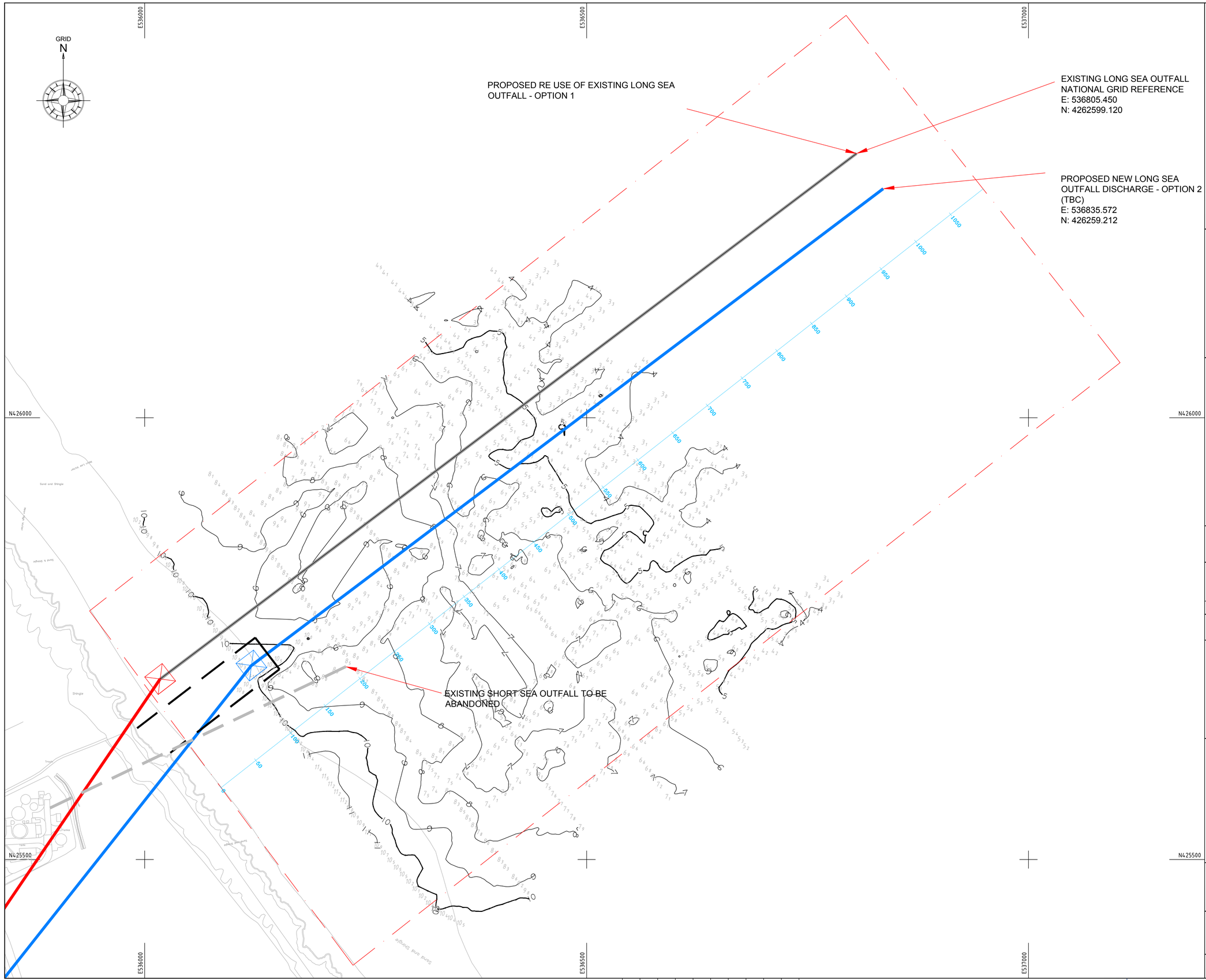
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED MC01 REFLECTOR
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/13

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 Isopachyte Sounding Value
- 50 Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
2. Positioning provided by a Applanix POS MV using the Real Time Kinematic (RTK) corrections provided by Leica Smartnet network service.
3. All levels are reduced to Chart Datum (CD) from WGS84 Ellipsoid height using the United Kingdom Hydrographic Office (UKHO) Vertical Offshore Reference Frame (VORF) model.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Contractor:

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Deeside, Flintshire
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Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED MC02 REFLECTOR
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/14

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050

Sand and Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- Isopachyte Sounding Value
- Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
2. Positioning provided by a Applanix POS MV using the Real Time Kinematic (RTK) corrections provided by Leica Smartnet network service.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
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NE1 4EE

Contractor:

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Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED MC03 REFLECTOR
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/15

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000

E536500

E537000

N426000

N425500

GRID
N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

Sand and Shingle

Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- Isopachyte Sounding Value
- Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
2. Positioning provided by a Applanix POS MV using the Real Time Kinematic (RTK) corrections provided by Leica Smartnet network service.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
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BD6 2SZ

Engineer:

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Enhancing Society Together

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Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED MC04 REFLECTOR
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/16

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

Legend:

- Contour
- Index Contour
- Site Boundary
- Isopachyte Sounding Value
- Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

Yorkshire Water Services Ltd
Western House
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BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

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Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

ISOPACHYTE TO INTERPRETED MC05 REFLECTOR
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/17

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000 E536500 E537000

N426000 N425500

GRID N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL
NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050

Sand and Shingle

Shingle

Sand and Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- 42 Isopachyte Sounding Value
- 50 Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
2. Positioning provided by a Applanix POS MV using the Real Time Kinematic (RTK) corrections provided by Leica Smartnet network service.
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9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

Yorkshire Water

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
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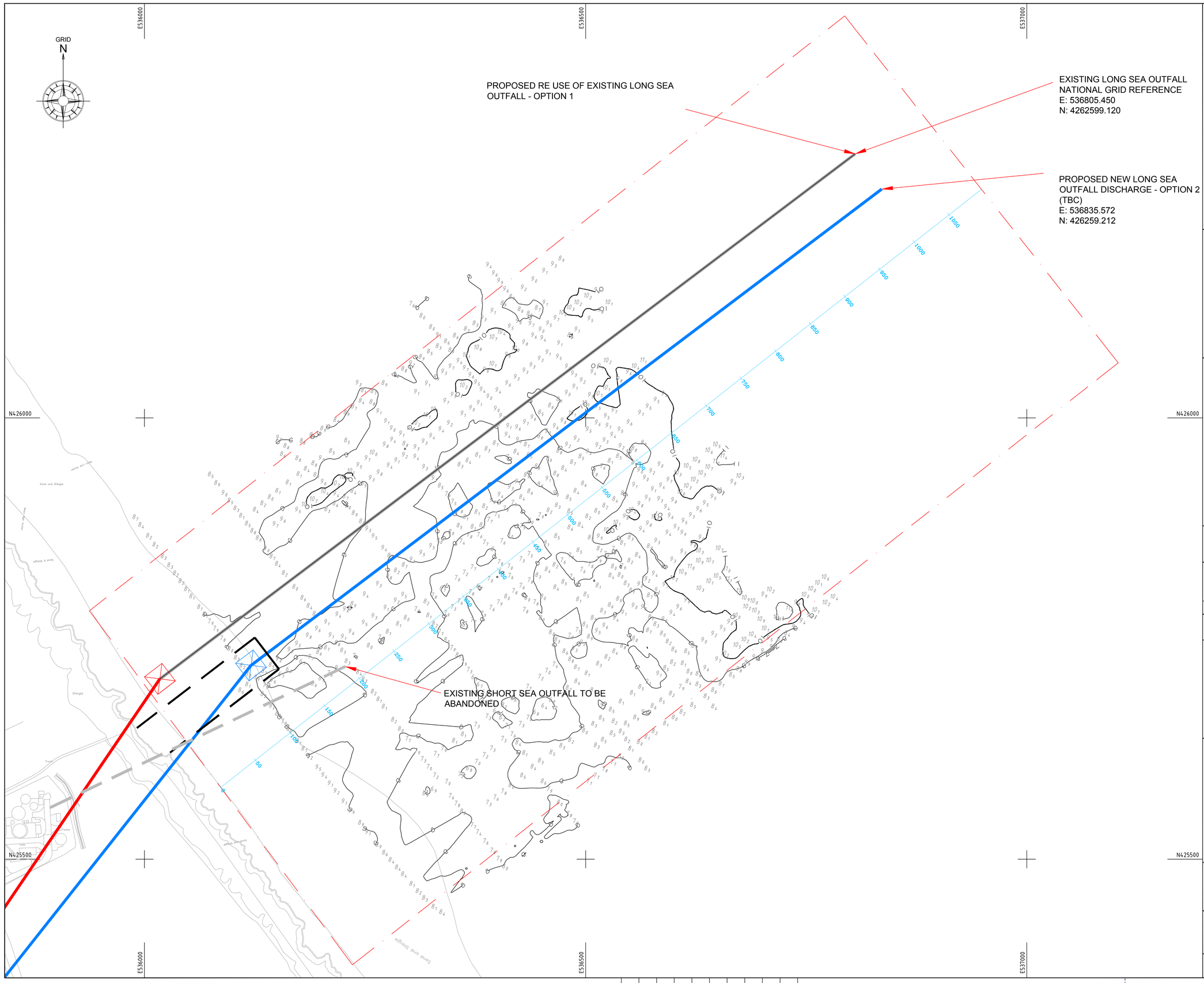
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED REFLECTOR MC01
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/18

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 — Isopachyte Sounding Value
- Center Line with Chainage (50)

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

YorkshireWater

Yorkshire Water Services Ltd
Western House
Halifax Road
Bradford
BD6 2SZ

Engineer:

Royal HaskoningDHV
Enhancing Society Together

Royal HaskoningDHV
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Contractor:

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Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED REFLECTOR MC02
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/19

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

Legend:

- Contour
- Index Contour
- Site Boundary
- Isopachyte Sounding Value
- Center Line with Chainage

Notes:

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Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

Yorkshire Water Services Ltd
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Engineer:

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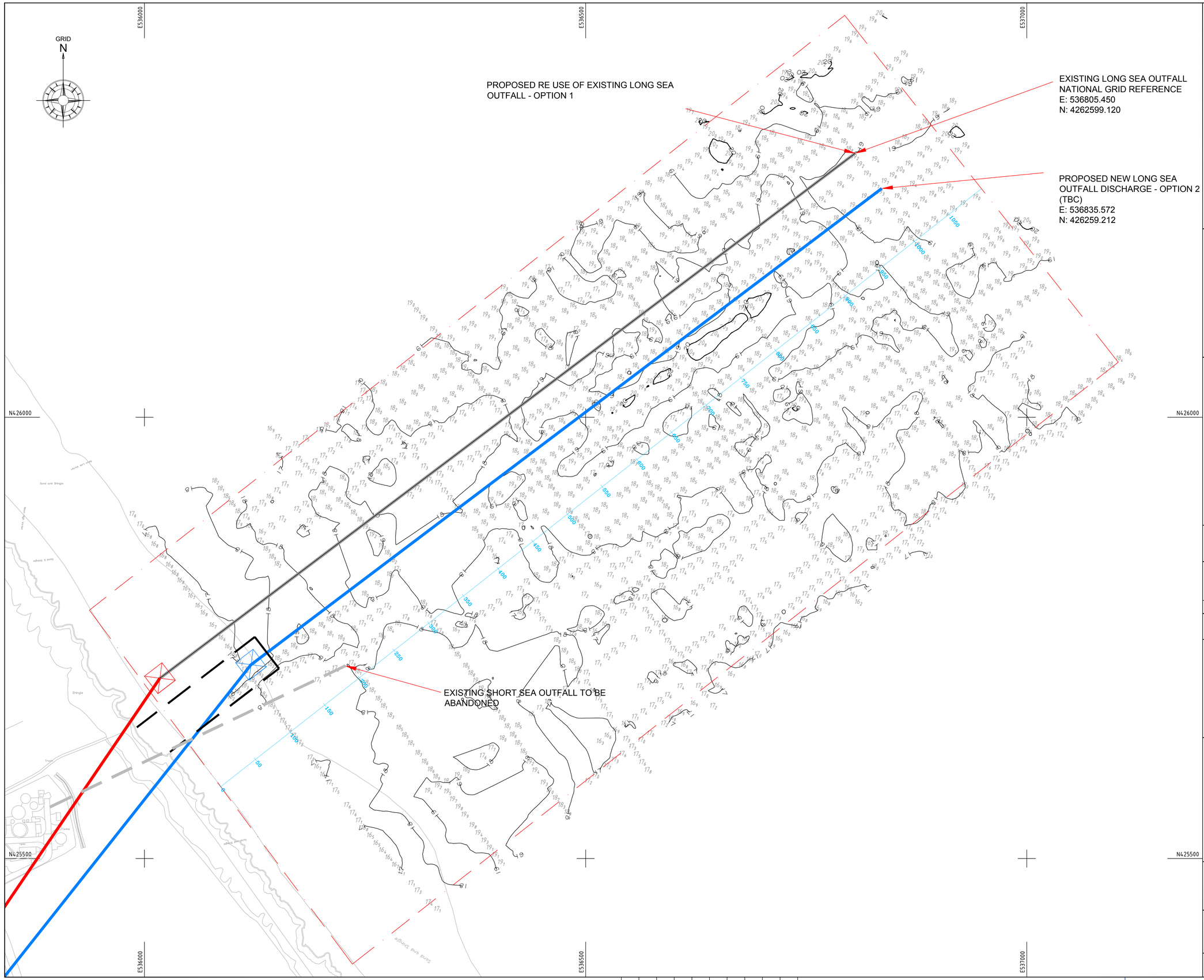
Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED REFLECTOR MC03
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/20

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1



Legend:

- Contour
- Index Contour
- Site Boundary
- 4 2 Isopachyte Sounding Value
- 50 Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	TE	Oct '17	TG	TG	Comments Addressed
0	TE	Sep '17	TE	TG	ISSUED

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

Client:

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Tel: +44(0)1244 288200

Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED REFLECTOR MC04
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/21

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

E536000
E536500
E537000
N426000
N425500

GRID N

PROPOSED RE USE OF EXISTING LONG SEA OUTFALL - OPTION 1

EXISTING LONG SEA OUTFALL NATIONAL GRID REFERENCE
E: 536805.450
N: 4262599.120

PROPOSED NEW LONG SEA OUTFALL DISCHARGE - OPTION 2 (TBC)
E: 536835.572
N: 426259.212

EXISTING SHORT SEA OUTFALL TO BE ABANDONED

Sand and Shingle
Shingle
Sand and Shingle

Legend:

- Contour
- Index Contour
- Site Boundary
- Isopachyte Sounding Value
- Center Line with Chainage

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
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10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:

Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
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Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	TE

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Contract:

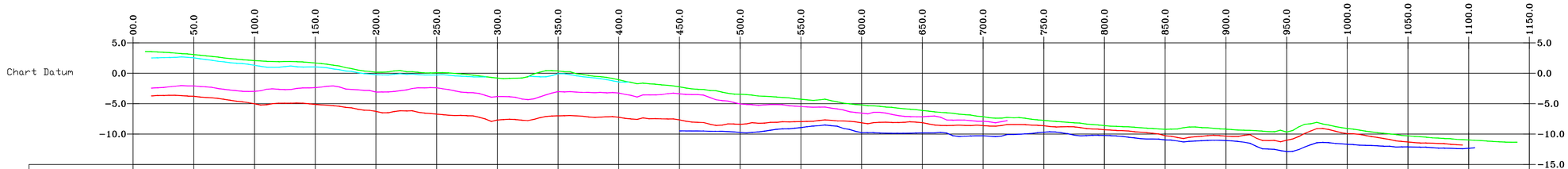
YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

REDUCED LEVEL TO INTERPRETED REFLECTOR MC05
Withernsea Outfall Multi-Channel Sub-bottom Investigation
L7058-17/22

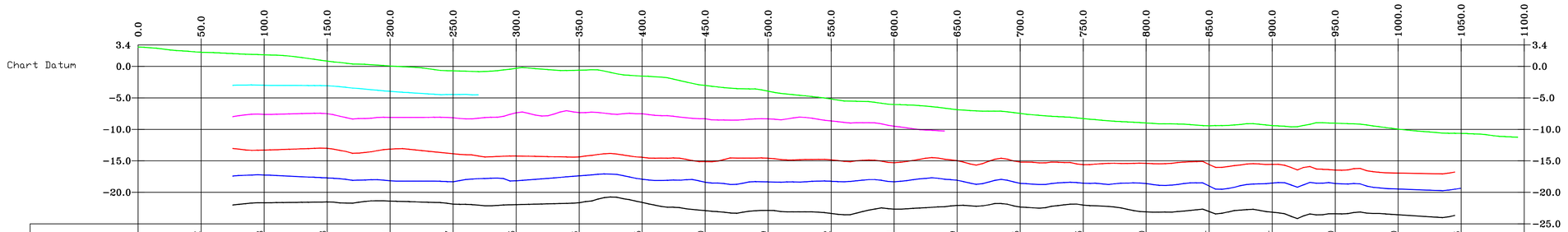
Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

Single Channel Seismic Reflection Geological Cross-section



Bed Level	3.1	2.1	1.7	0.2	0.1	−0.8	0.4	−1.1	−2.2	−3.5	−4.3	−5.2	−6.1	−7.1	−7.8	−8.6	−9.2	−9.2	−9.7	−9.1	−10.3	−11.0	
SC01 Reduced	2.5	1.3	1.1	−0.2	−0.3	−0.4	−0.1	−1.4	−2.2														
SC02 Reduced	−2.1	−3.0	−2.4	−3.1	−2.4	−3.8	−3.0	−3.2	−3.4	−5.1	−5.5	−6.6	−7.2	−7.9									
SC03 Reduced	−3.8	−5.0	−5.1	−6.3	−6.7	−7.7	−7.0	−7.2	−7.7	−8.4	−8.0	−8.1	−8.1	−8.6	−8.6	−9.3	−10.3	−10.3	−11.0	−9.9	−11.3		
SC04 Reduced									−9.5	−9.8	−8.9	−9.8	−9.8	−10.3	−9.7	−10.2	−11.0	−11.1	−12.9	−11.7	−12.1	−12.3	
Chainage	50.0	100.0	150.0	200.0	250.0	300.0	350.0	400.0	450.0	500.0	550.0	600.0	650.0	700.0	750.0	800.0	850.0	900.0	950.0	1000.0	1050.0	1100.0	1150.0

Multi Channel Seismic Reflection Geological Cross-section



Bed Level	2.2	1.8	0.8	0.1	−0.7	−0.3	−0.6	−1.5	−3.0	−3.9	−5.2	−6.1	−6.9	−7.5	−8.3	−9.0	−9.4	−9.4	−9.0	−10.0	−10.6		
MC01 Reduced		−3.0	−3.1	−4.0	−4.5																		
MC02 Reduced		−7.6	−7.5	−8.1	−8.1	−7.4	−7.3	−7.5	−8.3	−8.3	−8.7	−9.5											
SC03 Reduced		−13.3	−13.0	−13.1	−13.9	−14.2	−14.4	−14.4	−15.1	−14.6	−14.8	−15.3	−15.0	−15.2	−15.6	−15.4	−15.6	−15.5	−16.5	−16.9			
SC04 Reduced		−17.2	−17.7	−18.2	−18.3	−18.2	−17.4	−17.9	−18.4	−18.3	−18.2	−18.3	−18.1	−18.6	−18.5	−18.6	−19.0	−18.5	−18.6	−19.5	−19.3		
MC05 Reduced		−21.6	−21.5	−21.4	−21.9	−21.9	−21.6	−21.6	−22.9	−22.9	−23.4	−22.7	−22.1	−22.3	−22.0	−23.1	−23.0	−23.1	−23.4	−23.5			
Chainage	450.0	500.0	550.0	600.0	650.0	700.0	750.0	800.0	850.0	900.0	950.0	1000.0	1050.0	1100.0	1150.0	1200.0	1250.0	1300.0	1350.0	1400.0			

Single-Channel Legend:

- Denotes Bedlevel (Chart Datum)
- Denotes SC01 Reduced Level
- Denotes SC02 Reduced Level
- Denotes SC03 Reduced Level
- Denotes SC04 Reduced Level

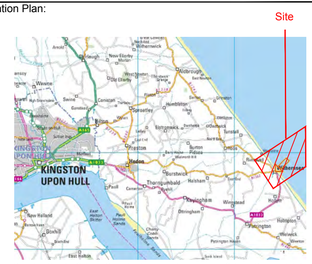
Multi-Channel Legend:

- Denotes Bedlevel (Chart Datum)
- Denotes MC01 Reduced Level
- Denotes MC02 Reduced Level
- Denotes MC03 Reduced Level
- Denotes MC04 Reduced Level
- Denotes MC05 Reduced Level

Notes:

1. Co-ordinate System: OS National Grid (OSGB1936). Transformation from WGS84 to OSGB1936 conducted using OSTN02 transformation Parameters.
2. Positioning provided by a Applanix POS MV using the Real Time Kinematic (RTK) corrections provided by Leica Smartnet network service.
3. All levels are reduced to Chart Datum (CD) from WGS84 Ellipsoid height using the United Kingdom Hydrographic Office (UKHO) Vertical Offshore Reference Frame (VORF) model.
4. Bathymetry data provided by R2Sonic 2022 Multibeam Echo Sounder. Soundings reduced to ellipsoid height using a Post Processed Kinematic (PPK) navigation solution produced in Applanix POSPac software using OSNET/OSI Rinex data.
5. Contours are generated from whole database, only selected levels are shown for clarity.
6. Side scan sonar data from a Klein 3000 system interfaced to a CodaOctopus DA4G Geophysical Acquisition System.
7. Single Channel SBP data from a SES 2000 parametric system.
8. Multi-Channel SBP data from Applied Acoustics Triple Plate S-Boom Boomer source, Applied Acoustic Engineering CSP-N and Geometrics MicroEel seismic streamer. Data recorded using a Geometrics Geode seismograph and Marine Multi Geode Operating Software.
9. Magnetic data from a Geometrics G882 Magnetometer.
10. Background mapping provided in digital format by Yorkshire Water.

Location Plan:



Scale: 1:2000

0 20m 40m 80m 120m 160m

Rev.	Drawn	Date	Checked	Approved	Details
1	ASB	Oct '17	TG	TG	Issued
0	ASB	Sep '17	ASB	TG	Issued

Survey Date:	Surveyor:	Drawn By:
20/07/2017	ASB	ASB

Client:

YorkshireWater

Yorkshire Water Services Ltd
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Engineer:

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Contract:

YORKSHIRE WATER WITHERNSEA OUTFALL
MARINE GROUND INVESTIGATION
PHASE 1 - GEOPHYSICAL SITE INVESTIGATION

DWG:

GEOLOGICAL CROSS SECTIONS - ASSUMED CENTRELINE
Withernsea Outfall
L7058-17/23

Original Sheet Size:	Scale:	Rev.:
A1	Horiz.1:2000 Vert.:	1

Appendix I – ESG Benthic Survey Results

1875

Tony Greenwood BSc (Hons)
Principal Surveyor
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Deeside Industrial Estate
Deeside

CEFAS Laboratory
Pakefield Road
Lowestoft
Suffolk
NR33 0HT

CHEMISTRY CERTIFICATE OF ANALYSIS

Report Number: XCHEM 17L
Date Sample Received: 25/8/2017
Laboratory Sample Number: See below
Sample Description: Sediment
Sample Storage Conditions: Frozen

Test Results

Metals
Method SOP No 2037, 2043 and 2161
Unit: in mg/kg (dry weight), total solids in %

Laboratory Sample Number	Sample Description	Total Solids	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
2017/163116	1A_11.0_00063	81.7	1.83	0.050	12.1	8.87	<0.026	13.9	5.83	26.8
2017/163117	2B_10.0_00063	83.5	35.1	0.070	55.8	15.7	<0.03	30.2	11.6	44.3
2017/163118	4A_9.0_00063	57.0	13.1	0.210	78.1	25.1	<0.045	54.1	19.7	86.8

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Organotins
Method SOP: organotins analysis in sediment
Unit: mg/kg (dry weight)

Laboratory Sample Number	Sample Description	DBT*	TBT*
2017/163116	1A_11.0_00063	<0.001	<0.001
2017/163117	2B_10.0_00063	<0.001	<0.001
2017/163118	4A_9.0_00063	<0.001	<0.001

THC
Method SOP: SOP 1597 and 1598
Unit: THC in mg/kg (dry weight)

Laboratory Sample Number	Sample Description	THC (Total Hydrocarbon Content)
2017/163116	1A_11.0_00063	228
2017/163117	2B_10.0_00063	176
2017/163118	4A_9.0_00063	443

Particle size analysis*

PSA-Description

Laboratory Sample Number	Sample description	Sediment description
2017/126675	1A_14/1/2016/00063_11.0	Gravelly, sandy mud
2017/126676	2B_14/1/2016/00063_10.0	Slightly muddy, sandy gravel
2017/126677	3B_14/1/2016/00063_11.0	Slightly muddy, sandy gravel
2017/126678	4A_14/1/2016/00063_9.0	Gravelly, sandy mud

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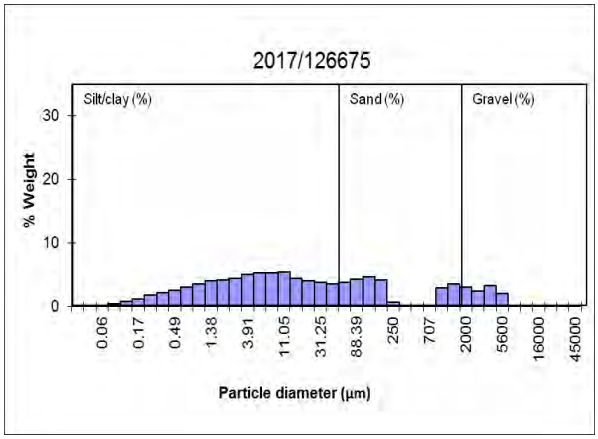
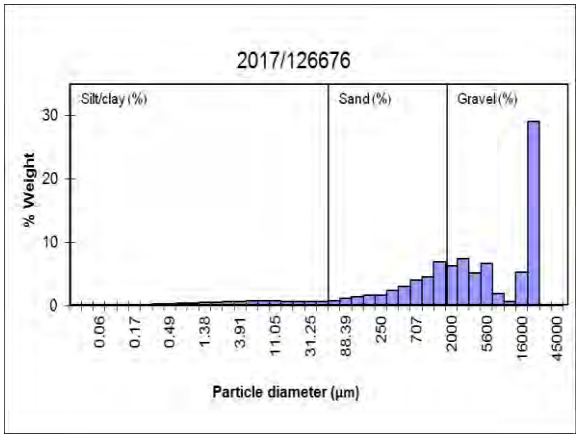
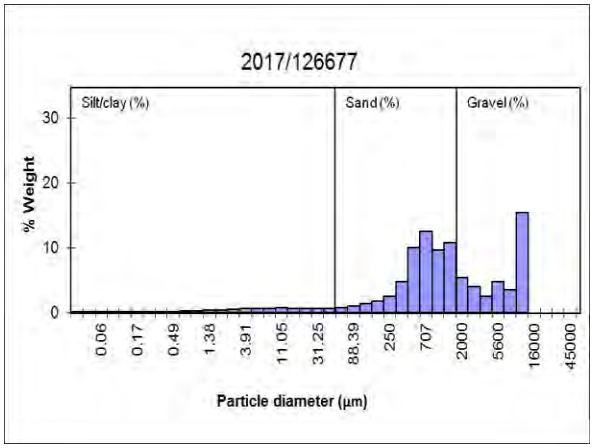
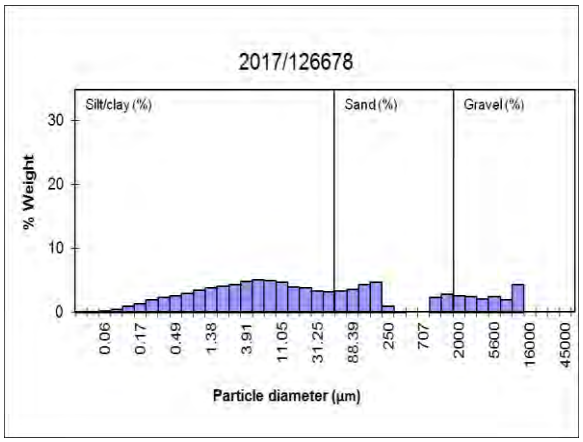
PSA-Minibars









PSA-Statistics

Laboratory Sample Number	Sample description	Gravel (%)	Sand (%)	Silt/Clay (%)	Very coarse and coarse sand (%)	Medium sand (%)	Fine sand and very fine sand (%)
2017/126675	1A_14/1/2016/00063_11.0	10.79	24.08	65.13	6.46	0.65	16.98
2017/126676	2B_14/1/2016/00063_10.0	62.66	27.96	9.38	18.62	4.19	5.15
2017/126677	3B_14/1/2016/00063_11.0	35.85	55.63	8.52	43.00	7.41	5.22
2017/126678	4A_14/1/2016/00063_9.0	15.86	22.02	62.12	5.15	0.94	15.93

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PSA_ Full distribution data (%)

Laboratory Sample Number	Sample description	-5.5	-5	-4.5	-4	-3.5	-3	-2.5	-2
		45mm	31.5mm	22.4mm	16mm	11.2mm	8mm	5.6mm	4mm
2017/126675	1A_14/1/2016/00063_11.0	0.000	0.000	0.000	0.000	0.000	0.000	2.058	3.257
2017/126676	2B_14/1/2016/00063_10.0	0.000	0.000	29.091	5.257	0.683	1.946	6.692	5.188
2017/126677	3B_14/1/2016/00063_11.0	0.000	0.000	0.000	0.000	15.416	3.589	4.812	2.610
2017/126678	4A_14/1/2016/00063_9.0	0.000	0.000	0.000	0.000	4.268	2.013	2.496	2.094

Laboratory Sample Number	Sample description	-1.5	-1	-0.5	0	0.5	1	1.5	2
		2.8mm	2mm	1.4mm	1mm	707um	500um	353.6um	250um
2017/126675	1A_14/1/2016/00063_11.0	2.439	3.031	3.525	2.932	0.000	0.000	0.001	0.650
2017/126676	2B_14/1/2016/00063_10.0	7.481	6.320	6.950	4.595	4.044	3.029	2.457	1.731
2017/126677	3B_14/1/2016/00063_11.0	4.038	5.383	10.767	9.666	12.557	10.014	4.822	2.585
2017/126678	4A_14/1/2016/00063_9.0	2.464	2.521	2.829	2.321	0.000	0.000	0.001	0.942

Laboratory Sample Number	Sample description	2.5	3	3.5	4	4.5	5	5.5	6
		176.8um	125um	88.39um	63um	44.2um	31.3um	22.1um	15.6um
2017/126675	1A_14/1/2016/00063_11.0	4.137	4.698	4.325	3.815	3.514	3.796	4.057	4.452
2017/126676	2B_14/1/2016/00063_10.0	1.703	1.479	1.123	0.847	0.681	0.636	0.643	0.628
2017/126677	3B_14/1/2016/00063_11.0	1.852	1.480	1.042	0.846	0.697	0.666	0.733	0.667
2017/126678	4A_14/1/2016/00063_9.0	4.712	4.281	3.556	3.381	3.235	3.336	3.780	3.913

Laboratory Sample Number	Sample description	6.5	7	7.5	8	8.5	9	9.5	10
		11um	7.8um	5.5um	3.9um	2.75um	1.95um	1.38um	0.98um
2017/126675	1A_14/1/2016/00063_11.0	5.409	5.338	5.292	4.996	4.426	4.173	4.000	3.568
2017/126676	2B_14/1/2016/00063_10.0	0.754	0.753	0.767	0.727	0.632	0.587	0.551	0.474
2017/126677	3B_14/1/2016/00063_11.0	0.817	0.728	0.700	0.637	0.513	0.493	0.449	0.350
2017/126678	4A_14/1/2016/00063_9.0	4.676	4.936	5.092	4.856	4.309	4.048	3.851	3.409

Laboratory Sample Number	Sample description	10.5	11	11.5	12	12.5
		0.69um	0.49um	0.34um	0.24um	0.17um
2017/126675	1A_14/1/2016/00063_11.0	3.036	2.609	2.215	1.747	1.184
2017/126676	2B_14/1/2016/00063_10.0	0.387	0.323	0.272	0.219	0.155
2017/126677	3B_14/1/2016/00063_11.0	0.278	0.243	0.209	0.157	0.093
2017/126678	4A_14/1/2016/00063_9.0	2.921	2.590	2.301	1.902	1.351

Laboratory Sample Number	Sample description	13	13.5	14	14.5	>14.5
		0.12um	0.09um	0.06um	0.04um	<0.04um
2017/126675	1A_14/1/2016/00063_11.0	0.753	0.404	0.144	0.018	0.001
2017/126676	2B_14/1/2016/00063_10.0	0.106	0.061	0.023	0.003	0.000
2017/126677	3B_14/1/2016/00063_11.0	0.052	0.028	0.011	0.001	0.000
2017/126678	4A_14/1/2016/00063_9.0	0.900	0.505	0.185	0.023	0.002

1875

Departure from testing conditions	
Results marked with an asterisk fall outside the scope of accreditation.	The results provided in this report only relate to the sample(s) tested

Report authorised by: Thi Bolam	**Signature:**
Position: Technical Manager	**Date:** 16/11/2017

Authorised Signatories: Jon Barber, Philippe Bersuder, Thi Bolam, Heather Emerson.

Withernsea Long Sea Outfall Replacement




Benthic Technical Report

January 2019

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Document Issue Log

Version / Issue	Comment	Date	Author	Checked by	Approved by
1	**Issued draft**	**27/10/17**	**KNE**	**IGP**	**IGP**
2	**Final after client review**	**28/11/17**	**PO**	**IGP**	**IGP**
3	**Amended Figure 2.2**	**17/01/19**	**CHHU**	**IGP**	**IGP**

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Contents

Figures

1. Introduction

Project background

1.1. The Withernsea Waste Water Treatment Works (WWTW) are located on the Holderness Coast in Yorkshire, approximately 2.5km south of Withernsea. The WWTW is run by Yorkshire Water Services (YWS) and has an associated long sea outfall, but as the WWTW is located within 100m of the coast edge there is a risk to the existing infrastructure from coastal erosion. The solution proposed by YWS is to build a new treatment works in a safer location and establish a new long sea outfall (LSO) approximately 100m to the south of the existing outfall.

1.2. The existing and proposed new LSO locations are within the Holderness Inshore Marine Conservation Zone (MCZ) which has been designated for a variety of habitats including subtidal coarse sediment, sand, mud and mixed sediments that support a diverse array of marine invertebrates, algae and fish.

Benthic surveys

1.3. In order to support planning and consenting the new LSO a range of marine environmental investigations have been planned. These include a sediment quality survey and a benthic ecological survey which are outlined in a document prepared by Royal Haskoning DHV (Q0453 - AMP 6 Investigation Withernsea Long Sea Outfall Replacement, Appendix 1).

1.4. Environmental Scientifics Group Limited (ESG) were contracted to undertake related marine ground investigations (geophysical and bathymetric survey). These were completed in advance of the sediment quality and benthic ecology surveys and used to confirm final target sample positions for the subsequent survey. ESG sub-contracted NIRAS Consulting Ltd (NIRAS) to provide a marine biologist and survey equipment (camera and grab), undertake faunal sample analysis and complete analysis/reporting of sediment quality and benthic ecology data.

2. Methodology

2.1. The benthic survey was completed between 25 and 27 July 2017 from the survey vessel 'Humber Guardian', provided by Briggs Marine under charter to ESG. Survey methods, based on protocols detailed in Appendix 1, are summarised below.

Figure 2.1. Survey vessel Humber Guardian.

Sediment quality survey

2.2. There were six target positions for sample collection. The survey team attempted to collect samples from within 25m of target location but moved by up to 100m if a minimum of three initial attempts were unsuccessful. Survey was initially attempted using a Day Grab but repeated failed grabs necessitated a switch to a mini-Hamon design more suited to collecting material from coarse ground. Both types of grab have a 0.1m^2 bucket area that can collect up to 10 litres of sediment.

2.3. The positions of samples collected for sediment quality survey are shown in Figure 2.2.

2.4. Even using a heavily weighted mini-Hamon grab ground conditions proved challenging for sample collection and samples were retained for analysis where total volume was below the minimum target volume of 5 litres if the marine biologist considered that larger samples were unlikely to be collected from the location.

2.5. The position, date, time and water depth were recorded and a photograph taken of each sample along with notes of sediment character.

2.6. Upon return of acceptable samples to the vessel (>5 litres where possible, fully closed grab jaws in all cases) sub-samples were collected using a clean, acetone wiped, metal scoop and transferred to a glass jar provided by the analysing laboratory (Cefas). Samples were marked with MMO Dredging Application Number, sample number and date. All samples were chilled immediately (<4^{0}C) and frozen within 24 hours of collection before transport (chilled, via specialist courier) to the analysing laboratory.

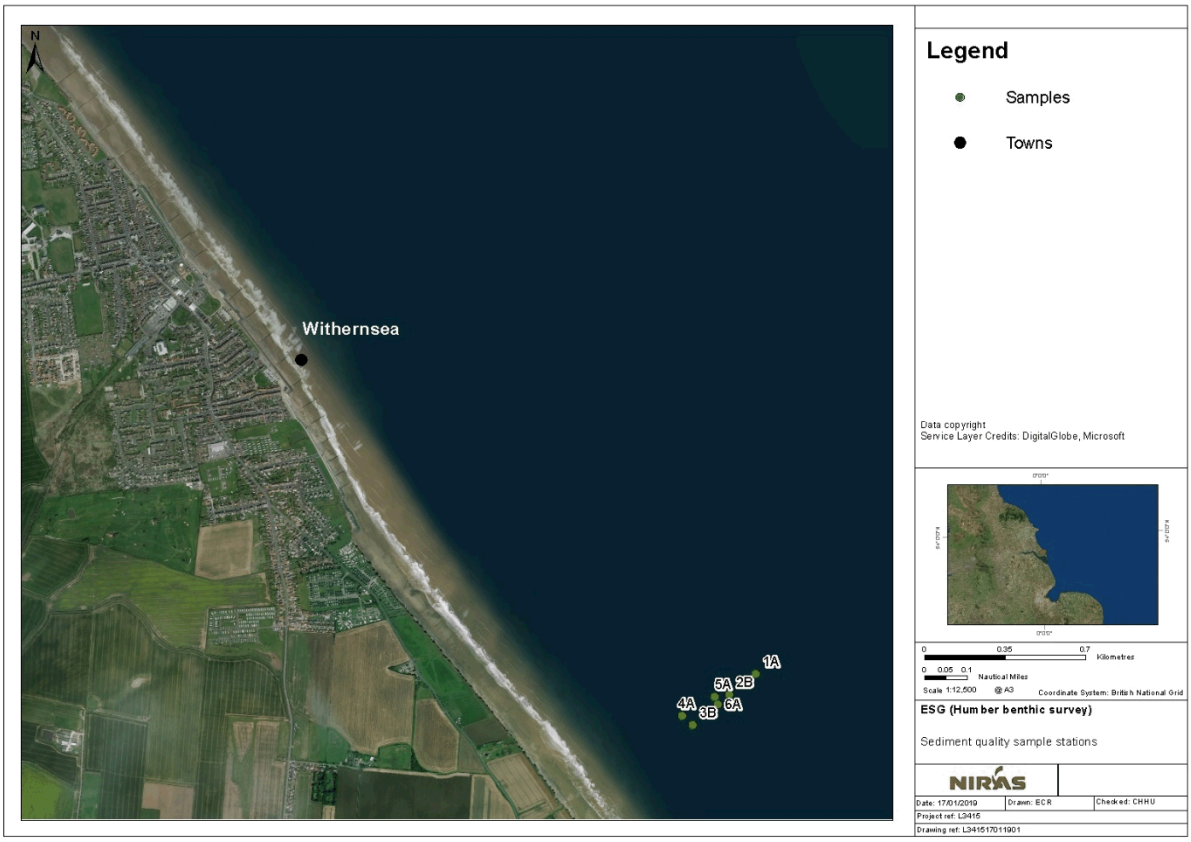


Figure 2.2. Sediment quality sample stations utilised for analysis.

Benthic ecological survey

2.7. The survey team was provided with six targets for survey. These were the four stations targeted for sediment quality survey, Stations 1, 2, 3 and 6, and two additional locations, Stations 4 and 5, which lay off the proposed alignment of the LSO to serve as references. Survey locations are detailed in subsequent sections alongside results (see for example Figure 3.4).

2.8. The approach adopted was to collect sediment samples for faunal and particle size analysis (PSA) using the same grab sampling approach described above for sediment quality investigations, together with drop down camera survey co-located positions.

Grab sampling

2.9. Protocols were to collect two grab samples at each survey location, additional to sediment quality samples at the four combined stations. In practice, because of the difficult ground conditions encountered material from successful grabs was utilised for ecological survey purposes when sufficient sediment remained following sub-sampling for sediment quality investigation.

2.10. After any sub-sampling for sediment quality/PSA purposes, sample photography and recording of visual observations the remaining sample material was gently washed over a 0.5mm sieve using a low pressure seawater hose. The retained material was back-washed into containers labelled both externally on the sample container and with an internal plastic tag. The samples were fixed by addition

of a 10% solution of buffered formalin to a final concentration of approximately 4% as soon as possible, ready for faunal analysis.

2.11. PSA sub-samples were collected using a small trowel since material was too coarse, and clays present as hard aggregations, which made use of a cut-off 100ml syringe as described in the Scope of Work (Appendix 1) impractical.

Camera survey

2.12. A drop-down camera system with a clearwater housing (sometimes termed 'freshwater lens') was used for the survey. This was the only option as the shallow, coastal nature of the site and the proximity to the Humber Estuary meant that turbid conditions were anticipated.

2.13. The Scope of Work (Appendix 1) suggested that video 'tows' should be completed by drifting the vessel with the camera hovering above the seabed. The poor visibility conditions, and strong currents other than at very limited periods around slack water, precluded such an approach since the camera had to be landed on the seabed (or present extremely close) before visual information was obtained. Instead, the drop-down camera was deployed at 3-5 separate locations within 25m of each target position.

2.14. Camera operations were nonetheless still limited to short periods of time around slack water.

2.15. Images obtained were reviewed briefly in the field and subjected to more detailed analysis by experienced marine biologists ashore to assess the nature of the sediment at the surface of the seabed and identify visible epifauna and algae. The information obtained from the images was referenced against guidance on reef habitats (Gubbay, 2007; Irving, 2009; Limpenny *et al.*, 2010).

Laboratory analysis

2.16. Faunal samples were analysed by NIRAS which participates in the UK National Marine Biological Analytical Quality Control (NMBAQC) scheme. Fixed samples were initially washed through a 0.5mm sieve, gently eluted with tap water and sorted with the aid of stereo-microscopy to remove macrofauna. Taxa were identified to species level wherever possible.

2.17. Sediment particle size samples were analysed by Cefas in line with NMBAQC protocols. Laser diffraction was used for all material <2mm. The rest of the sample was split at 1mm and the >1mm fraction dry sieved at 0.5ϕ intervals. The <1mm fraction was dried and weighed. Sieve and laser data were then merged to provide the full particle size distribution at 0.5ϕ intervals.

2.18. Statistics were then calculated as follows using Gradistat software:

- Mean particle size.
- Sorting coefficient.
- Skewness.
- Modal size.
- Kurtosis.

2.19. Contaminant testing was originally planned but in line with Section 2.2 of the Scope of Work (also MMO Sample Plan, Section 3.1) this was not progressed because samples were predominantly sand/gravel (with clay additionally present as hard aggregations from glacial till).

Statistical analysis & Reporting

2.20. Simple metrics (sediment descriptors, total number of taxa, number of individuals and biomass) were plotted using ArcGIS.

2.21. Statistical analyses suggested in the Scope of Work (Appendix 1) were:

- Hierarchical Cluster Analysis (to find "natural groupings" where samples within a group are more similar to each other than samples in different groups).
- Multidimensional Scaling (MDS) Ordination (to allow the construction of a "map" or configuration of the samples in multidimensional space).
- SIMPER Routine (to allow the comparison between groups of samples from one site to another to be made).
- ANOSIM (to test the null hypothesis (H_0) that there are no differences in community (or sediment) composition between the pooled sample categories featured in the investigation).

2.22. Multivariate routines were used to gain some insight into faunal community and sediment similarities/differences between stations. Pre-treatment of faunal data included removing all entries pertaining to juveniles of taxa and also removing large ambiguous groups such as 'Porifera turf sp.'.

2.23. Faunal data was first square-root transformed and then a similarity matrix was created using the Bray-Curtis methodology. Sediment data was not transformed prior to analysis as it was in a percentage format and therefore already standardized and a similarity matrix was created using the Euclidean Distance method.

2.24. The Bray-Curtis similarity matrix was then used to create a dendrogram and a multi-dimensional scaling plot of the faunal data. The Euclidean distance matrix was used to create a principal components analysis plot.

2.25. A Simprof test included as part of the creation of the dendrogram allowed the faunal data to be separated into groups of samples that were not significantly different from one another. This was followed up with Simper analysis to determine the taxa involved in the groupings.

2.26. Anosim was not undertaken on the samples owing to the very low replication, which would have led to a very low confidence in any results of the test.

3. Results

Sediments

3.1. Particle size analysis data are presented in Appendix 2 and sample photographs in Appendix 3.

3.2. Samples for sediment analysis were only obtained from five of the six stations; no sample was returned from Station 5A. The seabed was of mixed sediments with a generally high proportion of coarse particles and as a result only relatively small samples were obtained even with the Hamon grab. Samples were obtained from the four stations along the proposed LSO alignment but only at one reference location.

3.3. The relative proportion of each broad sediment category (i.e. mud, sand and gravel) is shown in Figure 3.1 and the mean grain size at each sample station in Figure 3.2. Care is needed when interpreting the figures as the particle size distributions were polymodal and therefore the mean grain sizes are indicative. In addition, the high apparent percentage of mud at Stations 1A and 4A should be treated with caution and in context of the actual nature of the samples (e.g. Plate 3-1). No mud (or silt) was noted in the field from samples collected (although plumes of sediment were mobilised from the seabed when the camera landed at Station 4); rather, clay was present as solid aggregations which broke up on collection and during subsequent storage and transport. The clay was subsequently further broken down for the purpose of particle size analysis but the resultant sediment description can be misleading from a biological perspective since such fine sediment, in consolidated form, is effectively an impenetrable substrate to most benthic organisms.

3.4. Sediment data were subject to a principal components analysis (Figure 3.3) which indicated similarities between samples 1 and 4, owing to the high proportion of silt (potentially an artefact of analysis as explained above) but a generally low similarity otherwise. Station 2 was characterised by coarse gravel, Station 3 by coarse sand and gravel, whereas Station 6 was more characterised by sands and fine gravel.

Plate 3-1. Image taken of grab sample from Station 1. Discrete pieces of consolidated clay are indicated with the arrows.

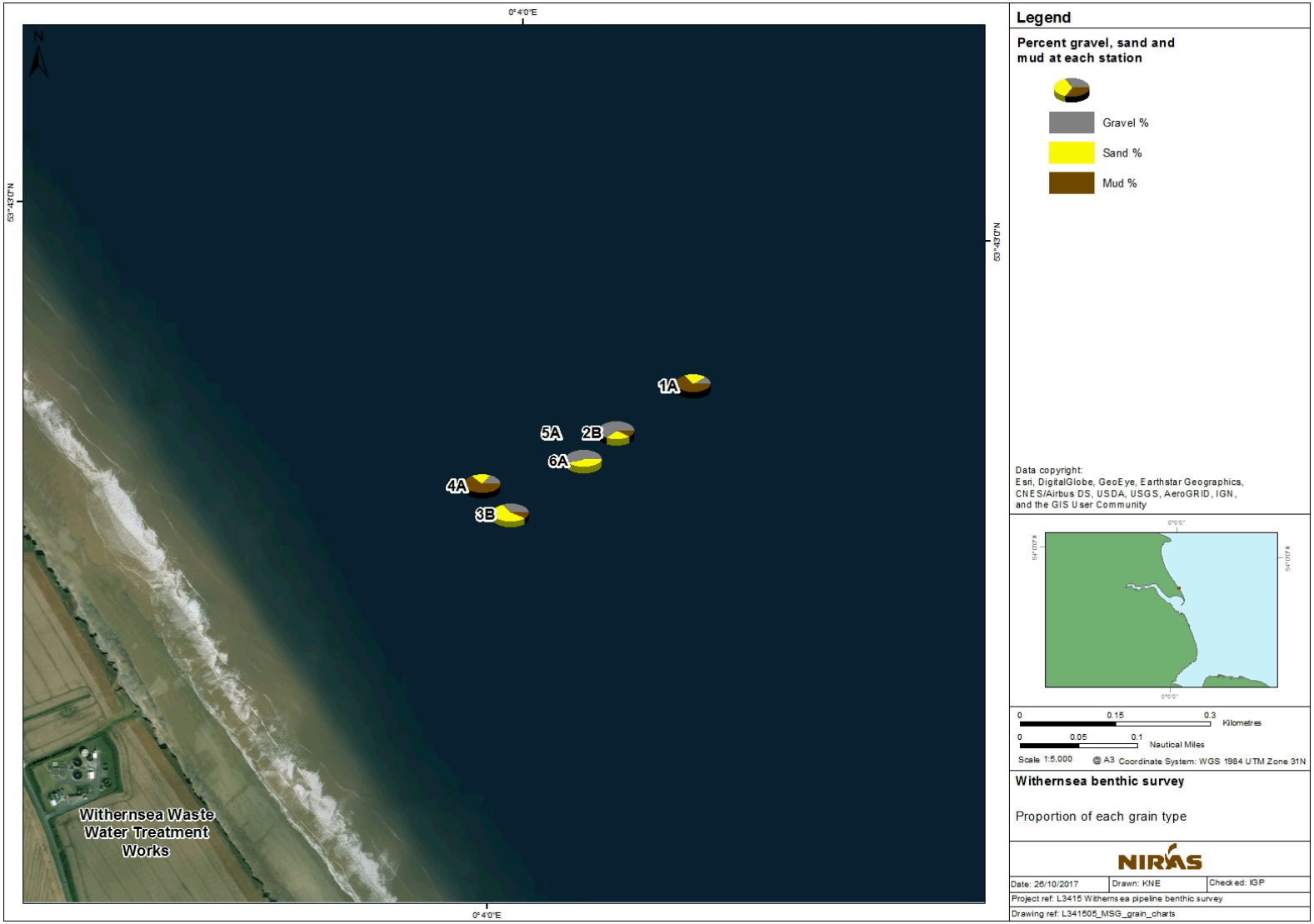


Figure 3.1: Percent of each grain type (mud, sand and gravel) at each sample station.

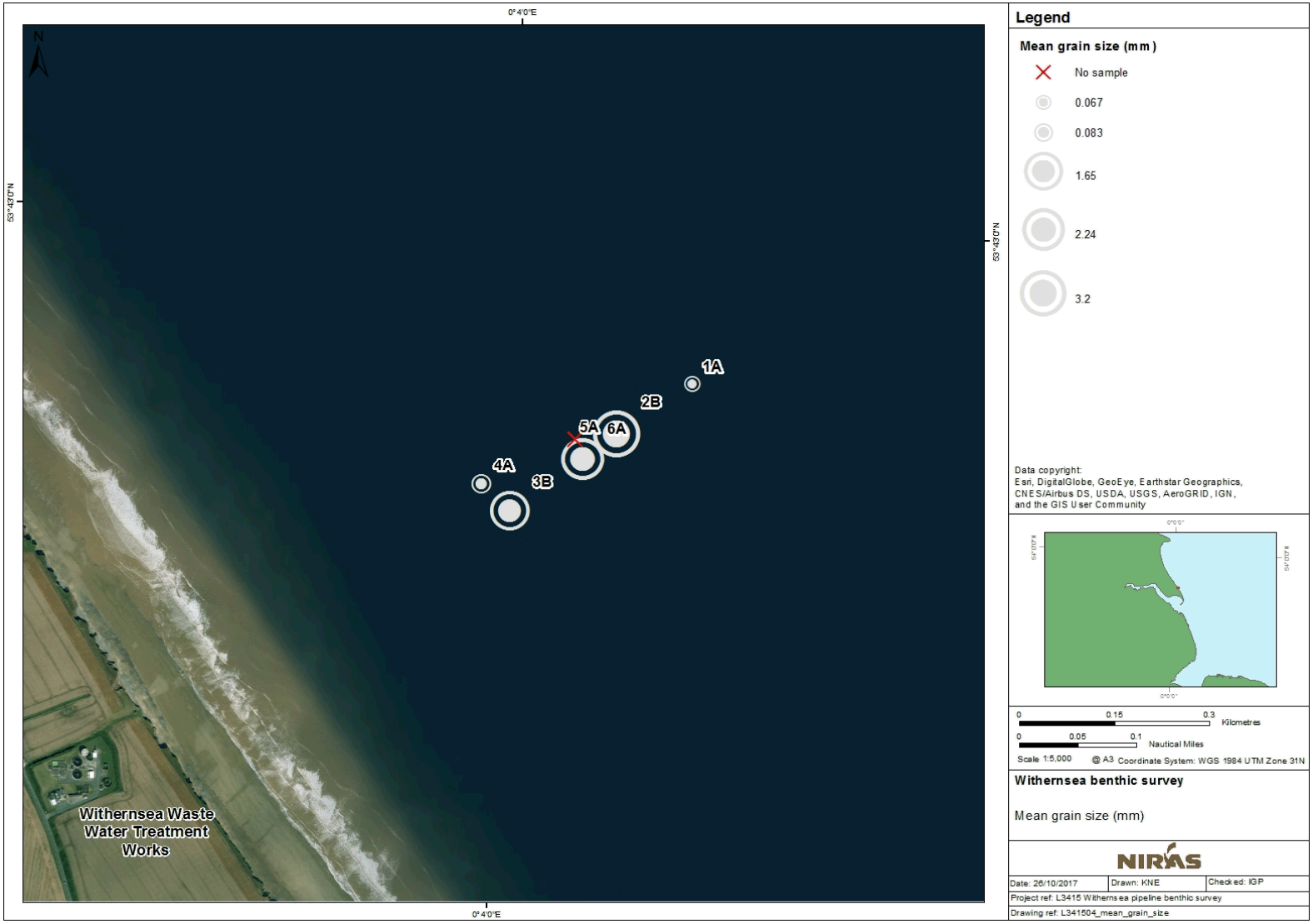


Figure 3.2: Mean grain size in millimetres at each sample station

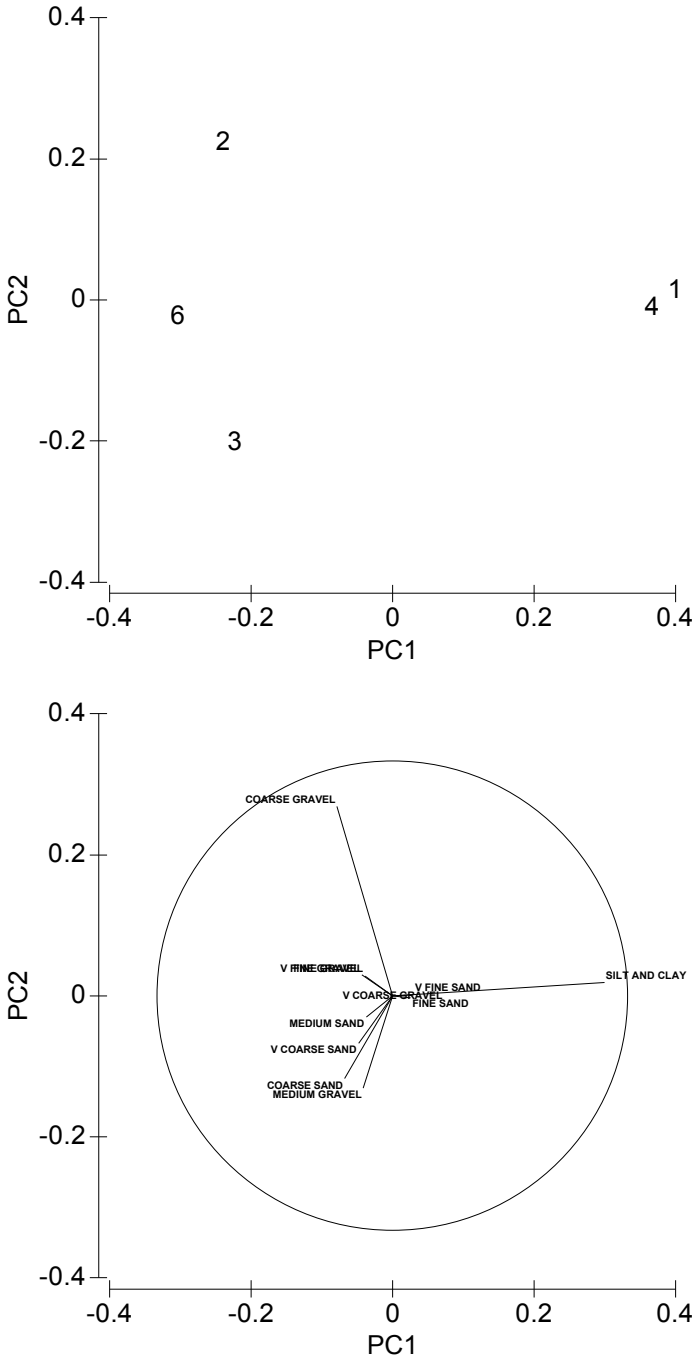


Figure 3.3: Principal components analysis with associated Eigenvectors of sediment data.

Fauna

3.5. The fauna (see Appendix 4 for raw data) was mainly characterized by epifaunal organisms, with relatively high abundances of barnacles and serpulid polychaetes but also a number of colonial organisms such as hydroids and bryozoans (these are typically recorded as 'present' rather than enumerated). The only abundant infaunal organism was the polychaete *Protodorvillea kerfersteini*.

3.6. The total number of taxa at each sample station is shown in Figure 3.4 which shows generally low numbers of taxa at most stations (ranging from 3 to 19) with the exception of Station 2B where there were a total of 36 separate taxa. It was at this station that there was the greatest proportion of coarse sediment and it had the highest mean grain size, reflected in the relatively high number of encrusting taxa recorded at this station.

3.7. The total number of individuals (with colonials included as '1' where they are usually recorded as 'present') is shown in Figure 3.5. The samples along the proposed LSO alignment contained a greater number of individuals compared to the reference samples, and this did not appear to be explained by any differences in sample volume.

3.8. Wet-weight biomass data are plotted in Figure 3.6 which indicates higher biomass on the proposed LSO alignment compared to the reference stations. Station 3B had the greatest biomass owing to the barnacles present in the sample, which made up approximately 90% of the mass at that station. There were also barnacles at Stations 2B and 6A but these were small and contributed little to the overall biomass at these stations which was dominated by polychaetes.

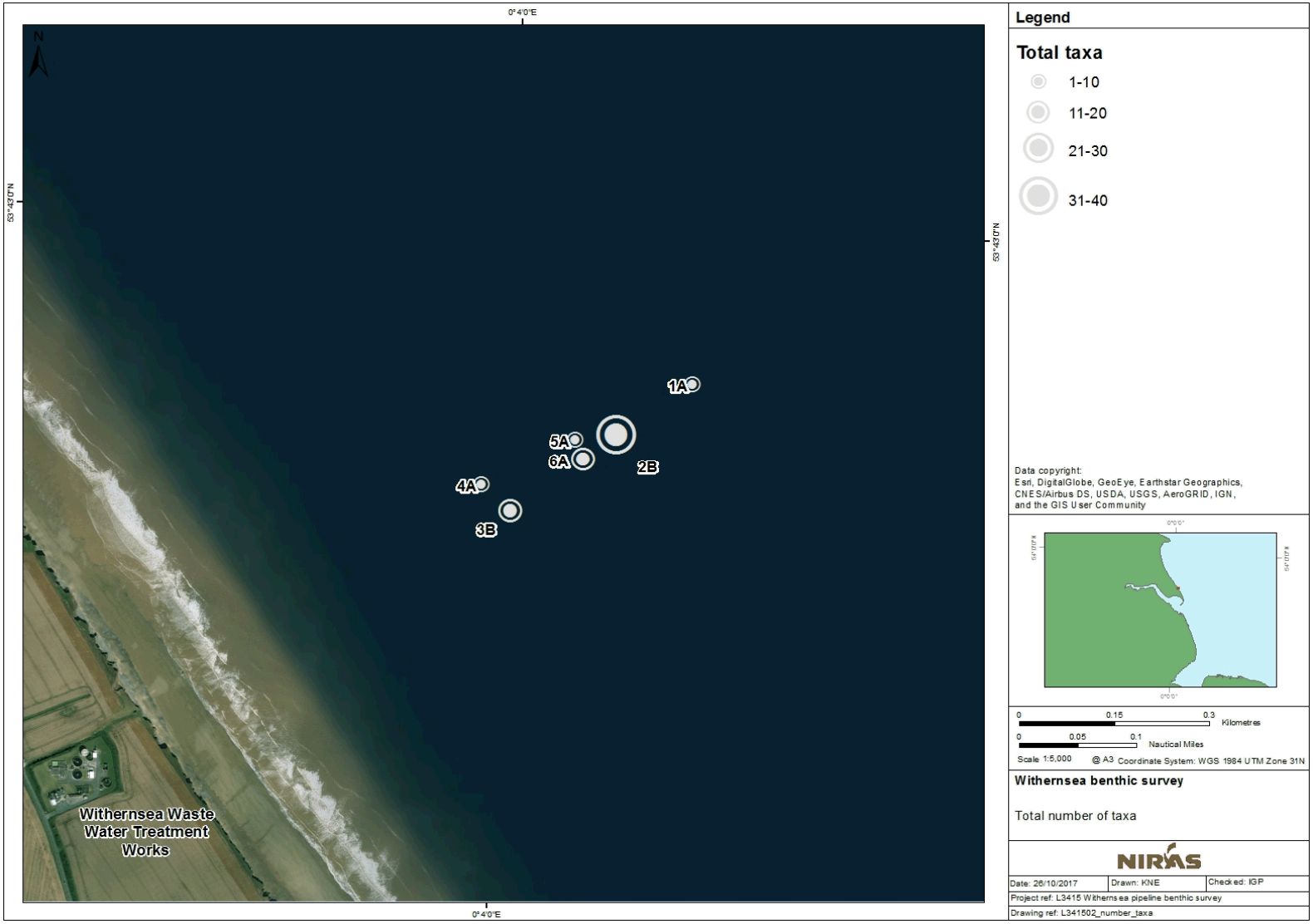


Figure 3.4: Total number of taxa at each sample station.

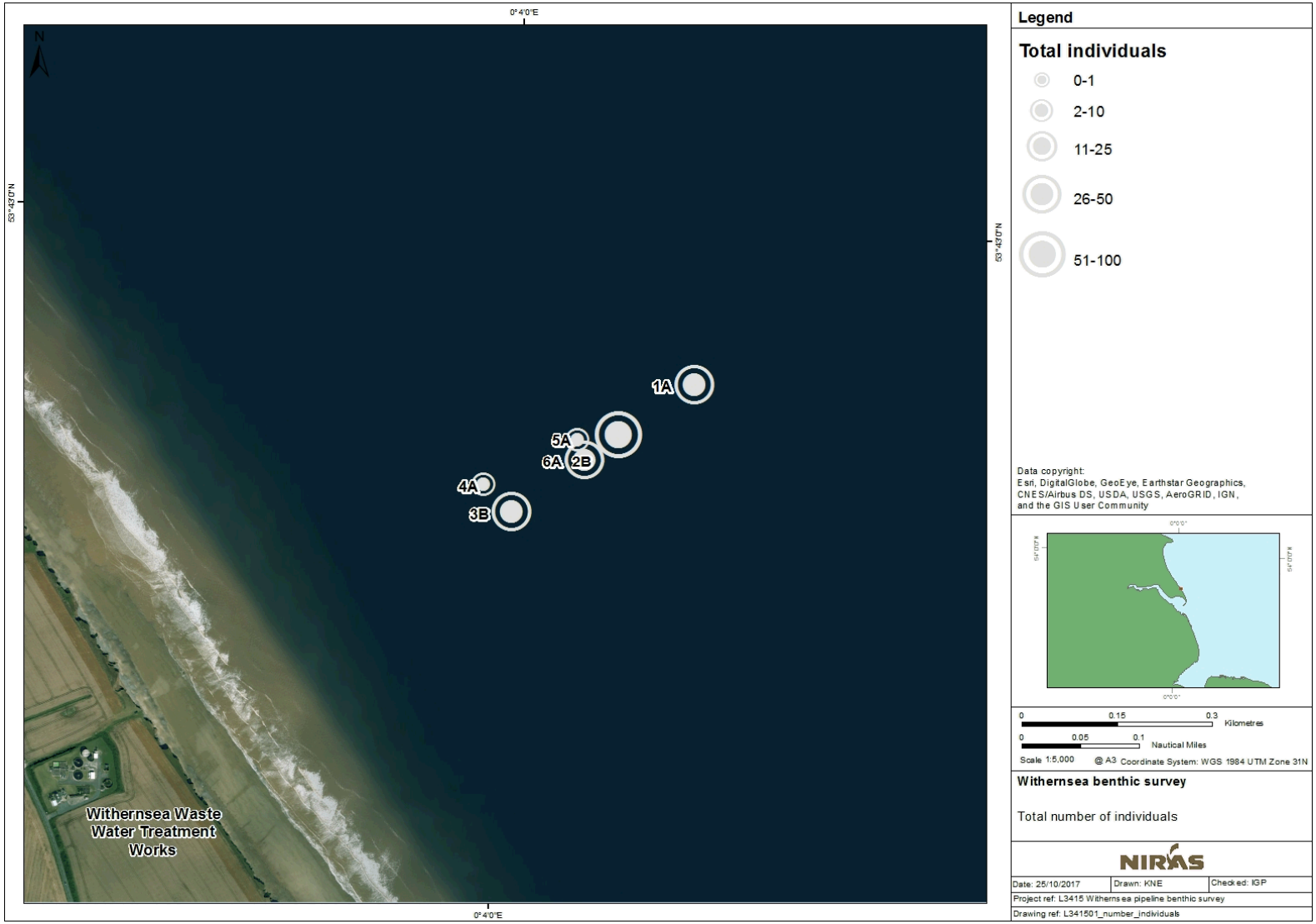


Figure 3.5: Total number of individuals at each sample station. Colonial organisms were enumerated as '1' for the purposes of mapping abundance.

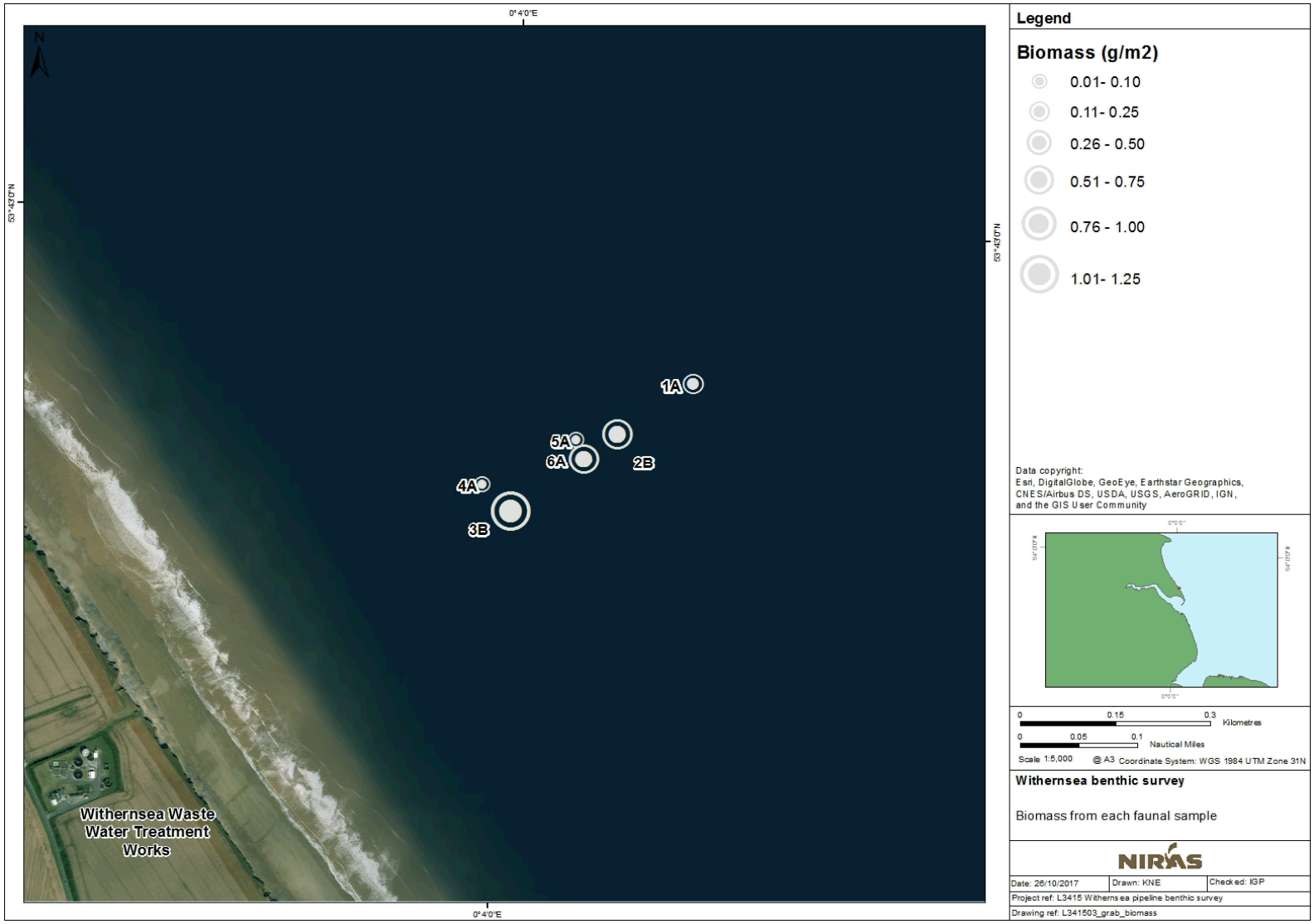


Figure 3.6: Total wet-weight biomass at each sample station.

3.9. Similarity of faunal communities was very low between sample stations with less than 50% similarity between all stations (Figure 3.7). Four of the six samples were grouped into two pairs that were not significantly distinguishable from one another by a Simprof test. The first of these pairings, Stations 5A and 6A, was based upon the relative abundance of *Protodorvillea kefersteini* and the presence of *Sabellaria spinulosa* but it is noteworthy that Station 5A only contained seven individuals from three taxa whereas Station 6A contained forty five individuals from nineteen taxa. The grouping of Stations 1A and 3B was characterised by the abundance of the barnacle *Balanus crenatus* and the presence of the tunicate *Molgula* sp. Sample 4A was different from the other samples owing to the presence of the crustaceans *Corophium volutator* and *Eurydice pulchra* but in common with other samples contained *Alcyonidium diaphanum* and *Balanus crenatus*. The relatively high diversity at Station 2B separated it from the other samples.

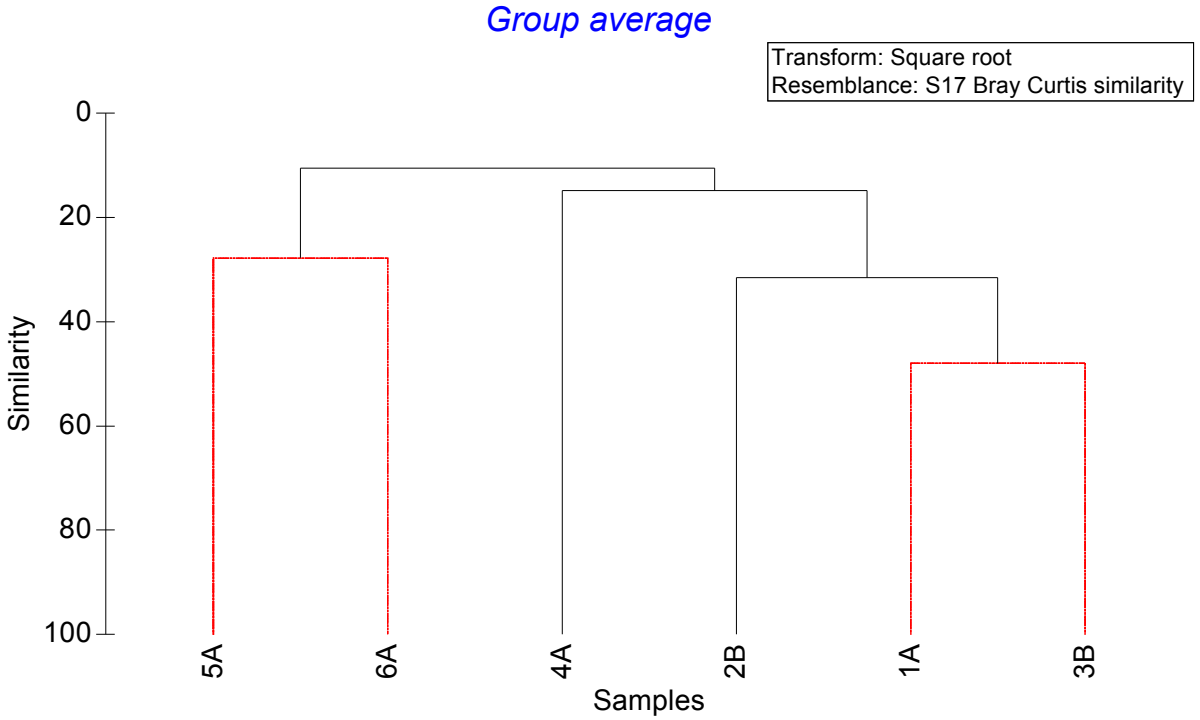


Figure 3.7. Dendrogram of faunal communities from Withernsea.

3.10. The MDS plot (Figure 3.8) also shows a low similarity between faunal samples and the low stress of the plot (0.02) indicates that the plot is a good 2D representation of multivariate space.

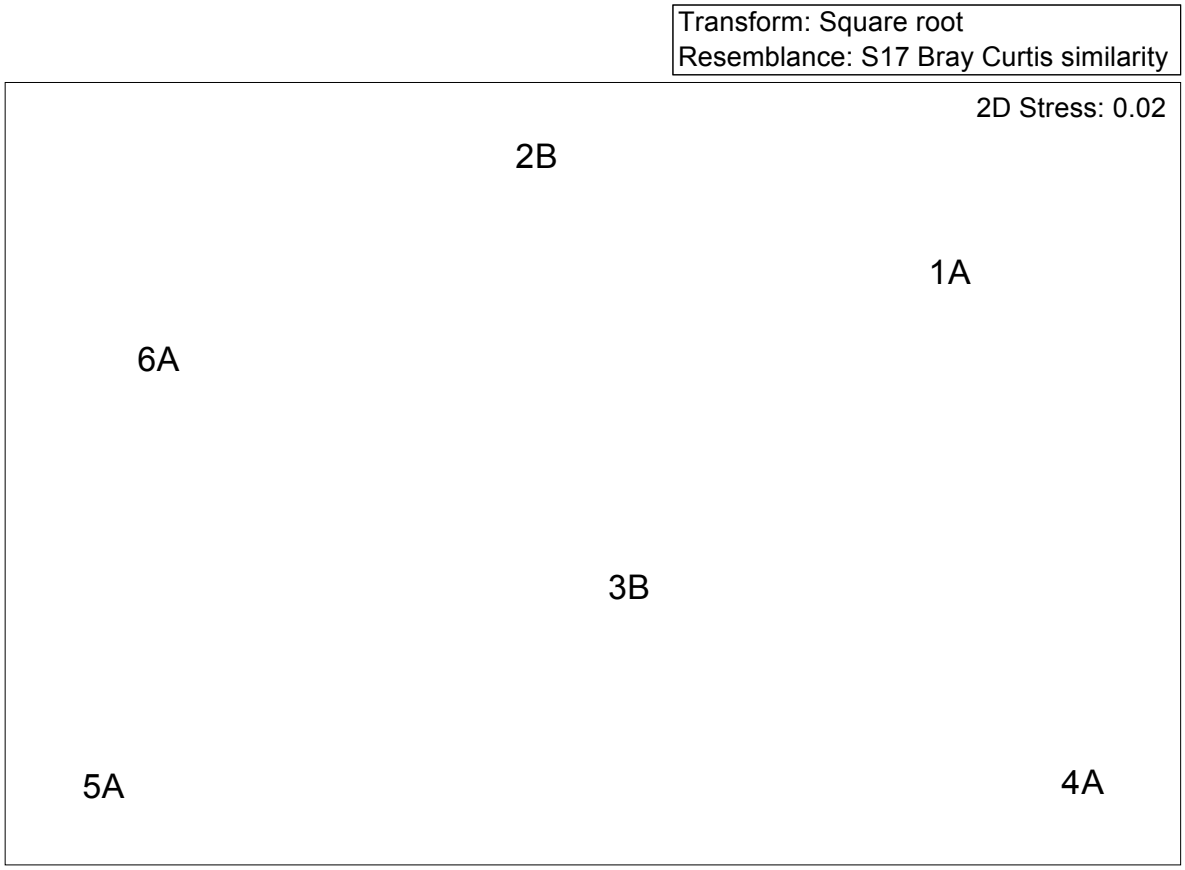


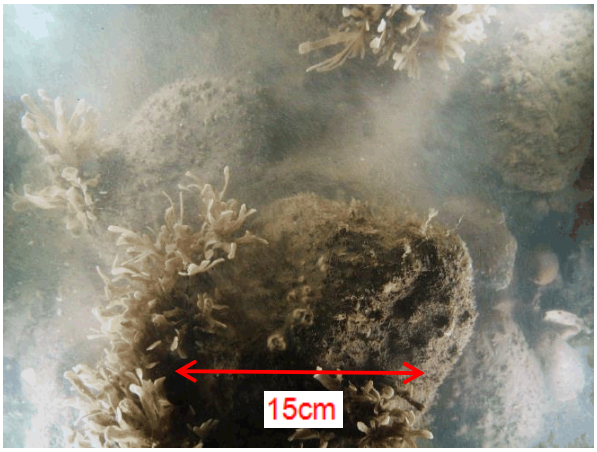
Figure 3.8. MDS plot of faunal communities at Withernsea

Drop Down Camera Survey

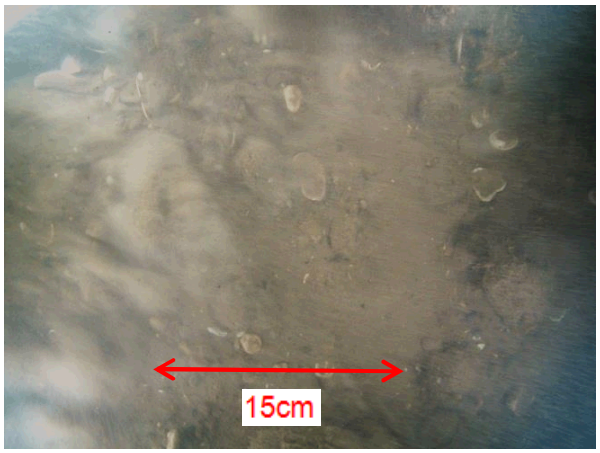
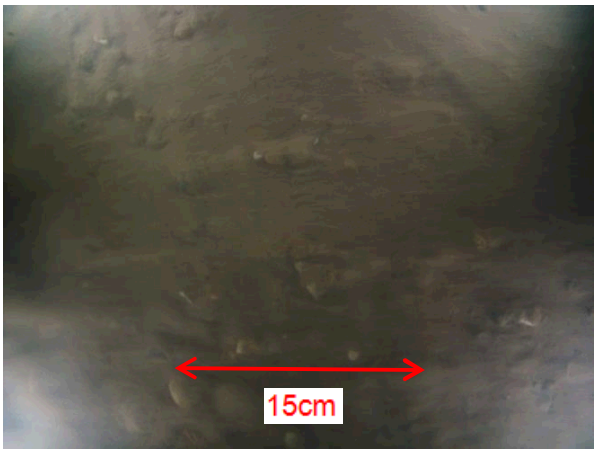
3.11. Seabed imagery is provided in Appendix 5. Representative images are provided in the text below.

3.12. The visibility off Withernsea was generally very poor but images of sufficient clarity to characterize the seabed were obtained at four stations. No useful information could be obtained from Station 4 (the seabed could not been seen until the drop down camera made contact, at which point clouds of sediment were released.

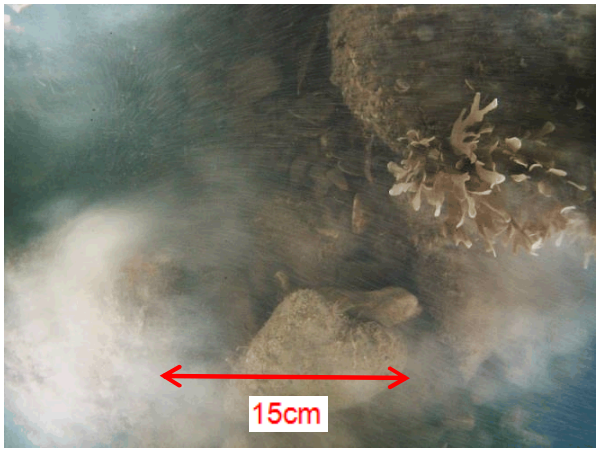
3.13. At Station 1, the seabed was of mainly coarse sediment including boulder, cobble and pebble but with interstitial fine sediment. There was a limited epifauna on the largest particles, including hornwrack *Flustra foliacea* as well as hydroids and sponges of indeterminate species.

Station 1	
	
Latitude 53°42.863 N Longitude 0°4.243 E	Latitude 53°42.863 N Longitude 0°4.241 E

3.14. At Stations 2 and 3 the seabed appeared to be made up of mixed sediments including the shells of dead bivalve molluscs. No epifauna was apparent in the images.

Station 2	Station 3
	
Latitude 53°42.810 N Longitude 0°4.092 E	Latitude 53°42.770 N Longitude 0°4.088 E

3.15. At Station 5, conditions were similar to Station 1 with boulders present and epifauna including *Flustra foliacea* as well as hydroids and a *Henricia* starfish. Station 6 had a mixed seabed similar to that recorded at Stations 2 and 3.

Station 5	Station 6
	
Latitude 53°42.811 N Longitude 0°4.099 E	Latitude 53°42.796 N Longitude 0°4.156 E

3.16. Data generated from the grab samples and drop down camera images were used to try to classify each of the sample stations as a biotope (see Figure 3.9). The lack of very large particles in the images for Stations 2 and 3 as well as the prevalence of barnacles and serpulids (along with encrusting bryozoa) in the grab samples led to the classification of SS.SCS.CCS.PomB *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles. At other stations, the larger particles with *Flustra foliacea* led to the classification of SS.SMX.CMx Circalittoral mixed sediment but the lack of fauna meant that the classification could not be taken any further. At Station 4A, there were no adequate images and the fauna from grab survey was very sparse and the classification was taken only as far as SS.SMX Sublittoral mixed sediment.

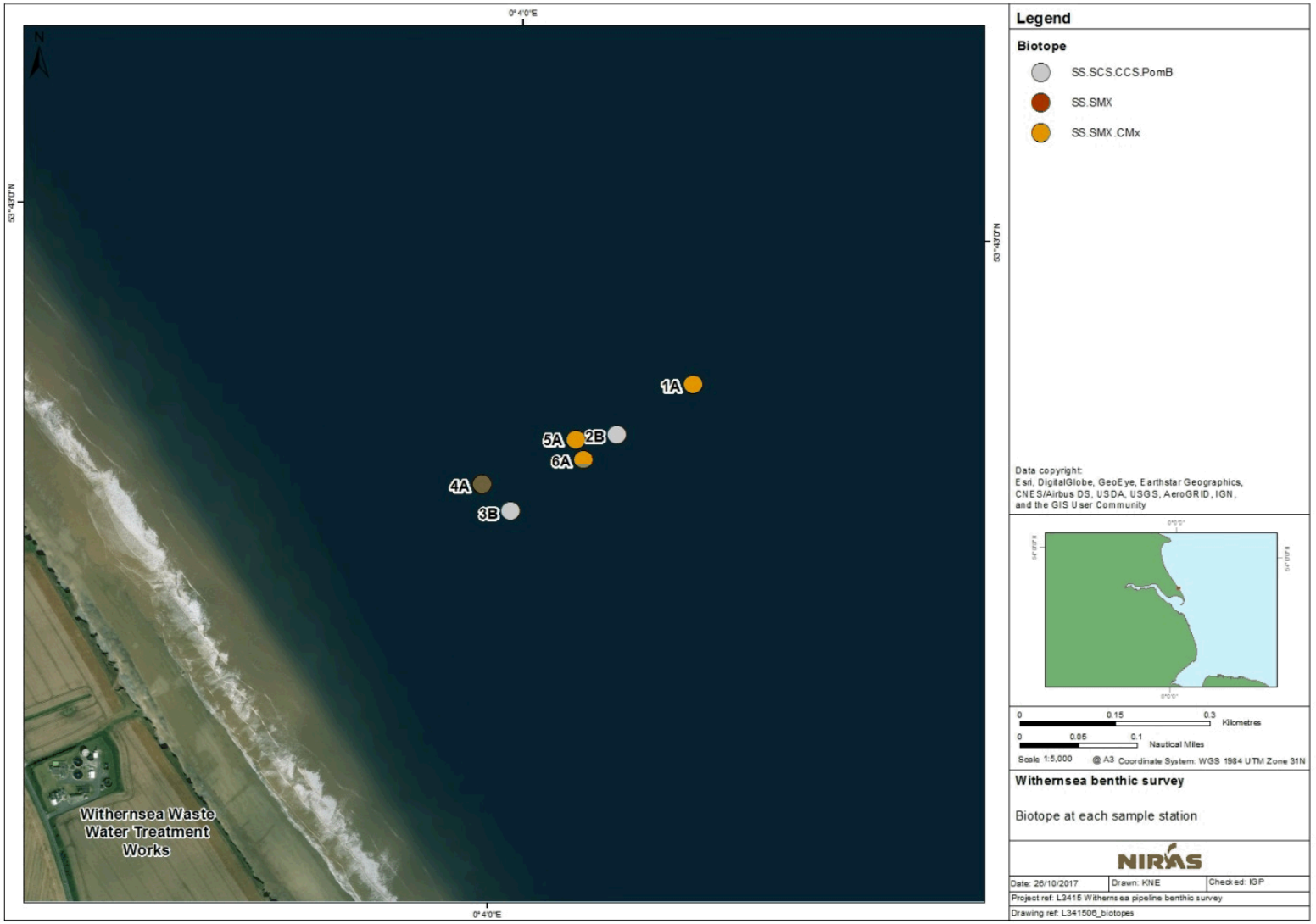


Figure 3.9: Potential biotopes at each sample station.

4. Discussion

4.1. The survey described in this report has provided details of benthic habitats and fauna in relation to the proposed alignment for a replacement LSO for the Withernsea Waste Water Treatment Works. The survey was undertaken in challenging conditions, particularly as the survey coincides with some of the largest spring tides of the year which meant that there were strong currents and elevated levels of suspended sediment. This, combined with the coarse nature of the seabed sediments throughout much of the survey area, meant that there were difficulties obtaining useful data. Nevertheless, the survey indicates that the area around the proposed LSO consists of mixed sediments and a sparse fauna with many scour-tolerant species.

4.2. Stations 1 and 5 showed some characteristics of rocky reef, which was not unexpected given the reasons for designation of the Holderness Inshore MCZ, within which the survey area lies (DEFRA, 2016). The drop-down camera images suggest that the larger particles sit on a matrix of finer sediments and with a generally low elevation (mainly the height of the particle itself). Many of the grab samples suggested a dominance by epifaunal organisms and it would appear from this survey, together with the wider acoustic survey ('gravel with cobbles' area in Appendix 6) that the reef features are extensive. Based on guidance from Irving (2009), much of the seabed in the survey area is of up to medium 'reefiness'.

4.3. The Ross worm Sabellaria spinulosa was present in some samples but only as an encrusting organism and there was no evidence of reef-like aggregations within the survey area.

4.4. More inshore parts of the survey area were clearly sandy according to the geophysical survey (side scan sonar, Appendix 6). There were no survey stations in this area, however.

5. References

Gubbay, S. (2007) Defining and managing *Sabellaria spinulosa* reefs: report of an inter-agency workshop. 1-2 May 2007. Joint Nature Conservation Committee, Peterborough. 405: 26pp.

Irving, R. (2009) The identification of the main characteristics of stony reef habitats under the Habitats Directive. JNCC Report No. 432.

Limpenny, D.S., Foster-Smith, R., Edwards, T.M., Hendrick, V.J., Diesing, M., Eggleton, J.D., Meadows, W.J., Crutchfield, Z., Pfeifer, S. & Reach, I.S. (2010) Best methods for identifying and evaluating *Sabellaria spinulosa* and cobble reef. ALSF Ref no MAL0008. Prepared for Natural England. 149pp.

DEFRA, 2016. Marine Conservation Zones: Holderness Inshore. https://www.gov.uk/government/publications/marine-conservation-zones-holderness-inshore

Appendices

Appendix 1: Scope of Work

Provided under separate cover.

Appendix 2: Raw sediment data

Particle size (ϕ)	Particle size	Sample 1	Sample 2	Sample 3	Sample 4	Sample 6
-5.5	45mm	0.00	0.00	0.00	0.00	0.00
-5	31.5mm	0.00	0.00	0.00	0.00	0.00
-4.5	22.4mm	0.00	29.09	0.00	0.00	0.00
-4	16mm	0.00	5.26	0.00	0.00	11.23
-3.5	11.2mm	0.00	0.68	15.42	4.27	2.75
-3	8mm	0.00	1.95	3.59	2.01	9.03
-2.5	5.6mm	2.06	6.69	4.81	2.50	7.57
-2	4mm	3.26	5.19	2.61	2.09	9.15
-1.5	2.8mm	2.44	7.48	4.04	2.46	8.54
-1	2mm	3.03	6.32	5.38	2.52	7.80
-0.5	1.4mm	3.52	6.95	10.77	2.83	7.96
0	1mm	2.93	4.60	9.67	2.32	6.08
0.5	707µm	0.00	4.04	12.56	0.00	5.29
1	500µm	0.00	3.03	10.01	0.00	5.54
1.5	353.6µm	0.00	2.46	4.82	0.00	5.89
2	250µm	0.65	1.73	2.58	0.94	5.56
2.5	176.8µm	4.14	1.70	1.85	4.71	3.11
3	125µm	4.70	1.48	1.48	4.28	2.07
3.5	88.39µm	4.33	1.12	1.04	3.56	1.49
4	63µm	3.82	0.85	0.85	3.38	0.63
4.5	44.2µm	3.51	0.68	0.70	3.23	0.32
5	31.3µm	3.80	0.64	0.67	3.34	0.00
5.5	22.1µm	4.06	0.64	0.73	3.78	0.00
6	15.6µm	4.45	0.63	0.67	3.91	0.00
6.5	11µm	5.41	0.75	0.82	4.68	0.00
7	7.8µm	5.34	0.75	0.73	4.94	0.00
7.5	5.5µm	5.29	0.77	0.70	5.09	0.00
8	3.9µm	5.00	0.73	0.64	4.86	0.00
8.5	2.75µm	4.43	0.63	0.51	4.31	0.00
9	1.95µm	4.17	0.59	0.49	4.05	0.00
9.5	1.38µm	4.00	0.55	0.45	3.85	0.00
10	0.98µm	3.57	0.47	0.35	3.41	0.00
10.5	0.69µm	3.04	0.39	0.28	2.92	0.00
11	0.49µm	2.61	0.32	0.24	2.59	0.00
11.5	0.34µm	2.22	0.27	0.21	2.30	0.00
12	0.24µm	1.75	0.22	0.16	1.90	0.00
12.5	0.17µm	1.18	0.16	0.09	1.35	0.00
13	0.12µm	0.75	0.11	0.05	0.90	0.00
13.5	0.09µm	0.40	0.06	0.03	0.50	0.00
14	0.06µm	0.14	0.02	0.01	0.18	0.00
14.5	0.04µm	0.02	0.00	0.00	0.02	0.00

Appendix 3: Grab Images

Provided under separate cover.

Appendix 4: Faunal data

Group	Family	Taxon	L3415-1A	L3415-2B	L3415-3B	L3415-4A	L3415-5A	L3415-6A
Ciliophora	Folliculinidae	Folliculinidae sp.	P					
Porifera		Porifera crust spp.	P		P			
Porifera	Grantiidae	*Grantia compressa*		P				
Porifera	Sycettidae	*Sycon ciliatum*		P				
Cnidaria	Corynidae	*Coryne* sp.		P				
Cnidaria	Sertulariidae	*Sertularella* spp.		P	P			
Cnidaria	Campanulariidae	*Laomedea flexuosa*	P	P				
Nemertea		Nemertea spp.		2				2
Nematoda		Nematoda spp.		1	1			
Entoprocta	Pedicellinidae	Pedicellina spp.		P				
Entoprocta	Pedicellinidae	*Barentsia gracilis*		P				
Annelida	Polynoidae	*Harmothoe* sp. damaged		1	1			
Annelida	Polynoidae	*Harmothoe clavigera*	1	1				
Annelida	Glyceridae	*Glycera lapidum*						1
Annelida	Syllidae	*Syllis armillaris*		1				
Annelida	Syllidae	*Syllides benedicti*		1				
Annelida	Syllidae	*Exogone verugera*						4
Annelida	Nephtyidae	*Nephtys* sp.juv.		1				
Annelida	Dorvilleidae	*Protodorvillea kefersteini*		15	1		5	16
Annelida	Paraonidae	*Aricidea* (*Aricidea*) *minuta*		1				
Annelida	Spionidae	*Spio goniocephala*						1
Annelida	Cirratulidae	*Caulleriella alata*	1					2
Annelida	Cirratulidae	*Chaetozone christiei*						1
Annelida	Cirratulidae	*Cirriformia tentaculata*						1
Annelida	Cirratulidae	*Dodecaceria* sp.		1				
Annelida	Capitellidae	*Mediomastus fragilis*				1		2
Annelida	Sabellariidae	*Sabellaria spinulosa*		3	2		1	1
Annelida	Ampharetidae	*Ampharete lindstroemi* agg.						1
Annelida	Terebellidae	Terebellidae sp. Juv.		1				
Annelida	Terebellidae	*Lanice conchilega*						2
Annelida	Terebellidae	*Polycirrus* spp.		2				3
Annelida	Sabellidae	*Pseudopotamilla reniformis*		2				
Annelida	Serpulidae	*Spirobranchus lamarcki*		11	1			
Annelida	Enchytraeidae	*Grania* sp.		2				
Chelicerata	Nymphonidae	*Nymphon brevirostre*		2				
Chelicerata	Ammotheidae	*Achelia* sp. juv.		1				
Chelicerata	Ammotheidae	*Achelia echinata*		2				1
Crustacea	Verrucidae	*Verruca stroemia*		19	1			
Crustacea	Balanidae	*Balanus crenatus*	37	12	21	2		
Crustacea		Harpacticoid copepod spp.		2				
Crustacea	Phoxocephalidae	*Metaphoxus fultoni*						1
Crustacea	Atylidae	*Nototropis guttatus*						1
Crustacea	Dexaminidae	*Tritaeta gibbosa*		1				
Crustacea	Cheirocratidae	*Cheirocratus* sp. female	2		1			2
Crustacea	Cheirocratidae	*Cheirocratus sundevalli*						2

Crustacea	Corophiidae	*Corophium volutator* juv.				7		
Crustacea	Cirolanidae	*Eurydice pulchra*				1		
Crustacea	Bodotriidae	*Bodotria scorpioides*					1	1
Crustacea		Decapoda larvae	3					
Crustacea	Polybiidae	*Liocarcinus* spp. juv.			1			
Mollusca	Onchidoridiidae	*Onchidoris depressa*		1				
Mollusca	Mytilidae	Mytilidae sp. juv.		5	2			1
Mollusca	Scrobiculariidae	*Abra alba*	1					
Bryozoa	Walkeriidae	*Walkeria uva*		P				
Bryozoa	Vesiculariidae	*Vesicularia spinosa*			P			
Bryozoa	Eucrateidae	*Eucratea loricata*		P				
Bryozoa	Electridae	*Electra pilosa*		P				
Bryozoa	Calloporidae	*Callopora dumerilii*	P	P	P			
Bryozoa	Bugulidae	*Bicellariella ciliata*		P				
Bryozoa	Escharellidae	*Escharella immersa*	P					
Bryozoa	Schizoporellidae	*Schizoporella* sp.		P				
Bryozoa	Alcyonidiidae	*Alcyonidium diaphanum*		P	P	P		
Tunicata		Tunicata sp. colonial		P		P		P
Tunicata	Molgulidae	*Molgula* spp.	2	1	2			

Appendix 5: Seabed Images

Provided under separate cover.

Appendix 6: Seabed Features Chart

Provided under separate cover.

Sample 1A

Sample 2B

Sample 3B

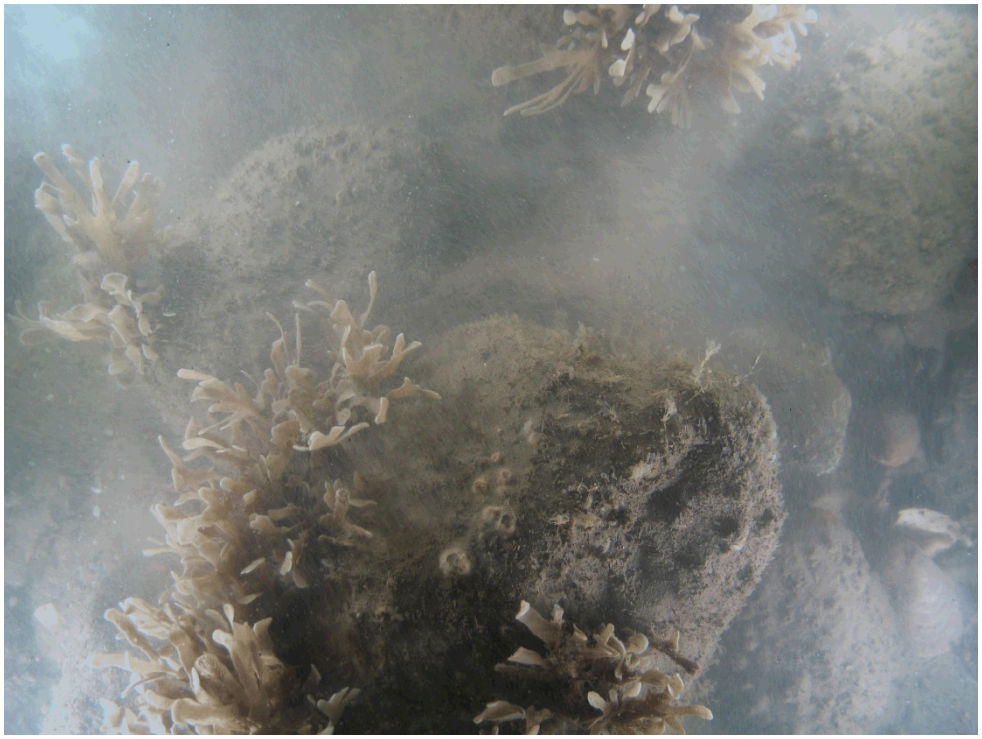
Sample 4A

Sample 5A

Sample 6A

Station 1

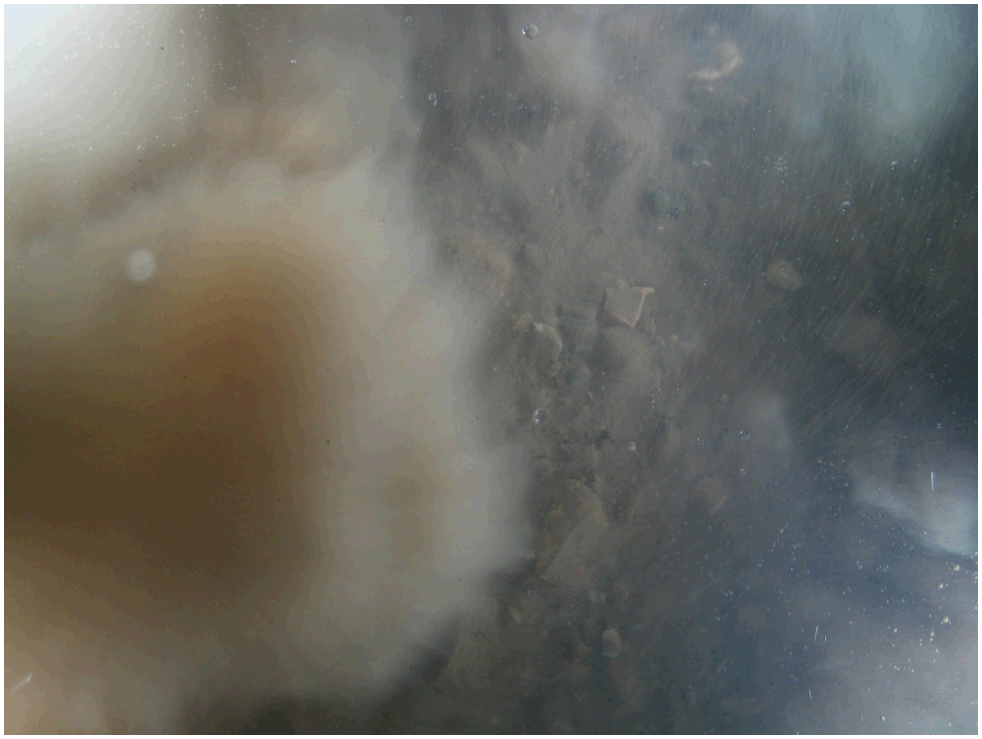
Station	Image	Time	Lat Deg	Lat DM	Long Deg	Long DM	Depth (m)
1	3775	14:17	53	42.863	0	4.243	11



Station	Image	Time	Lat Deg	Lat DM	Long Deg	Long DM	Depth (m)
1	3776	14:17	53	42.863	0	4.241	11

Station	Image	Time	Lat Deg	Lat DM	Long Deg	Long DM	Depth (m)
1	3777	14:18	53	42.863	0	4.24	11

Station 2



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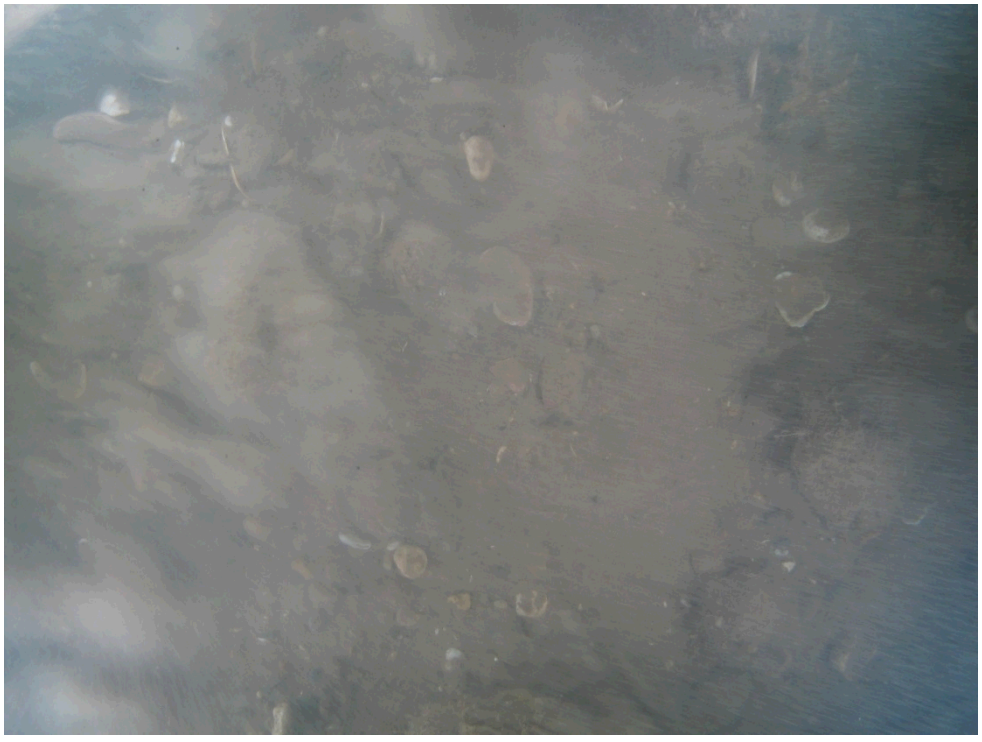

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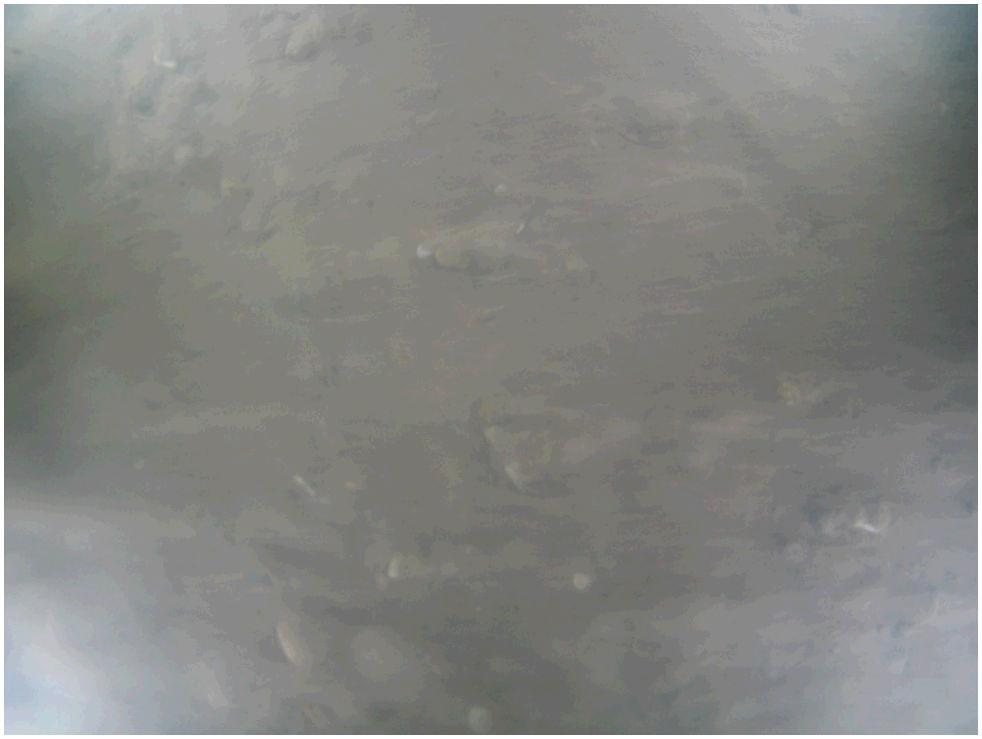

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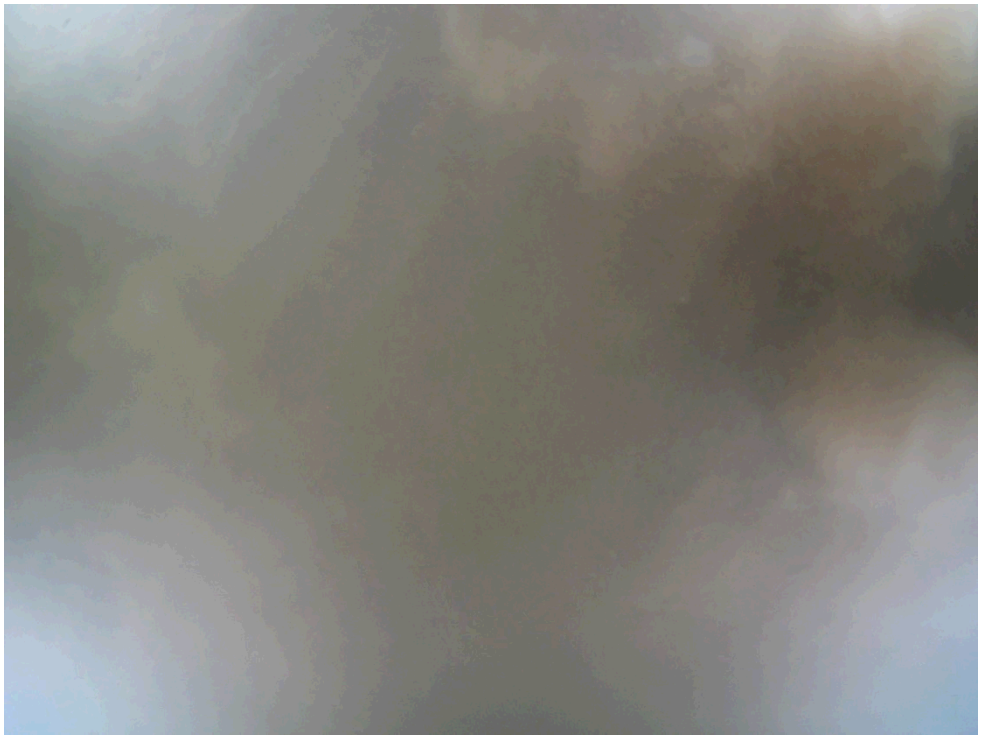

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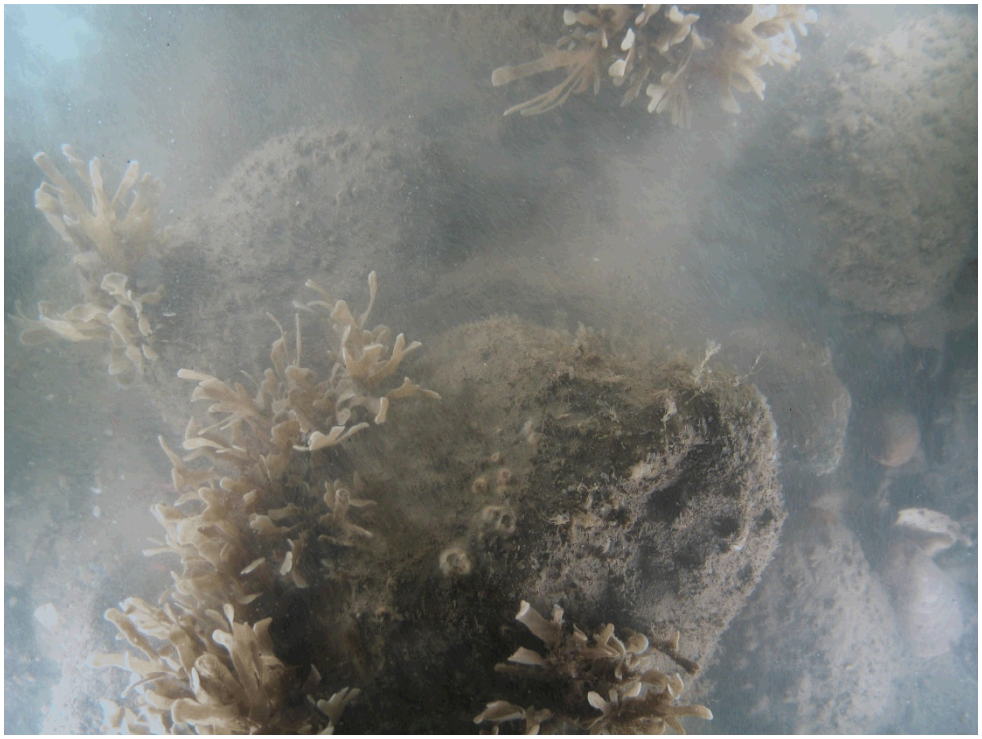

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5	3785	14:40	53	42.816	0	4.117	11

Station 6

Station	Image	Time	Lat Deg	Lat DM	Long Deg	Long DM	Depth (m)
6	3787	14:44	53	42.794	0	4.146	12

Station	Image	Time	Lat Deg	Lat DM	Long Deg	Long DM	Depth (m)
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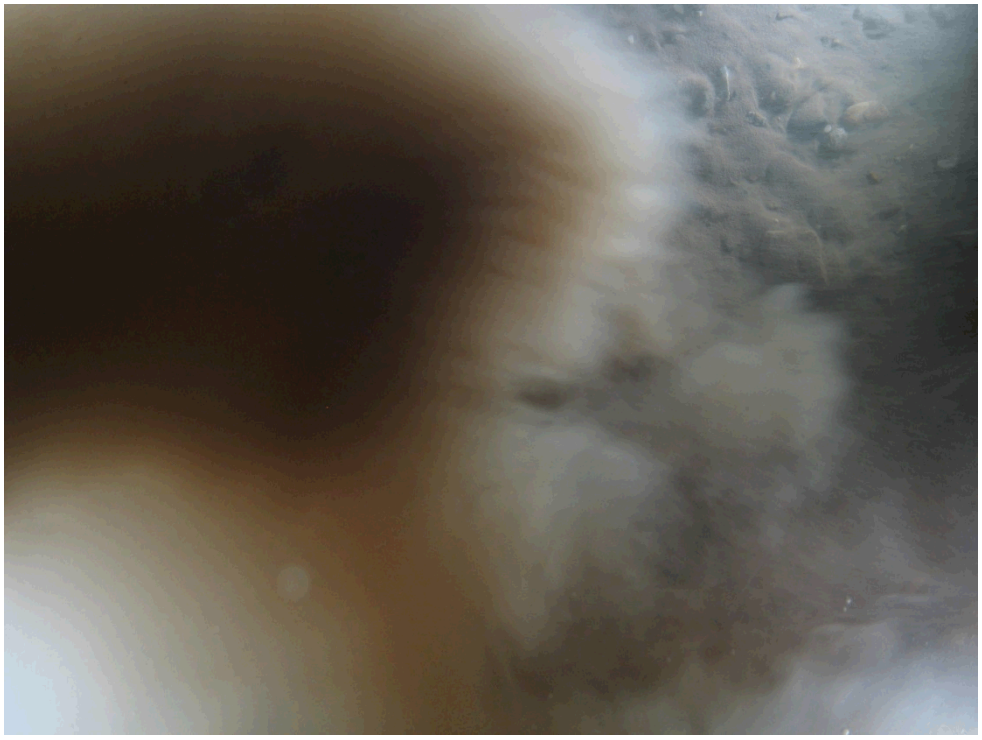

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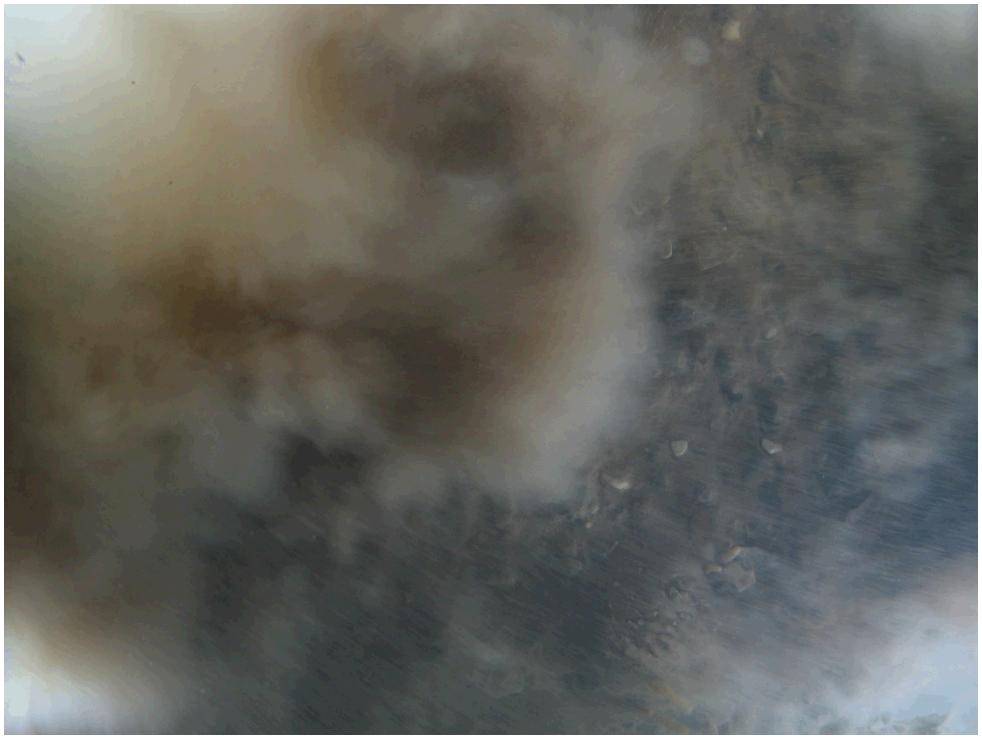

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Appendix J – Royal HaskoningDHV Intertidal Survey Results

Royal HaskoningDHV
Enhancing Society Together

REPORT

Withernsea Intertidal Ecology Survey

Withernsea LSO Replacement Scheme

Client: Yorkshire Water Services

Reference: I&BPB5063R002F0.1
Revision: 0.1/Final
Date: 12 December 2017

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Document title: Withernsea Intertidal Ecology Survey

Document short title:
Reference: I&BPB5063R002F0.1
Revision: 0.1/Final
Date: 12 December 2017
Project name: PB5063
Project number: PB5063
Author(s): Claire Gilchrist

Drafted by: Claire Gilchrist

Checked by: Gregor McNiven

Date / initials: 11/12/17 GMcN

Approved by: Wasim Hashim

Date / initials: 12/12/17 WH

Classification
Project related

Disclaimer

Royal HaskoningDHV

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Table of Figures

1 Introduction

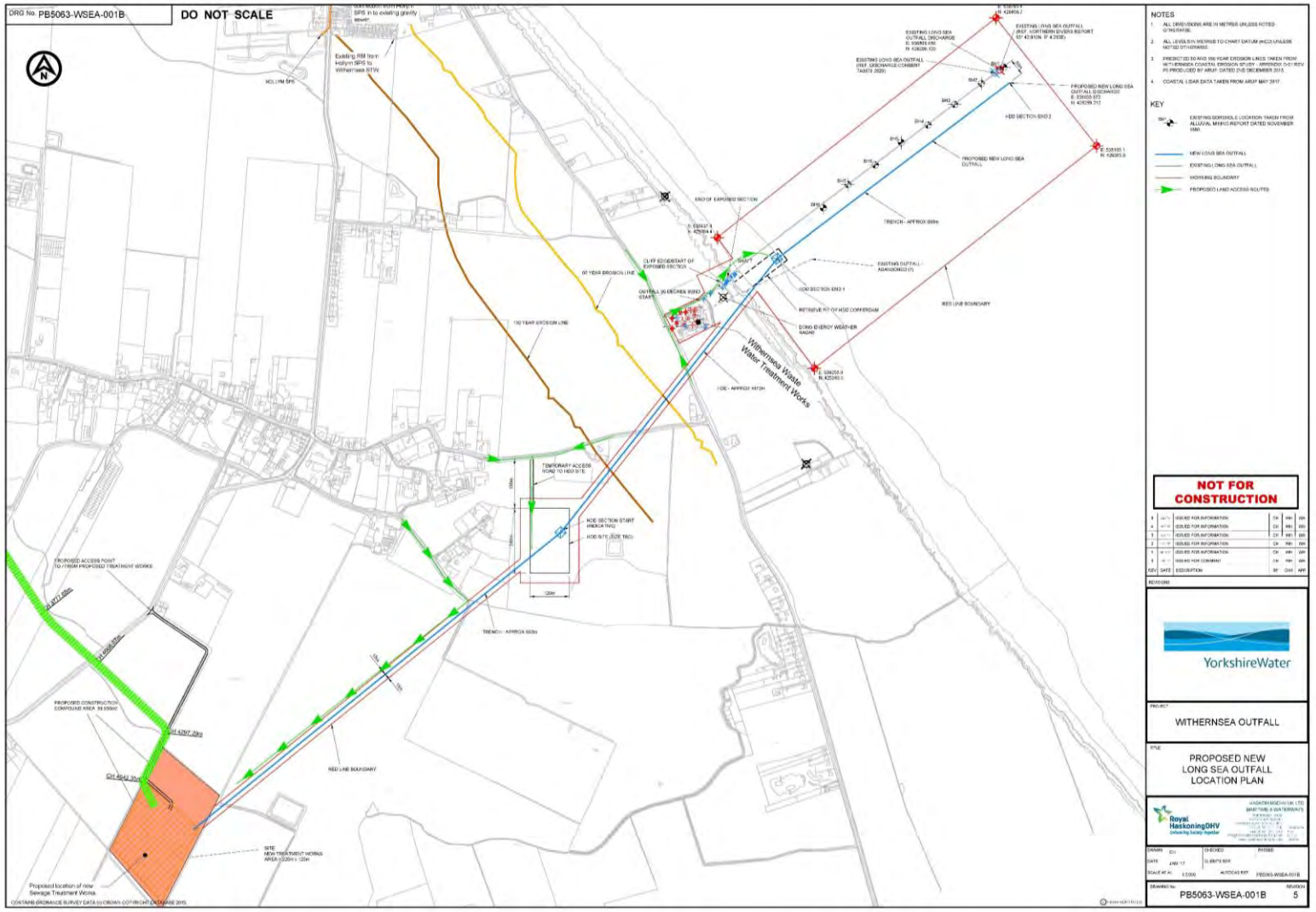
The existing Withernsea Waste Water Treatment Works (WwTW) and associated Long Sea Outfall (LSO) are at risk from ongoing coastal erosion. Yorkshire Water Services (YWS) therefore proposes to build a new WwTW and associated pipelines further inland, and also to construct a replacement LSO ('the proposed scheme'). The proposed replacement LSO will be approximately 3,500 in length, which includes a marine section totalling 1,000m in length. This would be located approximately 50m to the south of the existing LSO (**Figure 1.1**).

The site is located within the Holderness Inshore Marine Conservation Zone (MCZ). The MCZ was designated in January 2016 and covers an area of approximately 309km^2. The MCZ is designated for the following broad scale habitats and features that support a diverse array of marine invertebrates, algae and fish (Defra, 2016):

- Intertidal sand and muddy sand (A2.2).
- Moderate energy circalittoral rock (A4.2).
- High energy circalittoral rock (A4.1).
- Subtidal coarse sediment (A5.1).
- Subtidal mixed sediments (A5.4).
- Subtidal sand (A5.2).
- Subtidal mud (A5.3).
- Spurn Head (subtidal) (geological feature)

A subtidal ecological survey was undertaken by Niras (2017) at a number of sample locations along the pipeline length. To assess the condition and features of the intertidal sand and muddy sand (A2.2) that lie within the LSO route, a Phase 1 survey was undertaken by Royal HaskoningDHV. The results of which are presented within **Section 3** of this report.

Figure 1.1 Site location



2 Methodology

A Phase 1 marine ecological survey was undertaken on a low water neap tide (23 November 2017) to assess marine and coastal species present and their relative abundance. The red line boundary of the proposed works comprises an exposed clean sandy beach, covering of approximately 300m of the extent of the coast. The shore is approximately 100m wide from the cliffs to low water mark.

The Phase 1 survey was undertaken on a low water spring tide by a marine biologist. The survey comprised a full walkover survey of the foreshore with in-situ recording of habitats and conspicuous species. Habitat zonation and biotopes were mapped using ArcGIS software on a global positioning system (GPS) device. Photographs were also taken for reference.

The intertidal areas of the Holderness Inshore MCZ are describes as follows by Defra (2016);

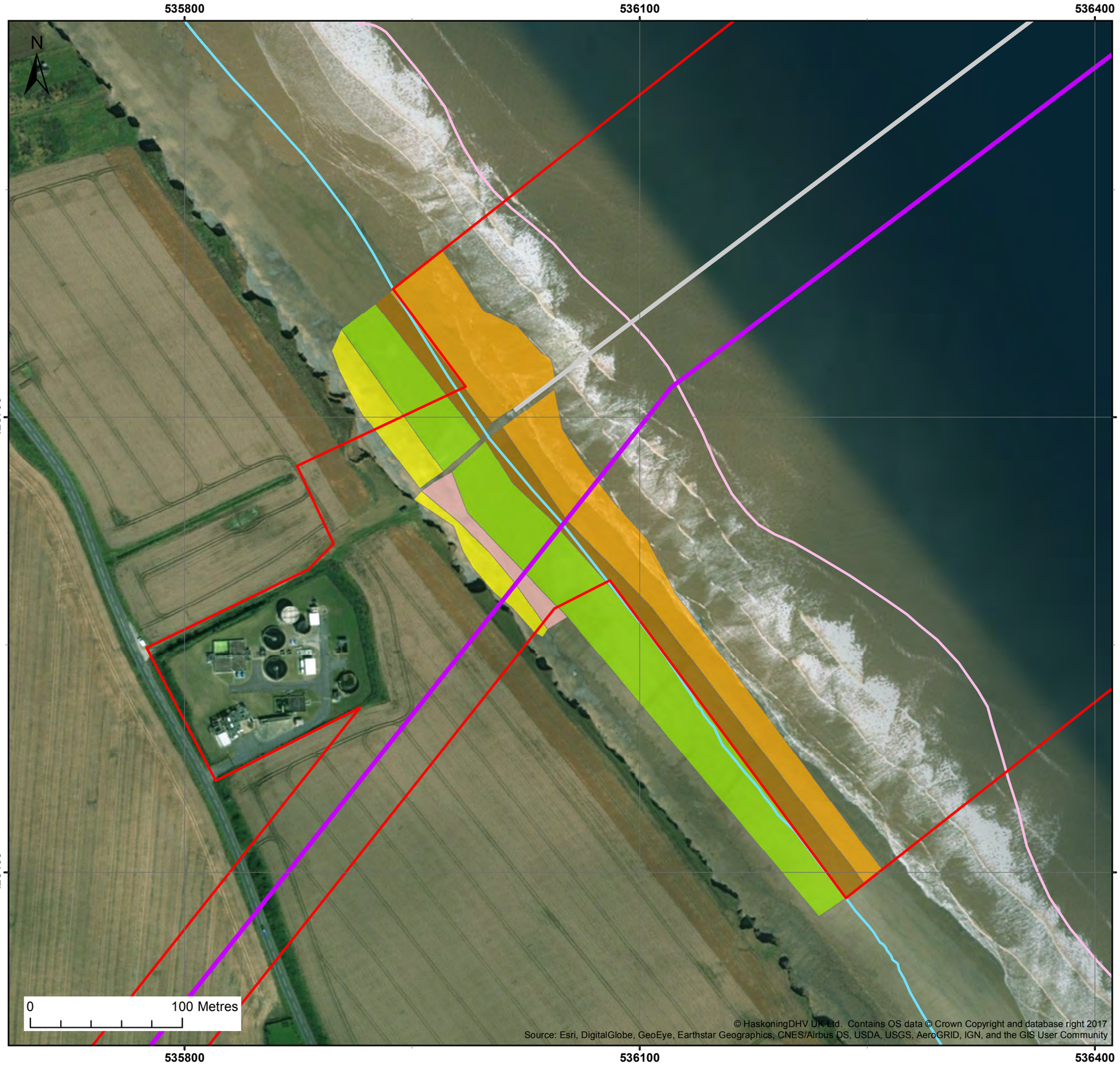
> *Partly above the water, the sandy beaches of intertidal sand and muddy sand are uncovered at low tide. These sandy shores may appear devoid of marine life, but are in fact home to many species, buried in the damp sand. On all but the most barren sandy shores, there will be different kinds of worms just beneath the surface.*

In order to fully assess the habitats present against this, and in order to gather information on key invertebrate species and sediment grain size, surface sediment samples from within each zonation or biotope identified in the walkover were processed in-situ. As per the JNCC (Joint Nature Conservation Committee) marine monitoring handbook (JNCC, 2001), a spade was used to sample approximately 0.02m^2 of sediment, dug to a depth of 20cm and sieved through a 0.5µm sieve.

A sediment sample was taken within each of the four zones identified, and processed through the 0.5µm sieve in-situ. As there were very sparse species present, a second sample was also processed, at another station at a distance of 5-10m. Stations were selected at random across the width of the survey area. Notes were made on sediment characteristics, species were listed and their qualitative abundance recorded.

3 Habitat survey results

The survey identified a relatively uniform and homogenous habitat within the survey area. The foreshore represented four distinct zones referred to as upper shore, mid-shore, lower-mid shore and lower shore on **Figure 3.1**. The shore slopes relatively steeply from the upper shore to mid-shore, following which the angle shallows and the beach slopes gently to the low water mark and near shore subtidal area. A description of these distinct zones is provided below.



Legend

- Redline boundary
- Proposed outfall
- Existing outfall
- MHW
- MLW

Ecology survey areas

- Upper shore
- Mid shore
- Lower mid shore
- Lower shore
- Clay lumps

Client:	Project:
Yorkshire Water Services	Withernsea Marine Outfall (PB5063)

Title:

Withernsea Intertidal Ecology Survey Mapping

Figure: 3.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	29/11/2017	TC	CG	A3	1:2,500

Co-ordinate system: British National Grid

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3.1 Upper shore

The upper shore consists of cobbles, shingle and gravel overlaying a coarse sand (>0.5µm) and gravel substrate (**Figure 3.2**). Above this point (MHW), lies occasional clay which has been eroded from the receding adjacent cliffs. No fauna or flora was identified within this zone, with sediments too coarse to pass through a 0.5µm sieve. The relevant biotope is LS.LCS.Sh.BarSh (barren littoral shingle) (JNCC, 2017).

Figure 3.2 Upper shore habitat

3.2 Mid-shore

The beach is made up of coarse to medium clean sand with occasional overlying shingle (**Figure 3.3**). Beneath the top 3cm of mobile sand, lies a coarser sediment layer, consisting of a higher proportion gravel and shingle with coarse sand. No fauna or flora was identified within this zone from passing sediments through a 0.5µm sieve. The relevant biotope is LS.LCS.Sh.BarSa (barren littoral sand) (JNCC, 2017).

Figure 3.3 Mid-shore habitat

3.3 Lower mid-shore

The lower zone of the mid-shore comprised medium sand with some overlying shingle and gravel. The darkly coloured substrate shown within the ripples on **Figure 3.4** was not believed to be organic content. Contrary to the mid shore, there was no deeper layer of sandy gravel present, this sediment type was present to below 10cm. As consistent throughout the other habitats, no fauna or flora was identified within this zone from passing sediments through a 0.5µm sieve. The relevant biotope is LS.LCS.Sh.BarSa (barren littoral sand) (JNCC, 2017).

Figure 3.4 Lower mid-shore habitat

3.4 Lower shore

Along the low water mark, pebbles and stones are intermingled with the sand, and occasionally, ephemeral green algae (Enteromorpha) was attached to these stones (**Figure 3.5**). There was no fauna located within this zone. The relevant biotope is LS.LCS.Sh.BarSa (barren littoral sand) (JNCC, 2017).

Figure 3.5 Lower shore habitat

4 Conclusions

The biotopes present within the proposed works boundary include LS.LCS.Sh.BarSh (barren littoral shingle) and LS.LCS.Sh.BarSa (barren littoral sand). Occasional green algae were found present on stones at the low shore mark, however, no other flora or fauna was present across the upper shore, mid-shore or lower mid-shore zones.

The above survey demonstrates a low ecological value to this intertidal area of Holderness Inshore MCZ.

5 References

Department for Environment, Food and Rural Affairs (Defra) (2016) Holderness Inshore Marine Conservation Zone Factsheet. January 2016

JNCC (2001) Marine Monitoring Handbook; Procedural Guideline No. 3-1 *In situ* intertidal biotope recording. Eds: Wyn, G. and Brazier, P. (CCW) March 2001.

JNCC (2017) Marine Habitat Classification. Available from: http://jncc.defra.gov.uk/marine/biotopes/BiotopeSearch.aspx. Accessed on: 07/12/2017

Niras (2017) Withernsea Long Sea Outfall Replacement: Benthic Technical Report. November 2017

Appendix K – Arup Breeding and Wintering Bird Survey Results

Yorkshire Water Services Ltd

Withernsea WwTW

Breeding Bird Survey Report

Issue | 31 July 2018

Job number 258408-00

Ove Arup & Partners Ltd
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United Kingdom
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ARUP

Document Verification

ARUP

Job title		Withernsea WwTW			**Job number** 258408-00
Document title		Breeding Bird Survey Report			**File reference** 0-15-08
Document ref					
Revision	**Date**	**Filename**	Withernsea Bird Report-Issue1-310718.docx		
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			Prepared by	Checked by	Approved by
		Name	Joseph Shepherdson		
		Signature			
Draft 2	30 July 2018	**Filename**	Breeding Bird Survey Report, Draft 2.docx		
		Description	Second Draft		
			Prepared by	Checked by	Approved by
		Name	Joseph Shepherdson	Rory Canavan	Rory Canavan
		Signature			
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		Description	Issue		
			Prepared by	Checked by	Approved by
		Name	Joseph Shepherdson	Rory Canavan	Rory Canavan
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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Drawings

Appendices

1 Introduction

Ove Arup & Partners Ltd (Arup) were commissioned by Yorkshire Water Services Ltd in relation to the proposed construction of a new Wastewater Treatment Works (WwTW) located near Withernsea, East Riding of Yorkshire.

Part of the services provided by Arup included the provision of a Preliminary Ecological Appraisal (PEA). The appraisal highlighted the requirement to undertake a breeding bird survey in order to inform the planning application for the new WwTW.

1.1 Site and Scheme Description

The proposed wider Scheme consists of various elements, some of which will be undertaken under permitted development. This report refers only to the New WwTW:

- A new WwTW located approximately 3km to the south of the town of Withernsea (central grid reference TA342238).

Other works undertaken under permitted development, but outside the remit of this report, include:

- The demolition of the existing Withernsea WwTW, located off Holmpton Road.
- A new Long Sea Outfall (LSO) connecting the proposed WwTW site to the North Sea over a distance of approximately 3.4km, comprising a 2.4km terrestrial section and 1 km from Mean High Water Spring (MHWS) to the discharge point.
- A new Rising Main connection from Withernsea to the proposed WwTW.

1.2 Survey Objectives

The survey objectives were to:

- Determine the presence of protected and/or otherwise notable bird species (including Red and Amber listed species in Birds of Conservation Concern 4 (BoCC4) and those that are “uncommon” in Yorkshire) which may influence the design of the project.
- To understand the breeding bird assemblage present using a transect survey methodology in representative habitats within the study area, assessing the species present and relative abundance within different habitat types.

1.3 Legislation & Biodiversity Framework

All wild birds, their nests and their eggs are afforded legal protection through the provisions in the Wildlife and Countryside Act 1981 (as amended) and the Countryside and Rights of Way (CRoW) Act 2000.

It is an offence, with certain exceptions, to:

- kill, injure or take any wild bird;
- take, damage or destroy the nest of any wild bird while it is in use of being built;
- take or destroy the eggs of any wild bird; and
- have in one's possession or control any wild bird (dead or alive), part of a wild bird or egg of a wild bird which have been taken in contravention of the Act, the Protection of Birds Act 1954 or the law of any EU Member State (which implements the EU Birds Directive 1979).

In addition to the above listed offences, it is also illegal to intentionally or recklessly disturb any wild bird listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), while it is nest building or is in, on or near a nest with eggs or young; or to disturb the dependent young of such species. Consent from Natural England would be required to cause disturbance while nesting or to disturb its dependent young.

Species of principal importance in England are listed under the provisions of Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. These include species in England that were identified as requiring action in the UK Biodiversity Action Plan (UK BAP) and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework.

In addition, the Kingston upon Hull City Council have produced the Hull Biodiversity Action Plan[1] which details actions to help maintain or enhance the nature conservation status of target species to be implemented as the local level that are of importance within the local area. East Riding of Yorkshire have also produced a Biodiversity Action Plan Strategy.[2] Both plans reference the Withernsea area. The Local Biodiversity Action Plans (LBAPs) includes some species that are not included on Section 41 of the NERC Act or the UK BAP priority List.

1.4 Conservation Status of Birds

The conservation status of birds in the UK is set out in Birds of Conservation Concern 4[3] in which birds are assigned to three lists:

[1] Hull Biodiversity Action Plan Summary. *The Kingston upon Hull City Council*
[2] East Ridings of Yorkshire Biodiversity Action Plan Strategy. (2010). *East Ridings of Yorkshire Council.*
[3] Eaton, M. A. (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. *British Birds, 108*, 708 - 746.

- Red List: species that are globally threatened, whose population or range has declined rapidly in recent years, and those whose populations have declined historically and not exhibited any signs of recovery. Species that have experienced a population decline of >50%.
- Amber List: species with an unfavourable conservation status in Europe, whose populations have declined moderately in recent years, including species that show a historical decline but whose populations have shown a substantial increase, species that are rare, with localised populations and those species of international importance with UK populations and species that have experienced a population decline or breeding range decline of 25% to 49%.
- Green list: All regularly occurring species that do not qualify under any of the Red or Amber criteria are green listed. The Green list also includes those species listed as recovering from historical decline in the last review that have continued to recover and do not qualify under any of the other criteria.

2 Methodology

2.1 Desk Study

Records of priority and notable bird species recorded within 2km of the proposed development were obtained from the North and East Yorkshire Ecological Data Centre (NEYEDC).

The Multi-Agency Geographic Information for the Countryside (MAGIC)[4] was consulted for:

- Statutory designated site information within 5km of the Site.

2.2 Survey Method

The survey methods were derived from current best practice as described in Bird Census Techniques[5] and Bird Monitoring Methods,[6] and conform to the recommendations of the Royal Society of the Protection of Birds (RSPB), the British Trust for Ornithology (BTO) and Joint Nature Conservation Committee (JNCC). Surveys consisted of walking pre-defined transect routes in all accessible habitat types.

All breeding bird surveys were carried out by experienced ornithologists who were able to identify birds by calls/songs and visually. The transect route was walked at a slow pace, pausing briefly at intervals to listen for song and to scan for birds flying overhead or taking flight from the surrounding area. All birds seen and heard were mapped in accordance with the BTO standard activity recording codes.

Bird registrations were captured on paper maps in the field and then recorded using ArcGIS mapping software. Additional data that was also recorded included weather data, species present, numbers of individuals and their behaviour.

Surveys were undertaken on five occasions in April, May, June and July 2018. The transect route was walked in the morning, from approximately one hour after sunrise until 11am. This is when levels of avian activity (particularly singing) are likely to be at their highest. On two of the five visits, the routes were walked in the opposite direction to the previous visit, to balance any temporal variation in behaviour levels.

Birds were considered to be breeding where they were recorded if any of the following applied:

- Birds were heard singing with habitat suitable for that species to breed within.

[4] MAGIC. http://magic.defra.gov.uk/ Accessed online 02/12/2017.
[5] Bibby, B. B *et al.* (2000). *Bird Census Techniques.* London: Academic Press
[6] Gilbert, G. G. (1998). *Bird Monitoring Methods: A Manual of Techniques.* Bedfordshire: RSPB.

- A pair of birds were recorded in or near habitat suitable for that species to breed within.
- Birds exhibited territorial behaviour *e.g.* displaying or prolonged agitation.
- Birds were seen carrying food, nest material or the faecal sacs of young.
- Nests, eggs and/or young were found to be present.

Where breeding signs were recorded, it is assumed that a 'breeding pair' or 'breeding territory' was present and these terms are used from this point forward within this report. However, professional judgement was used when determining whether a species was likely to have bred within the site based on species distribution and local abundance as well as anthropogenic effects such as disturbance of breeding birds from roads, public rights of way and grazing animals.

Determination of the number of breeding pairs on site is reported as a range, reflecting the precautionary approach adopted given multiple registrations or signs of breeding across survey visits within suitable breeding habitat.

Due to the assemblage of birds within the site and adjacent to the proposed development area and their relative tolerance to disturbance, a 50m buffer was applied whereby bird territories within 50m of the site were included in this report.

2.3 Transect Selection

The transect routes were devised in order to encompass a range of representative habitats on site which had the potential to support breeding birds. Primary predominant habitats for selection included hedgerow, scrub, arable fields, improved grassland, unimproved neutral grassland and scattered trees.

The transect routes were selected to cover the entirety of all breeding bird habitat within 50m of the new WwTW.

2.4 Reporting Methods

Drawing 1.1 identifies the likely territory locations of breeding birds based on the five survey visits. These results are then discussed within the Results section of this report. Results are discussed in the following order:

- An initial overview of all results gathered, including total species recorded within the study area.
- Results are then discussed in relation to the conservation status of the birds present and whether they are considered to be within the Zone of Influence[7] with regards to potential impacts of protected site populations, namely:

[7] The 'zone of influence' for a project is the area over which ecological features may be subject to significant effects as a result of the proposed project and associated activities. This is likely to

- Individual breeding features of the SPA/Ramsar site with a Zone of Influence considered to be 5km from the designated site boundary. Species designated as winter features are not considered in this report and are discussed in the winter bird survey report (Appendix A).
- Breeding bird features of Sites of Special Scientific Interest (SSSI) with a Zone of Influence considered to be 2km from the designated site boundary.
- Breeding birds listed on Schedule 1 of the Wildlife and Countryside Act 1981.
- Other species which are Red or Amber listed in Birds of Conservation Concern 4 (BoCC4)[1], but not included in the above groups.
- A summary of Section 7 species of principal importance.

2.5 Evaluation

Notable bird species are those which are listed on:

- Annex 1 of the Birds Directive;
- Schedule 1 of the Wildlife and Countryside Act 1981 (as amended);
- Section 7 of the Environment (Wales) Act 2006 (species of principal importance);
- Birds of Conservation Concern 4 (UK Red and Amber List species);
- East Ridings of Yorkshire Biodiversity Action Plan Strategy;
- Hull Biodiversity Action Plan.

2.6 Assumptions and Limitations

No account can be taken of the presence or absence of a bird species on any particular survey visit, since there may be extensive breeding territories within and beyond the survey area. Five survey visits provided adequate assessment of the presence or absence of breeding bird species within the site. However, professional judgement allows for the likely presence of an occupied nest site or presumed centre of a breeding territory within the survey area to be predicted with sufficient certainty so as to not significantly limit the validity of these findings.

extend beyond the project site, for example where there are ecological or hydrological links beyond site boundaries. Determining the zone of influence of the project and which important ecological features could be significantly affected is a key activity of the Scoping process (taken from CIEEM, 2016 – Chartered Institute of Ecology and Environmental Management (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland Terrestrial, Freshwater and Coastal (Second edition January 2016)).

3 Results

3.1 Desk Study

3.1.1 Designated sites

The search using MAGIC highlighted six statutory designated sites within a 5km radius of the site, Table 3.1.

Table 3.1: Statutory designated sites within 5km of the site.

Designation	Reason For Designation	Location
Holderness Inshore Marine Conservation Zone	The Marine and Coastal Access Act (2009) allows for the creation of Marine Conservation Zone(s) (MCZ) which protect a range of nationally important marine wildlife, habitats, geology and geomorphology. MCZs, together with other types of marine protected areas, will form the UK contribution to an international network of protected sites in the north east Atlantic. Holderness Inshore MCZ is an inshore site covering an area of approximately 309km^2. The mosaic of habitats within the designated area supports a diverse range of organisms including red algae, sponges and other encrusting fauna. The site also supports fish species such as European eel *Anguilla anguilla*, dab *Limanda limanda* and wrasse *Labrus* sp., as well as commercially significant crustaceans such as edible crab *Cancer pagurus*, velvet swimming crab *Necora puber* and lobster *Homarus gammarus*. The qualifying features for Holderness Inshore MCZ include: • Intertidal sand and muddy sand. • Moderate energy circalittoral rock. • High energy circalittoral rock. • Subtidal coarse sediment. • Subtidal mixed sediments. • Subtidal sand. • Subtidal mud. • Spurn head (subtidal).	Approximately 2.3km north east of the site.
Greater Wash SPA	The Greater Wash Special Protection Area is located off the coast of Eastern England, extending seaward from mean high water to a maximum of approximately 30km or 16nm offshore. It covers the marine environment from Bridlington Bay in the north to approximately Great Yarmouth in the south. The Greater Wash is known to provide areas of importance for over-wintering red-throated diver	Approximately 2.3km north east of the site.

Designation	Reason For Designation	Location
	Gavia stellata, little gull *Hydrocoloeus minutus* and common scoter *Melanitta nigra* during the winter period (October to April), and the classification as a SPA is proposed to protect these areas. In addition, the Greater Wash SPA would provide protection to important foraging areas for common tern *Sterna hirundo*, sandwich tern *Sterna sandvicensis* and little tern *Sternula albifrons*, which breed along the adjacent coastline. The seaward extent of the boundary is a composite of the seaward distribution of red throated diver and the tern species, approximately 30km or 16nm from shore at its furthest extent. It will encompass the; • foraging areas of breeding little tern found at the existing Humber Estuary, Gibraltar Point, The Wash, North Norfolk Coast and Great Yarmouth & North Denes SPA colonies; • breeding sandwich tern at The Wash and North Norfolk Coast SPA colonies; and • breeding common tern at North Norfolk Coast and Breydon Water SPA colonies. The boundary also includes areas with high densities of common scoter and little gull, and so these two species are being proposed as features to be protected within the SPA. The landward extent of the boundary will follow mean high water and abuts the SPAs along the East coast listed above.	
Humber Estuary SSSI	The Humber Estuary is a nationally important site with a series of nationally important habitats. These are the estuary itself (with its component habitats of intertidal mudflats and sandflats and coastal saltmarsh) and the associated saline lagoons, sand dunes and standing waters. The site is also of national importance for the geological interest at South Ferriby Cliff (Late Pleistocene sediments) and for the coastal geomorphology of Spurn. The estuary supports nationally important numbers of 22 wintering waterfowl and nine passage waders, and a nationally important assemblage of breeding birds of lowland open waters and their margins. It is also nationally important for a breeding colony of grey seals *Halichoerus grypus*, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus*, a vascular plant assemblage and an invertebrate assemblage.	Approximately 4.4km to the south of the site.
Humber Estuary SAC	The Humber is the second largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion on the tidal rivers of the Ouse and Trent. The range of salinity, substrate and exposure to wave action influences the estuarine habitats and the range of species that utilise them; these include a breeding bird assemblage,	Approximately 4.4km to the south of the site.

Designation	Reason For Designation	Location
	winter and passage waterfowl, river and sea lamprey, grey seal, vascular plants and invertebrates. Annex I habitats that are a primary reason for selection of the site: • Estuaries • Mudflats and sandflats not covered by seawater at low tide • Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site. • Atlantic salt meadows *Glauco puccinellietalia maririmae.* • Coastal lagoons* • Dunes with *Hippophae rhamnoides* • Embryonic shifting dunes • Mixed coastal dunes with herbaceous vegetation (‘grey dunes’)* • Salicornia and other annuals colonising mud and sand • Sandbanks which are slightly covered by sea water all the time • Shifting dunes along the shoreline with *Ammophila arenaria* (`white dunes’) Annex II species present as a qualifying feature, but not a primary reason for site selection: • Grey seal • River lamprey • Sea lamprey Priority features are denoted by an asterisk (*).	
Humber Estuary SPA	The Humber Estuary is located on the east coast of England, and comprises extensive wetland and coastal habitats. The inner estuary supports extensive areas of reedbed, with areas of mature and developing saltmarsh backed by grazing marsh in the middle and outer estuary. On the north Lincolnshire coast, the saltmarsh is backed by low sand dunes with marshy slacks and brackish pools. Parts of the estuary are owned and managed by conservation organisations. The estuary supports important numbers of waterbirds (especially geese, ducks and waders) during the migration periods and in winter. In summer, it supports important breeding populations of bittern *Botaurus stellaris*, marsh harrier *Circus aeruginosus*, avocet *Recurvirostra avosetta* and little tern. The site qualifies under article 4.1 of the Directive (79/409/EEC) as it is used regularly by 1% or more of the Great Britain populations of the following species listed in Annex I in any season: • Avocet • Bittern	Approximately 4.4km to the south of the site.

Designation	Reason For Designation	Location
	• Hen harrier *Circus cyaneus* • Golden plover *Pluvialis apricaria* • Bar-tailed godwit *Limosa lapponica* • Ruff *Philomachus pugnax* • Marsh harrier • Little tern The site qualifies under article 4.2 of the Directive (79/409/EEC) as it is used regularly by 1% or more of the biogeographical populations of the following regularly occurring migratory species (other than those listed in Annex I) in any season: • Shelduck *Tadorna tadorna* • Knot *Calidris canutus* • Dunlin *Calidris alpina* • Black-tailed godwit *Limosa limosa* • Redshank *Tringa tetanus* Assemblage qualification: The site qualifies under article 4.2 of the Directive (79/409/EEC) as it is used regularly by over 20,000 waterbirds (waterbirds as defined by the Ramsar Convention) in any season.	
Humber Estuary Ramsar	The Humber Estuary is the largest macro-tidal estuary on the British North Sea coast. It drains a catchment of some 24,240 square kilometres and is the site of the largest single input of freshwater from Britain into the North Sea. It has the second-highest tidal range in Britain (max 7.4 m) and approximately one-third of the estuary is exposed as mud or sand flats at low tide. The inner estuary supports extensive areas of reedbed with areas of mature and developing saltmarsh backed in places by limited areas of grazing marsh in the middle and outer estuary. On the north Lincolnshire coast the saltmarsh is backed by low sand dunes with marshy slacks and brackish pools. The Estuary regularly supports internationally important numbers of waterfowl in winter and nationally important breeding populations in summer. The site qualifies under Ramsar criterion 1,3,5,6 and 8.	Approximately 4.4 km to the south of the site.

3.1.2 Bird records

NEYEDC provided records of birds within 2km of the site. None of the birds identified during the data search were Schedule 1,[8] species or Species of Principal Importance in England.[9]

[8] Schedule 1 species of the Wildlife and Countryside Act 1981 (as amended)
[9] NERC Act 2006. Section 41: Species of Principal Importance in England

3.2 Field Survey

Details of the weather conditions during the surveys are provided in Table 3.2.

Table 3.2: Weather conditions.

Date	Start Time	Finish Time	Weather Conditions
16th April 2018	07.30	10.45	Beaufort F1, SW, Cloud 5/8, Dry, 7 ºC
26th April 2018	06.45	11:00	Beaufort F3/4, W, Cloud 4/8, Dry, 8 ºC
23rd May 2018	06:40	09.40	Beaufort F4, N, Cloud 8/8, Dry, 9 ºC
13th June 2018	06.35	10.30	Beaufort F1, SW, Cloud 5/8, Dry, 14 ºC
17th July 2018	06.45	10.35	Beaufort F1, W, Cloud 6/8, Dry, 16 ºC

A summary of the breeding bird territories is provided in Table 3.3. The taxonomic sequence of species listed is in accordance with the British List (British Ornithologists' Union, 2018.[10]

Table 3.3: Breeding bird territories within survey area.

Common Name	Scientific Name	Legal Protection & Nature Conservation Status	Estimated Number of Breeding Territories on and Within 50m of Site	Species Status in Yorkshire[11]
Skylark	*Alauda arvensis*	Red List, LBAP	3	Common (>10,000 records per year)
Wren	*Troglodytes troglodytes*		4	Abundant (>50,000 records per year)
Blackbird	*Turdus merula*		1	Abundant

[10] The British List, (2018). *British Ornithologists Union.* Ninth edition of the British List.
[11] Yorkshire Bird Report, (2014). *Yorkshire Naturalists Union*

House Sparrow	*Passer domesticus*	Red list, Species of Principal Importance	1	Abundant
Tree Sparrow	*Passer montanus*	Red list, Species of Principal Importance, and LBAP	2	Uncommon (101-1000 individual records each year in the past 10 years)
Meadow pipit	*Anthus pratensis*	Amber list and LBAP	1	Common
Dunnock	*Prunella modularis*	LBAP	1	Common
Linnet	*Linaria cannabina*	Red list, Species of Principal Importance, and LBAP	1	Common
Greenfinch	*Chloris chloris*		1	Common
Yellowhammer	*Emberiza citrinella*	Red list, Species of Principal Importance and LBAP	2	Fairly common (>1000 records per year)
Reed Bunting	*Emberiza schoeniclus*	Amber list, Species of Principal Importance, LBAP	2	Fairly common

A total of 11 bird species and 19 breeding territories were recorded within the proposed working area of the new WwTW.

The most abundant species were wren (4), skylark (3), tree sparrow (2), reed bunting (2) and yellowhammer (2).

Breeding territories of five Red Listed species were recorded within the proposed working area: house sparrow, tree sparrow, skylark, linnet and yellowhammer.

Breeding territories of two Amber Listed species were recorded within the proposed working area: reed bunting and meadow pipit.

House sparrow, tree sparrow, reed bunting, linnet and yellowhammer are also species of Principal Importance which are subject to the provisions of Sections 41 of the Natural Environment and Rural Communities (NERC) Act 2006.

Tree sparrow, dunnock, meadow pipit, linnet, yellowhammer, reed bunting and skylark are listed on the Hull Biodiversity Action Plan and the East Riding of Yorkshire Action Plan Strategy.

4 Evaluation

The local status of the bird species that were recorded within the proposed development area varied from abundant to uncommon, with most of the species recorded being common.[11]

In total, breeding territories of five Red Listed and two Amber Listed species were recorded. Many of the Red and Amber Listed species were represented by a single breeding territory with tree sparrow and reed bunting having two territories per species and skylark having three territories. The recorded distribution of breeding territories reflects the extent of suitable habitat for each species and their relative abundance is not unusual.

Red and Amber Listed species recorded within the proposed development area were associated with the following breeding habitats which are present on site:

- Isolated mature trees, hedgerows, scrub, adjoining field margins (house sparrow, tree sparrow, linnet and yellowhammer).
- Arable land (skylark, reed bunting and meadow pipit).
- Reedbed and drainage ditches (reed bunting).

Tree sparrow was the only ‘uncommon’ species recorded breeding within the survey area (Drawing 1.1), based on their behaviour it was considered they are likely to be breeding on site.

Seven species listed on the Local Biodiversity Action Plans were recorded on site, tree sparrow, linnet, dunnock, reed bunting, yellowhammer, meadow pipit and skylark.

In general the species recorded on site were found to be a typical assemblage of breeding birds associated with arable land, scattered broadleaved trees, hedgerows, scrub, reedbed and drainage ditches. The most important habitat on site was deemed to be the hedgerow.

5 Recommendations

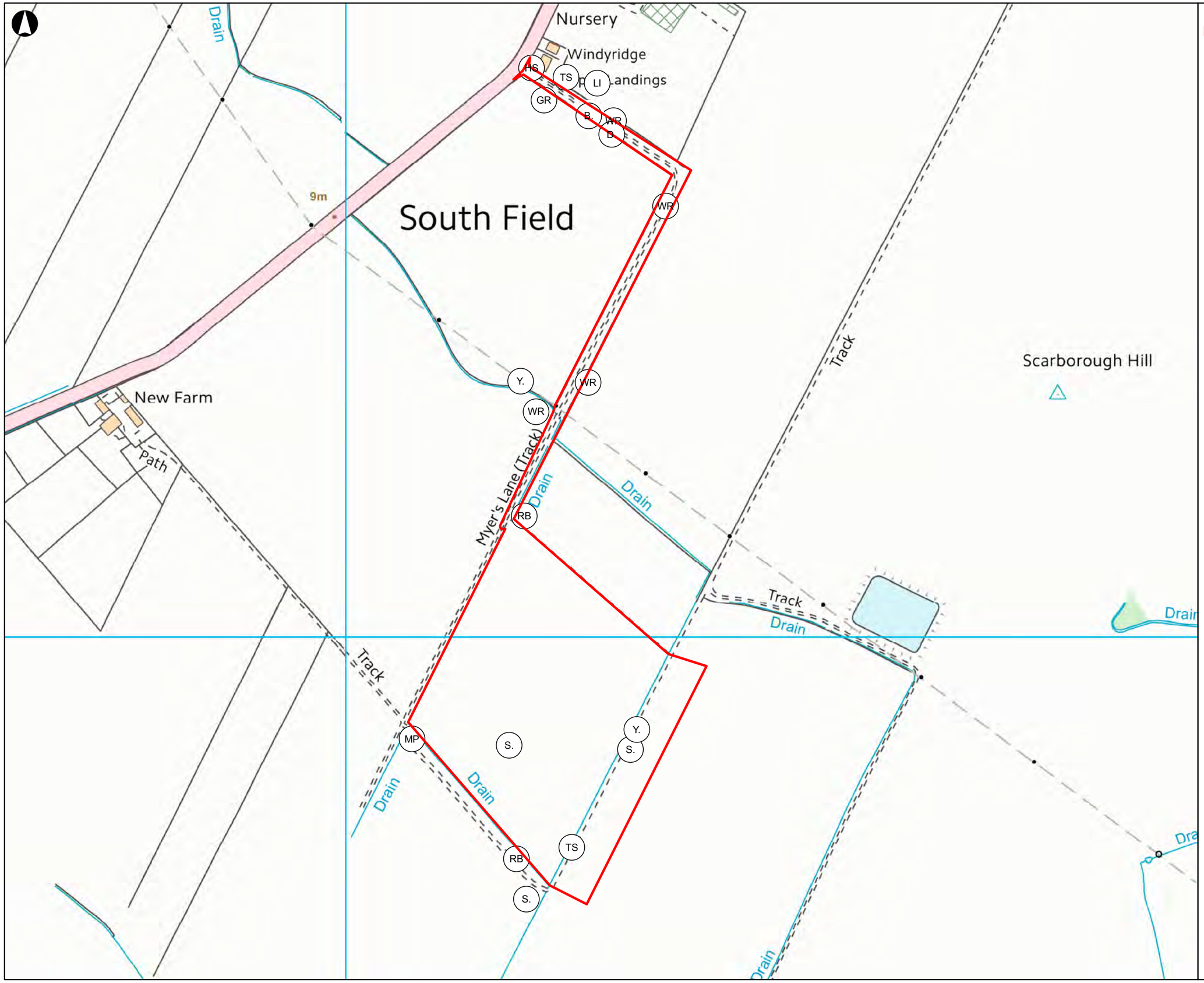
Based on the current plans for the proposed Scheme, the key recommendations are as follows:

- Scrub, hedgerows and broadleaved trees should be retained where possible. Habitat should be replaced/reinstated after temporary works. Where the loss of broadleaved trees is unavoidable, it is recommended that it is replaced at a ratio of 2:1.
- As an optional enhancement measure, existing hedgerow gaps should be filled with a locally characteristic species including hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa*, occasional oak *Quercus robus* and wild cherry *Prunus avium.*
- If vegetation clearance is to occur on suitable habitat for nesting birds within the nesting season (March – August), a nesting bird survey should be undertaken by a qualified ornithologist.

Drawings

Drawing 1.1: Breeding Bird Territory Mapping

A3



Legend

- Approximate Redline Boundary
- B. Blackbird
- LI Linnet
- D. Dunnock
- HS House Sparrow
- WR Wren
- Y. Yellowhammer
- TS Tree Sparrow
- S. Skylark
- RB Reed Bunting
- MP Meadow Pipit
- GR Greenfinch

Issue	Date	By	Chkd	Appd
P1	27-07-18	JS	DP	RC

Metres
0 50 100 200

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Client
Yorkshire Water Services

Job Title
Withernsea WwTW

Breeding Bird Territory Mapping

Scale at A3
1:4,000

Job No	Drawing Status
28408-00	**Issue**

Drawing No	Issue
1.1	**P1**

MXD Location

Appendix A

Withernsea Wintering Bird Report

A1

ORNITHOLOGICAL SUMMARY REPORT

WITHERNSEA WASTE WATER TREATMENT WORKS

(Wintering Birds)

(October 2017 – March 2018)

Waxwings Ornithology

Sunnybank Cottage

Ruston Parva

Driffield

East Yorkshire

YO25 4DG

Summary Prepared by; **Completed;**

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10th April 2018

Client; **On behalf of;**

OVE ARUP & Partners International Ltd.
Rose Wharf
78 East Street
Leeds
West Yorkshire
LS9 8EE

Survey Address;

South of Hollym, East Yorkshire.
Central grid reference TA 342 240

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Withernsea WwTW – Ornithological Summary: Wintering Birds

1. Introduction

Waxwings Ornithology was commissioned by Ove Arup & Partners International Ltd. on 18th October 2018 to undertake wintering bird surveys (WBS) at the site for the proposed new Withernsea Waste Water Treatment Works (WwTW) south of Hollym, East Yorkshire, between October 2017 and March 2018.

The site (WwTW construction compound red-line boundary) for the proposed WwTW is located within extensive arable farmland comprising large open fields, mainly utilised for cereal and rape-seed production, with few trees, tree-lines or hedgerows and field boundaries comprising mainly shallow field drains. The site is located one kilometre south of the village of Hollym (TA 342 240) and comprises one arable field (5.59 hectares) which will incorporate the proposed construction compound area and the new WwTW (225m x 125m - 2.8 hectares) which will be sited in the south-east section of the compound area. From the WwTW a new rising main will run through arable farmland c.1.6km north-west then c.2km north to a sewage pumping station in the town of Withernsea. Also from the WwTW, a new long sea outfall will run north-east through arable farmland for c.2.4km, reaching the coast between the existing sewage treatment plant and Neville's Farm at c.TA 362 255, and will run out to discharge into the North Sea.

Wintering bird surveys were undertaken by David Pearce, an experienced consultant ornithologist with over 14 years professional experience undertaking ornithological research, bird surveys and monitoring, site and species evaluation and providing advice on mitigation and habitat enhancement for birds throughout the United Kingdom. Joseph Sheperdson (Ove Arup) also undertook the wintering bird surveys from October 2017 to March 2018, Yan Yee Lau (Ove Arup) assisting on 8th February 2018 and an experienced associate ornithologist on 29th November 2017 and 12th March 2018.

This summary report presents findings of the site scoping survey on 20th October 2017 and 12 twice monthly surveys during high tide conditions between 23rd October 2017 and 27th March 2018.

2. Scoping Survey & Survey Rationale

The scoping survey on 20th October 2017 identified that the wider local area, including the proposed WwTW red-line boundary, includes extensive areas of open arable farmland with large field sizes which could potentially support foraging Golden Plover *Pluvialis apricaria* and Lapwing *Vanellus vanellus* during the winter period.

Golden Plover is listed as a qualifying species (wintering) for the Humber Estuary SPA (4.7km to the south). During the winter period (October to March) this species may commute substantial distances in varying aggregations, from inter-tidal areas on the estuary to high tide roosting and foraging areas including arable farmland and pasture. These movements may occur both diurnally and nocturnally. Given the relative close proximity to the SPA, diurnal winter bird surveys were proposed to cover the entire winter period to record the potential distribution and abundance of Golden Plover, a key target species, on site. Surveys would also record other potential wintering target species, including other wader species, wildfowl

and gulls utilising the fields for foraging. In addition to survey target species, other bird species (non-target species) would be recorded to inform on the wintering bird species assemblage in the area.

In addition, the inshore zone (c.1km from the coast) would be included in surveys to assess numbers of three key designated features of interest within the Greater Wash proposed SPA, which are Red-throated Diver *Gavia stellata*, Common Scoter *Melanitta nigra* and Little Gull *Hydrocoloeus minutus*.

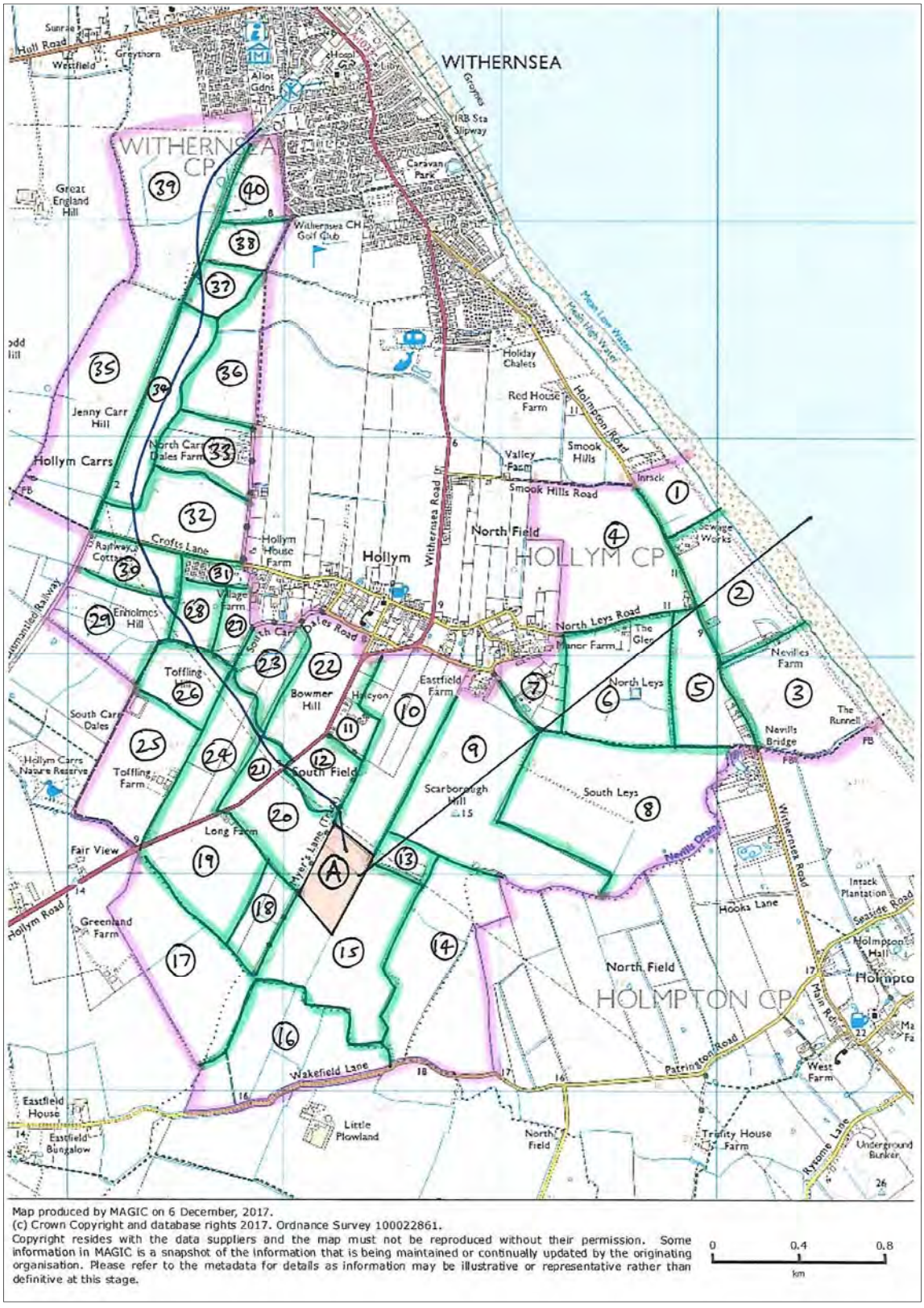

Figure 1. Site Location, WBS Boundary (Pink), Field Numbers, Routes of Rising Main & Long Sea Outfall

3. Methodology

Scoping survey work on 20th October, and additionally also on 26th October following notification of the amended route for the new rising main through fields west of the A1033, identified the extent of survey area for wintering bird surveys. Fields were mapped and numbered and survey methodology for twice monthly surveys of the WwTW site red-line boundary (A), and routes of the new rising main (blue line north-west) and new long sea outfall (blue line north-east) corridors proposed and agreed (Figure 1.).

Methodology to gather robust data throughout the winter bird survey area recording boundary incorporated Wetland Bird Survey (WeBS) methodology, based upon two diurnal winter bird survey visits per month (October 2017 to March 2018 – 12 survey visits totalling 38.25 hours) during high tide conditions on the Humber Estuary, and undertaken within two hours (maximum three hours) either side of high tide. High tide times for Spurn Head were used to account for tidal conditions on the Humber Estuary SPA. Golden Plover, Lapwing and other wader species, also wintering wildfowl and gulls using fields within the survey area were recorded on diurnal surveys and allocated to numbered fields to determine distribution and abundance. Other wintering bird species, e.g. passerines, were also recorded.

Each diurnal survey visit included a walkover survey to record activity and behaviour of target species and other species in numbered fields within a 500m buffer zone around the WwTW site red-line boundary. In addition flight-lines of target species over-flying the site or flying into or out of the site were also recorded. Each visit also incorporated an extensive drive-round survey to check fields within a c.500m corridor along the route of the proposed new long sea outfall to the north-east and the amended route for the new rising main to the north-west. Fields were observed and checked for target species using 10 x 42 binoculars and a tripod mounted telescope with 32x wide angle lens. Bird species were also recorded around the existing sewage works on the coast. In addition, a vantage point survey was undertaken on each visit during the winter period to record marine bird species, e.g. Red-throated Diver, foraging within the inshore zone where the new long sea outfall is proposed.

Table1. WBS Timetable & Weather Data October 2017 – March 2018

Survey Date	Survey	Survey Period	High Tide	m.	Low Tide	m.	SR	SS	Wind Speed	Wind Dir.	Cloud Cover	Temp. (°C)	Vis.	Precipitation	Remarks
20/10/2017	Scoping	0745-1200	0524	7.1	1152	1.0	0736	1753	F2	NW	7/8-4/8	15	>3km	none	mild, cloudy, sunny periods
23/10/2017	HW WBS	0800-1100	0712	6.8	1330	1.5	0742	1746	F2	SW	3/8-5/8	15	> 3km	none	mild, cloudy, sunny periods
26/10/2017	HW WBS	0800-1130	0855	5.9	1508	2.5	0747	1739	F2	SW	7/8	14	>3km	none	mild, cloudy
16/11/2017	HW WBS	1145-1500	1624	6.6	1007	1.5	0728	1601	F3	NW	4/8	10	> 3km	none	cool, cloudy, sunny periods
29/11/2017	HW WBS	1230-1530	1400	5.9	0722	2.3	0750	1545	F4-6	N	4/8-6/8	5-6	>3km	showers	cold, occ. rain/hail showers
15/12/2017	HW WBS	1245-1530	1549	6.3	0936	1.9	0811	1539	F3-4	N	6/8	4	> 3km	showers	cold, cloudy, occ. showers
22/12/2017	HW WBS	0830-1130	0741	6.3	1343	1.9	0816	1541	Calm	n/a	8/8	10	< 2km	none	mild, misty, calm
10/01/2018	HW WBS	0845-1145	1215	5.7	0556	2.2	0814	1602	F1	SW	8/8	6	>3km	drizzle	cold, foggy/misty, drizzle
23/01/2018	HW WBS	0845-1245	0914	6.1	1513	2.1	0800	1624	F3-4	SW	8/8-7/8	12	> 3km	none	mild, cloudy, breezy
08/02/2018	HW WBS	0845-1230	1120	5.6	1706	2.7	0734	1655	F2-3	NW	6/8	6	>3km	none	cold, cloudy, sunny intervals
23/02/2018	HW WBS	1145-1545	1021	5.8	1633	2.2	0704	1726	F3-4	SE	7/8	3	> 3km	none	cold, cloudy, sunny intervals
12/03/2018	HW WBS	1300-1500	1401	5.5	0750	3.0	0624	1759	F3-4	NE	8/8	5	>3km	rain	cold, overcast, rain - occ. heavy
27/03/2018	HW WBS	1100-1400	1405	5.8	0751	2.5	0650	1925	F2	NW	8/8	6	>3km	rain	cold, overcast, rain throughout

Access onto farmland within the survey area was not available during the winter period, therefore surveys were conducted from roads and public rights of way. Survey routes and timings were reversed on each

visit to alleviate recording bias. Following scoping surveys, assessment of logistics and consideration of the lack of agreed access to farmland, nocturnal surveys, incorporating two walkover and drive round survey visits within the core winter period December to February, to determine presence or absence of Golden Plover on site during the winter period were discounted.

4. Results

Analysis of data from 12 wintering bird survey visits undertaken between 23rd October 2017 (visit 1) and 27th March 2018 (visit 12) found that a total of 54 bird species were recorded. This total includes 12 target species (Table 2.), ten species recorded within the inshore zone of the coast (c.1km), either down on the sea or in flight (Table 3.) and 37 non-target species (Table 4.). Additional information on bird conservation status and bird legislation relative to the species recorded is given in Appendix 1.

Table 2. Number and Conservation Status of Target Bird Species (October 2017 – March 2018)

Target Bird Species WBS Oct 2017 - March 2018 Bird Species Systematic Order follows British Ornithologists Union (BOU 2018)		BTO Species Code	Schedule 1 Species	Rare Breeding Birds	UK BAP Species	European Red List	Global Red List	Annex 1 Species	Scientific Name	Maximum Counts (Target Species) Survey Visit Date 23/10/2017	26/10/2017	16/11/2017	29/11/2017	15/12/2017	22/12/2017	10/01/2018	23/01/2018	08/02/2018	23/02/2018	12/03/2018	27/03/2018	Recording Frequency 12 survey visits
1	Lapwing	L.			UK	VU	NT		*Vanellus vanellus*				195						34			2/12
2	Curlew	CU			UK	VU	NT		*Numenius arquata*				4	3			1					3/12
3	Herring Gull	HG			UK	NT			*Larus argentatus*	4	5	1								3		4/12
4	Greylag Goose	GJ							*Anser anser*						30E	9W	253	80		2	2W	6/12
5	Pink-footed Goose	PG		O					*Anser brachyrhynchus*		120W+9E						3					2/12
6	Snipe	SN							*Gallinago gallinago*								1	1				2/12
7	Redshank	RK							*Tringa totanus*				1									1/12
8	Black-headed Gull	BH							*Chroicocephalus ridibundus*	141	546	80	52	8	6	18		13		1		9/12
9	Common Gull	CM							*Larus canus*	36	27	85	13	6	1	113	124	92	17			10/12
10	Great Black-backed Gull	GB							*Larus marinus*								1S	2W				2/12
11	Cormorant	CA							*Phalacrocorax carbo*		1W											1/12
12	Golden Plover	GP						A1	*Pluvialis apricaria*		12		800	125				45W	13			5/12
TOTAL NUMBER of TARGET BIRD SPECIES RECORDED										3	6	3	6	4	3	3	6	6	3	3	1	TOTALS (12 visits) 12
BoCC4 Red Listed Species of Conservation Concern										1	1	1	2	1	0	0	1	0	1	1	0	3
BoCC4 Amber Listed Species of Conservation Concern										2	3	2	3	2	3	3	5	5	1	2	1	8
BoCC4 Green Listed Species (not currently considered of conservation concern)										0	2	0	1	1	0	0	0	1	1	0	0	2
Species Not Assessed by BoCC4										0	0	0	0	0	0	0	0	0	0	0	0	0
Protected Species Listed on Schedule 1 of the Wildlife & Countryside Act 1981 (as amended)										0	0	0	0	0	0	0	0	0	0	0	0	0
Species considered by the Rare Breeding Birds Panel (RBBP) (UK) - R = Regular Breeding Birds, O = Occasional Breeding Birds, C = Colonising Species, P = Potential Breeding Birds										0	1	0	0	0	0	0	1	0	0	0	0	1
UK Biodiversity Action Plan (UK BAP) Priority Species in England (UK)										1	1	1	2	1	0	0	1	0	1	1	0	3
International Union for Conservation of Nature (IUCN) European Red List (2015) VU = Vulnerable (Globally Threatened), NT = Near Threatened, (all other species = Least Concern)										1	1	1	2	1	0	0	1	0	1	1	0	3
IUCN Global Red List VU = Vulnerable (Globally Threatened), NT = Near Threatened, (all other species = Least Concern)										0	0	0	2	1	0	0	1	0	1	0	0	2
Species Listed in Annex 1 of the European Union (EU) Wild Birds Directive 2009 (A1)										0	1	0	1	1	0	0	0	1	1	0	0	1

4.1 Target Bird Species

Golden Plover, the key survey target species, was recorded on five visits. On 26th October 2017 a small flock of 12 birds were down briefly in field no. 17 and left south-east. On 29th November 2017 a flock of c.800 birds arrived from the north-east and circled the survey area south of the A1033, touching down briefly in field no. 9 before flying south-east. The flock later separated and smaller flocks of c.400 circled field no. 4, just inland from the existing sewage works, and of c.220 were observed foraging in field no. 21. On 15th December 2017 a flock of 45 birds arrived from the south-west and briefly circled field no. 17, leaving north-east, and a flock of 80 birds later circled field no. 9 before leaving south-east. On 8th February

2018 a flock of 45 birds flew east over fields 17 and 15, and on 23rd February 2018 13 birds were observed foraging, roosting and loafing in field no. 10.

Of the other survey target species Lapwing was recorded on two visits. On 29th November 2017 a flock of c.120 birds were associating with the flock of c.800 Golden Plover, landing briefly in field no. 9 and later observed foraging in field no. 4, an additional flock of 75 birds foraging with Golden Plover in field no. 21. On 23rd February 34 birds were foraging, roosting and loafing in field no. 10. with 13 Golden Plover. Curlew *Numenius arquata* were recorded on three visits. On 29th November four birds touched down briefly in field no. 12, on 15th December 2017 two birds were foraging in field no. 30 and one flew north-east from field no. 32 and on 23rd January 2018 one flew south-west from field 22.

Greylag Goose *Anser anser* were recorded on six visits. Flocks of 30 flew east on 22nd December 2017 and nine west on 10th January 2018, with flocks of 200 and 53 down foraging in field nos. 22 and 16 respectively on 23rd January 2018. On 8th February 2018 a flock of 80 birds were down foraging in field no. 22, on 12th March 2018 two were foraging in field no. 15 and on 27th March 2018 two flew east over the proposed WwTW site (field A). Pink-footed Goose *Anser brachyrhynchus* were recorded on two visits, skeins of 120 flew over west and nine west then east on 26th October 2017, and on 23rd January 2018 three were foraging with Greylag Geese in field no. 22. Single Snipe *Gallinago gallinago* were flushed from the margin of field A. (proposed WwTW site) on 23rd January 2018 and the margin of field 15 on 8th February 2018 and a single Redshank *Tringa totanus* was foraging on the small grassed area within the existing sewage works compound next to the coast on 29th November.

Common Gull *Larus canus* and Black-headed Gull *Chroicocephalus ridibundus* were present on ten and nine visits respectively. These were the two most frequently recorded species, observed foraging down in fields within the winter bird survey area, with respective maximum counts of 124 on 23rd January and 546 on 26th October. Herring Gull *Larus argentatus* were recorded on four visits, with birds in low single figures (max. 5 on 26th October 2017) foraging or loafing on fields, with Great Black-backed Gull *Larus marinus* only recorded moving over the recording area on two visits (max. 2 west on 8th February 2018). The only other water-bird species recorded was Cormorant *Phalacrocorax carbo*, with one moving west over the recording area on 26th October.

4.2 Inshore Bird Species

The key species recorded within the inshore zone was Red-Throated Diver. This species was recorded on six visits, including birds on the sea and birds moving north and south. Most observations involved fewer than ten birds foraging inshore during high tide conditions, with a maximum of 29 counted on 23rd February.

Of the other species recorded within the inshore zone, only Black-headed Gull (max. 5), Common Gull (max. 25), Great Black-backed Gull (max. 1) and Guillemot *Uria aalge* (max. 9) were observed down on the sea and foraging inshore, with additional birds in single figures recorded moving north and south. Curlew, Kittiwake *Rissa tridactyla*, Herring Gull, Eider *Somateria mollissima* and Sanderling *Calidris alba* were only recorded in flight moving north or south within the inshore zone.

Inshore Bird Species WBS Oct 2017 - March 2018 Bird Species Systematic Order follows British Ornithologists Union (BOU 2018)		BTO Species Code	Schedule 1 Species	Rare Breeding Birds	UK BAP Species	European Red List	Global Red List	Annex 1 Species	Scientific Name	Maximum Counts Inshore (birds on sea + birds flying N & S) Survey Visit Date 23/10/2017	26/10/2017	16/11/2017	29/11/2017	15/12/2017	22/12/2017	10/01/2018	23/01/2018	08/02/2018	23/02/2018	12/03/2018	27/03/2018	Recording Frequency 12 survey visits
1	Curlew	CU			UK	VU	NT		*Numenius arquata*										6S			1/12
2	Kittiwake	KI				VU			*Rissa tridactyla*				35N								1N		2/12
3	Herring Gull	HG			UK	NT			*Larus argentatus*													2N	1/12
4	Eider	E.				VU	NT		*Somateria mollissima*								1S						1/12
5	Sanderling	SS		P					*Calidris alba*										1S				1/12
6	Black-headed Gull	BH							*Chroicocephalus ridibundus*					5N								5	2/12
7	Common Gull	CM							*Larus canus*						1N				25	7N	1N		4/12
8	Great Black-backed Gull	GB							*Larus marinus*				1				1S		1N		1N,1S		4/12
9	Guillemot	GU					NT		*Uria aalge*				1+1N				2+1N,1S	4N	9+2N,7S	4N,2S			5/12
10	Red-throated Diver	RH	1	R				A1	*Gavia stellata*			9	3N,1S				8+1N,7S	2	29	5+7N			6/12
TOTAL NUMBER of BIRD SPECIES RECORDED (INSHORE SEA AREA)										0	0	1	4	1	1	0	4	2	6	4	4	TOTALS (12 visits) 10
BoCC4 Red Listed Species of Conservation Concern										0	0	0	1	0	0	0	0	0	1	1	1	3
BoCC4 Amber Listed Species of Conservation Concern										0	0	0	2	1	1	0	3	1	4	2	3	6
BoCC4 Green Listed Species (not currently considered of conservation concern)										0	0	1	1	0	0	0	1	1	1	1	0	1
Species Not Assessed by BoCC4										0	0	0	0	0	0	0	0	0	0	0	0	0
Protected Species Listed on Schedule 1 of the Wildlife & Countryside Act 1981 (as amended)										0	0	1	1	0	0	0	1	1	1	1	0	1
Species considered by the Rare Breeding Birds Panel (RBBP) (UK) - R = Regular Breeding Birds, O = Occasional Breeding Birds, C = Colonising Species, P = Potential Breeding Birds										0	0	1	1	0	0	0	1	1	2	1	0	2
UK Biodiversity Action Plan (UK BAP) Priority Species in England (UK)										0	0	0	0	0	0	0	0	0	1	0	1	2
International Union for Conservation of Nature (IUCN) European Red List (2015) VU = Vulnerable (Globally Threatened), NT = Near Threatened, (all other species = Least Concern)										0	0	0	1	0	0	0	1	0	1	1	1	4
IUCN Global Red List VU = Vulnerable (Globally Threatened), NT = Near Threatened, (all other species = Least Concern)										0	0	0	1	0	0	0	1	1	2	1	0	3
Species Listed in Annex 1 of the European Union (EU) Wild Birds Directive 2009 (A1)										0	0	1	1	0	0	0	1	1	1	1	0	1

Table 3. Number and Conservation Status of Inshore Bird Species (October 2017 – March 2018)

4.3 Non-Target Bird Species

Non-target bird species recorded from 12 survey visits included 11 red listed species of conservation concern, four amber listed species of conservation concern and 19 species not currently considered of conservation concern by Eaton *et al*. (2015) in Birds of Conservation Concern 4 (BoCC4). Two non-native species not assessed by BoCC4 were also recorded.

Non-target survey species included declining farmland bird species such as Grey Partridge *Perdix perdix*, Skylark *Alauda arvensis* and Yellowhammer *Emberiza citrinella*, all red listed, and Reed Bunting *Emberiza schoeniclus* which is amber listed. Grey Partridge were recorded in the south of the winter bird survey recording area in fields north of Wakefield Lane, Skylark mainly on fields south of the A1033, Yellowhammer from field boundary hedgerows and Reed Bunting from field boundary hedgerows and field boundary drains.

Key wintering bird species included Fieldfare *Turdus pilaris* (max. 100+ 23rd January 2018) and Redwing *Turdus iliacus* (max. 15 on 23rd October 2017 and 23rd March 2018). These species were recorded foraging on fields, mainly within the section south of the A1033, and were also recorded on field boundary hedgerows. Single Merlin *Falco columbarius* and Peregrine *Falco peregrinus* were recorded in flight hunting over fields on 29th November 2017 and 23rd February 2018 respectively.

Of the green-listed species Rook *Corvus frugilegus* was the most abundant species recorded (max. 120 on 22nd December 2017), with Carrion Crow *Corvus corax* frequently recorded in low single figures foraging on the open arable fields. Small passerine species, e.g. Blackbird *Turdus merula* and Blue Tit *Cyanistes caeruleus*, were recorded in low single figures.

Table 4. Number and Conservation Status of Non-Target Bird Species (October 2017 – March 2018)

	Non-Target Bird Species WBS Oct 2017 - March 2018 Bird Species Systematic Order follows British Ornithologists Union (BOU 2018)	BTO Species Code	Schedule 1 Species	Rare Breeding Birds	UK BAP Species	European Red List	Global Red List	Annex 1 Species	Scientific Name	Maximum Counts (Non-Target Species) Survey Visit Date 23/10/2017	26/10/2017	16/11/2017	29/11/2017	15/12/2017	22/12/2017	10/01/2018	23/01/2018	08/02/2018	23/02/2018	12/03/2018	27/03/2018	Recording Frequency 12 survey visits
1	Grey Partridge	P.			UK				*Perdix perdix*								20					1/12
2	Merlin	ML	1	R				A1	*Falco columbarius*				1NW									1/12
3	Skylark	S.			UK				*Alauda arvensis*	5	3		5					8	2		3	6/12
4	Starling	SG			UK				*Sturnus vulgaris*	50	400					1						3/12
5	Fieldfare	FF	1	R					*Turdus pilaris*	1						3	100+		35		30	5/12
6	Redwing	RE	1	R		NT	NT		*Turdus iliacus*	15	10										15	3/12
7	Song Thrush	ST			UK				*Turdus philomelos*	6	1					1	1	1				5/12
8	House Sparrow	HS			UK				*Passer domesticus*		1					2		4				3/12
9	Grey Wagtail	GL							*Motacilla cinerea*		1	1										2/12
10	Lesser Redpoll	LR			UK				*Acanthis cabaret*		4											1/12
11	Yellowhammer	Y.			UK				*Emberiza citrinella*		10					3		3			1	4/12
12	Stock Dove	SD							*Columba oenas*	7										6		2/12
13	Kestrel	K.							*Falco tinnunculus*					1					1			2/12
14	Dunnock	D.			UK				*Prunella modularis*		1			1								2/12
15	Meadow Pipit	MP				NT	NT		*Anthus pratensis*		1			1			4					3/12
16	Reed Bunting	RB			UK				*Emberiza schoeniclus*		2		2		2	2		3		1		6/12
17	Sparrowhawk	SH							*Accipiter nisus*		1		1									2/12
18	Buzzard	BZ							*Buteo buteo*	1	1					1		1				4/12
19	Moorhen	MH							*Gallinula chloropus*									1				1/12
20	Feral Pigeon	DV							*Columba livia*						8							1/12
21	Woodpigeon	WP							*Columba palumbus*				2								30	2/12
22	Peregrine	PE	1	R				A1	*Falco peregrinus*										1S			1/12
23	Magpie	MG							*Pica pica*		1				3					4		3/12
24	Rook	RO							*Corvus frugilegus*						120					4	9	3/12
25	Carrion Crow	C.							*Corvus corone*	1	1				2	2					6	5/12
26	Blue Tit	BT							*Cyanistes caeruleus*		2											1/12
27	Great Tit	GT							*Parus major*		1											1/12
28	Long-tailed Tit	LT							*Aegithalos caudatus*		1											1/12
29	Goldcrest	GC							*Regulus regulus*		1											1/12
30	Wren	WR							*Troglodytes troglodytes*		1				2		1					3/12
31	Blackbird	B.							*Turdus merula*	1	1			2	2		4	1		1		7/12
32	Robin	R.							*Erithacus rubecula*	1	1											2/12
33	Pied Wagtail	PW							*Motacilla alba*		1		2					1				3/12
34	Chaffinch	CH							*Fringilla coelebs*									1				1/12
35	Greenfinch	GR							*Chloris chloris*						2							1/12
36	Red-legged Partridge	RL							*Alectoris rufa*									2				1/12
37	Pheasant	PH							*Phasianus colchicus*		1					2						2/12
	TOTAL NUMBER of NON-TARGET BIRD SPECIES RECORDED									10	24	1	6	4	8	9	6	11	4	5	7	TOTALS (12 visits) 37
	BoCC4 Red Listed Species of Conservation Concern									5	8	1	2	0	0	5	3	4	2	0	4	11
	BoCC4 Amber Listed Species of Conservation Concern									1	3	0	1	3	1	1	1	1	1	2	0	4
	BoCC4 Green Listed Species (not currently considered of conservation concern)									4	12	0	3	1	7	2	2	5	1	3	3	19
	Species Not Assessed by BoCC4									0	1	0	0	0	0	1	0	0	0	0	0	2
	Protected Species Listed on Schedule 1 of the Wildlife & Countryside Act 1981 (as amended)									2	1	0	1	0	0	1	1	0	2	0	2	4
	Species considered by the Rare Breeding Birds Panel (RBBP) (UK) - R = Regular Breeding Birds, O = Occasional Breeding Birds, C = Colonising Species, P = Potential Breeding Birds									2	1	0	1	0	0	1	1	0	2	0	2	4
	UK Biodiversity Action Plan (UK BAP) Priority Species in England (UK)									3	8	0	2	0	1	5	2	5	1	1	2	9
	International Union for Conservation of Nature (IUCN) European Red List (2015) VU = Vulnerable (Globally Threatened), NT = Near Threatened, (all other species = Least Concern)									1	2	0	0	1	0	0	1	0	0	0	1	2
	IUCN Global Red List VU = Vulnerable (Globally Threatened), NT = Near Threatened, (all other species = Least Concern)									1	2	0	0	1	0	0	1	0	0	0	1	2
	Species Listed in Annex 1 of the European Union (EU) Wild Birds Directive 2009 (A1)									0	0	0	1	0	0	0	0	0	1	0	0	2

5. Evaluation of Wintering Bird Survey

The methodology adopted for the wintering bird survey adequately covered the winter period October 2017 to March 2018 and generated robust bird data for wintering bird species within the survey recording area, including the WwTW construction compound red-line boundary, adjacent and surrounding farmland habitat and the inshore zone along the coast. Overall, surveys revealed that the terrestrial winter bird survey recording area supports relatively few bird species and insignificant numbers of waders, wildfowl, gulls and other water-birds on the open arable farmland areas during the winter period. Likewise, the inshore recording zone, within one kilometre of the coast, was also found to support few wintering bird species

and insignificant numbers. The two most important bird species recorded from the 12 winter bird survey visits were Golden Plover (terrestrial areas) and Red-throated Diver (inshore zone).

Table 5. Target Bird Species Recorded by Field Number (October 2017 – March)

Field Number	Lapwing	Curlew	Herring Gull	Greylag Goose	Pink-footed Goose	Snipe	Redshank	Black-headed Gull	Common Gull	Golden Plover	No. of Registrations
(A)						1		2	5		8
1							1	1			2
2											0
3											0
4	1		1					8	6		16
5											0
6			3						1		4
7											0
8			1					1	1		3
9			1					2	3	1	7
10	1	1	1					3	5	1	12
11											0
12		1									1
13											0
14				1					1		2
15						1			1		2
16				1							1
17										1	1
18											0
19								1	1		2
20			1					3	5		9
21	1							1	2	1	5
22				2	1			1	1		5
23											0
24											0
25											0
26											0
27											0
28											0
29									2		2
30		1							2		3
31											0
32		1							1		2
33											0
34											0
35											0
36									1		1
37											0
38											0
39											0
40											0
Totals	3	4	6	3	1	2	1	10	16	4	88
Proposed WwTW Construction Compound (A) & Fields Within 500m Radius											

Wintering bird survey data for the number of registrations of target bird species by field (Table 5.) shows that Golden Plover were not recorded from field A. and there were only two registrations of this species in fields within a 500m radius during the winter period from October 2017 to March 2018 (Fields 9 & 10). The only target species recorded in this period foraging within field A., in order of frequency and abundance, were Common Gull, Black-headed Gull and Snipe. Common Gull and Black-headed Gull were also the most frequent and abundant species foraging in fields within a 500m radius of field A. Herring Gull, Curlew, Lapwing and Snipe were also recorded foraging in fields within a 500m radius of field A. but were less frequently recorded and less abundant. Flight lines into and out of this area by wintering target bird species, were low in number and were not observed to form any definite pattern or favour any particular direction.

The low number of registrations of Golden Plover from 12 visits within the wintering bird survey area, during high tide conditions over the winter period, indicates that the area is not used frequently by this species and is therefore perhaps not a traditional foraging and roosting location. Extensive areas of open arable farmland, and also pasture, which is a preferred foraging habitat for this species, exists within the wider Holderness area to the south, south-west and west of the site and provides ample foraging and roosting opportunities for the wintering population of Golden Plover from the Humber Estuary SPA.

The Humber Estuary is the most important wintering site for this species in the U.K., with peak counts exceeding 47,000 birds, most of Fennoscandian or Russian origin (YNU 2013). Golden Plover commute varying distances to largely traditional foraging and roosting areas, however, use of these areas may show wide fluctuations within and between years (Byrkjedal & Thompson 1998). Given the few registrations and relatively insignificant numbers of Golden Plover recorded from fields within the wintering bird survey recording area, compared with the Humber Estuary SPA wintering population, construction of the WwTW within field A. and the rising main and long sea outfall within terrestrial areas would present no significant effect on the SPA population and on this species in the local area.

The second important species identified from wintering bird surveys during the winter period was Red-throated Diver, which was recorded within the inshore zone. This species is a fairly common winter visitor and migrant in this area, with significant numbers wintering along the Holderness coast, which provides relatively shallow, sandy coastal areas for foraging, with key food items including small marine flatfish, molluscs and crustaceans. Peak counts in the Spurn area usually occur during main passage periods in March and September, for example 267 on 17th March 2013 and 158 on 26th September 2013 (YNU 2013).

Numbers recorded from wintering bird surveys were typical of random counts of this species which could be made from the Holderness coast during the winter period. Counts of this species, made from vantage point surveys incorporated in the wintering bird survey, increased during the late winter period, with a maximum of 29 birds observed foraging inshore on 23rd February 2018. Despite a small count, in comparison to peak counts from the Spurn area, it accords well with the increase in numbers of this species during the late winter period, as birds which have wintered in the southern North Sea commence movements northwards towards summer breeding areas, with a concomitant increase in numbers off the Holderness coast. There were no records of Common Scoter or Little Gull within the inshore zone from the winter bird surveys. Other bird species recorded inshore were noted infrequently and in insignificant

numbers. Construction of the new long sea outfall would take place during low tide conditions and would therefore not constitute any effect on Red-throated Diver or inshore marine water-birds which forage within this area during high tide conditions.

With regard to non-target species recorded from wintering bird surveys from October 2017 to March 2018, the proposed construction of the new WwTW, including the construction compound red-line boundary (field A) and the route of the rising main to the north-west and long sea outfall to the north-east would not constitute any significant effect on wintering bird species.

6. Recommendations & Mitigation

Construction works within field A. and adjacent fields would cause disturbance and displacement of birds during the breeding bird season from March to August, including key ground nesting species such as Skylark. Works to excavate and complete the rising main and long sea outfall within proposed corridor routes north-west and north-east of the WwTW compound would also cause disturbance and displacement to breeding birds, including ground nesting birds and birds which nest within field boundary hedgerows, including summer migrant breeding birds. Therefore, bird surveys to assess effects on breeding bird species and populations present within these areas are programmed to be undertaken between April and July 2018.

Five breeding bird survey visits will be undertaken, using amended visit Common Birds Census (CBC) territory mapping methodology to record breeding bird activity on site. Registrations of all bird species observed within or overflying the site, and heard singing and/or calling will be entered onto field survey maps using standard British Trust for Ornithology (BTO) species and activity codes. The site will be walked to within 100m of every point within the recording area boundary and the survey route reversed accordingly on each visit to alleviate recording bias.

Increasing bird biodiversity within the WwTW site compound and surrounding area, and also along the routes of the rising main and new long sea outfall is an important consideration. Results of the breeding bird survey will help to inform on the breeding bird assemblage within the recording area and also mitigation for both breeding and wintering birds on site.

Recommendations to achieve this should include;

- New planting throughout to reduce gaps in existing hedgerows.
- Increase the extent of hedgerows, tree-lines and also associated small farm woodlands (where feasible) to improve connectivity within the area through new planting. Hedgerows planted in double rows and incorporating Hawthorn *Crataegus monogyna* and Blackthorn *Prunus spinosa* and including hedgerows trees such as Alder *Alnus glutinosa*, Ash *Fraxinus excelsior* and Field Maple *Acer campestre* would provide benefit to several bird species.
- Hedgerows should be allowed to mature and only cut or trimmed with a suitable machine to prevent damage.
- Hedgerow cutting or trimming should be undertaken on a three year rotation (one side per year), to allow flowering and subsequent seed or fruit production.

- Field margins alongside hedgerows should be increased in size to at least three metres wide and left uncultivated and uncut to increase cover foraging opportunities for birds.
- Consider areas of spring sown cereals and crops and leave winter stubbles to assist with provision of foraging for wintering birds present on site, e.g. Skylark and Yellowhammer.
- Any site clearance and groundworks, such as removal of topsoil, vegetation and parts of any hedgerows should be undertaken outside the breeding bird season to prevent disturbance to breeding birds and allow completion of the breeding cycle undisturbed. Once works are complete parts of any hedgerows removed should be replanted.
- Should any development works be unavoidable during the period March to August, a site search should be undertaken by a qualified ornithologist to locate any active nests of breeding birds prior to any works commencing.

Appendix 1

United Kingdom Conservation Status of Birds

The fourth major review of the status of birds occurring in the United Kingdom, Channel Islands and the Isle of Man – Birds of Conservation Concern 4 (BoCC4) (Eaton *et al.* 2015), presents lists of conservation concern based on assessments using objective listing criteria and most recent data. The listing criteria assess global conservation status, historical population decline, recent population decline (numbers and geographical range), European conservation status, rarity, localised distribution, and international importance of populations.

Lists are denoted Red, Amber and Green in a simple 'traffic light' system to provide a single, easily understood measure for each species to convey concern and hence to help set priorities for conservation action. Species are assigned to each list depending upon the scale of population decline and concern which includes breeding and non-breeding populations.

- Red list criteria – Severe population decline (> 50%) over 25 years or longer term.
- Amber list criteria – Moderate population decline (> 25% but < 50%) over 25 years or longer term.
- Green list criteria – Species not currently considered of conservation concern.

The review concerns native bird species only and not those introduced to the United Kingdom by humans, whether intentionally or accidentally. Populations of non-native bird species are not considered of conservation value, indeed introduced species can be harmful to the natural environment (Eaton *et al.* 2015). These species are therefore not assessed for conservation attention and termed 'not assessed'.

Summary of Relevant Legislation with Regard to Birds

The primary legislation affecting wild birds in England and Wales is the Wildlife & Countryside Act (1981) as amended. The basic principle of this act is that all wild birds, their nests, and eggs are protected by law and some rare species are afforded additional protection from disturbance during the breeding season

(Schedule 1.). The term wild bird is defined as any bird of a species which is resident in, or a visitor to, the European territory of any Member State, in a wild state. Game birds are not included in this definition (except in certain sections of the Act) but are covered by the Game Acts which give protection in the close season.

The Wildlife & Countryside Act (1981) states that 'it is an offence, with certain exceptions, to:

1. intentionally kill, injure or take any wild bird.
2. intentionally take, damage or destroy the nest of any wild bird while it is in use or being built.
3. intentionally take or destroy the egg of any wild bird.
4. have in one's possession or control any wild bird (dead or alive), part of a wild bird or egg of a wild bird which has been taken in contravention of the Act, the Protection of Birds Act 1958 or the law of any EU Member State (which implements the EU Birds Directive 1979).
5. intentionally or recklessly disturb any wild bird listed on Schedule 1 while it is nest building or is in, on or near a nest with eggs or young; or disturb the dependant young of such a bird.
6. have in one's possession or control any birds of a species listed on Schedule 4 of the Act, unless registered and ringed in accordance with the Secretary of State's regulations.

Rare Breeding Birds in the United Kingdom

The U.K. Rare Breeding Bird Panel (RBBP) (www.rbbp.org.uk) collates data on over 160 species of rare breeding birds and scarcer non-native breeding species, and ensures data are archived properly and are used for conservation. This informs understanding of the status, distribution and population trends of the rarest breeding birds, too rare to monitor in any other way, and also species introduced to the U.K. Archived records form the definitive historical record of rare breeding birds in the U.K. Breeding species are categorised as – regular breeder, occasional breeder, colonising and potential breeder.

United Kingdom Biodiversity Action Plan Bird (UK BAP) Species

United Kingdom Biodiversity Action Plan (U.K. BAP) Bird Species (jncc.defra.gov.uk/uk bap priority bird species) are those identified by the Joint Nature Conservation Committee (JNCC) as being the most threatened and requiring conservation action under the U.K. Biodiversity Action Plan and included on a list of priority bird species, initially created between 1995 and 1999, and subsequently updated in response to the Species and Habitats Review Report published in 2007. Original species on the U.K. BAP list (1995-1999) have a Species Action Plan (SAP) which provides details of relevant conservation information and action. Following devolution, the U.K. BAP has recently (July 2012) been succeeded by the U.K. Post-2010 Biodiversity Framework which is focused at a country-level (England, Wales, Scotland & Northern Ireland) rather than at a U.K. level, with the list of priority bird species remaining an important reference source for conservation of individual bird species and also for conservation of bird biodiversity within a specified area or site. U.K. BAP species are identified in order to guide decision-makers, such as local planning authorities and regional authorities, in their duty to have regard to the conservation of bird biodiversity.

IUCN Red List Status (European Red List & Global Red List)

Birdlife International (the official International Union for Conservation of Nature (IUCN) Red List authority for birds) determines the global conservation status of birds (www.iucn.org/theme/species/birds). The IUCN red list is used by government agencies, wildlife departments, conservation-related non-governmental organisations (NGOs), natural resource planners, educational organisations, students, and the business community. It is crucial to identify bird species requiring targeted recovery efforts, but also for focusing on conservation to identify key sites and habitats that need conserving.

EU Biodiversity Legislation

Additional protection for birds is also provided to species listed within the European Union (EU) Wild Birds Directive 2009/147/EC (ec.europa.eu/environment/nature/legislation/birdsdirective & jncc.defra.gov.uk). This imposes strict legal obligations on EU member states to maintain populations of naturally occurring wild birds at levels corresponding to ecological requirements and to preserve a sufficient diversity and areas of habitats for their conservation. Bird species mentioned in Annex I (194 species and sub-species (races)) are particularly threatened and form the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution.

6. References

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Appendix L – Arup Noise Assessment

Yorkshire Water Services Ltd

Withernsea Wastewater Treatment Works

Noise Assessment

Issue | 26 June 2018

Job number 258408

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1 Introduction

1.1 Purpose of the document

This Noise Assessment has been prepared in relation to the proposed construction and operation of a new Wastewater Treatment work (WwTW) at Withernsea, East Riding of Yorkshire, by Yorkshire Water Services Ltd (YWS).

This report primarily focuses upon the mitigation of the operational noise impact of the proposed WwTW, however, consideration is also given to construction noise.

This report is supported by the following appendices:

- a glossary of acoustic terminology is presented in Appendix A;
- the detailed baseline noise survey presented in Appendix B; and
- construction noise assumptions are presented in Appendix C.

1.2 The Proposed Scheme

1.2.1 Why is the scheme required?

The current Withernsea WwTW serves Withernsea town and surrounding area. Due to its location near the cliff edge it is at risk of coastal erosion. It has been predicted that it will have to be abandoned within 5 to 10 years. A replacement works is therefore required, at a site further inland and the proposed scheme is delivering this WwTW.

1.2.2 The Wider Project

The Withersea WwTW is one element of wider project, which comprises (as shown on Figure 1):

- the existing Withernsea WwTW, located off Holmpton Road
- the Proposed WwTW (the subject of this planning application);
- a new LSO;
- a new Rising Main from Memorial Gardens Sewage Pumping Station (SPS) to the proposed WwTW; and
- a connection from the new Rising Main to the existing Hollym SPS.

The existing WwTW is to be decommissioned and removed to standards to be agreed with East Riding of Yorkshire Council (ERYC), to prevent it causing any pollution when the site is eroded.

Flows to the existing WwTW are mainly pumped from Memorial Gardens pumping station in Withernsea. This, and its associated storage tanks, will remain

in use. A new rising main will be required to divert the flows to the new treatment works, and the pumping plant modified as necessary to deliver the consented flows to the new treatment works.

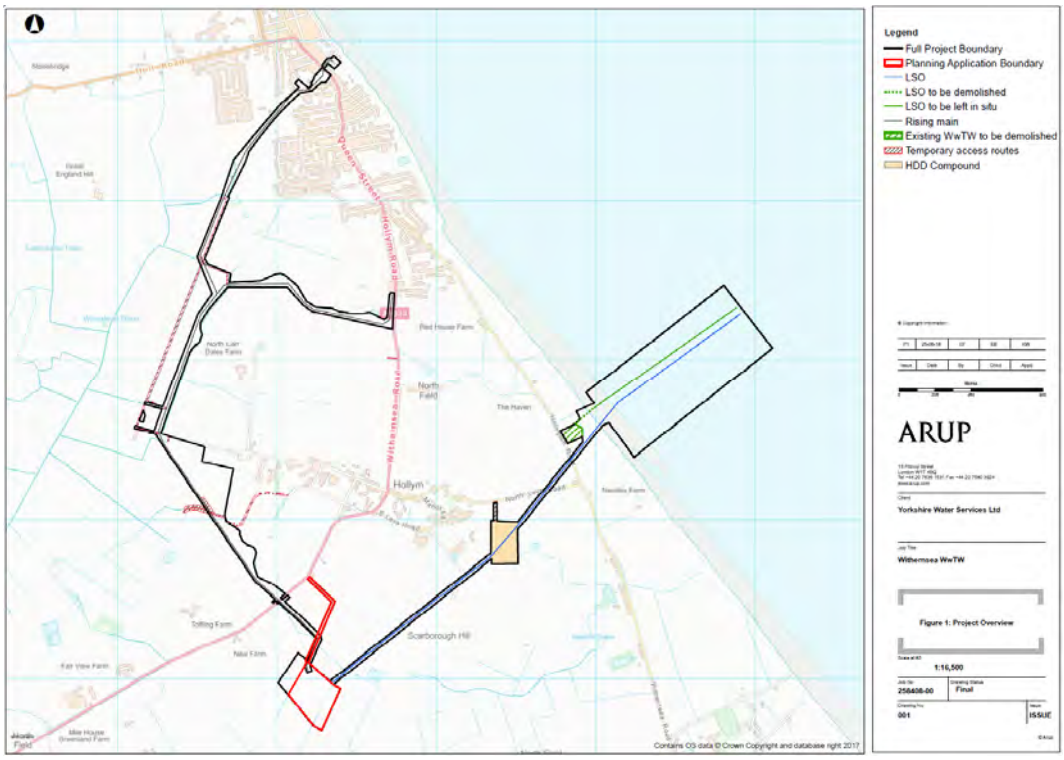
Further flows are pumped from Hollym pumping station near Withernsea Road Caravan Park into the existing rising main that runs from Memorial Gardens. The pumping station will remain in use and its rising main will be diverted to connect to the new Memorial Gardens rising main. The pumping plant will be modified as necessary to deliver the consented flows to the new treatment works.

A new long sea outfall will be required to take flows from the new WwTW site to a similar location to the existing discharge location, approximately 1km into the sea.

The new rising mains and long sea outfall are to be constructed using Yorkshire Waters Permitted Development Rights through the Town and Country Planning (General Permitted Development) (England) Order 2015, Part 13 of Schedule 2. The off shore elements of the project will be subject to a Marine Licence from the Marine Management Organisation (MMO).

This planning application relates only to the proposed Withernsea WwTW, shown in red on Figure 1.

Figure 1: Project Overview



1.3 Proposed Development

The proposed WwTW will comprise the following:

- two open treatment cells approximately 190 m x 102 m x 4.6 m (approximately 1.9 ha) each;
- floating wind powered mixers and fixed aeration baffles located within the treatment cells;
- reinforced concrete structure to house screening equipment, pumping plant and ultraviolet disinfection apparatus, which will be buried in the second cell embankment on three sides;
- one Glass Reinforced Plastic (GRP) kiosk approximately 20 m x 6 m x 3 m containing electrical panels and welfare facilities;
- two GRP kiosks 3 m x 3 m x 2.5 m located on the central embankment to house low-pressure fan blowers;
- new electrical, telephone and potable water connections; and
- a gantry approximately 18.9 m AOD for lifting the pumps for maintenance purposes.

The two treatment cells will be constructed from earth embankments with an impermeable membrane. The embankments will be between 2 to 4.5 m in height above the existing ground level, with an external grassed slope at a gradient of 1 in 25. The two cells will be cross connected with a pipe which can be shut off if required.

2 Key Policies and Guidance

This section provides an overview of planning policy and other considerations relevant to the noise assessment.

2.1 National Planning Policy

2.1.1 National Planning Policy Framework

The National Planning Policy Framework[1] (NPPF) provides guidance for local planning authorities and decision makers when drawing up plans and as a material consideration in determining applications.

The core principle of the NPPF is to advocate a presumption in favour of sustainable development, which in literal terms means that if the adverse impacts of a development are outweighed by the benefits, when assessed as a whole, then the development should be approved. Local policy should reflect this principle and therefore the Local Authority has a key role in determining within its Local Plan and noise policies what is "acceptable risk" in terms of noise pollution within its area.

The NPPF contains the following statements in relation to noise and vibration:

Paragraph 109 confirms that

"the planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability".

Paragraph 123, NPPF states that planning policies and decisions should aim to:

- *"avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions; and*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established"*

The NPPF does not therefore provide absolute limits on noise that are acceptable or unacceptable in a given situation. It does however, set out the need to use planning decisions, including through the use of conditions, to avoid or mitigate adverse impacts on health and quality of life resulting from noise.

[1] *National Planning Policy Framework*, Department for Communities and Local Government, 27 March 2012

The NPPF also refers to the Noise Policy Statement for England (NPSE)[2].

2.1.2 Noise Policy Statement for England

The NPSE published by Defra in March 2010 is applicable to all forms of noise (excluding occupational) and sets out the following aims:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.

2.1.3 National Planning Practice Guidance - Noise

Planning Practice Guidance for noise[3] (PPG-N) supplements the NPPF. PPG-N incorporates a dedicated document in respect of noise updated in March 2014 which advises how the planning system should manage potential noise impacts in new development.

Paragraph 1 of the NPPG states that "*noise needs to be considered when new developments may create additional noise*". The NPPG also identifies instances where potential noise impacts could be a concern through the noise exposure hierarchy. The guidance acknowledges that impacts depend on the type of development being considered and the character of the proposed location.

PPG-N draws on the principles of the NPSE in particular the concepts of 'no observed effect level' (NOEL), lowest observed adverse effect level (LOAEL) and significant observed adverse effect level (SOAEL).

The NOEL is the level below which there is no detectable effect on health and quality of life due to noise.

The LOAEL is the level above which adverse effects on health and quality of life can be detected.

The SOAEL is the level above which significant adverse effects on health and quality of life occur.

To achieve the first aim of the NSPE, it is necessary to avoid any impacts above the SOAEL.

Where the impact lies between the LOAEL and SOAEL, there is a requirement under the second aim to mitigate and minimise adverse effects on health and quality of life; although it is stated that this does not mean that these impacts cannot occur.

The NPSE acknowledges that SOAEL is likely to be different for different noise sources, for different receptors and at different times.

[2] Noise Policy Statement for England (NPSE) – Defra, March 2010
[3] http://planningguidance.communities.gov.uk/blog/guidance/noise/noise-guidance/

These terms are explained in the noise hierarchy taken from PPG-N and presented in **Error! Reference source not found.**below.

Table 1: Noise exposure hierarchy from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
Not noticeable	No effect	No observed effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No observed adverse effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed adverse effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant observed adverse effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

None of the policy documents gives numerical values for the effect levels, instead recognising that *"the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will*

depend on how various factors combine in any particular situation". These factors include:

- The source and absolute level of the noise together with the time of day it occurs. Some types and levels of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night.
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise.
- The spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e. whether or not the noise contains particular tonal characteristics or other particular features). The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary.

2.2 The Control of Pollution Act 1974

The Control of Pollution Act provides Local Authorities with the power to control noise from construction sites. This may include specific controls to restrict certain activities identified as causing particular problems. Also, conditions regarding hours of operation will generally be specified and noise and vibration limits at certain locations may be applied in some cases.

The powers include prosecution for failure to comply with the requirements of a notice served under the act, and a system of providing prior consents for works to be carried out in a specified manner so as to reduce the likelihood of causing disturbance ('Section 61 consents'). Noise generators can use the defence that best practicable means have been employed to control noise emissions.

2.3 Environmental Protection Act 1990

The Environmental Protection Act provides local authorities and individuals with powers to serve, or request a magistrate to serve, abatement notices against noise (including vibration) from premises that are considered to be a nuisance. Noise generators can use the defence that best practicable means have been used to control noise emissions or (in relation to construction noise) that the alleged nuisance arose from activities that were compliant with an extant consent under Section 61 of the Control of Pollution Act (prior consent).

3 Determination of LOAEL and SOAEL values for noise of an industrial noise

Table 2 sets out LOAEL and SOAEL values that have been applied to permanent (operational) noise from major infrastructure projects or have been determined or inferred from published guidance.

Table 2: Precedent LOAEL and SOAEL noise level values

Precedent / Guidance	Daytime ($dBL_{Aeq,16h}$)		Night-time ($dBL_{Aeq,8h}$)	
	LOAEL	SOAEL	LOAEL	SOAEL
HS2 – Permanent effects for operational railway for altered roads[4]	50	65	40	55
A14 Cambridge to Huntingdon Improvement Scheme – Permanent effects for roads traffic	50	63	40	55
WHO Night Noise Guidelines for Europe			40	55 (inferred)
AECOM[5] Road Traffic	56 (53 – 59)	66 (64 – 68)	46 (43 – 52)	56 (51 – 64)

In the absence of directly comparable precedents for noise of an industrial/ commercial nature, LOAEL and SOAEL values have been established for the proposed WwTW, based upon our professional knowledge and experience, the precedents above and other published standards and guidance.

BS 4142:2014: 'Methods for rating and assessing industrial and commercial sound' requires that assessments are undertaken in the context of the case. In particular, BS4142 advises that account be taken of the sensitivity of the receptor, stating *"take all pertinent factors into consideration, including...The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as*:

> *i) facade insulation treatment;*
>
> *ii) ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*
>
> *iii) acoustic screening.*

[4] HS2 in Information Paper E22: "Control of Noise from the operation of stationary systems" also implies, in relation to new and modified fixed plant, that a rating level ($L_{Ar,Tr}$) of 5dB below background by reference to BS4142:2014 represents a LOAEL and 5dB above background a SOAEL

[5] AECOM report for Defra January 2013 Minor revisions 2014 – "Possible Options for the Identification of SOAEL and LOAEL in Support of the NPSE"

This approach is advocated by the committee that prepared BS4142 in an explanatory Institute of Acoustics Bulletin article[6], stating that "*The intent of the guidance on incorporated design measures is that BS4142:2014 can be used to assess the impact of noise inside and outside new dwellings or rooms for residential purposes if the façade is of traditional construction i.e. with windows that can be opened and reliance on purge ventilation. Alternatively, if the façade is sealed or the building treated such that it might be reasonable to keep windows closed, then it will only be appropriate to use the method to assess the impact on external areas where commercial or industrial sound is incident. It follows that the assessment on external amenity areas should be carried out during times of the day when the amenity areas are likely to be used. If the circumstances do not lend themselves to the assessment method, such as may be the case for an insulated and sealed building, the standard defers to other guidance and criteria in addition or alternative to BS4142 that can inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of required noise mitigation e.g. BS 8233.*"

Consequently, the internal sound level within dwellings, advised in BS8233, with windows open, has been adopted as a LOAEL. The adopted SOAEL value is 15 dB higher. The proposed LOAEL and SOAEL values for the proposed WwTW are presented in Table 3.

Table 3: Proposed LOAEL and SOAEL values for existing residential receptors exposed to industrial noise

Space	**Daytime ($dBL_{Aeq,16h}$)**		**Night-time ($dBL_{Aeq,8h}$)**	
	LOAEL	**SOAEL**	**LOAEL**	**SOAEL**
Outdoors				
Outdoor space (free-field)	50	65	Not applicable	Not applicable
Indoors				
Living rooms (windows open)	30	45	Not applicable	Not applicable
Dining rooms (windows open)	35	50	Not applicable	Not applicable
Bedrooms (windows open)	30	45	30	45

[6] Phil Dunbavin et al, "BS4142:2014 – revision of the methods for rating and assessing industrial and commercial sound"; Institute of Acoustics Bulletin; Volume 40 No1 January / February 2015

4 Baseline conditions

4.1 Measurement locations

Measurement locations were selected to be representative of the nearest noise sensitive receptors at:

- Location 1 – South Leys Road (junction with Hollym Road), Hollym;
- Location 2 – South Leys Road (junction with Manor Lane), Hollym;
- Location 3 – Adjacent to the proposed WwTW;
- Location 4 – Northwest of the proposed WwTW– representative of residential properties on Hollym Road; and
- Location 5 – North of the proposed WwTW– representative of residential properties on Hollym Road.

Baseline measurement locations are identified in Figure 2 below.

Figure 2: Noise measurement locations (the indicative WwTW site boundary is shaded in red- please see drawing 41522050_01_G_0701 for formal red line boundary)

4.2 Measurement results

Table 4: Summary of measured daytime noise levels and Table 5: Summary of measured night time noise levels present a summary of the results of day and night time noise measurements at locations as indicated in 2. The full survey results are in Appendix B3.

For L_{Aeq} noise levels, the values presented in the tables are the logarithmic average of measured data. For L_{A90}, L_{A10} and $L_{Amax,F}$ noise levels, the values presented in the tables are the arithmetic average of the measured data.

Table 4: Summary of measured daytime noise levels

Location (see Figure)	dBL_{A90}	dBL_{Aeq}	dBL_{A10}	dBL_{Amax}
1	36	49	48	69
2	35	41	43	62
3	30	45	43	61
4	31	40	43	54
5	34	48	47	68

Table 5: Summary of measured night time noise levels

Location (see Figure)	dBL_{A90}	dBL_{Aeq}	dBL_{A10}	dBL_{Amax}
1	24	34	34	57
2	23	30	30	53
3	20	28	28	56
4	21	29	29	58
5	21	30	30	54

4.3 Receptors

For the purposes of this noise assessment the baseline data measured is considered to be representative of the following receptors (see Figure 3):

- Location 2 – Receptor A;
- Location 3 – Receptor G;
- Location 4 – Receptor B, C & D; and
- Location 5 – Receptor E & F.

The selection of representative measurement locations is based upon distance from Hollym Road, as this is considered to be the main noise source in the area.

Figure 3: Noise sensitive receptor (please see drawing 41522050_01_G_0701 for formal red line boundary)

5 Assessment of Construction noise impacts

5.1 Construction activity

It is anticipated that construction of the proposed WwTW will take approximately 18 months, with the earthworks elements being completed within one season (March – October). Construction of the proposed WwTW will therefore take approximately 12 months following the earthworks.

Piling is not anticipated to be required. The construction will largely be bulk earthworks, with some conventional reinforced concrete required. The treatment cells will be designed to be cut-and-fill neutral (*i.e.* all excavated subsoil will be used in the construction).

The site will be accessed via the publicly accessible Myer's Lane. Some temporary realignment of the sharp bend may be required to accommodate large Heavy Goods Vehicles (HGVs) and surface reinforcement (stoning) will be required. Table 6 shows the predicted average construction vehicle movements for the proposed WwTW.

Table 6: Average number of vehicle associated with construction of the proposed WwTW site.

Main Site	**Average number of Vehicle Trips**		
	Per month	Per week	Per day
Car/van	416.7	96.2	19.2
Concrete Wagons	3.8	0.9	0.2
Tippers Wagons	100.0	23.1	4.6
Low Loaders	2.5	0.6	0.1
Artics	2.9	0.7	0.1
Total	525.8	121.3	24.3

Construction works will predominantly be undertaken during the hours of Monday to Friday 07:30 – 17:30 and no weekend working is proposed.

Construction equipment is likely to comprise earthmoving and compaction equipment, for example bulldozers, excavators, sheep's foot rollers. Mobile cranes will be required for the construction of concrete structures, and for installation of mechanical and electrical equipment.

5.2 BS5228 Assessment methodology

Construction noise impacts are temporary in nature meaning that a higher level of noise impact is of lesser significance than would be the case for permanent noise changes.

Significance criteria for construction noise at residential receivers have been developed using the ABC method described in Annex E of BS 5228-1:2009+A1:2014. In this method, the threshold for a potential significant effect is determined from the existing ambient noise level, rounded to the nearest 5dB and evaluated using the categories set out in Table 7.

Table 7: Thresholds for potential significant effects at dwellings from on-site noise sources (from BS 5228-1:2009+A1:2014)

Assessment category and threshold value period	**Threshold values in decibels $dBL_{Aeq,T}$**		
	Category A	**Category B**	**Category C**
Night time (23:00 – 07:00)	45	50	55
Day time (07:00 – 19:00) Saturdays (07:00 – 13:00)	65	70	75
Other: Weekday evenings (19:00 – 23:00) Saturdays (13:00 – 23:00) Sundays* (07:00 – 23:00)	55	60	65
Where: Category A: are threshold values to use when ambient noise levels (rounded to the nearest 5dB) are less than these values. Category B: are values to use when ambient noise levels (rounded to the nearest 5dB) are the same as category A values. Category C: are values to use when ambient noise levels (rounded to the nearest 5dB) are higher than category A values.			

A potential significant effect is indicated where the construction site noise level (L_{Aeq}) exceeds the threshold level for the category appropriate to the ambient noise level. If the ambient noise level exceeds the highest threshold values given in **Error! Reference source not found.**Table 7 (i.e. the ambient noise level is higher than the Category C values), then a potential significant effect is deemed to occur if the construction site noise (L_{Aeq}) level for the period is greater than the ambient noise level.

Having established if there is a potentially significant effect using the ABC method, the final assessment of significance is made using professional judgement. This is evaluated by considering various other factors such as the number of properties affected, and any potential longer-term benefits that may arise due to short term disturbance.

In policy terms, the category C values are considered to represent a SOAEL in this assessment. Following PPG-N, the action would be to "*Mitigate and reduce to a minimum*" noise up to this level, which is consistent with the concepts of best practicable means (BPM). Noise above SOAEL is to be avoided, within the context of government policy on sustainable development.

The thresholds for potential significant effects for construction noise, established using the BS5228-1 ABC method and the baseline noise data are shown in Table 8.

Table 8: Threshold levels of significant effects for construction noise

Noise sensitive receptor (see Figure)	Approximate distance to site boundary (m)	Threshold values in decibels (dB), $L_{Aeq,T}$	
		Day (07:00 – 19:00)	Night (23:00 – 07:00)
A	1100	65	45
B	775	65	45
C	675	65	45
D	525	65	45
E	850	65	45
F	1050	65	45
G	1000	65	45

5.3 Predicted Noise Levels

The predicted daytime construction noise levels at noise sensitive receptors, for the different construction activities, are presented in Table 9. Assumptions and the basis for calculations are given in Appendix C.

Table 9: Predicted daytime construction noise levels

Noise sensitive receptor (see Figure)	Daytime threshold ($dBL_{Aeq,T}$)	Assumed activity noise level ($dBL_{Aeq,T}$)		
		Activity 1 – Earthworks and construction	Activity 2 – Site access via Myer's Lane	Activity 3 – Site access via new road
A	65	40	-	-
B	65	45	-	-
C	65	48	52	18
D	65	50	-	-
E	65	43	-	-
F	65	40	-	-
G	65	41	-	-

The values for 'Activity 1' are determined, assuming that all the activity is located towards the centre of the development and all operating simultaneously.

It has been calculated that the daytime construction noise levels at all noise sensitive receptors are within the adopted significance criteria and therefore the effects are **not significant**.

No evening and night-time construction work is proposed, however, limited evening construction works would be possible, within the significance criteria. Any intensive night time working is likely to result in major adverse noise effects, however equipment such as suitably attenuated de-watering pumps and generators, should be able to operate.

In the event that, despite use of Best Practicable Means (BPM), extended periods of elevated construction noise levels are anticipated and/or intensive night time working is required, then it may be appropriate for the contractor to seek a Section 61 agreement with the local authority under the CoPA. A Section 61 is a formal agreement between the contractor and the local authority, which allows the contractor and local authority to agree, for example, noise levels and hours of work.

Construction noise impacts can be controlled through a suitably worded planning condition and/or existing noise control legislation. Importantly the local Authority has powers under the CoPA to control noise from construction sites.

The impact of noise associated with the demolition of the existing WwTW will be assessed once details of the demolition strategy are known, however, given the remote location of the existing WwTW and limited number of sensitive noise receptors, noise from demolition is not anticipated to be significant.

6 Assessment of Operational Impacts

6.1 Operational activity

The proposed WwTW comprises two treatment cells constructed from earth embankments with an impermeable membrane. The embankments will be between 2 to 4.5 m in height above existing ground levels. There will be floating wind-powered mixers and fixed aeration baffles within treatment cells.

One 20 m x 6 m x 3 m Glass Reinforced Plastic (GRP) kiosk will be located at ground level containing electrical panels and welfare facilities. Two kiosks 3 m x 3 m x 2.5 m will be located on the central embankment to house low-pressure fan blowers.

During operation, the proposed WwTW will not be manned. Visual inspections will be undertaken 2-3 times per week. Other visits are expected as follows:

- Landscape maintenance visits (grass cutting) - 3 or 4 times a year;
- Single skip truck to remove screenings - 4 to 6 times a year;
- Mechanical plant maintenance - twice yearly; and
- Reactive maintenance - as necessary.

Access for operation will be via Myer's Lane. It is anticipated that this will be kept as a green lane, however, some upgrade works will be required (i.e. stoning) to correct rutting.

6.2 BS4142 Assessment methodology

BS 4142 *Methods for rating and assessing industrial and commercial sound* (2014) provides a method for rating external noise levels from factories, industrial premises or fixed installations of an industrial nature, such as building services plant, to determine the likelihood of complaints from occupants of nearby residential properties.

The method is based on the difference between the 'background noise level' without the industrial noise source and the 'rating noise level' of the industrial source, at the receiver location. The 'background noise level' ($L_{A90,T}$) is the noise existing in the absence of the 'specific noise level' from the industrial noise source at the receiver location expressed in terms of L_{A90}.

The 'specific noise level' ($L_{Aeq,Tr}$) can be subject to a weighting (penalty) of up to 21dB where it displays an identifiable character (such as tonality, impulsiveness, intermittency or a combination of these) to provide a 'rating level' ($L_{Ar,Tr}$). The 'background noise level' is subtracted from the rating level and the difference used to assess the likelihood of complaints as shown in Table 10. Typically, the greater this difference, the greater the magnitude of the impact.

Table 10: Summary of BS4142 assessment method

Difference between rating and background noise level	Assessment
+10dB or more	Indicative of a significant adverse impact, depending on the context
+ 5dB or more	Indicative of an adverse impact, depending on the context
0dB or less	Indicative of low impact, depending on the context

For this assessment, considering the very low background noise levels a rating level of parity with the background noise level has been adopted, as a significance threshold, which is indicative of low impact.

6.3 Predicted noise levels

A strategic noise model has been constructed for the proposed WwTW in SoundPlan noise modelling software. Noise propagation predictions have been made according to the ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors – Part 2: General method of calculation*.

The equipment sound power level limit which has been agreed with the design team and equipment manufacturer, has been used to inform the noise modelling exercise as presented in Table 11.

Table 11: Sound power level (L_W) for the proposed WwTW

Octave band centre frequency (Hz)								**A**
63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
75	75	80	84	87	80	71	61	89

The predicted operational noise levels are presented in Table 12.

Table 12: Predicted operational noise at nearby receptors

Noise sensitive receptor (see Figure)	**Operational sound level [dBL_{Aeq} re 2 x 10^{-5}Pa]**
A	10.1
B	14.1
C	15.9
D	19.2
E	13.6
F	11.5
G	15.6

6.4 BS4142 assessment

6.4.1 Day-time assessment

The result of the daytime BS4142 assessment for the proposed WwTW is presented in Table 13.

Table 13: BS4142 assessment (Daytime)

Noise sensitive receptor (see Figure)	Sound level [dB re 2 x 10^{-5}Pa]			Assessment
	Specific noise level ($L_{Ar,Tr}$)	Representative background noise level ($L_{A90,T}$)	Rating level minus background noise level	
A	10	35	-25	Low impact
B	14	31	-17	Low impact
C	16	31	-15	Low impact
D	19	31	-12	Low impact
E	14	34	-20	Low impact
F	12	34	-22	Low impact
G	16	30	-14	Low impact

6.4.2 Night-time assessment

The result of the night-time BS4142 assessment for the proposed WwTW is presented in in Table 14. It is assumed that the noise source does not attract a character correction; therefore, the 'rating level' is the same as the 'specific noise' level.

Table 14: BS4142 assessment (Night time)

Noise sensitive receptor (see Figure)	Sound level [dB re 2 x 10^{-5}Pa]			Assessment
	Specific noise level ($L_{Ar,Tr}$)	Representative background noise level ($L_{A90,T}$)	Rating level minus background noise level	
A	10	23	-13	Low impact
B	14	21	-7	Low impact
C	16	21	-5	Low impact
D	19	21	-2	Low impact
E	14	21	-7	Low impact
F	12	21	-9	Low impact
G	16	20	-4	Low impact

The BS4142 assessment presented above indicates a noise impact at all receptors is classified by BS4142 as low impact.

It is recommended that operational noise limits be set relative to existing measured background noise levels. Noise limits can be secured by a suitably worded planning condition and delivered during detailed design of the proposed WwTW. This is a standard approach to EIA and planning and is considered to provide a robust outcome, because the mitigation measures are well rehearsed and non-controversial.

The resultant operational noise levels at nearby receptors are considered to be less than a LOAEL; a level below which adverse effects on health and quality of life cannot be detected.

7 Conclusion

Arup has been commissioned by Yorkshire Water Services Ltd to undertake an assessment in respect to the demolition of the existing Withernsea Wastewater Treatment Works (WwTW), and construction of a new WwTW in the village of Hollym, East Riding of Yorkshire to treat the sewage from Withernsea town.

This report primarily focusses upon the mitigation of the operational noise impact of the proposed WwTW. Consideration is also given to construction noise.

Daytime construction noise levels at all noise sensitive receptors are within the adopted significance criteria and therefore the noise effects are assessed as not significant. No evening and night-time construction work is proposed, however some activities would be possible, within the significance criteria.

For operational noise a rating level of parity with the background (L_{A90}) noise level has been adopted, as a significance threshold, which is indicative of low impact. This approach results in operational noise levels that are lower than a LOAEL. By implementing the adopted operational significance thresholds as noise limits, the effects of operational noise would be assessed as not significant. The noise limits can be secured by a suitably worded planning condition and delivered during detailed design of the proposed WwTW.

Appendix A

Glossary of Acoustic Terminology

A1 Glossary of Acoustic Terminology

Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of 10^6:1 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The 'A' weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500Hz to 4kHz.

In some statistical descriptors the 'A' weighting forms part of a subscript, such as L_{A10}, L_{A90}, and L_{Aeq} for the 'A' weighted equivalent continuous noise level.

Equivalent continuous sound level

An index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

Frequency

Frequency is the rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the hertz (Hz), which is identical to cycles per second. A 1000Hz is often denoted as 1kHz, eg 2kHz = 2000Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes, the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

Maximum noise level

The maximum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125ms duration and fast time weighting (F) has an exponential time constant of 125ms which reflects the ear's response. Slow

time weighting (S) has an exponential time constant of 1s and is used to allow more accurate estimation of the average sound level on a visual display.

The maximum level measured with fast time weighting is denoted as $L_{Amax, F}$. The maximum level measured with slow time weighting is denoted $L_{Amax, S}$.

Sound pressure level

The sound power emitted by a source results in pressure fluctuations in the air, which are heard as sound.

The sound pressure level (L_p) is ten times the logarithm of the ratio of the measured sound pressure (detected by a microphone) to the reference level of 2 x 10^{-5}Pa (the threshold of hearing).

Thus L_p (dB) = 10 log $(P1/P_{ref})^2$ where P_{ref}, the lowest pressure detectable by the ear, is 0.00002 pascals (ie $2x10^{-5}$ Pa).

The threshold of hearing is 0dB, while the threshold of pain is approximately 130dB. Normal speech is approximately 60dBL_A and a change of 3dB is only just detectable. A change of 10dB is subjectively twice, or half, as loud.

Statistical noise levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for 10% of the time period under consideration, can be used for the assessment of road traffic noise (note that L_{Aeq} is used in BS 8233 for assessing traffic noise). The L_{90}, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. dB$L_{A10, 5min}$ or dB$L_{A90, 8hr}$.

Typical levels

Some typical dB(A) noise levels are given below:

Noise Level, dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside disco
90	Heavy lorries at 5 m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1 m
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber

Appendix B

Noise Survey

B1 Introduction

An environmental noise survey was undertaken by BlueTree acoustics in June 2016 to determine the noise climate around and at the periphery of the proposed WwTW facility at Hollym, Withernsea. Measurements have been taken to enable the assessment of how operational noise from proposed sources forming part of the development may affect existing dwellings.

B2 Methodology

Attended daytime noise measurements were undertaken between 10:11 and 15:45 on Thursday 9 June 2016. Attended night-time noise measurements were undertaken between 23:59 and 03:43 on Wednesday 15 June 2016.

The measurement locations were chosen to provide an indication of the typical ambient and background noise levels at times of the day, evening and night at the nearest noise sensitive receptors to the proposed development. The number and duration of measurements are provided in Table B1.

Location	Number and duration of measurements	
	Day	Night
1	3 x 15m	2 x 15m
2	3 x 15m	2 x 15m
3	3 x 15m	2 x 15m
4	3 x 15m	2 x 15m
5	3 x 15m	2 x 15m

Table B1: Summary of measurement periods for on and off-site measurement locations

L_{Aeq}, L_{A10}, L_{A90}, and L_{Amax} values were all stored. All broadband measurements were A-weighted. Measurements were made with a fast (0.125s) time constant.

The noise monitoring locations are shown in Figure B1. The equipment used is detailed in Table B2.

Figure B1: Site layout and measurement locations

Equipment	Manufacturer	Type
Precision grade sound level meter	Rion	NA28

Table B2: Noise survey equipment

The microphone was located at approximately 1.5m above the ground. The sound level meter and microphone are Type 1 conforming to BS EN 61672-1: 2003. The calibration of the sound level meter and microphone was checked before and after use, to confirm that there was no significant drift in meter response at the calibrator frequency and level. This verification indicated that there was less than 0.5dB variation between checks.

During the measurements, the weather was dry and wind speed less than 5m/s. All measurements were undertaken under acoustically free-field conditions, except where otherwise stated.

B3 Results

Start time (hh:mm:ss)	Elapsed time (mm:ss)	dBL_{A90}	dBL_{Aeq}	dBL_{A10}	$dBL_{Amax,F}$
10.11	15:00	35.6	42.6	45.8	62.0
12:02	15:00	34.2	51.5	46.0	73.6
14:04	15:00	38.6	48.9	51.1	70.8
23:59	15:00	28.1	35.7	38.3	56.2
02:06	15:00	19.1	29.0	29.7	57.8

Table B3: Measured noise levels at Location 1

Start time (hh:mm:ss)	Elapsed time (mm:ss)	dBL_{A90}	dBL_{Aeq}	dBL_{A10}	$dBL_{Amax,F}$
10:28	15:00	33.3	39.7	42.6	60.8
12:26	15:00	33.8	40.7	43.7	63.7
14:20	15:00	37.2	41.4	43.3	62.8
00:27	15:00	26.1	30.4	32.5	49.0
02:26	15:00	20.1	28.7	26.9	57.2

Table B4: Measured noise levels at Location 2

Start time (hh:mm:ss)	Elapsed time (mm:ss)	dBL_{A90}	dBL_{Aeq}	dBL_{A10}	$dBL_{Amax,F}$
10:57	15:00	27.6	44.7	41.7	67.1
12:55	15:00	29.6	47.6	47.6	64.5
14:45	15:00	32.1	36.8	40.0	50.2
01:09	15:00	20.2	25.9	26.1	52.0
02:47	15:00	19.4	28.6	30.3	59.1

Table B5: Measured noise levels at Location 3

Start time (hh:mm:ss)	Elapsed time (mm:ss)	dBL_{A90}	dBL_{Aeq}	dBL_{A10}	$dBL_{Amax,F}$
11:16	15:00	29.5	40.4	44.7	53.5
13:14	15:00	29.4	34.7	37.4	53.1
15:02	15:00	33.2	42.3	45.5	56.5
01:25	15:00	20.0	29.3	28.6	58.4
03:05	15:00	21.0	29.1	30.1	57.6

Table B6: Measured noise levels at Location 4

Start time (hh:mm:ss)	Elapsed time (mm:ss)	dBL_{A90}	dBL_{Aeq}	dBL_{A10}	$dBL_{Amax,F}$
11:40	15:00	32.5	38.0	39.5	62.9
13:38	15:00	33.8	51.8	52.8	73.5
15:30	15:00	34.9	45.4	49.0	68.1
01:44	15:00	19.3	28.7	27.8	59.6
03:28	15:00	23.2	30.2	32.9	47.6

Table B7: Measured noise levels at Location 5

Appendix C

Construction Noise Assumptions

C1 Construction noise assumptions

This section provides the construction activity assumptions which form the basis for the prediction of construction noise in accordance with *British Standard 5228-1:2009+A1:2014 - Code of practice for noise and vibration on construction and open sites - Part 1: Noise*. The following processes have been assessed.

Activity 1 – Site enabling works and construction – tracked excavators, movements of tipper trucks moving material, vibratory roller, dump trucks, road sweeper. Concrete pours – foundation and basement works, using truck mixers and lorry mounted concrete pumps and craning of materials.

The values are determined, assuming that all the activity is located at the centre of the Site and all operating simultaneously. This represents a more typical case when the sources are located further away.

Activity 2 & 3 – Vehicles accessing the site via Myer's road (10m metres from the nearest receptor) or dedicated road (260m metres from the nearest receptor) for construction vehicles. It is assumed that the number of movements advised in Section 5.1 are concentrated in a 3 month period and comprise a two way trip.

Table C1: Construction noise assumptions

Activity name	Source	Sound power (dBL_{WA})	Number	On-time (%)
Activity 1 – Enabling / earthworks				
Dozer	BS5228 Table C 2-1	103	2	40
Tracked Excavator	BS5228 Table C 2-3	106	2	50
Wheeled Loader	BS5228 Table C 2-28	104	2	40
Vibratory Roller	BS5228 Table C 5-21	108	1	60
Dump Truck (Tipping Fill)	BS5228 Table C 2-30	107	1	40
Dump Truck (Empty)	BS5228 Table C 2-31	115	1	40
Road Sweeper	BS5228 Table C 4-90	104	1	50
Activity 1 – Construction				
Tower Crane	BS5228 Table C 4-49	105	1	50
Tracked Excavator	BS5228 Table C 4-63	105	1	10
Diesel Generator	BS5228 Table C 6-39	93	1	100
Pump Boom + Vibrating Poker	BS5228 Table C 4-36	99	2	20
Concrete Pump	BS5228 Table C 3-25	106	2	20
Concrete Mixer Truck	BS5228 Table C 4-20	108	10	10
Telescopic Handler	BS5228 Table C 4-54	107	2	40
Dumper	BS5228 Table C 4-3	104	4	40
Activity 2 & 3				
Car	Estimate	95	60	0.004
Concrete Mixer Truck	BS5228 Table C 4-20	108	2	0.004
Tipper Lorry	BS5228 Table C 8-20	107	37	0.004
Lorry	BS5228 Table C 2-34	108	2	0.004

Appendix M – Arup Archaeological DBA

Appendix N

Heritage Desk Based Assessment

Yorkshire Water

Withernsea Wastewater Treatment Works

Historic Environment Desk-Based Assessment

Final | 9 January 2018

Job number 21 May 2018

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Contents

Executive summary

Ove Arup & Partners Ltd ('Arup') has been commissioned by Yorkshire Water to produce a Historic Environment Desk-Based Assessment (DBA), in respect of the demolition of the existing Withernsea Wastewater Treatment Works (WwTW), construction of a new WwTW, (the 'Main Site') and associated infrastructure, including a Rising Main and a Long Sea Outfall (LSO), in the village of Hollym, East Riding of Yorkshire. An additional connection from Hollym Sewage Pumping Station (SPS) to the proposed Rising Main is also proposed.

Documentary sources were consulted from the National Heritage List for England (NHLE), Humber HER, Easting Riding Local Archives and online sources in order to identify archaeological constraints that may affect any proposed development.

The proposed Scheme site lies within largely open and broadly flat agricultural land. The proposed Scheme does not fall within any conservation areas.

No archaeological investigations have been carried out within the proposed development area. Five heritage assets, dated to the Post-medieval to Modern periods, are recorded within the proposed development area.

The potential for unknown archaeology on the site pertaining to the Prehistoric, Romano-British, Early-medieval, Medieval, and Post-medieval periods is anticipated to be moderate. The potential for encountering Modern and Geoarchaeological evidence is considered to be low.

The proposed Scheme will entail the excavation of trenches to enable the installation of Rising Main and LSO, anticipated to reach depths of approximately -1.2 m below current ground level. Directional drilling of the Rising Main is anticipated through the town of Withernsea and open cut excavations are expected for the remainder of the route where the alignment passes across agricultural fields.

The proposed Scheme is expected to incur adverse impacts on potential buried archaeology as a consequence of:

- cut-and-fill excavation practises and the establishment of reinforced concrete foundations for the installation of the Main Site[1];
- cut-and-backfill trenching of the Rising Main service route;
- cut-and-backfill trenching of the LSO service route from the Main Site to the Horizontal Directional Drilling (HDD) starting point[2].

The proposed Scheme will require a programme of evaluative measures as a planning condition, from which appropriate archaeological mitigation may be ascertained. Evaluative measures are anticipated to be geo-physical surveys, and field walking investigations. Watching briefs are expected mitigation measures.

1 No piling activity is envisaged during the construction phase of the Main Site.
2 Horizontal Directional Drilling (HDD) will mechanically bore the LSO service route to the intertidal zone. Shallow dredging is expected in the sub tidal zone of the sea.

Further mitigation measures will be considered following the result of evaluative measures.

1 Introduction

1.1 Project background

A Historic Environment DBA was produced for the Yorkshire Water WwTW in 2016[3], however, as a consequence of changes to the proposed Scheme a refreshed desk-based assessment was required.

Ove Arup & Partners Ltd ('Arup') has been commissioned by Yorkshire Water (hereafter referred to as 'the Applicant') to produce a Historic Environment desk-based assessment, in respect of the demolition of the existing Withernsea Wastewater Treatment Works (WwTW), construction of a new WwTW, (the 'main site') and associated infrastructure, including a Rising Water Main, connecting the Memorial Gardens pumping station in Withernsea with the Main Site, and a long sea outfall (LSO), in Withernsea, East Riding of Yorkshire. A connection from the Hollym Pumping Station to the Rising Water Main is also proposed. This report only assesses the terrestrial aspects of the proposed Scheme.

This scheme is proposed in anticipation of long-term erosion effects[4].

1.2 Site description

The site is centred on NGR TA 34214, 23946, within the borough of Holderness, East Riding of Yorkshire, see Figure 1, Appendix B.

The proposed main site is located within an area of field systems, agricultural buildings and structures and some residential dwellings east of Hollym road, and approximately 1km south of Hollym. From the Memorial Gardens Pumping Station in Withernsea town, the proposed intake pipeline runs south down Pier Road, on to Station Road to St Nicholas Park and then follows the route of the former Withernsea Branch railway and farmland towards the main site. The LSO will run northeast towards the existing WwTW and into the sea.

The proposed development area (PDA) and surrounding area is characterised as an expansive landscape of arable farmland with sporadic distributions of building and built infrastructure[5]. The area is broadly flat with some tree species populating some field boundaries and within settlements. The primary activity within the proposed development area is arable agricultural practises. Withernsea is characterised as an urban settlement with relatively higher building density with metalled roads and surfaces. Within the 500m buffer study area of the proposed development area the minimum OD height is +3m, the maximum OD height is +15m[6].

3 Stenton, M. (2016). Withernsea Water Treatment Works, Archaeological Desk-Based Assessment. Report No. 042/2016. Trent and Peak Archaeology: Unpublished Report
4 The Rapid Coastal Zone Assessment survey (RCZA) notes that the glacial till Holderness coastline is receding at an estimated rate of 1.8m+ per year.
5 Information sourced from: 'East Riding of Yorkshire Landscape Character Area: Selected Settlements Update 2013, Withernsea'
6 Information sourced from: Contemporary OS mapping, *Bing Maps (*accessed 03/01/2018) https://www.bing.com/maps

1.3 Underlying Geology

The British Geological Survey indicates that the site lies upon Flamborough Chalk deposits of biogenic and detrital sedimentary rock formed approximately 72 to 86 million years ago. Glacigenic Devensian Till deposits are the recorded superficial deposits for the majority of the site. Alluvium associated with field irrigation systems is recorded as underlying a section of the course of the proposed intake pipework. Glaciofluvial deposits of Devensian sand and gravel are also extant within the proposed route of the Rising Main. Relatively small and sporadic pockets of lacustrine deposits of sand, silts and clay are distributed within the study area. One lacustrine deposit is recorded in the north-east corner of the proposed main site.

BGS Borehole records in table 1 indicate more detailed geological information within/close by the proposed development area:

Table 1: Summary of British Geological Survey Borehole records

BGS Borehole Record Log	Approximate Location	Geological Summary
TA32SW17 (Excavated in 1994)	Within 50m north-east of the main site.	Stiff brown grey mottled sandy clayey silt from -0.90m to -2.70m
TA32SW18 (Excavated in 1997)	Within 50m north-east of the main site.	Stiff red brown clayey silt at a depth of -1m and very stiff red brown clayey silt at a depth of -1.6m to -2.8m.
TA32NW20 (Excavated in 1986)	At the site of the former railway station, where the Rising Main will follow a course under the road.	Made ground comprised of brick rubble at a depth of -0.5m, underlain by firm brown silty sandy clay. This correlates with the findings of a watching brief in 2007 (EHU1373).
TA32NW22 (Excavated in 1986)	At the site of the former railway station, where the Rising Main will follow a course under the road.	Made ground to a depth of -1.7m.
TA32NW23 (Excavated in 1988)	Near the Withernsea pumping station that fronts pier road	Made ground at a depth of -2.4m. It was underlain by a stiff brown sandy clay layer that continued to a depth of -7.7m.

2 Proposed Scheme

2.1 Summary of Proposed Scheme

The proposed Scheme entails the installation of a Rising Main intake pipe running from the Memorial Gardens pumping station in Withernsea, under the open field systems of Hollym parish, staying close to the footprint of the disused Withernsea Branch railway line, the pipelines route will correct to a southwest direction and follow the course of telegraph poles and feed into the new WwTW. An ancillary pipeline will be installed that will run east-west and connect the Hollym pumping station, by Withernsea Road (A1033), to the primary Rising Main pipeline. The construction of the new WwTW will comprise of two waste treatment cells with grass-topped sloped embankments encasing the cells. The embankments shall be constructed from the earth spoil produced during initial construction. From the new WwTW, the scheme will entail another pipeline installation for the LSO, in a northeast direction, to the east of the Hollym, and connect to the HDD starting point that fronts onto North Leys road. The LSO pipeline will run to the existing sewage works and continue seawards. The discharge point of the LSO is to be located at the sea bed at a depth of approximately -14mOD. The existing sewage works is to be demolished.

2.2 Main Site

The proposed main site will be comprised of two treatment cells. Each cell will have a surface area of 1.9 ha, three sides of which will be buried by earthen embankments[7]. The associated embankments will vary between 2 m to 4.5 m height above existing ground levels.

A concrete structure 14 m x 9 m x 4.5 m high is proposed. A Glass Reinforced Plastic (GRP) kiosk measuring 20 m x 6 m x 3 m high is proposed at ground level, to contain toilet and washing facilities. Two GRP kiosks measuring 3 m x 3 m x 2.5 m high are proposed to sit on the central embankment.

The majority of the construction work will be bulk earthworks gathering materials from within the site. Excavations are expected to take place and all excavated subsoils are expected to be used to construct the embankments. No piling activity is expected to occur during construction, instead reinforced concrete raft foundations are anticipated.

2.3 Rising Main

The proposed Rising Main will run for approximately 4.5 km, from the Memorial Gardens sewage pumping station, through arable land to the main site. The pipework with be directionally drilled through Withernsea town and cut and cover trenching will be used across the agricultural land to the south. Conventional trenching is expected to reach 1.2 m below ground level, however variable depths along the route may be anticipated. The exact design details for the route of the

7 Refer to technical drawing: PB5063-WSEA-001

rising main have yet to be finalised however it will closely follow the alignment of the former Hull to Withernsea railway line. At approximately NGR TA 33532 26617 the route leaves the former railway line continuing adjacent to the railway line until at Crofts Lane it changes direction to the southeast following an existing telephone line towards the main site.

2.4 Long Sea Outfall

The proposed LSO will run approximately 3.4 km from the main site to the offshore discharge point. The offshore marine length of the LSO will be approximately 50 m south of the existing offshore LSO. Installation of this development will be delivered using cut and cover trenching for approximately 1.4 km from the main site to the Horizontal Directional Drilling (HDD) point[8]. It is anticipated that the excavation of this leg of the route would reach depths where archaeology may be present. HDD will be conducted from the HDD start point to the intertidal zone.

2.5 Existing WwTW

The proposed Scheme entails the demolition of the existing WwTW and the existing LSO. Design details are undergoing further discussion at the time of this report however it is understood that demolition plant and tipper wagons shall be necessary for the removal of crushed concrete. Tankers will be required for the removal of liquid waste. The extent of waste generated is unknown at the time of this report.

3 Aims and Objectives

The aim of this desk-based assessment is to provide an overview of available data relating to the history and archaeological potential of the site, along with the significance of effects to archaeology at the site. The assessment will:

- identify the presence of any known or potential buried heritage assets that may be impacted by the proposed development;
- describe the significance of such assets, as required by national planning policy;
- assess the likely impacts upon the significance of the assets arising from the proposed development; and
- provide recommendations for further assessment where necessary of the historic assets affected, and/or mitigation aimed at reducing or removing completely any adverse impacts upon buried heritage assets.

8 Ibid.

4 Methodology

4.1 Planning policy context

National policy

Statutory protection for archaeology is principally provided by the Ancient Monuments and Archaeological Areas Act of 1979 amended by the National Heritage Act (2002).

National Planning Policy in England is set out in the National Planning Policy Framework (NPPF). The NPPF was published on 27th March 2012, replacing all previous Planning Policy Statements, including Planning Policy Statement 5 (PPS 5): Planning for the Historic Environment.

The purpose of the planning system is to contribute to the achievement of sustainable development. The NPPF, Section 12: Conserving and enhancing the historic environment, identifies the contribution to protecting and enhancing the built and historic environment that the development process can achieve. Significantly, the NPPF does not distinguish between buildings, archaeology or landscape, but treats them collectively as heritage assets.

Paragraph 131, states:

In determining planning applications, local planning authorities should take account of:

- *the desirability of sustaining or enhancing the significance of heritage assets and putting them to viable uses consistent with their conservation;*
- *the positive contribution that conservation of heritage assets can make to sustainable communities including their economic vitality; and*
- *the desirability of new development making a positive contribution to local character and distinctiveness.*

Paragraph 132, states:

Great weight should be given to the conservation of the significance of designated heritage assets and that harm to this significance (either through alteration or destruction of the asset, or through development within its setting) requires 'clear and convincing justification'. The harm or loss needs to be outweighed by the public benefits of the proposed development and substantial harm to or loss of a grade II listed building; park or garden should be exceptional. Substantial harm to or loss of designated heritage assets of the highest significance, notably scheduled monuments, protected wreck sites, battlefields, grade I and II listed buildings, grade I and II* registered parks and gardens, and world heritage sites, should be wholly exceptional.*

Paragraph 135, states:

The effect of an application on the significance of a non-designated heritage asset should be taken into account in determining the application. In weighing applications that affect directly or indirectly non-designated heritage assets, a balanced judgement will be required having regard to the scale of any harm or loss and the significance of the heritage asset.

Paragraph 139, states:

Non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments should be considered subject to the policies for designated heritage assets.

Historic England's guidance on the NPPF notes that total loss of the asset or substantial harm may alternatively be justified if all of the following tests are met:

- there is no viable use of the heritage asset that can be found in the medium term including through marketing to find alternative owners;
- the heritage asset is preventing all reasonable uses of the site;
- public support for or ownership of the asset is demonstrably not possible; and
- the harm or loss is outweighed by the benefits of bringing the site back into use.

Local policy

The East Riding of Yorkshire Council outlines its historic environment objectives and policies in the Local Plan Strategy Document (adopted April 2016), which contains the following relevant policies:

Policy ENV 8:

Valuing our heritage

A. Where possible, heritage assets should be used to reinforce local distinctiveness, create a sense of place, and assist in the delivery of the economic well-being of the area. This can be achieved by putting assets, particularly those at risk, to an appropriate, viable and sustainable use.

B. The significance, views, setting, character, appearance and context of heritage assets, both designated and non-designated, should be conserved, especially the key features that contribute to the East Riding's distinctive historic character including:

1. Those elements that contribute to the special interest of Conservation Areas, including the landscape setting, open spaces, key views and vistas, and important unlisted buildings identified as contributing to the significance of each Conservation Area in its appraisal;

2. Listed Buildings and their settings;

3. Historic Parks and Gardens and key views in and out of these landscapes;

4. The dominance of the church towers and spires as one of the defining features of the landscape, such as those of Holderness and the Wolds;

5. Heritage assets associated with the East Yorkshire coast and the foreshore of the Humber Estuary;

6. The historic, archaeological and landscape interest of the Registered Battlefield at Stamford Bridge;

7. The historic cores of medieval settlements, and, where they survive, former medieval open field systems with ridge and furrow cultivation patterns;

8. The nationally important archaeology of the Yorkshire Wolds; and

9. Those parts of the nationally important wetlands where waterlogged archaeological deposits survive.

C. Development that is likely to cause harm to the significance of a heritage asset will only be granted permission where the public benefits of the proposal outweigh the potential harm.

Proposals which would preserve or better reveal the significance of the asset should be treated favourably.

D. Where development affecting archaeological sites is acceptable in principle, the Council will seek to ensure mitigation of damage through preservation of the remains in situ as a preferred solution. When in situ preservation is not justified, the developer will be required to make adequate provision for excavation and recording before or during development.

No conservation areas fall within the boundary of the proposed development area or 500m study area.

Guidance

The Chartered Institute for Archaeologists (CIfA) provides guidance for historic environment desk-based assessment. This guidance was adopted as approved practice in 1994, updated in January 2017, and sets the standard that:

A desk based assessment will:

- *determine, as far as is reasonably possible from existing records, the nature, extent and significance of the historic environment within a specified area;*
- *be undertaken using appropriate methods and practices which satisfy the stated aims of the project, and which comply with the Code of conduct, Code of approved practice for the regulation of contractual arrangements in field archaeology, and other relevant by-laws of the CIfA; and*
- *establish the impact of the proposed development on the significance of the historic environment (or will identify the need for further evaluation to do so), and will enable reasoned proposals and decisions to be made whether to mitigate, offset or accept without further intervention that impact.*

Guidance on the assessment of the setting of heritage assets is set out in Good Planning Advice 3: The Setting of Heritage Assets, published by Historic England in December 2017. The document sets out guidance on managing change within the settings of heritage assets including archaeological remains and historic buildings, sites, areas and landscapes intended to assist implementation of planning policy.

The document defines setting as 'the surroundings in which a heritage asset is experienced'. The guidance advises that:

> *'While setting can be mapped in the context of an individual application or proposal, it cannot be definitively and permanently described for all time as a spatially bounded area or as lying within a set distance of a heritage asset. This is because the surroundings of a heritage asset will change over time, and because new information on heritage assets may alter what might previously have been understood to comprise their setting and the values placed on that setting and therefore the significance of the heritage asset.'*

4.2 Scope and Consultation

The study area comprises a 500m radius from the boundary of the proposed Scheme. This radius is considered appropriate based upon professional judgement and is proportional to the site and its setting. Within this area all designated and non-designated heritage assets have been identified.

The following have been consulted in preparing this assessment:

- Humber Archaeological Partnership;
- East Riding local archives;
- Online historical resources;
- Archaeological Data Service (ADS) and;
- Historic England Aerial Photography Archives.

Preliminary pre-application consultation with Mr James Goodyear of the Humber Archaeology Partnership has been undertaken (Appendix E).

4.3 Assumptions and limitations

Data used to compile this assessment consists of secondary information derived from a variety of sources, predominately the Humber HER, the National Heritage List for England (NHLE) and the Archaeological Data Service. The assumption is made that this data, as well as that derived from other secondary sources, is accurate.

The Humber HER is a record of known archaeological and historic assets. It is not an exhaustive record of all surviving historic assets and does not preclude the existence of further assets which are unknown at present.

A site visit was not carried out owing to restrictions on land access.

Previous archaeological investigations in the study area are limited in extent and do not allow the archaeological potential of the area to be fully understood.

A lack of available cartographic resources has limited the coverage of historic maps and map regression exercise.

4.4 Assessment of significance

Environmental value of heritage assets

There is no specific guidance published by either the CIfA or Historic England for assessing the environmental value (significance) of heritage assets. In the absence of this, the assessment has been carried out in accordance with the Design Manual for Roads and Bridges Volume 11, Section 3, Part 2 'Cultural Heritage', and Chapter 5, Section 5.10 'Evaluating the Archaeological Resource' (DMRB Vol 11 Sec 3 Pt 2).

Table 2 summarises the criteria used for the determination of the environmental value of heritage assets.

Table 2: Factors for assessing environmental value of heritage assets

Value	Typical descriptors
Very High	World heritage sites (including nominated sites) Assets of acknowledged international importance Assets that can contribute significantly to acknowledged international research objectives
High	Nationally important assets (scheduled monuments, Grade I and II* listed buildings, Grade I registered parks and gardens) Assets with the potential to contribute to national research objectives
Medium	Designated (conservation areas, Grade II listed buildings, Grade II registered parks and gardens) or non-designated assets that are of regional importance Assets with the potential to contribute to regional research objectives
Low	Assets of local importance (locally listed buildings) Assets compromised by poor preservation and/or poor survival of contextual associations Assets of limited value, but with potential to contribute to local research objectives
Negligible	Assets with very little or no surviving archaeological interest

Magnitude of impact

The approach used to assess significance of impact is determined by two variables; the environmental value of the asset, as described in Table 1 and the magnitude of impact (change) upon the asset. This takes into account the severity of impact from the proposed activity.

Table 3 summarises the type of impact and its magnitude, according to the DMRB methodology.

Table 3: Magnitude of impact

Magnitude of impact	Description of impact
Major	Complete destruction/demolition of site or feature. Change to the site or feature resulting in a fundamental change in our ability to understand and appreciate the resource and its historical context and setting.
Moderate	Change to the site or feature resulting in an appreciable change in our ability to understand and appreciate the resource and its historical context and setting.
Minor	Change to the site or feature resulting in a small change in our ability to understand and appreciate the resource and its historical context and setting.
Negligible	Negligible change or no material change to the site or feature. No real change in our ability to understand and appreciate the resource and its historical context and setting.
No Change	No change.

Significance of effect

In accordance with the DMRB methodology, the significance of effect upon the cultural heritage resources is assessed according to the matrix approach described by Table 4: Significance of effect. The effects may be either adverse or beneficial, depending on the nature of the impact. It should be noted that the initial assessment is made for the proposed project without mitigation; in the event that mitigation is proposed the residual effect as a result of mitigation is determined separately. Where the matrix suggests more than one likely outcome, for instance slight or moderate, professional judgement is used to arrive at an appropriate result.

Table 4: Significance of effect

		MAGNITUDE OF CHANGE				
		No Change	Negligible	Minor	Moderate	Major
ENVIRONMENTAL VALUE	Very High	Neutral	Slight	Moderate / Large	Large / Very Large	Very Large
	High	Neutral	Slight	Moderate / Slight	Moderate / Large	Large / Very Large
	Medium	Neutral	Neutral / Slight	Slight	Moderate	Moderate / Large
	Low	Neutral	Neutral / Slight	Neutral / Slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral / Slight	Neutral / Slight	Slight

4.5 Archaeological potential

The assessment of the archaeological potential of a site is based upon an understanding of the known archaeological and other cultural heritage assets in the area, combined with an understanding of the site history and site formation history. Potential is assessed qualitatively here, and follows the below criteria.

Table 5: Assessment archaeological potential

Archaeological Potential	Qualitative criteria
Low potential	The site is considered to be unlikely to contain archaeological evidence, or archaeological evidence has previously been removed or severely truncated by previous development or investigation.
Medium potential	There is historical or indirect evidence to suggest unknown archaeological materials or features may be encountered.
High potential	The site is considered to be likely to contain archaeological evidence based on deposit modelling, geophysical survey or other indirect evidence, or archaeological evidence is present on part of the site but the extent and condition of the evidence is unconfirmed.

5 Baseline

The archaeological baseline, including elements of the historic landscape, is discussed below. This includes information both from within the site and within 500m of the proposed Scheme alignment, refer to Appendix A for a full list of assets and Appendix B for a map of assets. It also incorporates the observations gained via map regression, see Appendix C.

Known heritage assets are referred to in the baseline by the reference number assigned by the Humber HER, prefixed with HER No. The same reference numbers can also be found in Appendix A and on Figures 2 to 5.

NHLE No. prefixes assigned to listed built heritage and archaeology are found in *Appendix A.*

Discussion of the historical and archaeological background uses approximate historical periods as defined by English Heritage[9].

Table 6 – Historical periods and date ranges as defined by English Heritage and Historic England

Period	Date range	Breakdown of Period
Prehistoric	500,000 BC - AD43	Palaeolithic - 500,000 – 10,000BC
		Mesolithic - 10,000 – 4,000BC
		Neolithic - 4,000 – 2,200BC
		Bronze age - 2,200 – 700BC
		Iron age - 700BC – AD43
Romano-British	AD43 - 410	
Early Medieval (Anglo-Saxon)	410 - 1066	
Medieval	1066 - 1540	
Post-Medieval	1540 - 1901	Tudor - 1485 - 1603 (Elizabethan - 1558 – 1603)
		Stuart - 1603 – 1714 (Jacobean 1603 – 1625)
		Hanoverian – 1714 –1837 (Georgian 1714– 1830)
		Victorian - 1837 - 1901
Modern	1901 - 2100	20th century – 1901 – 1999
		21st century – 2000 – 2100

[9] Taken from PastScape's database of information on England's archaeology and architecture available at: http://pastscape.org.uk/TextPage.aspx, accessed 07/12/2017

5.1 Historical and archaeological background

Prehistoric (Palaeolithic to Iron Age - 500,000 BC to AD 43)

During the Palaeolithic (40,000-10,000 BC), after the last glacial maximum, further climate warming meant the environment changed from steppe-tundra to birch and pine woodland. It is probably at this time that Britain first saw continuous occupation. Erosion has removed much of the Palaeolithic land surfaces and finds are typically sparse and residual. An elephant's tooth (MHU2654) was discovered at the cliff edge on the north promenade in Withernsea town. This may indicate the very different climatic conditions the area experienced at that time from the present day. Low sea levels meant that the area of the Withernsea and Hollym formed part of an inland plain. The coastline would have been much further out as the land mass known as Doggerland, now submerged in the North Sea, would have been a principal activity area for hunter-gather communities.

The Withernsea Mere (MHU8993), a silt-filled depression, situated on the cliff edge may have been a pre-historic pond, potentially containing ecofacts and artefacts such as lithics. The RCZA survey noted there is no longer any trace of this feature as contemporary mapping indicates the site of the mere has modern development. Furthermore, it may have been of a later date. Humber HER dates it from the Lower Palaeolithic to Medieval period.

The Mesolithic hunter-gather groups of the postglacial period (10,000-4,000 BC) inhabited a largely wooded environment, with the river valleys being favoured for their reliable sources of food (hunting and fishing) and water as well as providing a means of transportation and communication. Evidence for prehistoric occupation from at least the Mesolithic period is sparse around the Withernsea area. Although no evidence has been recorded in the modern intertidal zone at Withernsea, a possible submerged forest called 'Noah's Wood' of possible Mesolithic date was recorded in 1839 (MHU8993).

The Neolithic (4,000-2,000 BC) is generally considered to be the transition period when hunter-gatherer society changed to farming and settled communities, with large scale forest clearance occurring over large areas of the British Isles for the cultivation of crops and the construction of communal monuments. An evaluation of the study area has shown no known heritage assets of this period.

The Bronze Age (2,000-600 BC) is characterised by technological change, when copper and bronze eventually replaced flint and stone as the main material for everyday tools. The period is marked by increasing social complexity and organised landscapes, probably resulting from population increase and resource pressure. Evidence within the study area remains sparse. A possible round barrow cemetery (MHU19411) is situated approximately 800m east of the main site. A barbed-and-tanged arrowhead (HMU2628) was recovered 200m south of this feature. A cluster of three barrows (MHU19218) are located approximately 150m west of the proposed development area for the rising main, however the condition of these features is unknown. Two logboats (MHU2655) were found

approximately 330m northwest of the proposed development area of the Rising Main. The boats were a similar construction to Bronze Age logboat examples along the Holderness coastline[10].

During the Iron Age (600 BC-AD43) the climate became cooler and wetter, and the period saw an expanding population necessitating the intensification of agricultural practices and the use of marginal land. Evidence within the study area suggests artistry and craftsmanship may have been prevalent, with examples like the Withernsea Figurine (MHU17846). The sculpture is 10.8cm in height and 7cm in diameter. The object depicts a male person with his left arm forward and his right arm reaching for a sword on the figure's back[11]. A bronze coin denoting the image of Cunobeline, a British chief of the Trinovantes, reigning c. AD 10 - AD 40s, was recovered on the beach at Holmpton[12].

Settlement remains have not been found within the study area, however in 2009 a settlement was found a short distance outside of the study area near Eastfield, approximately 1.25km southwest of the main site[13]. Settlement features typical of the Iron Age, ring ditches and penannular features were recorded showing almost continuous domestic occupation from the late Iron Age and until to the 3rd/4th century AD. Many sherds were recovered from the excavation, representing an estimated 645 separate ceramic vessels. Animal bone assemblage suggests the husbandry and possession of herds of cattle, sheep and other livestock such as horses and pigs. Early Iron Age inhumations have also been recovered during archaeological investigations in preparation of a pipeline between Burstwick and Rimswell[14].

Circular cropmarks (MHU19211; MHU19213), identified in aerial photography, within the Hollym area may indicate ring ditches however are undated, therefore cannot confidently assumed to be prehistoric features.

Romano-British (AD 43 to 410)

In addition to the settlement evidence from Eastfield which showed continuity of occupation from the Iron Age Evidence for Roman activity in Withernsea is demonstrated by pottery sherds found at Queen Street (MHU19656) and possible cinerary urns from Bannister Street (MHU2657).

Low volumes of Romano-British pottery sherds, representing a single vessel, were present in Church Lane (MHU15820), Hollym.

The most substantial evidence was the claim that a hoard of 500 bronze coins (HMU2616), dated to AD 258-293, and were recovered of the shore near Intake in

10 Supposed recovery occurred in 1715 and 1785 however no physical remains are now extant. The craft were recorded by lacustrine deposits it is suggested they were used primarily, if not exclusively, on lakes extant during the Bronze Age (McGrail 1990, 112).
11 The objects was recovered among post-medieval brick in a private garden. This has led to some doubting the figurines authenticity (Stead 1988).
12 The Trinovantes tribe territory once encompassed an area of present-day Essex and Suffolk. This may imply long-distance, most likely seaborne, contacts with other British communities. It is interesting as the Holderness region was not producing coins at this time.
13 Network Archaeology 2009, 112-115
14 Pers. Com. Northern Archaeological Associates. Dec, 2017

1881. It was reported that a storm had washed the hoard out of the cliff and onto the beach where it was found[15]. The other known example of Roman coinage is a silver denarius (MHU17843) depicting Emperor Hadrian, dated AD 117 – 138. It was found east of Hollym.

Early medieval (AD 410 to 1066)

The settlement at Withernsea was extant prior to 1066[16] implying early medieval activity however evidence of human occupation during this time is scarce as the early medieval footprint of Withernsea fell into the sea as a result of coastal erosion (MHU14622).

Medieval (AD 1066 to 1540)

Owthorne and Withernsea were spatially well-defined, separate settlements during the medieval period (MHU14662; MHU8992).

The Domesday Book of 1086 recorded Withernsea as 'Widfornessei'. It was a very small settlement extant prior to the Norman Conquests. The village boasted an estimated 3 households. The surrounding area was predominantly agricultural with 40 'ploughlands' and a 100 acre meadow[17]. After 1066, Withernsea and its hinterland were assigned to the Counts of Aumale. The village of Hollym is first recorded in the Domesday Book as sitting within the 'soke of the Withernsea Manor'[18] .

St Mary's Church, Withernsea (MHU14668) is recorded in the 12th century. This churched formed part of the 'sisterkirkes', an informal twinning with the Church of St Peter in Owthorne[19]. No physical evidence of St Mary's church exists as a result of the coastal erosion in the 15th century.

Withernsea was turned over the Crown authority in the late 13th century. The settlement was granted an established market by the 14th century and two three-day fairs, respectively granted in 1338 and 1348[20]. Humber HER notes that Owthorne boasted a manor house with ancillary buildings in its curtilage in the 14th century. By 1377, it was recorded that 116 taxpayers dwelt within Hollym. References to shipping and ship building imply that Withernsea served as a minor port until the greater area of the medieval footprint was lost to coastal erosion in the 15th century. The distribution of evidence in the Humber HER demonstrated continued activity on some parts of Withernsea's modern footprint following the loss of the majority of the medieval townscape to the sea. The Church of St Nicholas (MHU4993) was built on Priest Hill in AD 1488. It is noted by the RCZA survey that moated sites, small hamlets and farmsteads may have been

15 Miles, G.T.J & W. Richardson, 1911
16 Information sourced from: Domesday Book, Phillimore reference: 14E [15] . 4M
17 Ibid.
18 Open Domesday
19 Withernsea History
20 Information sourced from: Atkinson, D. (1998). *Watching Brief at Queen Street South, Withernsea*. Report No. 282. Humber Field Archaeology: Unpublished report

extant near Withernsea and have subsequently been lost to erosion or truncated by long-term farming practises.

Post-medieval (AD 1540 to 1901)

In 1672, hearth tax returns recorded 60 'households' in Hollym Parish. By 1743, 70 families were listed in the area. This figure dropped to 65 families in 1764. The 1801 census recorded the population as 223 within the parish[21].

The Thomas Jeffery's 1771 map of Holderness indicates minimal building between Withernsea and Hollym except for the presence of windmills/cornmills (MHU14666) that would have likely supported local arable agricultural practises. The 1855 Ordnance Survey illustrated that the predominant land use continued to be arable agriculture. The Humber HER notes that a windmill and vicarage (MHU14658; MHU14655) were built upon the footprint of the 14th century manor house at Owthorne. The village of Hollym had a very low population density. The majority of the settlement was comprised of open parcels of land within which sat farmers' homes. A public house, called the Plough Inn, was extant and situated close to the Grade II listed Church of St Nicholas (MHU2612), first built in 1814.

A restoration process of the ruins of St. Nicholas' Church began in the early 19th century following the initial abandonment in 1609 and the loss of the Church of St Peter to the sea by the early 19th century. By 1859, the church of St. Nicholas had been restored for purpose as a functioning place of worship (MHU4993).

In the later post-medieval period, Withernsea developed into a popular seaside resort, an attraction that became increasingly common during the 18th/19th centuries. The increased industrial presence was likely a consequence of tourism prompted by the construction of the Hull to Withernsea railway branch (MHU11372; MHU8830) in 1852. Associated with the development of Withernsea as a sea-side tourist attraction is the expansion of residential dwellings and consequently, increased density in the town. A hotel (MHU7487) on Queen Street South was constructed near to the railway station to cater for visitors. Increased housing development provided for more-permanent visitors.

The area of Owthorne and Hollym increasingly developed industrial practises during the 19th century that left physical impacts on the landscape and topography. A number of brick works were established, at the intersection (MHU11414) between Crofts Lane, which lead to Hollym, and the Hull to Withernsea Railway branch. A large dry depression within a field system is all that is visible in the present day. Late 19th century Ordnance Survey indicated a water-filled pits extents when the brickfield was functioning. Other brickworks were situated at the southern extent of Withernsea (MHU11363; MHU11364), and another was further south, on the east side of Holmpton Road (MHU11374). A former gas works, bordering the site of the former railway station, was also functioning within the proposed site until the early 20th century. Gas works provided domestic power for housing built from supplies produced by the multiple

21 Information sourced from: 1801-1851 Population tables, Population Abstract for England & Wales, in: *1851 Census of Great Britain*

brickworks. These industrial sites and new housing, for the most part, were built on previously open space.

By 1893, the Withernsea lighthouse (MHU1880) was completed. It was brick-built, stuccoed and whitewashed. The tower was approximately 38 metres high. It ceased operation in 1976. The lighthouse is extant in the present day, it remains an important landmark that dominates the landscape and is Grade II listed.

Modern (1901-Present)

Ordnance Survey evidence indicates that the rural areas of and within the proposed development area altered little from post-medieval patterns. Withernsea experienced further urbanisation with residential areas constructed to the north and south of Pier Road. By this time, the settlements of Withernsea and Owthorne appeared to have become indistinct from each other. Attractions such as the Italian gardens (MHU22028) were built that boasted a pleasure garden and tennis courts.

A new gas works was extant south of the railway terminal by 1910. Brickworks appeared to have ceased operation in Withernsea by the 1920s/1930s as housing development appeared to stagnate by the mid-20th century. Humber HER records a war memorial (MHU22029) dedicated to men from within the parish who served and died during the Great War (1914-1918). Unveiled in 1921 within the Italian Gardens (MHU22028), it is now a Grade II listed monument, see *Appendix A* for NHLE detail.

By 1927-1929, the Withernsea Mere (MHU8993), had been built over by a seafront promenade and gardens.

An Anglian Church, St. Matthew's was constructed in 1934 (MHU20845). It was situated with the Owthorne footprint and fronted the Hull road. It was given Grade II listed for its architectural influences that were inspired by medieval gothic styles.

The majority of modern heritage assets noted by the Humber HER are military defence networks built during the Second World War (1939-1945). In urban areas these defence networks took the form of roadblocks, anti-tank blocks and concrete pillboxes for gun emplacements. The Humber HER indicates that a military camp (MHU21446) was established on the footprint of post-medieval brickworks (MHU11364). The Humber HER notes most Second World War assets were situated outside the study area, along the coastline, or within the boundary of the existing WwTW, see *Appendix A* for further detail. Most assets of this type were usually superficially planted with shallow foundations. It is difficult to affirm whether these assets are extant without a site visit (see limitations). It is likely that assets of this type were removed or lost to coastal erosion. The site of a military direction finding station (MHU19060) and possible RAF radar mast (MHU21463) are recorded approximately 260m north of the LSO proposed route.

Hollym, witnessed negligible development or change. Some small housing units were recorded in 1952 in Hollym with small land parcels attached. Similar housing units were recorded at this time along the Withernsea Road, now A1033, and the intersection with Smook Hills Road.

The Hull to Withernsea railway, first built in the mid-19th century, ceased operation in 1965, and the Withernsea railway station was later demolished in 2007 (EHU1373).

5.2 Previous archaeological investigations

Proposed Development Area

No known previous archaeological investigations have taken place within the proposed development area.

500m Study Area

Within the study area of the proposed Scheme three previous archaeological investigations have taken place.

A watching brief (EHU1373) was conducted in 2007 on groundworks for the development of a two-storey police station within the footprint of the former Withernsea Railway station (MHU11372). The 19th century station, platforms and railway line was demolished. No earlier archaeological features or artefacts were noted.

A watching brief (EHU647) carried out in 1999 recorded a Romano-British pit feature (MHU19656) at Queen's Street Withernsea. Within this feature was a single pottery sherd, possibly from a bowl with a beaded rim dating to the 2nd/3rd century AD. The majority of the Romano-British material in the vicinity of Withernsea has been recovered from the base of the cliff front or within the modern intertidal zone. Atkinson (1999) suggested further monitoring should be conducted in an effort to ascertain a greater understanding of the Romano-British extent in the area.

In 2014, a watching brief (EHU2113) was undertaken within the footprint of the 19th century Italian Gardens (MHU22028). Masonry and a brick boundary wall associated with the Italian Gardens were identified however no other archaeological features or artefacts were recovered.

5.3 Archaeological potential

Although there is evidence for activity of Palaeolithic to Neolithic date in the study area it is concentrated in the vicinity of the cliff and beach at North Parade, Withernsea. The potential for encountering Palaeolithic to Neolithic remains in the proposed development area is judged to be medium. If encountered they are likely to comprise small quantities of lithic remains.

Evidence for Bronze Age activity in the study area is comprised of a number of burial monuments in the form of barrows scattered south of Withernsea and Hollym and two log boats found in Withernsea Mere. The potential for encountering Bronze Age remains in the proposed development area is considered medium. If encountered the remains might comprise the ploughed out remnants of burial monuments with associated artefactual and environmental material.

The BGS notes a lacustrine deposit situated in the north-east corner of the proposed main site, see Section 1.3. This deposit is likely, depending on the degree of waterlogging, to provide good survival of palaeoenvironmental remains and possibly also of artefactual remains.

Only two finds of Iron Age date are known from the study area.. Furthermore, excavations approximately 1.25km southwest of the main site carried out in 2008-2009. Considering this evidence, the low volume of Iron Age assets is likely related to a lack of thorough investigation, therefore a medium potential for encountering Iron Age evidence is anticipated.

Romano-British evidence from within the study area has been found predominantly along the Holderness coast with one findspot recovered in Hollym. The evidence consists of primarily findspots not found in situ. This distribution is in keeping with historic erosion trends and might imply that a more substantial roman footprint may have been lost to the sea. The implication of the known record is that moneyed trade was taking place across this area as the majority of evidence was coinage. This may suggest a market and possible settlement. If such places existed they may have been lost to erosion however archaeological extent is unknown, see *Previous Archaeological Investigations & Limitations*. Failure to identify Romano-British archaeology with Aerial Photography may not imply a lack of evidence. The compact boulder clay and silt geology, seasonally churned up by ploughing can affect the visibility of archaeological signatures. It is considered the potential for encountering Romano-British evidence is medium.

The known early medieval and medieval towns of Owthorne and Withernsea are understood to have been lost to the sea (MHU14662). The Humber HER has recorded no archaeological features or artefacts within the proposed development area or study area that pertain to the early medieval period, however given the lack of thorough investigation, archaeological extent of the area is unknown. It is therefore considered the potential for encountering Early Medieval evidence is medium. Given the rarity of material from this period any recovered would be of medium to high value.

Recorded medieval evidence is concentrated within the known medieval footprints of Owthorne and Withernsea. This evidence has long since been demolished/built-over by subsequent developments. Some further evidence is situated south close to the A1033 road, in Hollym, and south of Hollym. No discernable distribution pattern is identified. The site of a windmill (MHU9200), sits approximately 20m to the west of the proposed main site boundary according to the Humber HER. Its proximity to the site may suggest the possibility of encountering associated remains and/or features. The site of a medieval moated site (MHU2615) is approximately 120m south of the proposed HDD starting point boundary. Ploughing may have had an adverse effect on potential buried evidence. Furthermore, as mentioned above archaeological extent of the area is unknown. It is therefore considered the potential for encountering medieval evidence is medium.

The Humber HER indicates that there is a defined distribution pattern focussing at the town centre and becoming more scattered and sparse to the south. The majority of extant post-medieval assets across the study area comprise of church

buildings, maritime structures, public houses, residential properties and farm houses. Brickyards, gasworks, and windmills have been dismantled or built over by subsequent development. As *section 1.3* indicates the underlying geology in modern Withernsea within the northern zone of the proposed development area comprises of made ground related to known post-medieval evidence approximately -0.5m to -1.5m. Furthermore, the route of the Rising Main follows the 19th century railway line. The dismantlement of the line in the latter-half of the 20th century would suggest only trace features may be encountered. Archaeological investigations conducted within modern Withernsea and cartographic evidence provide a firm understanding of post-medieval evidence within the proposed development area and study area. A map regression shows that, except for the urban sprawl to the north, the landscape has remained relatively unaltered as vast open land utilised for arable farming with sporadic distributions of farm houses. It is therefore considered that there is a low potential for encountering post-medieval evidence, if, however, evidence is encountered it is likely to be of low value.

Known modern evidence follows a similar trend to the post-medieval evidence however with a greater concentration, mostly Second World War assets, along the coastline and very few heritage assets inland. Cartographic evidence indicate a lack of modern development/activity within the proposed development area therefore it is considered that there is a low potential for encountering modern archaeological evidence, furthermore if evidence is encountered it is likely to be of low value.

Despite the lack of development within the proposed development area, environmental evidence is sparse. Section 1.3 notes sporadic distributions of lacustrine deposits, one deposit is situated in the north-east corner of the proposed main site. BGS borehole samples taken close by do not record any geoarchaeological evidence. As such it is considered that there is a low potential for geoarchaeological remains.

Overall, archaeological potential is medium. The volume and scale of previous archaeological investigation is wholly inadequate to inform archaeological potential. Furthermore, apart from one, all investigations were carried out within Withernsea town. The Humber HER results show that the majority of known heritage assets have been focused along the coastline, with sporadic distributions of assets further inland. It should also be noted that the archaeological investigations mostly sit within the Withernsea town footprint, this might imply a distribution bias in the record. Archaeological investigations appear to have recovered remarkably little of the results presented by Humber HER. Most known heritage assets appear to have been identified through other means, i.e. observation visible assets, aerial photography, cartographic and textual references, and informal surface recoveries. The implication is that this area is not devoid of archaeological signatures but adequate investigation and monitoring to sufficiently understand the areas archaeological extent has not taken place. Consequently, archaeological potential must be regarded as medium.

Table 7: Archaeological potential of the site

Description	Potential within proposed development site
Remains associated with prehistoric activity	Medium
Remains associated with Romano-British activity	Medium
Remains associated with early medieval activity	Medium
Remains associated with medieval activity	Medium
Remains associated with post-medieval activity	Medium
Remains associated with modern activity	Low
Remains with geoarchaeological potential	Low

5.4 Identification and significance of heritage assets

The heritage assets within the proposed development area are detailed in table 6.

No conservation areas sit within the proposed development area or study area.

The study area contains one Grade II* listed building, the medieval church of St. Nicholas in Withernsea and three Grade II listed buildings and one Grade II listed monument. Three designated heritage assets are outside of the study area in Hollym. Nonetheless, professional judgment considers it appropriate to incorporate these assets into this report as their proximity to the Main Site may incur setting impacts.

Within the study area there are 115 non-designated heritage assets. These include various find spots, indications of occupational evidence and historical references.

Further details of the heritage assets within the Humber HER can be found in Appendix A.

Table 8: Heritage assets within proposed development area & designated heritage assets within study area

Name	Description	National Heritage List ID	Environmental Value
Heritage assets within the proposed development area			
FORMER HULL TO WITHERNSEA RAILWAY LINE	19th century railway track, cut and embankment built in 1852. Track was dismantled in the later 20th century.	MHU8830	Low
SITE OF WITHERNSEA GAS WORKS	19th century gas works adjacent to railway station. Disused by the early 20th century.	MHU11371	Low

Name	Description	National Heritage List ID	Environmental Value
WITHERNSEA HOSPITAL & HOTEL, QUEEN ST SOUTH	19th century hospital and hotel complex. Disused by the early 20th century and replaced by a convalescence home with attached gardens.	MHU7487	Low
ANTI-TANK BLOCKADE	20th century anti-tank blockade situated to the west of the Hull to Withernsea railway line.	MHU18876	Low
SITE OF WEAPONS PIT & TRENCH	20th century beach defence trench network. Structure has been removed or lost to the sea.	MHU19164	Low
SITE OF BRICKWORKS	19th century brickworks and yard and the intersection between Crofts Lane and the Hull to Withernsea Railway Line. Disused by the early 20th century.	MHU11414	Low
Designated heritage assets within study area			
Church of St. Nicholas, Park Avenue, Withernsea	A Grade II* listed functioning church first constructed in 1488. It was abandoned in the early 17th C. and subsequently refitted in the mid-19th C.	1366257 MHU4993	High
Withernsea Lighthouse and adjoining Keeper's House	A Grade II listed disused lighthouse built in 1893, keeper's house built concurrently. The lighthouse is whitewashed and only contained an inspection chamber and upper lamp room. A prominent landmark that ceased operation in 1976.	1083479 MHU2612	Medium
Outbuildings, garden wall & gate at Withernsea Lighthouse	Grade II listed ancillary features to Withernsea lighthouse constructed in 1893. Outbuildings of whitewashed stuccoed brick.	1310188 MHU9075	Medium
St. Matthew's Church	A Grade II listed functioning church building constructed in Withernsea in 1935. The building's design was influenced by medieval gothic styles.	1392281 MHU20845	Medium
War Memorial , Withernsea	A Grade II listed structure constructed in the early 20th century. It was unveiled in 1921 to commemorate the war dead of the Great War (1914-1918).	1439669 MHU22029	Medium
Church of St. Nicholas, Hollym	A Grade II listed functioning church building. Its tower was constructed in 1814, the remainder of the building was built in 1884.	1083479 MHU2612	Medium
Gravestone, approximately 20m SW of the Church of St. Nicholas, Hollym	A Grade II listed structure dated to 1743, and dedicated to Mary Tock and children. It remains one of the best examples of 18th C. carved gravestones in the East Riding area.	1310412 MHU3489	Medium

Name	Description	National Heritage List ID	Environmental Value
Pinfold on Northside road, Hollym	A Grade II listed structure constructed in the 18th C. or possibly earlier. It was built from cobble stones, approximately 10m diameter, and has a circular plan. Its walls are 1m high.	1083480 MHU11377	Medium

6 Assessment

6.1 Potential physical impacts

Previous Land Use

Footprint of the Main Site

Mapping in the 1771-1772, see *Appendix C*, indicates the main site area was open space and principally used as farm land during the 18th century. Most likely arable agriculture, evident by the neighbouring cornmills. This pattern is similar to agricultural practises noted in the Domesday Book, see *Medieval Baseline*. Ordnance Survey mapping illustrates the present-day field boundaries at the location of the proposed main site is the same as recorded in the 1855. No change or developments are recorded since 1855 to the proposed main site. Truncating impacts may have resulted from ploughing.

Footprint of the Rising Main

The Hull to Withernsea railway line was completed in 1854. Construction would have certainly had a truncating impact on potential buried archaeology. Documentary evidence records the closure of the line in 1965 and the demolition of the Withernsea station in 2007 (Jobling 2007). This action may have had further truncation impacts. Where the Rising Main route extends through farmland the possible truncating impacts are the same as the Main Site.

In Withernsea, a collection of unmarked buildings were extant on the western side of the railway in 1855. Opposite to the Withernsea train station was the Queen's Hotel, fronting a sea view with an L-shaped ancillary building behind it. In front of the hotel were gardens and the central road running through Withernsea. The area west of the Church of St. Nicholas, Withernsea was a wooded area marked as pleasure gardens and parkland in 1855. Gas works were recorded by the 1890s in the location of the unmarked collection of buildings. *Appendix C* indicates these structures were dismantled in the 20th century and replaced by new developments indicating continued truncation and destruction of potential archaeology within the Withernsea railway terminal area.

In the area of the Memorial Gardens pumping station, regularly planted trees bordered a promenade that led to a pier. A war memorial and communal hall were located within the footprint of the pumping station. 1995 mapping and aerial photography, see *Appendix C & Appendix D*, indicated that the war memorial had been moved to a location outside of the proposed development area, the communal hall had been dismantled, and the pumping station had been erected. The war memorial likely required shallow truncation, posing a very isolated impact. The construction of housing units, public spaces and utilities piping likely posed physical impacts on any underlying archaeology.

Footprint of the Long Sea Outfall

Sewage works on the site of the current WwTW were recorded extant by 1975, see *Appendix C*. The construction of these works would have likely had a truncating and adverse impact on any potential archaeology within its footprint.

As mentioned above in relation to the Main Site and Rising Main, historic evidence of ploughing may have resulted in truncating impacts.

Impact of the proposed Scheme

Rising Main and LSO installations are anticipated to comprise tunnelling and conventional cut-and-cover practises. The design details regarding the terrestrial depth of the pipeline are not finalised however it is anticipated that terrestrial trenching will reach approximately -1.2m below current ground level, however this may vary along the route.

Any surviving below ground archaeology is likely to be of low to medium value. The below ground work associated with excavation for the installation of pipework, and the excavations associated with the construction of the new WwTW will have a negative impact.

Vehicles will likely have to use the main road running through Hollym. Heavy vehicles and plant travelling within the village will likely have a negligible/minor polluting effect that may adversely alter the physical appearance of nearby designated heritage assets, particularly the Grade II listed Church of St. Nicholas, Hollym (MHU2612).

The temporary access routes, vehicle housing and worker shelters may require surface development not identified in the scheme. It is not expected that such works would have long-lasting detrimental effects to the integrity of the landscape. There is a potential for shallow foundation blocks to penetrate below the topsoil and encounter unknown archaeology.

The demolition of buried structures at the existing WwTW may incur damage through contact with equipment or disruptive vibrations. Conversely, any buried archaeology would likely have been removed during the construction phase of the existing WwTW therefore the potential to produce physical impacts to buried archaeology within the existing WwTW sites footprint is considered negligible.

No designated heritage assets are anticipated to be subject to physical impacts.

Impacts to archaeological assets are detailed below in Table .

Table 9: Summary of potential physical impacts

Heritage asset	Impact derived from	Magnitude of change	Significance of effects	Proposed mitigation	Residual effects
Site of Withernsea Hospital, Queen Street South	Excavation of trenches for the installation of Rising Main	Minor / Moderate	Slight Adverse	Watching brief and archaeological recording during construction ground works.	Slight Adverse

Heritage asset	Impact derived from	Magnitude of change	Significance of effects	Proposed mitigation	Residual effects
Site of Withernsea Gas Works	Excavation of trenches for the installation of Rising Main	Minor / Moderate	Slight Adverse	Watching brief and archaeological recording during construction ground works.	Slight Adverse
Grade II Church of St. Nicholas, Hollym (MHU2612)	Pollutants concentrated from high quantity of heavy duty vehicles travelling in close proximity during main site construction.	Negligible	Neutral/ Slight Adverse	Monitor and manage traffic through Hollym appropriately in accordance with CoCP.	Neutral/ Slight Adverse
Grade II Pinfold on Northside Road, Hollym	Pollutants concentrated from high quantity of heavy duty vehicles travelling in close proximity during main site construction.	Negligible	Neutral/ Slight Adverse	Monitor and manage traffic through Hollym appropriately in accordance with CoCP.	Neutral/ Slight Adverse
As yet unknown archaeological or palaeo-environmental remains deposits within the construction footprint	Excavation of trenches for the installation of Rising Main, LSO and Main Site. Shallow excavations/foundations for the installation of temporary construction infrastructure. Demolition of existing WwTW	Moderate Minor Neutral	Moderate Adverse Slight Adverse Neutral	Watching brief and archaeological recording during geotechnical works (if required) and construction ground works. Consider appropriate measures in accordance with the CoCP.	Moderate Adverse Slight Advers Neutral

6.2 Potential setting impacts

This area of Holderness is broadly flat and boasts high visual sensitivity[22]. Design of the main site may approach visual setting sympathetically as the treatment cells are to be encased in grassed earth embankments rising up to 4.5m above existing ground levels. The design of the main site is not dissimilar to the existing WwTW that has been effectively concealed with use of hedges as screening. This should help to shield and establish the works in the landscape in a subtle fashion.

During the construction phases, vehicles and plant will be highly visible. A total of 6310 vehicles, (scheme description 11/12/2017), are expected to be required, over the anticipated 18 month construction period, for the building of the main site. Construction access is expected to be via Myer's Lane, however dedicated temporary roads are suggested. Given the volume of traffic expected during construction, temporary roads and prefab work structures may be anticipated. The

22 Information sourced from: 'Easting Riding of Yorkshire Landscape Character Assessment: Selected Settlements Update 2013, Withernsea'.

sheer quantity and concentration will be alien to the landscape. Damage and/or truncation to the topsoil of field systems may only have negligible visual setting impacts as the farm land is regularly ploughed. The Grade II listed 19th century lighthouse at Withernsea commands the landscape. Construction of the Rising Main will sit within this assets zone of theoretical visibility[23]. It is considered that this will have a minor visual setting impact on the lighthouse as the construction activity will temporarily alter the landscape within which this asset dominates[24]. If permanent access upgrades are required appropriate measures to limit visual setting impacts should be considered.

The demolition and construction phases may incur minor noise setting impacts, however without observing usual noise conditions, see *limitations*, the assessment is limited in how confident it ascribes noise setting impacts. Given the landscape character is primarily low-density, open space, it is anticipated that noise generated will travel and have slight adverse setting impacts for the designated heritage assets within the village of Hollym. During operation, noise impacts are considered to be negligible.

Once operational, another consideration is any potential odour impacts. The main site will be located outside of the predefined 400m odour buffer from settlements[25]. The Odour Modelling Report has predicted West/Southwest predominate wind directions, therefore odours will usually tend to be carried any from the vicinity of designated heritage assets in Hollym. The Odour Modelling Report has predicted predominate winds in West/Southwest directions, therefore odours will usually tend to be carried any from the vicinity of designated heritage assets in Hollym. Furthermore, as the predominant surrounding land use is arable farming it is possible that designated heritage assets are already subjected to odour impacts through fertilisers.

Setting Impacts to designated heritage assets are detailed below in Table 10.

Table 10 – Setting Impacts to designated heritage assets

Designated Heritage Asset	Setting Impact	Temporary/ Permanent	Magnitude of change	Significance of effects	Proposed mitigation	Residual effects
Church of St. Nicholas, Hollym	Noise during construction of the pipelines and main site.	Temporary	Minor	Slight Adverse	Monitor noise levels during construction.	Slight

23 Approximately 10-20 HGV movements and 10-20 car/van movements will be anticipated per day over a 12-18 month construction period
24 The original setting of the lighthouse, based upon its historical function, would have been a maritime focus. Since ceasing maritime related operation in 1976 it functions as a museum and part of its significance is its prominence in the terrestrial landscape.
25 H&M Environmental Ltd, Odour Modelling Report 2017

Designated Heritage Asset	Setting Impact	Temporary/ Permanent	Magnitude of change	Significance of effects	Proposed mitigation	Residual effects
Pinfold on Northside Road, Hollym	Noise during construction of the pipelines and main site.	Temporary	Minor	Slight Adverse	Monitor noise levels during construction.	Slight
Lighthouse, Withernsea	Visual impact during construction phase of rising main	Temporary	Negligible/ Minor	Slight Adverse	Consider screening and other appropriate actions in accordance with the CoCP to limit the visual impacts of construction.	Slight

7 Conclusion

7.1 Discussion

Baseline evidence of Prehistoric and Romano-British periods are recorded outside the proposed development area. Medieval settlements are recorded at Owthorne and Withernsea, but, expect for the church of St. Nicholas, little to nothing remains due to subsequent development. The 19th century to 21st century, the rural landscape has been relatively unaltered. Some developments have taken including: a railway line, sewage works and residential units. The Humber HER provides accurate information of the known assets however does not represent the archaeological extent of the area. As discussed in the *Limitations* and *Previous Archaeological Investigations,* investigations have been concentrated within one area of the proposed Scheme, evaluated small-scale sites and/or provided erroneous data. Furthermore, a study of the Humber HER archive has revealed many assets are surface finds collected accidentally or documentary evidence with no surviving materials. Consequently, archaeological potential has been assessed as detailed in table 5, see *Archaeological Potential*.

As discussed in *Potential physical impacts,* there are six heritage assets recorded within the proposed development site. Four assets of low value are recorded within the footprint of urban Withernsea where directional drilling of the Rising Main is anticipated. No visible evidence of the former gas works (MHU11371) and former hotel/hospital (MHU7487) are visible above ground, however buried evidence may potentially survive. The embankments and cut of the former Hull to Withernsea railway (MHU8830) are extant. The site of 20th century anti-tank blockades (MHU18876) intersects the proposed Rising Main route. No evidence above ground is visible in historic and contemporary mapping. Dependent on the drilling depth potential remains may be moderately physically impacted should they fall within the construction footprint.

The former 19th century brickyard (MHU14414) is recorded at the access point for the Rising Main development, see *Appendix B*. No evidence is visible above ground and the asset is of low value, buried evidence may be extant. Truncation may occur if topsoil striping to create surfaces for vehicles are anticipated. The anticipated footprint of the proposed Scheme suggest that the magnitude of change would be of negligible/minor impact to these low valued assets, resulting in a neutral impact.

No physical impacts are anticipated to the Second World War weapons pit/trench system (MHU19164) as it is will be out of the reach of the HDD tunnelling.

There is also the potential that unknown deposits or remains of archaeological interest will be truncated by ground excavation, and tunnelling associated with the proposed Scheme. The magnitude of potential effects is considered to be moderate adverse. Furthermore, where access routes, storage areas and accommodations are anticipated the associated superficial truncations may have a slight adverse effect.

The proposed Scheme may incur minor temporary setting impacts to designated heritage assets within the vicinity of the proposed development area however negligible permanent setting impacts are expected. See *Potential setting impacts* for further detail.

7.2 Next steps

Preliminary pre-application consultation has been undertaken with Mr James Goodyear of the Humber Archaeological Partnership. (Appendix E).

The lack of understanding archaeological extent must be addressed before the proposal can proceed to the next stage. This may be done through various evaluative measures.

Where truncation through development has not taken place along the routes of the Rising Main, LSO and site of the proposed WwTW geo-physical may be considered. However, the systematic and long-term ploughing practises of the firm boulder clay and silts, see *Underlying Geology,* may affect the accuracy of results. Ground Penetrating Radar (GPR) surveys may also be considered, however ploughing impacts may incur similar limitations. Another evaluative measure that should be considered is field walking surveys. Given the agricultural practises, this measure is appropriate. Field surveys allow large tracts of space to be recorded without the need for specialist equipment. While it cannot determine in situ archaeology it can provide a general picture of the archaeological record. Concentrated scatters of surface finds, based on period/type can help identify archaeological signatures and patterns. Field surveys record scattered soil markings and topography that may be indicative of archaeological features. Topography was not assessed for this report, see Section 4 (Limitations). Conversely, this measure observes the surface and as noted in Section 4 (Archaeological Potential) deeper buried archaeology, usually prehistoric, may escape ploughing impacts and remain undetected. To ensure the most reliable and accurate coverage this report proposes that a package of evaluative measures be adopted instead of a single option.

Once the evaluative phase is complete and archaeological extent is understood to the best of professional ability an appropriate mitigation strategy can be devised. This is likely to include watching briefs along transects of conventional trenching for the Rising Main, LSO and Main Site. Archaeological excavations may be considered following the results of evaluative measures.

Where physical and setting impacts related to construction-related activities may affect designated and non-designated heritage assets, measures should be devised, in consultation of the Code of Construction Practise, to minimise these impacts.

The scope and methodology for such works should be agreed with the Humber Archaeological Partnership Development Management Archaeologist prior to the commencement of development.

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National Grid 1975-1978, 1:2,500

National Grid 1995, 1:2,500

APPENDIX A

Cultural Heritage Gazetteer

Cultural Heritage Assets within the Proposed Development Area								
HER reference	**Site Name**	**Type**	**Form**	**Date Range**	**Period**	**Map Sheet**	**NGR**	**Designation**
MHU11371	SITE OF GAS WORKS	Monument	GAS WORKS	AD 1800 - 1899	Post Medieval	TA32NW	TA 3411 2767	N/A
MHU18876	ANTI-TANK BLOCKS	Monument	ANTI TANK BLOCK	AD 1901 - Present	Modern	TA32NW	TA 3401 2759	N/A
MHU19164	SITE OF WEAPONS PIT & TRENCH	Monument	WEAPONS PIT, TRENCH	AD 1901 - Present	Modern	TA32NE	TA 3618 2562	N/A
MHU7487	WITHERNSEA HOSPITAL, QUEEN ST SOUTH	Building	HOTEL, STABLE, HOSPITAL	AD 1854	Post Medieval	TA32NW	TA 3424 2773	N/A
MHU8830	HULL TO WITHERNSEA RAILWAY	Monument	RAILWAY LINE	AD 1854 - 1965	Post Medieval	TA32NW	TA 3440 2796	N/A

Cultural Heritage Assets outside Proposed Development Area								
HER reference	**Site Name**	**Type**	**Form**	**Date Range**	**Period**	**Map Sheet**	**NGR**	**Designation**
MHU2654	ELEPHANTS TOOTH	Find Spot	FINDSPOT	500000 to 10001 BC	Palaeolithic	TA32NW	TA 342 282	
MHU8993	SITE OF MERE, NEAR OLD WITHERNSEA	Monument	LAKE	500000 BC to AD 1539	Lower Palaeolithic to Medieval	TA32NW	TA 34500 28010	
MHU2653	NOAH'S WOOD SUBMERGED FOREST	Landscape	SUBMARINE FOREST	10000 to 4001 BC	Mesolithic	TA32NW	TA 343 282	
MHU19218	THREE BARROWS?	Monument	ROUND BARROW	2350 to 701 BC	Bronze Age	TA32NW	TA 334 265	
MHU19411	POSSIBLE ROUND BARROW CEMETERY	Monument	ROUND BARROW	2350 to 701 BC	Bronze Age	TA32SE	TA 352 240	
MHU2655	TWO LOGBOATS	Maritime	FINDSPOT	2350 to 701 BC	Bronze Age	TA32NW	TA 342 282	
MHU747	SITE OF POSSIBLE BARROW	Monument	BARROW	2350 BC to AD 42	Early Bronze Age to Late Iron Age	TA32NE	TA 3525 2507	
MHU17846	CHALK FIGURINE, WITHERNSEA	Find Spot	FINDSPOT	800 BC to AD 42	Iron Age	TA32NW	TA 346 274	
MHU2614	IRON AGE BRONZE COIN OF CUNOBELINE	Find Spot	FINDSPOT	800 BC to AD 42	Iron Age	TA32NE	TA 3644 2532	
MHU19215	CIRCULAR FEATURE	Monument	RING DITCH	500000 BC to AD 42	Prehistoric	TA32NW	TA 3443 2607	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU15820	POSSIBLE RB VASE, CHURCH LANE	Find Spot	FINDSPOT	AD 43 to 409	Roman	TA32NW	TA 34 25	
MHU17843	DENARIUS OF HADRIAN, E OF HOLLYM	Find Spot	FINDSPOT	AD 43 to 199	Roman	TA32NE	TA 365 253	
MHU19656	RB PIT AT WITHERNSEA	Monument	PIT	AD 101 to 299	Roman	TA32NW	TA 3443 2770	
MHU2616	ROMAN COIN HOARD, INTAKE FARM	Find Spot	FINDSPOT	AD 43 to 299	Roman	TA32NE	TA 359 259	
MHU2657	ROMAN POTTERY	Find Spot	FINDSPOT	AD 43 to 409	Roman	TA32NW	TA 341 281	
MHU14653	SITE OF MANOR HOUSE, OWTHORNE	Monument	MANOR HOUSE	AD 1300 to 1399	Medieval	TA32NW	TA 34 28	
MHU14668	SITE OF CHURCH OF ST MARY	Monument	CHURCH	AD 1100 to 1499	Medieval	TA32NW	TA 34 28	
MHU2615	SITE OF SOUTH LEYS MOATED SITE	Monument	MOAT	AD 1066 to 1539	Medieval	TA32SE	TA 355 246	
MHU2649	SITE OF CHURCH OF ST PETER	Monument	ANGLICAN CHURCH	AD 1066 to 1539	Medieval	TA32NW	TA 3423 2835	
MHU8992	OWTHORNE LOST VILLAGE	Monument	DESERTED SETTLEMENT	AD 1066 to 1539	Medieval	TA32NW	TA 34 28	
MHU11734	SITE OF WINDMILL	Monument	WINDMILL	AD 1066 to 1899	Medieval to Post Medieval	TA32NW	TA 348 257	
MHU14655	SITE OF WINDMILLS, OWTHORNE	Monument	WINDMILL	AD 1300 – 1699	Medieval to Post Medieval	TA32NW	TA 34 28	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU14658	SITE OF VICARAGE, OWTHORNE	Monument	VICARAGE	AD 1066 - 1899	Medieval to Post Medieval	TA32NW	TA 34 28	
MHU21440	MEDIEVAL/POST MEDIEVAL RIDGE AND FURROW	Monument	RIDGE AND FURROW	AD 1066 - 1899	Medieval to Post Medieval	TA32NW	TA 33790 27870	
MHU4993	CHURCH OF ST NICHOLAS, PARK AVENUE (NORTH SIDE, OFF)	Building	ANGLICAN CHURCH	AD 1400 - 1699	Medieval to Post Medieval	TA32NW	TA 3424 2767	Grade II* Listing 1366257
MHU9200	SITE OF WINDMILL, SOUTH FIELD	Monument	WINDMILL	AD 1066 – 1899	Medieval to Post Medieval	TA32SW	TA 34 24	
MHU9727	WITHERNSEA MED/PM SETTLEMENT	Monument	TOWN	AD 1066 - 1899	Medieval to Post Medieval	TA32NW	TA 344 274	
MHU11362	SITE OF TITHE BARN	Monument	FARM	AD 1800 – 1850	Post Medieval	TA32NW	TA 3471 2690	
MHU11414	SITE OF BRICKYARD	Monument	BRICKWORKS, SITE	AD 1800 - 1899	Post Medieval	TA32NW	TA 3313 2559	
MHU11372	WITHERNSEA RAILWAY STATION	Building	RAILWAY STATION	AD 1800 - 1899	Post Medieval	TA32NW	TA 3420 2774	
MHU11368	FORMER LIFEBOAT STATION	Building	LIFEBOAT STATION	AD 1881	Post Medieval	TA32NW	TA 3418 2798	
MHU11369	SITE OF WINDMILL	Monument	WINDMILL	AD 1800 – 1899	Post Medieval	TA32NW	TA 3417 2787	
MHU11370	FORMER SMITHY	Building	BLACKSMITHS WORKSHOP	AD 1540 – 1899	Post Medieval	TA32NW	TA 3418 2797	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU11373	SITE OF PLEASURE GARDENS	Monument	PLEASURE GARDEN	AD 1870 - 1899	Post Medieval	TA32NW	TA 3420 2765	
MHU11374	SITE OF BRICK WORKS	Monument	BRICKWORKS	AD 1800 – 1899	Post Medieval	TA32NE	TA 3525 2645	
MHU11377	PINFOLD, NORTHSIDE ROAD	Monument	POUND	AD 1540 – 1899	Post Medieval	TA32NW	TA 3464 2519	Grade II Listing Number 1083480
MHU11378	SITE OF HOLLYM MILL, MILL FARM	Monument	WINDMILL	AD 1850 – 1899	Post Medieval	TA32SE	TA 3523 2488	
MHU11430	SITE OF SIGNAL BOX, CROFTS LANE	Monument	SIGNAL BOX, SITE	AD 1800 – 1899	Post Medieval	TA32NW	TA 3313 2530	
MHU14661	SITE OF SCHOOL HOUSE, OWTHORNE	Monument	SCHOOL HOUSE	AD 1700 - 1799	Post Medieval	TA32NW	TA 34 28	
MHU14663	INTACK FARM	Building	FARM	AD 1800 – 1899	Post Medieval	TA32NE	TA 3578 2590	
MHU14665	SITE OF WINDMILL	Monument	WINDMILL	AD 1600 – 1650	Post Medieval	TA32NW	TA 34 27	
MHU14666	SITE OF WINDMILL, HOLLYM ROAD	Monument	WINDMILL	AD 1800 - 1899	Post Medieval	TA32NW	TA 34 25	
MHU14667	FORMER BOAT HOUSE, ARTHUR STREET	Monument	BOAT HOUSE	AD 1862 – 1899	Post Medieval	TA32NW	TA 33 28	
MHU14669	SITE OF CHAPEL	Monument	ANGLICAN CHURCH	AD 1857 – 1899	Post Medieval	TA32NW	TA 34 28	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU14671	FORMER PRIMITIVE METHODIST CHAPEL, ALMA STREET	Building	PRIMITIVE METHODIST CHAPEL	AD 1858 - 1899	Post Medieval	TA32NW	TA 33 28	
MHU14672	FORMER BOARD SCHOOL	Building	BOARD SCHOOL	AD 1875 - 1899	Post Medieval	TA32NW	TA 3387 2798	
MHU1880	WITHERNSEA LIGHTHOUSE AND ADJOINING KEEPER'S HOUSES	Building	LIGHTHOUSE, HOUSE	AD 1893 – Present	Post Medieval	TA32NW	TA 3393 2796	Grade II Listing Number 1083470
MHU21454	POST MEDIEVAL RIDGE AND FURROW	Monument	RIDGE AND FURROW	AD 1540 - 1899	Post Medieval	TA32NE	TA 35080 26740	
MHU21459	POST MEDIEVAL RIDGE AND FURROW	Monument	RIDGE AND FURROW	AD 1540 - 1899	Post Medieval	TA32NW	TA 34310 26140	
MHU21462	SITE OF POST MEDIEVAL RIDGE AND FURROW	Monument	RIDGE AND FURROW	AD 1540 - 1899	Post Medieval	TA32NE	TA 35610 25880	
MHU21464	POST MEDIEVAL RIDGE AND FURROW	Monument	RIDGE AND FURROW	AD 1540 - 1899	Post Medieval	TA32SE	TA 35950 24780	
MHU2612	CHURCH OF ST NICHOLAS	Building	ANGLICAN CHURCH	AD 1814 - Present	Post Medieval	TA32NW	TA 3446 2523	Grade II Listing Number 1083479

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU3489	GRAVESTONE, ST NICHOLAS CHURCH	Building	GRAVESTONE	AD 1743 – Present	Post Medieval	TA32NW	TA 3443 2520	Grade II Listing Number 1310412
MHU4994	PIER GATEWAY	Building	GATE	AD 1850 - 1899	Post Medieval	TA32NW	TA 342 280	
MHU8994	SITE OF VICARAGE HOUSE	Monument	VICARAGE	AD 1540 - 1599	Post Medieval	TA32NW	TA 342 253	
MHU9205	SITE OF SCHOOL, NORTHSIDE ROAD	Monument	SCHOOL, SITE	AD 1800 – 1899	Post Medieval	TA32NW	TA 34 25	
MHU19259	MILITARY BUILDING, SOUTH LEYS	Monument	MILITARY BUILDING	AD 1900	Post Medieval to Modern	TA32SE	TA 3556 2421	
MHU21726	WHALEBONE, WHALEBONE FARM, HOLLYM	Monument	ARCH?	AD 1800 – Present	Post Medieval to Modern	TA32NW	TA 3403 2535	
MHU22028	SITE OF ITALIAN GARDENS, WITHERNSEA	Monument	ITALIAN GARDEN	AD 1901 – 1995	Post Medieval to Modern	TA32NW	TA 3447 2774	
MHU9075	OUTBUILDINGS, GARDEN WALL & GATE	Building	GATE, GARDEN WALL, OUTBUILDING	AD 1893 – Present	Post Medieval to Modern	TA32NW	TA 3393 2795	Grade II Listing Number 1310188
MHU18750	PILLBOX, N OF INTACK FARM	Monument	PILLBOX	AD 1939-1945	Modern	TA32NE	TA 3573 2603	
MHU18877	PILLBOX, THE PROMENADE	Monument	PILLBOX, PLATFORM	AD 1939-1945	Modern	TA32NW	TA 3413 2832	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU18886	ANTI-TANK BLOCKS	Monument	ANTI TANK BLOCK	AD 1939-1945	Modern	TA32NW	TA 3430 2803	
MHU19059	INTACK FARM AA BATTERY SITE	Monument	ANTI AIRCRAFT BATTERY	AD 1939-1945	Modern	TA32NE	TA 3561 2618	
MHU19060	SITE OF DIRECTION FINDING STATION	Monument	MILITARY BUILDING	AD 1939-1945	Modern	TA32NE	TA 3556 2546	
MHU19061	INTACK FARM PILLBOX SITE	Monument	PILLBOX, BARBED WIRE ENTANGLEMENT	AD 1939-1945	Modern	TA32NE	TA 3592 2599	
MHU19062	INTACH FARM PILLBOX SITE	Monument	PILLBOX, BARBED WIRE ENTANGLEMENT	AD 1939-1945	Modern	TA32NE	TA 3585 2590	
MHU19063	NEVILLE'S FARM WEAPONS PIT SITE	Monument	WEAPONS PIT	AD 1939-1945	Modern	TA32NE	TA 3627 2514	
MHU19064	INTACK FARM SEARCHLIGHT BATTERY	Monument	SEARCHLIGHT EMPLACEMENT, HUT	AD 1939-1945	Modern	TA32NE	TA 3576 2611	
MHU19065	INTACK FARM PILLBOX SITE	Monument	PILLBOX, BARBED WIRE ENTANGLEMENT	AD 1939-1945	Modern	TA32NE	TA 3570 2611	
MHU19067	SITE OF TRENCH, LEE AVENUE	Monument	TRENCH	AD 1939-1945	Modern	TA32NW	TA 3466 2757	
MHU19159	SITE OF GUN EMPLACEMENT	Monument	GUN EMPLACEMENT, BARBED WIRE ENTANGLEMENT	AD 1939-1945	Modern	TA32NE	TA 3643 2537	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU19892	CONCRETE BASE, WITHERNSEA	Monument	BEACH DEFENCE, ANTI TANK OBSTACLE	AD 1939-1945	Modern	TA32NW	TA 3440 2796	
MHU20844	UNITED REFORMED CHURCH (CONGREGATIONAL)	Building	CHURCH	AD 1901 – Present	Modern	TA32NW	TA 3443 2752	
MHU20845	ST MATTHEW CHURCH	Building	ANGLICAN CHURCH	AD 1934 – Present	Modern	TA32NW	TA 3387 2795	Grade II Listing Number 1392281
MHU21439	SITE OF WWII ROADBLOCK	Monument	ROADBLOCK	AD 1939-1945	Modern	TA32NW	TA 34050 28050	
MHU21441	SITE OF WWII PILLBOX	Monument	PILLBOX	AD 1939-1945	Modern	TA32NW	TA 34630 27750	
MHU21442	SITE OF WWII PILLBOX, SOUTH PROMENADE	Monument	PILLBOX	AD 1939-1945	Modern	TA32NW	TA 34760 27590	
MHU21444	WWII ROADBLOCK	Monument	ROADBLOCK	AD 1939-1945	Modern	TA32NW	TA 34380 27470	
MHU21445	WWII ROADBLOCK	Monument	ROADBLOCK	AD 1939-1945	Modern	TA32NW	TA 34710 27450	
MHU21453	SITE OF WWII PILLBOX AND MILITARY BUILDING	Monument	PILLBOX, MILITARY BUILDING	AD 1939-1945	Modern	TA32NW	TA 34520 26750	
MHU21458	SITE OF WWII MILITARY CAMP	Monument	MILITARY CAMP	AD 1939-1945	Modern	TA32NW	TA 34580 26450	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU21460	SITE OF WWII TRACKWAYS AND BARBED WIRE	Monument	TRACKWAY, BARBED WIRE OBSTRUCTION	AD 1939-1945	Modern	TA32NE	TA 35860 25990	
MHU21461	WWII FORTIFIED FARM AND MILITARY BUILDINGS	Monument	FORTIFIED BUILDING, FARM BUILDING, BARBED WIRE ENTANGLEMENT, TRACKWAY, MILITARY BUILDING	AD 1939-1945	Modern	TA32NE	TA 35770 25910	
MHU21463	SITE OF POSSIBLE WORLD WAR II RADAR MAST BASE, NEVILLE'S FARM	Monument	RADAR MAST?	AD 1939-1945	Modern	TA32NE	TA 36600 25200	
MHU22029	WWI WAR MEMORIAL, WITHERNSEA	Monument	WAR MEMORIAL, CENOTAPH	AD 1921 – Present	Modern	TA32NW	TA 3443 2772	Grade II Listing Number 1439669
MHU19211	TWO CIRCULAR CROPMARKS	Monument	RING DITCH	Undated	Undated	TA32NW	TA 3406 2567	
MHU19212	CIRCULAR CROPMARK	Monument	RING DITCH	Undated	Undated	TA32NW	TA 3465 2587	
MHU19214	POSSIBLE TRACKWAY	Monument	ROAD	Undated	Undated	TA32NW	TA 3407 2607	
MHU19216	THREE CIRCULAR CROPMARKS?	Monument	RING DITCH	Undated	Undated	TA32NW	TA 342 260	

HER reference	Site Name	Type	Form	Date Range	Period	Map Sheet	NGR	Designation
MHU19236	ENCLOSURE & ?CIRCULAR CROPMARKS	Monument	RECTANGULAR ENCLOSURE	Undated	Undated	TA32NW	TA 3338 2702	
MHU19398	ENCLOSURE AND DITCH, SOUTH FIELD	Monument	ENCLOSURE, DITCH	Undated	Undated	TA32SW	TA 3448 2437	

Designated Cultural Heritage Assets outside Proposed Development Area						
HER No. & NLHE No.	**Name**	**Type**	**Form**	**Description**	**Period**	**Designation**
MHU4993 1366257	Church of St. Nicholas, Park Avenue (North Side, off)	Building	Anglican Church	A Grade II* listed functioning church first constructed in 1488. It was abandoned in the early 17th C. when its roof collapsed in 1608 and subsequently refitted in the mid-19th C. Extensive restorations of 1858 included rebuilding north aisle and south porch, partial rebuilding of south aisle and nave, re-roofing, re-flooring, renewal of all window tracery, new tower parapet, new vestry.	Medieval to Post-Medieval	Grade II*
MHU3489 1310412	Gravestone approximately 20m SW of St. Nicholas Church, Hollym	Monument	Gravestone	A Grade II listed monument dated to 1743, and dedicated to Mary Tock and children. Built from Sandstone ashlar and shaped with rustic relief carvings with central cherub's head flanked by flowers bearing cherub's heads, it remains one of the best examples of 18th C. carved gravestones in the East Riding area.	Post-Medieval	Grade II
MHU11377 1083480	Pinfold on Northside Road, Hollym	Monument	Pinfold	A Pinfold, typical of the 18th C., although it may be of possibly earlier date. It is constructed from random cobbles and is circular in plan. It measures approximately 10 metres diameter, and the walls are approximately 1 metre high. The entrance fronts onto Northside Road, Hollym	Post-Medieval	Grade II

HER No. & NLHE No.	Name	Type	Form	Description	Period	Designation
MHU2612 1083479	Church of St. Nicholas, Hollym	Building	Anglican Church	A Grade II listed functioning church building. Its tower was constructed in 1814 by William Hutchinson, the remainder of the building was built in 1884 by James Demaine. The tower is constructed from grey brick, the nave is constructed from primarily yellow brick, as well as sandstone ashlar and red brick dressings. The roof is made from Westmorland slate. Within the tower are two steps to round-arched entrance with a double board door and a round-arched recessed panel with ashlar keystone inscribed "BUILT".	Post-Medieval	Grade II
MHU1880 1083470	Withernsea Lighthouse & Adjoining Keeper's Houses	Building	Lighthouse and residential unit	A Grade II listed disused lighthouse built in 1893, keeper's house built concurrently. The lighthouse is stuccoed and whitewashed. The interior only contains two storeys, an inspection chamber and upper lamp room. A prominent landmark that ceased operation in 1976.	Post-Medieval	Grade II
MHU9075 1310188	Outbuildings, Garden Wall and Gate at Withernsea Lighthouse	Building	Gate, Garden Wall, and Outbuilding	Grade II listed ancillary features to Withernsea lighthouse constructed in 1893. Outbuildings of whitewashed stuccoed brick. A Coped garden wall, ramped-up to outbuildings. A Central north gateway to the street, with square- section coped piers, wooden gate, and flanking walls with smaller similar piers to a recessed entrance.	Post-Medieval	Grade II
MHU20845 1392281	St. Matthew's Church, Withernsea	Building	Anglican Church	A Grade II listed functioning church building constructed in Withernsea in 1935 by Sir William Milner of Milner & Craze. The building's design was influenced by medieval gothic styles. Externally faced with rough red bricks, handmade by York and Acomb Brick Co. Internally it is faced with light coloured sand-lime bricks produced by the Midhurst Brick Co. Architectural mouldings using specially shaped bricks were used. Areas of plain walling employ English Bond techniques. The roof is constructed using triple laid, handmade plain red tiles.	Modern	Grade II
MHU22029 1439669	WW1 War Memorial, Withernsea	Monument	War Memorial	Withernsea Old War Memorial is located in the Memorial Gardens on Queen Street in Withernsea. It consists of a Latin cross with recessed front and rear faces bearing emblems in relief. The cross is set upon a tapering octagonal shaft which rests on the apex of a square moulded plinth set on a three-stepped base.	Modern	Grade II

Previous Archaeological Investigations outside Proposed Development Area							
Event ID No.	**Name**	**Type of Investigation**	**Reference**	**Organisation**	**Year**	**Map Sheet**	**Grid Reference**
EHU2113	WATCHING BRIEF AT THE BOAT COMPOUND, SOUTH PARADE, WITHERNSEA	Watching Brief	WB2013.034	Humber Field Archaeology	2014	TA32NW	TA 3446 2776
EHU1373	WATCHING BRIEF AT OPEN MARKET, STATION ROAD, WITHERNSEA	Watching Brief	WB2007.033	Humber Field Archaeology	2007	TA32NW	TA 34198 27745
EHU647	WATCHING BRIEF AT QUEEN STREET SOUTH	Watching Brief	WIT 98	Humber Field Archaeology	1998	TA32NW	TA 3442 2770

APPENDIX B

Maps of HER assets and Study Area

Figure 1: Site Location

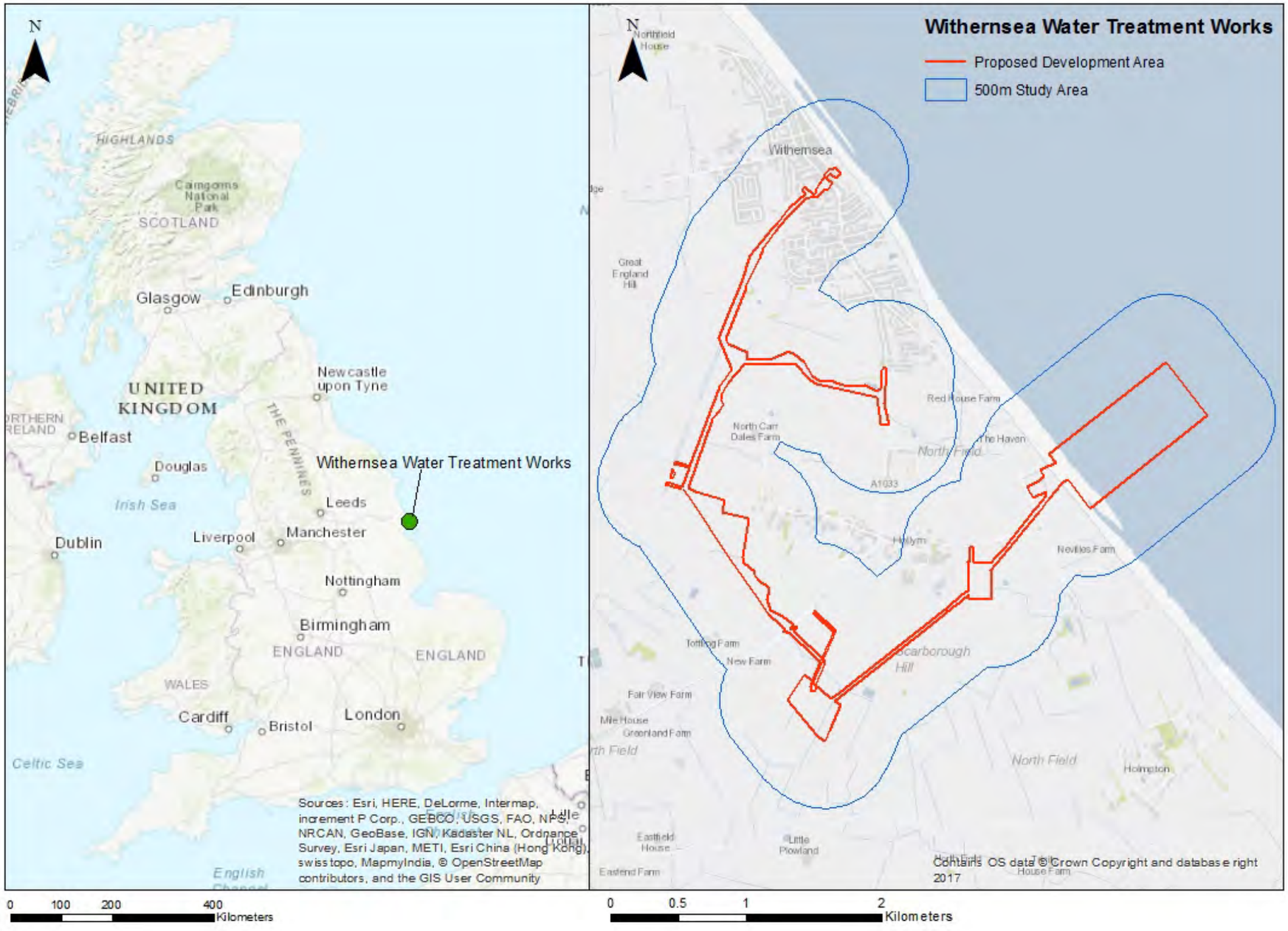


Figure 1: Archaeological Events

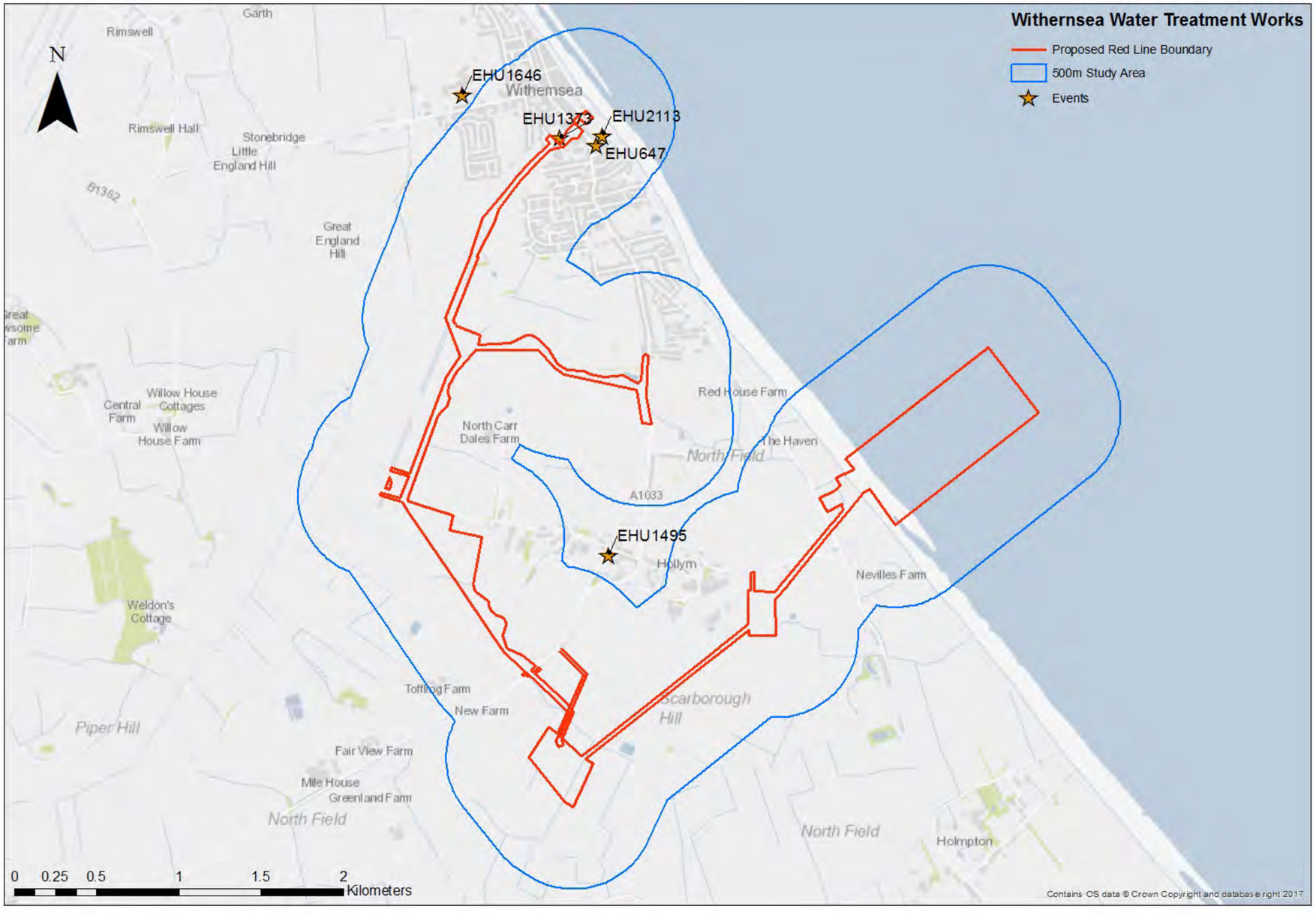


Figure 3: Designated Assets

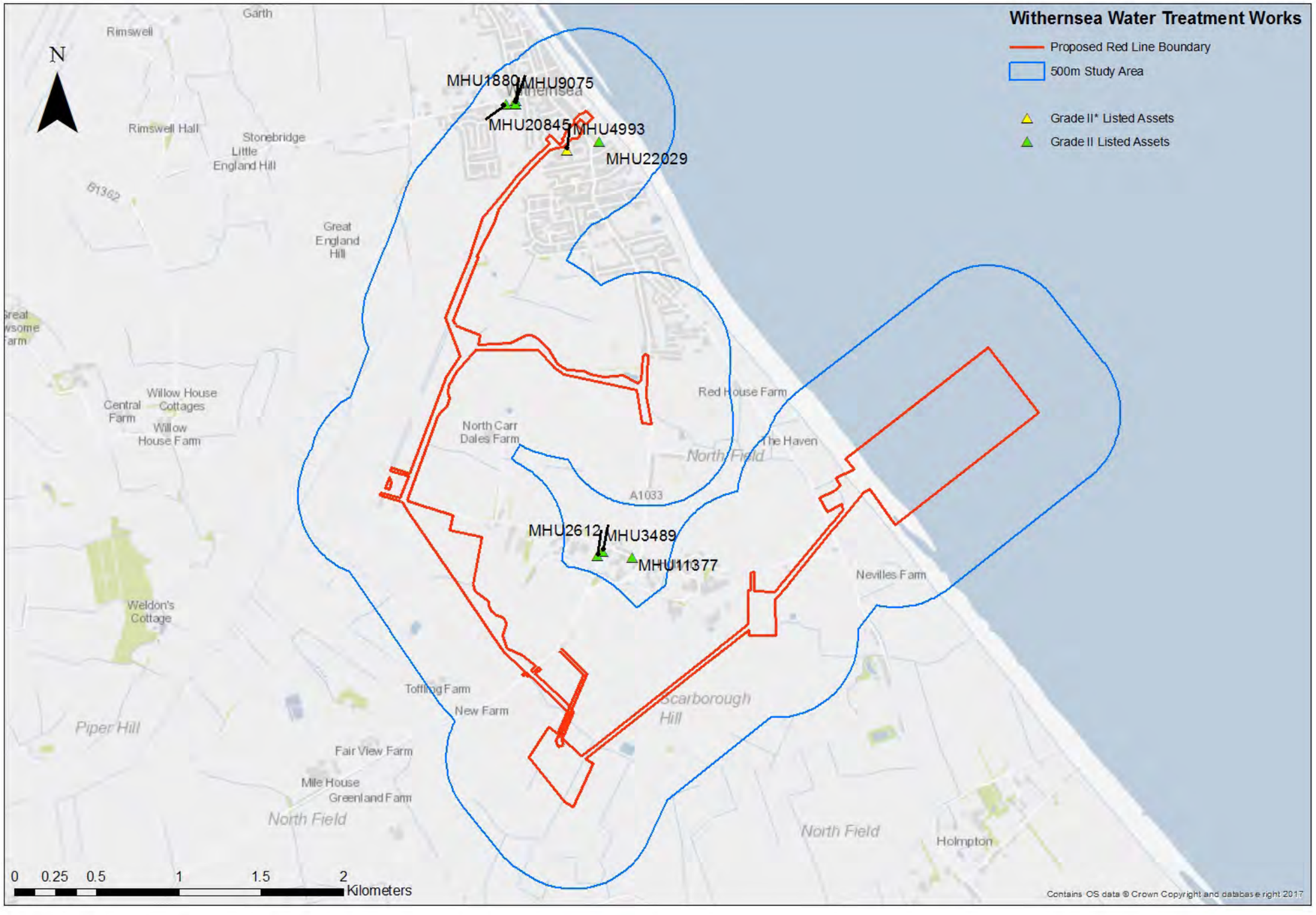


Figure 4: Palaeolithic to Medieval Assets

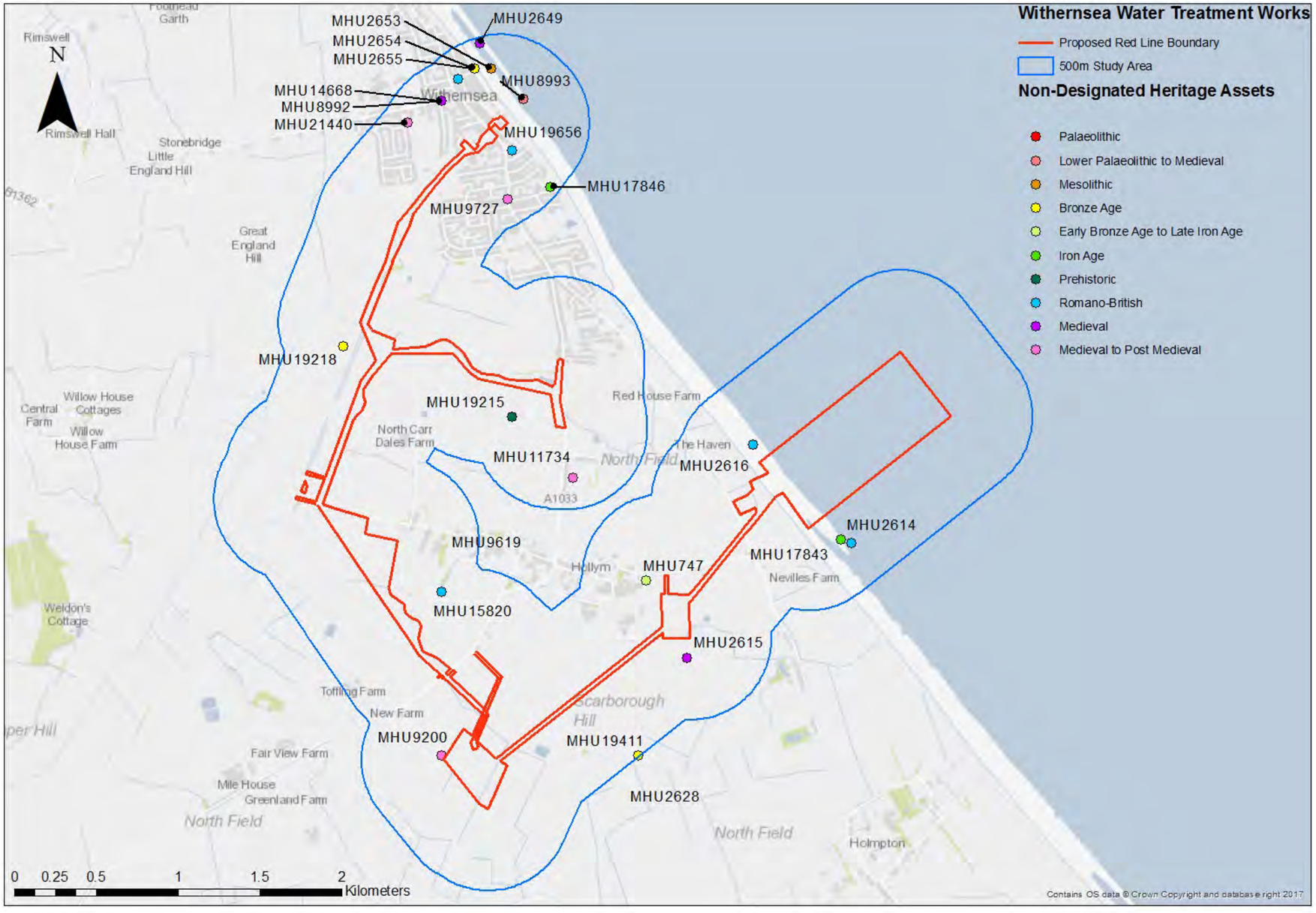
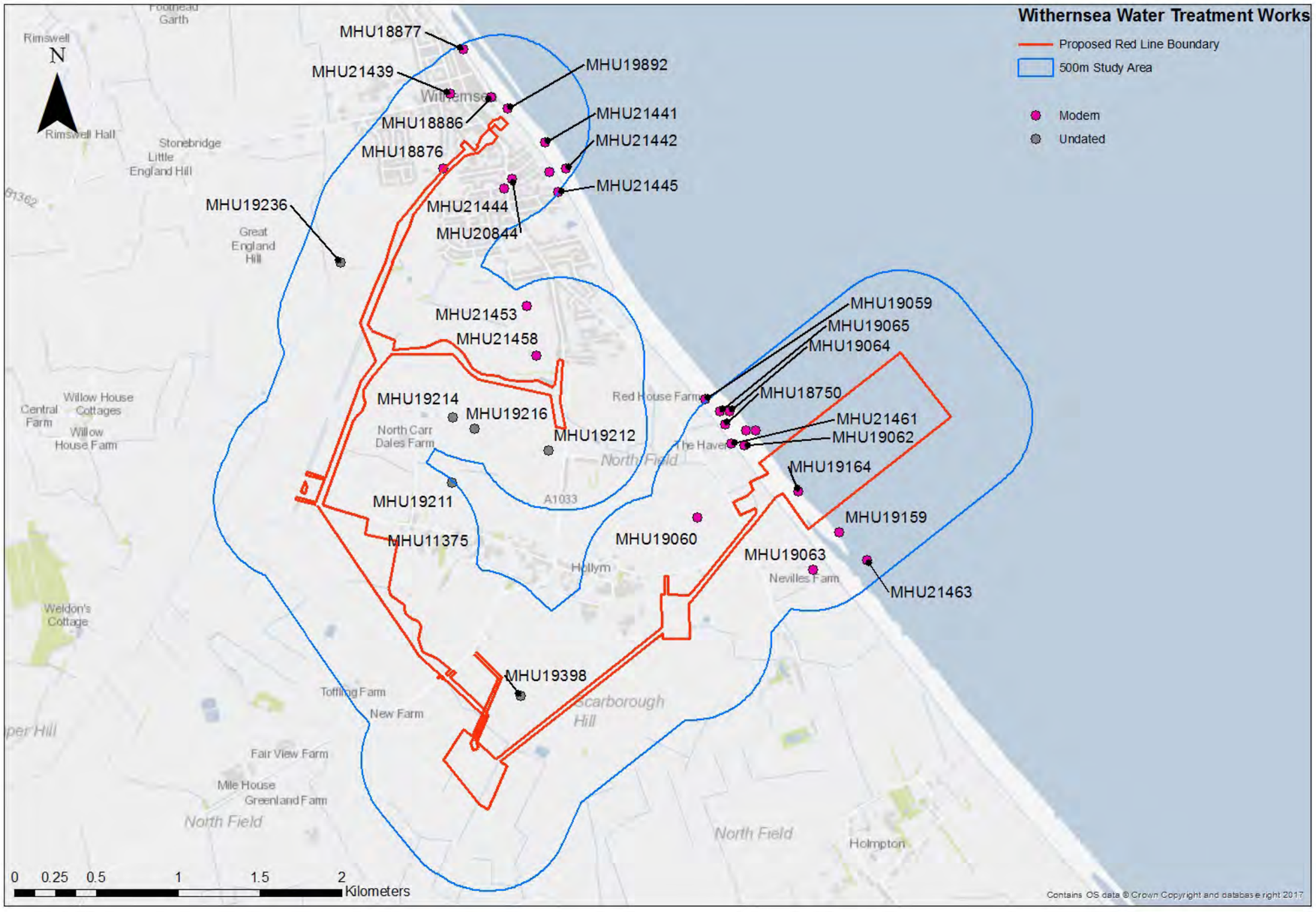


Figure 5: Post-Medieval to Modern Assets

Figure 6: Modern & Undated Assets



APPENDIX C

Historic maps

Maps marked in bold are displayed in the figures below

Map reference	Within Proposed Development Area			Outside Proposed Development Area
	Main Site	**Rising Main**	**LSO**	
Jeffery's, 1771-1772	No discernable features recorded	Rising Main route insect roads running south west out of Hollym	HDD starting point insect roads running south east out of Hollym	Small urban footprints of Owthorne, Withernsea and Hollym visible. A church marked in Owthorne and Withernsea each. These churches formed part of the 'sisterkirkes' twinning, See *Baseline* for further detail. Cornmill between Withernsea and Hollym visible. A church is recorded within Hollym village.
1855 Ordnance Survey, 1:10,000	Field parcels with well-defined partitions visible.	Hull to Withernsea railway line visible, partially within the route of the Rising Main. Brickfield extant at intersection between railway line and Crofts Lane.	New coastal road recorded (intersected by LSO route).	Field parcels with well-defined partitions visible. Hull to Withernsea railway line visible. Church in Hollym visible.
1855 Ordnance Survey – Withernsea Detail, 1:2,500	No change	A collection of unmarked buildings were extant on the western side of the railway. Opposite to the Withernsea train station was the Queen's Hotel, fronting a sea view with an L-shaped ancillary building behind it. In front of the hotel were gardens and the central road running through Withernsea. The area of the Memorial Gardens pumping station was undeveloped, open land at that time. A wooded area marked as pleasure gardens and parkland is recorded.	No change	Slight urban footprint to the north of the PDA in the Owthorne area. Notably buildings included two inns. Also to the north was the Withernsea Mere. To the south of the PDA was the Grade II* listed Church of St. Nicholas on Priest Hill. A dancing saloon was situated to the south-eastern extent of the pleasure gardens. A large, elongated building marked, 'Church House' was extant just west of the Church of St. Nicholas.
1891-1892 Ordnance Survey, 1:10,000	No change	No change	No change	New brickworks established across the study area.
1891-1892 Ordnance Survey – Withernsea Detail, 1:2,500	No change	Gas works established just west of railway terminal. Tree lined promenade to the pier recorded in the Memorial Gardens pumping station area.	No change	Increased urbanisation to the north with new residential units and road networks developed. To the South, Kirkfield house and farm houses are recorded.
1909-1910 Ordnance Survey, 1:10,000	No change	Brickfield at Crofts Lane/ Railway intersection now disused.	No change	Substantial urban footprint developed in the Withernsea area. Farms were demolished and replaced by rows of terraced housing.
1909-1910 Ordnance Survey – Withernsea Detail, 1:2,500	No change	Gas works west of the Railway terminal now disused. Queen's Hotel turned into a convalescent home and hospital with additions built behind the main building.	No change	New gas works built south of railway track for the Holderness Gas Co. Relatively substantial urbanisation in Withernsea. Police station, coastguard station, school and lighthouse built amongst residential units. The Pier Tower gate to the beach is first recorded. School visible in Owthorne area.
1927-1928 Ordnance Survey, 1:10,000	No change	No change	No change	Continued trend of dense urbanisation in Withernsea. Owthorne and Withernsea are spatially indistinct from each other. Rows of terraced housing units built adjacent to the Queens Street South and the road leading to Hollym.

1927-1929 Ordnance Survey – Withernsea Detail, 1:2,500	No change	War memorial and communal building built on Pier Road in the area of Memorial Garden pumping station. Parkland and gardens west of the Church of St. Nicholas were no longer recreational public space. The area encompassed within the PDA was a wooded margin with a large warehouse structure close by.	No change	Pleasure Gardens, (Park Avenue) is completely built over with terraced housing units. Withernsea Mere built over by promenade and gardens. Italian Gardens, south-east of Memorial gardens and north of the Queens Road South is first recorded. Expansion of school complex in Owthorne area.
1951-1952 Ordnance Survey, 1:10,000	No change	No change	No change	Continued urban developments in Withernsea. Residential units built down the Hollym-Withernsea road and Smook Hills Road. New small residential housing with associated land parcels/garden space were extant in Hollym.
1951-1952 Ordnance Survey - Withernsea Detail, 1:2500	No change	No change	No change	The warehouse structure noted in the 1920s just west of the Church of St. Nicholas has been demolished and a new large warehouse building has been built by the eastern boundary of the wooded area. Expansion of school complex in Owthorne area. Grade II listed Church of St. Matthew recorded west of the Grade II listed lighthouse.
1975-1978 National Grid, 1:10,000	No change	Brickfield at the Railway/ Crofts Lane intersection is no longer recorded. The Hull to Withernsea railway track is dismantled and the line discontinued.	A sewage works is recorded within the footprint of the present-day WwTW	Withernsea continued to develop into a relative urban sprawl. Minor developments in Hollym.
1975-1978 National Grid – Withernsea Detail, 1:2,500	No change	An open market is recorded and the gardens in front of the hospital are not recorded. In the footprint of the Memorial Gardens pumping station the communal elongated hall has been removed and the space is used as a car park.	No change	No change
1995 National Grid – Withernsea Detail, 1:2,500	No change	Area of Memorial Gardens recorded as it appears in the present day. War memorial has been moved outside of the PDA. Now sits on the south-east boundary of the Memorial Gardens pumping station PDA.	No change	No change

Figure 7: Jeffery's, 1771-1772

Figure 8: 1855 Ordnance Survey 1:10,560 - North

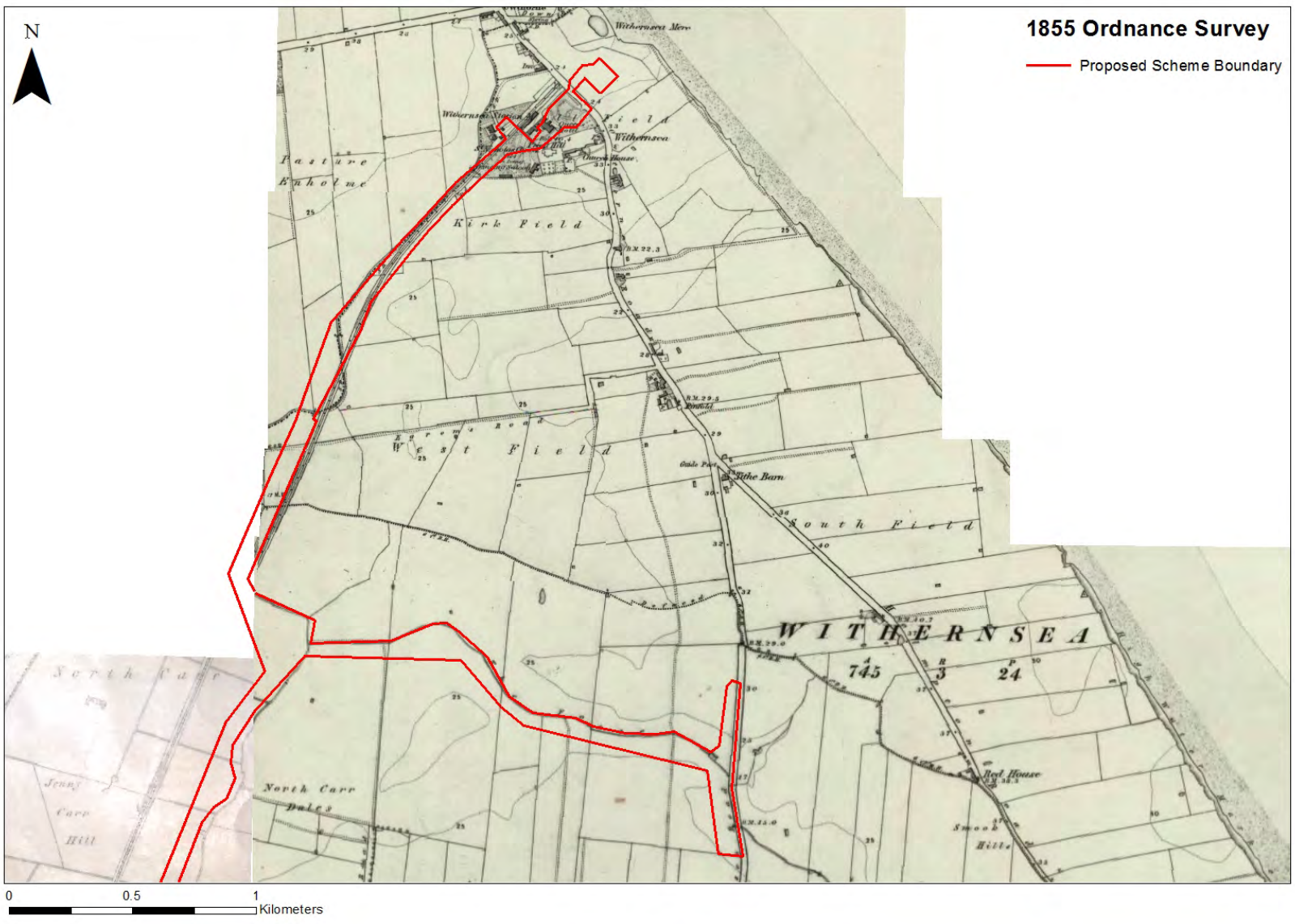


Figure 9: 1855 Ordnance Survey 1:10,560 - South

Figure 10: 1855 Ordnance Survey 1:10,560 – West

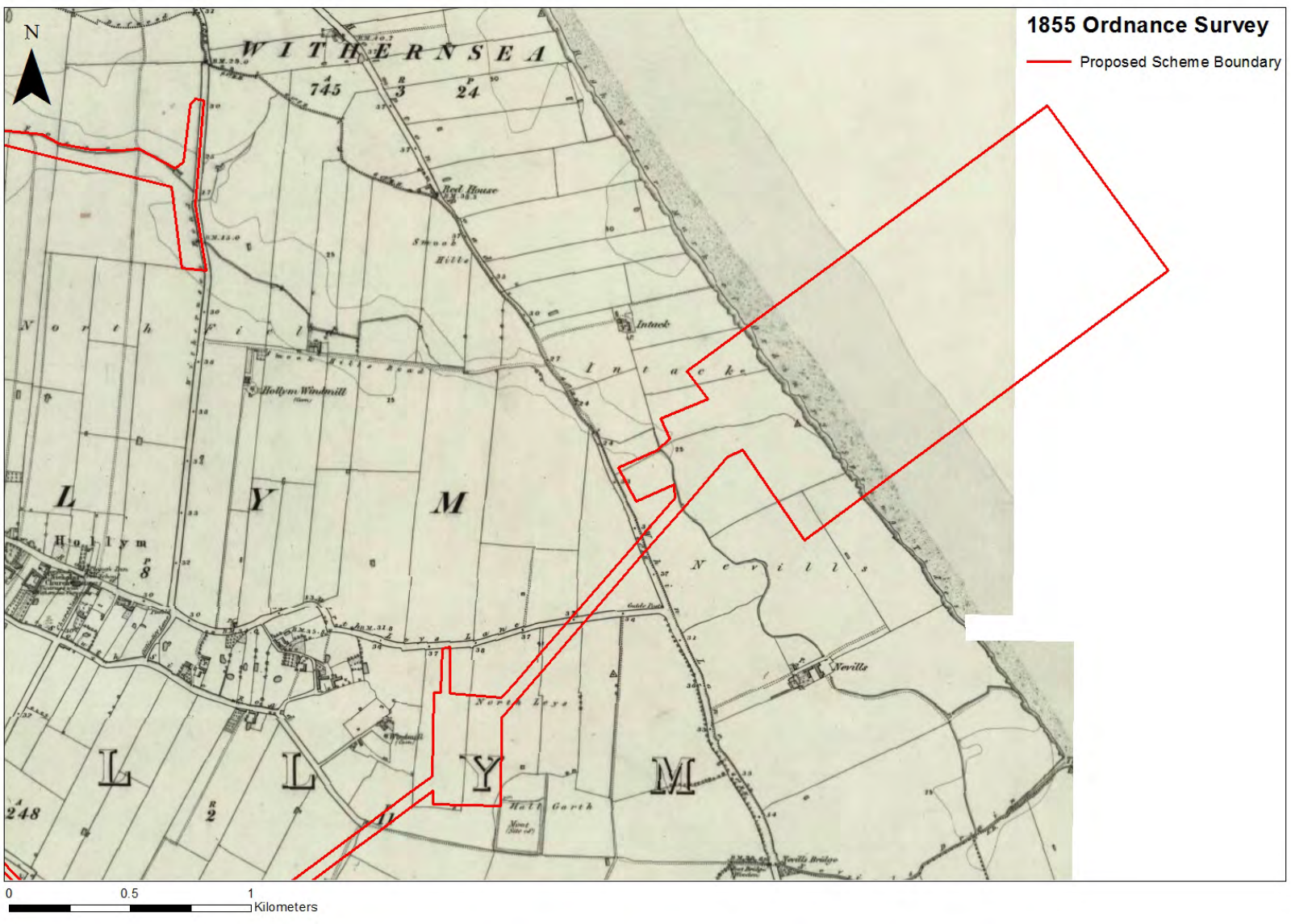


Figure 11: 1855 Ordnance Survey 1:2,500 – Withernsea detail

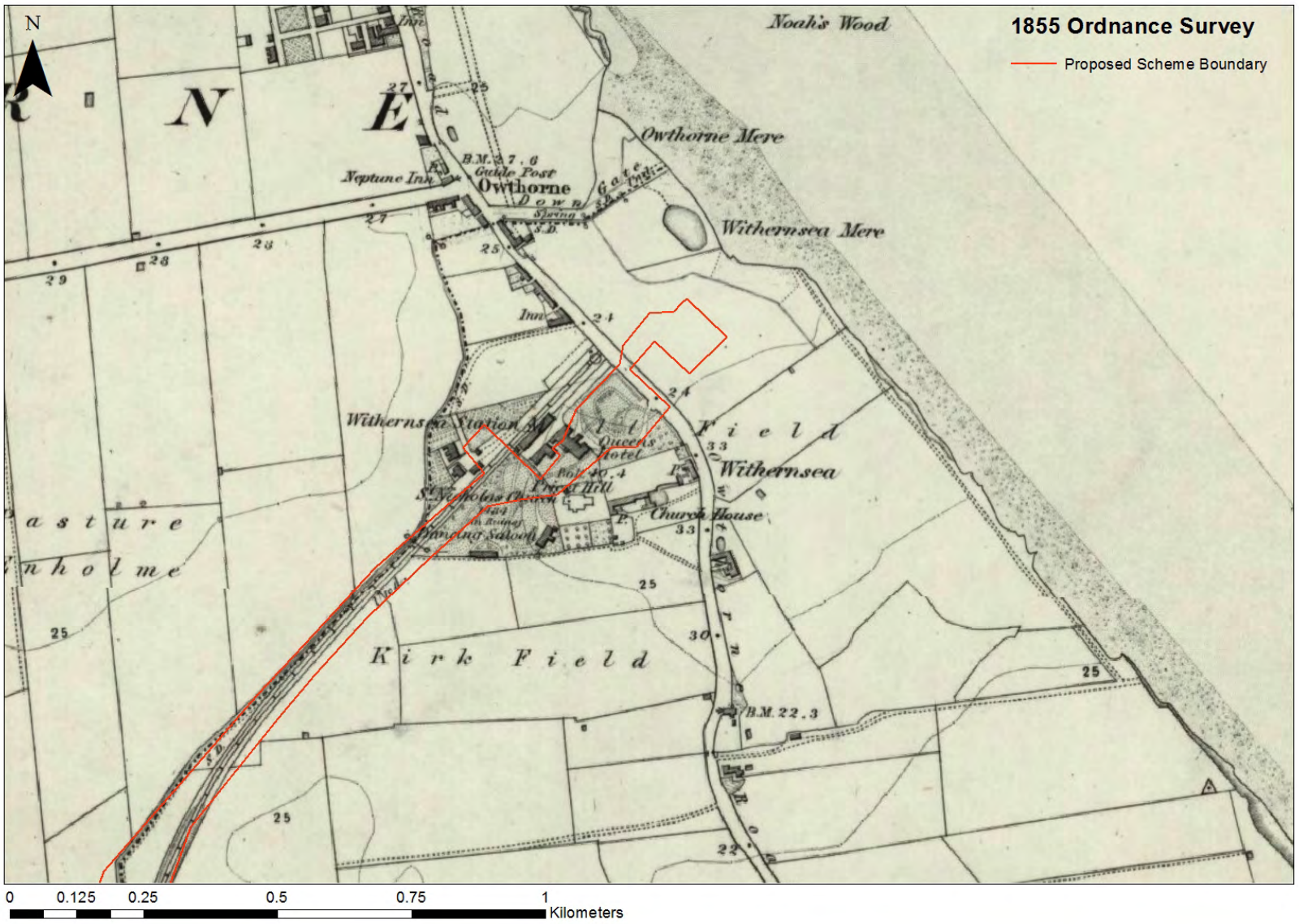


Figure 12: 1891-1892 Ordnance Survey 1:2,500 – Withernsea Detail

Figure 13: 1908-1910 Ordnance Survey 1:10,560 – North (Courtesy of Groundsure Ltd)

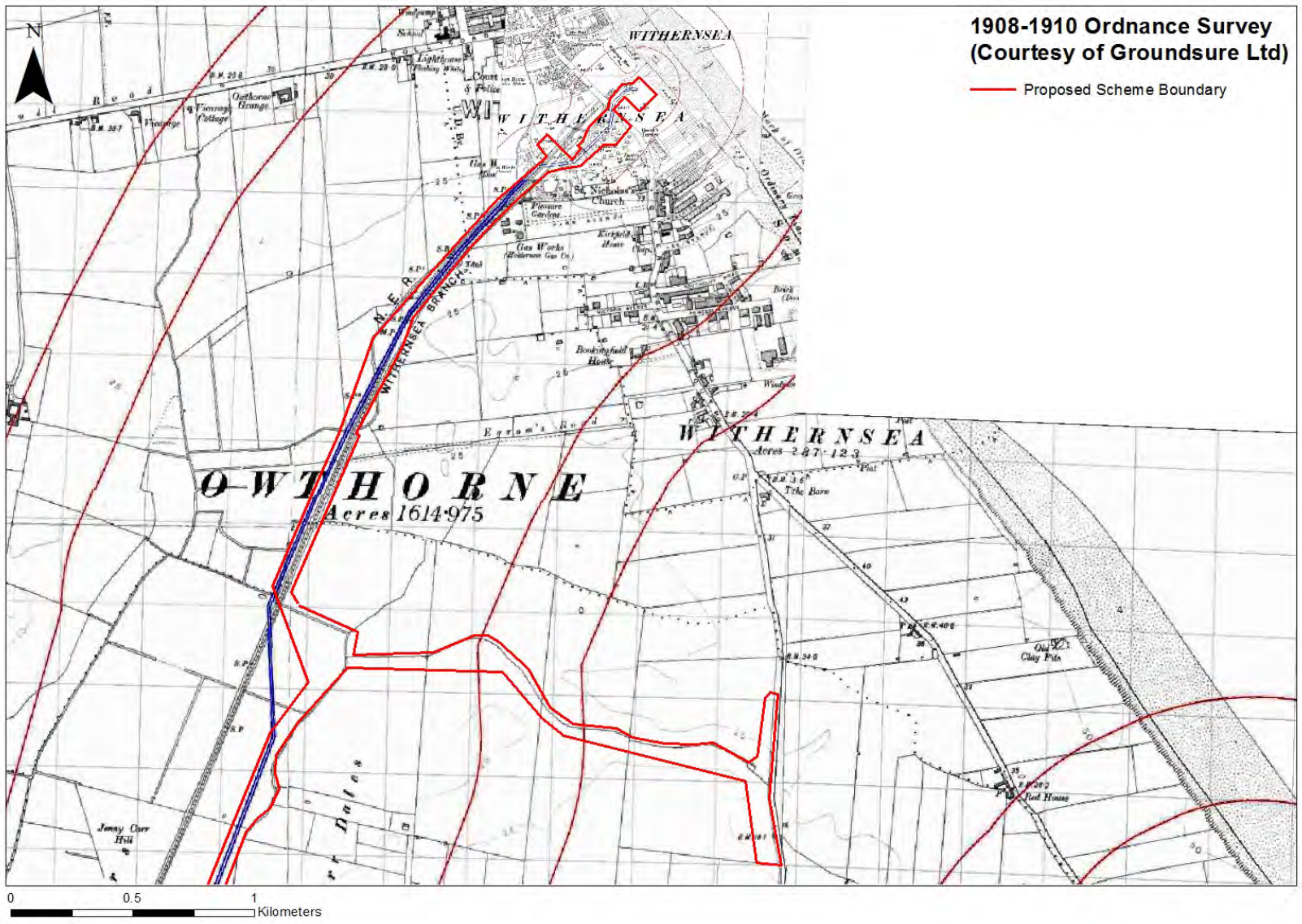


Figure 14: 1908-1910 Ordnance Survey 1:10,560 – South (Courtesy of Groundsure Ltd)

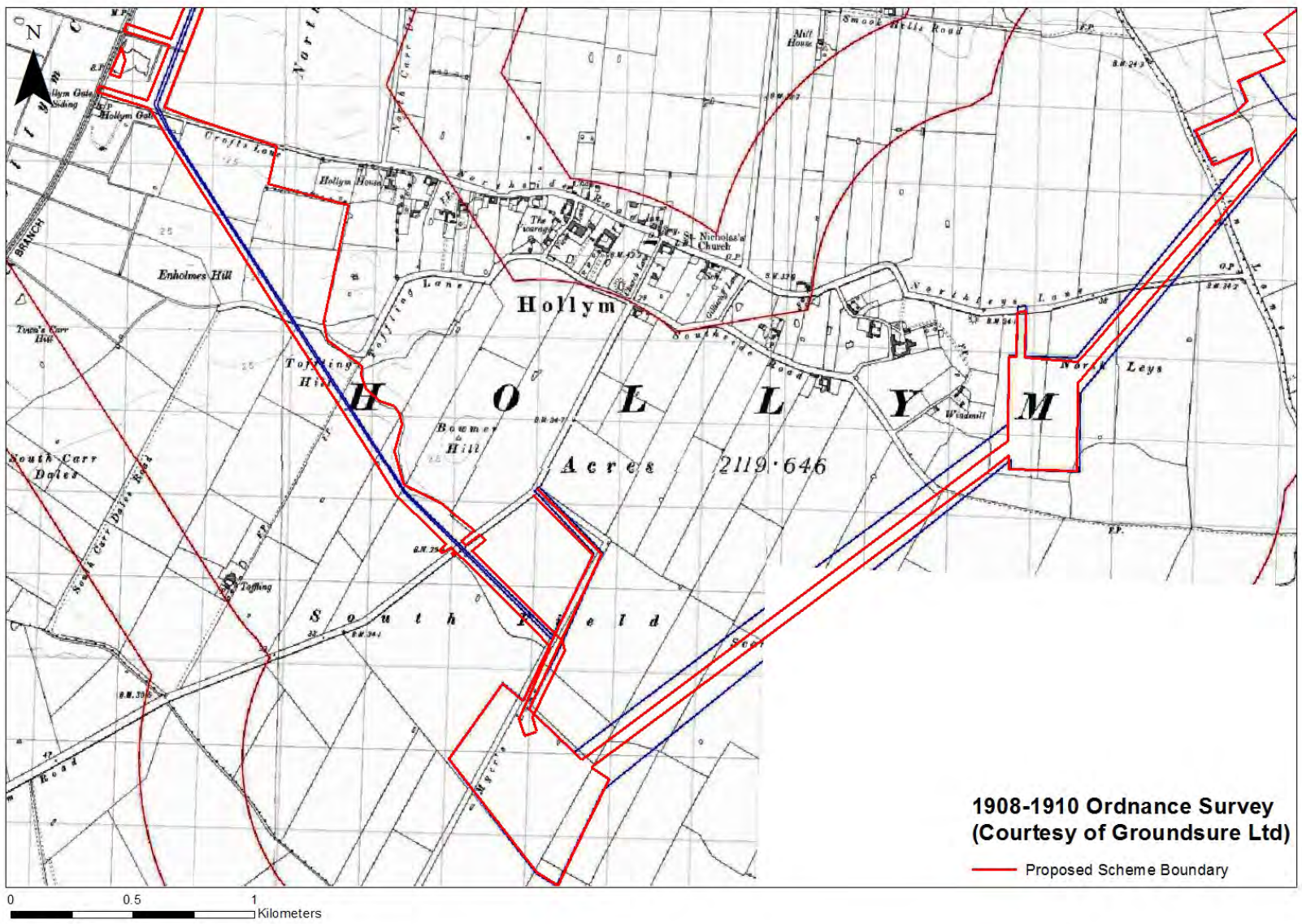


Figure 15: 1908-1910 Ordnance Survey 1:10,560 – West (Courtesy of Groundsure Ltd)

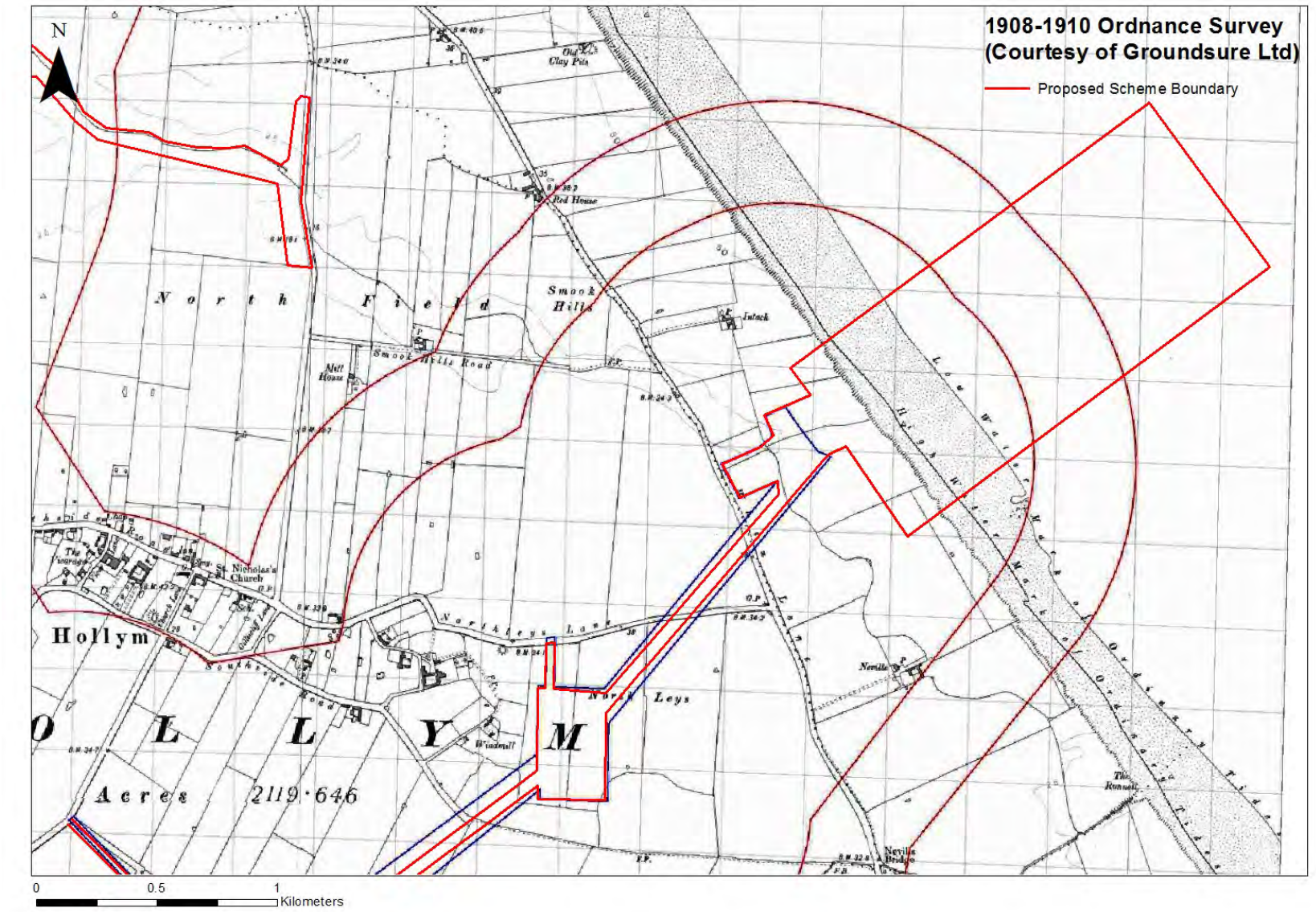


Figure 16: 1909-1910 Ordnance Survey 1:2,500 – Withernsea detail

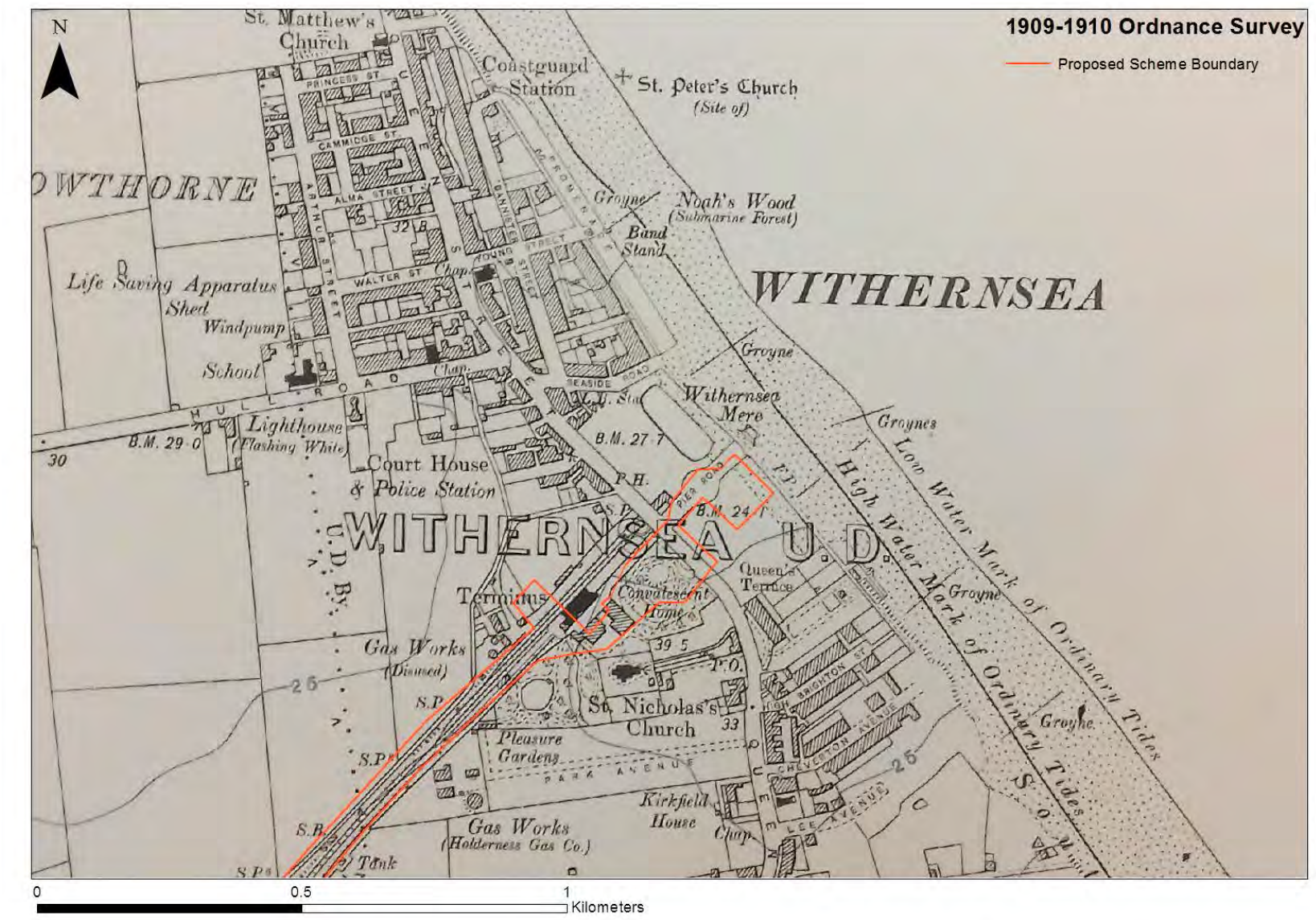


Figure 17: 1927-1929 Ordnance Survey 1:2,500 – Withernsea detail

Figure 18: 1951-1952 Ordnance Survey 1:2,500 – Withernsea detail

Figure 19: 1975 National Grid 1:10,000 – North (Courtesy of Groundsure Ltd)

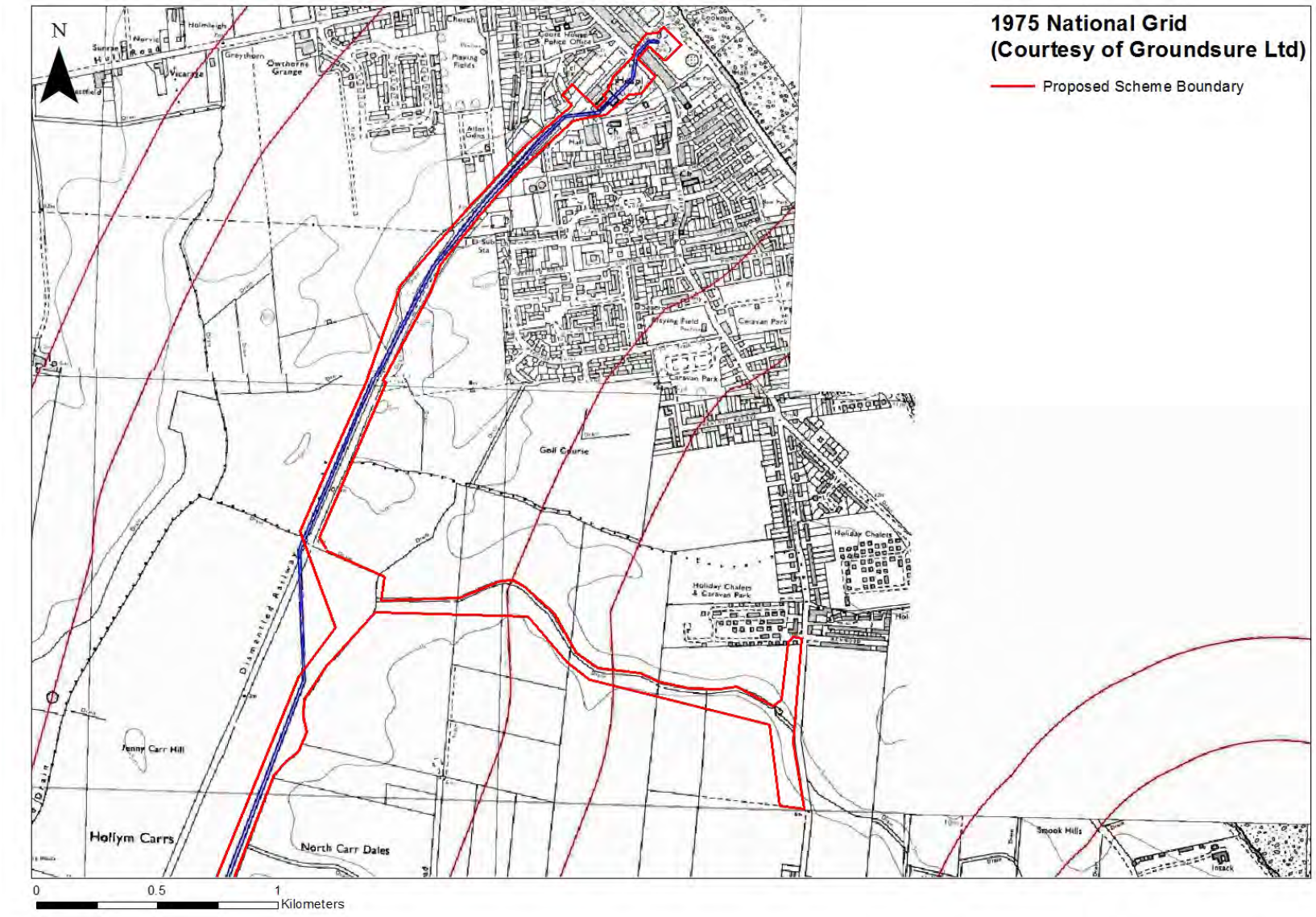


Figure 20: 1975 National Grid 1:10,000 – South (Courtesy of Groundsure Ltd)

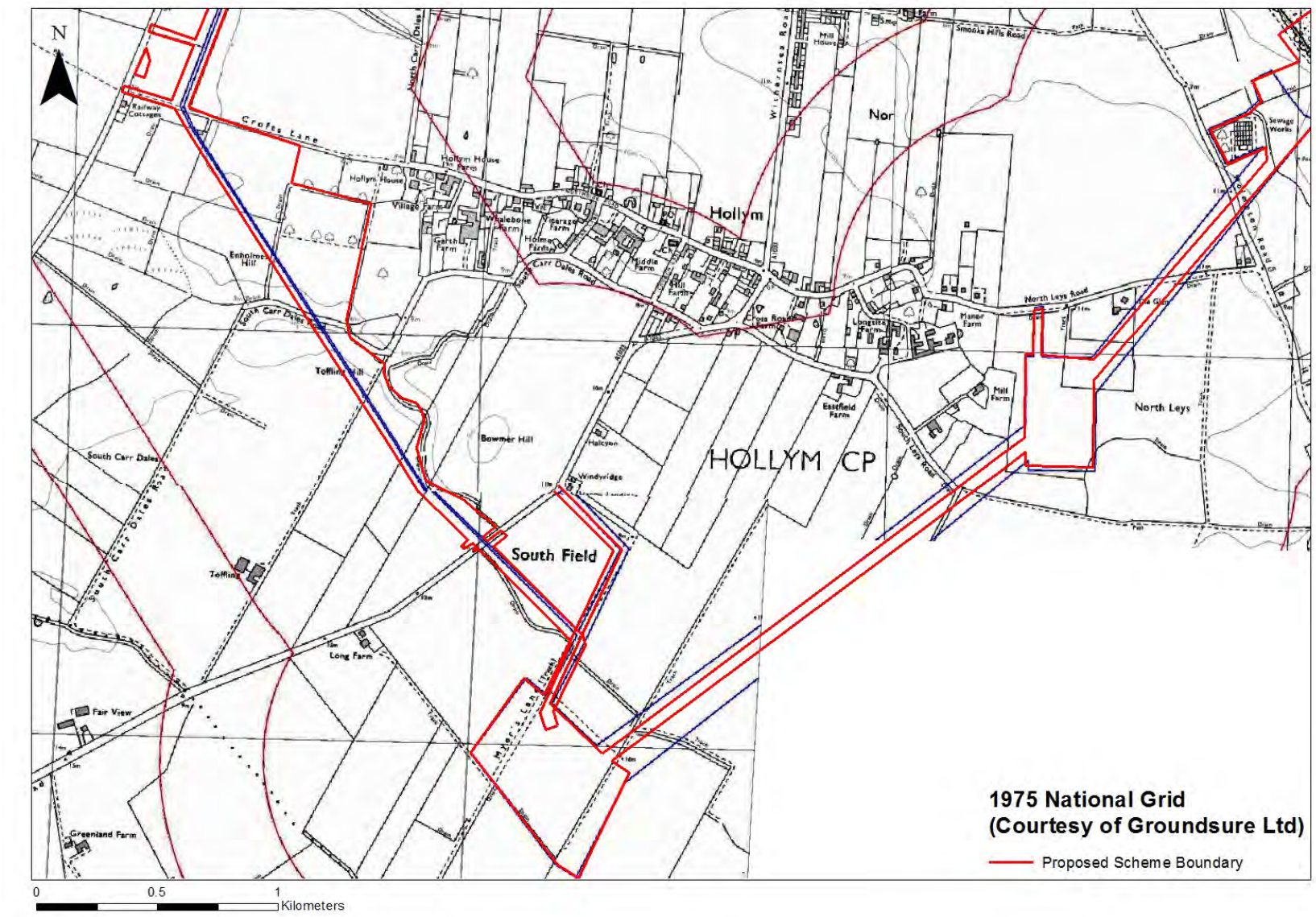


Figure 21: 1975 National Grid 1:10,000 – West (Courtesy of Groundsure Ltd)

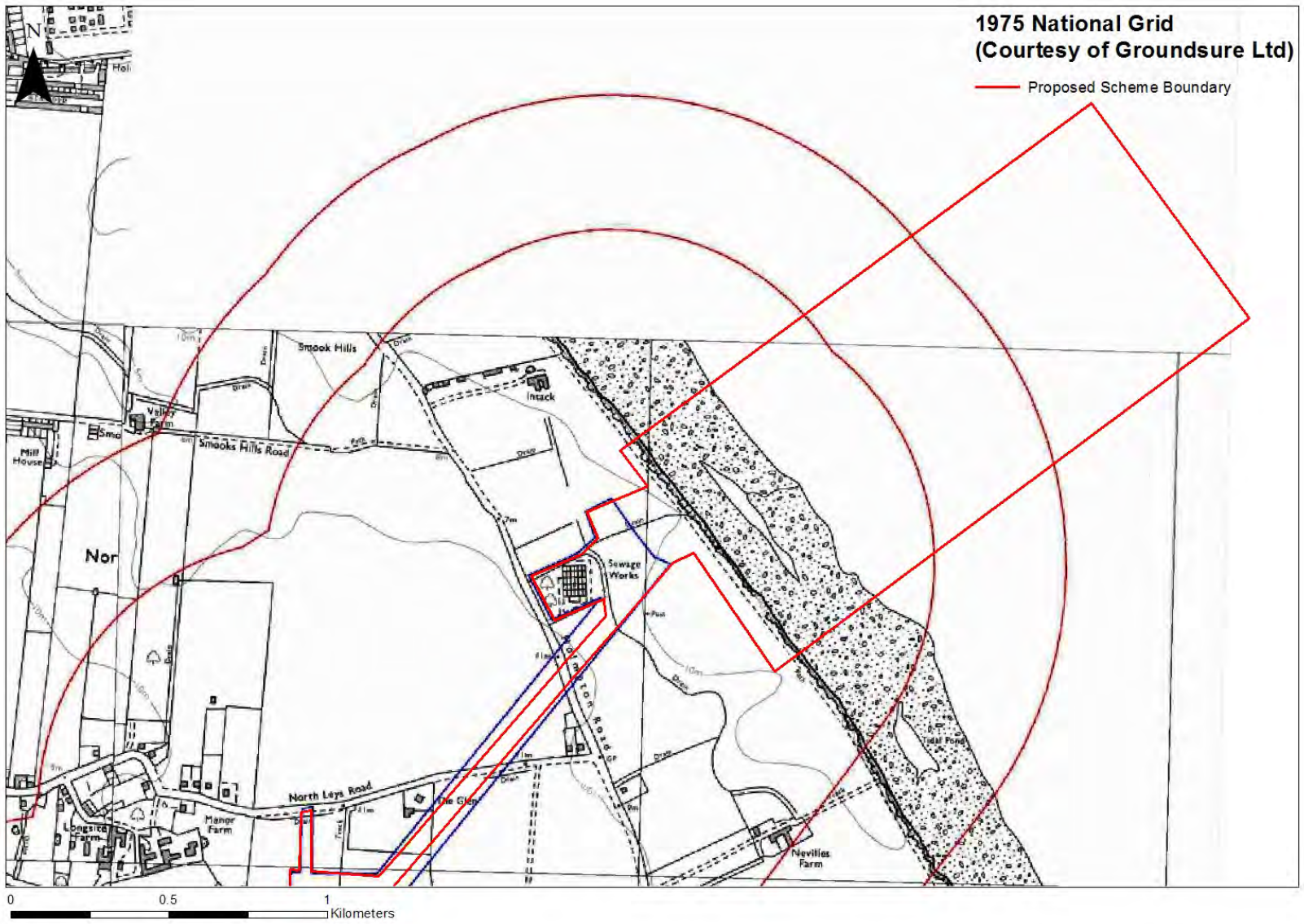


Figure 22: 1975-1978 National Grid 1:2,500 – Withernsea Detail

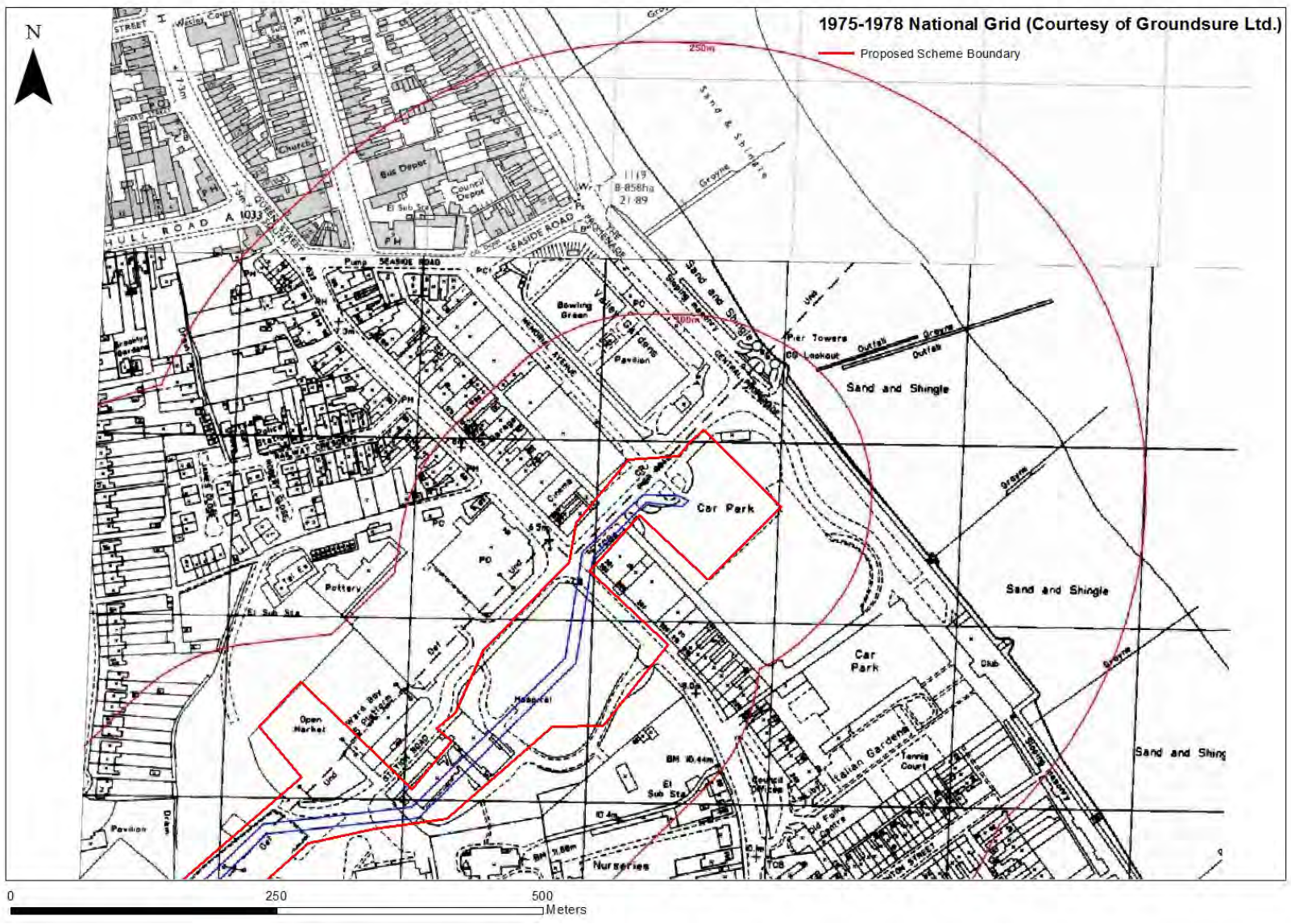
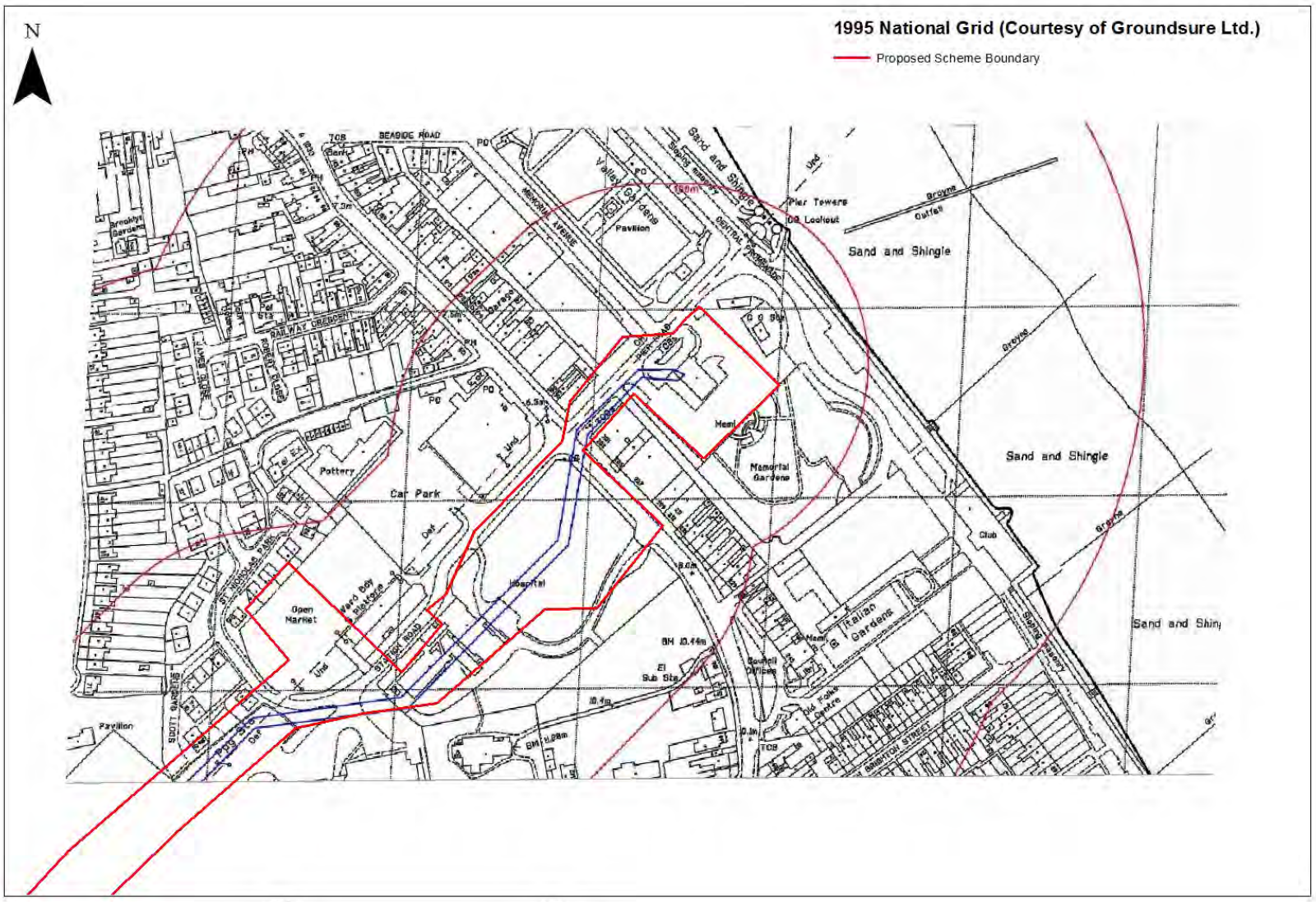


Figure 23: 1995 National Grid 1:2,500 – Withernsea Detail



APPENDIX D

Aerial Photography

Aerial photography was received from the Historic England Swindon Aerial Photography archive. Professional examination of the received images appears to indicate no visible archaeological signatures.

The table below details the received aerial photography examined for this report.

Date	Centre Point (NGR)	Sortie Number	Library No.	Frame No.
22 JUL 2003	TA 335 274	OS/03647	24208	25
13 JUN 2003	TA 341 237	OS/03615	24205	49
09 JUN 2003	TA 341 262	OS/03612	24203	165
09 JUN 2003	TA 334 262	OS/03612	24203	166
09 JUN 2003	TA 335 249	OS/03612	24203	268
08 JUN 1997	TA 349 244	OS/97190	22314	101
08 JUN 1997	TA 344 244	OS/97190	22314	102
30 MAR 1997	TA 345 255	OS/97052	20868	46
12 MAY 1984	TA 331 253	OS/84116	12621	41
12 MAY 1984	TA 337 249	OS/84116	12621	42
12 MAY 1984	TA 334 266	OS/84116	12621	60
06 JUL 1977	TA 337 273	MAL/77022	7460	222
06 JUL 1977	TA 343 266	MAL/77022	7460	223
16 APR 1972	TA 337 268	MAL/72028	6155	87
18 JUN 1970	TA 346 267	OS/70240	10560	58
18 JUN 1970	TA 333 266	OS/70240	10560	60
18 JUN 1970	TA 344 241	OS/70240	10560	112
22 JAN 1969	TA 335 266	RAF/58/9309	15233	2
22 JAN 1969	TA 332 251	RAF/58/9309	15233	42
18 JUL 1968	TA 332 263	RAF/58/8898	15231	37
18 JUL 1968	TA 336 271	RAF/58/8898	15231	38
28 FEB 1949	TA 348 242	RAF/541/231	980	3011
28 FEB 1949	TA 346 265	RAF/541/231	980	4049
17 NOV 1947	TA 346 255	RAF/CPE/UK/2396	750	3027
17 NOV 1947	TA 340 238	RAF/CPE/UK/2396	750	4026
17 NOV 1947	TA 348 238	RAF/CPE/UK/2396	750	4027
27 DEC 1946	TA 342 265	RAF/CPE/UK/1911	531	3004
27 DEC 1946	TA 335 263	RAF/CPE/UK/1911	531	3005
21 SEP 1946	TA 343 268	RAF/CPE/UK/1748	467	2068
21 SEP 1946	TA 334 268	RAF/CPE/UK/1748	467	2069
21 SEP 1946	TA 341 246	RAF/CPE/UK/1748	467	3078
21 SEP 1946	TA 335 246	RAF/CPE/UK/1748	467	3079

APPENDIX E

Humber Archaeological Partnership Consultation Letter

Consultation was sought from the Humber Archaeological Partnership Development Management Archaeologist, Mr James Goodyear. A briefing note was prepared and approved by Mr Goodyear and Ove Arup & Partners Ltd. Cultural Heritage team.

Minutes

ARUP

Project title	Withernsea Water Treatment Works	Job number 258408-03
Meeting name and number	HAP Consultation	File reference
Location	HAP Offices, The Old School, Hull, HU2 0LN	Time and date 1400hrs 14 December 2017
Purpose of meeting	Consultation with Humber City Council Development Management Archaeologist	
Present	Mr James Goodyear (HAP) Mr Piers Thomas (Arup)	
Apologies		
Circulation	Those present + Mr David Lakin (Arup)	

Action

1. Consultation regarding DBA guidelines and addition to the WwTW scheme.

The change and addition to the WwTW scheme was noted however the opinion of the Development Management Archaeologist was unchanged. The suggestion was that a scheme of this scale would require a desk based assessment. A Historic Environment DBA has been initiated by the client

A query was made in relation to specific guidelines Arup may need to adhere to in order to produce a desk based assessment approved by Humber City Council. No specific guidelines were required however, it was noted that best practise would be to follow DBA guidelines set out by the Chartered Institute for Archaeologists (CIfA).

A query was made in relation to the size of the study area buffer produced around the proposed development area. A study area extending out 500m was deemed acceptable by the Development Management Archaeologist.

Prepared by	Piers Thomas
Date of circulation	
Date of next meeting	

Appendix N – ESG Terrestrial Ground Investigation

WITHERNSEA LONG SEA OUTFALL GROUND INVESTIGATION

FACTUAL REPORT ON GROUND INVESTIGATION

Report No A7063-17

October 2017

Carried out for:
Ward & Burke Construction Limited
On behalf of Yorkshire Water
Unit N
Bourne End Business Park
Cores End Road
Bourne End
Bucks
SL8 5AS

Engineer:
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle Upon Tyne
NE1 4EE

Please be aware that as of 17 October 2017, Environmental Scientifics Group Limited has become SOCOTEC UK Limited. This is a name change only, the legal identity of the company, including company registration number remains unchanged.

In the interim period during the rebranding process please note that some reports may display two logos and company references.

ESG
Askern Road, Carcroft,
Doncaster, South Yorkshire, DN6 8DG
Tel: +44 (0) 01302 723456
email: geo.doncaster@esg.co.uk

Report No A7063-17

October 2017

Issue No Date	Status	Prepared by	Checked by	Approved by
1 Sept 2017	Draft report	NAME and QUALIFICATIONS M STANLEY BSc FGS SIGNATURE	NAME and QUALIFICATIONS T CLIFFORD BEng FGS SIGNATURE	NAME and QUALIFICATIONS SIGNATURE
2 Oct 2017	Final report	NAME and QUALIFICATIONS A WARD MSc FGS MCIWEM SIGNATURE	NAME and QUALIFICATIONS M STANLEY BSc FGS SIGNATURE	NAME and QUALIFICATIONS T CLIFFORD BEng FGS SIGNATURE
		NAME and QUALIFICATIONS SIGNATURE	NAME and QUALIFICATIONS SIGNATURE	NAME and QUALIFICATIONS SIGNATURE

SOCOTEC UK Limited was formerly known as Environmental Scientifics Group Limited. The Certificate of Incorporation on Change of Name was filed on 16 October 2017

C O N T E N T S

1 INTRODUCTION

In June 2017 ESG was commissioned by Ward and Burke Construction Limited (WB), on behalf of Yorkshire Water (YW), to carry out a ground investigation at Withernsea, East Riding of Yorkshire. The investigation was required to obtain geotechnical information for the proposed replacement of an existing outfall and the associated infrastructure.

The Investigation Supervisor, on behalf of YW, was Royal HaskoningDHV (RHDHV).

The scope of the investigation was specified by RHDHV and comprised cable percussion boreholes, dynamic sampling, trial pits and laboratory testing. The investigation was performed in accordance with the contract specification, the general requirements of BS 5930 (2015), BS EN 1997-2 (2007), BS EN ISO 22475-1 (2006) and other relevant related standards identified below. The fieldwork took place between 10 and 31 July 2017.

This report presents the factual records of the fieldwork and laboratory testing. The information is also presented as digital data as defined in AGS (2017).

2 SITE SETTING

2.1 Location and Description

The existing treatment works is located about 125 m from the beach, approximately 2.5 km south east of Withernsea, East Riding of Yorkshire. The route of the investigation extends about 2.5 km inland from the treatment works and is approximately centred at National Grid reference TA 358 254, see Site Location Plan in Appendix A.

The site predominately comprises agricultural land adjacent to Holmpton Road and Hollym Road. Ground investigation works were also undertaken between the tides on the upper part of beach, at the base of the cliff close to the treatment works.

2.2 Published Geology

The published geological map for the area, BGS Sheet 81 (1991) and the BGS Geology of Britain Viewer (2017) show the site located on Glacial Till overlying Flamborough Chalk of the Upper Cretaceous. There are also Beach Deposits recorded as Tidal Flat and Modern Beach Deposits.

3 FIELDWORK

The exploratory hole locations were selected by RHDHV and set out from local features. The co-ordinates and ground levels were surveyed by ESG to National Grid and Ordnance Datum, as shown on the Site Plan in Appendix A.

The exploratory holes are listed in the following table; with more detail provided in the Exploratory Hole Summary presented in Appendix B.

TABLE 1 : EXPLORATORY HOLES

TYPE	QUANTITY	MAXIMUM DEPTH (m)	REMARKS
Cable Percussion Boring	9	25.00	BH401 to 409
Dynamic Sampling	2	6.45	BH410, 410A, 411 and 411A. *Carried out on the beach. All plant and equipment was lifted onto the beach, by crane, from the top of the cliff.*
Trial Pits	23	4.10	TP302 to 322, 314A and 318A (Machine dug) *TP301 cancelled by the WB/YW.*

The exploratory hole logs are presented in Appendix B. These provide information including the equipment and methods used, samples taken, tests carried out, water observations and descriptions of the strata encountered. Explanation of the terms and abbreviations used on the logs is given in the Key to Exploratory Hole Records in Appendix B, together with other explanatory information. The logging of soil is in accordance with BS EN ISO 14688-1+A1 (2013) for soils, as amplified by BS 5930 (2015).

Standard penetration tests (SPT) were carried out in accordance with BS EN ISO 22476-3+A1 (2011) and the SPT hammer energy ratio certificate is included in Appendix B. The SPT results are presented on the logs as uncorrected N values.

Photographs of the trial pits are presented in Appendix D.

On completion of the fieldwork, geotechnical samples were transported to the Doncaster laboratory of ESG for testing and temporary retention.

4 LABORATORY TESTING

Geotechnical laboratory testing was scheduled by RHDHV and was carried out in accordance with BS 1377 (1990), BS EN ISO 17892 (2014) Part 1 and 2 unless otherwise stated. The testing is summarised below and the results are presented in Appendix C.

- Water Content Determination
- Atterberg Limit Determination
- Particle Size Distribution Analysis
- pH and Water Soluble Sulphate Content of Soils Magnesium, Chloride, Nitrate, Acid Soluble Sulphate and Total Sulphur. Test methods are BS 1377 or others recognised in BRE Special Digest 1 (2005); they are indicated on the results report sheets in Appendix C.
- Unconsolidated Undrained Triaxial Compression Testing
- One Dimensional Oedometer Consolidation Testing
- Laboratory Vane Testing

REFERENCES

AGS : 2017 : Electronic transfer of geotechnical and geoenvironmental data (Edition 4.0.4, 2017). Association of Geotechnical and Geoenvironmental Specialists.

BGS England and Wales Sheet 81 : 1991 : Patrington. 1:50,000 geological map (solid and drift). British Geological Survey.

BGS Geology of Britain Viewer : 2017. www.bgs.ac.uk. British Geological Survey.

BRE Special Digest 1 : 2005 : Concrete in aggressive ground. Building Research Establishment.

BS 1377 : 1990 : Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930 : 2015 : Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2 : 2007 : Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1:2002+A1 : 2013 : Geotechnical investigation and testing - Identification and classification of soil - Part 1 Identification and description. British Standards Institution.

BS EN ISO 14688-2:2004+A1 : 2013 : Geotechnical investigation and testing - Identification and classification of soil - Part 2 Principles for a classification. British Standards Institution.

BS EN ISO 22475-1 : 2006 : Geotechnical investigation and testing – Sampling methods and groundwater measurements - Part 1 Technical principles for execution. British Standards Institution.

BS EN ISO 22476-3:2005+A1 : 2011 : Geotechnical investigation and testing - Field testing - Part 3 Standard penetration test. British Standards Institution.

APPENDIX A

FIGURES AND DRAWINGS

Site Location Plan

Notes: Scale 1:50 000	**Project** WITHERNSEA LONG SEA OUTFALL GROUND INVESTIGATION **Project No.** A7063-17 **Carried out for** Ward & Burke Construction Limited	**Figure** **A1**

535000m

535500m

536000m

425500m

425000m

60 YEAR EROSION LINE

100 YEAR EROSION LINE

SEE INSET

LIDAR DATA

+1.1

CPT201

MEAN HIGH WA

BH101 BH102 BH103 BH104 BH105 BH106

B1 B2 B3 B4

TP1 TP2 TP3 TP4

RB1 RB2

Area 60.305m
Perimeter 42.794m

Area 168.789m
Perimeter 57.577m

Area 811.261m²
Perimeter 494.536m

Area 650.175m²
Perimeter 423.942m

BH401 535491.300 424914.559 11.28

BH402 535544.222 425001.012 11.35

BH403 535620.075 425086.198 11.39

BH404 535670.895 425150.769 10.83

BH405 535719.189 425199.573 10.48

BH406 535842.386 425334.457 11.03

BH407 535844.293 425428.166 10.45

BH408 535965.017 425481.702 8.29

BH409 535998.989 425636.076 -0.03

BH410 536035.961 425593.961 -0.50

BH411 536078.986 425616.075 2.93

TP301 534401.614 424022.112 9.88

TP302 534486.027 424088.311 10.33

TP303 534564.117 424152.769 10.09

TP304 534641.792 424215.308 10.61

TP305 534725.535 424282.054 11.78

TP306 534805.689 424339.338 13.00

TP307 534872.174 424403.361 10.25

TP308 534955.238 424462.186 10.94

TP309 535030.235 424529.660 11.38

TP310 535110.563 424589.518 10.73

TP311 535157.800 424632.142 9.81

TP312 535306.341 424754.414 10.97

TP313 535340.669 424781.784 11.51

TP314 535425.159 424844.068 11.57

TP315 535508.628 424908.843 11.04

TP316 535639.205 424848.701 10.95

TP317 535639.915 425112.331 10.95

TP318 535742.225 425258.233 10.44

TP319 535802.580 425300.242 10.94

TP320 535828.833 425585.250 10.79

TP321 535939.205 425448.701 8.16

TP322 535970.964 425574.393 9.99

CONTROL & DATUM INFORMATION

Co-ordinates and levels are based upon OSGB 1936 National Grid (OSGB36) and Ordnance Survey Datum Newlyn (ODN).

They are derived using realtime on site GPS survey, that utilises the National Grid Transformation OSTN15GB and the National Geoid Model OSGM15GB.

The data obtained for use in this drawing involved the use of realtime GPS survey and total station survey.

COORDINATES

Reference	East	North	Elevation	Description
BH401	535491.300	424914.559	11.28	Borehole
BH402	535544.222	425001.012	11.35	Borehole
BH403	535620.075	425086.198	11.39	Borehole (Staked out)
BH404	535670.895	425150.769	10.83	Borehole (Staked out)
BH405	535719.189	425199.573	10.48	Borehole
BH406	535770.426	425272.203	10.59	Borehole
BH407	535842.386	425334.457	11.03	Borehole
BH408	535844.293	425428.166	10.45	Borehole
BH409	535965.017	425481.702	8.29	Borehole
BH410	535998.989	425636.076	-0.03	Borehole (Staked out)
BH411	536035.961	425593.961	-0.50	Borehole (Staked out)
TP301	534401.614	424022.112	9.88	Trial Pit
TP303	534486.027	424088.311	10.33	Trial Pit
TP304	534564.117	424152.769	10.09	Trial Pit
TP305	534641.792	424215.308	10.61	Trial Pit
TP306	534725.535	424282.054	11.78	Trial Pit
TP307	534805.689	424339.338	13.00	Trial Pit
TP308	534872.174	424403.361	10.25	Trial Pit
TP309	534955.238	424462.186	10.94	Trial Pit
TP310	535030.235	424529.660	11.38	Trial Pit
TP311	535110.563	424589.518	10.73	Trial Pit
TP312	535157.800	424632.142	9.81	Trial Pit
TP313	535306.341	424754.414	10.97	Trial Pit
TP314	535340.669	424781.784	11.51	Trial Pit
TP315	535425.159	424844.068	11.57	Trial Pit
TP316	535508.628	424908.843	11.04	Trial Pit
TP317	535639.915	425112.331	10.95	Trial Pit (Staked out)
TP318	535742.225	425258.233	10.44	Trial Pit
TP319	535802.580	425300.242	10.94	Trial Pit
TP320	535828.833	425585.250	10.79	Trial Pit
TP321	535939.205	425448.701	8.16	Trial Pit
TP322	535970.964	425574.393	9.99	Trial Pit

LEGEND TO SYMBOLS

- Denotes Borehole Location
- Denotes Trial Pit Location
- Denotes Borehole Location (Norwest Holst Feb 1998)
- Denotes Borehole Location (Soil Mechanics Feb 2002)
- Denotes Trial Pit Location (Soil Mechanics Feb 2002)

Scale: 1:2000

0 20m 40 80 120 160

Title

SITE PLAN

Project

WITHERNSEA LONG SEA OUTFALL GROUND INVESTIGATION

Client

Ward & Burke Construction Limited

ESG

Date	Drawn By	Approv. By
29.07.17	NH	TC

Sheet Size	Scale	Project No
A1	1:2000	A7063-17

Drawing No	Rev
A2.2	0

APPENDIX B

EXPLORATORY HOLE RECORDS

Exploratory Hole Summary	B1
Key to Exploratory Hole Records	Key
SPT Hammer Energy Ratio Report	SPT Hammer Reference: SM39, AR598, AR1842, G1 and G3
Borehole Logs	BH401 to BH411, BH410A and BH411A
Trial Pit Logs	TP302 to 322, 314A and 318A

Exploratory Hole Summary

Hole ID	Hole Depth, (m)	Hole Type	Eastings, (m)	Northings, (m)	Ground Level, (m AOD)	Hole Remarks
BH401	25.00	CP	535491.30	424916.56	11.28	
BH402	25.00	CP	535544.22	425001.01	11.35	
BH403	25.00	CP	535620.08	425086.20	11.39	
BH404	25.00	CP	535670.90	425150.77	10.83	
BH405	25.00	CP	535719.19	425199.57	10.48	
BH406	25.00	CP	535770.43	425272.20	10.59	
BH407	25.00	CP	535842.39	425334.46	11.03	
BH408	25.00	CP	535864.29	425428.17	10.45	
BH409	25.00	CP	535965.02	425481.70	8.29	
BH410	6.50	DS	535998.99	425636.08	-0.03	Carried out on beach bewteen tides. All plant and equipment lifted onto beach by crane from cliff top.
BH410A	11.40	RO / DS	-	-	-	
BH411	6.55	DS	536035.96	425593.96	-0.50	
BH411A	12.00	RO / DS	-	-	-	
TP301	-	TP	-	-	-	Cancelled by WB / YW
TP302	3.70	TP	534401.61	424022.11	9.88	
TP303	3.50	TP	534486.03	424088.31	10.33	
TP304	3.80	TP	534564.12	424152.77	10.09	
TP305	3.80	TP	534641.79	424215.31	10.61	
TP306	3.90	TP	534725.54	424282.05	11.78	
TP307	3.80	TP	534800.69	424339.34	13.00	
TP308	3.60	TP	534872.17	424403.36	10.25	
TP309	3.80	TP	534955.26	424462.19	10.94	
TP310	3.90	TP	535030.24	424529.66	11.38	
TP311	3.70	TP	535110.56	424589.52	10.73	
TP312	3.90	TP	535157.80	424632.14	9.81	
TP313	3.90	TP	535306.34	424754.41	10.97	
TP314	0.60	TP	535340.67	424781.78	11.51	
TP314A	3.80	TP	535342.67	424783.78	11.51	
TP315	3.90	TP	535425.16	424844.07	11.57	
TP316	4.10	TP	535508.63	424958.84	11.04	
TP317	4.00	TP	535639.92	425112.33	10.95	
TP318	1.00	TP	535742.23	425238.23	10.44	
TP318A	3.70	TP	535744.23	425240.23	10.44	
TP319	4.00	TP	535802.58	425300.24	10.94	
TP320	3.80	TP	535828.83	425385.25	10.79	
TP321	4.00	TP	535939.21	425448.70	8.16	
TP322	3.60	TP	535970.96	425574.39	9.99	

Key to Exploratory Hole Records

SAMPLES

Undisturbed

U	Driven tube sample	nominally 100 mm diameter and full recovery unless otherwise stated
UT	Driven thin wall tube sample	
TW	Pushed thin wall tube sample	
P	Pushed piston sample	
L	Liner sample (from Windowless or similar sampler), full recovery unless otherwise stated	
CBR	CBR mould sample	
BLK	Block sample	
CS	Core sample (from rotary core) taken for laboratory testing	
AMAL	Amalgamated sample	

Disturbed

D	Small sample
B	Bulk sample

Other

W	Water sample
G	Gas sample
	Environmental chemistry samples (in more than one container where appropriate)
ES	Soil sample
EW	Water sample

Comments Sample reference numbers are assigned to every sample taken. A sample reference of 'NR' indicates that attempt was made to take a tube sample, however, there was no recovery.

Monitoring samples taken after completion of hole construction are not shown on the exploratory hole logs.

TESTS

SPT S or SPT C — Standard Penetration Test, open shoe (S) or solid cone (C)

The Standard Penetration Test is defined in BS EN ISO 22476-3:2005+A1:2011. The incremental blow counts are given in the Field Records column; each increment is 75 mm unless stated otherwise and any penetration under self weight in mm (SW) is noted. Where the full 300 mm test drive is achieved the total number of blows for the test drive is presented as N = ** in the Test column. Where the test drive blows reach 50 the total blow count beyond the seating drive is given (without the N = prefix).

IV	*in situ* Vane shear strength, peak (p) and remoulded (r)
HV	Hand vane shear strength, peak (p) and remoulded (r)
PP	Pocket penetrometer test, converted to shear strength
KFH, KRH, KPI	Permeability tests (KFH = falling head, KRH = rising head; KPI = packer inflow); results provided in Field Records column (one value per stage for packer tests)

DRILLING RECORDS

The mechanical indices (TCR/SCR/RQD & If) are defined in BS 5930:2015

TCR	Total Core Recovery, %
SCR	Solid Core Recovery, %
RQD	Rock Quality Designation, %
If	Fracture spacing, mm. Minimum, typical and maximum spacings are presented. The term non-intact (NI) is used where the core is fragmented.

Flush returns, estimated percentage with colour where relevant, are given in the Records column

CRF	Core recovered (length in m) in the following run
AZCL	Assessed zone of core loss
NR	Not recovered

GROUNDWATER

▼	Groundwater strike
▽	Groundwater level after standing period

Key to Exploratory Hole Records

INSTALLATION

Standpipe/ piezometer

Details of standpipe/piezometer installations are given on the Record. Legend column shows installed instrument depths including slotted pipe section or tip depth, response zone filter material type and layers of backfill.

The type of instrument installed is indicated by a code in the Legend column at the depth of the response zone:

SP Standpipe
SPIE Standpipe piezometer
PPIE Pneumatic piezometer
EPIE Electronic piezometer

Inclinometer or Slip Indicator

The installation of vertical profiling instruments is indicated on the Record. The base of tubing is shown in the Legend column.

The type of instrument installed is indicated by a code in the Legend column at the base of the tubing:

ICE Biaxial inclinometer
ICM Inclinometer tubing for use with probe
SLIP Slip indicator

Settlement Points or Pressure Cells

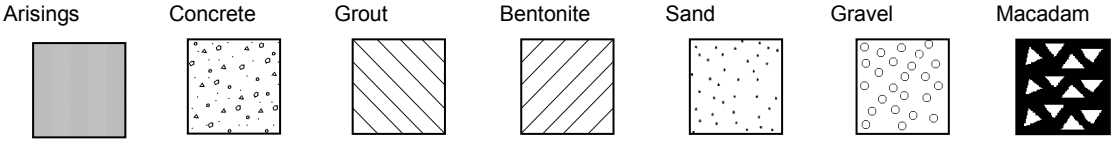
The installation of single point instruments is indicated on the Record. The location of the measuring device is shown in the Legend column.

The type of instrument installed is indicated by a code in the Legend column:

ESET Electronic settlement cell/gauge
ETM Magnetic extensometer settlement point
EPCE Electronic embedment pressure cell
PPCE Electronic push in pressure cell

INSTALLATION LEGENDS

A legend describing the installation is shown in the rightmost column. Legends used to describe the backfill materials as indicated below.



NOTES

1 Soils and rocks are described in accordance with BS EN ISO 14688-1:2002+A1:2013 and 14689-1:2003 respectively as amplified by BS 5930:2015.

2 For fine soils, consistency determined during description is reported for those strata where undisturbed samples are available. Where the logger considers that the sample may not be representative of the condition in situ, for whatever reason, the reported consistency is given in brackets. The reliability of the sample is indicated by Probably or Possibly as appropriate. Hence (Probably firm) indicates the logger is reasonably confident of the assessment, but (Possibly firm) means less certainty. Where the samples available are too disturbed to allow a reasonable assessment of the in situ condition, no consistency is given.

3 Evidence of the occurrence of very coarse particles (cobbles and boulders) is presented on the logs, however, because of their size in relation to the exploratory hole these records may not be fully representative of their size and frequency in the ground mass.

4 The declination of bedding and joints is given with respect to the normal to the core axis. Thus in a vertical borehole this will be the dip.

5 The assessment of SCR, RQD and Fracture Spacing excludes artificial fractures

6 Water level observations of discernible entries during the advancing of the exploratory hole are given at the foot of the log and in the Legend column. The term "none observed" is used where no discrete entries are identified although this does not necessarily indicate that the hole has not been advanced below groundwater level. Under certain conditions groundwater cannot be observed, for instance, drilling with water flush or overwater, or boring at a rate much faster than water can make its way into the borehole In addition, where appropriate, water levels in the hole at the time of recovering individual samples or carrying out in situ tests and at shift changes are given in the Records column.

7 The borehole logs present the results of Standard Penetration Tests recorded in the field without correction or interpretation. However, in certain ground conditions (eg high hydraulic head or where very coarse particles are present) some judgement may be necessary in considering whether the results are representative of in situ mass conditions.

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX59JP

SPT Hammer Ref:	SM39
Test Date:	29/06/2017
Report Date:	06/07/2017
File Name:	SM39.spt
Test Operator:	SH

Instrumented Rod Data

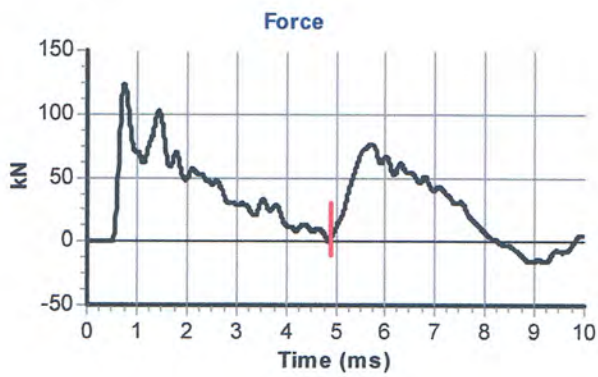
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	11609

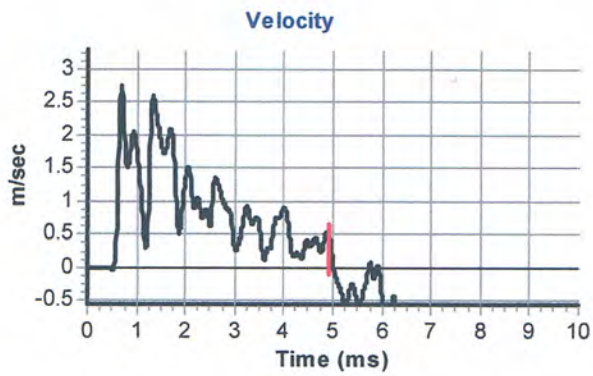
SPT Hammer Information

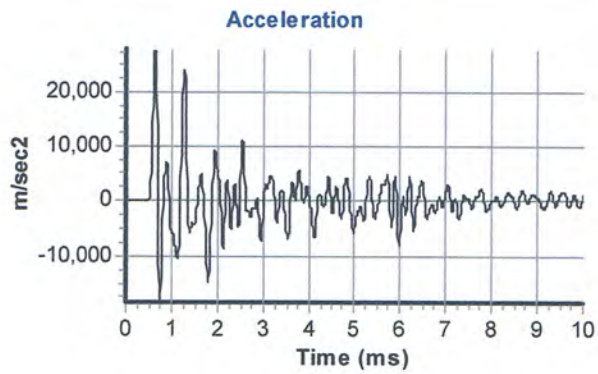
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

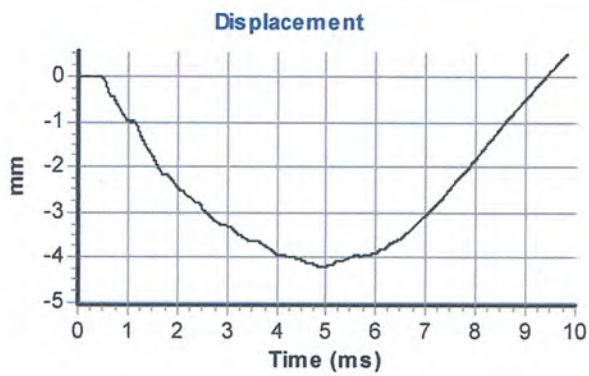
Comments / Location

CALIBRATION









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	290

Energy Ratio E_r (%): **61**

Signed: M.GARDNER
Title: FITTER

The recommended calibration interval is 12 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX59JP

SPT Hammer Ref:	AR598
Test Date:	29/06/2017
Report Date:	29/06/2017
File Name:	AR598.spt
Test Operator:	SH

Instrumented Rod Data

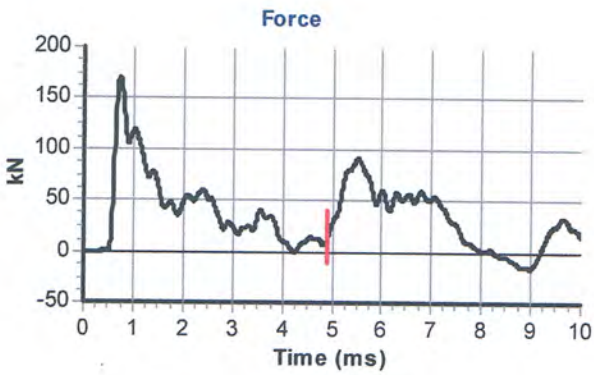
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	11609

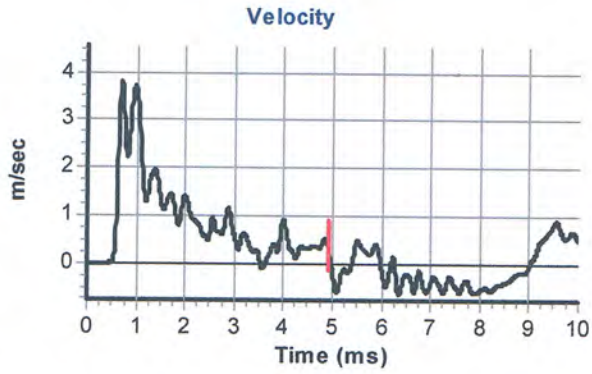
SPT Hammer Information

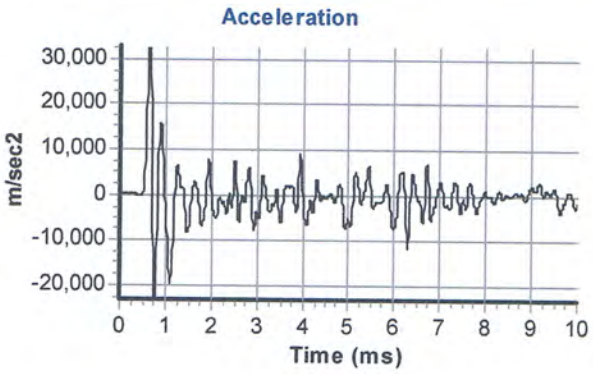
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

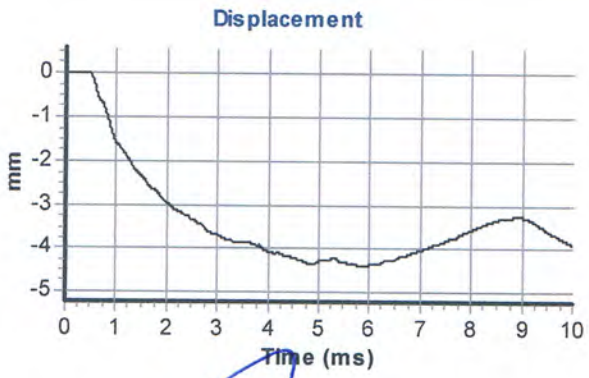
Comments / Location

CALIBRATION









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	358

Energy Ratio E_r (%): **76**

Signed: S. HOWARTH

Title: FITTER

The recommended calibration interval is 12 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX59JP

SPT Hammer Ref:	AR1842
Test Date:	11/07/2017
Report Date:	11/07/2017
File Name:	AR1842.spt
Test Operator:	SH

Instrumented Rod Data

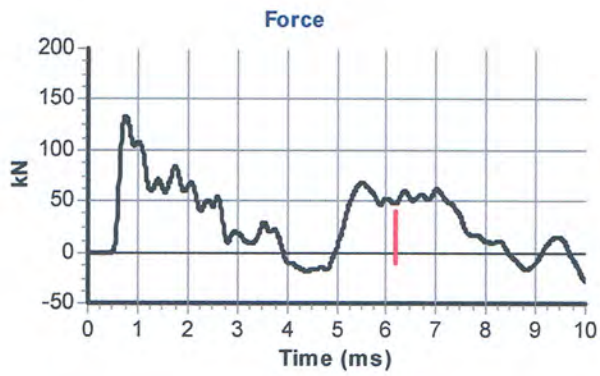
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	11609

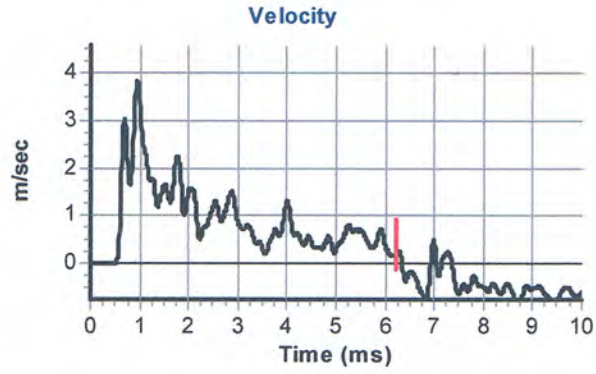
SPT Hammer Information

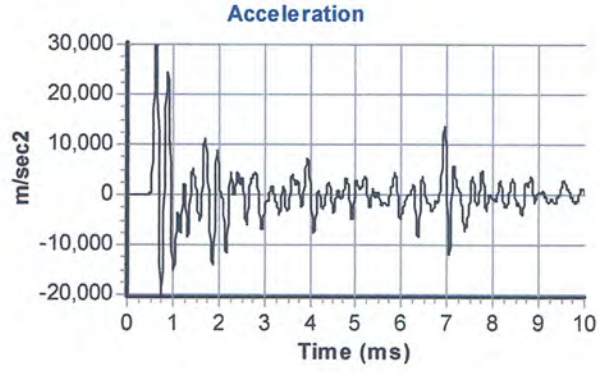
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location

CALIBRATION







Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	325

Energy Ratio E_r (%): **69**

Signed: S. HOWARTH

Title: FITTER

The recommended calibration interval is 12 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX59JP

SPT Hammer Ref:	G1
Test Date:	06/12/2016
Report Date:	06/12/2016
File Name:	G1.spt
Test Operator:	SH

Instrumented Rod Data

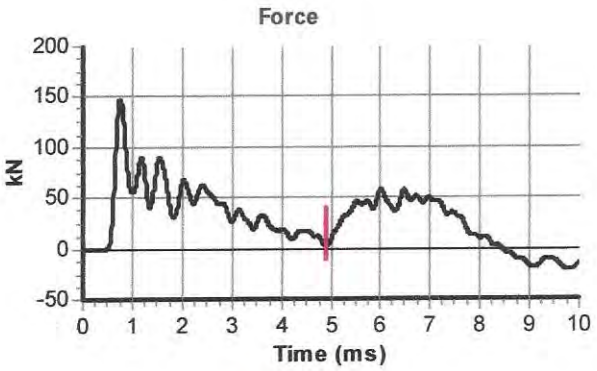
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.1
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	7079

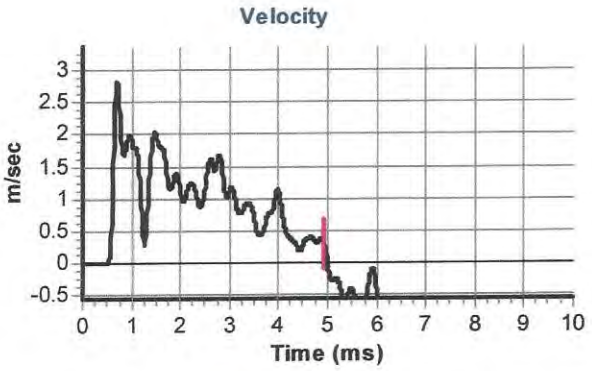
SPT Hammer Information

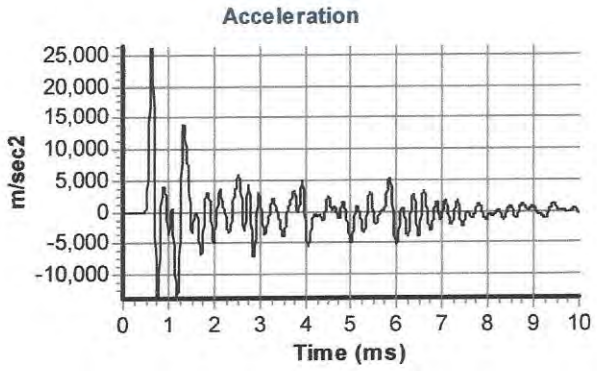
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

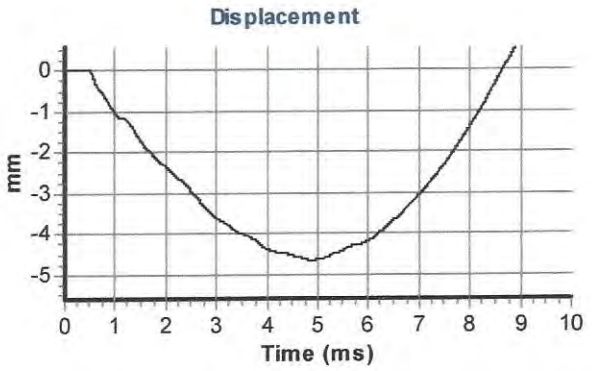
Comments / Location

CALIBRATION









Calculations

Area of Rod A (mm2):	918
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	276

Energy Ratio E_r (%): **58**

Signed: M.GARDNER

Title: FITTER

The recommended calibration interval is 12 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX59JP

SPT Hammer Ref:	G3
Test Date:	06/12/2016
Report Date:	06/12/2016
File Name:	G3.spt
Test Operator:	SH

Instrumented Rod Data

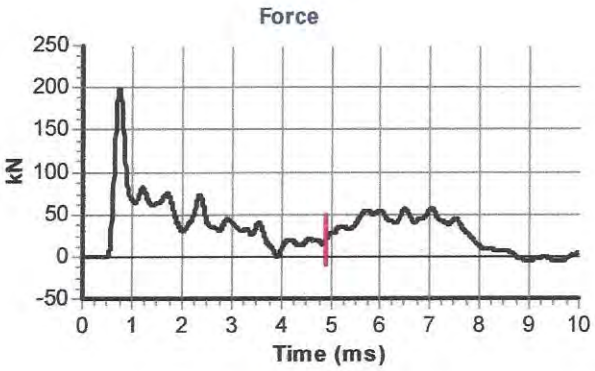
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.1
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	7079

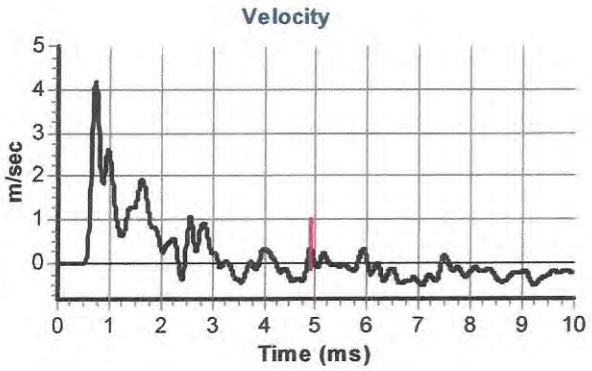
SPT Hammer Information

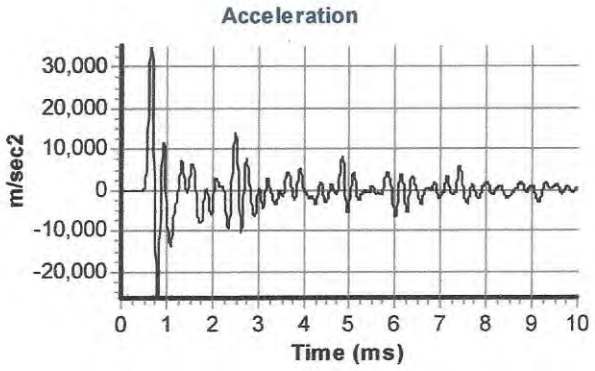
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location

CALIBRATION







Calculations

Area of Rod A (mm2):	918
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	326

Energy Ratio E_r (%): **69**

Signed: M.GARDNER

Title: FITTER

The recommended calibration interval is 12 months

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.28 mOD
Logged	DT	13/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535491.30
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 424916.56
Approved	TC	14/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		0.00-1.20 Hand excavated inspection pit.			Firm brown slightly sandy gravelly CLAY. Gravel is angular to rounded, fine to medium of various lithologies and occasional rootlets (TOPSOIL).		(0.30)		
0.20	D 1						0.30 +10.98		
0.50 - 1.00	B 2				Stiff to very stiff slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including sandstone and chalk.	0.50-1.00 occasional rootlets			
1.00	D 3					1.00-1.20 rare rootlets			
1.20 - 1.65	SPTS	N=24 (3,4/5,6,6,7)	1.20	Dry					
1.20	D 4								
1.20 - 1.70	B 5								
2.00 - 2.45	UT 6	40 blows 100% rec	2.00	Dry					
2.45	HV	p 208 to >217kPa, r							
2.50	D 7	205kPa							
3.00 - 3.45	SPTS	N=13 (2,1/3,2,4,4)	3.00	Dry					
3.00	D 8								
3.00 - 3.50	B 9								
4.00 - 4.45	UT 10	60 blows 100% rec	4.00	Dry			(7.70)		
4.45	HV	p 151kPa, r 81kPa							
4.50	D 11								
5.00 - 5.45	SPTS	N=12 (1,2/3,2,3,4)	5.00	Dry					
5.00	D 12								
5.00 - 5.50	B 13								
6.00 - 6.45	UT 14	75 blows 100% rec	6.00	Dry					
6.45	HV	p 124kPa, r 67kPa				6.50-6.60 gravel			
6.50	D 15								
7.00 - 7.45	SPTS	N=17 (2,3/4,4,5,4)	7.00	Dry					
7.00	D 16								
7.00 - 7.50	B 17								
8.00 - 8.45	UT 18	70 blows 100% rec	8.00	Dry	Firm greyish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to medium of sandstone and chalk.		8.00 +3.28		
8.45	HV	p 63kPa, r 26kPa							
8.50	D 19								
9.00 - 9.45	SPTS	N=17 (3,3/4,4,5,4)	9.00	Dry					
9.00	D 20								
9.00 - 9.50	B 21								
							(3.00)		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks
0.00 - 25.00	No water encountered during drilling.

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:18

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH401

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.28 mOD
Logged	DT	13/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535491.30
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 424916.56
Approved	TC	14/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
10.00 - 10.45	UT 22	60 blows 89% rec	10.00	Dry	Firm greyish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to medium of sandstone and chalk.				
			13/07/17	1835					
10.45 10.50	HV D 23	p 49kPa, r 30kPa	10.50	Dry		10.50 becoming fine to coarse gravel			
			14/07/17	0800					
			10.50	Dry					
11.00 - 11.45 11.00 11.00 - 11.50	SPTS D 24 B 25	N=34 (3,4/6,8,9,11)	11.00	Dry	Stiff to very stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including sandstone and chalk.		11.00 +0.28		
12.00 - 12.45	UT 26	75 blows 100% rec	12.00	Dry					
12.45 12.50	HV D 27	p 170kPa, r 72kPa							
13.00 - 13.45 13.00 13.00 - 13.50	SPTS D 28 B 29	N=28 (4,4/5,6,7,10)	13.00	Dry					
14.00 - 14.45	UT 30	60 blows 100% rec	14.00	Dry					
14.45 14.50	HV D 31	p 104kPa, r 43kPa							
15.00 - 15.45 15.00 15.00 - 15.50	SPTS D 32 B 33	N=33 (3,4/6,7,9,11)	15.00	Dry					
16.00 - 16.45 16.00 - 16.50	UT NR B 34	70 blows No Recovery	16.00	Dry					
17.00 - 17.45	UT 35	70 blows 100% rec	17.00	Dry					
17.45 17.50	HV D 36	p 158kPa, r 77kPa							
18.00 - 18.45 18.00 18.00 - 18.50	SPTS D 37 B 38	N=41 (6,7/8,10,11,12)	18.00	Dry			(14.00)		
19.00 - 19.45	UT 39	75 blows 100% rec	19.00	Dry					
19.45 19.50	HV D 40	p 183kPa, r 69kPa							

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:18

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH401

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.28 mOD
Logged	DT	13/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535491.30
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 424916.56
Approved	TC	14/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 - 20.45 20.00 20.00 - 20.50	SPTS D 41 B 42	N=37 (7,8/8,9,9,11)	20.00	Dry	Stiff to very stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including sandstone and chalk.				
21.00 - 21.45	UT 43	75 blows 100% rec	21.00	Dry					
21.45 21.50	HV D 44	p 183kPa, r 72kPa							
22.00 - 22.45 22.00 22.00 - 22.50	SPTS D 45 B 46	N=43 (6,7/9,11,11,12)	22.00	Dry					
23.00 - 23.45	UT 47	75 blows 100% rec	23.00	Dry					
23.45 23.50	HV D 48	p 132kPa, r 39kPa							
24.00 - 24.45 24.00 24.00 - 24.50	SPTS D 49 B 50	N=44 (7,8/9,11,12,12)	24.00	Dry					
24.50 - 25.00	B 51								
			14/07/17 25.00	1828 Dry					
					END OF EXPLORATORY HOLE		25.00 -13.72		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:18

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH401

Borehole Log

SOCOTEC

Drilled	DS/MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.35 mOD
Logged	MS	13/07/2017	Dando 2000.	1.20	9.00	200	9.00	**Coordinates (m)**	E 535544.22
Checked	TC	**End**	Cable percussion boring.	9.00	25.00	150	25.00	**National Grid**	N 425001.01
Approved	TC	17/07/2017	SPT Hammer ID: AR1842, Rod type 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
0.00 - 0.35	B 1	0.00-1.20 Hand excavated inspection pit.	13/07/17	1230 Dry	Brown clayey SAND with frequent rootlets (TOPSOIL).		(0.35)		
0.35 - 1.20	B 2				Firm reddish brown, locally mottled black, slightly sandy, locally slightly gravelly, CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies. Occasional rootlets.		0.35 +11.00		
1.20 - 1.65 1.20 1.20 - 1.70	SPTS D 3 B 4	N=11 (2,2/2,3,3,3)	1.20	Dry			(1.35)		
2.00 - 2.45	UT 5	37 blows 100% rec	2.00	Dry	Stiff, locally firm, brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of chalk, mudstone, sandstone and flint.	2.00-2.50 very stiff	1.70 +9.65		
2.45	HV	p >217kPa, r N/A							
3.00 - 3.45 3.00 3.00 - 3.50	SPTS D 6 B 7	N=13 (2,3/3,3,4,3)	3.00	Dry					
4.00 - 4.45	UT 8	48 blows 100% rec	3.00	Dry					
4.45 4.45	HV D 9	p 146kPa, r 67kPa							
5.00 - 5.45 5.00 5.00 - 5.50	SPTS D 10 B 11	N=19 (2,3/4,5,5,5)	3.20	Dry			(8.30)		
6.00 - 6.45	UT 12	38 blows 100% rec	3.20	Dry					
6.45	HV	p 88kPa, r 40kPa	13/07/17 3.20 14/07/17 3.20	1730 Dry 0730 Dry					
7.00 - 7.45 7.00 7.00 - 7.50	SPTS D 13 B 14	N=17 (3,4/3,4,5,5)	3.20	Dry					
8.00 - 8.45	UT 15	37 blows 100% rec	3.20	Dry					
8.45 8.45	HV D 16	p 143kPa, r 56kPa							
9.00 - 9.45 9.00 9.00 - 9.50	SPTS D 17 B 18	N=23 (4,5/6,6,5,6)	3.20	Dry			10.00 +1.35		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:19

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH402

Borehole Log

SOCOTEC

Drilled	DS/MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.35 mOD
Logged	MS	13/07/2017	Dando 2000.	1.20	9.00	200	9.00	**Coordinates (m)**	E 535544.22
Checked	TC	**End**	Cable percussion boring.	9.00	25.00	150	25.00	**National Grid**	N 425001.01
Approved	TC	17/07/2017	SPT Hammer ID: AR1842, Rod type 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Time Casing / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
10.00 - 10.45	UT 19	36 blows 100% rec	3.20 Dry	(Probably firm) brown clayey SILT.				
10.45	D 20					(0.80)		
10.60	D 21							
						10.80 +0.55		
11.00 - 11.45	SPTS	N=25 (5,6/6,7,6,6)	11.00 Damp	Stiff, becoming very stiff, greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of chalk, mudstone and sandstone. Rare gravel size lenses of silty fine to medium sand.				1
11.00	D 22							
11.00 - 11.50	B 23							
12.00 - 12.45	UT 24	56 blows 100% rec	11.00 Damp					
12.45	HV	p 163kPa, r 86kPa						
13.00 - 13.45	UT 25	49 blows 100% rec	12.00 Damp					
13.45	HV	p 137kPa, r 50kPa						
14.00 - 14.45	SPTS	N=26 (4,5/6,6,7,7)	12.00 Dry					
14.00	D 26							
14.00 - 14.50	B 27							
15.00 - 15.45	UT 28	51 blows 100% rec	12.00 Dry					
15.45	HV	p 156kPa, r 66kPa						
16.00 - 16.45	SPTS	N=26 (4,6/6,7,7,6)	12.00 Dry					
16.00	D 29							
16.00 - 16.50	B 30		14/07/17 1430					
			12.00 Dry					
			17/07/17 1230					
			12.00 Dry					
17.00 - 17.45	UT 31	65 blows 100% rec	17.00 Dry					
17.45	HV	p 157kPa, r 66kPa						
17.50	D 32							
18.00 - 18.45	SPTS	N=35 (5,6/7,9,9,10)	18.00 Dry			(14.20)		
18.00	D 33							
18.00 - 18.50	B 34							
19.00 - 19.45	UT 35	70 blows 89% rec	19.00 Dry					
19.45	HV	p 189kPa, r 87kPa						
19.50	D 36							1

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)
1	11.00	Damp	
1	20.00	Damp	

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:19

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH402

Borehole Log

SOCOTEC

Drilled	DS/MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.35 mOD
Logged	MS	13/07/2017	Dando 2000.	1.20	9.00	200	9.00	**Coordinates (m)**	E 535544.22
Checked	TC	**End**	Cable percussion boring.	9.00	25.00	150	25.00	**National Grid**	N 425001.01
Approved	TC	17/07/2017	SPT Hammer ID: AR1842, Rod type 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 - 20.45 20.00 20.00 - 20.50	SPTS D 37 B 38	N=35 (6,7/8,8,9,10)	20.00	Damp	Stiff, becoming very stiff, greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of chalk, mudstone and sandstone. Rare gravel size lenses of silty fine to medium sand.				
21.00 - 21.45	UT 39	75 blows 67% rec	21.00	Damp					
21.45 21.50	HV D 40	p >217kPa, r N/A							
22.00 - 22.45 22.00 22.00 - 22.50	SPTS D 41 B 42	N=37 (6,7/8,9,10,10)	22.00	Damp					
23.00 - 23.45 23.00 - 23.50	UT NR B 43	70 blows No Recovery	23.00	Damp					
23.50 - 23.95 23.50 - 24.00	UT NR B 44	70 blows No Recovery	23.00	Damp					
24.00 - 24.45 24.00 24.00 - 24.50	SPTS D 45 B 46	N=41 (7,8/9,10,11,11)	24.00	Damp					
			17/07/17 25.00	1720 Damp					
25.00	D 47				END OF EXPLORATORY HOLE		25.00 -13.65		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

AGS

Scale 1:50

03/11/2017 08:59:19

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH402

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.39 mOD
Logged	MS	21/07/2017	Dando 2000.	1.20	12.00	200	12.00	**Coordinates (m)**	E 535620.08
Checked	TC	**End**	Cable percussion boring.	12.00	25.00	150	25.00	**National Grid**	N 425086.20
Approved	TC	24/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		0.00-1.20 Hand excavated inspection pit.	21/07/17	1000					
0.20	D 1		0.00	Dry	Firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of various lithologies and occasional rootlets (TOPSOIL).		(0.30) 0.30 +11.09		
0.50 - 1.00	B 2				Very stiff reddish brown slightly sandy slightly gravelly to gravelly CLAY. Gravel is angular to subrounded fine to coarse of chalk, mudstone, sandstone and coal. Occasional gravel size lenses of fine to medium sand.	0.50-1.00 rare rootlets			
1.00	D 3								
1.20 - 1.65	SPTS	N=11 (2,3/2,3,3,3)	1.20	Dry			(2.70)		
1.20	D 4								
1.20 - 1.70	B 5								
2.00 - 2.45	UT 6	50 blows 100% rec	2.00	Dry					
2.45	HV	p >217kPa, r N/A							
2.50	D 7								
3.00 - 3.45	SPTS	N=12 (2,2/3,3,3,3)	3.00	Dry	Stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of chalk, mudstone and sandstone. Rare gravel size pockets of fine sand and silt.		3.00 +8.39		
3.00	D 8								
3.00 - 3.50	B 9								
4.00 - 4.45	UT 10	55 blows 100% rec	4.00	Dry					
4.50	D 11								
5.00 - 5.45	SPTS	N=14 (2,3/3,3,4,4)	5.00	Dry					
5.00	D 12								
5.00 - 5.50	B 13								
6.00 - 6.45	UT 14	60 blows 100% rec	6.00	Dry					
6.50	D 15								
7.00 - 7.45	SPTS	N=14 (2,3/3,4,3,4)	7.00	Dry					
7.00	D 16								
7.00 - 7.50	B 17								
8.00 - 8.45	UT 18	60 blows 100% rec	8.00	Dry					
8.50	D 19								
9.00 - 9.45	SPTS	N=19 (3,4/5,4,5,5)	9.00	Dry					
9.00	D 20								
9.00 - 9.50	B 21								
						10.00 becoming locally firm			

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks
0.00 - 25.00	No water encountered during drilling.

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:19

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole BH403

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.39 mOD
Logged	MS	21/07/2017	Dando 2000.	1.20	12.00	200	12.00	**Coordinates (m)**	E 535620.08
Checked	TC	**End**	Cable percussion boring.	12.00	25.00	150	25.00	**National Grid**	N 425086.20
Approved	TC	24/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
10.00 - 10.45	UT 22	65 blows 100% rec	10.00	Dry	Stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of chalk, mudstone and sandstone. Rare gravel size pockets of fine sand and silt.				
10.50	D 23								
			21/07/17	1820					
			11.00	Dry					
11.00 - 11.45	SPTS	N=14 (2,3/3,4,3,4)							
11.00	D 24		24/07/17	0300					
11.00 - 11.50	B 25		11.00	Dry					
12.00 - 12.45	UT 26	65 blows 100% rec	12.00	Dry					
12.50	D 27								
13.00 - 13.45	SPTS	N=19 (2,3/4,5,5,5)	13.00	Dry					
13.00	D 28								
13.00 - 13.50	B 29								
14.00 - 14.45	UT 30	65 blows 100% rec	14.00	Dry			(22.00)		
14.50	D 31								
15.00 - 15.45	SPTS	N=18 (3,3/4,4,5,5)	15.00	Dry					
15.00	D 32								
15.00 - 15.50	B 33								
16.00 - 16.45	UT 34	65 blows 100% rec	16.00	Dry					
16.50	D 35								
17.00 - 17.45	SPTS	N=20 (3,4/5,4,5,6)	17.00	Dry					
17.00	D 36								
17.00 - 17.50	B 37								
18.00 - 18.45	UT 38	70 blows 100% rec	18.00	Dry					
18.50	D 39								
19.00 - 19.45	SPTS	N=19 (3,4/5,4,5,5)	19.00	Dry					
19.00	D 40								
19.00 - 19.50	B 41								

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:19

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole BH403

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.39 mOD
Logged	MS	21/07/2017	Dando 2000.	1.20	12.00	200	12.00	**Coordinates (m)**	E 535620.08
Checked	TC	**End**	Cable percussion boring.	12.00	25.00	150	25.00	**National Grid**	N 425086.20
Approved	TC	24/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 - 20.45	UT 42	70 blows 100% rec	20.00	Dry	Stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of chalk, mudstone and sandstone. Rare gravel size pockets of fine sand and silt.				
20.50	D 43								
21.00 - 21.45	SPTS	N=23 (4,5/6,5,6,6)	21.00	Dry					
21.00	D 44								
21.00 - 21.50	B 45								
22.00 - 22.45	UT 46	65 blows 67% rec	22.00	Dry					
22.50	D 47								
23.00 - 23.45	SPTS	N=26 (5,6/7,6,6,7)	23.00	Dry					
23.00	D 48								
23.00 - 23.50	B 49								
24.00 - 24.45	UT 50	70 blows 100% rec	24.00	Dry					
24.50	D 51								
24.50 - 25.00	B 52								
			24/07/17 25.00	1812 Damp					
					END OF EXPLORATORY HOLE		25.00 -13.61		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH403

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.83 mOD
Logged	MS/JM	19/07/2017	Dando 2000.	1.20	10.00	200	10.00	**Coordinates (m)**	E 535670.90
Checked	TC	**End**	Cable percussion boring.	10.00	25.00	150	25.00	**National Grid**	N 425150.77
Approved	TC	20/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
0.20	D 1	0.00-1.20 Hand excavated inspection pit.	19/07/17 0.00	0800 Dry	Firm brown slightly gravelly sandy CLAY. Gravel is angular to subangular fine to medium of sandstone, mudstone and coal. Occasional rootlets(TOPSOIL).		(0.30) 0.30 +10.53		
0.50 - 1.00	B 2				Stiff, locally firm and very stiff, brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, chalk and rare coal.				
1.00	D 3								
1.20 - 1.65	SPTS	N=12 (2,2/3,3,3,3)	1.20	Dry					
1.20	D 4								
1.20 - 1.70	B 5								
2.00 - 2.45	UT 6	45 blows 100% rec	2.00	Dry					
2.45	HV	p >217kPa, r N/A							
2.50	D 7								
3.00 - 3.45	SPTS	N=12 (2,2/2,3,3,4)	3.00	Dry					
3.00	D 8								
3.00 - 3.50	B 9								
4.00 - 4.45	UT 10	50 blows 100% rec	4.00	Dry					
4.45	HV	p >217kPa, r N/A							
4.50	D 11								
5.00 - 5.45	SPTS	N=14 (2,3/3,3,4,4)	5.00	Dry					
5.00	D 12								
5.00 - 5.50	B 13						(10.70)		
6.00 - 6.45	UT 14	55 blows 100% rec	6.00	Dry					
6.45	HV	p 166kPa, r 92kPa							
6.50	D 15								
7.00 - 7.45	SPTS	N=17 (2,3/4,4,5,4)	7.00	Dry					
7.00	D 16								
7.00 - 7.50	B 17								
8.00 - 8.45	UT 18	60 blows 100% rec	8.00	Dry					
8.45	HV	p 119kPa, r 55kPa							
8.50	D 19								
9.00 - 9.45	SPTS	N=16 (3,4/4,3,4,5)	9.00	Dry					
9.00	D 20								
9.00 - 9.50	B 21								

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks
0.00 - 25.00	No water encountered during drilling.

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

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Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH404

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.83 mOD
Logged	MS/JM	19/07/2017	Dando 2000.	1.20	10.00	200	10.00	**Coordinates (m)**	E 535670.90
Checked	TC	**End**	Cable percussion boring.	10.00	25.00	150	25.00	**National Grid**	N 425150.77
Approved	TC	20/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Time Casing	Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
10.00 - 10.45	UT 22	65 blows 78% rec	10.00	Dry	Stiff, locally firm and very stiff, brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, chalk and rare coal.				
10.45 10.50	HV D 23	p 135kPa, r 61kPa							
11.00 - 11.45 11.00 11.00 - 11.50	SPTS D 24 B 25	N=20 (3,3/4,5,5,6)	11.00	Dry	Stiff, locally firm, greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of chalk, mudstone and sandstone. Rare gravel size pockets of silty fine sand.		11.00 -0.17		
12.00 - 12.45	UT 26	65 blows 100% rec	12.00	Dry					
12.45 12.50	HV D 27	p 142kPa, r 70kPa							
13.00 - 13.45 13.00 13.00 - 13.50	SPTS D 28 B 29	N=24 (3,4/5,6,6,7)	13.00	Dry					
14.00 - 14.45	UT 30	65 blows 89% rec	14.00	Dry					
14.45 14.50	HV D 31	p 157kPa, r 90kPa							
15.00 - 15.45 15.00 15.00 - 15.50	SPTS D 32 B 33	N=21 (3,3/4,5,6,6)	15.00	Dry					
			19/07/17 16.00	1900 Dry					
16.00 - 16.45	UT 34	65 blows 100% rec	20/07/17 16.00	1000 Dry					
16.45 16.50	HV D 35	p 86kPa, r 41kPa							
17.00 - 17.45 17.00 17.00 - 17.50	SPTS D 36 B 37	N=19 (3,4/5,4,5,5)	17.00	Dry					
18.00 - 18.45	UT 38	65 blows 100% rec	18.00	Dry			(14.00)		
18.45 18.50	HV D 39	p 128kPa, r 49kPa							
19.00 - 19.45 19.00 19.00 - 19.50	SPTS D 40 B 41	N=22 (4,4/5,6,5,6)	19.00	Dry					

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:20

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole BH404

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.83 mOD
Logged	MS/JM	19/07/2017	Dando 2000.	1.20	10.00	200	10.00	**Coordinates (m)**	E 535670.90
Checked	TC	**End**	Cable percussion boring.	10.00	25.00	150	25.00	**National Grid**	N 425150.77
Approved	TC	20/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 - 20.45	UT 42	65 blows 100% rec	20.00	Dry	Stiff, locally firm, greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of chalk, mudstone and sandstone. Rare gravel size pockets of silty fine sand.				
20.45 20.50	HV D 43								
21.00 - 21.45 21.00 21.00 - 21.50	SPTS D 44 B 45	N=27 (4,5/6,6,7,8)	21.00	Dry					
22.00 - 22.45	UT 46	70 blows 100% rec	22.00	Dry					
22.45 22.50	HV D 47	p 162kPa, r 94kPa							
23.00 - 23.45 23.00 23.00 - 23.50	SPTS D 48 B 49	N=28 (6,7/6,7,8,7)	23.00	Dry					
24.00 - 24.45	UT 50	75 blows 100% rec	24.00	Dry					
24.45 24.50 24.50 - 25.00	HV D 51 B 52	p 123kPa, r 57kPa							
			20/07/17 25.00	1800 Damp					
					END OF EXPLORATORY HOLE		25.00 -14.17		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:20

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH404

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.48 mOD
Logged	JM	18/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535719.19
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425199.57
Approved	TC	18/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth. Sample 33 missing.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		0.00-1.20 Hand excavated inspection pit.	18/07/17	0800	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with frequent rootlets (TOPSOIL).		(0.20)		
0.20	D 1			Dry			0.20 +10.28		
0.50 - 1.00	B 2				Stiff, locally firm, brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, chalk and coal.				
1.00	D 3								
1.20 - 1.65	SPTS	N=18 (2,3/4,4,5,5)	1.20	Dry					
1.20	D 4								
1.20 - 1.70	B 5								
2.00 - 2.45	UT 6	40 blows 100% rec	2.00	Dry					
2.45	HV	p >217kPa, r N/A							
2.50	D 7								
3.00 - 3.45	SPTS	N=12 (2,2/3,2,3,4)	3.00	Dry					
3.00	D 8								
3.00 - 3.50	B 9								
4.00 - 4.45	UT 10	55 blows 100% rec	4.00	Dry					
4.45	HV	p 186 to >217kPa, r 155kPa							
4.50	D 11								
5.00 - 5.45	SPTS	N=12 (2,2/2,3,3,4)	5.00	Dry		5.00-5.50 slightly gravelly sandy			
5.00	D 12								
5.00 - 5.50	B 13								
6.00 - 6.45	UT 14	60 blows 100% rec	6.00	Dry					
6.45	HV	p 96kPa, r 62kPa							
6.50	D 15								
7.00 - 7.45	SPTS	N=16 (2,3/4,4,4,4)	7.00	Dry					
7.00	D 16								
7.00 - 7.50	B 17								
8.00 - 8.45	UT 18	60 blows 100% rec	8.00	Dry			(15.80)		
8.45	HV	p 42kPa, r 26kPa							
8.50	D 19								
9.00 - 9.45	SPTS	N=14 (3,4/3,4,3,4)	9.00	Dry					
9.00	D 20								
9.00 - 9.50	B 21								

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks
0.00 - 25.00	No water encountered during drilling.

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:20

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH405

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.48 mOD
Logged	JM	18/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535719.19
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425199.57
Approved	TC	18/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth. Sample 33 missing.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
10.00 - 10.45	UT 22	50 blows 100% rec	10.00	Dry	Stiff, locally firm, brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, chalk and coal.				
10.45 10.50	HV D 23	p 118kPa, r 74kPa							
11.00 - 11.45 11.00 11.00 - 11.50	SPTS D 24 B 25	N=18 (3,4/5,4,4,5)	11.00	Dry					
12.00 - 12.45	UT 26	66 blows 100% rec	12.00	Dry					
12.45 12.50	HV D 27	p 190kPa, r 87kPa							
13.00 - 13.45 13.00 13.00 - 13.50	SPTS D 28 B 29	N=25 (3,4/5,6,7,7)	13.00	Dry					
14.00 - 14.45	UT 30	65 blows 100% rec	14.00	Dry					
14.45 14.50	HV D 31	p 137kPa, r 65kPa							
15.00 - 15.45 15.00	SPTS D 32	N=22 (3,3/4,5,6,7)	15.00	Dry					
16.00 - 16.45	UT 34	65 blows 100% rec	16.00	Dry					
16.45 16.50	HV D 35	p 92kPa, r 50kPa			Stiff, locally firm, brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone, mudstone, chalk, rare flint and quartzite.		16.00 -5.52		
17.00 - 17.45 17.00 17.00 - 17.50	SPTS D 36 B 37	N=29 (4,5/6,7,8,8)	17.00	Dry					
18.00 - 18.45	UT 38	65 blows 100% rec	18.00	Dry					
18.45 18.50	HV D 39	p 73kPa, r 35kPa							
19.00 - 19.45 19.00 19.00 - 19.50	SPTS D 40 B 41	N=27 (4,5/5,6,7,9)	19.00	Dry		19.00 stiff brown slightly sandy slightly gravelly clay. Gravel is angular to subangular fine to coarse of sandstone, mudstone and chalk			

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:20

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH405

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.48 mOD
Logged	JM	18/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535719.19
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425199.57
Approved	TC	18/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth. Sample 33 missing.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 - 20.45	UT 42	65 blows 100% rec	20.00	Dry	Stiff, locally firm, brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone, mudstone, chalk, rare flint and quartzite.				
20.45 20.50	HV D 43	p 109kPa, r 55kPa					(9.00)		
21.00 - 21.45 21.00 21.00 - 21.50	SPTS D 44 B 45	N=33 (5,6/8,8,9,8)	21.00	Dry					
22.00 - 22.45	UT 46	70 blows 100% rec	22.00	Dry					
22.45 22.50	HV D 47	p 162kPa, r 83kPa							
23.00 - 23.45 23.00 23.00 - 23.50	SPTS D 48 B 49	N=32 (4,6/7,8,8,9)	23.00	Dry					
24.00 - 24.45	UT 50	77 blows 100% rec	24.00	Dry					
24.45 24.50 24.50 - 25.00	HV D 51 B 52	p 131kPa, r 75kPa							
			18/07/17 25.00	1700 Dry					
					END OF EXPLORATORY HOLE		25.00 -14.52		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:20

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH405

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.59 mOD
Logged	RH	28/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535770.43
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425272.20
Approved	TC	31/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
0.20	D 1	0.00-1.20 Hand excavated inspection pit.	28/07/17	0800	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of sandstone and chalk with frequent rootlets (TOPSOIL).		(0.30)		
							0.30 +10.29		
0.50 - 1.00	B 2				Firm to stiff dark brown, mottled reddish and orange brown, slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine and medium, locally coarse, of various lithologies including igneous, mudstone, sandstone, chalk and coal.				
1.00	D 3								
1.20 - 1.65	SPTS	N=10 (2,2/2,2,3,3)	1.20	Dry					
1.20	D 4								
1.20 - 1.70	B 5								
2.00	HV	p 178kPa, r 34kPa	2.00	Dry					
2.00 - 2.45	UT 6	60 blows 100% rec							
2.50	D 7								
							(4.70)		
3.00 - 3.45	SPTS	N=10 (2,2/2,3,2,3)	3.00	Dry					
3.00	D 8								
3.00	B 9								
4.00	HV	p 180kPa, r 38kPa	4.00	Dry					
4.00 - 4.45	UT 10	65 blows 100% rec							
4.50	D 11								
5.00 - 5.45	SPTS	N=12 (2,3/3,3,3,3)	5.00	Dry					
5.00	D 12								
5.00 - 5.50	B 13								
					Firm, becoming stiff, dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine and medium of mudstone, sandstone and chalk.		5.00 +5.59		
6.00	HV	p 129kPa, r 33kPa	6.00	Dry					
6.00 - 6.45	UT 14	65 blows 100% rec							
6.50	D 15								
7.00 - 7.45	SPTS	N=14 (3,3/3,3,4,4)	7.00	Dry					
7.00	D 16								
7.00 - 7.50	B 17								
8.00	HV	p 50kPa, r 14kPa	8.00	Dry					
8.00 - 8.45	UT 18	65 blows 100% rec							
8.50	D 19								
9.00 - 9.45	SPTS	N=17 (2,3/4,4,5,4)	9.00	Dry					
9.00	D 20								
9.00 - 9.50	B 21								

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:21

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH406

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.59 mOD
Logged	RH	28/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535770.43
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425272.20
Approved	TC	31/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
10.00 10.00 - 10.45	HV UT 22	p 99kPa, r 34kPa 70 blows 100% rec	10.00	Dry	Firm, becoming stiff, dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine and medium of mudstone, sandstone and chalk.				
10.50	D 23								
			28/07/17 11.00	1800 Dry					
11.00 - 11.45 11.00 11.00 - 11.50	SPTS D 24 B 25	N=13 (2,3/3,3,3,4)	31/07/17 11.00	0800 Dry					
12.00 12.00 - 12.45	HV UT 26	p 162kPa, r 43kPa 65 blows 100% rec	12.00	Dry					
12.50	D 27								
13.00 - 13.45 13.00 13.00 - 13.50	SPTS D 28 D 29	N=15 (2,3/4,3,4,4)	13.00	Dry					
14.00 14.00 - 14.45	HV UT 30	p 171kPa, r 49kPa 65 blows 100% rec	14.00	Dry					
14.50	D 31								
15.00 - 15.45 15.00 15.00 - 15.50	SPTS D 32 B 33	N=17 (3,3/4,4,4,5)	15.00	Dry			(20.00)		
16.00 16.00 - 16.45	HV UT 34	65 blows 100% rec	16.00	Dry		16.00-16.35 UT sample wet			
16.50	D 35								
17.00 - 17.45 17.00 17.00 - 17.50	SPTS D 36 B 37	N=17 (2,3/4,4,5,4)	17.00	Dry					
18.00 18.00 - 18.45	HV UT 38	p 52kPa, r 20kPa 70 blows 100% rec	18.00	Dry					
18.50	D 39								
19.00 - 19.45 19.00 19.00 - 19.50	SPTS D 40 B 41	N=17 (3,3/3,4,5,5)	19.00	Dry					

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)
1	20.00	Damp	

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:21

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH406

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**		10.59 mOD
Logged	RH	28/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**		E 535770.43
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**		N 425272.20
Approved	TC	31/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.							

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 20.00 - 20.45	HV UT 42	p 97kPa, r 21kPa 70 blows 70% rec	20.00	Damp	Firm, becoming stiff, dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine and medium of mudstone, sandstone and chalk.				
20.50	D 43								
21.00 - 21.45 21.00 21.00 - 21.50	SPTS D 44 B 45	N=18 (3,3/4,5,5,4)	21.00	Dry					
22.00 22.00 - 22.45	HV UT 46	p 115kPa, r 36kPa 70 blows 75% rec	22.00	Dry					
22.50	D 47								
23.00 - 23.45 23.00 23.00 - 23.50	SPTS D 48 B 49	N=18 (4,4/4,5,5,4)	23.00	Dry					
24.00 24.00 - 24.45	HV UT 50	p 110kPa, r 34kPa 65 blows 75% rec	24.00	Dry					
24.50 24.50 - 25.00	D 51 B 52								
			31/07/17 25.00	1800 Dry					
					END OF EXPLORATORY HOLE		25.00 -14.41		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:21

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH406

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.03 mOD
Logged	MS/RM	26/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535842.39
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425334.46
Approved	TC	27/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		0.00-1.20 Hand excavated inspection pit.	26/07/17	0755					
0.20	D 1		0.00	Dry	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with frequent rootlets (TOPSOIL).		(0.30) 0.30 +10.73		
0.50 - 1.00	B 2				Firm becoming stiff brown, locally mottled black, slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including coal, chalk, sandstone and mudstone.				
1.00	D 3								
1.20 - 1.65	SPTS	N=11 (2,2/3,3,2,3)	1.20	Dry					
1.20	D 4								
1.20 - 1.70	B 5						(2.70)		
2.00 - 2.45	UT 6	50 blows 100% rec	2.00	Dry		2.00-2.50 very stiff			
2.45	HV	p >217kPa, r N/A							
2.50	D 7								
3.00 - 3.45	SPTS	N=12 (2,2/2,3,3,4)	3.00	Dry			3.00 +8.03		
3.00	D 8				Stiff, locally firm, brown, locally reddish brown, slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of chalk, mudstone and sandstone.				
3.00 - 3.50	B 9								
4.00 - 4.45	UT 10	55 blows 100% rec	4.00	Dry		4.00-4.50 very stiff			
4.45	HV	p >217kPa, r N/A							
4.50	D 11								
5.00 - 5.45	SPTS	N=14 (2,2/3,3,4,4)	5.00	Dry					
5.00	D 12								
5.00 - 5.50	B 13								
6.00 - 6.45	UT 14	60 blows 100% rec	6.00	Dry		6.00 stiff, locally firm			
6.45	HV	p 128kPa, r 63kPa							
6.50	D 15					6.50 brown			
7.00 - 7.45	SPTS	N=14 (3,3/3,3,4,4)	7.00	Dry					
7.00	D 16								
7.00 - 7.50	B 17								
8.00 - 8.45	UT 18	60 blows 100% rec	8.00	Dry					
8.45	HV	p 135kPa, r 66kPa							
8.50	D 19								
9.00 - 9.45	SPTS	N=15 (2,3/4,3,4,4)	9.00	Dry					
9.00	D 20								
9.00 - 9.50	B 21								

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks
0.00 - 25.00	No groundwater encountered during drilling.

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:21

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH407

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.03 mOD
Logged	MS/RM	26/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535842.39
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425334.46
Approved	TC	27/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
10.00 - 10.45	UT 22	65 blows 100% rec	10.00	Dry	Stiff, locally firm, brown, locally reddish brown, slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of chalk, mudstone and sandstone.				
10.45 10.50	HV D 23	p 119kPa, r 59kPa							
11.00 - 11.45 11.00 11.00 - 11.50	SPTS D 24 B 25	N=14 (2,3/3,3,4,4)	11.00	Dry					
12.00 - 12.45	UT 26	65 blows 100% rec	12.00	Dry					
12.45 12.50	HV D 27	p 165kPa, r 95kPa							
			26/07/17 13.00	1813 Dry					
13.00 - 13.45 13.00 13.00 - 13.50	SPTS D 28 B 29	N=16 (3,4/4,3,4,5)	27/07/17 13.00	0754 Dry					
14.00 - 14.45	UT 30	65 blows 100% rec	14.00	Dry			(22.00)		
14.45 14.50	HV D 31	p 118kPa, r 54kPa							
15.00 - 15.45 15.00 15.00 - 15.50	SPTS D 32 B 33	N=16 (3,4/4,3,4,5)	15.00	Dry					
16.00 - 16.45	UT 34	65 blows 100% rec	16.00	Dry					
16.45 16.50	HV D 35	p 56kPa, r 13kPa							
17.00 - 17.45 17.00 17.00 - 17.50	SPTS D 36 B 37	N=18 (3,3/4,4,5,5)	17.00	Dry					
18.00 - 18.45	UT 38	70 blows 100% rec	18.00	Dry		18.00-18.50 indistinctly laminated			
18.45 18.50	HV D 39	p 121kPa, r 28kPa							
19.00 - 19.45 19.00 19.00 - 19.50	SPTS D 40 B 41	N=18 (3,4/4,4,5,5)	19.00	Dry					

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:21

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH407

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	11.03 mOD
Logged	MS/RM	26/07/2017	Dando 2000.	1.20	11.00	200	11.00	**Coordinates (m)**	E 535842.39
Checked	TC	**End**	Cable percussion boring.	11.00	25.00	150	25.00	**National Grid**	N 425334.46
Approved	TC	27/07/2017	SPT Hammer ID: AR1842, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 - 20.45	UT 42	70 blows 100% rec	20.00	Dry	Stiff, locally firm, brown, locally reddish brown, slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of chalk, mudstone and sandstone.				
20.45 20.50	HV D 43	p 121kPa, r 37kPa							
21.00 - 21.45 21.00 21.00 - 21.50	SPTS D 44 B 45	N=20 (4,4/4,5,6,5)	21.00	Dry					
22.00 - 22.45	UT 46	70 blows 100% rec	22.00	Dry					
22.45 22.50	HV D 47	p 95kPa, r 34kPa							
23.00 - 23.45 23.00 23.00 - 23.50	SPTS D 48 B 49	N=24 (5,6/6,5,6,7)	23.00	Dry					
24.00 - 24.45	UT 50	75 blows 100% rec	24.00	Dry					
24.45 24.50 24.50 - 25.00	HV D 51 B 52	p 132kPa, r 54kPa							
			27/07/17 25.00	1821 Dry					
					END OF EXPLORATORY HOLE		25.00 -13.97		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:21

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH407

Borehole Log

SOCOTEC

Drilled	DS/PS	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.45 mOD
Logged	DT	11/07/2017	Dando 2000.	1.20	12.95	200	12.95	**Coordinates (m)**	E 535864.29
Checked	TC	**End**	Cable percussion boring.	12.95	25.00	150	24.50	**National Grid**	N 425428.17
Approved	TC	13/07/2017	SPT Hammer ID: AR598, Rod type: BW.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
0.00 - 0.30	B 1	0.00-1.20 Hand excavated inspection pit.			Brown clayey fine to medium SAND with frequent rootlets (TOPSOIL).		(0.30)		
0.30 - 1.20	B 2				Firm brown slightly gravelly sandy CLAY. Gravel is angular to rounded fine to coarse of various lithologies including sandstone and chalk with occasional rootlets.		0.30 +10.15		
1.20 - 1.65 1.20 1.20 - 1.70	SPTS D 3 B 4	N=11 (2,2/3,2,3,3)	0.00	Dry	Stiff to very stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is angular to well rounded fine to coarse of various lithologies.	1.20-1.60 rare rootlets	(0.90) 1.20 +9.25		
2.20 - 2.70 2.20 - 2.80	UT NR B 5	87 blows No Recovery	2.20	Dry					
2.80 - 3.25	UT 6	38 blows 100% rec	11/07/17 2.20 12/07/17 2.20	1715 Dry 0730 Dry					
3.25 3.25	HV D 7	p 202 to >217kPa, r 81kPa							
3.50 - 3.95 3.50 3.50 - 4.00	SPTS D 8 B 9	N=11 (2,3/2,3,3,3)	3.20	Dry					
4.50 - 4.95	UT 10	36 blows 100% rec	3.20	Dry					
4.95 4.95	HV D 11	p 163kPa, r 75kPa							
5.50 - 5.95 5.50 5.50 - 6.00	SPTS D 12 B 13	N=20 (3,3/4,5,5,6)	3.20	Dry					
6.50 - 6.95	UT 14	41 blows 100% rec	3.20	Dry					
6.95 6.95	HV D 15	p 167kPa, r 86kPa							
7.50 - 7.95 7.50 7.50 - 8.00	SPTS D 16 B 17	N=19 (2,3/4,4,5,6)	3.20	Dry					
8.50 - 8.95	UT 18	36 blows 100% rec	3.20	Dry					
8.95	HV	p 152kPa, r 100kPa							
9.50 - 9.95 9.50 9.50 - 10.00	SPTS D 19 B 20	N=15 (3,3/3,4,3,5)	3.20	Dry					

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:22

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH408

Borehole Log

SOCOTEC

Drilled	DS/PS	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.45 mOD
Logged	DT	11/07/2017	Dando 2000.	1.20	12.95	200	12.95	**Coordinates (m)**	E 535864.29
Checked	TC	**End**	Cable percussion boring.	12.95	25.00	150	24.50	**National Grid**	N 425428.17
Approved	TC	13/07/2017	SPT Hammer ID: AR598, Rod type: BW.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
					Stiff to very stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is angular to well rounded fine to coarse of various lithologies.				
10.50 - 10.95	UT 21	40 blows 100% rec	3.20	Dry					
10.95	HV	p 176kPa, r 68kPa							
11.50 - 11.95 11.50 11.50 - 12.00	SPTS D 22 B 23	N=21 (3,3/4,5,6,6)	3.20	Dry		11.50-12.00 gravel is mainly chalk			
12.50 - 12.95	UT 24	52 blows 100% rec	3.20	Dry					
12.95 12.95	HV D 25	p 171kPa, r 93kPa				13.00 driller reports sand lens	(23.80)		1
13.50 - 13.95 13.50 13.50 - 14.00	SPTS D 26 B 27	N=21 (3,4/4,5,6,6)	3.20	Damp					
14.50 - 14.95	UT 28	43 blows 67% rec	3.20	Damp					
14.95	HV								
15.50 - 15.95 15.50 15.50 - 16.00	SPTS D 29 B 30	N=21 (4,4/5,5,5,6)	13.50	Damp					
16.50 - 16.95	UT 31	56 blows 100% rec	13.50	Damp					
16.95 16.95	HV D 32	p 37kPa, r 19kPa							
17.50 - 17.95 17.50 17.50 - 18.00	SPTS D 33 B 34	N=26 (5,6/6,7,6,7)	13.50	Damp					
18.50 - 18.95	UT 35	74 blows 100% rec	13.50	Damp					
			12/07/17 13.50	1735 Dry					
18.95	HV	p 154kPa, r 63kPa							
			13/07/17 13.50	0730 Dry					
19.50 - 19.95 19.50 19.50 - 20.00	SPTS D 36 B 37	N=25 (5,6/6,7,6,6)	13.50	Dry					

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)
1	13.00	Seepage	

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:22

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH408

Borehole Log

SOCOTEC

Drilled	DS/PS	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	10.45 mOD
Logged	DT	11/07/2017	Dando 2000.	1.20	12.95	200	12.95	**Coordinates (m)**	E 535864.29
Checked	TC	**End**	Cable percussion boring.	12.95	25.00	150	24.50	**National Grid**	N 425428.17
Approved	TC	13/07/2017	SPT Hammer ID: AR598, Rod type: BW.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
					Stiff to very stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is angular to well rounded fine to coarse of various lithologies.				
20.50 - 20.95	UT 38	84 blows 100% rec	13.50	Dry					
21.50 - 21.95 21.50 21.50 - 22.00	SPTS D 39 B 40	N=29 (5,6/7,7,7,8)	13.50	Dry					
22.50 - 22.95	UT 41	77 blows 100% rec	13.50	Dry					
23.50 - 23.95 23.50 23.50 - 24.00	SPTS D 42 B 43	N=27 (5,5/6,7,6,8)	13.50	Dry					
24.50 - 24.95 24.50 24.50 - 25.00	SPTS D 44 B 45	N=28 (5,5/6,7,7,8)	13.50 13/07/17 24.50	Dry 1130 Dry					
					END OF EXPLORATORY HOLE		25.00 -14.55		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

AGS

Scale 1:50

03/11/2017 08:59:22

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH408

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	8.29 mOD
Logged	MS	11/07/2017	Dando 2000.	1.20	15.00	200	15.00	**Coordinates (m)**	E 535965.02
Checked	TC	**End**	Cable percussion boring.	15.00	25.00	150	24.50	**National Grid**	N 425481.70
Approved	TC	12/07/2017	SPT Hammer ID: SM39, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		0.00-1.20 Hand excavated inspection pit.			Brown silty fine to medium SAND with frequent rootlets (TOPSOIL).		(0.30)		
0.20	D 1						0.30 +7.99		
0.50 - 1.00	B 2				Brown gravelly clayey fine to medium SAND. Gravel is angular to subrounded fine to coarse of various lithologies. Occasional rootlets.		(0.70)		
1.00	D 3						1.00 +7.29		
1.20 - 1.65	SPTS	N=20 (2,3/4,5,5,6)	1.20	Dry	Stiff brown, locally greyish brown, slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of chalk, mudstone, sandstone and chert.				
1.20	D 4								
1.20 - 1.70	B 5								
2.00 - 2.45	UT 6	40 blows 100% rec	2.00	Dry					
2.45	HV	p 186kPa, r 74kPa							
2.50	D 7								
3.00 - 3.45	SPTS	N=20 (3,4/5,4,5,6)	3.00	Dry					
3.00	D 8								
3.00 - 3.50	B 9								
4.00 - 4.45	UT 10	50 blows 89% rec	4.00	Dry					
4.45	HV	p >217kPa, r 105kPa							
4.50	D 11								
4.80	D 12								
5.00 - 5.45	SPTS	N=14 (2,2/3,3,4,4)	5.00	Dry		5.00-10.00 locally firm			
5.00	D 13								
5.00 - 5.50	B 14						(9.00)		
6.00 - 6.45	UT 15	50 blows 100% rec	6.00	Dry					
6.45	HV	p 131kPa, r 68kPa							
6.50	D 16								
7.00 - 7.45	SPTS	N=12 (2,3/3,2,3,4)	7.00	Dry					
7.00	D 17								
7.00 - 7.50	B 18								
8.00 - 8.45	UT 19	50 blows 100% rec	8.00	Dry					
8.45	HV	p 140kPa, r 64kPa							
8.50	D 20								
9.00 - 9.45	SPTS	N=15 (3,3/3,4,4,4)	9.00	Dry					
9.00	D 21								
9.00 - 9.50	B 22								
			11/07/17 10.00	1800 Dry			10.00 -1.71		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:22

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH409

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	8.29 mOD
Logged	MS	11/07/2017	Dando 2000.	1.20	15.00	200	15.00	**Coordinates (m)**	E 535965.02
Checked	TC	**End**	Cable percussion boring.	15.00	25.00	150	24.50	**National Grid**	N 425481.70
Approved	TC	12/07/2017	SPT Hammer ID: SM39, Rod type: 54mm Whitworth.						

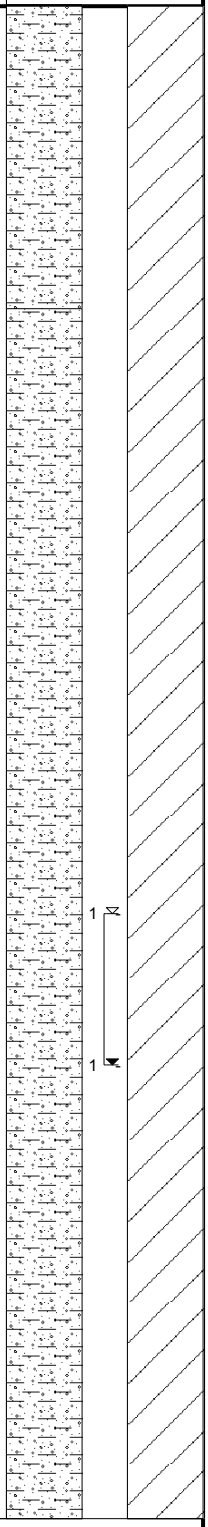
Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
10.00 - 10.45	UT 23	50 blows 100% rec	10.00 12/07/17 10.00	Dry 0800 Dry
10.45 10.50	HV D 24	p 93kPa, r 51kPa		
11.00 - 11.45 11.00 11.00 - 11.50	SPTS D 25 B 26	N=11 (2,3/3,2,3,3)	11.00	Dry
12.00 - 12.45	UT 27	50 blows 100% rec	12.00	Dry
12.45 12.50	HV D 28	p 159kPa, r 92kPa		
13.00 - 13.45 13.00 13.00 - 13.50	SPTS D 29 B 30	N=21 (2,4/5,4,5,7)	13.00	Dry
14.00 - 14.45	UT 31	50 blows 100% rec	14.00	Dry
14.50	D 32			
15.00 - 15.45 15.00 15.00 - 15.50	SPTS D 33 B 34	N=19 (3,4/5,4,5,5)	15.00	Dry
16.00 - 16.45	UT 35	50 blows 89% rec	16.00	Dry
16.45 16.50	HV D 36	p 155kPa, r 107kPa		
17.00 - 17.45 17.00 17.00 - 17.50	SPTS D 37 B 38	N=22 (3,4/5,5,6,6)	17.00	Dry
18.00 - 18.45	UT 39	60 blows 100% rec	18.00	16.00
18.45 18.50	HV D 40	p >217kPa, r N/A		
19.00 - 19.45 19.00 19.00 - 19.50	SPTS D 41 B 42	N=23 (4,4/5,5,6,7)	19.00	16.60

Strata Description

Main	Detail	Depth, Level (Thickness)
Firm greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of chalk, mudstone and sandstone.		(2.00)
Stiff greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of chalk, mudstone and sandstone.	14.45-14.50 greyish brown gravelly clayey fine to coarse sand. Gravel is angular to subrounded fine to coarse of chalk	12.00 -3.71 (13.00)

Legend / Backfill



Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)
1	17.00	Rose to 16.00 m after 30 minutes. Seepage	

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:22

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH409

Borehole Log

SOCOTEC

Drilled	MR	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	8.29 mOD
Logged	MS	11/07/2017	Dando 2000.	1.20	15.00	200	15.00	**Coordinates (m)**	E 535965.02
Checked	TC	**End**	Cable percussion boring.	15.00	25.00	150	24.50	**National Grid**	N 425481.70
Approved	TC	12/07/2017	SPT Hammer ID: SM39, Rod type: 54mm Whitworth.						

Samples and Tests

Strata Description

Depth	Type & No.	Records	Date / Casing	Time / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
20.00 - 20.45	UT 43	100 blows 100% rec	20.00	17.00	Stiff greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of chalk, mudstone and sandstone.				
20.45 20.50	HV D 44	p >217kPa, r N/A							
21.00 - 21.45 21.00 21.00 - 21.50	SPTS D 45 B 46	N=38 (4,6/8,8,11,11)	21.00	17.30					
22.00 - 22.45	UT 47	100 blows 89% rec	22.00	18.00					
22.45 22.50	HV D 48	p >217kPa, r N/A							
23.00 - 23.45 23.00 23.00 - 23.50	SPTS D 49 B 50	N=39 (5,6/7,9,11,12)	23.00	18.70					
24.00 - 24.50	UT 51	100 blows 100% rec	24.00	19.40					
24.45 24.50 - 25.00	HV B 52	p >217kPa, r N/A							
			12/07/17 24.50	1800 19.40					
					END OF EXPLORATORY HOLE		25.00 -16.71		

Groundwater Entries

No.	Depth Strike (m)	Remarks	Depth Sealed (m)

Depth Related Remarks

Depths (m)	Remarks

Hard Boring

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

AGS

Scale 1:50

03/11/2017 08:59:22

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH409

Borehole Log

SOCOTEC

Drilled	Geocore	**Start**	
Logged	RM		25/07/2017
Checked	TC	**End**	
Approved	TC		25/07/2017

Equipment, Methods and Remarks

Comacchio 205.
Machine excavated.
SPT Hammer ID: G1, Rod type: NWY.
Carried out on beach between tides.

Depth from (m)	to (m)	Diameter (mm)	Casing Depth (m)
0.00	2.50	100	2.50
2.50	4.00	80	4.50
4.00	6.00	100	

Ground Level	-0.03 mOD
Coordinates (m)	E 535998.99
National Grid	N 425636.08

Samples and Tests

Strata Description

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
0.00 - 0.10	D 1					SAND.		(0.25)		
0.00 - 1.00	B 2					(not collected in sample tube)		0.25 -0.28		
						Firm to stiff thinly and thickly laminated dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium, locally coarse, of chalk, mudstone and sandstone. Dustings of brown silt on laminae surfaces.		(1.00)		1
1.00 - 1.45	U 3									
						Firm to stiff dark brown slightly gravelly slightly sandy to sandy CLAY. Gravel is subangular to subrounded fine and medium, locally coarse, of chalk, mudstone and sandstone.	1.30 band of greyish brown fine to coarse sand approximately 40mm wide	1.25 -1.28		
1.50	D 4									
1.50 - 2.50	B 5									
2.40	D 6									
2.50 - 2.95	SPTS		N=19 (2,3/4,5,5,5)							
2.50 - 2.95	D 7									
2.50 - 3.50	B 8									
3.50 - 4.00	U 9							(5.25)		
							4.00-5.55 possible sand horizon. Some evidence in sample liners and poor recovery			
5.00 - 5.45	SPTS		N=4 (1,0/0,1,1,2)							
5.00 - 5.45	D 10									
5.00 - 6.00	B 11									
6.00 - 6.50	U 12									
				25/07/17 4.50	1700					
						END OF EXPLORATORY HOLE		6.50 -6.53		

Groundwater Entries

No.	Depth Strike	Remarks	Depth Sealed
1	0.90		

Depth Related Remarks

Depths (m)	Remarks

Chiselling Details

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:23

Project	WITHERNSEA LONG SEA OUTFALL
Project No.	A7063-17
Carried out for	Ward & Burke Construction Limited

Borehole

BH410

Sheet 1 of 1

Borehole Log

SOCOTEC

Drilled	Geocore	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	
Logged	MS	14/08/2017	Comacchio 205 Rotary Open Hole Drilling & Dynamic Sampling SPT Hammer ID: G1, Rod type: NWY Carried out on beach between tides.	0.00	12.00	146	4.50	**Coordinates (m)**	
Checked	TC	**End**						**National Grid**	
Approved	TC	14/08/2017							

Samples and Tests

Strata Description

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
						Brown gravelly fine to coarse SAND. Gravel is subangular to rounded fine to coarse of flint, quartz, shell fragments and sandstone. (BEACH DEPOSITS)		(0.20) 0.20		
						ROTARY OPEN HOLE DRILLING Brown slightly sandy gravelly CLAY. (Driller's description)		(6.30)		
6.50 - 6.70	D 1					Stiff, locally firm, brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of chalk, flint, sandstone and mudstone.		6.50		
6.70 - 7.50	B 2							(2.20)		
9.00 - 9.38 9.00 - 9.45	SPT D 3		52 (8,11/15,14,17,6 for 10mm)			Dense to very dense brown gravelly very silty fine to coarse SAND. Gravel is subangular to rounded fine to coarse of flint, quartz, chalk and sandstone. Occasional gravel size pockets of reddish brown clay.		8.70		

Groundwater Entries

No.	Depth Strike	Remarks	Depth Sealed

Depth Related Remarks

Depths (m)	Remarks

Chiselling Details

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

AGS

Scale 1:50

03/11/2017 08:59:23

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH410A

Borehole Log

SOCOTEC

Drilled	Geocore	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	
Logged	MS	14/08/2017	Comacchio 205 Rotary Open Hole Drilling & Dynamic Sampling SPT Hammer ID: G1, Rod type: NWY Carried out on beach between tides.	0.00	12.00	146	4.50	**Coordinates (m)**	
Checked	TC	**End**						**National Grid**	
Approved	TC	14/08/2017							

Samples and Tests

Strata Description

Depth	TCR SCR RQD	If	Records/Samples	Date / Time Casing / Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
					Dense to very dense brown gravelly very silty fine to coarse SAND. Gravel is subangular to rounded fine to coarse of flint, quartz, chalk and sandstone. Occasional gravel size pockets of reddish brown clay.		(2.70)		
				14/08/17 0000 4.50 0.00					
					END OF EXPLORATORY HOLE		11.40		

Groundwater Entries

No.	Depth Strike	Remarks	Depth Sealed

Depth Related Remarks

Depths (m)	Remarks
11.40	Hole terminated due to blowing sands

Chiselling Details

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:23

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH410A

Borehole Log

SOCOTEC

Drilled	Geocore	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	-0.50 mOD
Logged	RM	27/07/2017	Comacchio 205.	0.00	2.60	120	2.60	**Coordinates (m)**	E 536035.96
Checked	TC	**End**	Machine excavated.	2.60	3.60	100	3.60	**National Grid**	N 425593.96
Approved	TC	27/07/2017	SPT Hammer ID: G3, Rod type: NWY.	3.60	5.10	90	4.50		
			Carried out on beach between tides.	5.10	6.10	80			

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
0.00 - 0.13	D 1				
0.13 - 1.00	B 2				
0.90	D 3				
1.00 - 1.45	SPTS		N=5 (1,1/1,1,1,2)		
1.00 - 1.45	D 4				
1.00 - 2.00	B 6				
1.10	D 5				
1.90	D 7				
2.00 - 2.60	U 8				
2.60	D 9				
2.60 - 3.60	B 10				
3.60 - 4.05	SPTS		N=35 (1,3/6,9,9,11)		
3.60 - 4.15	D 11				
3.60 - 4.60	B 12				
4.60 - 5.10	U 13				
5.10 - 6.10	B 14				
6.10 - 6.55	SPTS		N=41 (4,4/11,10,11,9)		
6.10 - 6.55	D 15			27/07/17 4.50	0000 Dry

Strata Description

Main	Detail	Depth, Level (Thickness)
Greyish yellowish brown fine slightly gravelly fine to coarse SAND. Gravel is subrounded fine and medium of sandstone.		0.13 (0.13) -0.63
Firm to stiff dark brown slightly sandy slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of chalk, sandstone, mudstone and coal.	1.38-3.20 thinly and thickly laminated 1.60 becoming stiff	(3.17)
Medium dense to dense dark greyish brown very gravelly silty fine to coarse SAND. Gravel is subrounded fine and medium of sandstone.		3.30 -3.80 (2.25)
Stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of chalk, sandstone, mudstone and coal.	5.55-6.10 indistinctly laminated	5.55 -6.05 (1.00)
END OF EXPLORATORY HOLE		6.55 -7.05

Legend

Backfill

Groundwater Entries

No.	Depth Strike	Remarks	Depth Sealed

Depth Related Remarks

Depths (m)	Remarks

Chiselling Details

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:24

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH411

Sheet 1 of 1

Borehole Log

SOCOTEC

Drilled	Geocore	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	
Logged	MS	14/08/2017	Comacchio 205 Rotary Open Hole Drilling & Dynamic Sampling SPT Hammer ID: G3, Rod type: NWY Carried out on beach between tides.	0.00	11.40	146	7.30	**Coordinates (m)**	
Checked	TC	**End**						**National Grid**	
Approved	TC	14/08/2017							

Samples and Tests

Strata Description

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
						Brown gravelly fine to coarse SAND. Gravel is subangular to rounded fine to coarse of quartz, shell fragments, mudstone and sandstone. (BEACH DEPOSITS)		(0.90)		
						Brown boulder CLAY. (Driller's description)		0.90		
								(5.60)		
						Stiff brown, locally reddish brown, slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of chalk, flint, sandstone, mudstone and coal.		6.50		
6.85 - 7.00	D 1									
7.00 - 7.90	B 2									
7.90 - 8.00	D 3									
8.00 - 8.50	B 4						8.00 becoming locally firm, indistinctly laminated, greyish brown	(3.00)		
8.50 - 8.70	D 5									
9.00 - 9.45	U 6									
9.45 - 9.50	D 7									
9.50 - 9.90	B 8									
						Brown very gravelly clayey fine to coarse SAND. Gravel is subangular to rounded fine to coarse of chalk, flint and sandstone.		9.50 (0.40) 9.90		

Groundwater Entries

No.	Depth Strike	Remarks	Depth Sealed

Depth Related Remarks

Depths (m)	Remarks

Chiselling Details

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:24

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH411A

Borehole Log

SOCOTEC

Drilled	Geocore	**Start**	**Equipment, Methods and Remarks**	**Depth from (m)**	**to (m)**	**Diameter (mm)**	**Casing Depth (m)**	**Ground Level**	
Logged	MS	14/08/2017	Comacchio 205 Rotary Open Hole Drilling & Dynamic Sampling SPT Hammer ID: G3, Rod type: NWY Carried out on beach between tides.	0.00	11.40	146	7.30	**Coordinates (m)**	
Checked	TC	**End**						**National Grid**	
Approved	TC	14/08/2017							

Samples and Tests

Strata Description

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
						Brown sandy gravelly CLAY. (Driller's description)		(0.60)		
						Greyish brown slightly clayey SAND and GRAVEL. (Driller's description)		10.50 (1.50)		
				14/08/17 7.30	0000 0.00					
						END OF EXPLORATORY HOLE		12.00		

Groundwater Entries

No.	Depth Strike	Remarks	Depth Sealed

Depth Related Remarks

Depths (m)	Remarks
12.00	Hole terminated due to blowing sands

Chiselling Details

Depths (m)	Duration (mins)	Tools used

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

03/11/2017 08:59:24

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Borehole

BH411A

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 25/07/2017 **End** 25/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.60 m A / D / B / C 310 (Deg)	**Ground Level** 9.88 mOD **Coordinates (m)** E 534401.61 **National Grid** N 424022.11	

Samples and Tests

Depth	Type & No.	Records
		25/07/17
0.20	D1	
0.60	HV	p 84kPa, r 30kPa
0.60 - 1.00	B2	
1.15	D3	
1.20	HV	
1.20	HV	p 238kPa, r 147kPa
1.50	D4	
2.00 - 2.10	B5	
2.20	D6	
		25/07/17 Dry
3.60 - 3.70	B7	

Strata Description

Main	Detail	Depth, Level (Thickness)	Legend	Backfill
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with occasional rootlets (TOPSOIL).		(0.10) 0.10 +9.78		
Firm brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of various lithologies, predominately flint and chalk.		(0.30) 0.40 +9.48		
Stiff, becoming very stiff with depth, fissured orangish brown, locally mottled yellowish brown, slightly sandy, locally slightly gravelly, CLAY. Gravel is angular to subangular fine to coarse of various lithologies including siltstone, sandstone, coal, flint and quartzite. Fissures are randomly oriented, smooth with silt coating.		(0.70) 1.10 +8.78		
Very stiff fissured orangish brown, mottled greenish grey, slightly sandy CLAY. Fissures are randomly oriented, smooth and clean.	1.50-1.70 soft brown mottled greenish grey sandy silty clay	(1.00) 2.10 +7.78		
Very stiff fissured orangish brown, locally mottled greenish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of various lithologies including mudstone, sandstone, flint, chalk and quartzite. Cobbles are angular to subangular of flint and sandstone. Fissures are randomly oriented, smooth with yellowish brown coating.		(1.60) 3.70 +6.18		
END OF EXPLORATORY HOLE				

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.70	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Partly cloudy

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:16

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP302

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged DT **Checked** TC **Approved** TC	**Start** 25/07/2017 **End** 25/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.10 m A / D / B / C 102 (Deg)	**Ground Level** 10.33 mOD **Coordinates (m)** E 534486.03 **National Grid** N 424088.31	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		25/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with occasional rootlets (TOPSOIL).		(0.20)		
0.20	D1		Firm brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of various lithologies including flint, coal and chalk.		0.20 +10.13		
					(0.20)		
0.60 - 0.90	B2		Very stiff fissured orangish brown, mottled greenish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of various lithologies including chalk, sandstone, mudstone, flint and quartzite. Fissures are randomly oriented, smooth with yellowish brown and dark grey staining,		0.40 +9.93		
1.10	D3						
					(3.10)		
2.40 - 3.00	B4			2.40-3.10 slightly sandy gravelly clay with low cobble content of chalk and sandstone			
		25/07/17 Dry					
3.40	D5						
			END OF EXPLORATORY HOLE		3.50 +6.83		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.50	No groundwater encountered during excavation.
0.00 - 3.50	Material not suitable for hand vane test.

Stability Stable

Shoring None

Weather Partly cloudy

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:17

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP303

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 26/07/2017 **End** 26/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 108 (Deg)	**Ground Level** 10.09 mOD **Coordinates (m)** E 534564.12 **National Grid** N 424152.77	

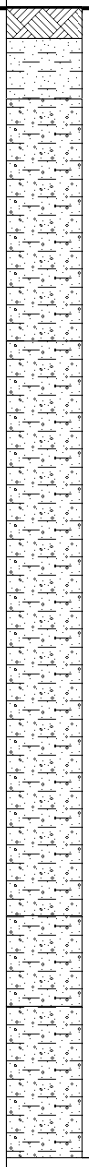
Samples and Tests

Depth	Type & No.	Records
		26/07/17
0.20	D1	
0.40 - 0.60	B2	
1.00 - 1.20	B3	
1.40 - 2.00	B4	
2.40	D5	
3.10 - 3.20	B6	
3.40	D7	
		26/07/17 Dry

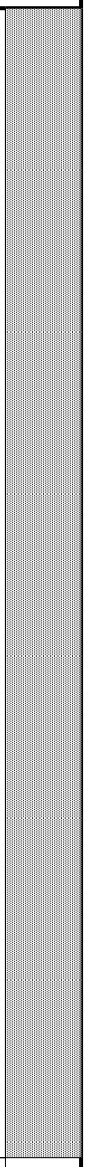
Strata Description

Main	Detail	Depth, Level (Thickness)
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +9.99
Soft to firm brown sandy CLAY with frequent rootlets.		(0.20) 0.30 +9.79
Stiff, becoming very stiff, fissured orangish brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Cobbles are angular to subangular of flint and sandstone.		(0.80) 1.10 +8.99
Very stiff fissured brown, mottled bluish greenish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal and flint. Cobbles are angular to subangular of chalk and sandstone. Fissures are randomly oriented, smooth and clean.		(1.90) 3.00 +7.09
Stiff indistinctly laminated reddish brown, mottled greenish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal, flint and quartzite.		(0.30) 3.30 +6.79
Firm to stiff bluish grey, mottled yellowish brown, slightly sandy slightly gravelly, locally very gravelly, CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including flint, chalk, siltstone and sandstone.		(0.50) 3.80 +6.29
END OF EXPLORATORY HOLE		

Legend



Backfill



Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.80	No groundwater encountered during excavation.
0.00 - 3.80	Material not suitable for hand vane test.

Stability Stable

Shoring None

Weather Overcast, raining

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:17

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP304

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged RM	**Start** 26/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m, Length 2.70 m, 110 (Deg)	**Ground Level**	10.61 mOD
Checked TC	**End** 26/07/2017			**Coordinates (m)**	E 534641.79
Approved TC				**National Grid**	N 424215.31

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		26/07/17	Firm slightly gravelly sandy CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +10.51		
0.20	D1		Soft to firm brown slightly sandy CLAY with frequent rootlets.		(0.30) 0.40 +10.21		
0.50 - 0.80	B2		Stiff to very stiff fissured orangish brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, flint and quartzite. Cobbles are angular to subangular of chalk and sandstone. Fissures are randomly oriented, smooth and clean.		(0.60) 1.00 +9.61		
1.20 - 1.60	B3		Very stiff fissured brown, mottled greenish grey, slightly sandy slightly gravelly, locally very gravelly, CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, coal, sandstone and flint. Cobbles are angular to subangular fine to coarse of sandstone. Fissures are randomly oriented, smooth with greenish grey clay.				
2.00	D4				(2.80)		
2.60	D5			2.80-3.80 occasional pockets of fine to coarse sand approximately 50 -100mm			
3.10 - 3.40	B6						
3.60	D7	26/07/17 Dry			3.80 +6.81		
			END OF EXPLORATORY HOLE				

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.80	No groundwater encountered during excavation.

Stability Stable

Shoring None

Weather Overcast, raining

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:17

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP305

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 26/07/2017 **End** 26/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.50 m A / D / B / C 119 (Deg)	**Ground Level** 11.78 mOD **Coordinates (m)** E 534725.54 **National Grid** N 424282.05	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		26/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with occasional rootlets (TOPSOIL).		(0.10) 0.10 +11.68		
0.20	D1		Firm, becoming stiff, slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of flint and quartzite.		(0.30) 0.40 +11.38		
0.50	D2		Very stiff orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including sandstone, flint, mudstone and quartzite.		(0.30) 0.70 +11.08		
0.80 - 1.00	B3		Very stiff reddish brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk and sandstone. Cobbles are angular to subangular of flint and sandstone.				
1.30 - 1.60	B4						
					(2.70)		
2.20 - 2.50	B5						
3.50 - 3.80	B6		Stiff to very stiff dark brown, locally mottled greenish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone and coal.		3.40 +8.38		
		26/07/17 Dry			(0.50)		
			END OF EXPLORATORY HOLE		3.90 +7.88		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.90	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:17

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP306

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 26/07/2017 **End** 26/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 210 (Deg)	**Ground Level** 13.00 mOD **Coordinates (m)** E 534800.69 **National Grid** N 424339.34	

Samples and Tests

Depth	Type & No.	Records
		26/07/17 1.80
0.20	D1	
0.60 - 1.00	B2	
1.50	D3	
1.80	B4	
2.10	D5	
		26/07/17
3.70 - 3.80	B6	

Strata Description

Main	Detail	Depth, Level (Thickness)	Legend	Backfill
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to rounded, fine to medium of various lithologies with occasional rootlets (TOPSOIL).		(0.10) 0.10 +12.90		
Firm to stiff brown slightly sandy CLAY with frequent rootlets.		(0.30) 0.40 +12.60		
Stiff orangish brown, locally mottled greenish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone and flint.		(0.70) 1.10 +11.90		
Reddish brown gravelly, locally clayey, SAND. Gravel is angular to subangular fine to coarse of flint and sandstone.		(0.50) 1.60 +11.40		
Stiff, becoming very stiff, fissured orangish brown, mottled greenish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth with greenish grey clay infill.		(2.20)		1
END OF EXPLORATORY HOLE		3.80 +9.20		

Groundwater Entries

No.	Depth Strike (m)	Remarks
1	1.80	Seepage

Remarks

Depth (m)	Remarks
0.00 - 3.80	Material not suitable for hand vane test.

Stability Stable
Shoring None
Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:18

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP307

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 26/07/2017 **End** 26/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 210 (Deg)	**Ground Level** 10.25 mOD **Coordinates (m)** E 534872.17 **National Grid** N 424403.36	

Samples and Tests

Depth	Type & No.	Records
		26/07/17
0.20	D1	
0.60 - 0.90	B2	
1.10 - 1.20	B3	
1.60	D4	
2.60 - 2.80	B5	
3.00	D6	
3.20	D7	
		26/07/17 1.40

Strata Description

Main	Detail	Depth, Level (Thickness)
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +10.15
Firm dark brown slightly sandy CLAY with frequent rootlets.		(0.30) 0.40 +9.85
Stiff, becoming very stiff, fissured orangish brown, mottled greenish grey, slightly sandy, locally slightly gravelly, CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.60) 1.00 +9.25
Orangish brown slightly gravelly to gravelly very clayey fine to coarse SAND. Gravel is angular to rounded fine to coarse predominately of flint and sandstone.		(1.40) 2.40 +7.85
Stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal, siltstone and flint.		(1.20) 3.60 +6.65
END OF EXPLORATORY HOLE		

Legend: 1

Backfill

Groundwater Entries

No.	Depth Strike (m)	Remarks
1	1.40	Slow inflow

Remarks

Depth (m)	Remarks
0.00 - 3.60	Material not suitable for hand vane test.

Stability Stable
Shoring None
Weather Partly cloudy

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:18

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP308

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged DT **Checked** TC **Approved** TC	**Start** 27/07/2017 **End** 27/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 116 (Deg)	**Ground Level** 10.94 mOD **Coordinates (m)** E 534955.26 **National Grid** N 424462.19	

Samples and Tests

Depth	Type & No.	Records
0.20	D1	
0.50 - 1.00	B2	
1.10 - 1.40	B3	
2.00 - 2.30	B4	
2.60 - 2.90	B5	
3.10	D6	
3.60	D7	Dry

Strata Description

Main	Detail	Depth, Level (Thickness)
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with occasional rootlets (TOPSOIL).		(0.10) 0.10 +10.84
Firm to stiff brown slightly sandy CLAY with frequent rootlets.		(0.30) 0.40 +10.54
Stiff to very stiff fissured reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(1.50) 1.90 +9.04
Orangish brown, mottled bluish grey, slightly gravelly very silty, predominantly fine to medium, SAND.		(0.60) 2.50 +8.44
Soft to firm friable brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.50) 3.00 +7.94
Stiff to very stiff reddish brown, mottled bluish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.80) 3.80 +7.14
END OF EXPLORATORY HOLE		

Legend

Backfill

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.80	No groundwater encountered during excavation.

Stability Stable

Shoring None

Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:18

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP309

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged RM/DT **Checked** TC **Approved** TC	**Start** 27/07/2017 **End** 27/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 115 (Deg)	**Ground Level** 11.38 mOD **Coordinates (m)** E 535030.24 **National Grid** N 424529.66	

Samples and Tests / Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		27/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +11.28		
0.20	D1		Soft to stiff brown slightly sandy CLAY with frequent rootlets.		(0.30) 0.40 +10.98		
			Firm to stiff fissured orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(0.60)		
0.90	B2				1.00 +10.38		
			Stiff to very stiff, locally fissured, reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(0.70)		
1.40	B3				1.70 +9.68		
			Orangish brown silty fine to coarse SAND.		(0.20) 1.90 +9.48		
1.80	D4						
2.00	B5		Stiff to very stiff, locally fissured, reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(1.50)		
3.00	D6						
			Very stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		3.40 +7.98		
3.50	D7			3.60 becoming mottled bluish grey	(0.50)		
		27/07/17 Dry			3.90 +7.48		
			END OF EXPLORATORY HOLE				

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.90	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25 03/11/2017 09:00:18

Project **WITHERNSEA LONG SEA OUTFALL**
Project No. **A7063-17**
Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP310

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged RM/DT **Checked** TC **Approved** TC	**Start** 27/07/2017 **End** 27/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 123 (Deg)	**Ground Level** 10.73 mOD **Coordinates (m)** E 535110.56 **National Grid** N 424589.52	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		27/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +10.63		
0.20	D1		Soft to firm brown slightly sandy CLAY with frequent rootlets.		(0.30) 0.40 +10.33		
0.50	B2		Stiff to very stiff fissured orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(0.40) 0.80 +9.93		
0.90	D3		Very stiff reddish brown, locally mottled bluish grey, gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(1.00) 1.80 +8.93		
2.00	B4		Firm to stiff dark brown, locally mottled bluish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Cobbles are subangular to subrounded of sandstone.		(1.90) 3.70 +7.03		
2.80	B5						
3.50	D6	27/07/17 Dry					
			END OF EXPLORATORY HOLE				

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.70	No groundwater encountered during excavation.

Stability Stable

Shoring None

Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:19

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP311

Trial Pit Log

SOCOTEC

Logged RM/DT **Checked** TC **Approved** TC	**Start** 27/07/2017 **End** 27/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 124 (Deg)	**Ground Level** 9.81 mOD **Coordinates (m)** E 535157.80 **National Grid** N 424632.14	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		27/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +9.71		
0.20	D1		Soft to firm brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal, quartzite and brick. Cobbles are angular to subrounded of various lithologies including sandstone, quartzite and brick. (MADE GROUND)		(0.20) 0.30 +9.51		
0.60	B2		Stiff to very stiff fissured brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(0.40) 0.70 +9.11		
1.20	B3		Stiff, locally fissured, reddish brown, locally mottled bluish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Cobbles are subangular to rounded of various lithologies including chalk and sandstone. Fissures are randomly oriented, smooth and clean.		(1.50)		
2.00	D4						
2.40	B5		Stiff to very stiff, locally fissured, dark brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Cobbles are angular to rounded of sandstone and chalk. Fissures are randomly oriented, smooth and clean with silt infill.		2.20 +7.61		
3.30	D6				(1.70)		
		27/07/17 Dry			3.90 +5.91		
			END OF EXPLORATORY HOLE				

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.90	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:19

Project WITHERNSEA LONG SEA OUTFALL

Project No. A7063-17

Carried out for Ward & Burke Construction Limited

Trial Pit

TP312

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 25/07/2017 **End** 25/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 1.10 m A / D / B / C 85 (Deg)	**Ground Level** 10.97 mOD **Coordinates (m)** E 535306.34 **National Grid** N 424754.41	

Samples and Tests

Depth	Type & No.	Records
		25/07/17
0.20	D1	
0.50 - 1.00	B2	
1.10	D3	
2.20 - 2.30	B4	
3.20	D5	
		25/07/17 Dry

Strata Description

Main	Detail	Depth, Level (Thickness)	Legend	Backfill
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of various lithologies with occasional rootlets (TOPSOIL).		(0.10) 0.10 +10.87		
Firm, locally stiff, slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of various lithologies including flint, sandstone coal and quartzite.		(0.40) 0.50 +10.47		
Firm to stiff orangish brownish, mottled greenish grey and yellowish brown, slightly sandy slightly gravelly CLAY. Gravel is angular to subangular of flint and mudstone.	2.30-3.10 slightly sandy gravelly clay with low cobble content	(3.40)		
END OF EXPLORATORY HOLE		3.90 +7.07		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.90	No groundwater encountered during excavation.
2.30 - 3.10	Material not suitable for hand vane test.

Stability Stable
Shoring None
Weather Partly cloudy

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:19

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP313

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 25/07/2017 **End** 25/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 1.80 m A / D / B / C 90 (Deg)	**Ground Level** 11.51 mOD **Coordinates (m)** E 535340.67 **National Grid** N 424781.78	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		25/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +11.41		
0.20	D1		Firm brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of various lithologies including sandstone, chalk, flint and quartzite.		(0.20) 0.30 +11.21		
		Dry	Stiff orangish brown, mottled yellowish brown, slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of chalk, flint, coal and sandstone.		(0.30)		
0.50	B2		END OF EXPLORATORY HOLE	0.60 50mm clay pipe	0.60 +10.91		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 0.60	No groundwater encountered during excavation.
0.60	Trial pit terminated due to obstruction, drain pipe (50mm clay pipe).

Stability Stable

Shoring None

Weather Partly cloudy

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:19

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP314

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 25/07/2017 **End** 25/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.10 m A / D / B / C 220 (Deg)	**Ground Level** 11.51 mOD **Coordinates (m)** E 535342.67 **National Grid** N 424783.78	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		25/07/17	Firm slightly gravelly sandy CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +11.41		
0.20	D1		Soft to firm slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of various lithologies including flint and sandstone.		(0.30)		
0.40	HV	p 173kPa, r 101kPa	Firm to stiff, becoming very stiff with depth, fissured orangish brown, mottled light grey, slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including flint, sandstone, coal and siltstone. Fissures are randomly oriented with silt coating.		0.40 +11.11		
1.00 - 1.50	B2						
1.80 - 2.30	B3						
					(3.40)		
				2.40-3.80 sandy gravelly clay with low cobble content			
2.60	D4						
3.10 - 3.50	B5						
		25/07/17 Dry					
3.80	D6		END OF EXPLORATORY HOLE		3.80 +7.71		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.80	No groundwater encountered during excavation.
0.60 - 3.80	Material not suitable for hand vane test.

Stability Stable
Shoring None
Weather Partly cloudy

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:20

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP314A

Trial Pit Log

SOCOTEC

Logged RM	**Start** 25/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m, Length 2.60 m, 82 (Deg)	**Ground Level**	11.57 mOD
Checked TC	**End** 25/07/2017			**Coordinates (m)**	E 535425.16
Approved TC				**National Grid**	N 424844.07

Samples and Tests

Depth	Type & No.	Records
		25/07/17
0.20	D1	
0.30	HV	p 87kPa, r 36kPa
0.40 - 1.00	B2	
0.80	HV	
0.80	HV	p 231kPa, r 149kPa
1.20 - 1.90	B3	
2.10 - 2.80	B4	
3.10	D5	
		25/07/17 Dry
3.80 - 3.90	B6	

Strata Description

Main	Detail	Depth, Level (Thickness)
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to angular of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +11.47
Firm brown slightly sandy CLAY with frequent rootlets.		(0.20) 0.30 +11.27
Firm to stiff fissured orangish brown, locally mottled yellowish brown, slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal and flint. Fissures are randomly oriented.		(0.80) 1.10 +10.47
Very stiff fissured brown, mottled light grey and greenish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth with silty coating.	2.00 becoming, locally with low cobble content. Cobbles are angular to subangular of flint and sandstone	(2.80) 3.90 +7.67
END OF EXPLORATORY HOLE		

Legend: Backfill

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.90	No groundwater encountered during excavation.
1.00 - 3.90	Material not suitable for hand vane test.

Stability Stable
Shoring None
Weather Partly cloudy

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25 03/11/2017 09:00:20

Project **WITHERNSEA LONG SEA OUTFALL**
Project No. **A7063-17**
Carried out for **Ward & Burke Construction Limited**

Trial Pit **TP315**

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 25/07/2017 **End** 25/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.80 m A / D / B / C 84 (Deg)	**Ground Level** 11.04 mOD **Coordinates (m)** E 535508.63 **National Grid** N 424958.84	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		25/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to rounded, fine to coarse of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +10.94		
0.20	D1		Firm to stiff fissured orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, quartzite and flint. Fissures are randomly oriented, smooth and clean.		(0.10) 0.20 +10.84		
0.50	HV	p 186kPa, r 101kPa	Stiff to very stiff orangish brown, mottled greenish grey, locally mottled yellowish brown, slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, flint, sandstone and siltstone.				
1.00 1.00 1.00 - 1.20	HV HV B2	p 212kPa, r 153kPa					
					(2.80)		
2.10	B3						
2.80	D4						
3.00 - 3.50	B5		Firm to stiff brown, locally yellowish brown, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, mudstone and flint. Cobbles are angular to subangular of flint and chalk.		3.00 +8.04		
		25/07/17 Dry		3.50-4.10 occasional pockets of coarse sand approximately 20mm	(1.10)		
4.10	D6		END OF EXPLORATORY HOLE		4.10 +6.94		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 4.10	No groundwater encountered during excavation.

Stability Stable

Shoring None

Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:20

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP316

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 24/07/2017 **End** 24/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.60 m A / D / B / C 252 (Deg)	**Ground Level** 10.95 mOD **Coordinates (m)** E 535639.92 **National Grid** N 425112.33	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		24/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +10.85		
0.20	D1		Firm to stiff orangish brown slightly sandy, locally slightly gravelly, CLAY. Gravel is angular to rounded fine to coarse of flint, sandstone, chalk and coal.				
0.50	D2						
					(1.40)		
1.00 - 1.50	B3						
			Stiff to very stiff fissured reddish brown, mottled greenish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, flint, sandstone and coal. Fissures are randomly oriented, smooth and clean.		1.50 +9.45		
1.60 - 2.00	B4						
2.10	D5			2.10-2.80 slightly sandy gravelly clay			
					(2.50)		
2.90 - 3.30	B6						
3.50	D7						
3.80 - 4.00	B8	24/07/17 Dry					
			END OF EXPLORATORY HOLE		4.00 +6.95		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 4.00	No groundwater encountered during excavation.
0.00 - 4.00	Material not suitable for hand vane test.

Stability Stable

Shoring None

Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:20

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP317

Trial Pit Log

SOCOTEC

Logged RM/DT **Checked** TC **Approved** TC	**Start** 27/07/2017 **End** 27/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 123 (Deg)	**Ground Level** 10.44 mOD **Coordinates (m)** E 535742.23 **National Grid** N 425238.23	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		27/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +10.34		
0.20	D1		Firm brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.20) 0.30 +10.14		
0.60	B2	27/07/17 Dry	Firm to stiff fissured orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(0.60) 0.90 +9.54		
1.00	B3		Very stiff fissured reddish brown, locally mottled bluish grey, sandy gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.	1.00 150mm diameter clay drainage pipe	(0.10) 1.00 +9.44		
			END OF EXPLORATORY HOLE				

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 1.00	No groundwater encountered during excavation.
1.00	Trial pit terminated due to obstruction, 4 inch clay drainage pipe.

Stability Stable

Shoring None

Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:21

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP318

Trial Pit Log

SOCOTEC

Logged DT **Checked** TC **Approved** TC	**Start** 27/07/2017 **End** 27/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 123 (Deg)	**Ground Level** 10.44 mOD **Coordinates (m)** E 535744.23 **National Grid** N 425240.23	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		27/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to rounded, fine to medium of various lithologies with occasional rootlets (TOPSOIL).		(0.10) 0.10 +10.34		
0.20	D1		Firm brown slightly sandy slightly gravelly CLAY with frequent rootlets . Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.20) 0.30 +10.14		
0.60	B2		Firm to stiff fissured orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(0.60)		
1.00	B3		Very stiff fissured reddish brown, locally mottled bluish grey, slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		0.90 +9.54		
2.10	D4				(2.80)		
2.70	D5						
3.40	B6	27/07/17 Dry		3.40-3.70 locally grading to silt.			
			END OF EXPLORATORY HOLE		3.70 +6.74		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.70	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Overcast

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

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Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP318A

Trial Pit Log

SOCOTEC

Logged DT **Checked** TC **Approved** TC	**Start** 28/07/2017 **End** 28/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 91 (Deg)	**Ground Level** 10.94 mOD **Coordinates (m)** E 535802.58 **National Grid** N 425300.24	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		28/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +10.84		
0.20	D1		Firm brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.20) 0.30 +10.64		
0.60	B2		Stiff to very stiff fissured orangish brown slightly sandy slightly gravelly, locally gravelly, CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.70)		
1.20	B3		Stiff to very stiff fissured reddish brown, locally mottled bluish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal, quartzite and mudstone. Cobbles are angular to subrounded of mudstone, quartzite and sandstone. Fissures are randomly orientated, smooth and clean.		1.00 +9.94		
2.20	D4				(2.10)		
3.00	B5						
3.20	D6		Orangish brown silty fine to coarse SAND.		3.10 +7.84		
3.60	D7		Reddish brown gravelly very silty, predominantly fine to medium, SAND.		(0.40) 3.50 +7.44		
		28/07/17 Dry	Firm to stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite.		(0.20) 3.70 +7.24		
3.90	B8				(0.30)		
			END OF EXPLORATORY HOLE		4.00 +6.94		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 4.00	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Sunny

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:21

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP319

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged DT **Checked** TC **Approved** TC	**Start** 28/07/2017 **End** 28/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.90 m A / D / B / C 68 (Deg)	**Ground Level** 10.79 mOD **Coordinates (m)** E 535828.83 **National Grid** N 425385.25	

Samples and Tests

Strata Description

Depth	Type & No.	Records	Main	Detail	Depth, Level (Thickness)	Legend	Backfill
		28/07/17	Firm slightly sandy slightly gravelly CLAY. Gravel is angular to rounded, fine to coarse of various lithologies with occasional rootlets (TOPSOIL).		(0.10) 0.10 +10.69		
0.20	D1		Soft to firm brown slightly sandy slightly gravelly CLAY with frequent rootlets.		(0.20) 0.30 +10.49		
0.50	B2		Firm to stiff fissured orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly orientated smooth and clean.		(0.60) 0.90 +9.89		
1.10	D3		Stiff to very stiff fissured reddish brown, locally mottled bluish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Cobbles are angular to subrounded of sandstone and quartzite. Fissures are randomly, orientated smooth and clean.				
2.00	B4				(2.90)		
3.00	D5						
		28/07/17 Dry					
3.70	B6				3.80 +6.99		
			END OF EXPLORATORY HOLE				

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.80	No groundwater encountered during excavation.

Stability Stable

Shoring None

Weather Sunny

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:21

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP320

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 24/07/2017 **End** 24/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 0.80 m Length 2.50 m A / D / B / C 42 (Deg)	**Ground Level** 8.16 mOD **Coordinates (m)** E 535939.21 **National Grid** N 425448.70	

Samples and Tests

Depth	Type & No.	Records
		24/07/17 Dry
0.30	D1	
1.10 - 1.50	B2	
1.60	D3	
2.10 - 2.70	B4	
3.00	D5	
		24/07/17 Dry
4.00	B6	

Strata Description

Main	Detail	Depth, Level (Thickness)	Legend	Backfill
Firm slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.20)		
		0.20 +7.96		
Firm to stiff brown, mottled orangish brown, slightly gravelly slightly sandy to sandy CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, quartzite, sandstone, coal and flint. Cobbles are subangular to subrounded of flint.		(1.80)		
		2.00 +6.16		
Stiff to very stiff fissured brown, mottled greenish grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subangular fine to coarse of various lithologies including chalk, sandstone, flint, coal and quartzite. Cobbles are angular to subangular of flint. Fissures are randomly oriented, smooth and clean.		(2.00)		
END OF EXPLORATORY HOLE		4.00 +4.16		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 4.00	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Overcast, raining

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:21

AGS

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP321

Sheet 1 of 1

Trial Pit Log

SOCOTEC

Logged RM **Checked** TC **Approved** TC	**Start** 24/07/2017 **End** 24/07/2017	**Equipment, Methods and Remarks** JCB 3CX. Machine excavated.	**Dimension and Orientation** Width 1.10 m Length 3.10 m A / D / B / C 210 (Deg)	**Ground Level** 9.99 mOD **Coordinates (m)** E 535970.96 **National Grid** N 425574.39	

Samples and Tests

Depth	Type & No.	Records
		24/07/17 Dry
0.40	D1	
1.10	B2	
1.50	D3	
2.20	B4	
2.80	B5	
3.10	D6	
		24/07/17 Dry

Strata Description

Main	Detail	Depth, Level (Thickness)	Legend	Backfill
Firm slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded, fine to medium of various lithologies with frequent rootlets (TOPSOIL).		(0.10) 0.10 +9.89		
Firm to stiff fissured orangish brown, locally mottled yellowish brown, slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, sandstone, coal and quartzite. Fissures are randomly oriented, smooth and clean.		(1.10) 1.20 +8.79		
Stiff to very stiff fissured brown, mottled light grey, slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of various lithologies including chalk, quartzite, sandstone, coal and flint. Cobbles are angular to subangular of flint and quartzite. Fissures are randomly oriented.		(2.40)		
END OF EXPLORATORY HOLE		3.60 +6.39		

Groundwater Entries

No.	Depth Strike (m)	Remarks

Remarks

Depth (m)	Remarks
0.00 - 3.60	No groundwater encountered during excavation.

Stability Stable
Shoring None
Weather Overcast, raining

Notes: For explanation of symbols and abbreviations see Key to Exploratory Hole Records. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

03/11/2017 09:00:22

Project **WITHERNSEA LONG SEA OUTFALL**

Project No. **A7063-17**

Carried out for **Ward & Burke Construction Limited**

Trial Pit

TP322

APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS

Index Properties – Summary of Results	INDX 1 to 4
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Unconsolidated Undrained Triaxial Compression Tests – Summary of Results	UUSUM 1 to 3
Determination of Shear Strength by Laboratory Vane – Summary of Results	LVane
One Dimensional Consolidation Test	OED 1 to 9
Chemical Tests	EFS/177905 EFS/177907 EFS/177908 EFS/177909 EFS/177910 EFS/177911 EFS/178565 EFS/178571

INDEX PROPERTIES - SUMMARY OF RESULTS

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	ρ Mg/m3	ρ_d Mg/m3	w %	< 425 µm sieve %	W_L %	W_P %	I_P	ρ_s Mg/m3	Remarks
BH401	5	1.20	1.70	B	Brown slightly sandy slightly gravelly CLAY.			18.5	90	40 a	20	20		
BH401	13	5.00	5.50	B	Brown slightly sandy slightly gravelly CLAY.			17.1	91	32 a	16	16		
BH401	29	13.00	13.50	B	Brown slightly sandy slightly gravelly CLAY.			32.2	84	38 a	17	21		
BH401	34	16.00	16.50	B	Brown slightly sandy slightly gravelly CLAY.			21.6	92	39 a	19	20		
BH402	4	1.20		B	Brown slightly sandy CLAY.			19.1	99	43 a	22	21		
BH402	7	3.00		B	Brown slightly sandy slightly gravelly CLAY.			13.9	92	36 a	17	19		
BH402	14	7.00		B	Brown slightly sandy slightly gravelly CLAY.			16.2	92	36 a	17	19		
BH402	27	14.00		B	Brown slightly sandy slightly gravelly CLAY.			24	91	39 a	19	20		
BH402	38	20.00		B	Brown slightly sandy slightly gravelly silty CLAY.			27	96	42 a	19	23		
BH403	13	5.00		B	Brown slightly sandy slightly gravelly CLAY.			18	77	36 a	18	18		
BH403	21	9.00		B	Brown slightly sandy slightly gravelly CLAY.			17	84	33 a	18	15		
BH403	29	13.00		B	Brown slightly sandy slightly gravelly CLAY.			19	82	33 a	16	17		
BH403	41	19.00		B	Brown slightly sandy slightly gravelly CLAY.			24	94	42 a	19	23		
BH404	9	3.00		B	Brown slightly sandy slightly gravelly CLAY.			19	87	41 a	18	23		
BH404	17	7.00		B	Brown slightly sandy slightly gravelly CLAY.			18	86	35 a	17	18		
BH404	29	13.00		B	Brown slightly sandy slightly gravelly CLAY.			19	88	32 a	15	17		
BH404	41	19.00		B	Brown slightly sandy slightly gravelly CLAY.			21	97	33 a	16	17		
BH405	5	1.20		B	Brown slightly sandy slightly gravelly CLAY.			18	87	36 a	18	18		
BH405	9	3.00		B	Brown slightly sandy slightly gravelly CLAY.			19	93	41 a	18	23		
BH405	17	7.00		B	Brown slightly sandy slightly gravelly CLAY.			21	90	36 a	18	18		
BH405	29	13.00		B	Brown slightly sandy slightly gravelly CLAY.			17	92	34 a	17	17		
BH405	41	19.00		B	Brownish grey slightly sandy slightly gravelly CLAY.			23	95	39 a	20	19		
BH406	9	3.00		B	Brown slightly sandy slightly gravelly CLAY			18	88	37 a	19	18		
BH406	17	7.00		B	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.			18	92	37 a	18	19	2.73-p	
BH406	25	11.00		B	Brown slightly sandy slightly gravelly CLAY			17	91	33 a	16	17		
BH406	37	17.00		B	Brown slightly sandy slightly gravelly CLAY			16	92	36 a	17	19		
BH406	49	23.00		B	Brown slightly sandy slightly gravelly CLAY.			17	89	34 a	17	17		
BH407	5	1.20		B	Brown slightly sandy slightly gravelly CLAY			21	90	37 a	17	20		
BH407	13	5.00		B	Brown slightly sandy slightly gravelly CLAY.			16	85	38 a	18	20	2.71-p	
BH407	21	9.00		B	Brown slightly sandy slightly gravelly CLAY.			16	88	35 a	17	18		
BH407	33	15.00		B	Brown slightly sandy slightly gravelly CLAY.			18	89	36 a	17	19		
BH407	52	24.50		B	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.			19	92	36 a	18	18		
BH408	4	1.20		B	Brown slightly sandy slightly gravelly CLAY.			10	94	41 a	21	20		
BH408	13	5.50		B	Brown slightly sandy slightly gravelly CLAY.			18	92	33 a	16	17		

General notes: All above tests carried out to BS1377 : 1990 unless annotated otherwise. See individual test reports for further details.

Key :

p	bulk density, linear	WL Liquid limit	WP	Plastic limit	<425um preparation	*ps particle density*
pd	dry density	a 4 point cone test	NP	non - plastic	n from natural soil	-g = gas jar
w	moisture content	b 1 point cone test	IP	Plasticity Index	s sieved specimen	-p = small pyknometer
*	test carried out to BS EN ISO 17892-1 2014					

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

INDEX PROPERTIES - SUMMARY OF RESULTS

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	ρ Mg/m3	ρ_d Mg/m3	w %	< 425 µm sieve %	W_L %	W_P %	I_P	ρ_s Mg/m3	Remarks
BH408	20	9.50		B	Brown slightly sandy slightly gravelly CLAY.			20.4	97	39 a	18	21		
BH408	27	13.50		B	Reddish brown slightly sandy slightly gravelly CLAY.			21.2	88	39 a	17	22		
BH408	34	17.50		B	Dark brown slightly sandy slightly gravelly CLAY.			21	91	36 a	16	20		
BH409	9	3.00		B	Brown slightly sandy slightly gravelly CLAY.			21.6	93	42 a	20	22		
BH409	18	7.00		B	Brown slightly sandy slightly gravelly silty CLAY.			19.2	91	32 a	16	16		
BH409	26	11.00		B	Brown slightly sandy slightly gravelly CLAY.			27.7	96	40 a	18	22		
BH409	34	15.00		B	Brown slightly sandy slightly gravelly CLAY.			29	90	42 a	19	23		
BH409	46	21.00		B	Brown slightly sandy slightly gravelly CLAY.			24	88	38 a	17	21		
BH410	2	0.00		B	Brown slightly sandy slightly gravelly CLAY.			20	95	38 a	18	20		
BH410	5	1.50		B	Brown slightly gravelly sandy CLAY			16	77	32 a	16	16		
BH410	8	2.50		B	Brown slightly sandy slightly gravelly CLAY			17	87	34 a	16	18		
BH410	11	5.00		B	Brown slightly sandy slightly gravelly CLAY.			24	84	33 a	16	17		
BH410A	2	6.70		B	Dark brown slightly sandy slightly gravelly CLAY with chalk fragments.			17						
BH411	2	0.13		B	Brown slightly sandy slightly gravelly CLAY.			19	88	35 a	17	18		
BH411	6	1.00		B	Brown slightly sandy slightly gravelly CLAY.			17	92	36 a	18	18		
BH411	10	2.60		B	Brown slightly sandy slightly gravelly CLAY.			18	90	37 a	18	19	2.72-p	
BH411	11	3.60		D	Brown slightly gravelly sandy CLAY			14	61	25 a	14	11		
BH411	15	6.10		D	Greyish brown slightly sandy slightly gravelly CLAY			15						
BH411A	2	7.00		B	Brown slightly sandy slightly gravelly CLAY.			14						
BH411A	6	9.00		U	Firm to stiff brown slightly sandy slightly gravelly CLAY.			23						
TP302	2	0.60		B	Brown slightly sandy CLAY			33	99	77 a	34	43		
TP302	4	1.50		D	Brown slightly gravelly sandy CLAY			21	95	33 a	16	17		
TP302	5	2.00		B	Light brown clayey SILT			27	100	65 a	28	37		
TP302	7	3.60		B	Dark brown slightly sandy slightly gravelly silty CLAY			17	93	38 a	18	20		
TP303	2	0.60		B	Brown slightly sandy slightly gravelly CLAY.			14	95	46 a	21	25		
TP303	4	2.40		B	Brown slightly sandy slightly gravelly clayey SILT with one cobble			13	83	37 a	19	18		
TP303	5	3.40		D	Brown slightly sandy slightly gravelly CLAY			16	92	38 a	19	19		
TP304	1	0.20		D	Brown slightly sandy slightly gravelly CLAY with occasional rootlets			17	96	38 a	20	18		
TP304	2	0.40		B	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.			19	95	53 a	23	30		
TP304	4	1.40		B	Brown slightly sandy slightly gravelly CLAY.			14	93	40 a	19	21		
TP304	6	3.10		B	Brown slightly sandy slightly gravelly SILT.			16	76	38 a	18	20		
TP305	2	0.50		B	Brown slightly sandy slightly gravelly CLAY			19	98	56 a	25	31		
TP305	6	3.10		B	Brown slightly sandy slightly gravelly CLAY.			16	92	38 a	18	20		
TP306	3	0.80		B	Brown slightly sandy slightly gravelly SILT			17	95	50 a	22	28		

General notes: All above tests carried out to BS1377 : 1990 unless annotated otherwise. See individual test reports for further details.

Key :

p	bulk density, linear	WL Liquid limit	WP	Plastic limit	<425um preparation	*ps particle density*
pd	dry density	a 4 point cone test	NP	non - plastic	n from natural soil	-g = gas jar
w	moisture content	b 1 point cone test	IP	Plasticity Index	s sieved specimen	-p = small pyknometer
*	test carried out to BS EN ISO 17892-1 2014					

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INDEX PROPERTIES - SUMMARY OF RESULTS

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	ρ Mg/m3	ρ_d Mg/m3	w %	< 425 µm sieve %	W_L %	W_P %	I_P	ρ_s Mg/m3	Remarks
TP306	5	2.20		B	Brown slightly sandy slightly gravelly CLAY.			16	87	35 a	19	16		
TP306	6	3.50		B	Brown slightly sandy slightly gravelly clayey SILT			14.6	87	35 a	16	19		
TP307	2	0.60		B	Brown slightly sandy slightly gravelly CLAY			13.5	93	40 a	20	20		
TP307	6	3.70		B	Brown slightly sandy slightly gravelly CLAY.			16.9	88	38 a	18	20		
TP308	2	0.60		B	Brown slightly sandy clayey SILT			23.8	100	65 a	28	37		
TP308	3	1.10		B	Light brown gravelly silty SAND			15.4	83	29 a	15	14		
TP308	5	2.60		B	Brown slightly sandy slightly gravelly SILT.			16.7	91	31 a	16	15		
TP309	2	0.50		B	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.			14	93	51 a	23	28		
TP309	4	2.00		B	Brown slightly gravelly sandy clayey SILT			17	94	25 a	15	10		
TP309	5	2.60		B	Brown slightly sandy slightly gravelly CLAY			18	85	33 a	18	15		
TP310	2	0.90		B	Brown slightly sandy slightly gravelly SILT			16	96	50 a	21	29		
TP310	5	2.00		B	Brown slightly sandy slightly gravelly CLAY			18	95	41 a	20	21		
TP311	2	0.50		B	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.			15	92	48 a	22	26		
TP311	5	2.80		B	Brown slightly sandy slightly gravelly clayey SILT.			16	91	37 a	19	18		
TP312	1	0.20		D	Brown slightly sandy slightly gravelly CLAY with occasional rootlets			22	96	50 a	25	25		
TP312	3	1.20		B	Brown slightly sandy slightly gravelly CLAY.			16	93	43 a	20	23		
TP312	5	2.40		B	Dark brown slightly sandy slightly gravelly CLAY.			17	95	42 a	19	23		
TP313	2	0.50		B	Brown slightly sandy slightly gravelly CLAY			21	96	48 a	21	27		
TP313	4	2.20		B	Brown slightly sandy slightly gravelly CLAY			16	90	36 a	20	16		
TP314A	2	1.00		B	Brown slightly sandy slightly gravelly CLAY			18	91	41 a	20	21		
TP314A	3	1.80		B	Brown slightly sandy slightly gravelly silty CLAY			12	87	37 a	18	19		
TP314A	5	3.10		B	Brown slightly sandy slightly gravelly clayey SILT			17	91	35 a	18	17		
TP315	2	0.40		B	Brown slightly sandy slightly gravelly CLAY			18	96	47 a	24	23		
TP315	6	3.80		B	Brown slightly sandy slightly gravelly CLAY.			15	79	35 a	17	18		
TP316	2	1.00		B	Brown slightly sandy slightly gravelly silty CLAY			16	96	42 a	20	22		
TP316	3	2.10		B	Brown slightly sandy slightly gravelly clayey SILT			15	84	38 a	19	19		
TP316	5	3.00		B	Brown slightly sandy slightly gravelly CLAY			16	88	34 a	16	18		
TP317	3	1.00		B	Brown slightly sandy clayey SILT			21	97	57 a	24	33		
TP317	6	2.90		B	Brown slightly sandy slightly gravelly CLAY.			13	84	32 a	16	16		
TP318A	2	0.60		B	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.			22	96	52 a	23	29		
TP318A	6	3.40		B	Brown slightly sandy slightly gravelly CLAY.			15	88	34 a	26	8		
TP319	2	0.60		B	Brown slightly sandy slightly gravelly CLAY with one cobble.			13	74	50 a	21	29		
TP319	3	1.20		B	Brown slightly sandy slightly gravelly CLAY with occasional rootlets and one cobble.			11	70	41 a	19	22		
TP319	7	3.60		D	Brown slightly gravelly sandy CLAY with occasional rootlets			15	84	22 a	14	8		

General notes: All above tests carried out to BS1377 : 1990 unless annotated otherwise. See individual test reports for further details.

Key :

p	bulk density, linear	WL Liquid limit	WP	Plastic limit	<425um preparation	*ps particle density*
pd	dry density	a 4 point cone test	NP	non - plastic	n from natural soil	-g = gas jar
w	moisture content	b 1 point cone test	IP	Plasticity Index	s sieved specimen	-p = small pyknometer
*	test carried out to BS EN ISO 17892-1 2014					

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INDEX PROPERTIES - SUMMARY OF RESULTS

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	ρ Mg/m3	ρ_d Mg/m3	w %	< 425 µm sieve %	W_L %	W_P %	I_P	ρ_s Mg/m3	Remarks
TP319	8	3.90		B	Brown slightly sandy slightly gravelly CLAY.			15.7	89	34 a	16	18		
TP320	2	0.50		B	Brown slightly sandy slightly gravelly CLAY.			18.1	94	48 a	21	27		
TP320	4	2.00		B	Brown slightly sandy slightly gravelly CLAY			15.3	91	38 a	19	19		
TP321	2	1.10		B	Brown slightly sandy slightly gravelly CLAY			21.7	91	50 a	26	24		
TP321	4	2.10		B	Brown slightly sandy slightly gravelly CLAY			14.9	95	39 a	17	22		
TP321	6	4.00		B	Dark brown slightly sandy slightly gravelly clayey SILT			15.3	92	34 a	17	17		
TP322	2	1.10		B	Brown slightly sandy slightly gravelly silty CLAY			27.1	86	48 a	20	28		
TP322	5	2.80		B	Brown slightly sandy slightly gravelly SILT			16	92	38 a	18	20		

General notes: All above tests carried out to BS1377 : 1990 unless annotated otherwise. See individual test reports for further details.

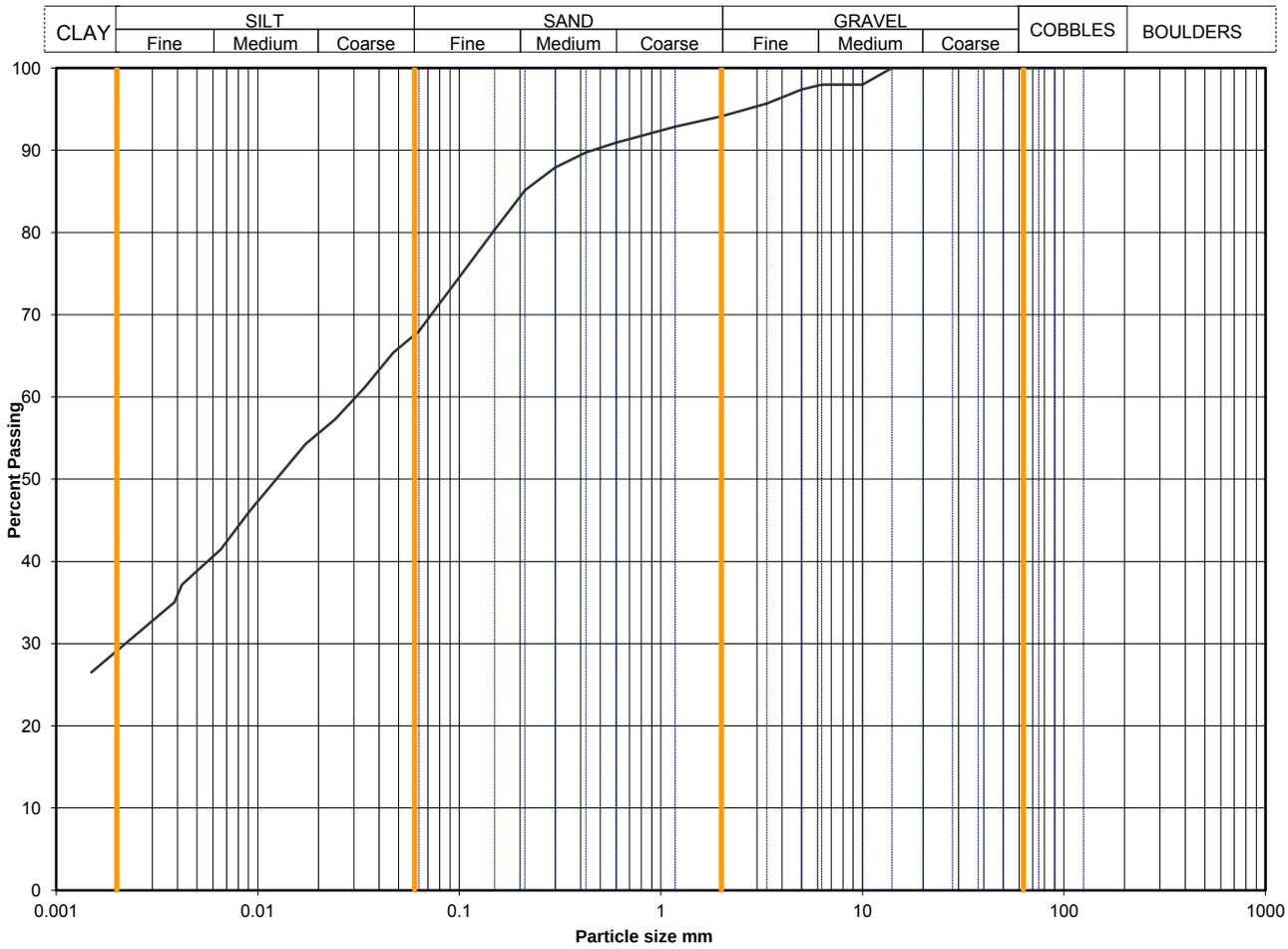
Key :

ρ	bulk density, linear	WL Liquid limit	WP	Plastic limit	<425um preparation	*ps particle density*
pd	dry density	a 4 point cone test	NP	non - plastic	n from natural soil	-g = gas jar
w	moisture content	b 1 point cone test	IP	Plasticity Index	s sieved specimen	-p = small pyknometer
*	test carried out to BS EN ISO 17892-1 2014					

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH401
		Sample Depth (m BGL)	1.20 - 1.70
	A7063-17/0-20170713061945	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	68
90	100	0.0471	65
75	100	0.0338	61
63	100	0.0242	57
50	100	0.0173	54
37.5	100	0.0091	46
28	100	0.0066	41
20	100	0.0042	37
14	100	0.0039	35
10	98	0.0015	27
6.3	98		
5.0	97		
3.35	96		
2.00	94		
1.18	93		
0.600	91		
0.425	90	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	85		
0.150	80	1.8	
0.063	68		

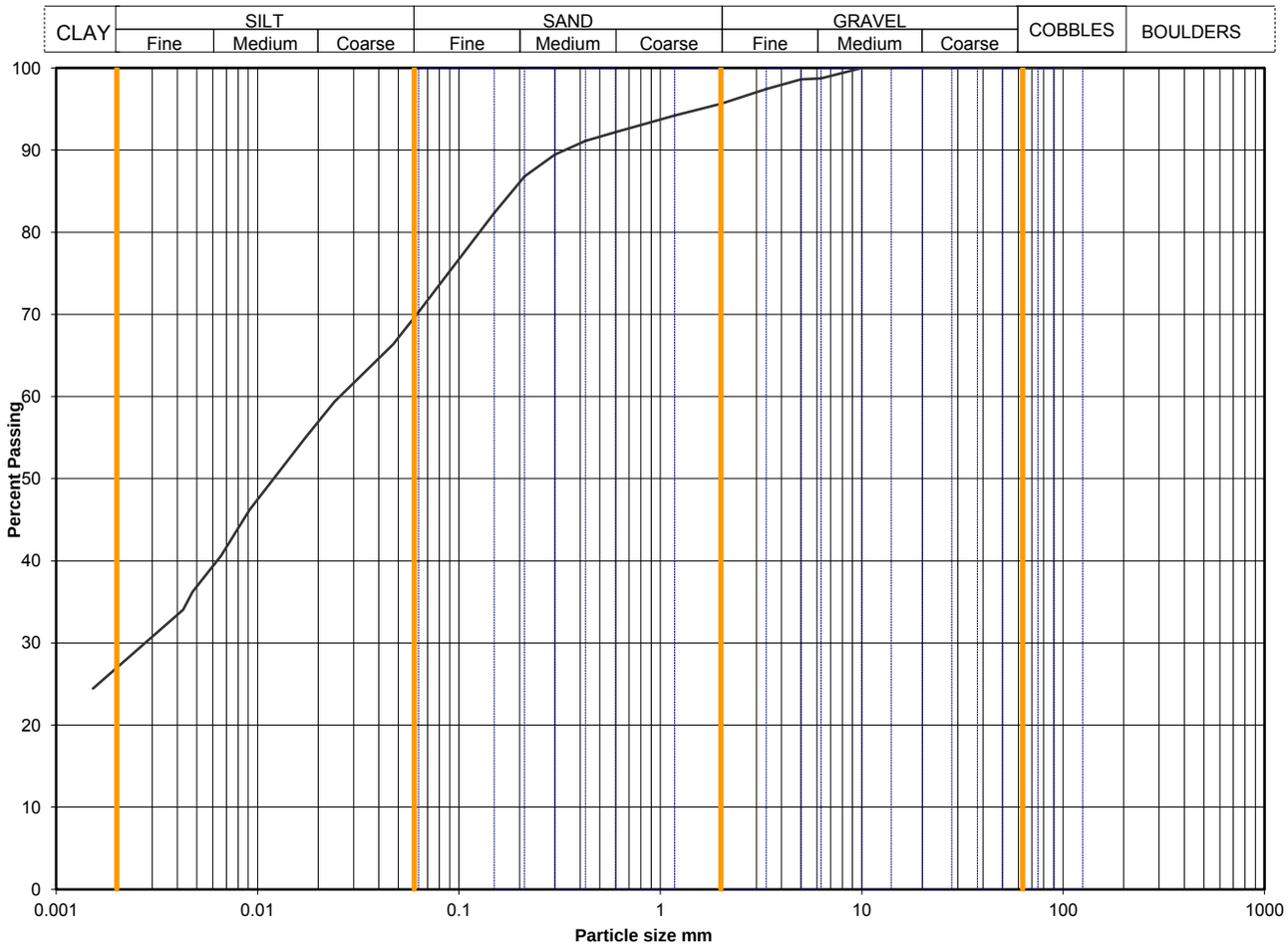
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	6	6
	Sand	26	26
*<60mm values to aid description only	Silt	39	39
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH401
		Sample Depth (m BGL)	5.00 - 5.50
	A7063-17/0-20170713062638	Sample Type and No	B13
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0471	66
75	100	0.0337	63
63	100	0.0241	59
50	100	0.0173	55
37.5	100	0.0092	46
28	100	0.0066	41
20	100	0.0048	36
14	100	0.0043	34
10	100	0.0015	24
6.3	99		
5.0	99		
3.35	97		
2.00	96		
1.18	94		
0.600	92		
0.425	91	2.65	
0.300	89	Dry mass of sample, kg	
0.212	87		
0.150	82	1.9	
0.063	70		

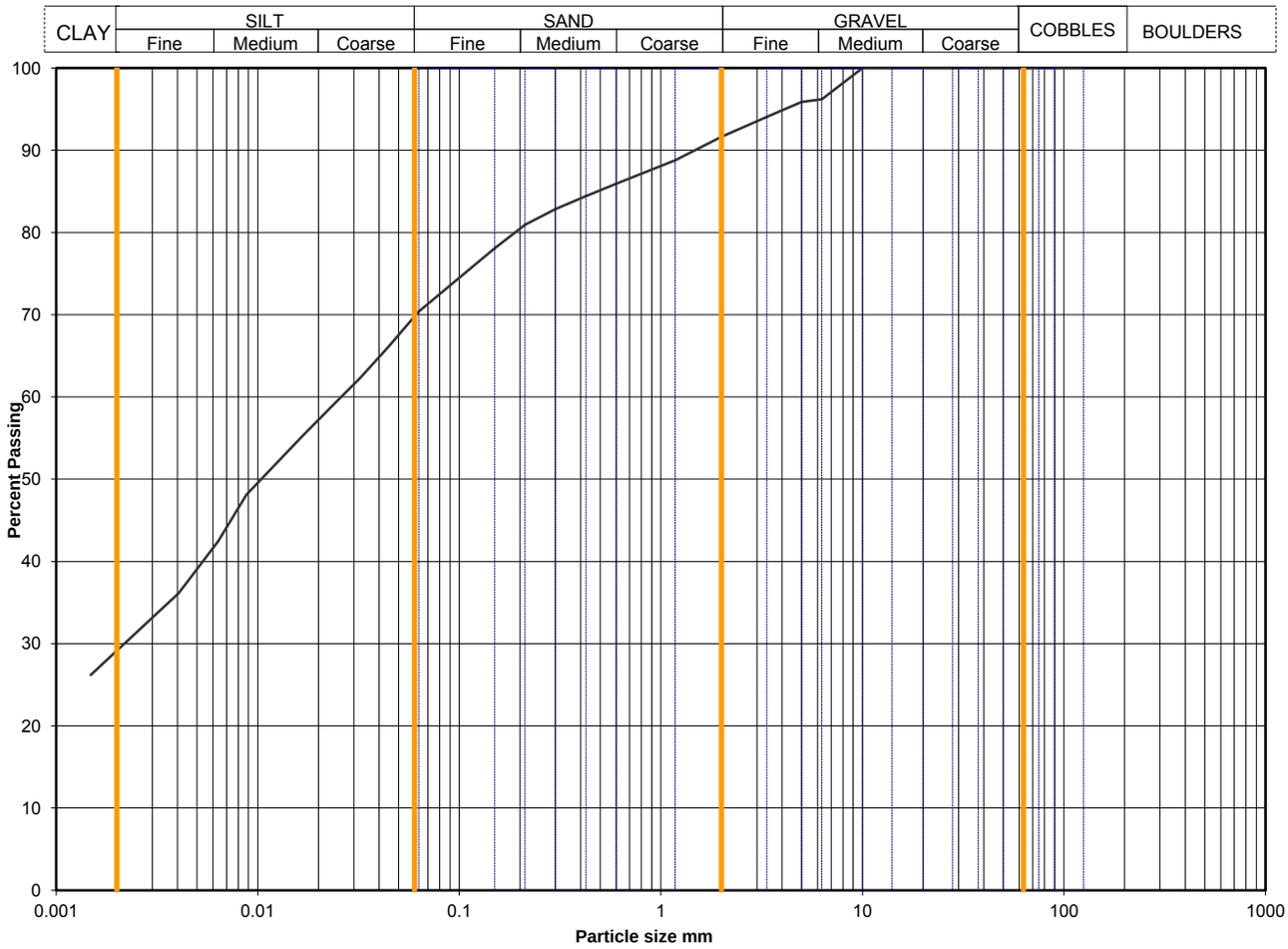
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	25	25
*<60mm values to aid description only	Silt	43	43
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH401
		Sample Depth (m BGL)	13.00 - 13.50
	A7063-17/0-20170714121316	Sample Type and No	B29
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0447	66
75	100	0.0321	62
63	100	0.0231	59
50	100	0.0166	55
37.5	100	0.0088	48
28	100	0.0064	42
20	100	0.0045	38
14	100	0.0040	36
10	100	0.0015	26
6.3	96		
5.0	96		
3.35	94		
2.00	92		
1.18	89		
0.600	86		
0.425	84	2.65	
0.300	83	Dry mass of sample, kg	
0.212	81		
0.150	78	1.6	
0.063	70		

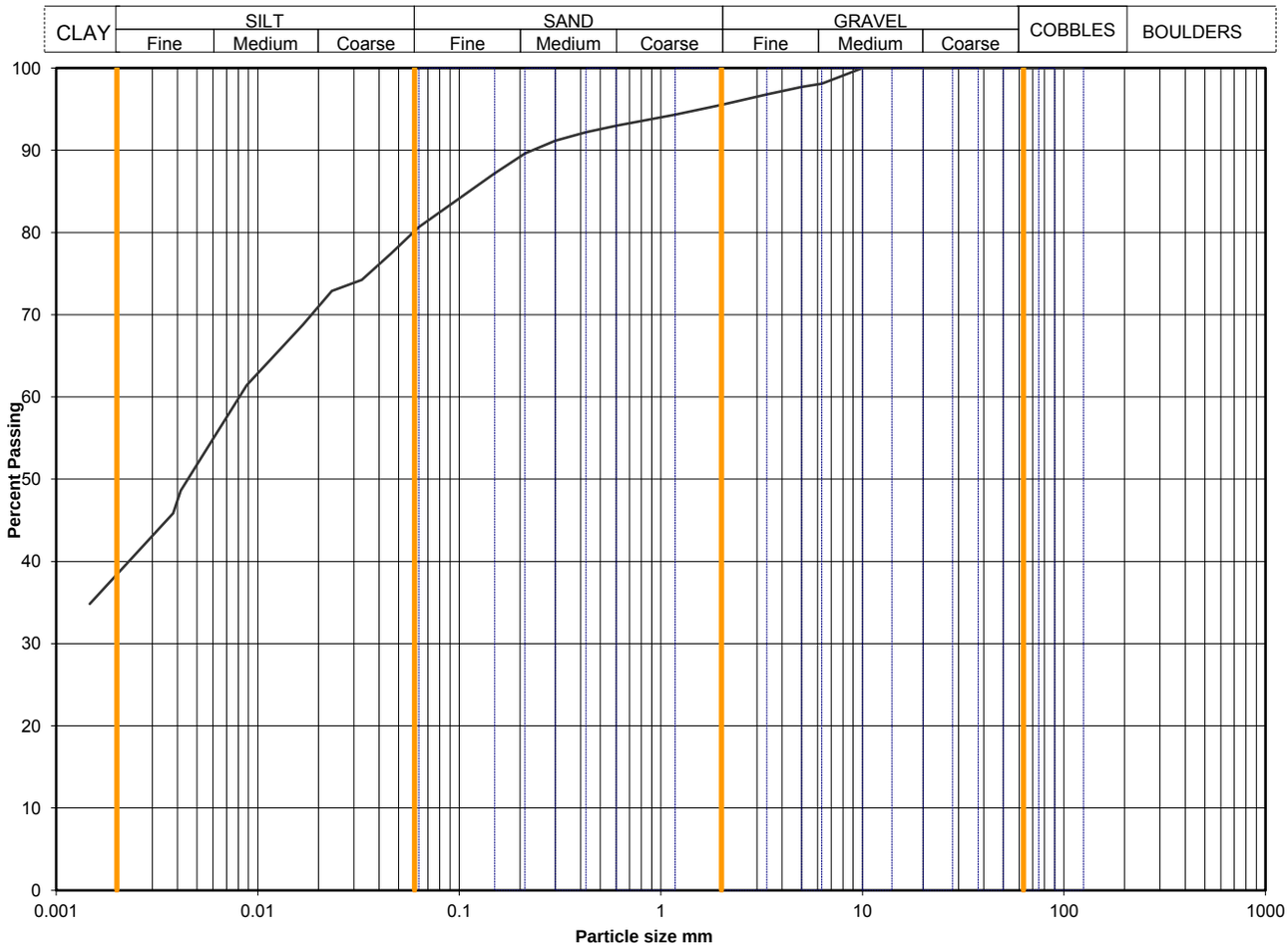
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	21	21
*<60mm values to aid description only	Silt	41	41
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH401
		Sample Depth (m BGL)	16.00 - 16.50
	A7063-17/0-20170714121618	Sample Type and No	B34
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	81
90	100	0.0459	77
75	100	0.0328	74
63	100	0.0233	73
50	100	0.0167	69
37.5	100	0.0088	61
28	100	0.0062	55
20	100	0.0042	49
14	100	0.0038	46
10	100	0.0015	35
6.3	98		
5.0	98		
3.35	97		
2.00	96		
1.18	94		
0.600	93		
0.425	92	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	90		
0.150	87	1.0	
0.063	81		

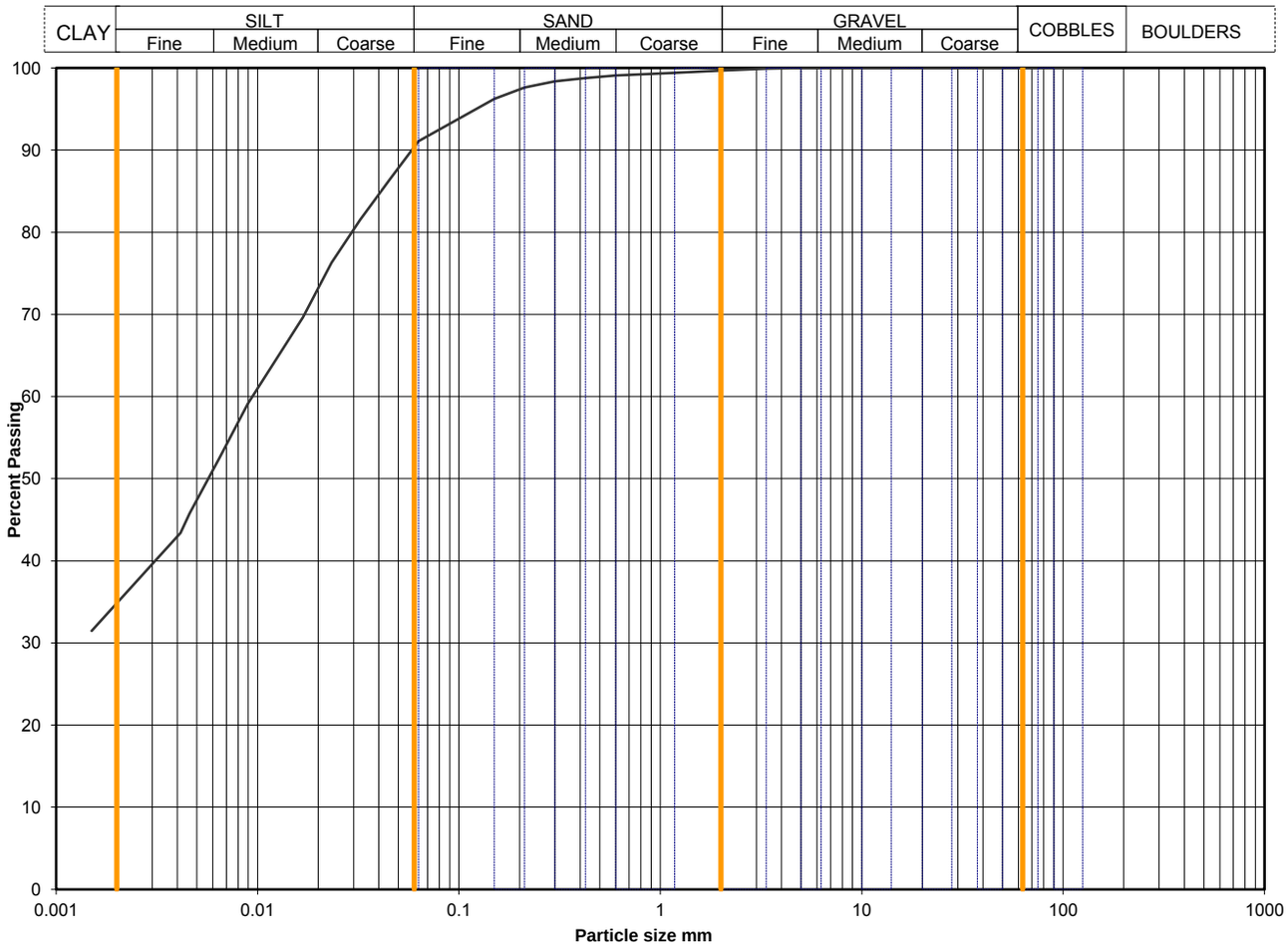
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	15	15
*<60mm values to aid description only	Silt	42	42
	Clay	38	38

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH402
		Sample Depth (m BGL)	1.2
	A7063-17-20170713061836	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	91
90	100	0.0451	86
75	100	0.0324	82
63	100	0.0233	76
50	100	0.0168	70
37.5	100	0.0089	59
28	100	0.0064	52
20	100	0.0046	46
14	100	0.0041	43
10	100	0.0015	31
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	99		
0.600	99		
0.425	99	2.65	
0.300	98	Dry mass of sample, kg	
0.212	98		
0.150	96	0.8	
0.063	91		

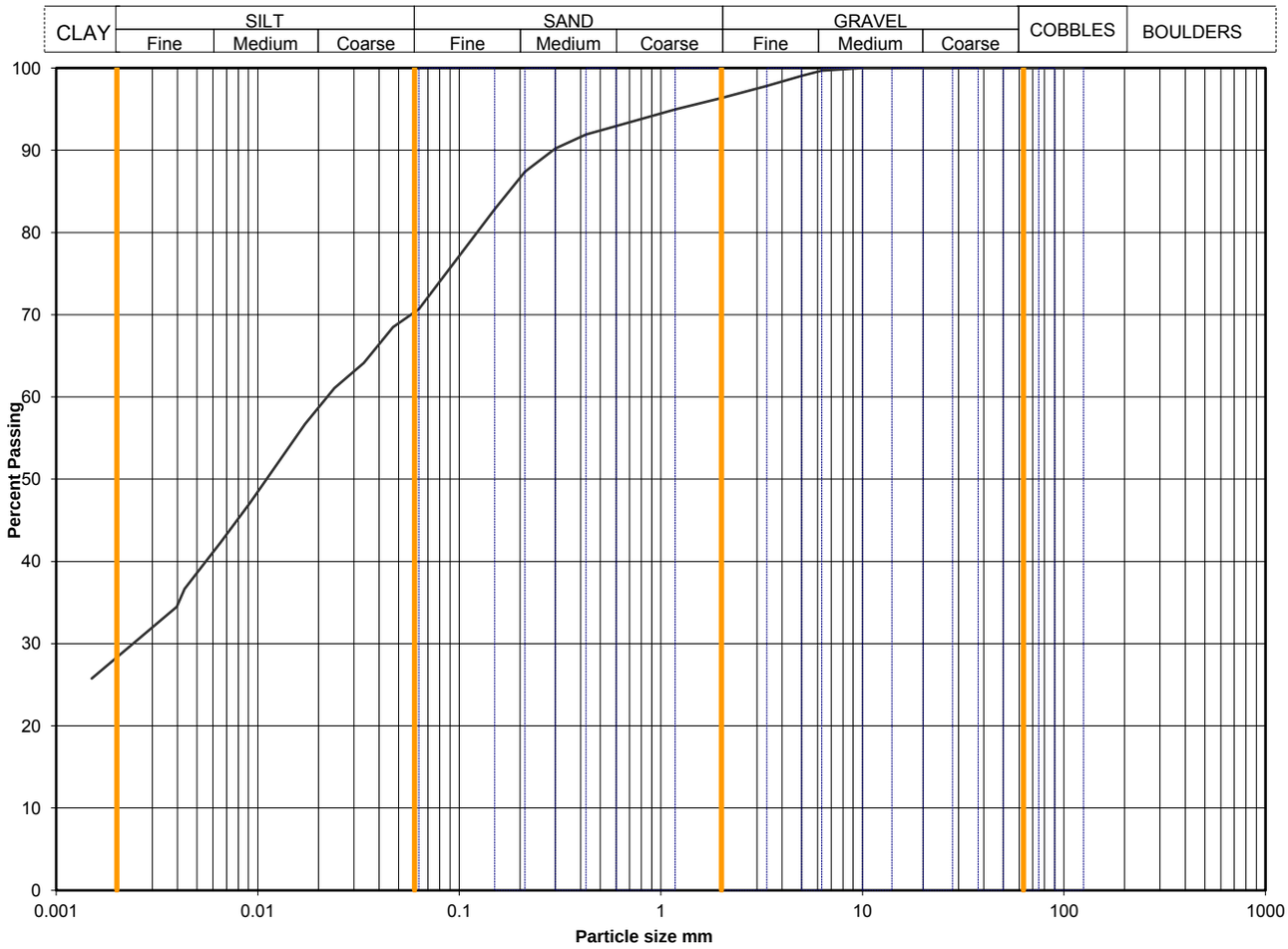
Soil description	Brown slightly sandy CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	9	9
*<60mm values to aid description only	Silt	56	56
	Clay	35	35

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH402
		Sample Depth (m BGL)	3
	A7063-17-20170713062050	Sample Type and No	B7
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	71
90	100	0.0468	69
75	100	0.0336	64
63	100	0.0240	61
50	100	0.0172	57
37.5	100	0.0091	47
28	100	0.0066	42
20	100	0.0043	37
14	100	0.0040	34
10	100	0.0015	26
6.3	100		
5.0	99		
3.35	98		
2.00	96		
1.18	95		
0.600	93		
0.425	92	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	87		
0.150	83	2.1	
0.063	71		

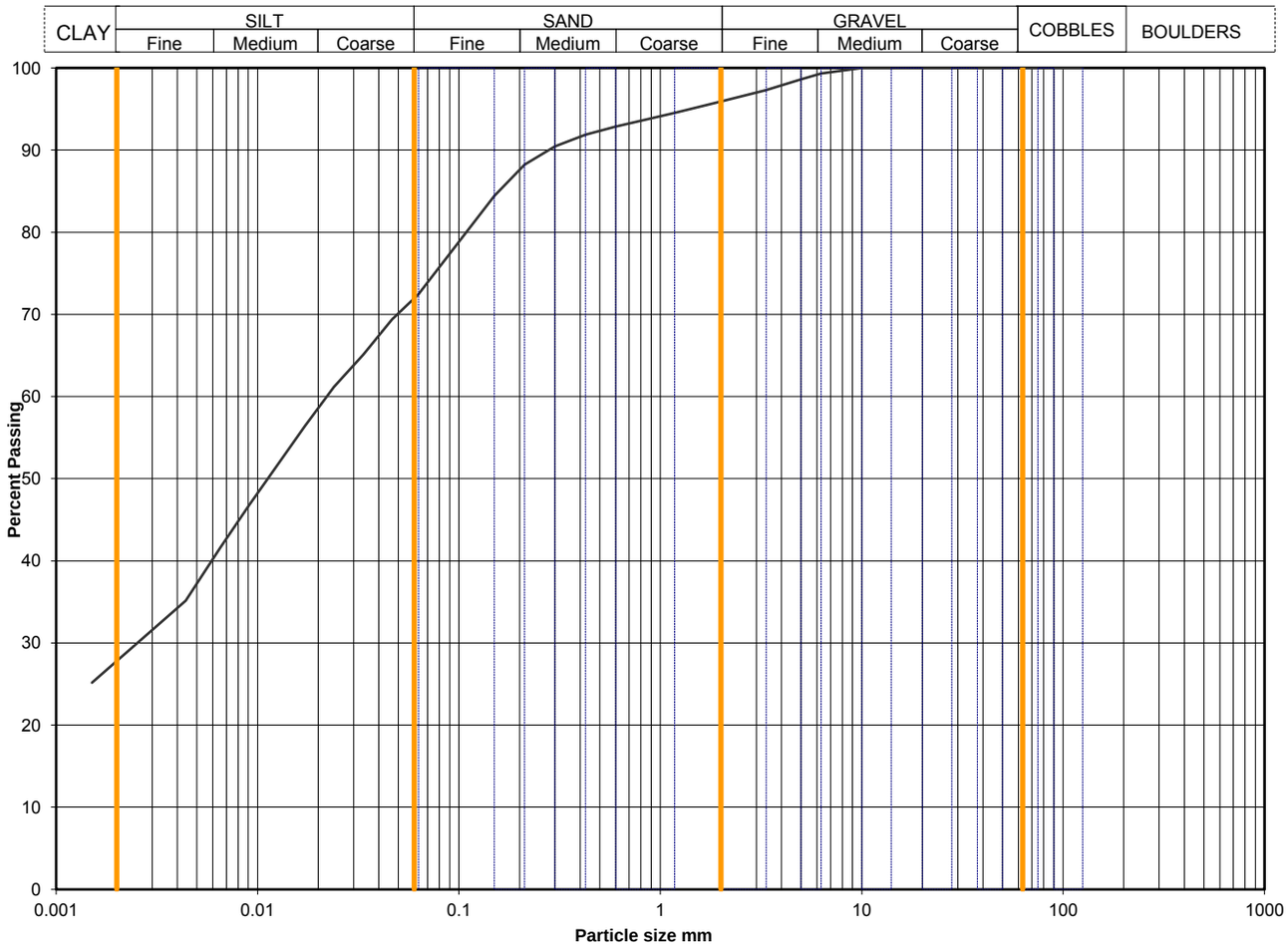
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	26	26
*<60mm values to aid description only	Silt	42	42
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH402
		Sample Depth (m BGL)	7
	A7063-17-20170714054454	Sample Type and No	B14
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0466	69
75	100	0.0334	65
63	100	0.0239	61
50	100	0.0172	56
37.5	100	0.0091	47
28	100	0.0066	42
20	100	0.0044	35
14	100	0.0040	34
10	100	0.0015	25
6.3	99		
5.0	99		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	92	2.65	
0.300	90	Dry mass of sample, kg	
0.212	88		
0.150	84	1.4	
0.063	72		

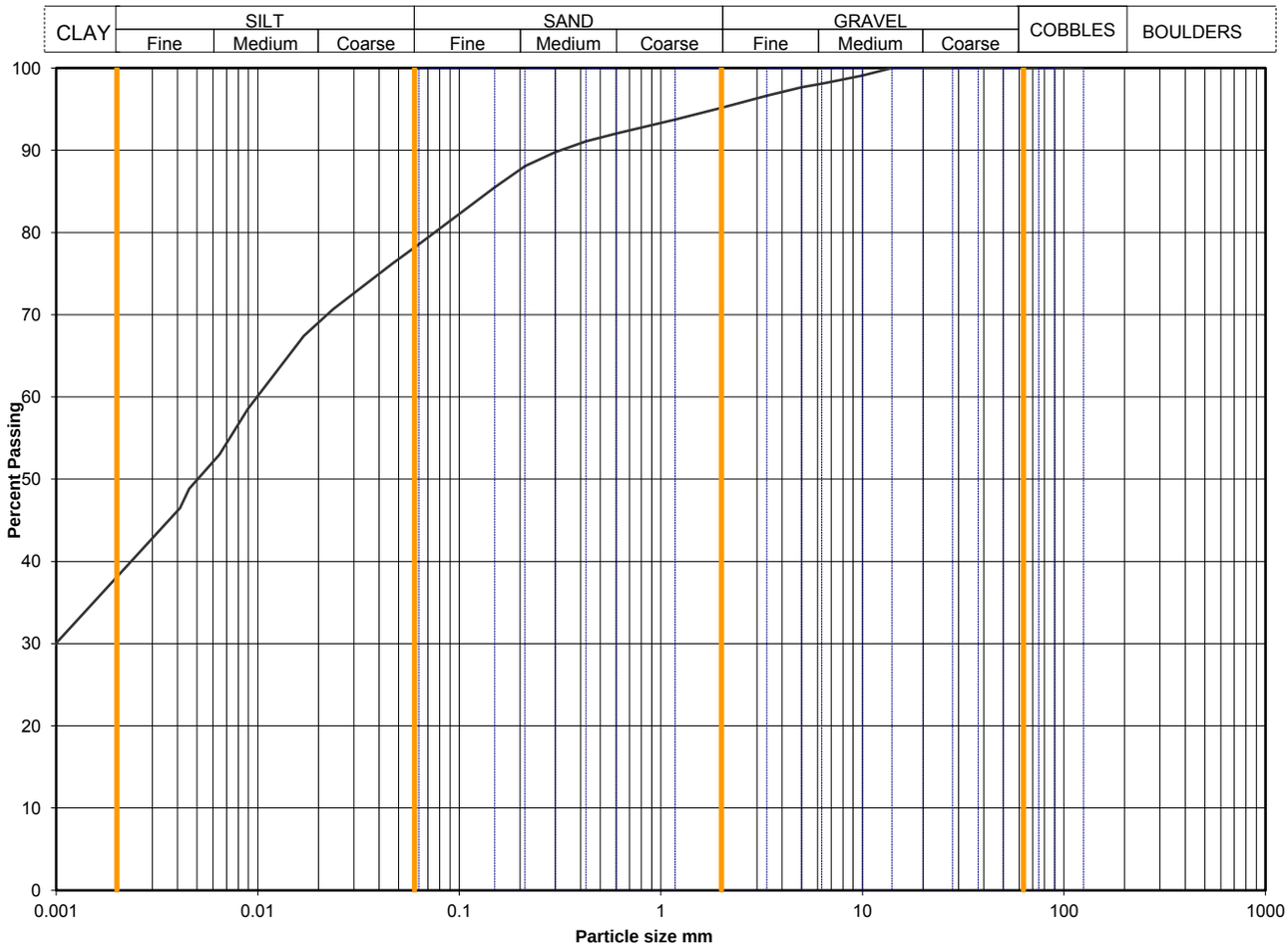
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	23	23
*<60mm values to aid description only	Silt	45	45
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH402
		Sample Depth (m BGL)	14
	A7063-17-20170714055326	Sample Type and No	B27
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	79
90	100	0.0466	76
75	100	0.0332	73
63	100	0.0237	71
50	100	0.0169	67
37.5	100	0.0090	59
28	100	0.0064	53
20	100	0.0046	49
14	100	0.0041	46
10	99	0.0008	28
6.3	98		
5.0	98		
3.35	97		
2.00	95		
1.18	94		
0.600	92		
0.425	91	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	88		
0.150	86	9.8	
0.063	79		

Soil description	Brown slightly sandy slightly gravelly CLAY.
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377
Remarks	

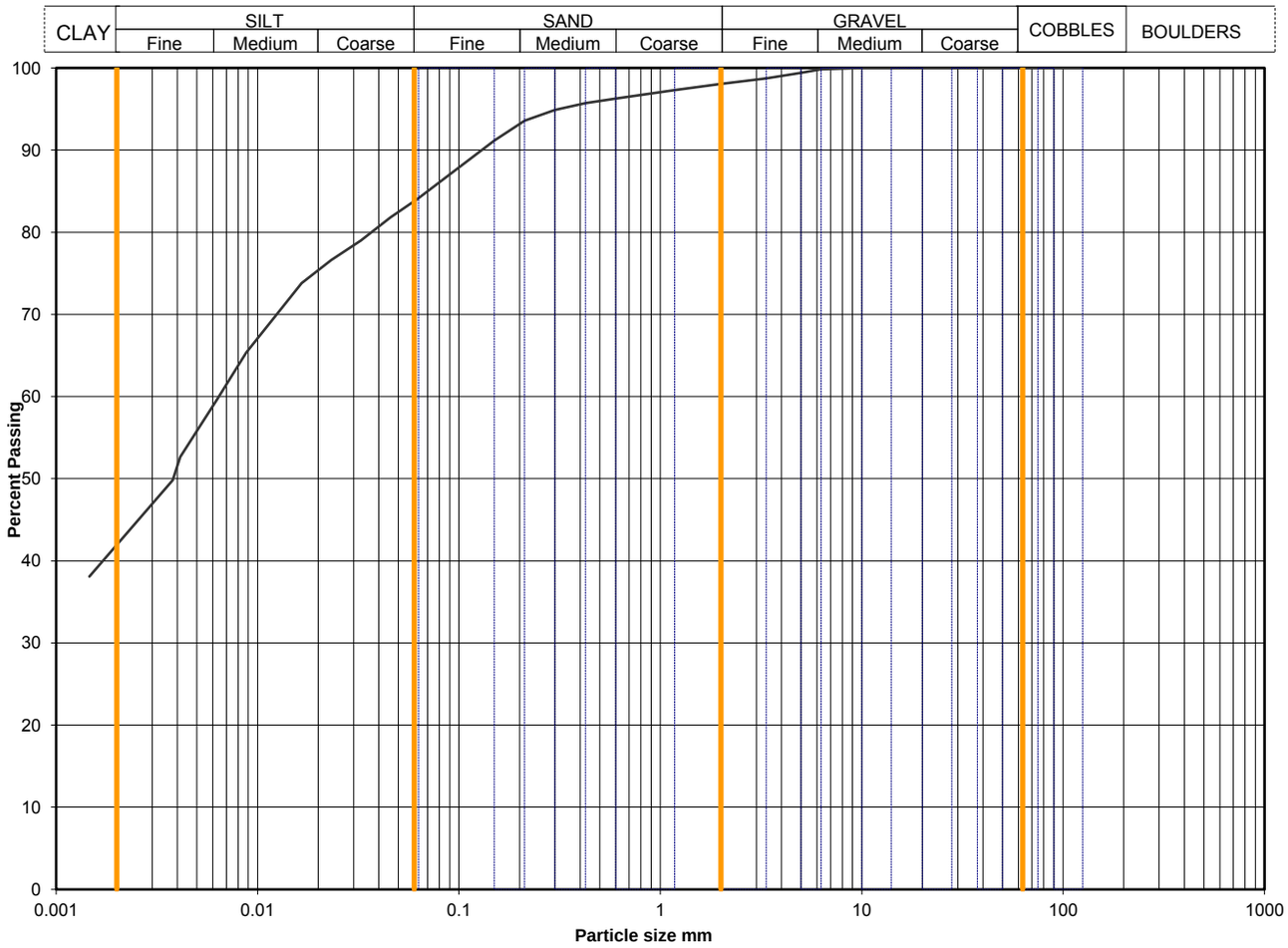
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	17	17
*<60mm values to aid description only	Silt	40	40
	Clay	38	38

Uniformity Coefficient	D60 / D10	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH402
		Sample Depth (m BGL)	20
	A7063-17/0-20170718081359	Sample Type and No	B38
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	84
90	100	0.0457	82
75	100	0.0326	79
63	100	0.0232	77
50	100	0.0166	74
37.5	100	0.0088	65
28	100	0.0063	60
20	100	0.0041	53
14	100	0.0038	50
10	100	0.0015	38
6.3	100		
5.0	99		
3.35	99		
2.00	98		
1.18	97		
0.600	96		
0.425	96	2.65 assumed	
0.300	95	Dry mass of sample, kg	
0.212	94		
0.150	91	0.4	
0.063	84		

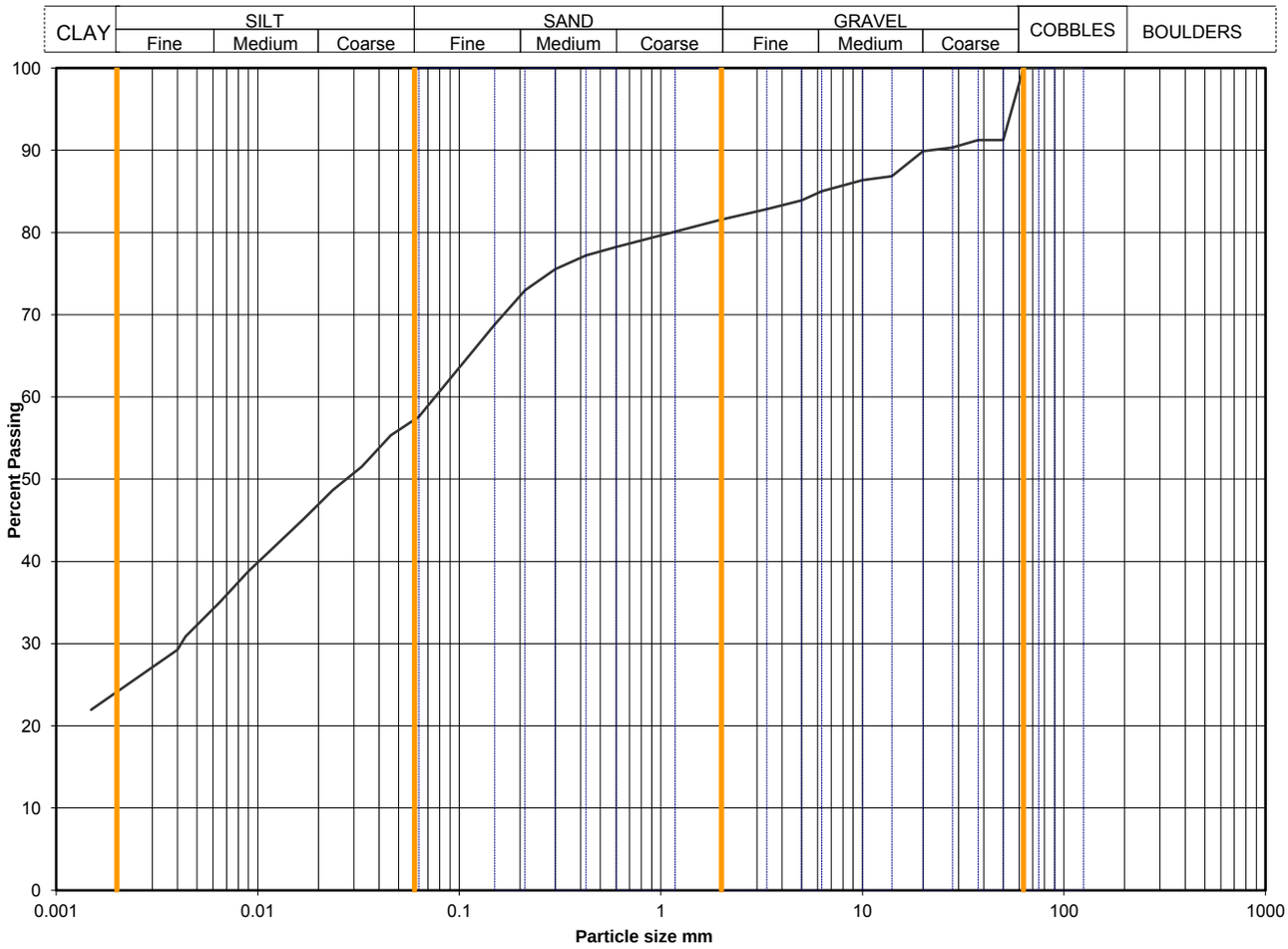
Soil description	Brown slightly sandy slightly gravelly silty CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	14	14
*<60mm values to aid description only	Silt	42	42
	Clay	42	42

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH403
		Sample Depth (m BGL)	5
	A7063-17/0-20170721011531	Sample Type and No	B13
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	58
90	100	0.0457	55
75	100	0.0329	52
63	100	0.0236	49
50	91	0.0169	45
37.5	91	0.0090	39
28	90	0.0065	35
20	90	0.0044	31
14	87	0.0040	29
10	86	0.0015	22
6.3	85		
5.0	84		
3.35	83		
2.00	82		
1.18	80		
0.600	78		
0.425	77	2.65 assumed	
0.300	76	Dry mass of sample, kg	
0.212	73		
0.150	69	4.3	
0.063	58		

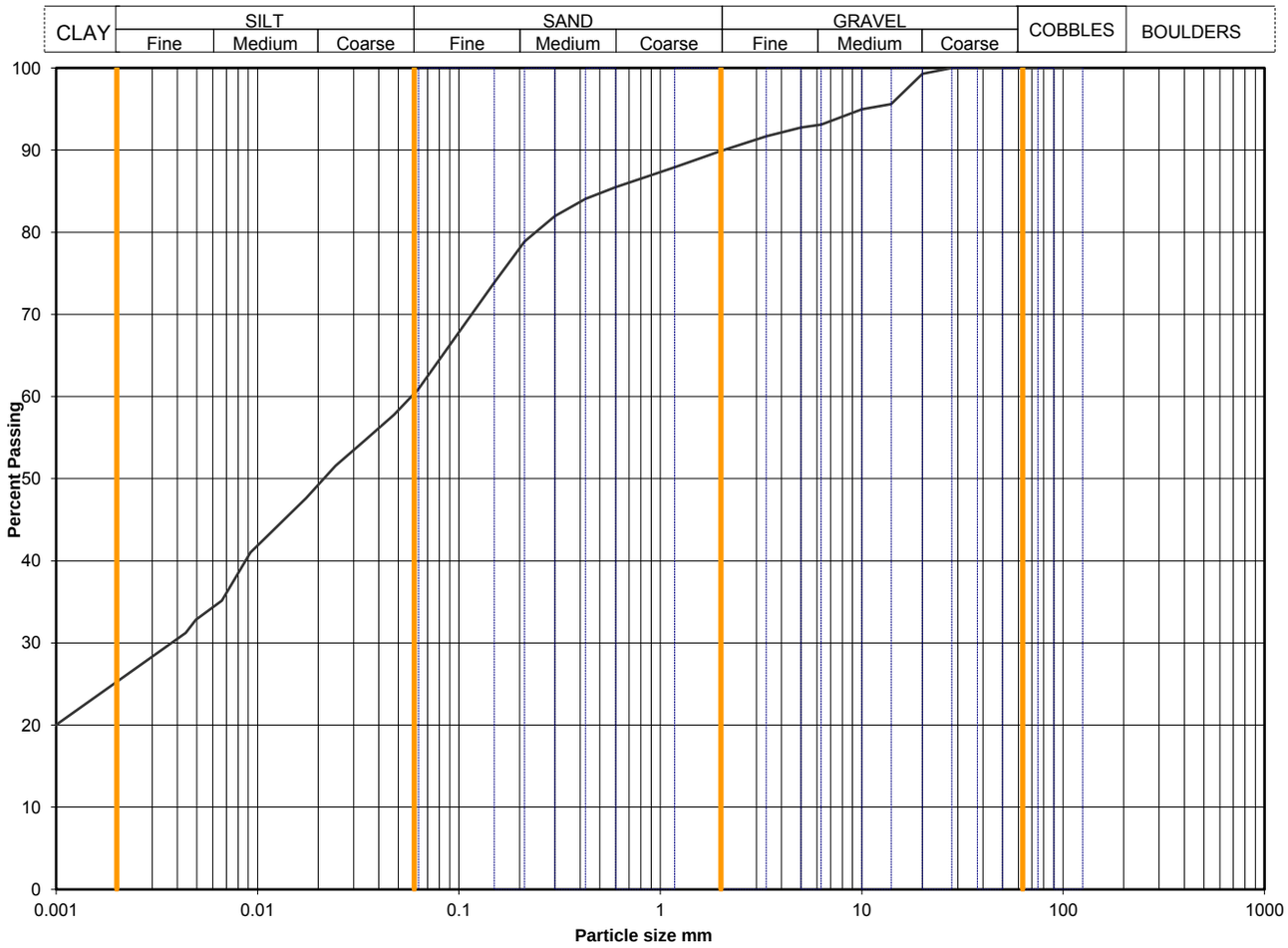
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	18	18
	Sand	24	24
*<60mm values to aid description only	Silt	33	33
	Clay	24	24

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH403
		Sample Depth (m BGL)	9
	A7063-17/0-20170721011853	Sample Type and No	B21
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	61
90	100	0.0477	58
75	100	0.0341	55
63	100	0.0244	52
50	100	0.0175	48
37.5	100	0.0092	41
28	100	0.0066	35
20	99	0.0049	33
14	96	0.0044	31
10	95	0.0008	19
6.3	93		
5.0	93		
3.35	92		
2.00	90		
1.18	88		
0.600	85		
0.425	84	2.65 assumed	
0.300	82	Dry mass of sample, kg	
0.212	79		
0.150	74	8.7	
0.063	61		

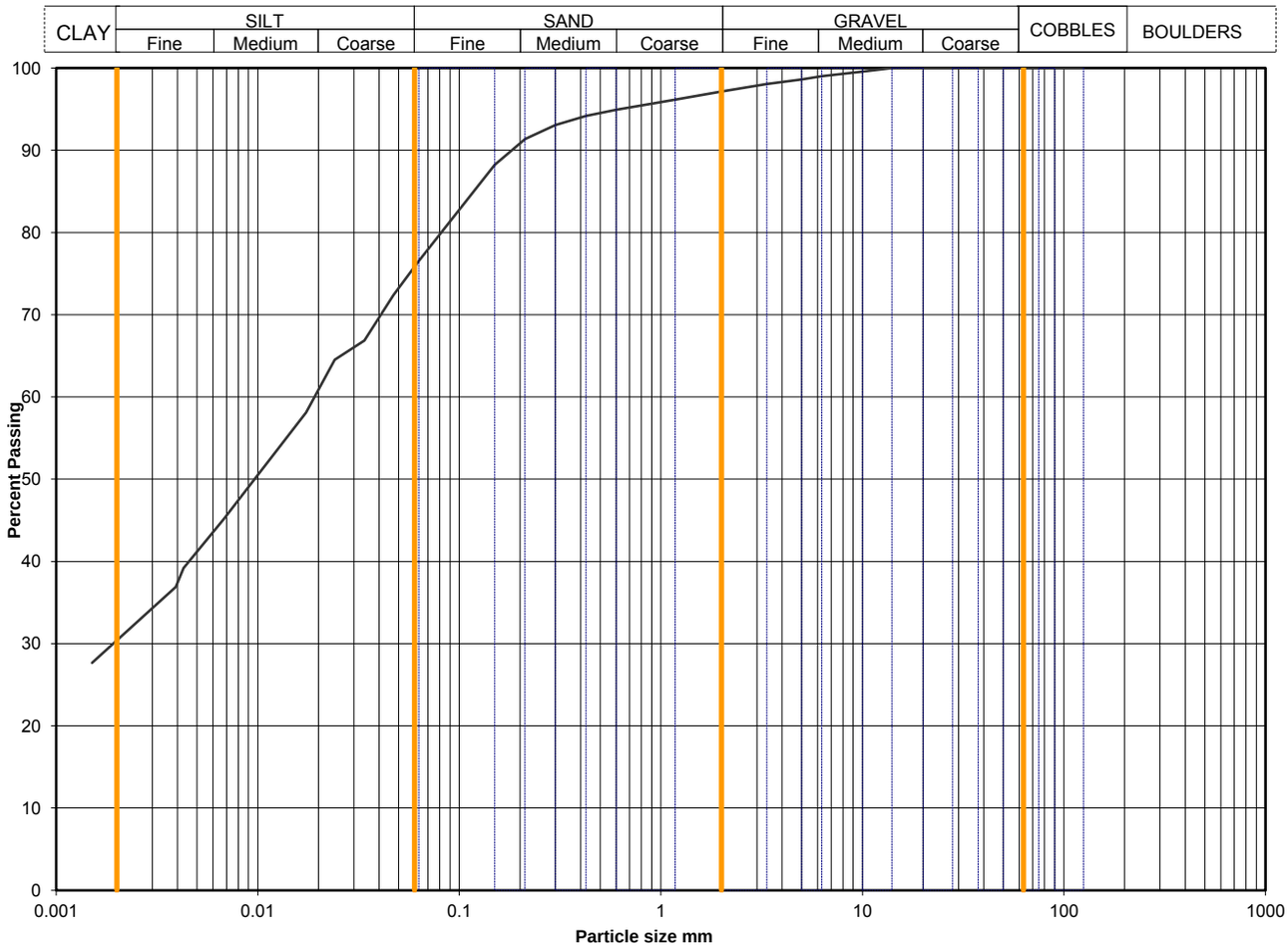
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	10	10
	Sand	29	29
*<60mm values to aid description only	Silt	36	36
	Clay	25	25

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH403
		Sample Depth (m BGL)	19
	A7063-17/0-20170724034837	Sample Type and No	B41
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	77
90	100	0.0471	72
75	100	0.0338	67
63	100	0.0241	65
50	100	0.0174	58
37.5	100	0.0092	49
28	100	0.0068	45
20	100	0.0043	39
14	100	0.0039	37
10	100	0.0015	28
6.3	99		
5.0	99		
3.35	98		
2.00	97		
1.18	96		
0.600	95		
0.425	94	2.65 assumed	
0.300	93	Dry mass of sample, kg	
0.212	91		
0.150	88	7.7	
0.063	77		

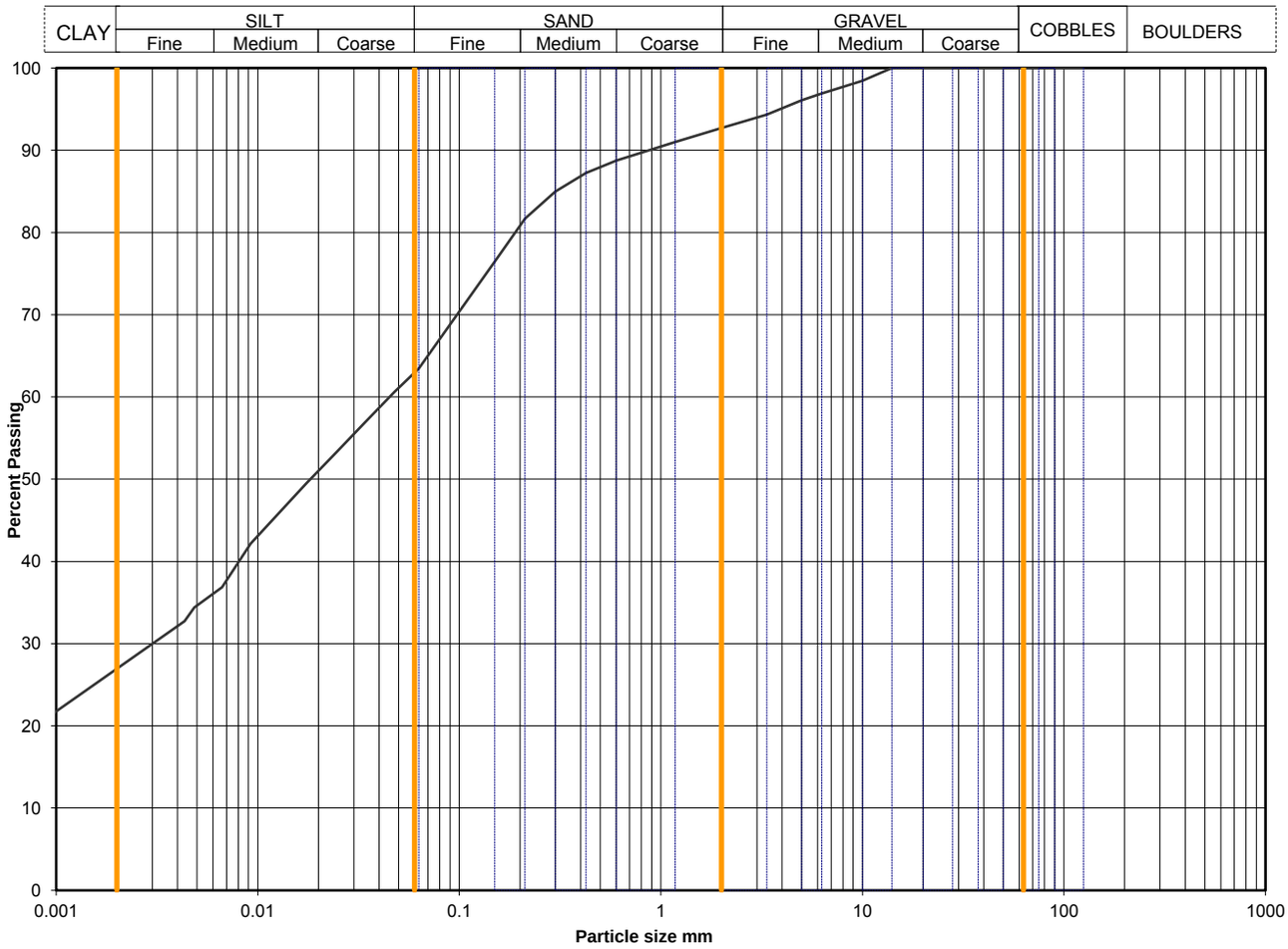
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	21	21
*<60mm values to aid description only	Silt	46	46
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH404
		Sample Depth (m BGL)	3
	A7063-17/0-20170719063432	Sample Type and No	B9
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	63
90	100	0.0477	61
75	100	0.0341	57
63	100	0.0244	53
50	100	0.0175	50
37.5	100	0.0092	42
28	100	0.0066	37
20	100	0.0049	34
14	100	0.0043	33
10	98	0.0008	20
6.3	97		
5.0	96		
3.35	94		
2.00	93		
1.18	91		
0.600	89		
0.425	87	2.65 assumed	
0.300	85	Dry mass of sample, kg	
0.212	82		
0.150	76	6.3	
0.063	63		

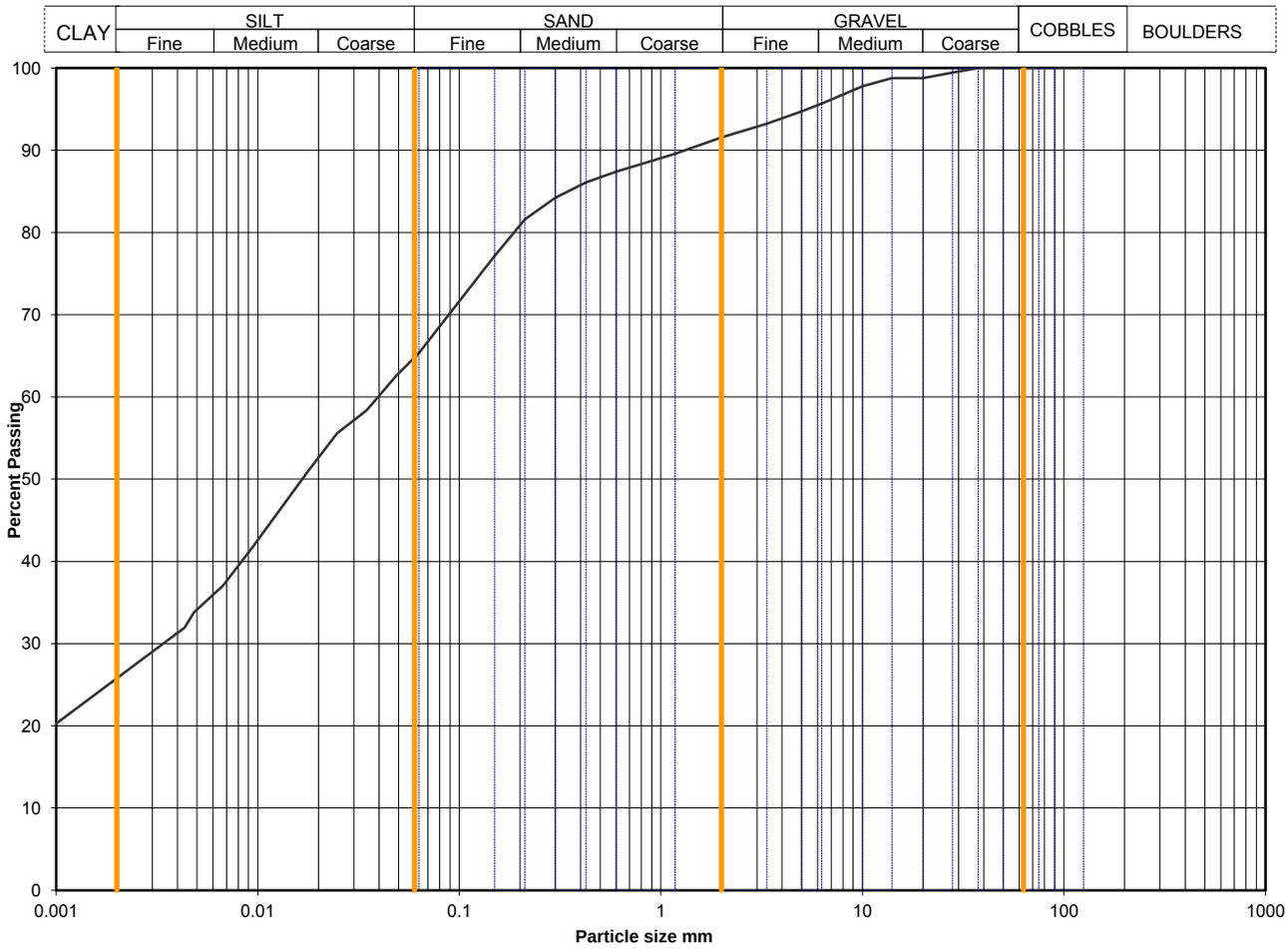
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	29	29
*<60mm values to aid description only	Silt	37	37
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH404
		Sample Depth (m BGL)	7
	A7063-17/0-20170719064503	Sample Type and No	B17
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	65
90	100	0.0485	63
75	100	0.0347	58
63	100	0.0248	56
50	100	0.0177	51
37.5	100	0.0094	42
28	99	0.0067	37
20	99	0.0048	34
14	99	0.0043	32
10	98	0.0008	19
6.3	96		
5.0	95		
3.35	93		
2.00	92		
1.18	90		
0.600	87		
0.425	86	2.65 assumed	
0.300	84	Dry mass of sample, kg	
0.212	82		
0.150	77	8.0	
0.063	65		

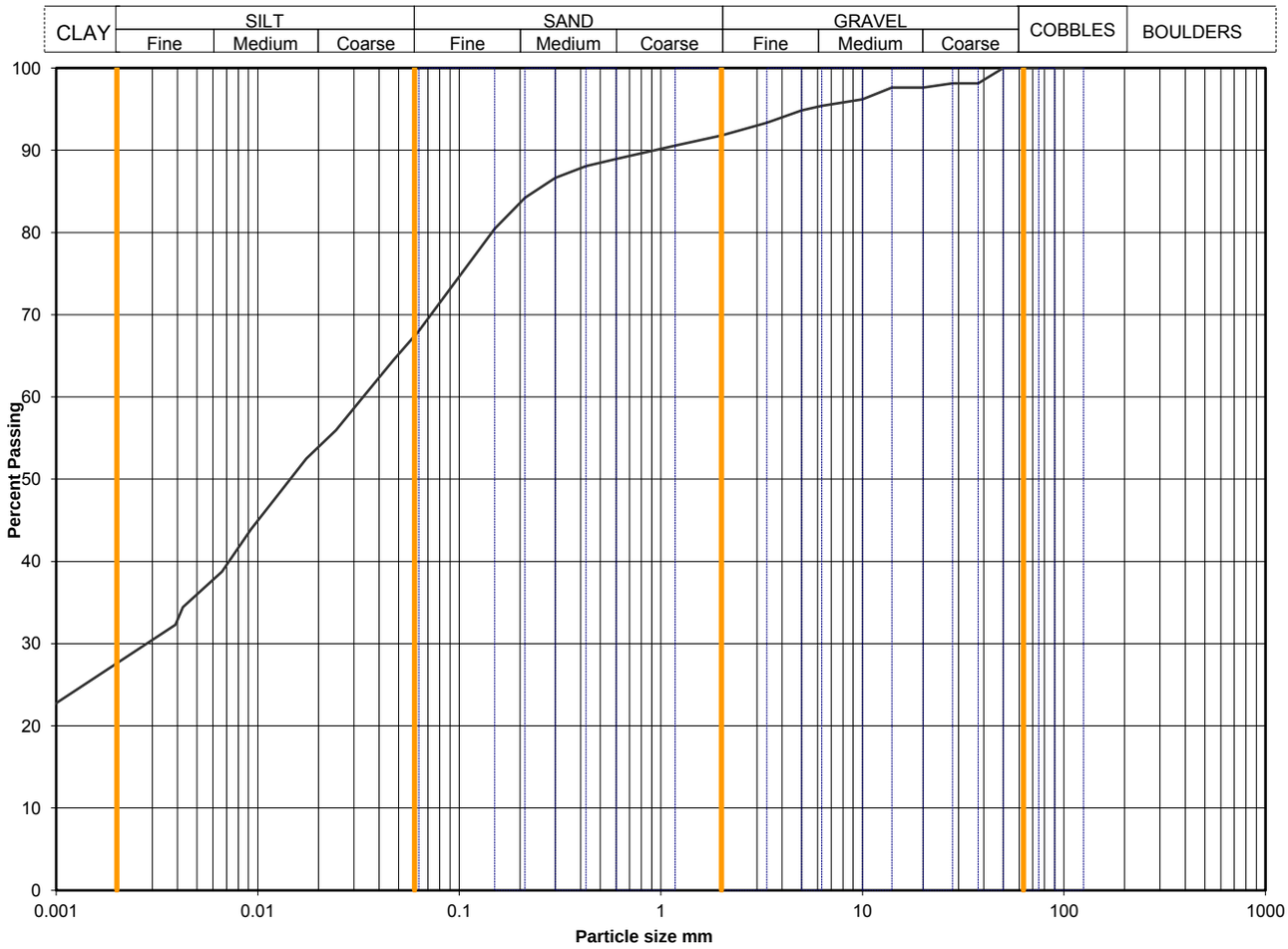
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	26	26
*<60mm values to aid description only	Silt	40	40
	Clay	26	26

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH404
		Sample Depth (m BGL)	13
	A7063-17/0-20170719065552	Sample Type and No	B29
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	68
90	100	0.0475	65
75	100	0.0341	60
63	100	0.0244	56
50	100	0.0175	53
37.5	98	0.0093	44
28	98	0.0066	39
20	98	0.0043	34
14	98	0.0039	32
10	96	0.0008	22
6.3	95		
5.0	95		
3.35	93		
2.00	92		
1.18	91		
0.600	89		
0.425	88	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	84		
0.150	80	9.1	
0.063	68		

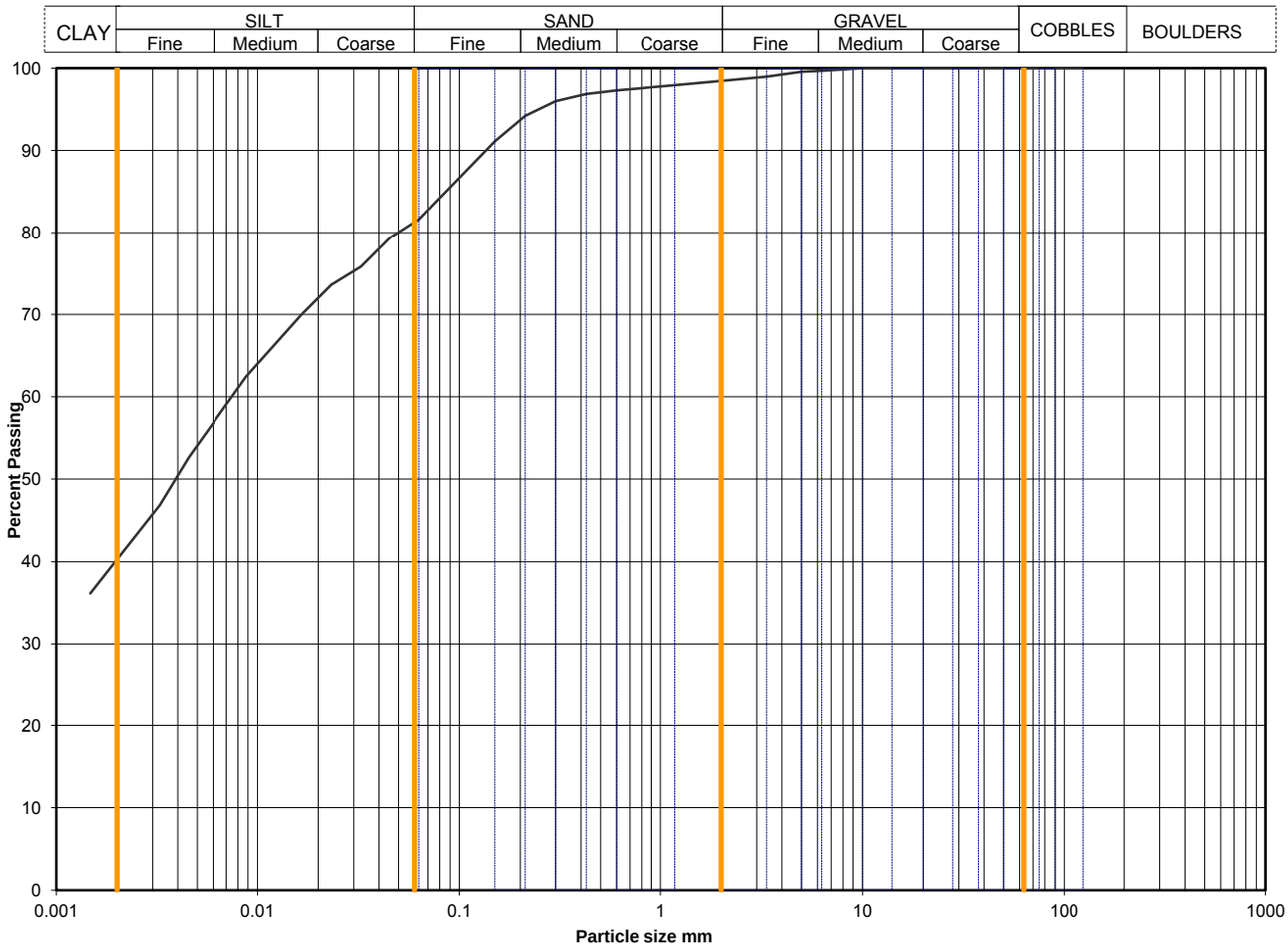
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	24	24
*<60mm values to aid description only	Silt	40	40
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH404
		Sample Depth (m BGL)	19
	A7063-17/0-20170720010504	Sample Type and No	B41
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	82
90	100	0.0456	79
75	100	0.0326	76
63	100	0.0232	74
50	100	0.0166	70
37.5	100	0.0088	62
28	100	0.0045	53
20	100	0.0033	47
14	100	0.0015	36
10	100		
6.3	100		
5.0	100		
3.35	99		
2.00	98		
1.18	98		
0.600	97		
0.425	97	2.65 assumed	
0.300	96	Dry mass of sample, kg	
0.212	94		
0.150	91	9.3	
0.063	82		

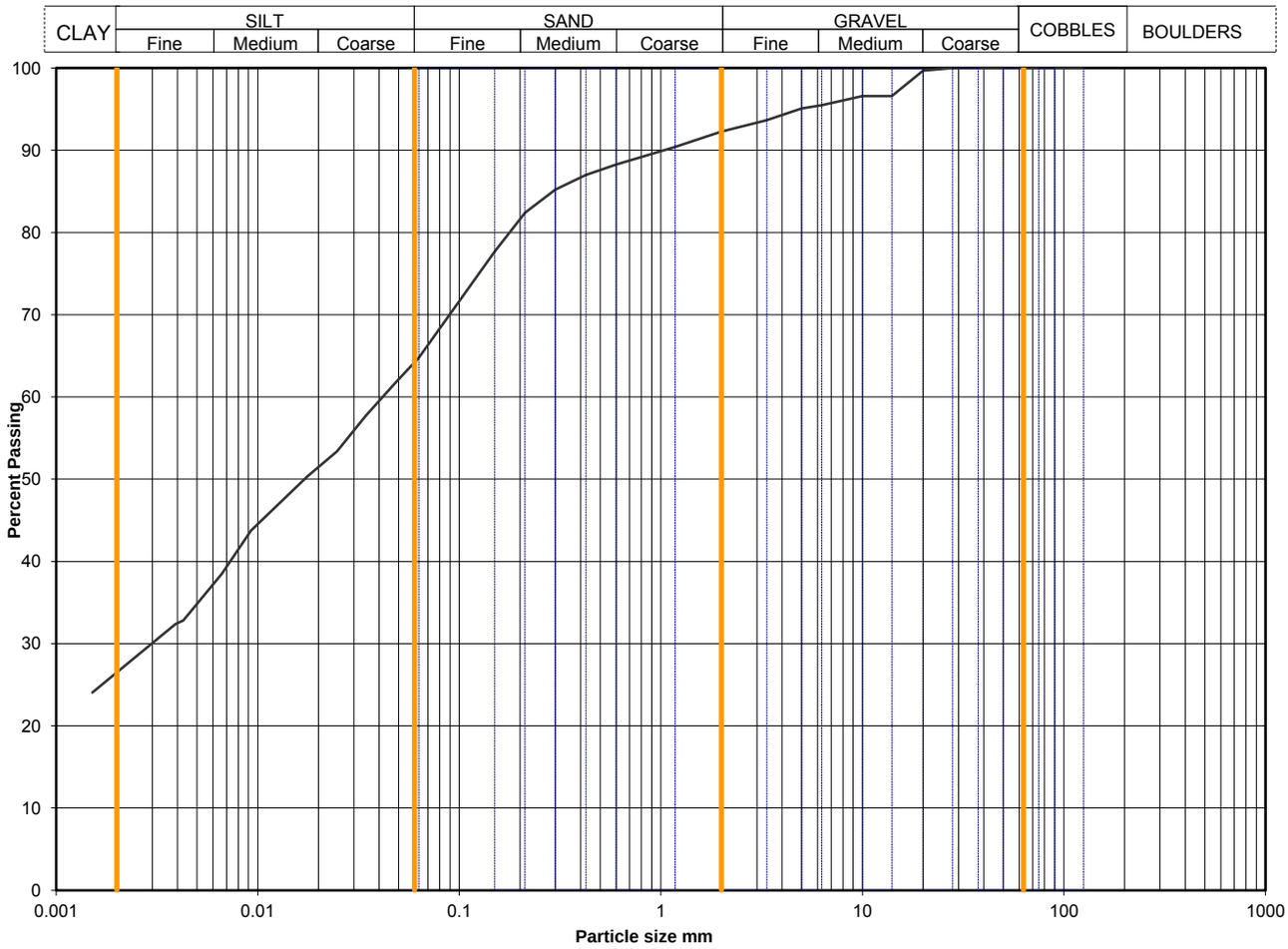
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	17	17
*<60mm values to aid description only	Silt	41	41
	Clay	40	40

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH405
		Sample Depth (m BGL)	1.2
	A7063-17/0-20170718113006	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	65
90	100	0.0481	62
75	100	0.0345	58
63	100	0.0247	53
50	100	0.0176	50
37.5	100	0.0093	44
28	100	0.0067	39
20	100	0.0043	33
14	97	0.0039	32
10	97	0.0015	24
6.3	96		
5.0	95		
3.35	94		
2.00	92		
1.18	90		
0.600	88		
0.425	87	2.65 assumed	
0.300	85	Dry mass of sample, kg	
0.212	82		
0.150	78	7.0	
0.063	65		

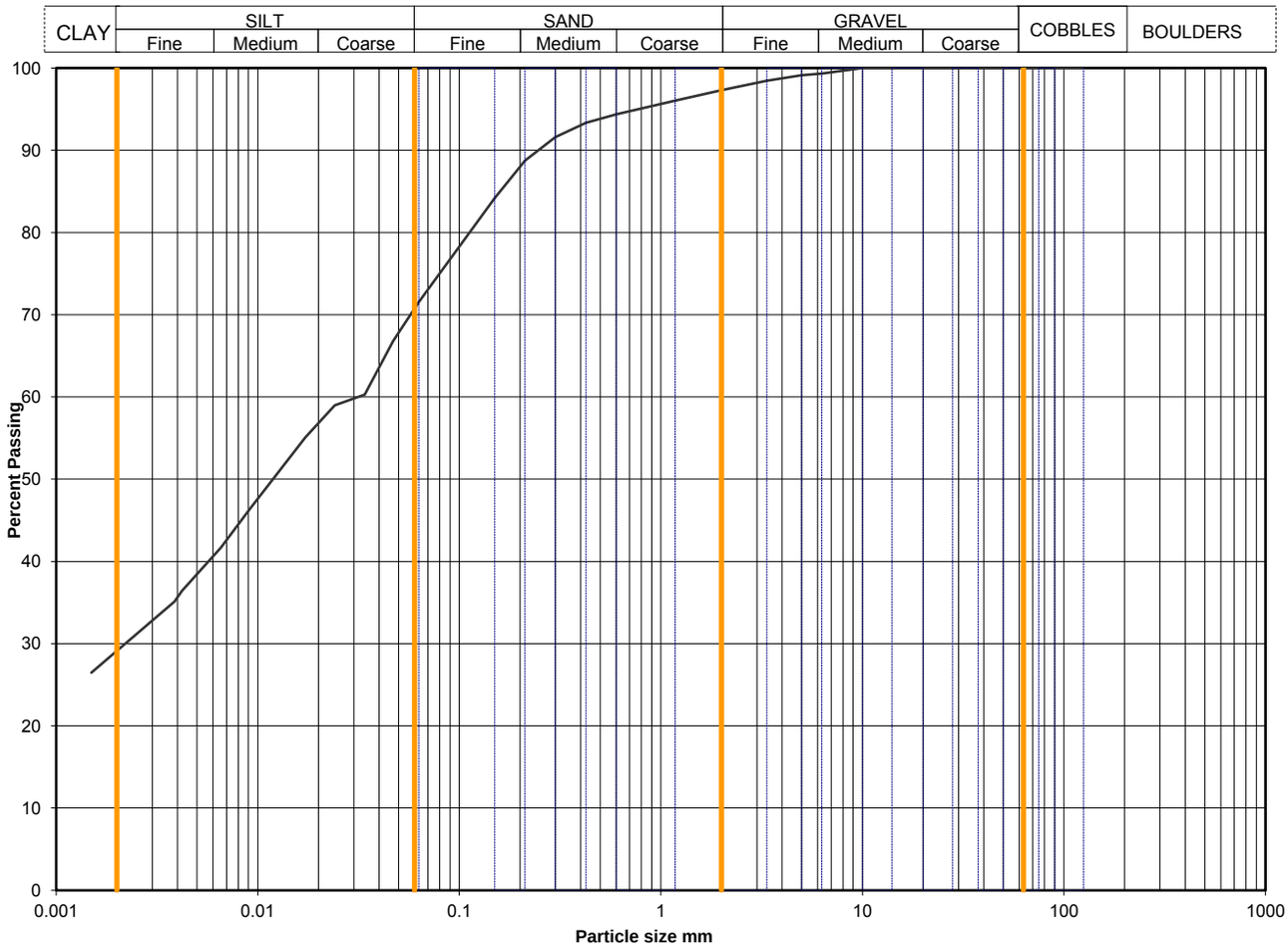
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	28	28
*<60mm values to aid description only	Silt	38	38
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH405
		Sample Depth (m BGL)	3
	A7063-17/0-20170718113304	Sample Type and No	B9
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0470	67
75	100	0.0339	60
63	100	0.0241	59
50	100	0.0173	55
37.5	100	0.0091	46
28	100	0.0066	42
20	100	0.0042	36
14	100	0.0039	35
10	100	0.0015	26
6.3	99		
5.0	99		
3.35	98		
2.00	97		
1.18	96		
0.600	94		
0.425	93	2.65 assumed	
0.300	92	Dry mass of sample, kg	
0.212	89		
0.150	84	1.1	
0.063	72		

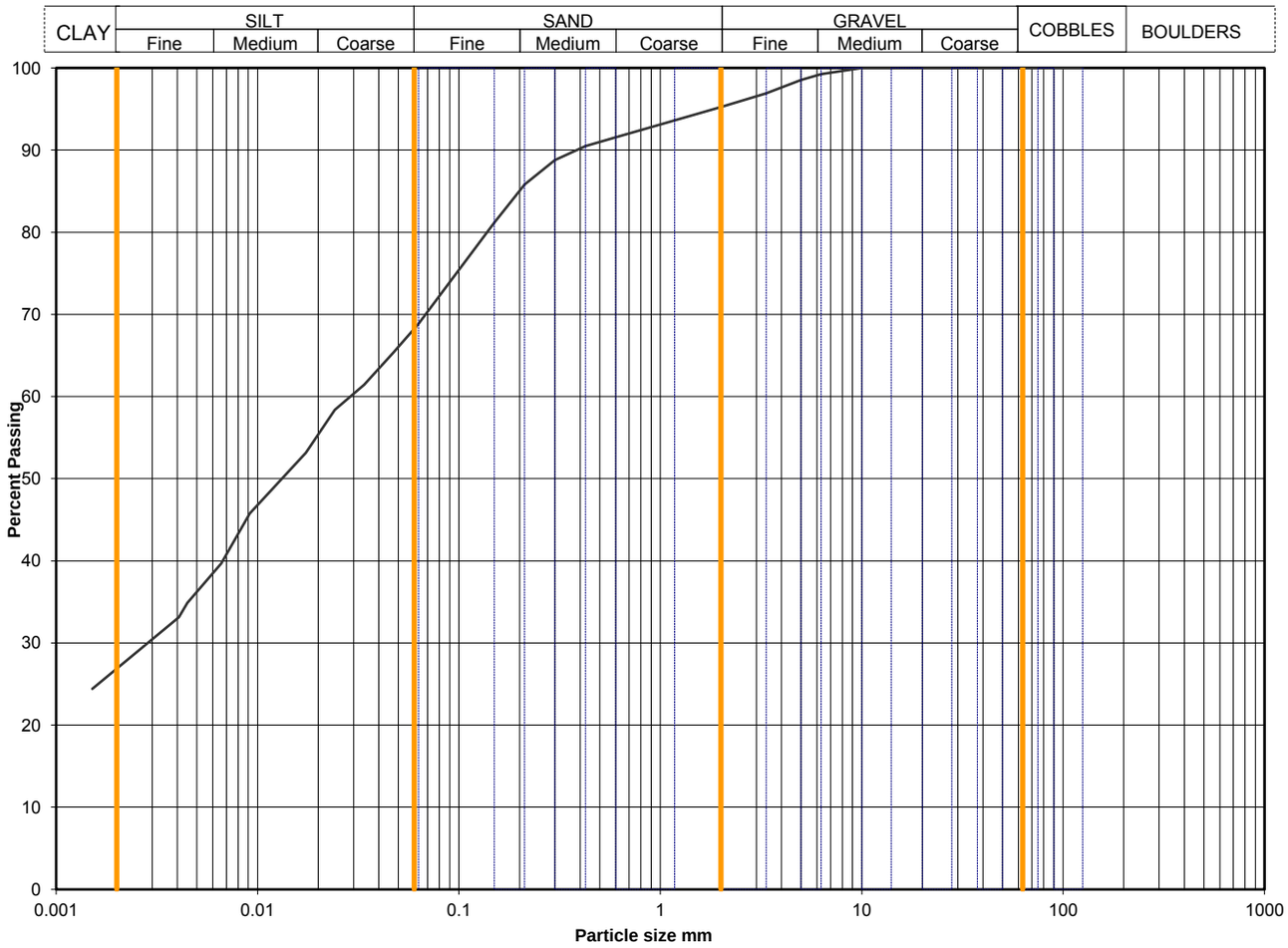
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	26	26
*<60mm values to aid description only	Silt	42	42
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH405
		Sample Depth (m BGL)	7
	A7063-17/0-20170718113545	Sample Type and No	B17
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	69
90	100	0.0473	65
75	100	0.0338	61
63	100	0.0242	58
50	100	0.0174	53
37.5	100	0.0092	46
28	100	0.0066	40
20	100	0.0045	35
14	100	0.0041	33
10	100	0.0015	24
6.3	99		
5.0	99		
3.35	97		
2.00	95		
1.18	94		
0.600	92		
0.425	90	2.65	
0.300	89	Dry mass of sample, kg	
0.212	86		
0.150	81	1.0	
0.063	69		

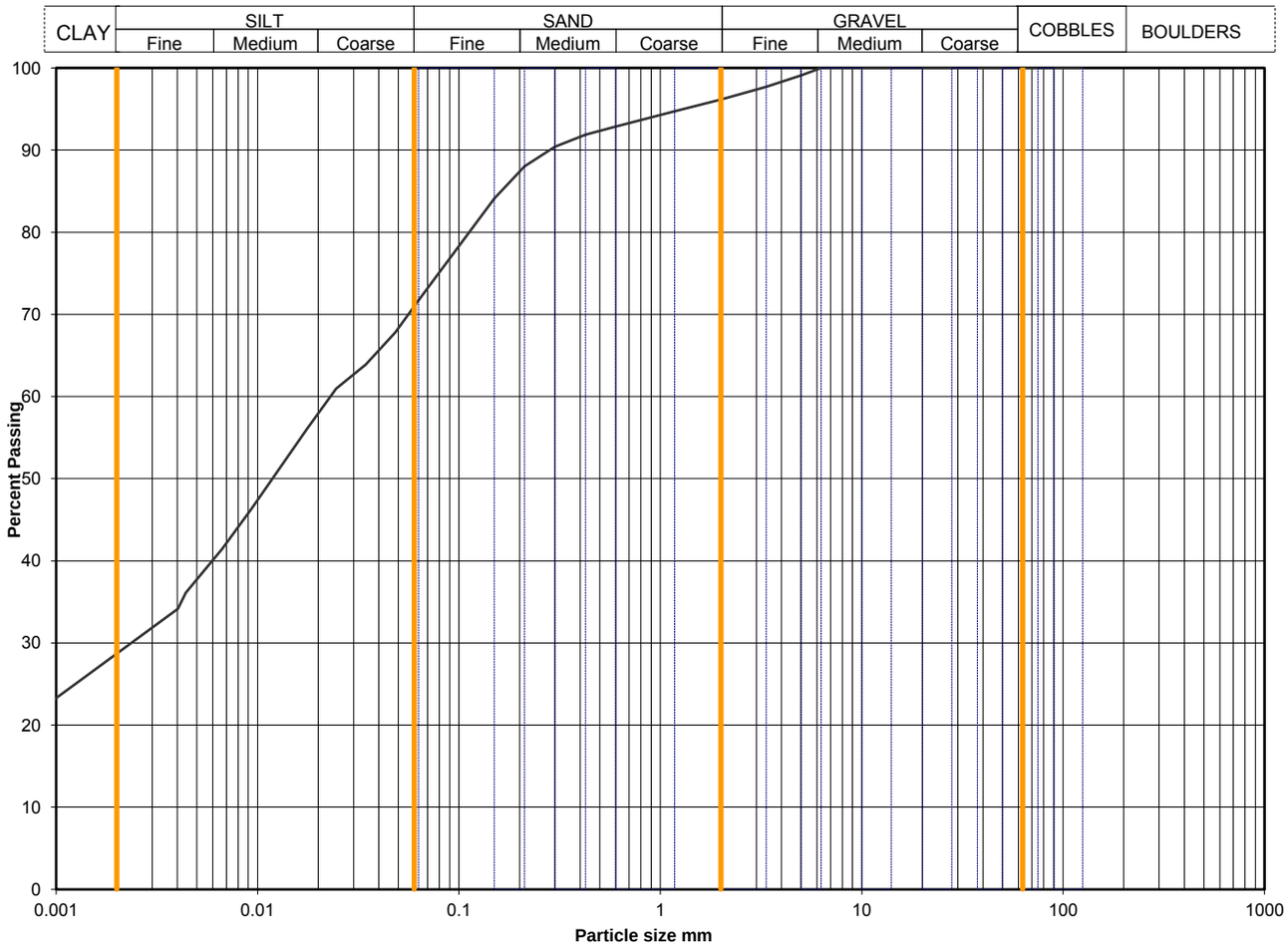
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	26	26
*<60mm values to aid description only	Silt	42	42
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH405
		Sample Depth (m BGL)	13
	A7063-17/0-20170718051846	Sample Type and No	B29
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0483	68
75	100	0.0345	64
63	100	0.0246	61
50	100	0.0176	56
37.5	100	0.0093	46
28	100	0.0067	41
20	100	0.0044	36
14	100	0.0040	34
10	100	0.0008	22
6.3	100		
5.0	99		
3.35	98		
2.00	96		
1.18	95		
0.600	93		
0.425	92	2.65	
0.300	90	Dry mass of sample, kg	
0.212	88		
0.150	84	1.0	
0.063	72		

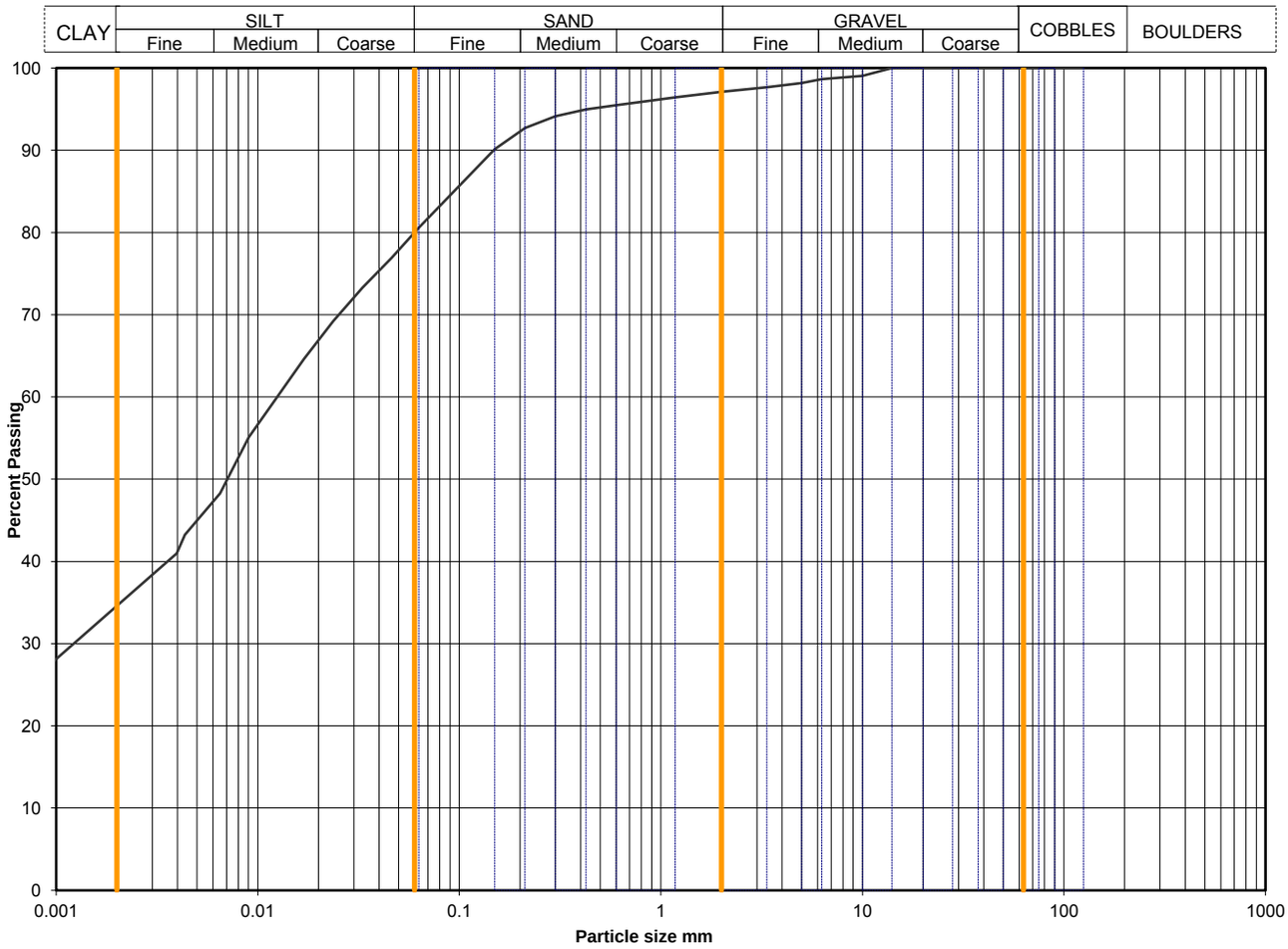
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	24	24
*<60mm values to aid description only	Silt	43	43
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH405
		Sample Depth (m BGL)	19
	A7063-17/0-20170718053711	Sample Type and No	B41
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	81
90	100	0.0462	77
75	100	0.0331	73
63	100	0.0237	69
50	100	0.0170	65
37.5	100	0.0090	55
28	100	0.0065	48
20	100	0.0044	43
14	100	0.0040	41
10	99	0.0008	26
6.3	99		
5.0	98		
3.35	98		
2.00	97		
1.18	96		
0.600	95		
0.425	95	2.65 assumed	
0.300	94	Dry mass of sample, kg	
0.212	93		
0.150	90	8.2	
0.063	81		

Soil description	Brownish grey slightly sandy slightly gravelly CLAY.
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377
Remarks	

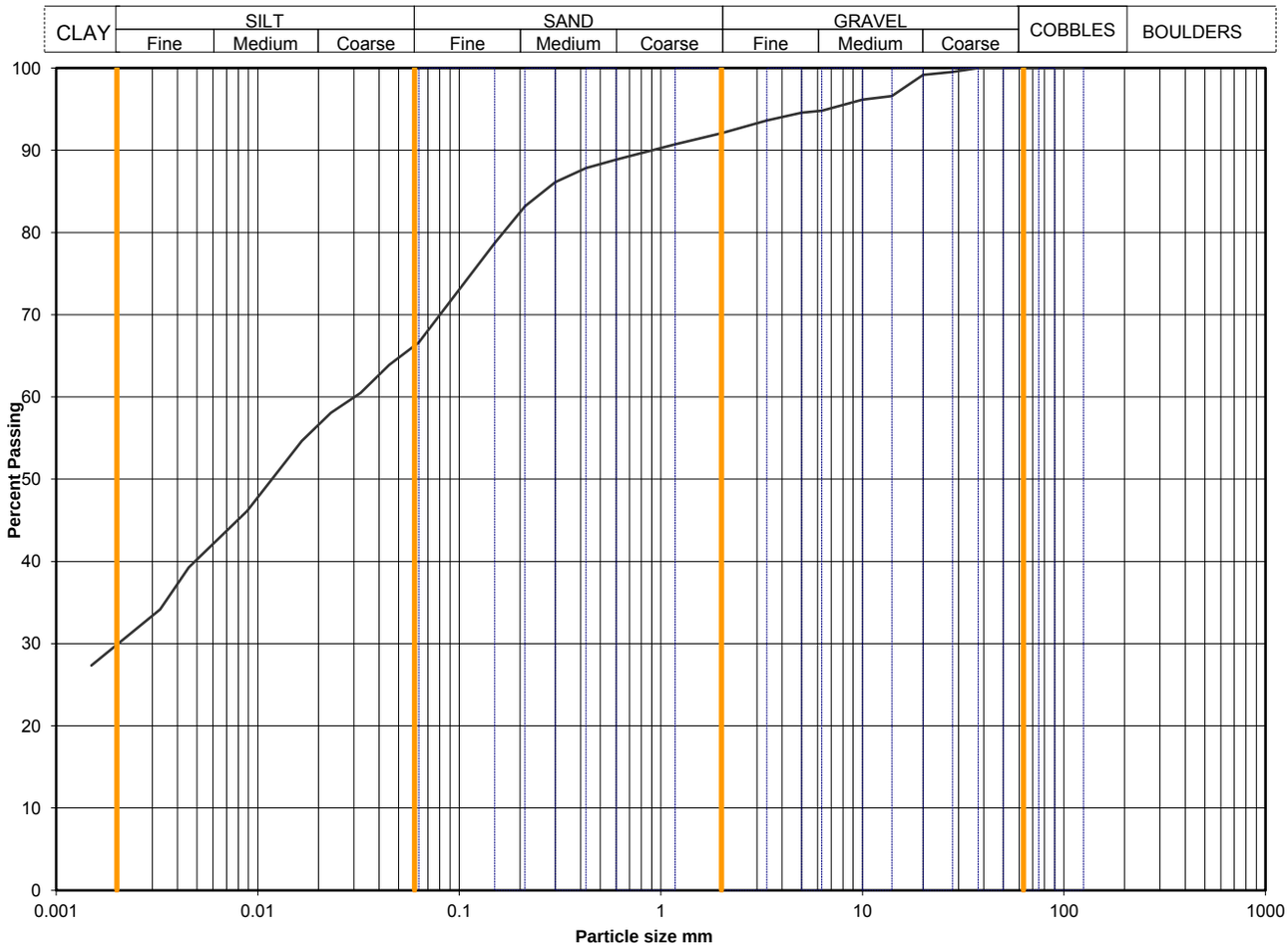
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	17	17
*<60mm values to aid description only	Silt	46	46
	Clay	35	35

Uniformity Coefficient	D60 / D10	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH406
		Sample Depth (m BGL)	3
	A7063-1720170802122742	Sample Type and No	B9
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	67
90	100	0.0449	64
75	100	0.0323	60
63	100	0.0231	58
50	100	0.0166	55
37.5	100	0.0089	46
28	100	0.0046	39
20	99	0.0033	34
14	97	0.0015	27
10	96		
6.3	95		
5.0	95		
3.35	94		
2.00	92		
1.18	91		
0.600	89		
0.425	88	2.65 assumed	
0.300	86	Dry mass of sample, kg	
0.212	83		
0.150	79	8.0	
0.063	67		

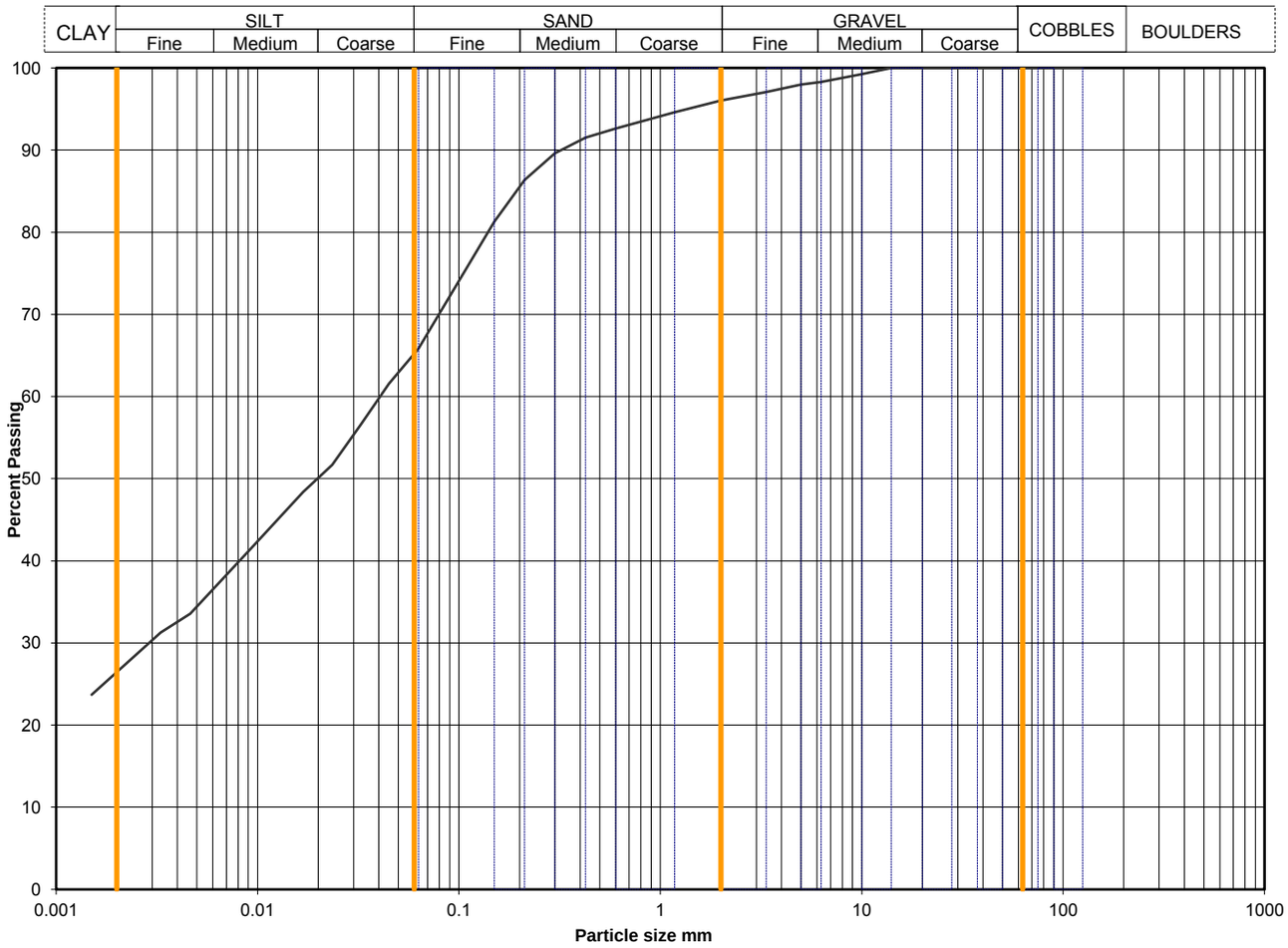
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	25	25
*<60mm values to aid description only	Silt	37	37
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH406
		Sample Depth (m BGL)	7
	A7063-1720170802123026	Sample Type and No	B17
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	66
90	100	0.0449	62
75	100	0.0325	57
63	100	0.0235	52
50	100	0.0169	48
37.5	100	0.0090	41
28	100	0.0046	34
20	100	0.0033	31
14	100	0.0015	24
10	99		
6.3	98		
5.0	98		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	92	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	86		
0.150	81	6.5	
0.063	66		

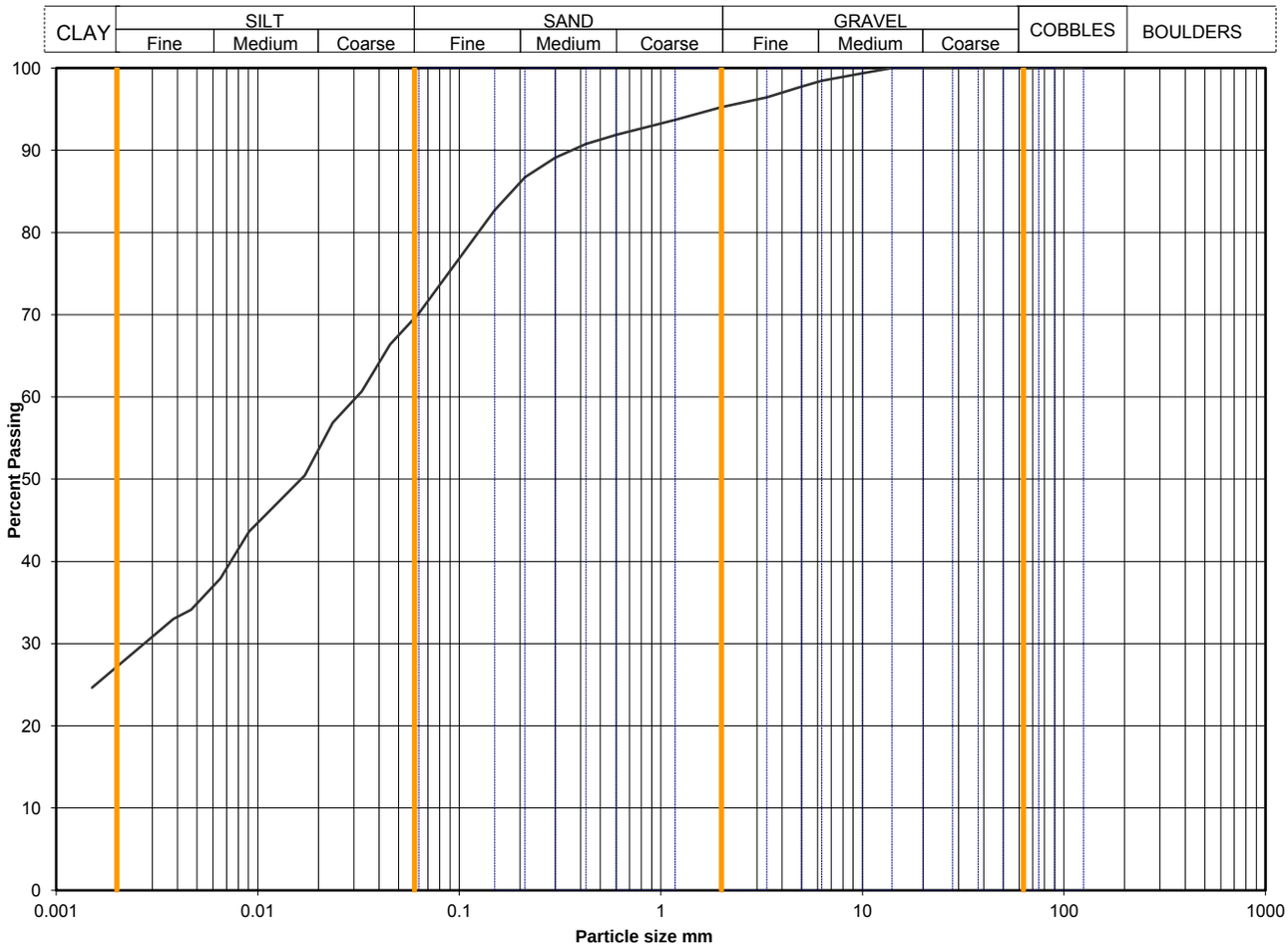
Soil description	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	30	30
*<60mm values to aid description only	Silt	39	39
	Clay	26	26

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH406
		Sample Depth (m BGL)	11
	A7063-1720170802123501	Sample Type and No	B25
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0454	66
75	100	0.0329	61
63	100	0.0236	57
50	100	0.0171	50
37.5	100	0.0090	44
28	100	0.0065	38
20	100	0.0047	34
14	100	0.0038	33
10	99	0.0015	25
6.3	98		
5.0	98		
3.35	96		
2.00	95		
1.18	94		
0.600	92		
0.425	91	2.65 assumed	
0.300	89	Dry mass of sample, kg	
0.212	87		
0.150	83	7.0	
0.063	70		

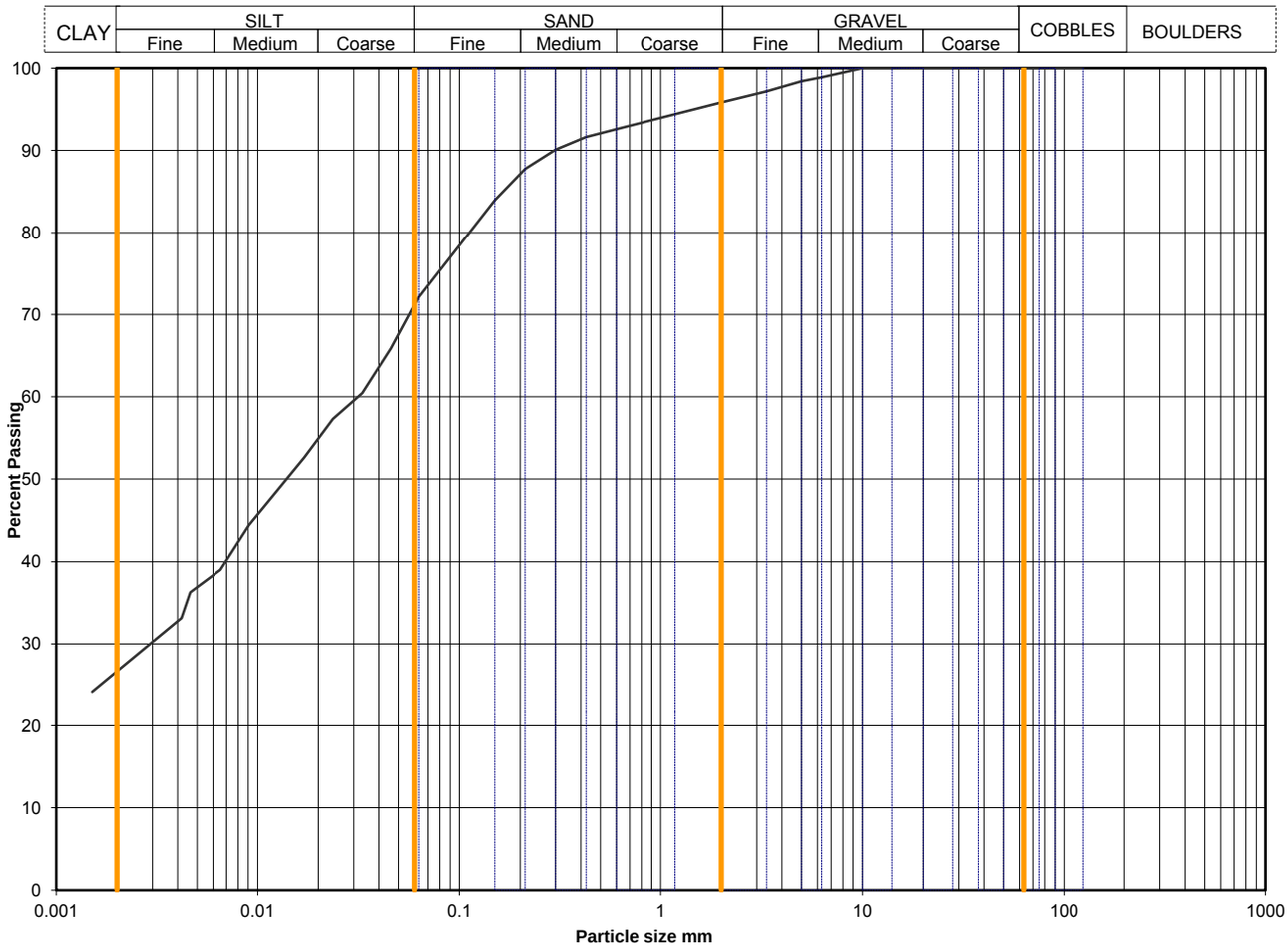
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	25	25
*<60mm values to aid description only	Silt	43	43
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH406
		Sample Depth (m BGL)	17
	A7063-1720170802123925	Sample Type and No	B37
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0459	66
75	100	0.0331	60
63	100	0.0237	57
50	100	0.0170	53
37.5	100	0.0091	44
28	100	0.0065	39
20	100	0.0046	36
14	100	0.0042	33
10	100	0.0015	24
6.3	99		
5.0	98		
3.35	97		
2.00	96		
1.18	94		
0.600	93		
0.425	92	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	88		
0.150	84	4.6	
0.063	72		

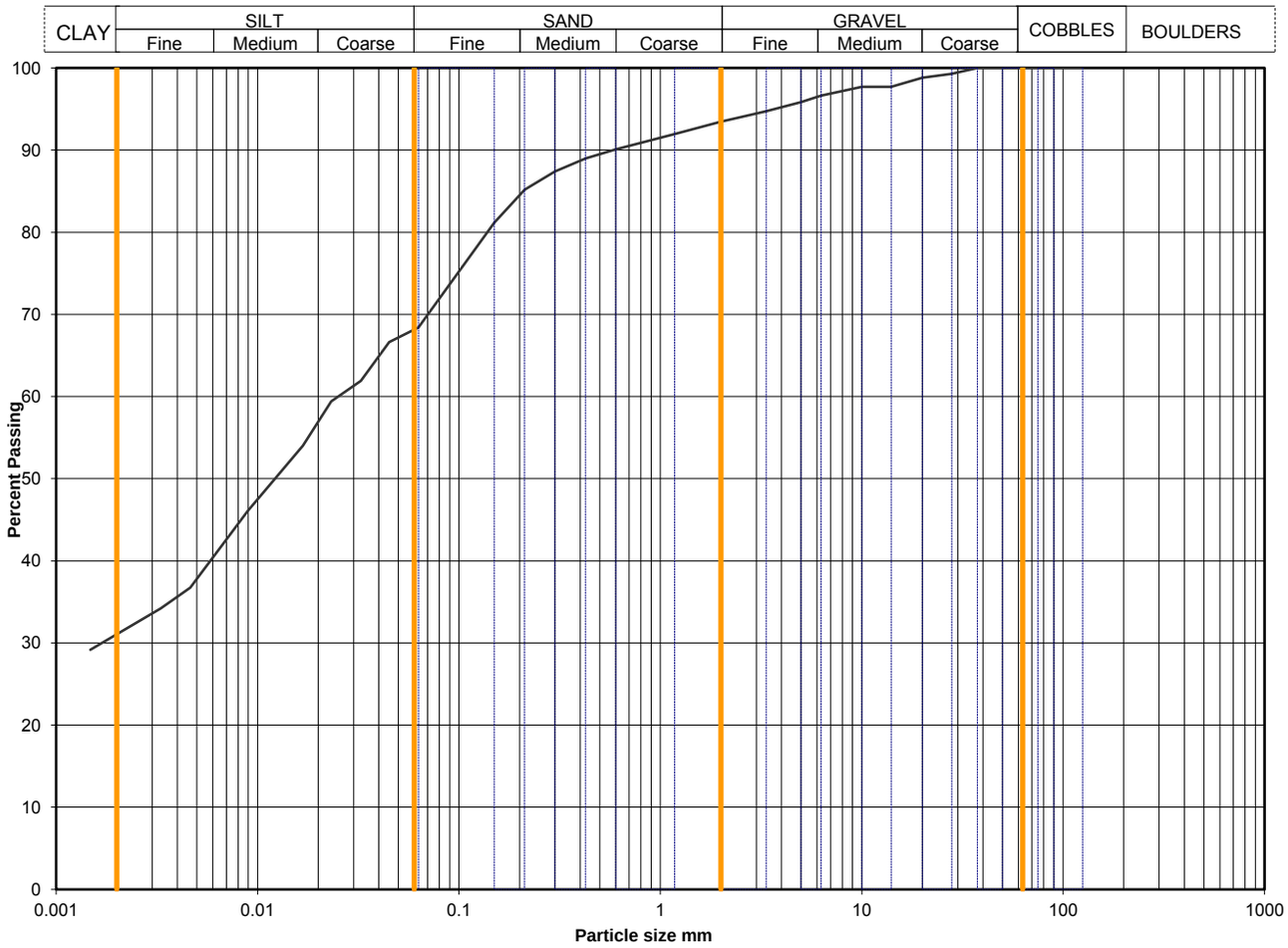
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	24	24
*<60mm values to aid description only	Silt	45	45
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH406
		Sample Depth (m BGL)	23
	A7063-1720170802124230	Sample Type and No	B49
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	68
90	100	0.0451	67
75	100	0.0325	62
63	100	0.0232	59
50	100	0.0168	54
37.5	100	0.0089	46
28	99	0.0046	37
20	99	0.0033	34
14	98	0.0015	29
10	98		
6.3	97		
5.0	96		
3.35	95		
2.00	93		
1.18	92		
0.600	90		
0.425	89	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	85		
0.150	81	10.5	
0.063	68		

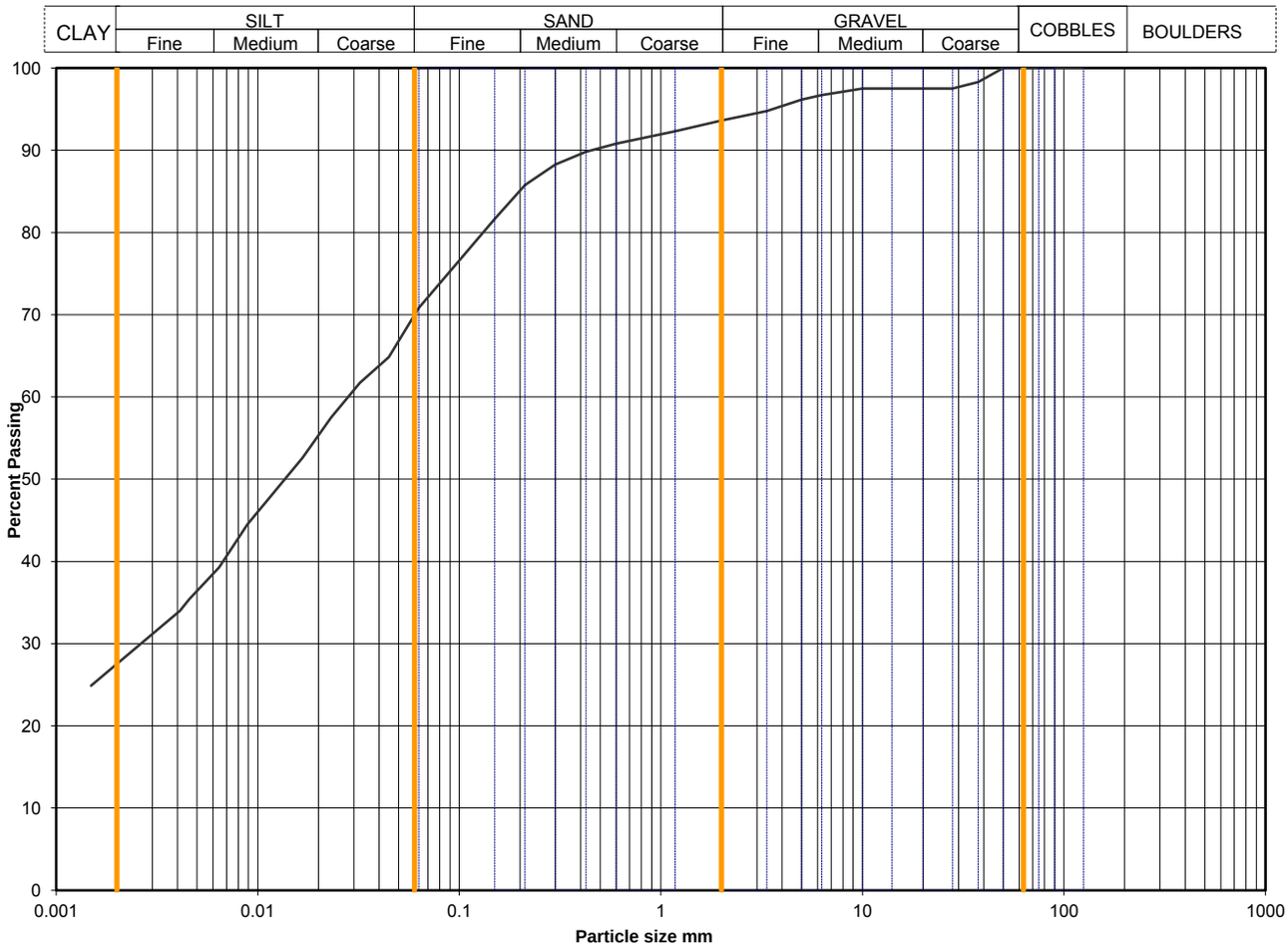
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	25	25
*<60mm values to aid description only	Silt	37	37
	Clay	31	31

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH407
		Sample Depth (m BGL)	1.2
	A7063-17/0-20170727075253	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	71
90	100	0.0447	65
75	100	0.0321	62
63	100	0.0231	57
50	100	0.0167	53
37.5	98	0.0089	45
28	97	0.0064	39
20	97	0.0046	35
14	97	0.0041	34
10	97	0.0015	25
6.3	97		
5.0	96		
3.35	95		
2.00	94		
1.18	92		
0.600	91		
0.425	90	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	86		
0.150	82	7.0	
0.063	71		

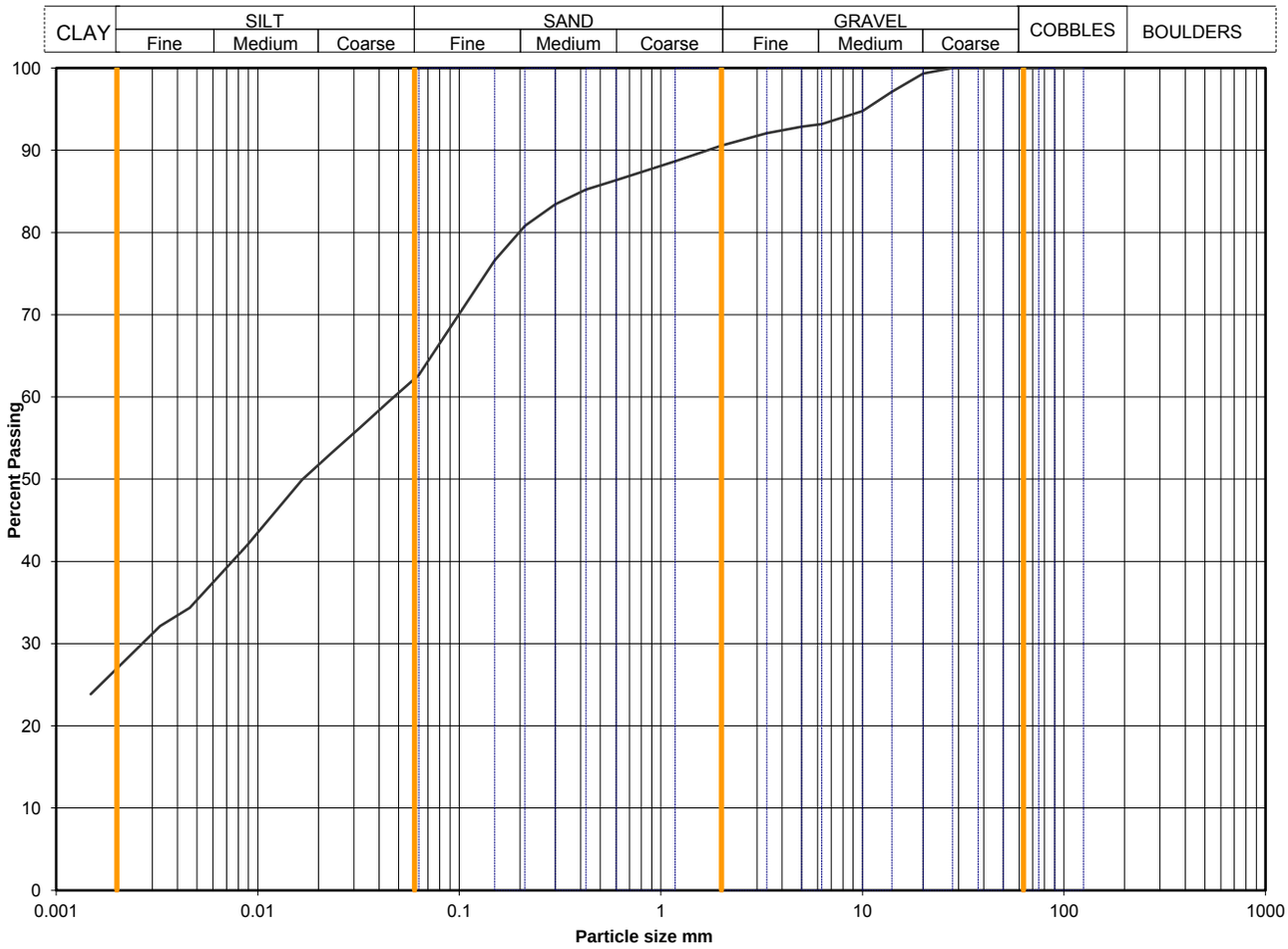
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	6	6
	Sand	23	23
*<60mm values to aid description only	Silt	43	43
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH407
		Sample Depth (m BGL)	5
	A7063-17/0-20170727075750	Sample Type and No	B13
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	63
90	100	0.0449	59
75	100	0.0323	56
63	100	0.0232	53
50	100	0.0166	50
37.5	100	0.0089	42
28	100	0.0046	34
20	99	0.0033	32
14	97	0.0015	24
10	95		
6.3	93		
5.0	93		
3.35	92		
2.00	91		
1.18	89		
0.600	86		
0.425	85	2.65	assumed
0.300	83	Dry mass of sample, kg	
0.212	81		
0.150	77	6.2	
0.063	63		

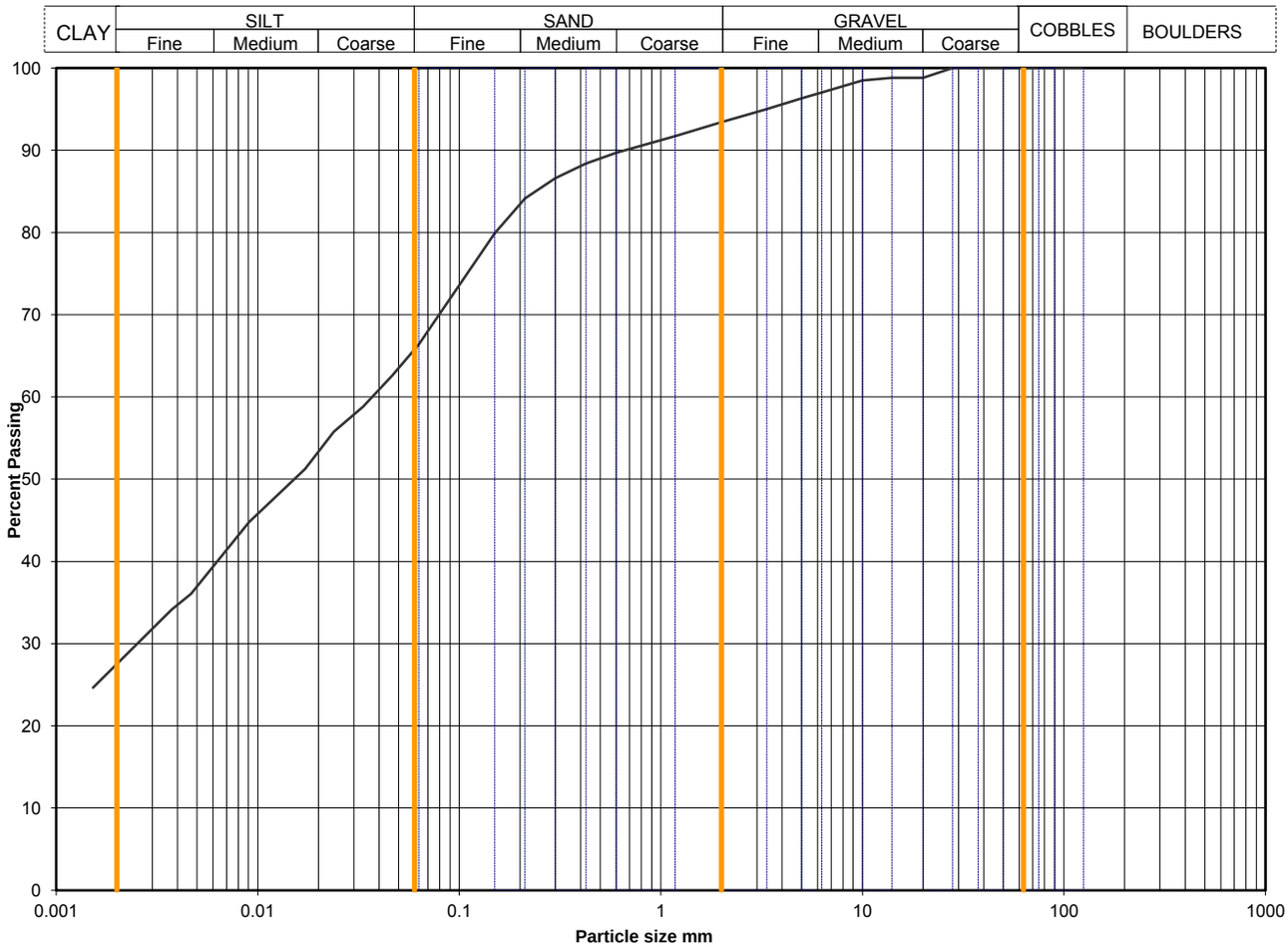
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	9	9
	Sand	28	28
*<60mm values to aid description only	Silt	36	36
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH407
		Sample Depth (m BGL)	9
	A7063-17/0-20170727080720	Sample Type and No	B21
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	66
90	100	0.0465	63
75	100	0.0334	59
63	100	0.0239	56
50	100	0.0172	51
37.5	100	0.0091	45
28	100	0.0047	36
20	99	0.0038	34
14	99	0.0015	25
10	98		
6.3	97		
5.0	96		
3.35	95		
2.00	93		
1.18	92		
0.600	90		
0.425	88	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	84		
0.150	80	7.4	
0.063	66		

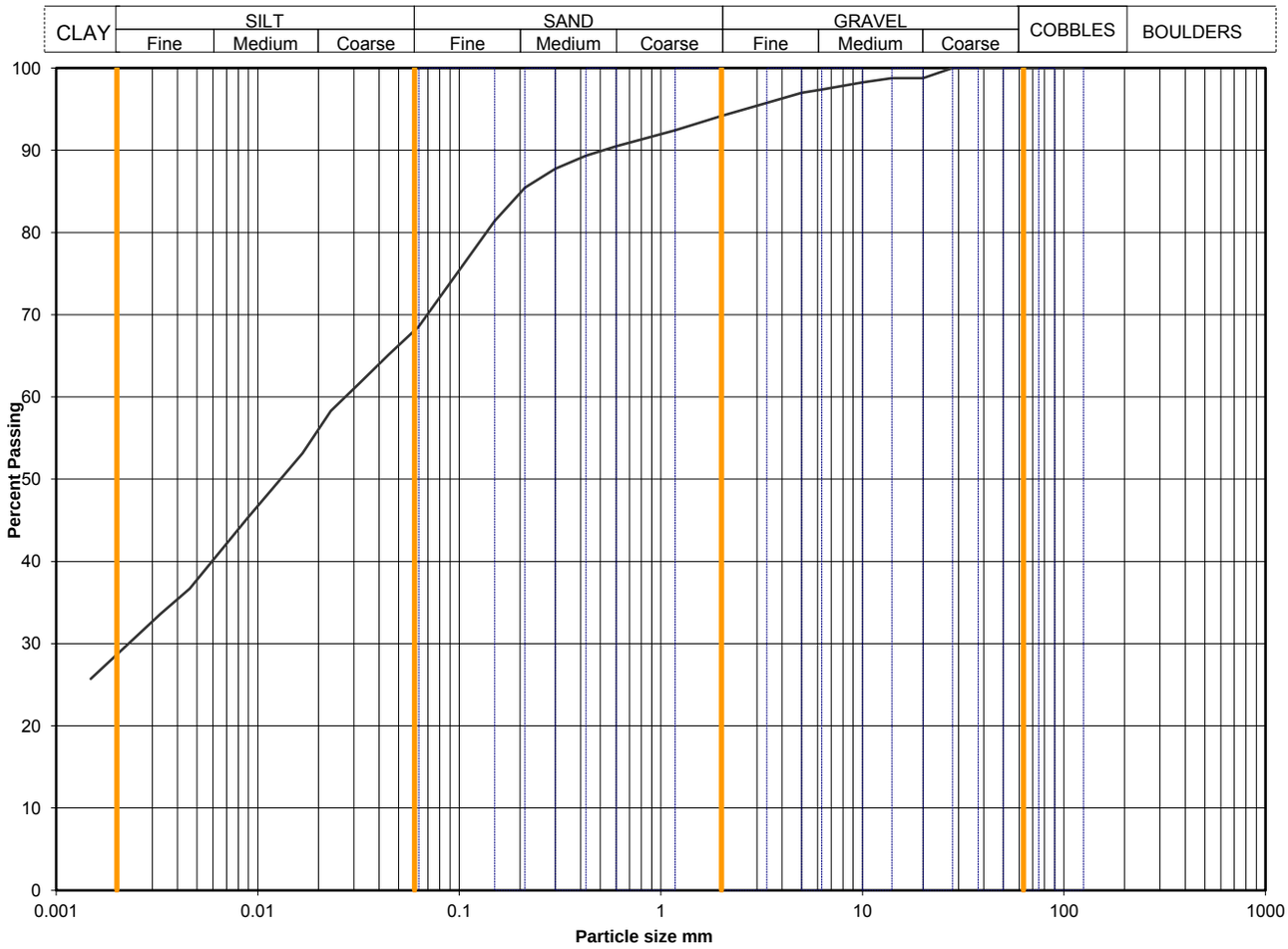
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	27	27
*<60mm values to aid description only	Silt	39	39
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH407
		Sample Depth (m BGL)	15
	A7063-17/0-20170728081105	Sample Type and No	B33
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	69
90	100	0.0447	65
75	100	0.0321	62
63	100	0.0231	58
50	100	0.0167	53
37.5	100	0.0089	45
28	100	0.0046	37
20	99	0.0033	34
14	99	0.0015	26
10	98		
6.3	97		
5.0	97		
3.35	96		
2.00	94		
1.18	92		
0.600	90		
0.425	89	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	85		
0.150	81	11.6	
0.063	69		

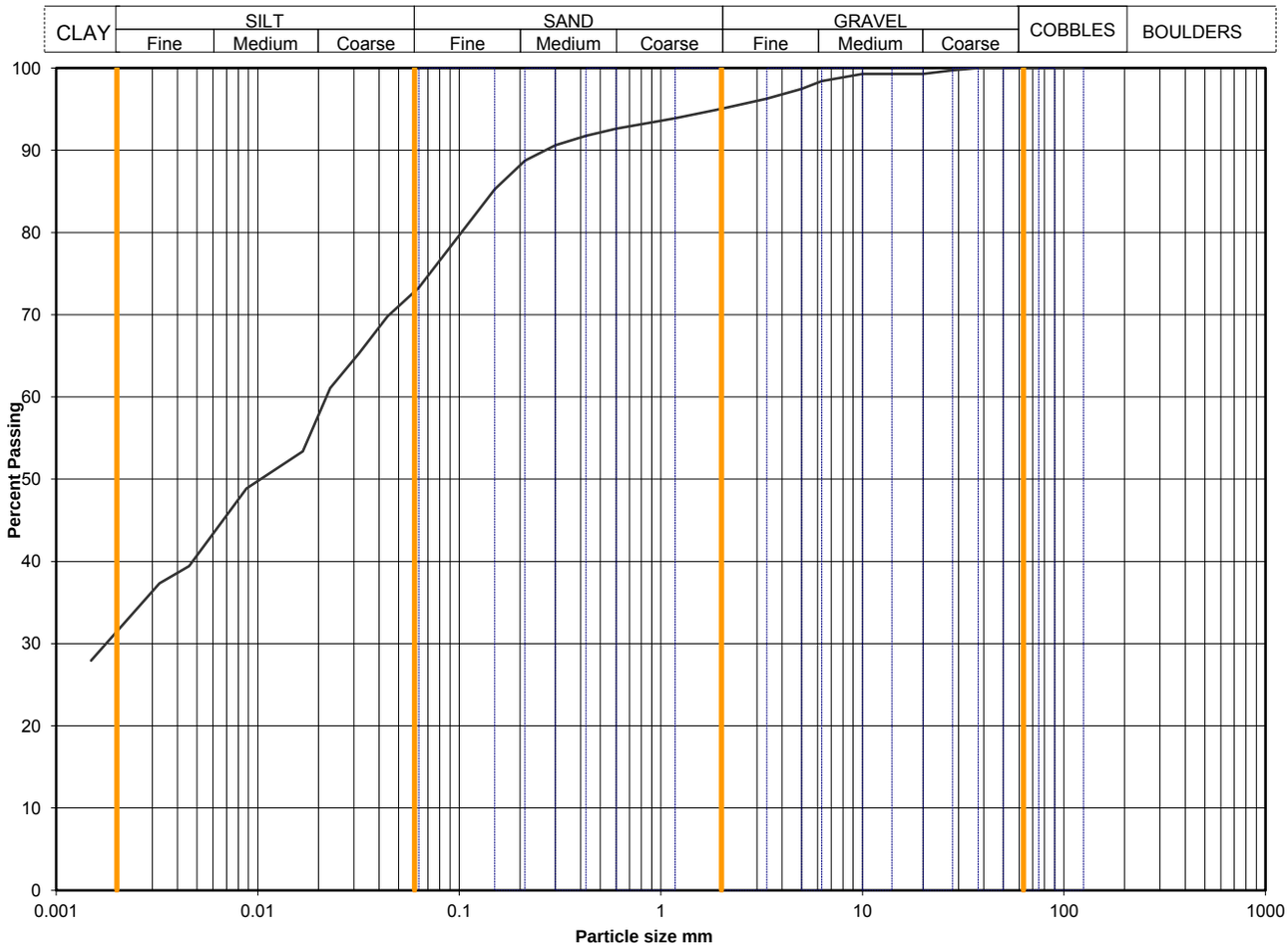
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	6	6
	Sand	26	26
*<60mm values to aid description only	Silt	40	40
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH407
		Sample Depth (m BGL)	24.5
	A7063-17/0-20170728082033	Sample Type and No	B52
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	73
90	100	0.0440	70
75	100	0.0318	65
63	100	0.0229	61
50	100	0.0167	53
37.5	100	0.0088	49
28	100	0.0046	39
20	99	0.0033	37
14	99	0.0015	28
10	99		
6.3	98		
5.0	97		
3.35	96		
2.00	95		
1.18	94		
0.600	93		
0.425	92	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	89		
0.150	85	11.3	
0.063	73		

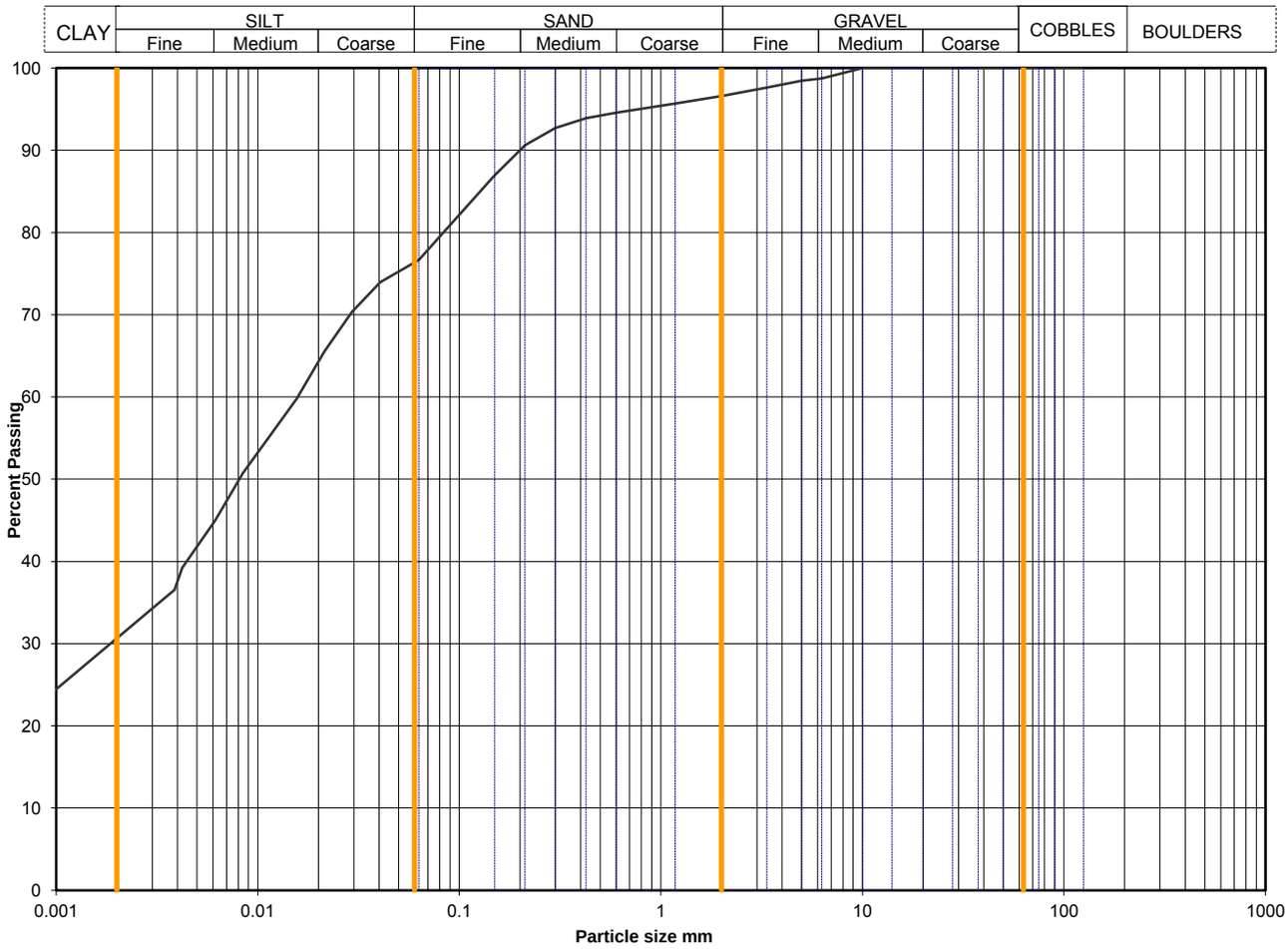
Soil description	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	22	22
*<60mm values to aid description only	Silt	42	42
	Clay	31	31

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH408
		Sample Depth (m BGL)	1.2
	A7063-17-20170711055737	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	77
90	100	0.0406	74
75	100	0.0294	70
63	100	0.0214	66
50	100	0.0156	60
37.5	100	0.0085	51
28	100	0.0061	45
20	100	0.0042	39
14	100	0.0039	37
10	100	0.0008	23
6.3	99		
5.0	98		
3.35	98		
2.00	97		
1.18	96		
0.600	95		
0.425	94	2.65 assumed	
0.300	93	Dry mass of sample, kg	
0.212	91		
0.150	87	1.1	
0.063	77		

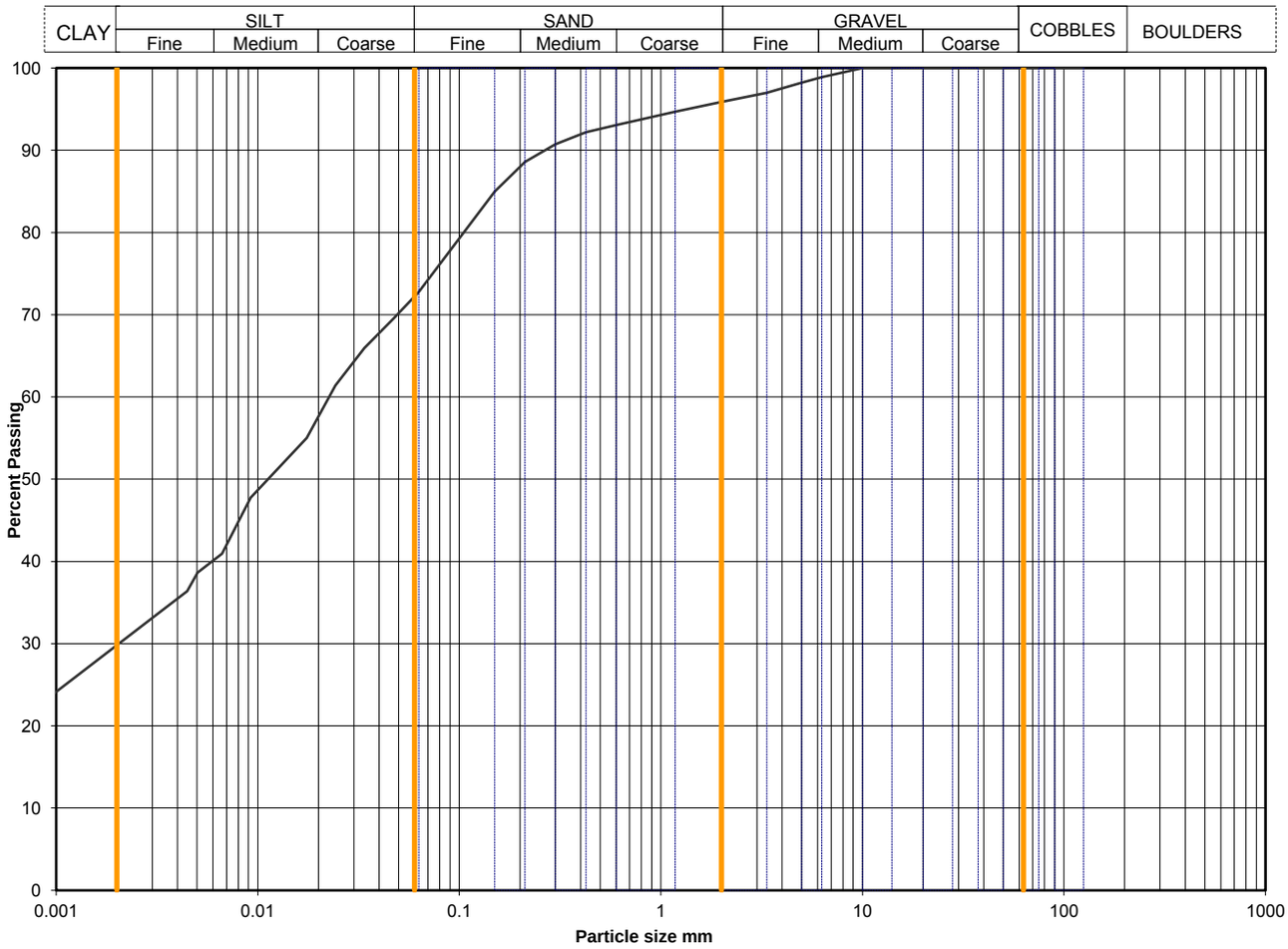
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	20	20
*<60mm values to aid description only	Silt	46	46
	Clay	31	31

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH408
		Sample Depth (m BGL)	5.5
	A7063-17-20170712054237	Sample Type and No	B13
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	73
90	100	0.0473	70
75	100	0.0338	66
63	100	0.0243	61
50	100	0.0175	55
37.5	100	0.0092	48
28	100	0.0066	41
20	100	0.0050	39
14	100	0.0045	36
10	100	0.0008	23
6.3	99		
5.0	98		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	92	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	89		
0.150	85	9.7	
0.063	73		

Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	23	23
*<60mm values to aid description only	Silt	43	43
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

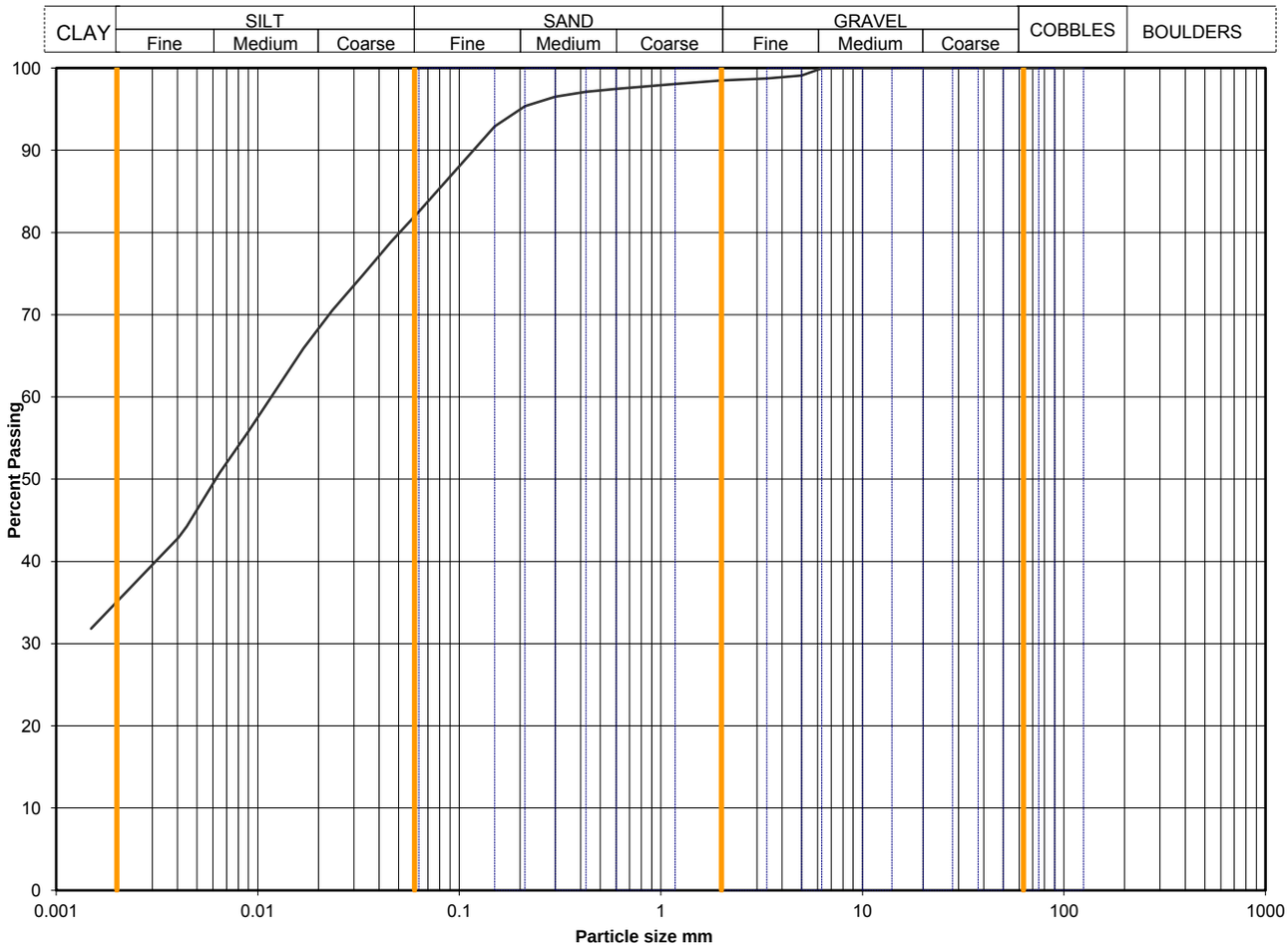
Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

QA Ref SLR 2,9 Rev 2.10 Oct 16	UKAS TESTING 1157	Project No A7063-17 Project Name WITHERNSEA LONG SEA OUTFALL	Printed: 14/09/2017 15:51	**Figure** **PSD**

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH408
		Sample Depth (m BGL)	9.5
	A7063-17-20170712054843	Sample Type and No	B20
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	83
90	100	0.0458	79
75	100	0.0328	75
63	100	0.0235	71
50	100	0.0169	66
37.5	100	0.0090	56
28	100	0.0064	51
20	100	0.0045	44
14	100	0.0040	43
10	100	0.0015	32
6.3	100		
5.0	99		
3.35	99		
2.00	98		
1.18	98		
0.600	97		
0.425	97	2.65	
0.300	97	Dry mass of sample, kg	
0.212	95		
0.150	93	1.2	
0.063	83		

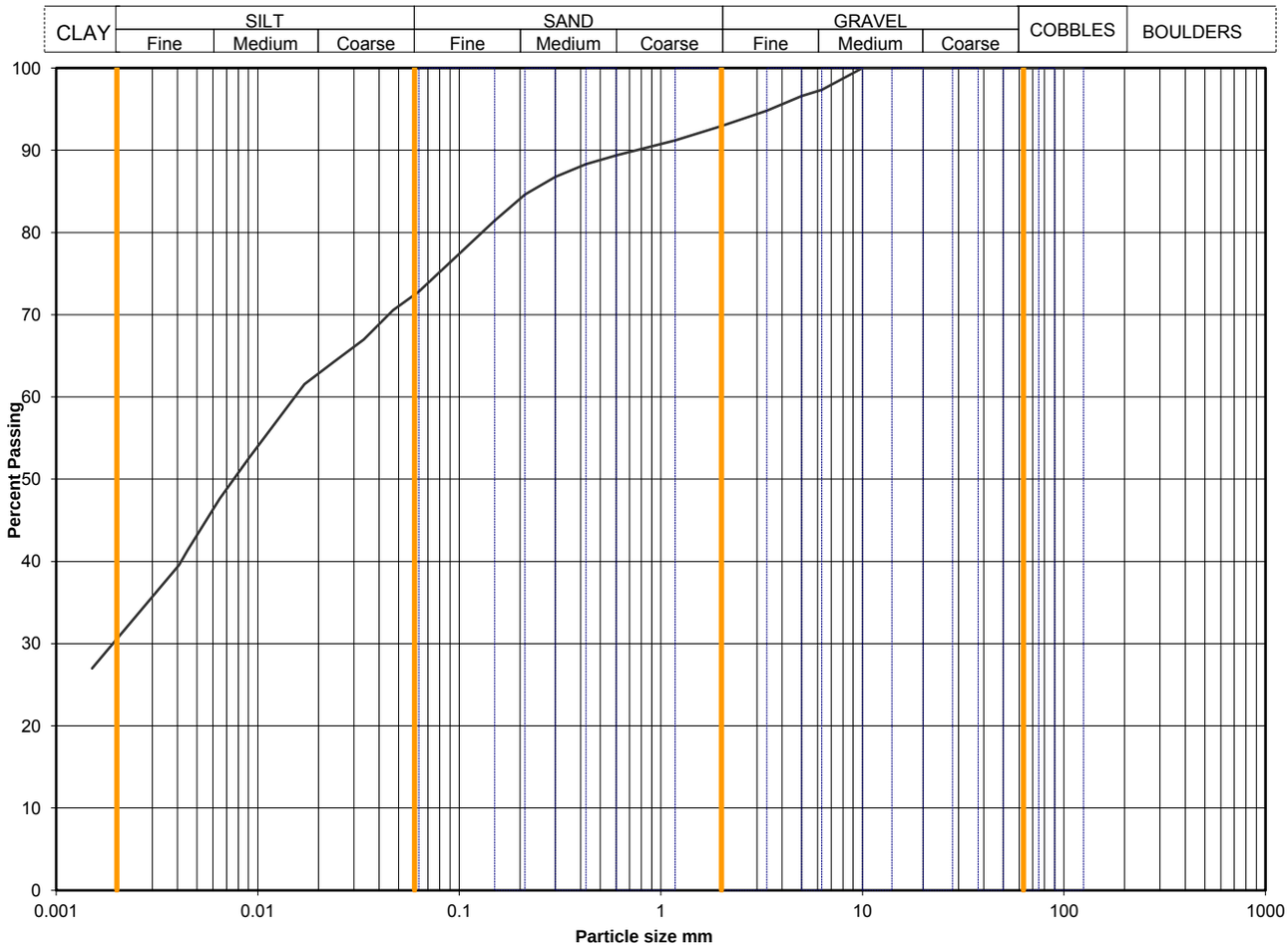
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	16	16
*<60mm values to aid description only	Silt	47	47
	Clay	35	35

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH408
		Sample Depth (m BGL)	13.5
	A7063-17-20170712055538	Sample Type and No	B27
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	73
90	100	0.0468	71
75	100	0.0335	67
63	100	0.0239	64
50	100	0.0170	62
37.5	100	0.0090	53
28	100	0.0065	48
20	100	0.0045	41
14	100	0.0041	40
10	100	0.0015	27
6.3	97		
5.0	97		
3.35	95		
2.00	93		
1.18	91		
0.600	89		
0.425	88	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	85		
0.150	81	1.5	
0.063	73		

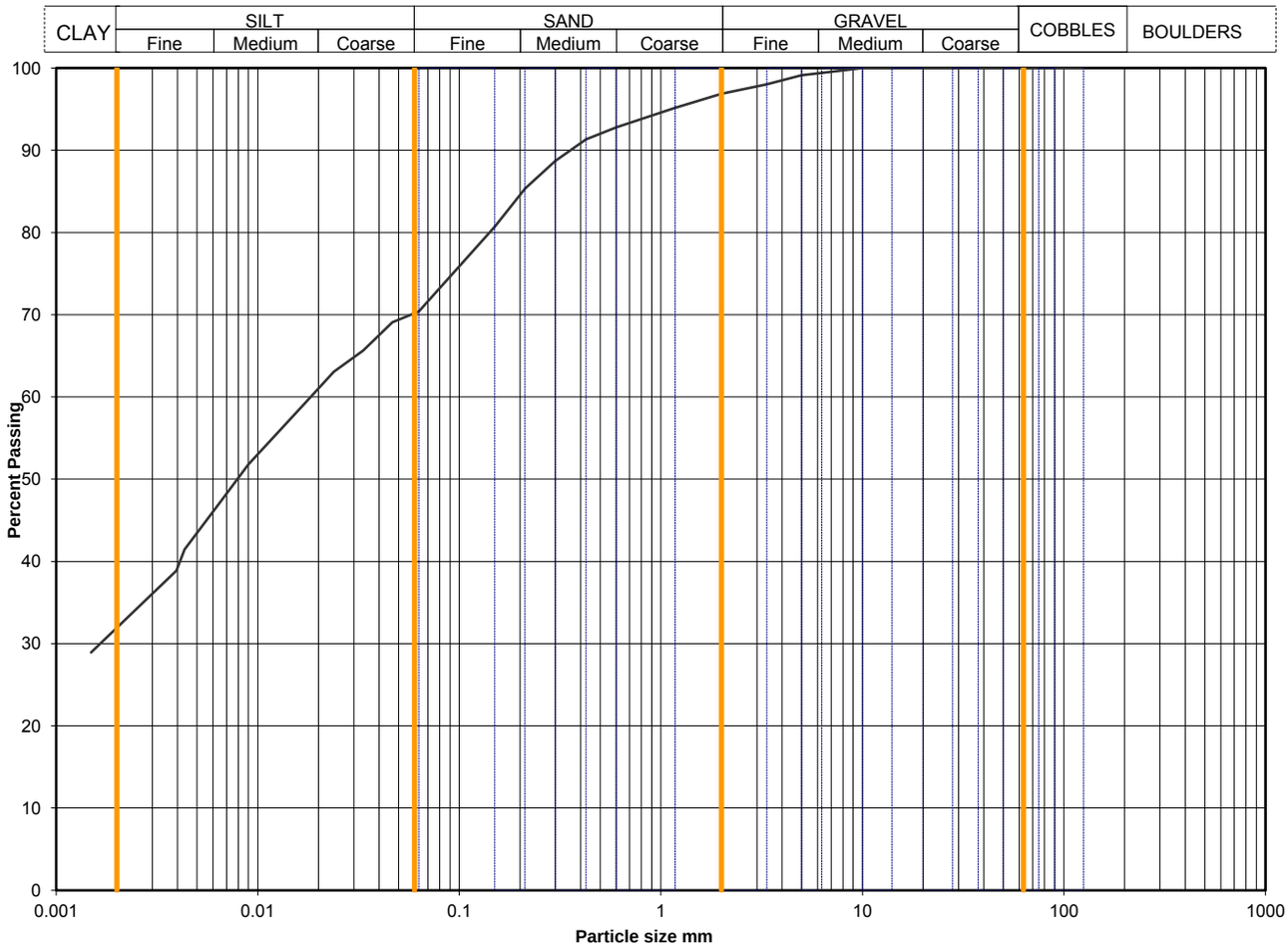
Soil description	Reddish brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	20	20
*<60mm values to aid description only	Silt	42	42
	Clay	31	31

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH408
		Sample Depth (m BGL)	17.5
	A7063-17-20170712060215	Sample Type and No	B34
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0466	69
75	100	0.0334	66
63	100	0.0238	63
50	100	0.0170	59
37.5	100	0.0090	52
28	100	0.0065	47
20	100	0.0043	41
14	100	0.0040	39
10	100	0.0015	29
6.3	99		
5.0	99		
3.35	98		
2.00	97		
1.18	95		
0.600	93		
0.425	91	2.65 assumed	
0.300	89	Dry mass of sample, kg	
0.212	85		
0.150	81	4.0	
0.063	70		

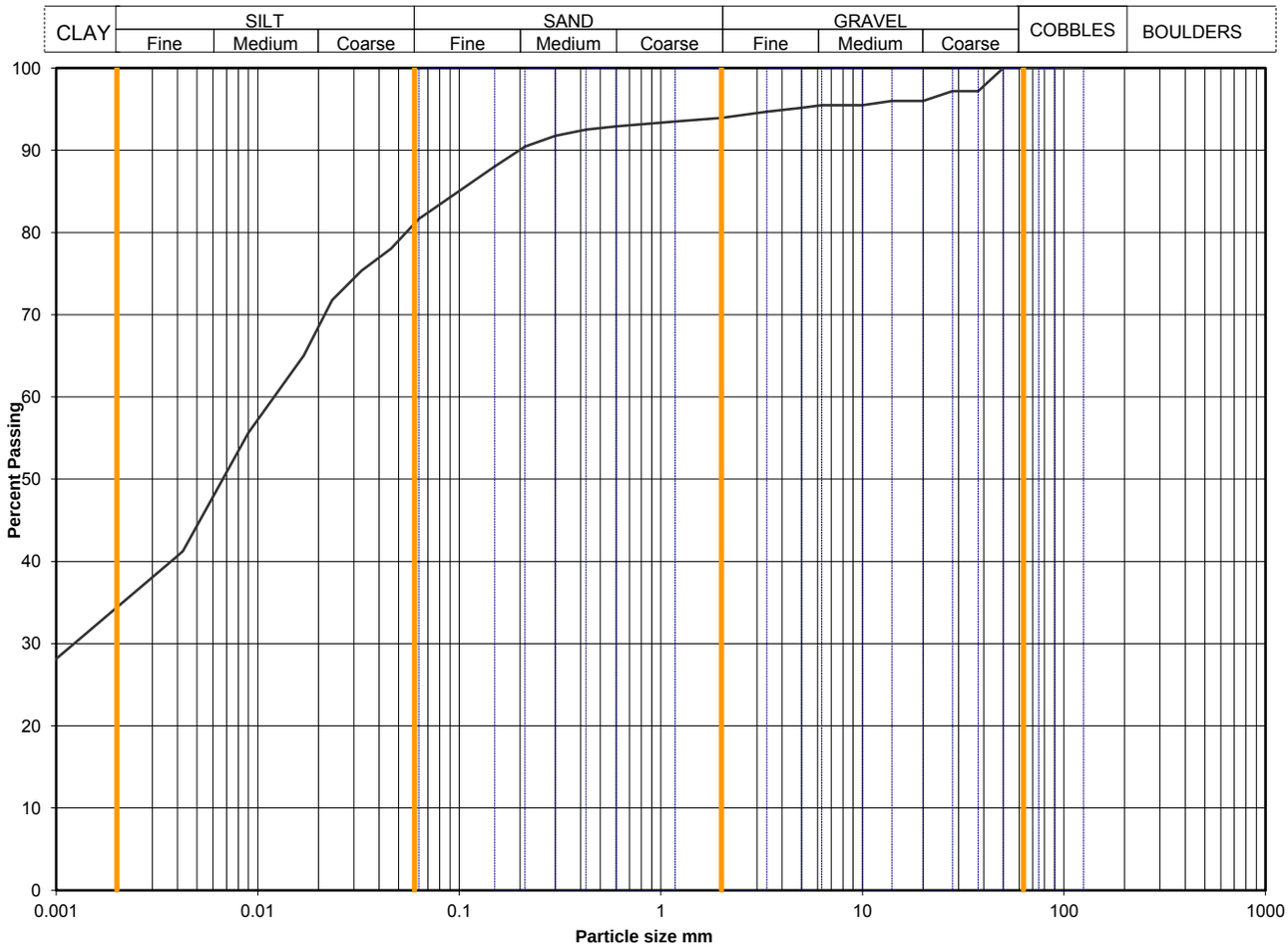
Soil description	Dark brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	26	26
*<60mm values to aid description only	Silt	38	38
	Clay	32	32

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH409
		Sample Depth (m BGL)	3
	A7063-17/0-20170711123304	Sample Type and No	B9
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	82
90	100	0.0459	78
75	100	0.0327	75
63	100	0.0234	72
50	100	0.0169	65
37.5	97	0.0090	56
28	97	0.0065	49
20	96	0.0042	41
14	96	0.0039	40
10	95	0.0008	26
6.3	95		
5.0	95		
3.35	95		
2.00	94		
1.18	94		
0.600	93		
0.425	93	2.65 assumed	
0.300	92	Dry mass of sample, kg	
0.212	90		
0.150	88	5.3	
0.063	82		

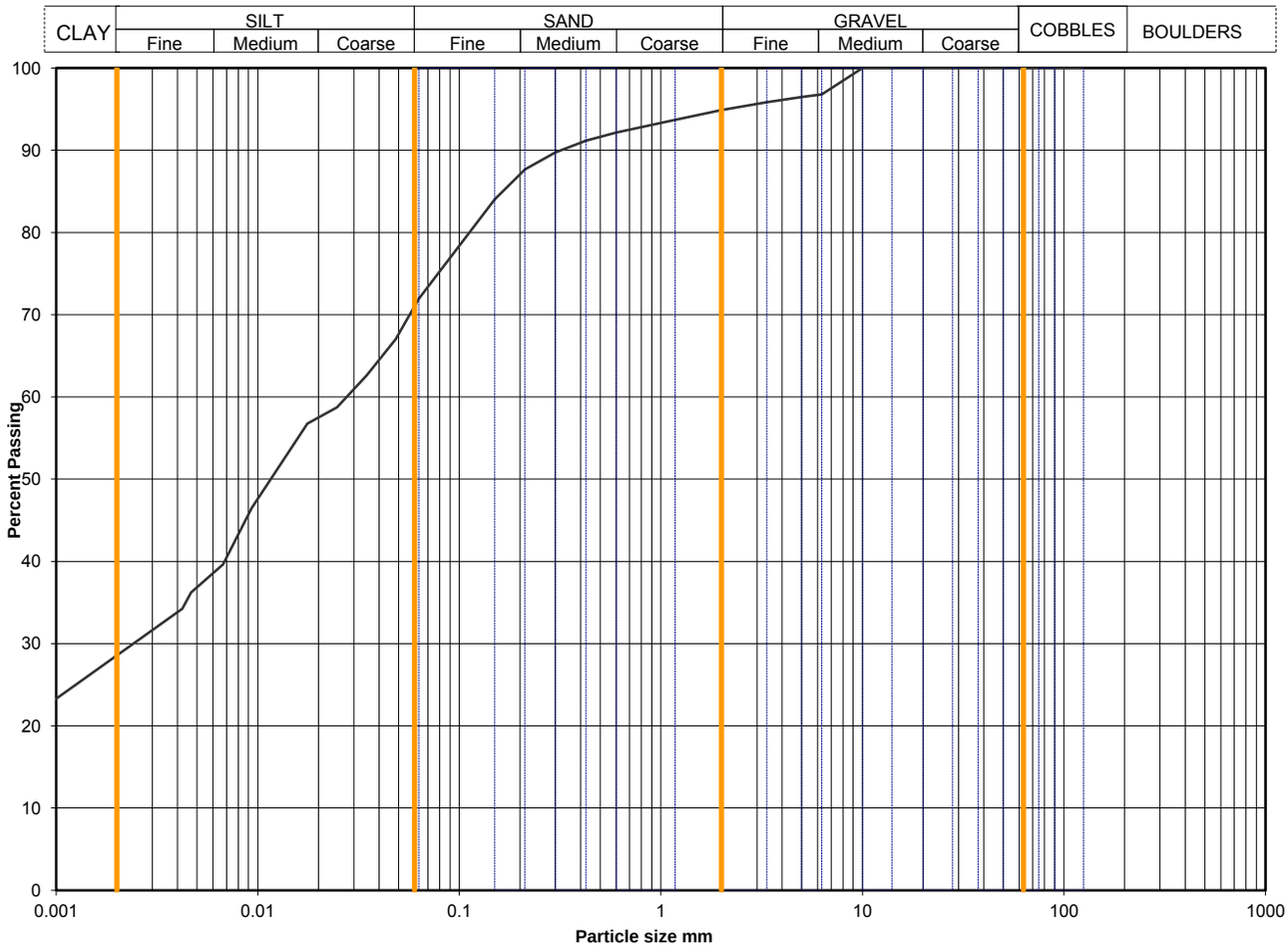
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	6	6
	Sand	12	12
*<60mm values to aid description only	Silt	47	47
	Clay	34	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH409
		Sample Depth (m BGL)	7
	A7063-17/0-20170711041427	Sample Type and No	B18
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0484	67
75	100	0.0346	63
63	100	0.0248	59
50	100	0.0176	57
37.5	100	0.0093	46
28	100	0.0067	40
20	100	0.0047	36
14	100	0.0042	34
10	100	0.0008	22
6.3	97		
5.0	96		
3.35	96		
2.00	95		
1.18	94		
0.600	92		
0.425	91	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	88		
0.150	84	1.4	
0.063	72		

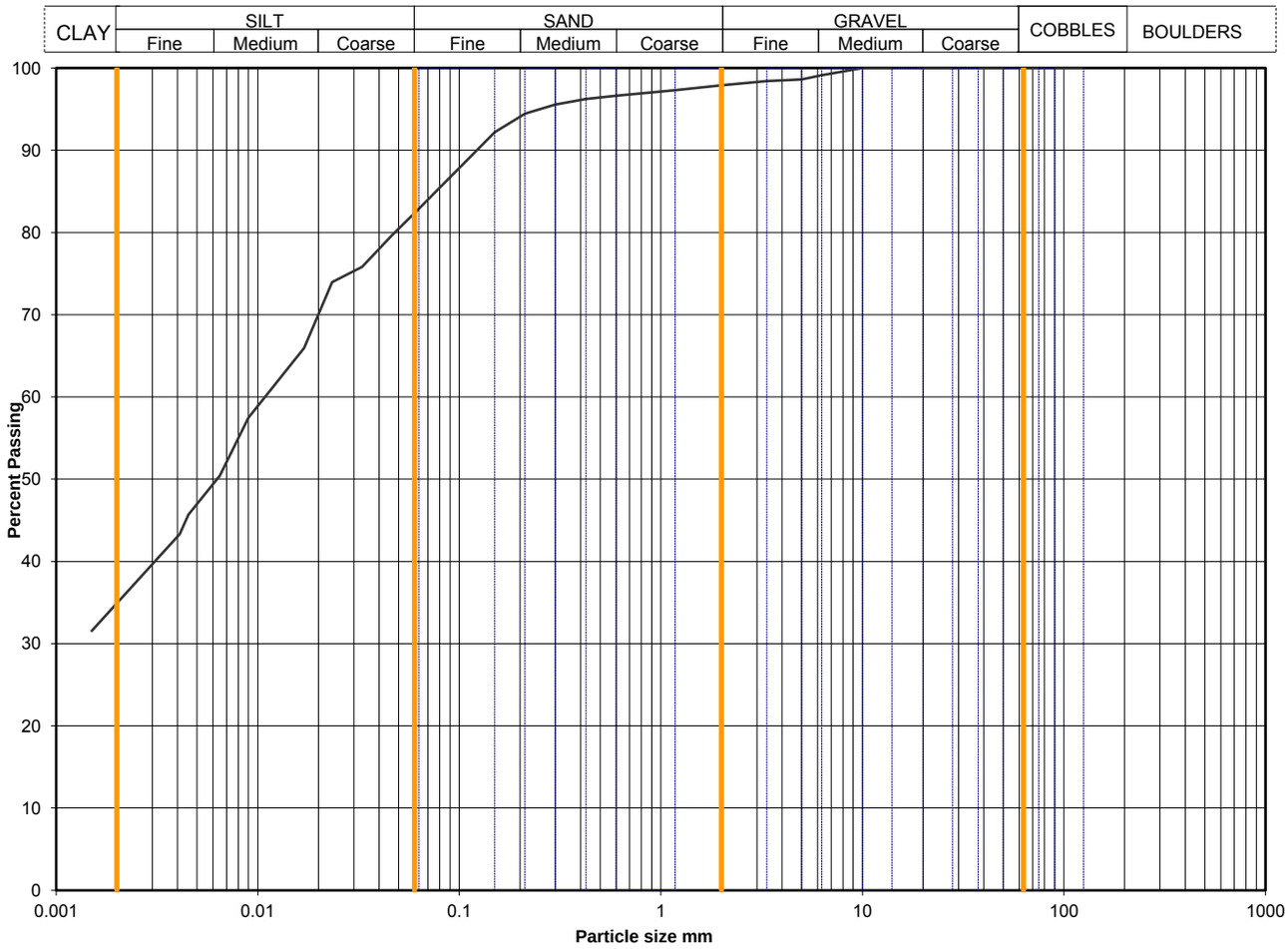
Soil description	Brown slightly sandy slightly gravelly silty CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	23	23
*<60mm values to aid description only	Silt	43	43
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH409
		Sample Depth (m BGL)	11
	A7063-17/0-20170712022129	Sample Type and No	B26
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	83
90	100	0.0460	80
75	100	0.0329	76
63	100	0.0234	74
50	100	0.0170	66
37.5	100	0.0090	57
28	100	0.0065	50
20	100	0.0045	46
14	100	0.0041	43
10	100	0.0015	32
6.3	99		
5.0	99		
3.35	98		
2.00	98		
1.18	97		
0.600	97		
0.425	96	2.65 assumed	
0.300	96	Dry mass of sample, kg	
0.212	94		
0.150	92	0.7	
0.063	83		

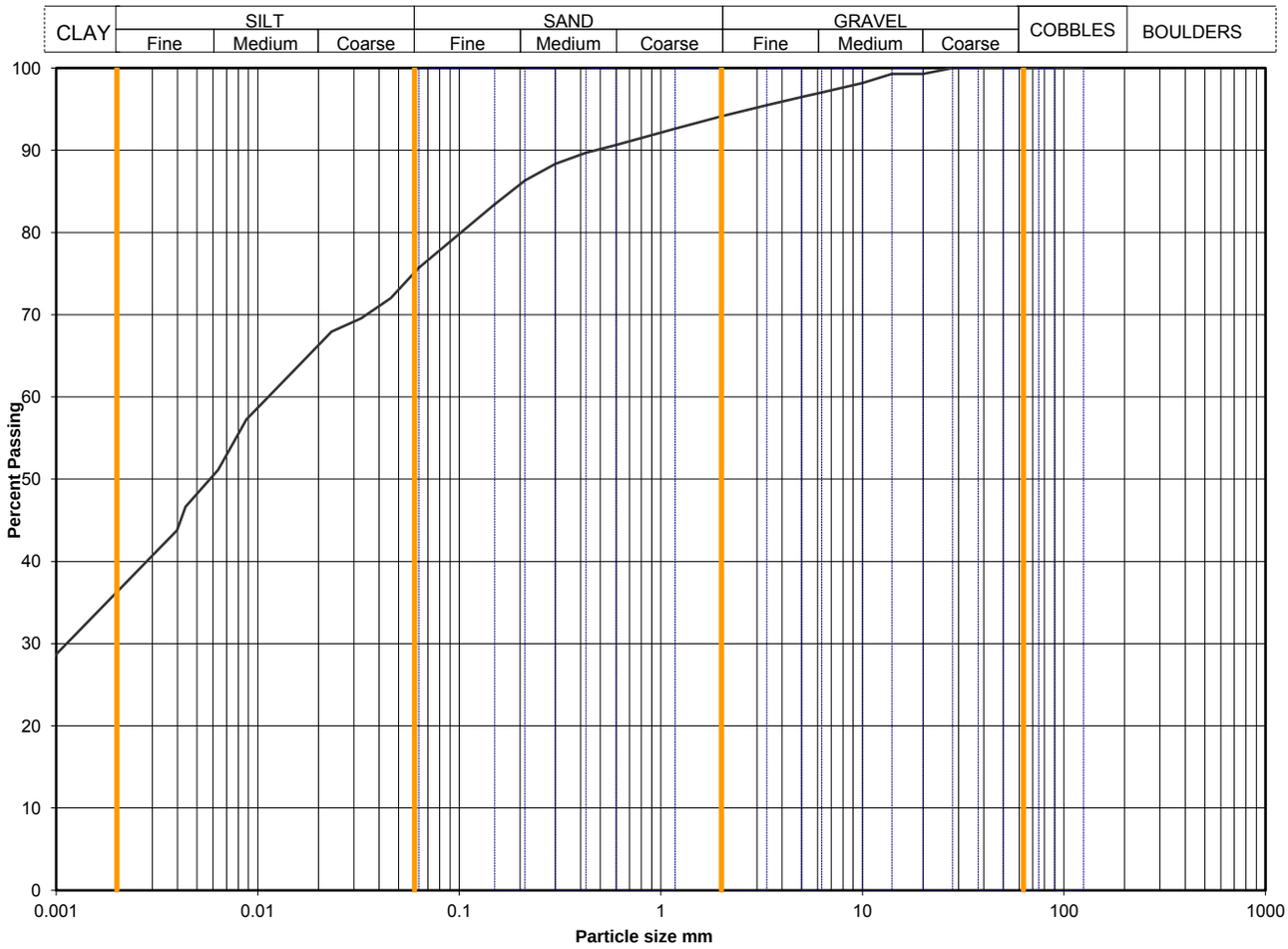
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	15	15
*<60mm values to aid description only	Silt	48	48
	Clay	35	35

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH409
		Sample Depth (m BGL)	15
	A7063-17/0-20170712022608	Sample Type and No	B34
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	76
90	100	0.0457	72
75	100	0.0326	70
63	100	0.0232	68
50	100	0.0166	64
37.5	100	0.0088	57
28	100	0.0064	51
20	99	0.0044	47
14	99	0.0040	44
10	98	0.0008	27
6.3	97		
5.0	96		
3.35	95		
2.00	94		
1.18	93		
0.600	91		
0.425	90	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	86		
0.150	83	4.4	
0.063	76		

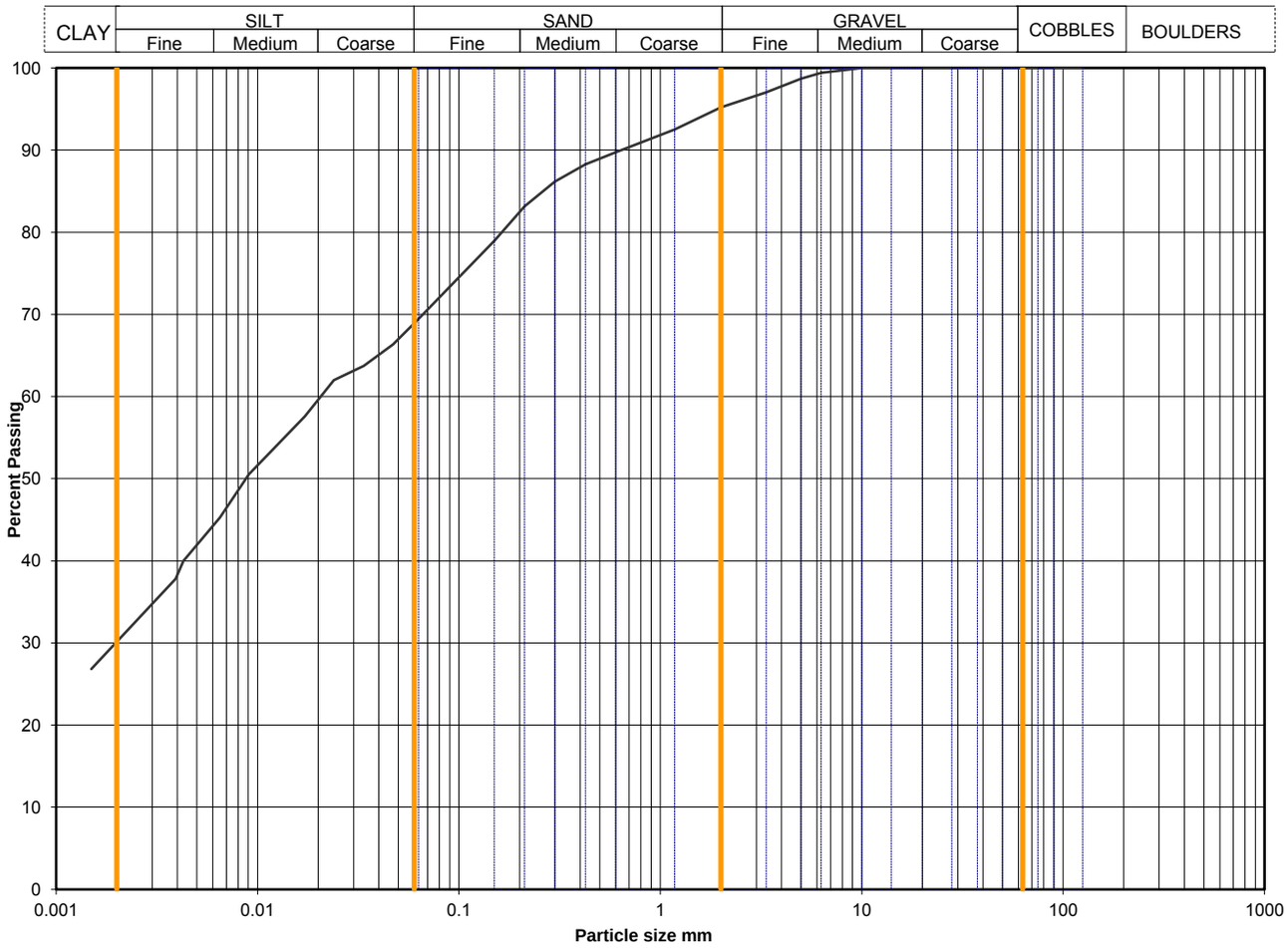
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	6	6
	Sand	18	18
*<60mm values to aid description only	Silt	39	39
	Clay	36	36

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH409
		Sample Depth (m BGL)	21
	A7063-17/0-20170712024714	Sample Type and No	B46
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	69
90	100	0.0472	66
75	100	0.0337	64
63	100	0.0239	62
50	100	0.0172	58
37.5	100	0.0091	51
28	100	0.0065	45
20	100	0.0043	40
14	100	0.0039	38
10	100	0.0015	27
6.3	99		
5.0	99		
3.35	97		
2.00	95		
1.18	93		
0.600	90		
0.425	88	2.65	
0.300	86	Dry mass of sample, kg	
0.212	83		
0.150	79	0.9	
0.063	69		

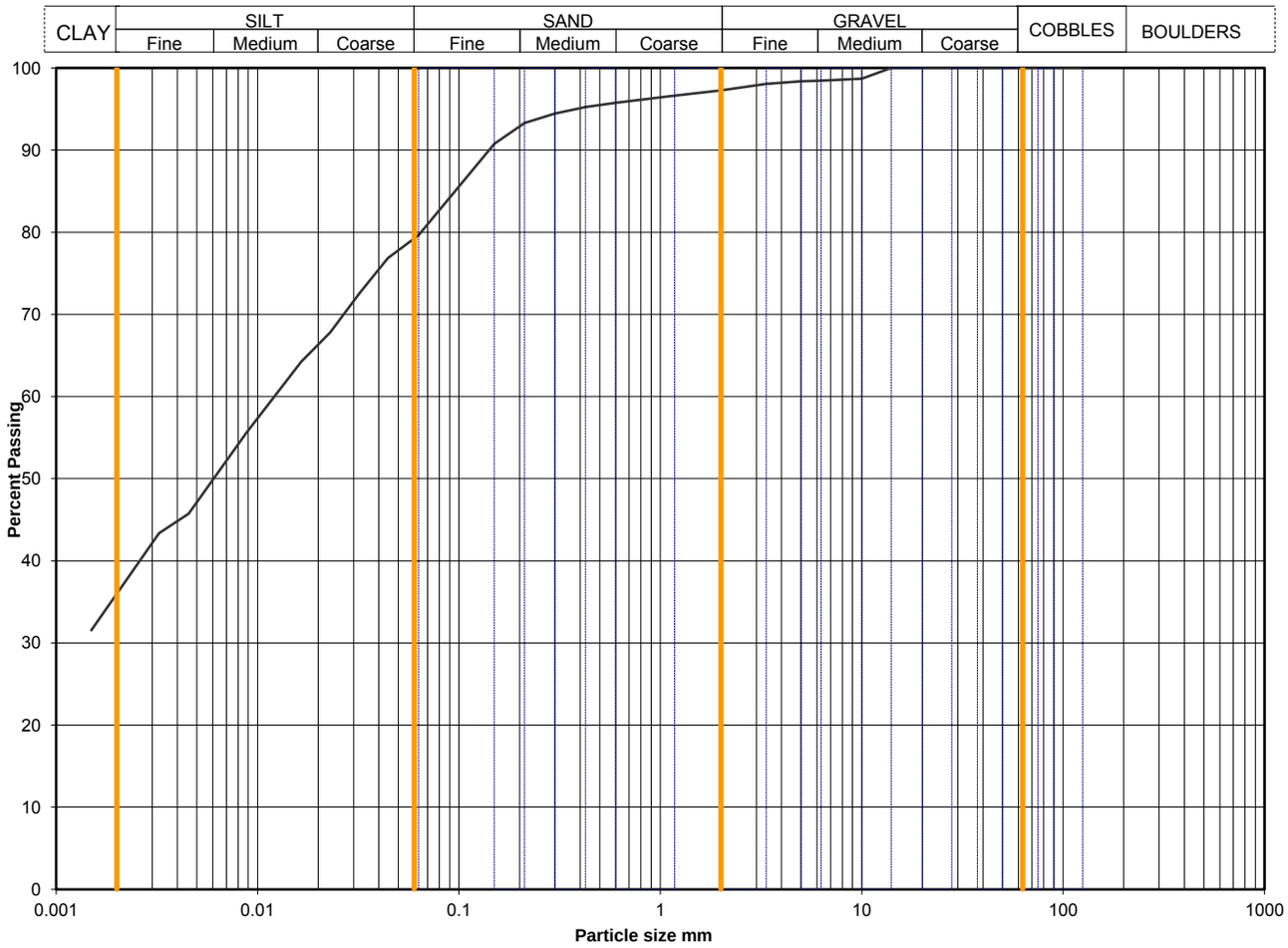
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	26	26
*<60mm values to aid description only	Silt	39	39
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH410
		Sample Depth (m BGL)	0
	A7063-1720170803101134	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	80
90	100	0.0444	77
75	100	0.0319	73
63	100	0.0230	68
50	100	0.0165	64
37.5	100	0.0088	56
28	100	0.0045	46
20	100	0.0032	43
14	100	0.0015	32
10	99		
6.3	98		
5.0	98		
3.35	98		
2.00	97		
1.18	97		
0.600	96		
0.425	95	2.65 assumed	
0.300	94	Dry mass of sample, kg	
0.212	93		
0.150	91	2.0	
0.063	80		

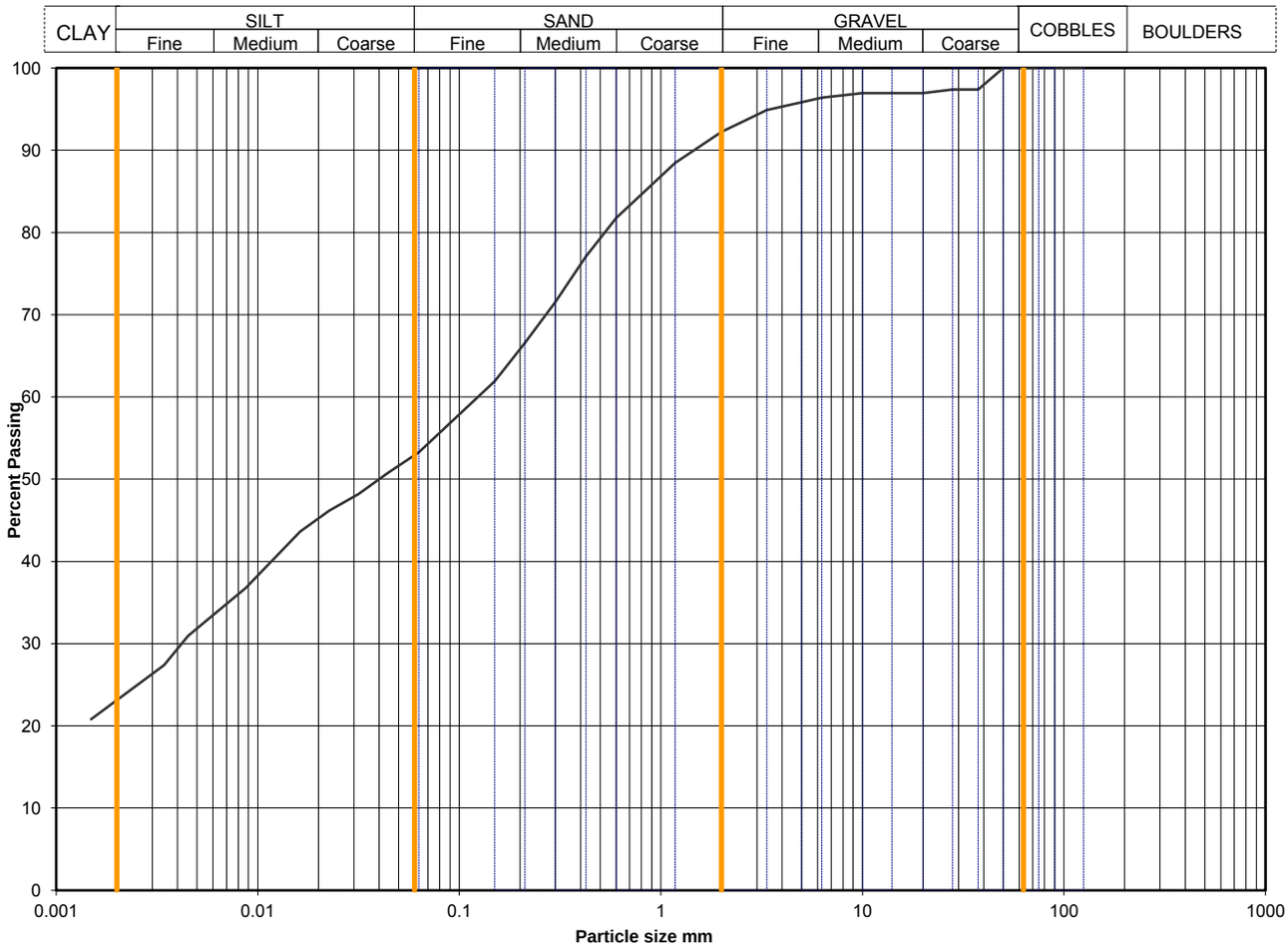
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	18	18
*<60mm values to aid description only	Silt	44	44
	Clay	36	36

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH410
		Sample Depth (m BGL)	1.5
	A7063-1720170803101146	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	53
90	100	0.0440	51
75	100	0.0316	48
63	100	0.0227	46
50	100	0.0163	44
37.5	97	0.0087	37
28	97	0.0045	31
20	97	0.0034	27
14	97	0.0015	21
10	97		
6.3	96		
5.0	96		
3.35	95		
2.00	92		
1.18	88		
0.600	82		
0.425	77	2.65 assumed	
0.300	72	Dry mass of sample, kg	
0.212	67		
0.150	62	7.2	
0.063	53		

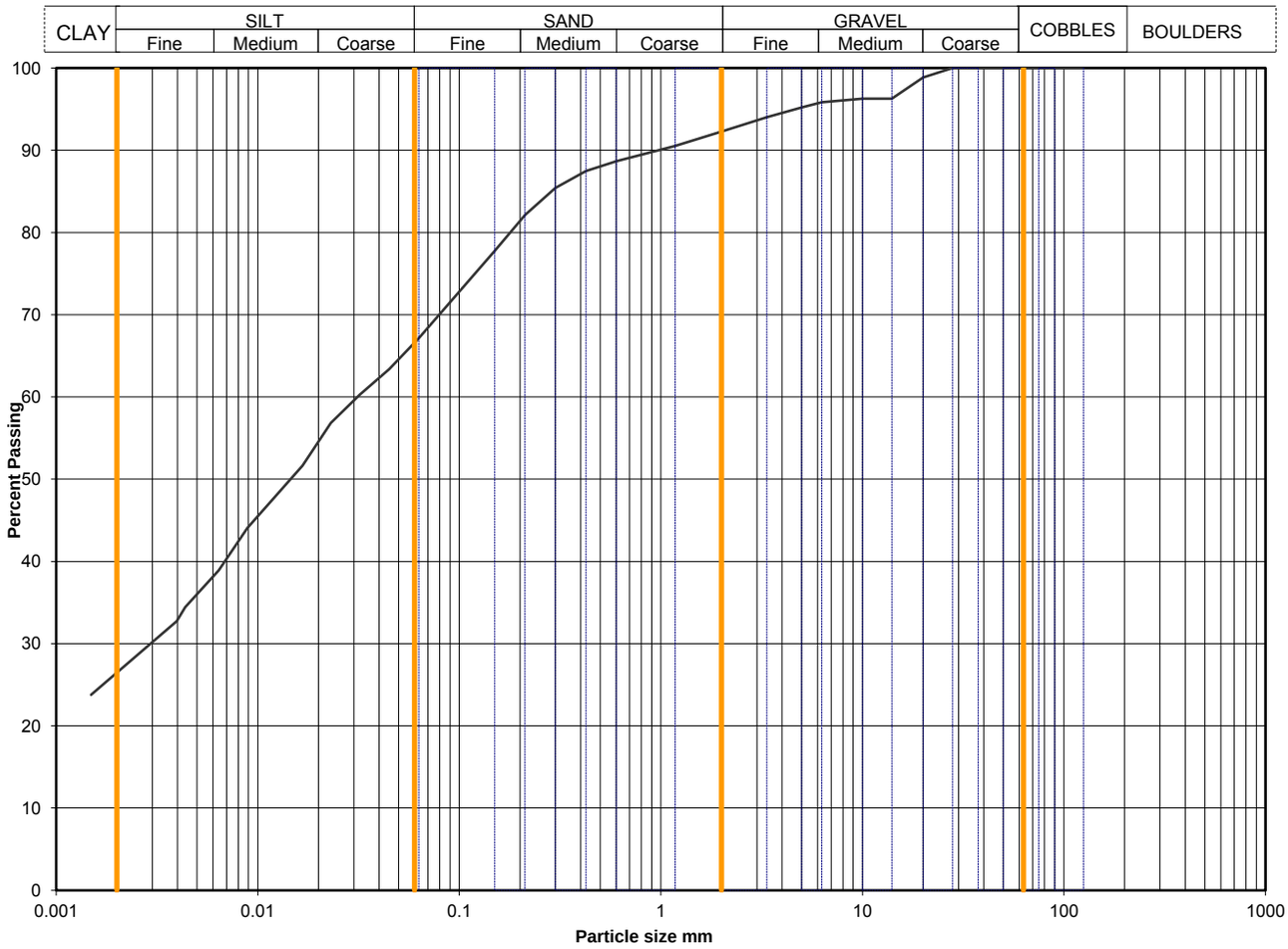
Soil description	Brown slightly gravelly sandy CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	39	39
*<60mm values to aid description only	Silt	30	30
	Clay	23	23

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH410
		Sample Depth (m BGL)	2.5
	A7063-1720170803101203	Sample Type and No	B8
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	67
90	100	0.0448	63
75	100	0.0321	60
63	100	0.0231	57
50	100	0.0167	52
37.5	100	0.0089	44
28	100	0.0064	39
20	99	0.0044	34
14	96	0.0040	33
10	96	0.0015	24
6.3	96		
5.0	95		
3.35	94		
2.00	92		
1.18	91		
0.600	89		
0.425	87	2.65 assumed	
0.300	85	Dry mass of sample, kg	
0.212	82		
0.150	78	4.5	
0.063	67		

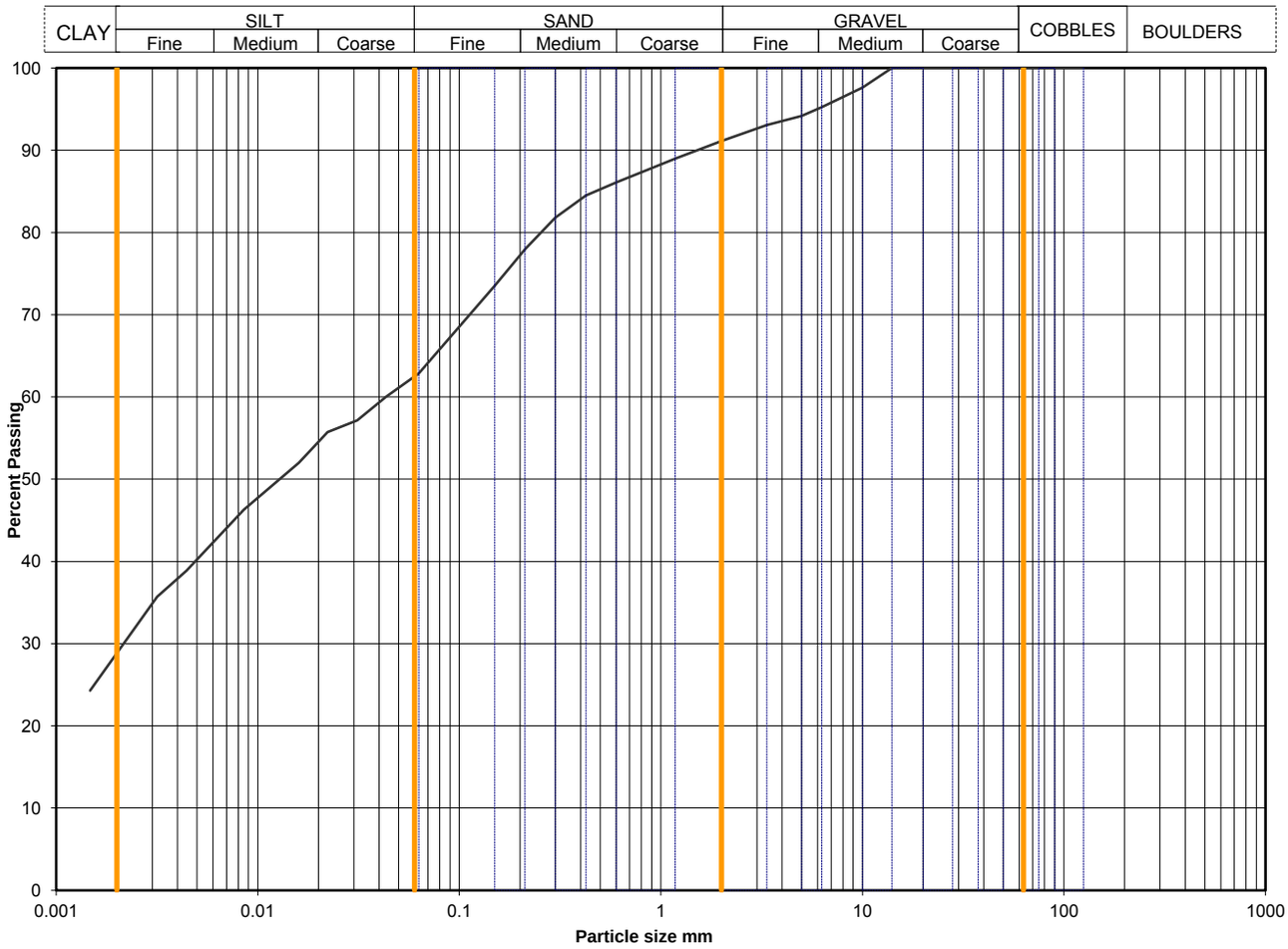
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	25	25
*<60mm values to aid description only	Silt	41	41
	Clay	26	26

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH410
		Sample Depth (m BGL)	5
	A7063-1720170803101221	Sample Type and No	B11
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	63
90	100	0.0433	60
75	100	0.0311	57
63	100	0.0222	56
50	100	0.0160	52
37.5	100	0.0085	46
28	100	0.0044	39
20	100	0.0032	36
14	100	0.0015	24
10	98		
6.3	95		
5.0	94		
3.35	93		
2.00	91		
1.18	89		
0.600	86		
0.425	84	2.65 assumed	
0.300	82	Dry mass of sample, kg	
0.212	78		
0.150	74	3.0	
0.063	63		

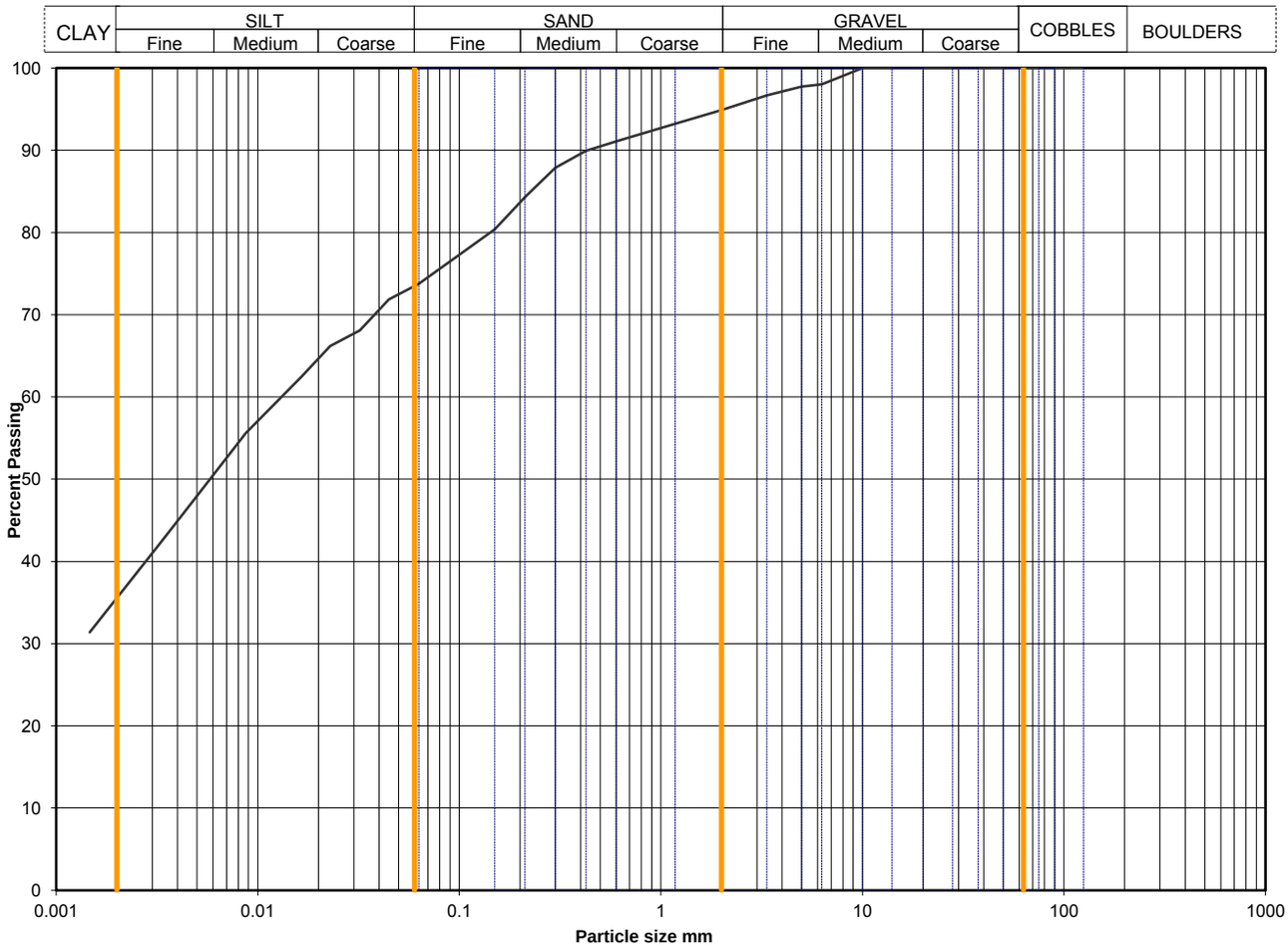
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	9	9
	Sand	28	28
*<60mm values to aid description only	Silt	34	34
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH410A
		Sample Depth (m BGL)	6.7
	A7063-1720170824022532	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	74
90	100	0.0447	72
75	100	0.0321	68
63	100	0.0229	66
50	100	0.0164	62
37.5	100	0.0087	56
28	100	0.0045	47
20	100	0.0032	42
14	100	0.0015	31
10	100		
6.3	98		
5.0	98		
3.35	97		
2.00	95		
1.18	93		
0.600	91		
0.425	90	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	84		
0.150	80	6.7	
0.063	74		

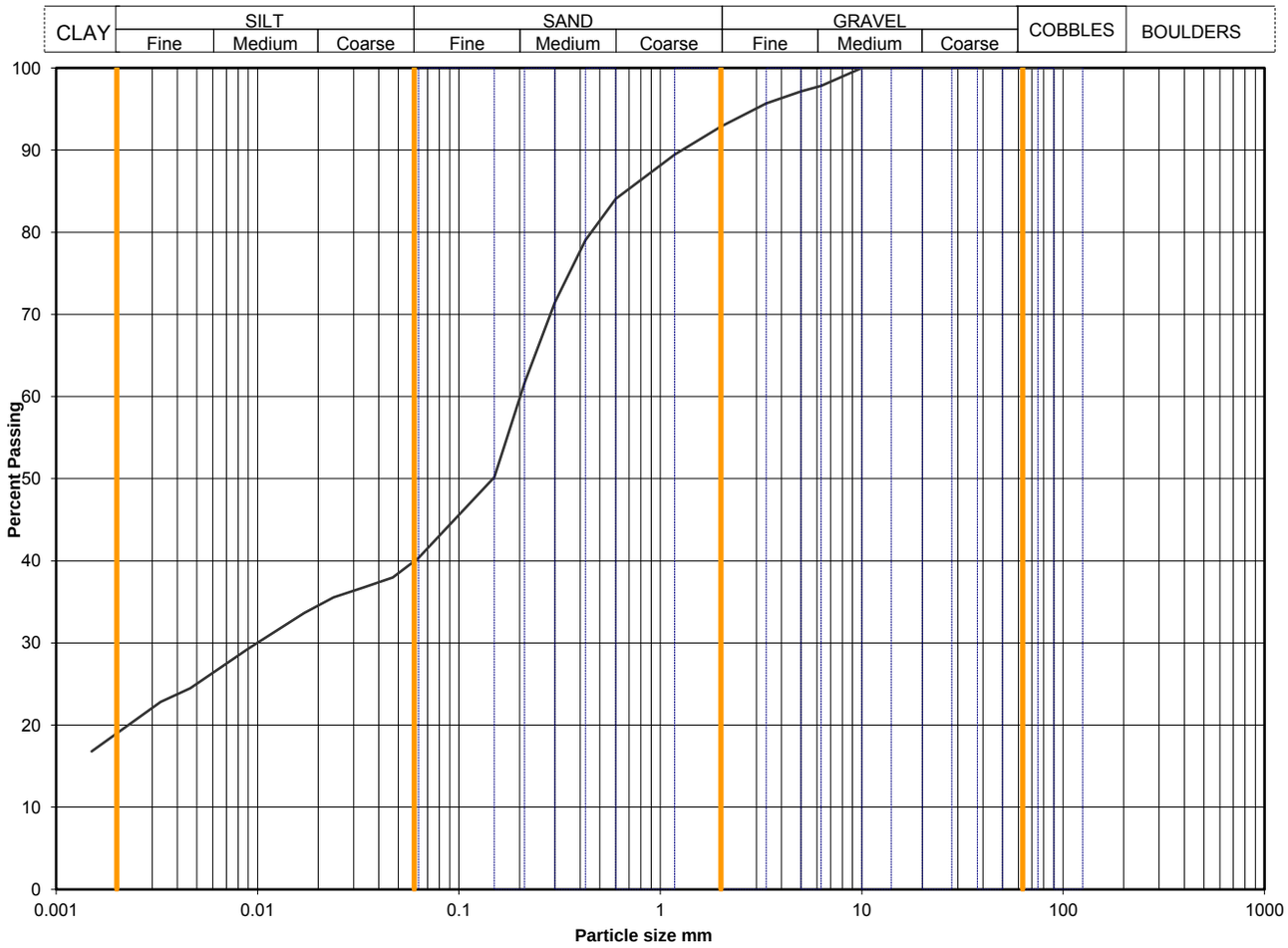
Soil description	Dark brown slightly sandy slightly gravelly CLAY with chalk fragments.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	21	21
*<60mm values to aid description only	Silt	38	38
	Clay	36	36

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH410A
		Sample Depth (m BGL)	9
	A7063-1720170824022542	Sample Type and No	D3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	40
90	100	0.0470	38
75	100	0.0335	37
63	100	0.0238	36
50	100	0.0170	34
37.5	100	0.0090	29
28	100	0.0046	25
20	100	0.0033	23
14	100	0.0015	17
10	100		
6.3	98		
5.0	97		
3.35	96		
2.00	93		
1.18	89		
0.600	84		
0.425	79	2.65 assumed	
0.300	71	Dry mass of sample, kg	
0.212	62		
0.150	50	0.8	
0.063	40		

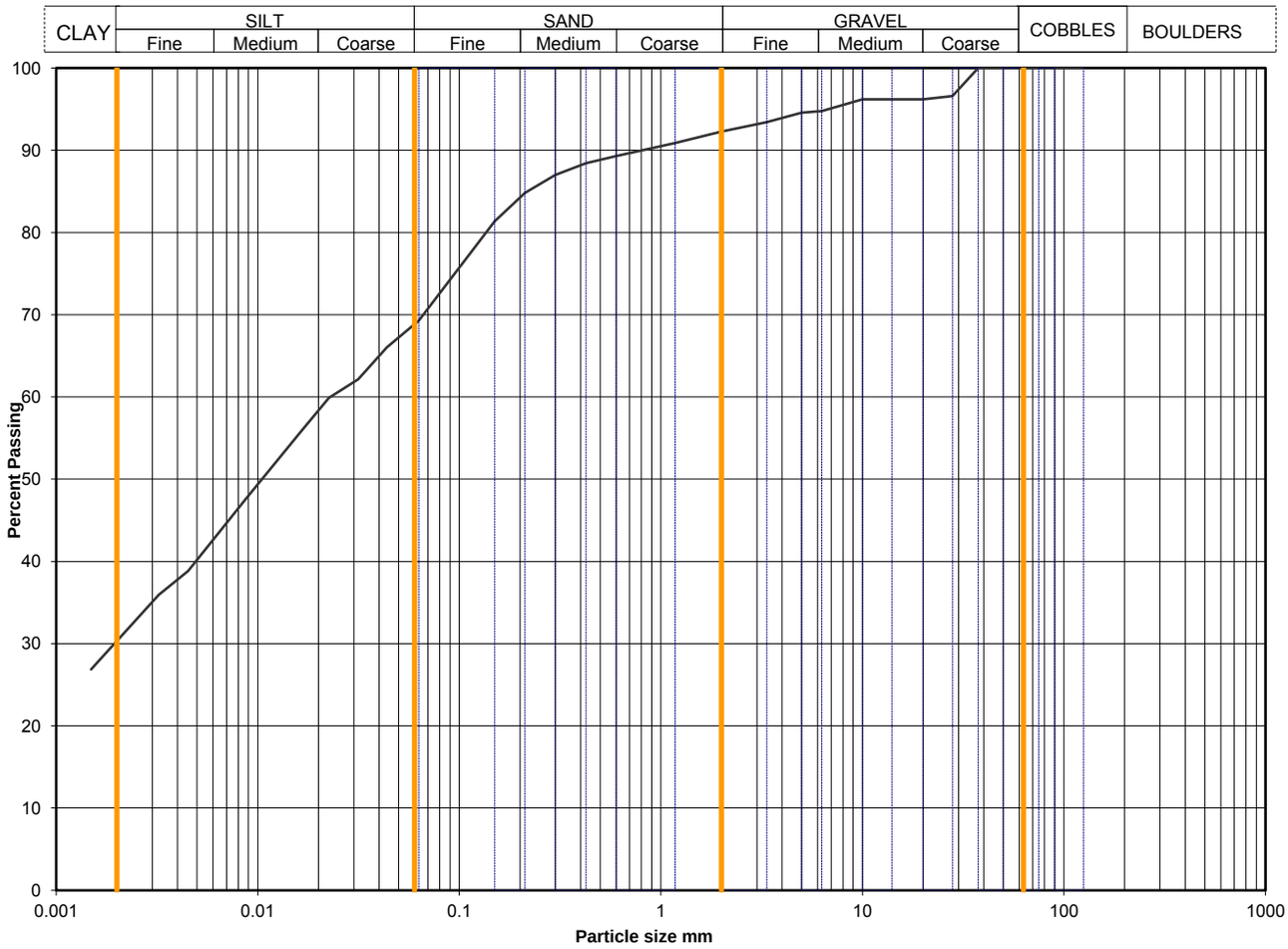
Soil description	Greyish brown gravelly SAND with frequent clay pockets.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	53	53
*<60mm values to aid description only	Silt	21	21
	Clay	19	19

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH411
		Sample Depth (m BGL)	0.13
	A7063-1720170803100034	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	69
90	100	0.0437	66
75	100	0.0315	62
63	100	0.0225	60
50	100	0.0163	56
37.5	100	0.0087	48
28	97	0.0045	39
20	96	0.0032	36
14	96	0.0015	27
10	96		
6.3	95		
5.0	95		
3.35	93		
2.00	92		
1.18	91		
0.600	89		
0.425	88	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	85		
0.150	81	15.0	
0.063	69		

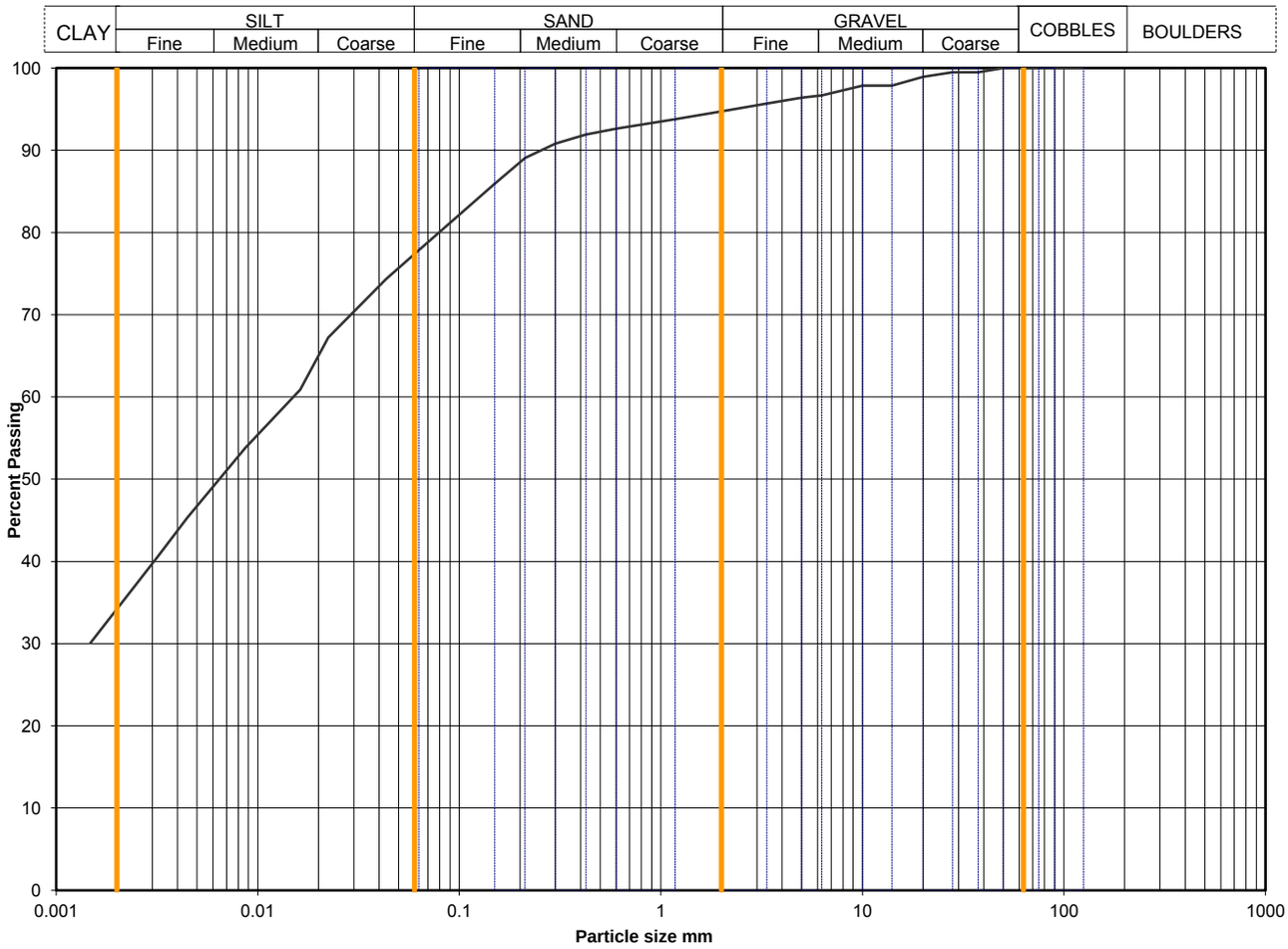
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks	hydro: 9		
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	23	23
*<60mm values to aid description only	Silt	39	39
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH411
		Sample Depth (m BGL)	1
	A7063-1720170803100048	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	78
90	100	0.0433	74
75	100	0.0311	71
63	100	0.0224	67
50	100	0.0163	61
37.5	100	0.0087	54
28	100	0.0045	45
20	99	0.0032	41
14	98	0.0015	30
10	98		
6.3	97		
5.0	96		
3.35	96		
2.00	95		
1.18	94		
0.600	93		
0.425	92	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	89		
0.150	86	16.9	
0.063	78		

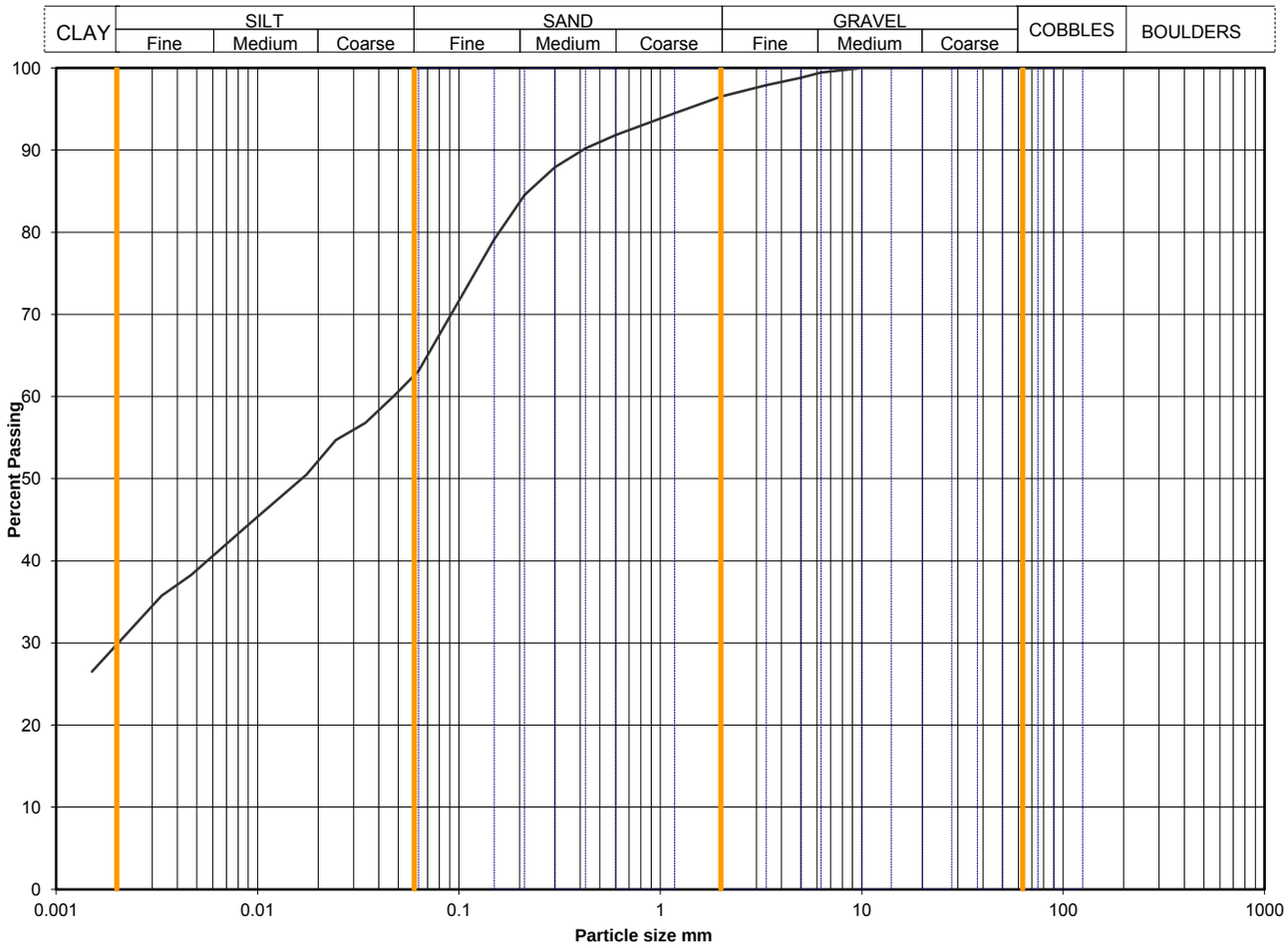
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	17	17
*<60mm values to aid description only	Silt	44	44
	Clay	34	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH411
		Sample Depth (m BGL)	2.6
	A7063-1720170803100152	Sample Type and No	B10
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	63
90	100	0.0480	60
75	100	0.0343	57
63	100	0.0244	55
50	100	0.0175	50
37.5	100	0.0092	45
28	100	0.0047	38
20	100	0.0033	36
14	100	0.0015	27
10	100		
6.3	99		
5.0	99		
3.35	98		
2.00	97		
1.18	95		
0.600	92		
0.425	90	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	85		
0.150	79	7.1	
0.063	63		

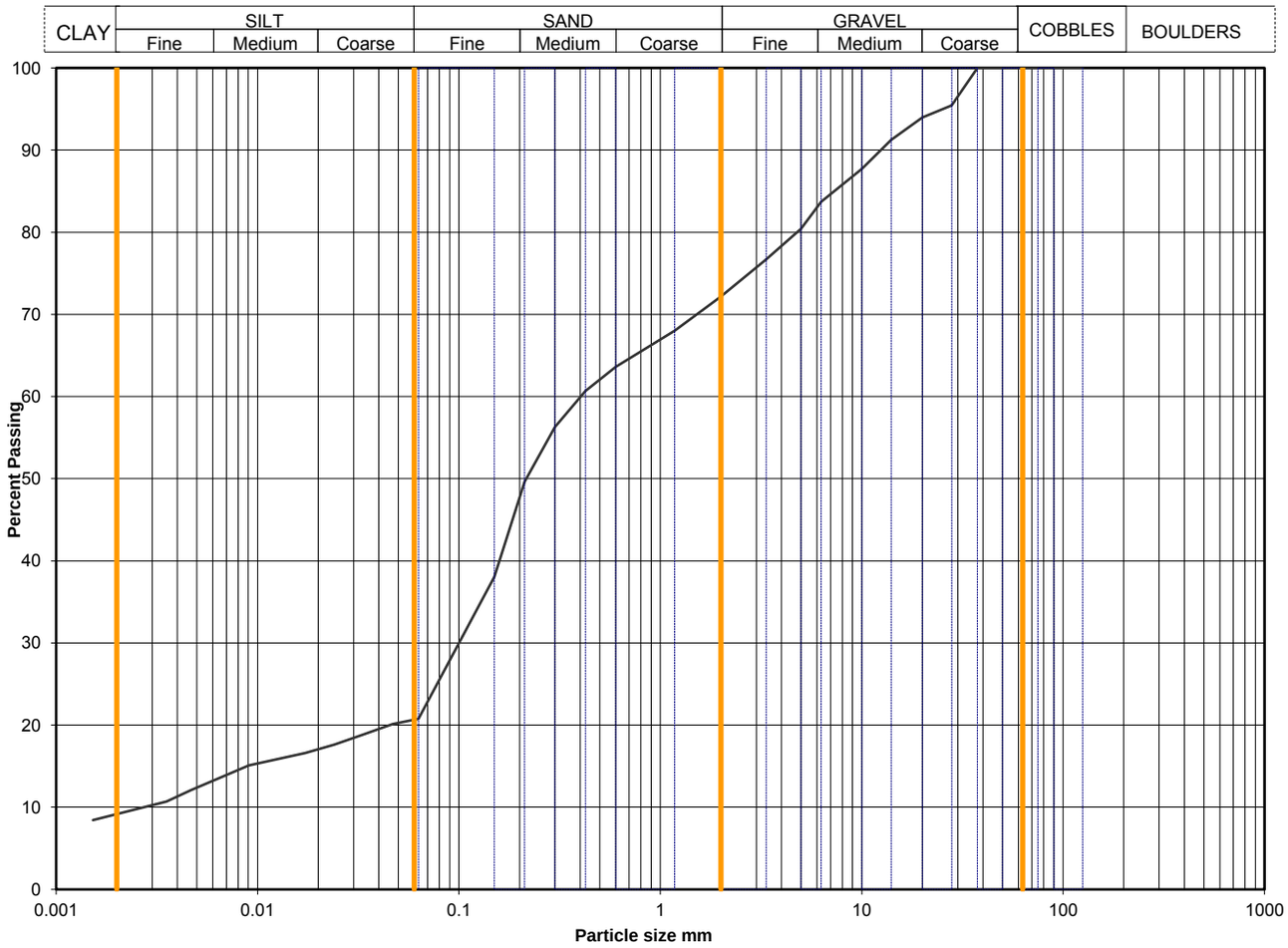
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	33	33
*<60mm values to aid description only	Silt	33	33
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH411
		Sample Depth (m BGL)	3.6
	A7063-1720170803100156	Sample Type and No	D11
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	21
90	100	0.0468	20
75	100	0.0336	19
63	100	0.0241	18
50	100	0.0172	17
37.5	100	0.0090	15
28	95	0.0047	12
20	94	0.0035	11
14	91	0.0015	8
10	88		
6.3	84		
5.0	80		
3.35	77		
2.00	72		
1.18	68		
0.600	64		
0.425	61	2.65 assumed	
0.300	56	Dry mass of sample, kg	
0.212	50		
0.150	38	3.8	
0.063	21		

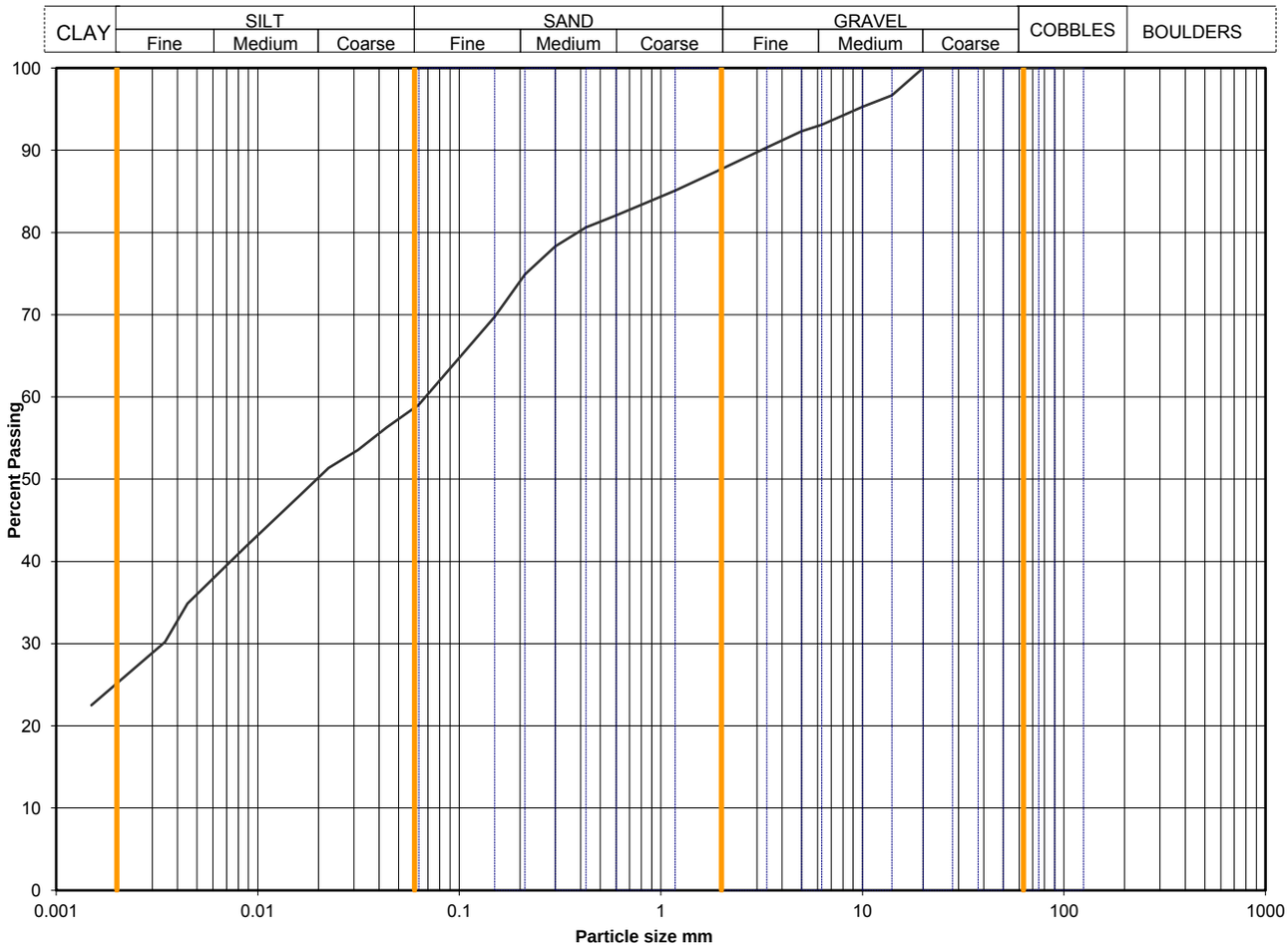
Soil description	Brown slightly gravelly sandy CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	28	28
	Sand	51	51
*<60mm values to aid description only	Silt	12	12
	Clay	9	9

Uniformity Coefficient	**D60 / D10**	144

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH411
		Sample Depth (m BGL)	6.1
	A7063-1720170803100243	Sample Type and No	D15
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	59
90	100	0.0436	56
75	100	0.0314	54
63	100	0.0225	51
50	100	0.0162	48
37.5	100	0.0087	42
28	100	0.0045	35
20	100	0.0035	30
14	97	0.0015	23
10	95		
6.3	93		
5.0	92		
3.35	90		
2.00	88		
1.18	85		
0.600	82		
0.425	81	2.65 assumed	
0.300	78	Dry mass of sample, kg	
0.212	75		
0.150	70	0.4	
0.063	59		

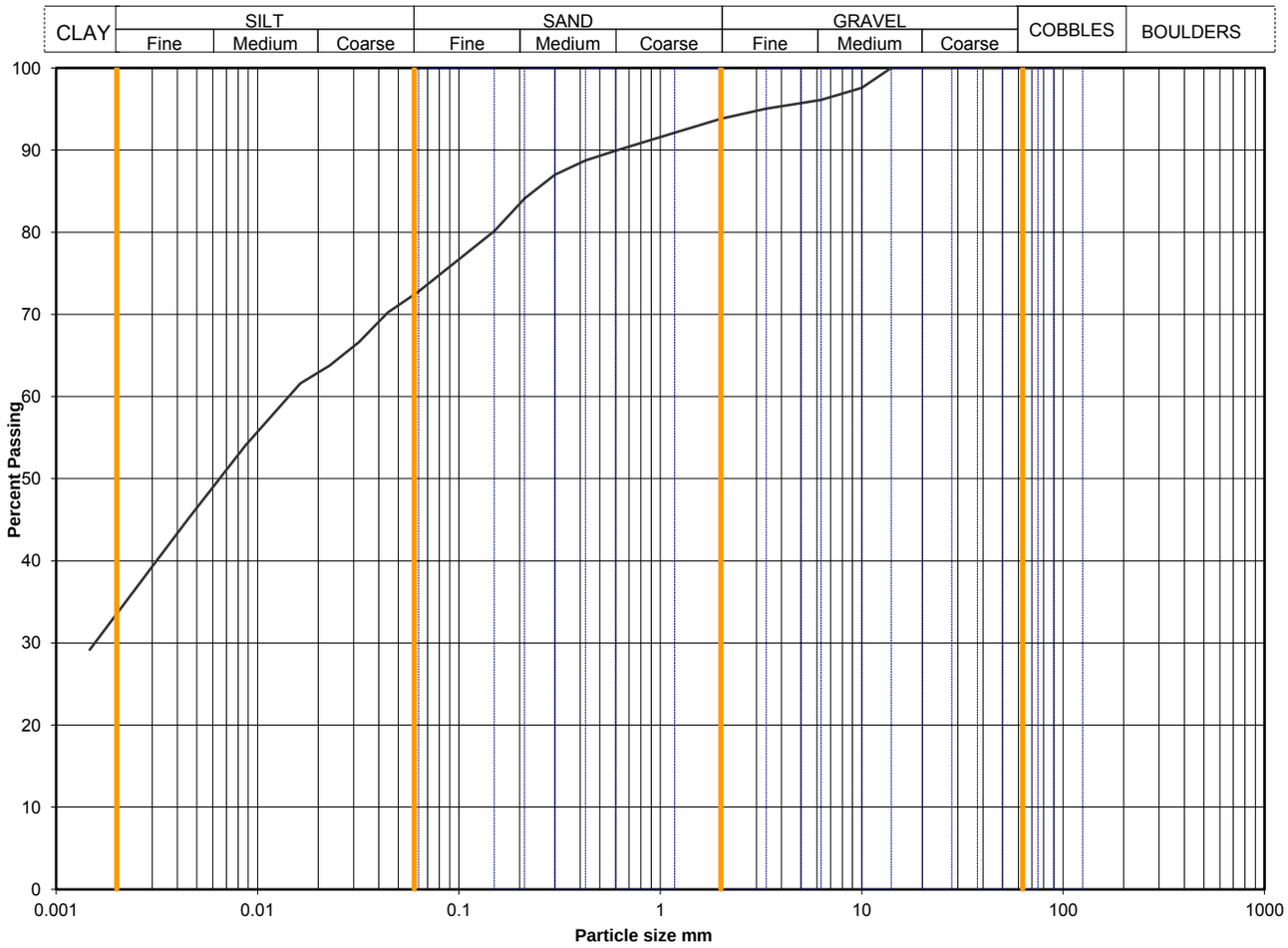
Soil description	Greyish brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: pre dried, Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	12	12
	Sand	29	29
*<60mm values to aid description only	Silt	34	34
	Clay	25	25

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH411A
		Sample Depth (m BGL)	7
	A7063-1720170824022647	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	73
90	100	0.0444	70
75	100	0.0319	67
63	100	0.0228	64
50	100	0.0163	62
37.5	100	0.0087	54
28	100	0.0045	45
20	100	0.0032	40
14	100	0.0015	29
10	98		
6.3	96		
5.0	96		
3.35	95		
2.00	94		
1.18	92		
0.600	90		
0.425	89	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	84		
0.150	80	6.0	
0.063	73		

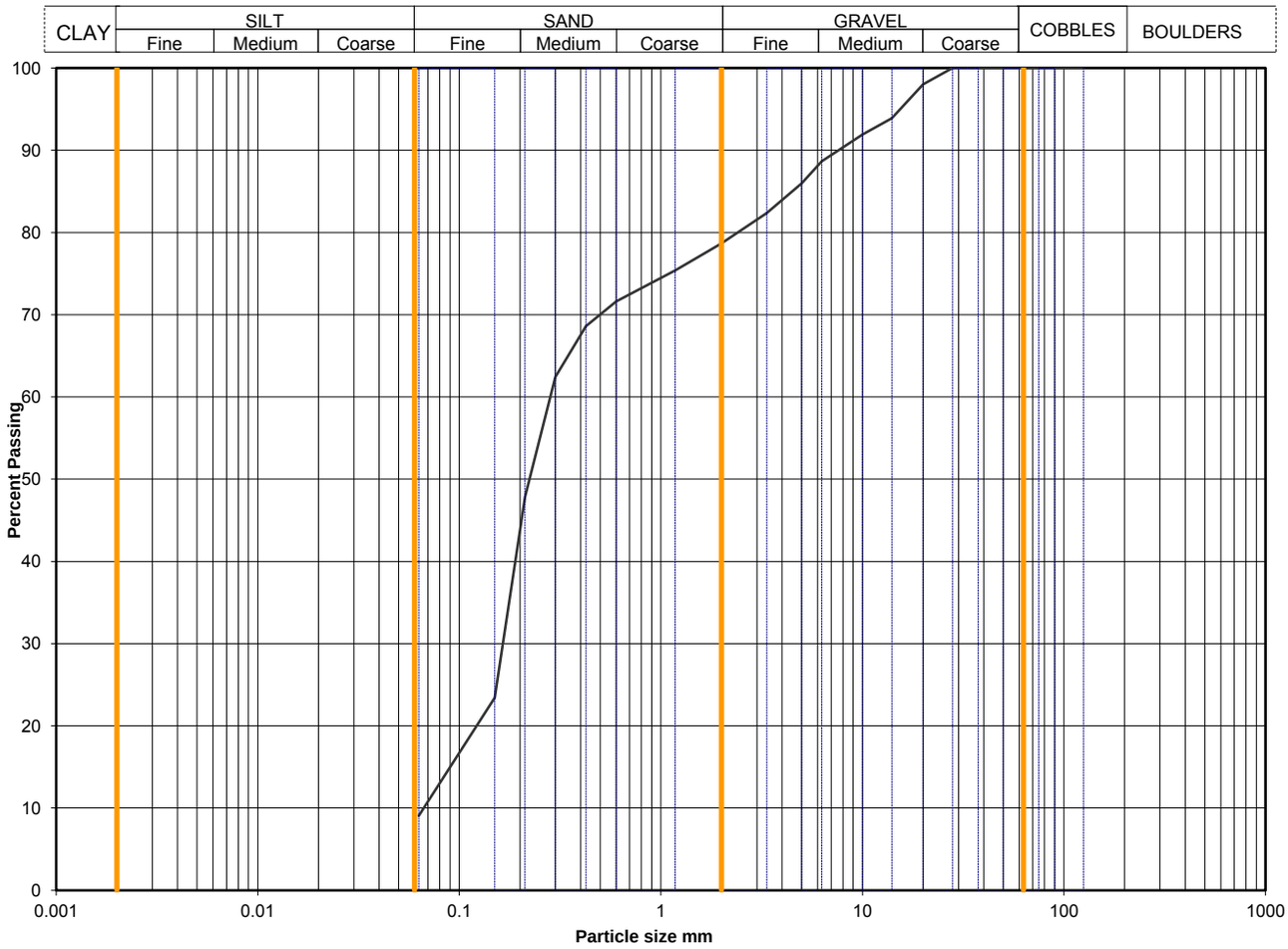
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	6	6
	Sand	21	21
*<60mm values to aid description only	Silt	39	39
	Clay	34	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	BH411A
		Sample Depth (m BGL)	9.5
	A7063-1720170824022827	Sample Type and No	B8
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	94		
10	92		
6.3	89		
5.0	86		
3.35	82		
2.00	79		
1.18	75		
0.600	72		
0.425	69		
0.300	62	Dry mass of sample, kg	
0.212	48		
0.150	23	2.2	
0.063	9		

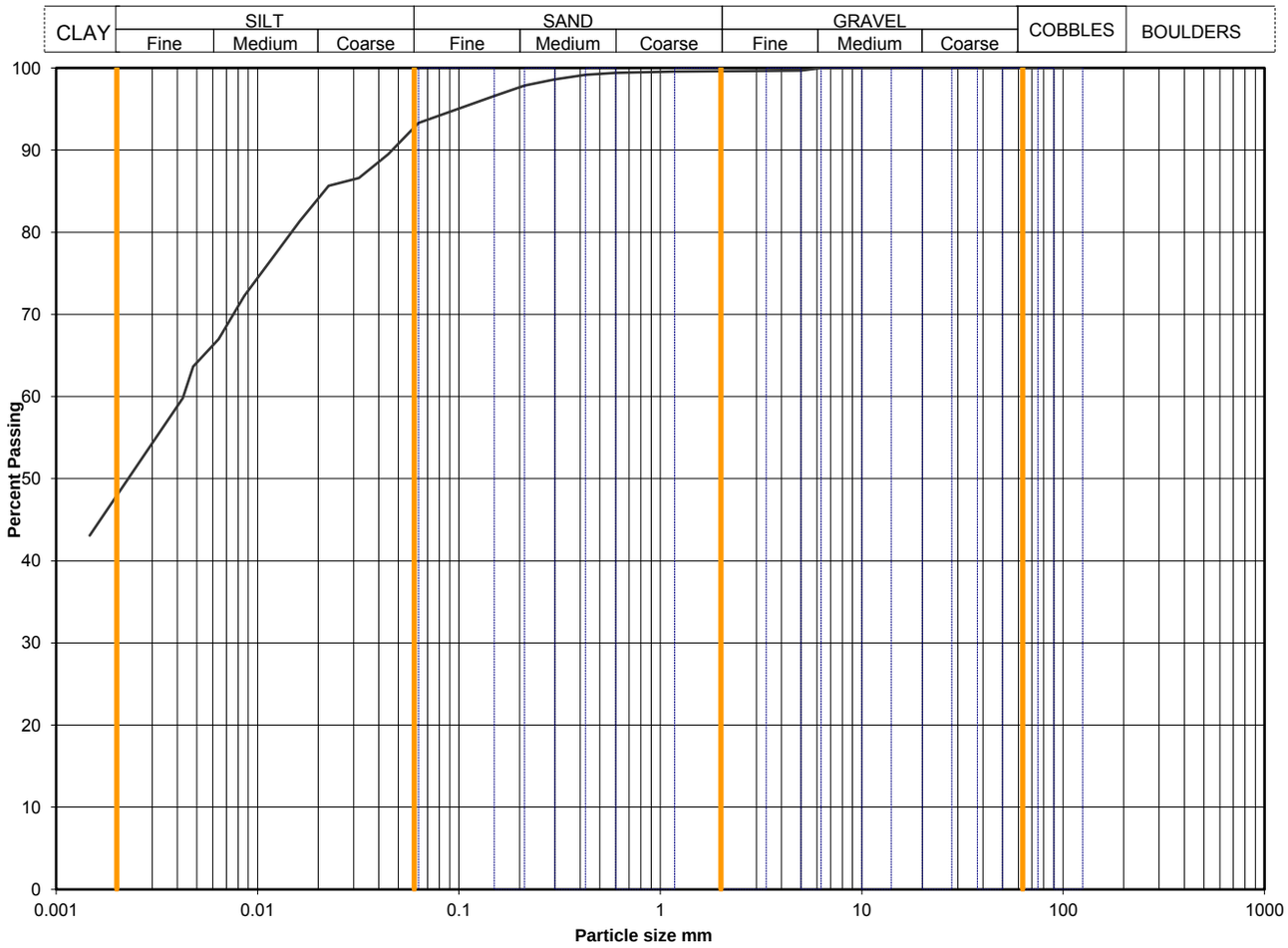
Soil description	Brown very gravelly silty SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	21	21
	Sand	70	70
*<60mm values to aid description only	Silt	silt+clay =	
	Clay	9	9

Uniformity Coefficient	**D60 / D10**	4

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.3 dry sieve
	Sedimentation	none

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP302
		Sample Depth (m BGL)	0.6
	A7063-17-20170726055905	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	93
90	100	0.0446	89
75	100	0.0318	87
63	100	0.0226	86
50	100	0.0162	81
37.5	100	0.0086	72
28	100	0.0064	67
20	100	0.0048	64
14	100	0.0043	60
10	100	0.0015	43
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	99		
0.425	99	2.65 assumed	
0.300	99	Dry mass of sample, kg	
0.212	98		
0.150	97	7.2	
0.063	93		

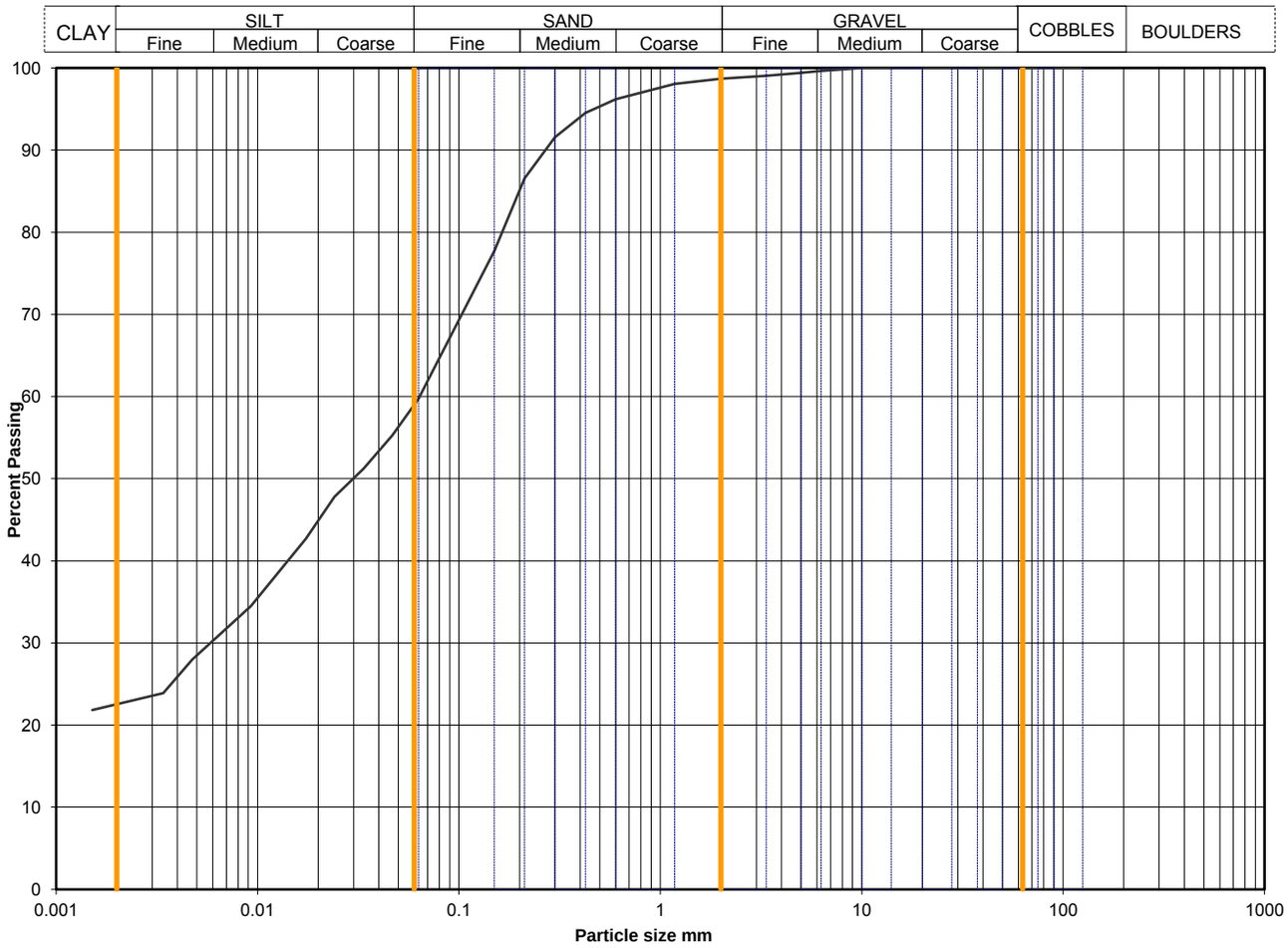
Soil description	Brown slightly sandy CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	6	6
*<60mm values to aid description only	Silt	45	45
	Clay	48	48

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP302
		Sample Depth (m BGL)	1.5
	A7063-17-20170726055937	Sample Type and No	D4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	60
90	100	0.0467	55
75	100	0.0336	51
63	100	0.0241	48
50	100	0.0174	43
37.5	100	0.0093	34
28	100	0.0047	28
20	100	0.0034	24
14	100	0.0015	22
10	100		
6.3	100		
5.0	99		
3.35	99		
2.00	99		
1.18	98		
0.600	96		
0.425	95	2.65 assumed	
0.300	92	Dry mass of sample, kg	
0.212	87		
0.150	78	0.7	
0.063	60		

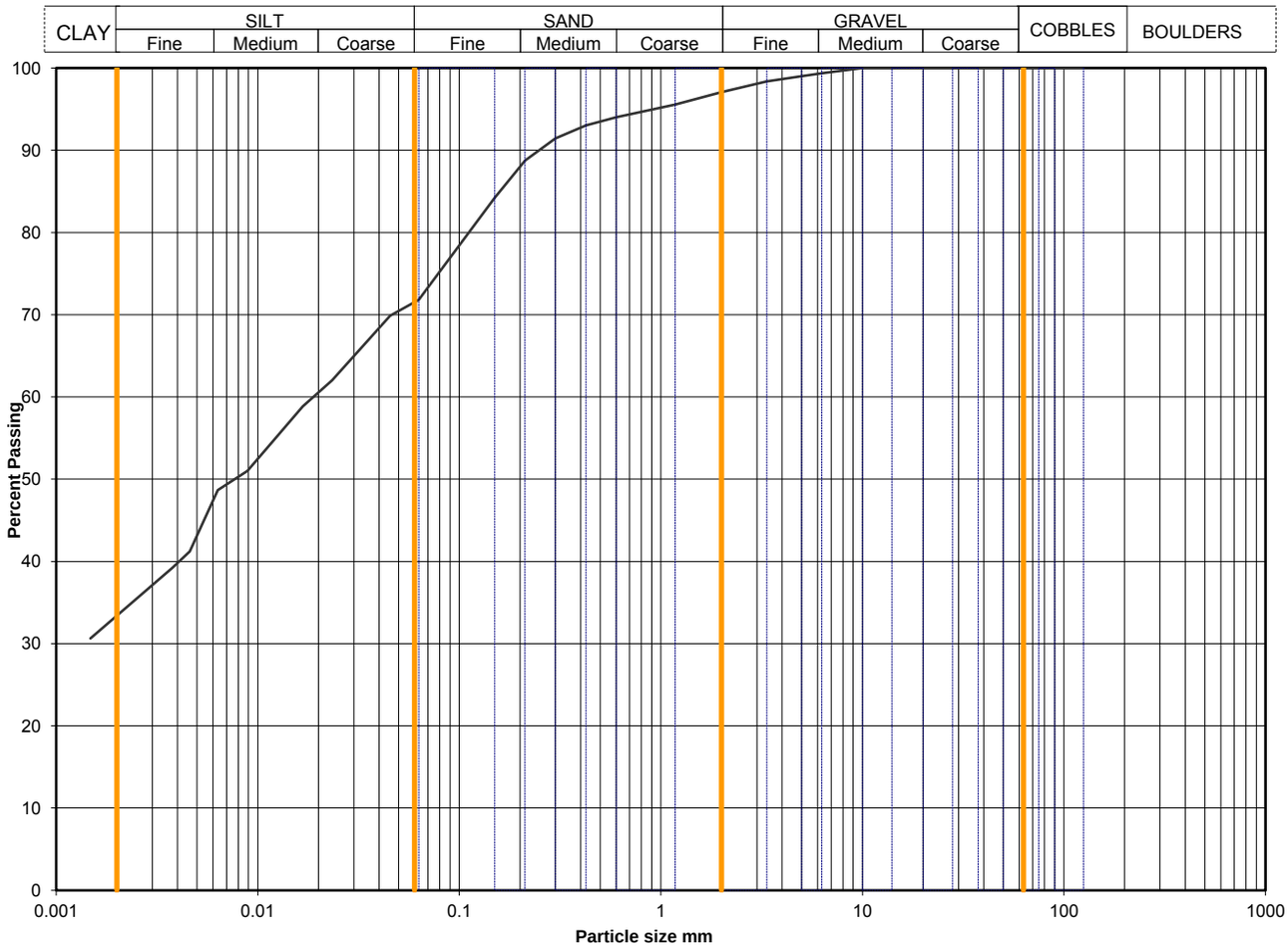
Soil description	Brown slightly gravelly sandy CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	1	1
	Sand	39	39
*<60mm values to aid description only	Silt	37	37
	Clay	23	23

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP302
		Sample Depth (m BGL)	3.6
	A7063-17-20170726060207	Sample Type and No	B7
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0454	70
75	100	0.0326	66
63	100	0.0234	62
50	100	0.0168	59
37.5	100	0.0089	51
28	100	0.0063	49
20	100	0.0046	41
14	100	0.0038	39
10	100	0.0015	31
6.3	99		
5.0	99		
3.35	98		
2.00	97		
1.18	96		
0.600	94		
0.425	93	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	89		
0.150	84	3.8	
0.063	72		

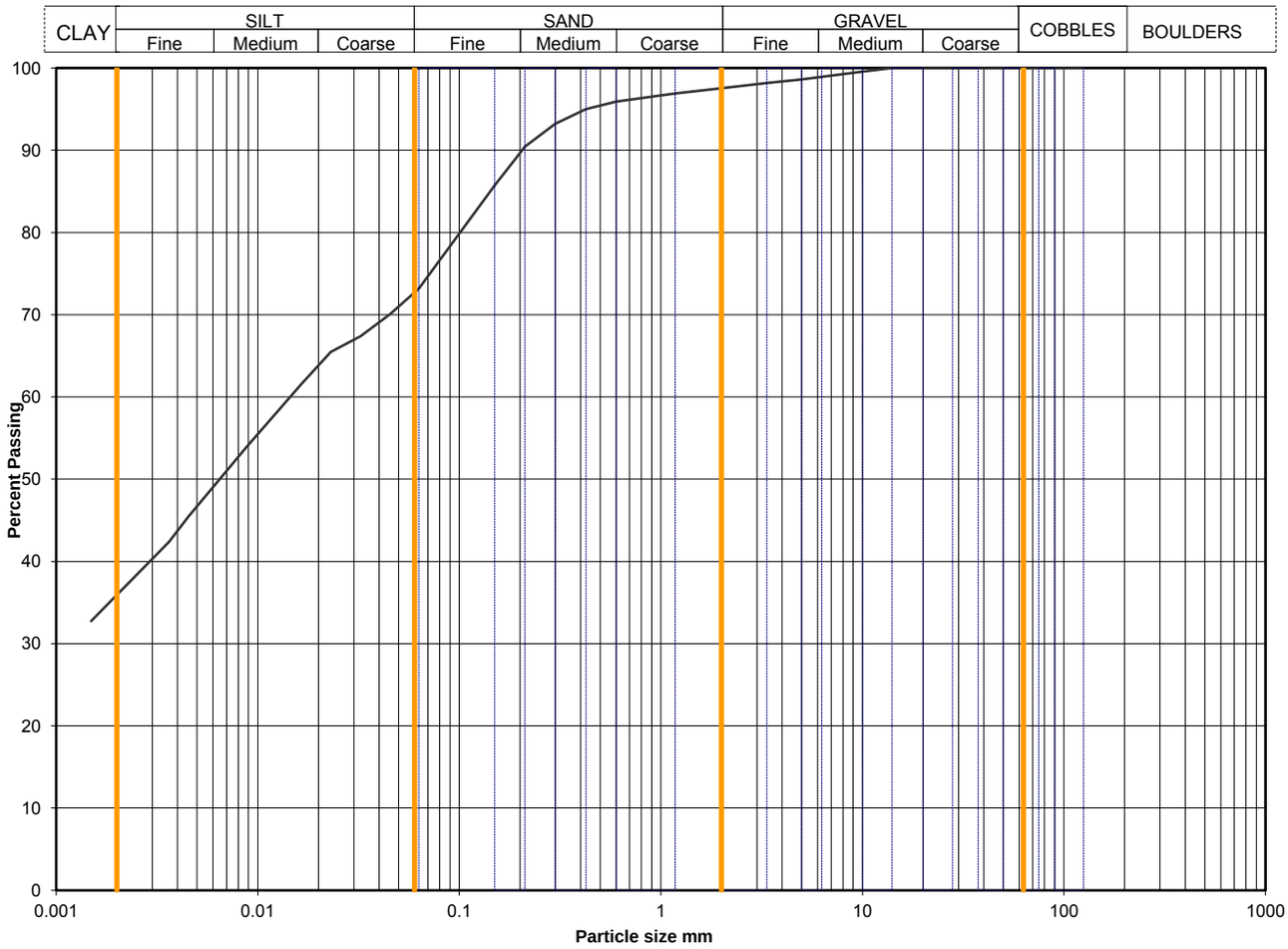
Soil description	Dark brown slightly sandy slightly gravelly silty CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	25	25
*<60mm values to aid description only	Silt	38	38
	Clay	33	33

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP303
		Sample Depth (m BGL)	0.6
	A7063-17-20170725115407	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	73
90	100	0.0453	70
75	100	0.0324	67
63	100	0.0231	65
50	100	0.0166	62
37.5	100	0.0088	54
28	100	0.0045	45
20	100	0.0036	42
14	100	0.0015	33
10	100		
6.3	99		
5.0	99		
3.35	98		
2.00	98		
1.18	97		
0.600	96		
0.425	95	2.65 assumed	
0.300	93	Dry mass of sample, kg	
0.212	90		
0.150	86	8.8	
0.063	73		

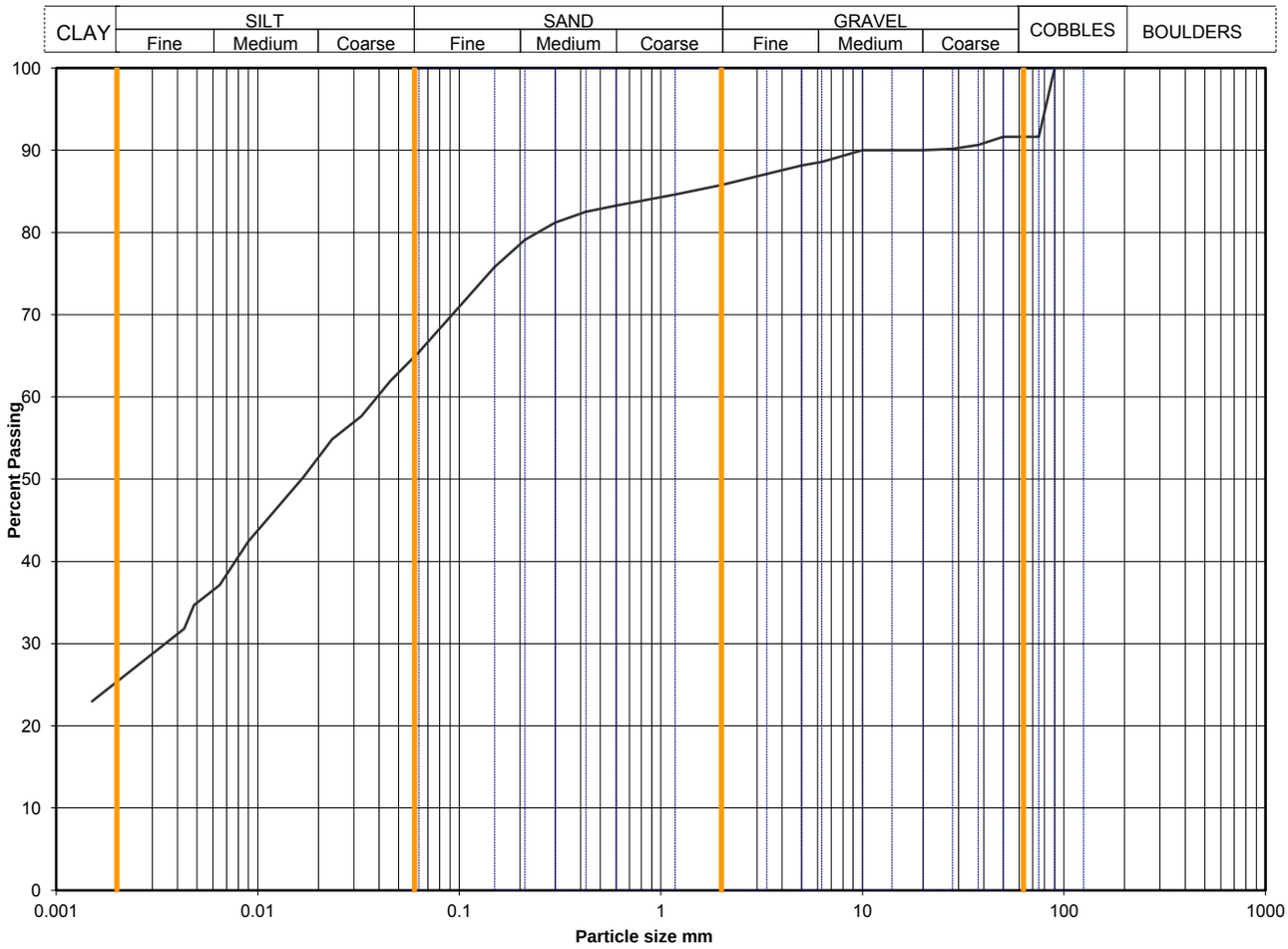
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	24	24
*<60mm values to aid description only	Silt	37	37
	Clay	36	36

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP303
		Sample Depth (m BGL)	2.4
	A7063-17-20170725115538	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	65
90	100	0.0454	62
75	92	0.0327	58
63	92	0.0234	55
50	92	0.0169	50
37.5	91	0.0090	42
28	90	0.0065	37
20	90	0.0048	35
14	90	0.0043	32
10	90	0.0015	23
6.3	89		
5.0	88		
3.35	87		
2.00	86		
1.18	85		
0.600	83		
0.425	83	2.65 assumed	
0.300	81	Dry mass of sample, kg	
0.212	79		
0.150	76	10.8	
0.063	65		

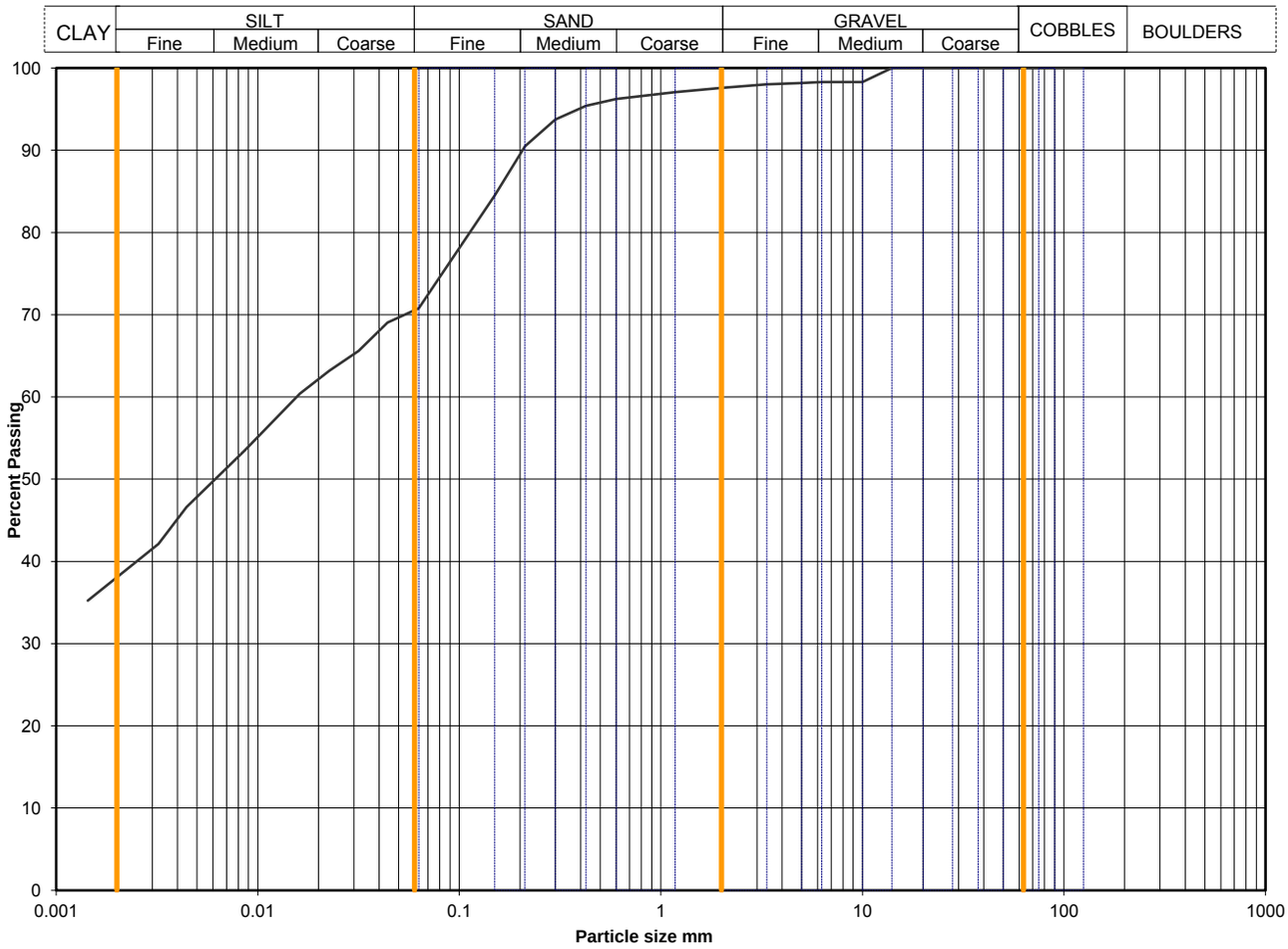
Soil description	Brown slightly sandy slightly gravelly clayey SILT with one cobble		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	8	0
	Gravel	6	7
	Sand	20	22
*<60mm values to aid description only	Silt	40	43
	Clay	25	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP304
		Sample Depth (m BGL)	0.4
	A7063-17-20170726105808	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	71
90	100	0.0440	69
75	100	0.0316	66
63	100	0.0226	63
50	100	0.0162	60
37.5	100	0.0086	54
28	100	0.0044	47
20	100	0.0032	42
14	100	0.0014	35
10	98		
6.3	98		
5.0	98		
3.35	98		
2.00	98		
1.18	97		
0.600	96		
0.425	95	2.65 assumed	
0.300	94	Dry mass of sample, kg	
0.212	91		
0.150	84	8.8	
0.063	71		

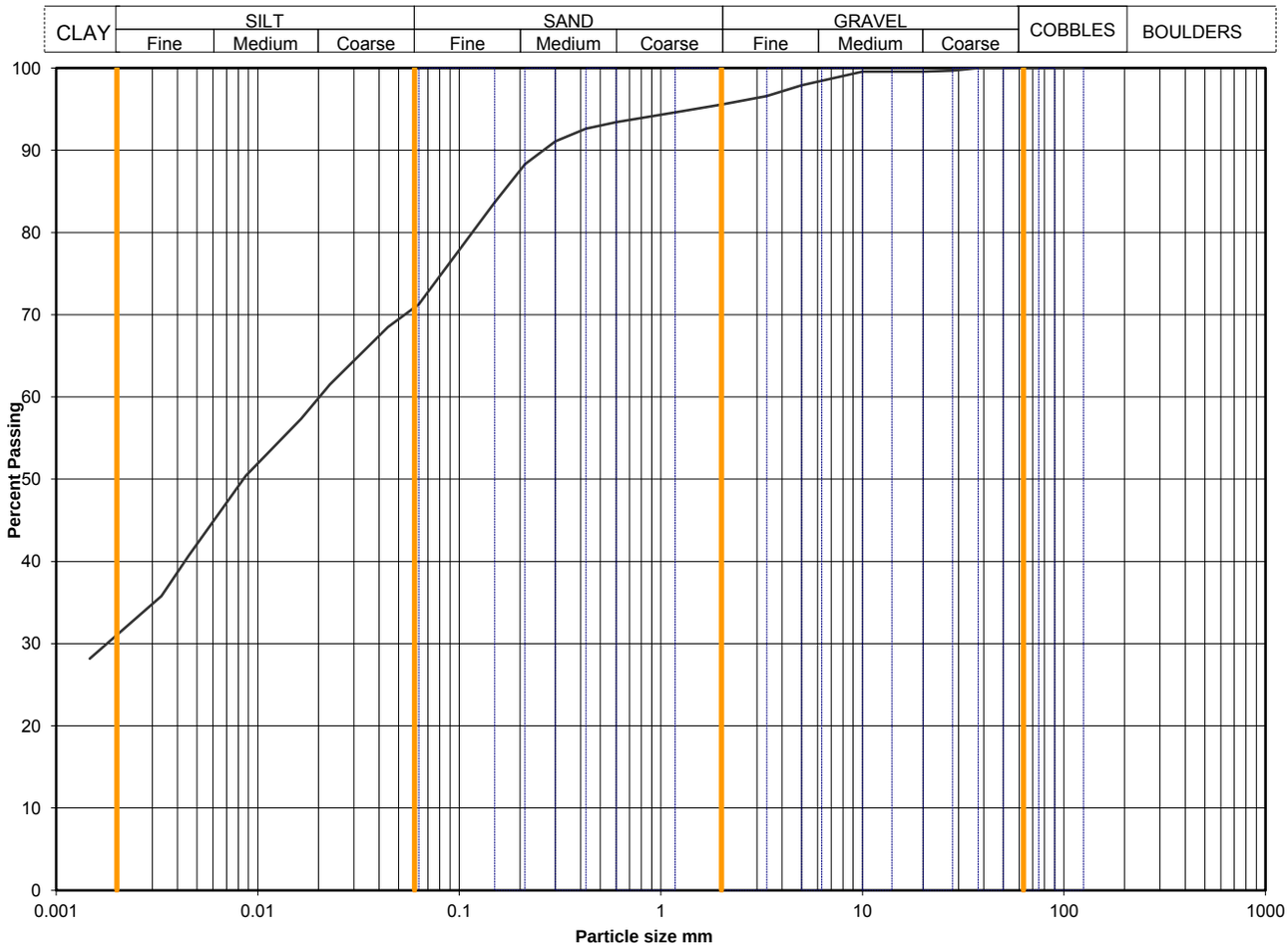
Soil description	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	27	27
*<60mm values to aid description only	Silt	33	33
	Clay	38	38

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP304
		Sample Depth (m BGL)	1.4
	A7063-17-20170726105937	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	71
90	100	0.0442	68
75	100	0.0318	65
63	100	0.0228	62
50	100	0.0164	57
37.5	100	0.0087	50
28	100	0.0045	41
20	100	0.0033	36
14	100	0.0015	28
10	100		
6.3	98		
5.0	98		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	93	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	88		
0.150	84	8.9	
0.063	71		

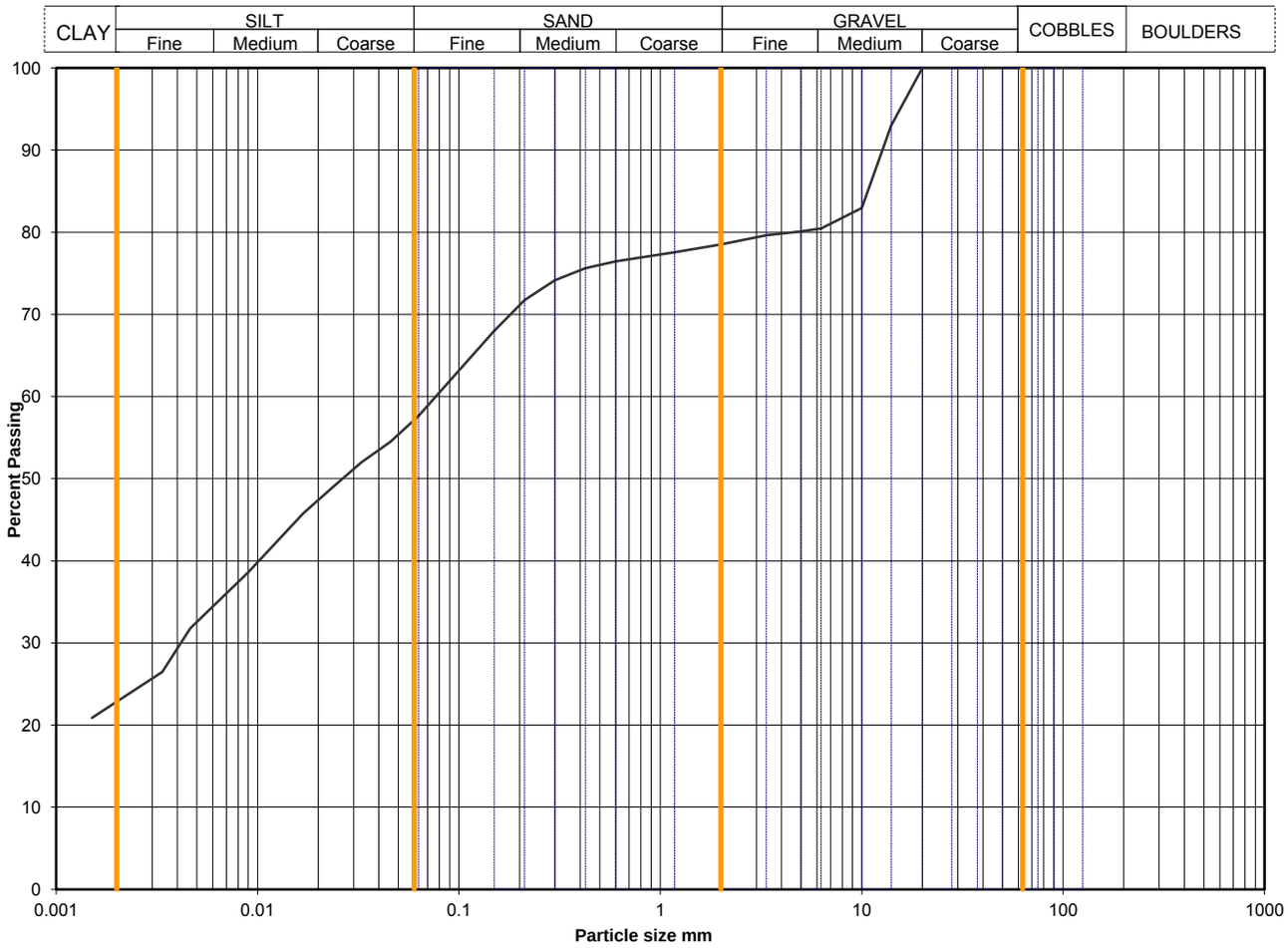
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	24	24
*<60mm values to aid description only	Silt	40	40
	Clay	31	31

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP304
		Sample Depth (m BGL)	3.1
	A7063-17-20170726110055	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	58
90	100	0.0458	55
75	100	0.0328	52
63	100	0.0235	49
50	100	0.0169	46
37.5	100	0.0090	39
28	100	0.0046	32
20	100	0.0034	26
14	93	0.0015	21
10	83		
6.3	80		
5.0	80		
3.35	80		
2.00	79		
1.18	78		
0.600	76		
0.425	76	2.65 assumed	
0.300	74	Dry mass of sample, kg	
0.212	72		
0.150	68	1.8	
0.063	58		

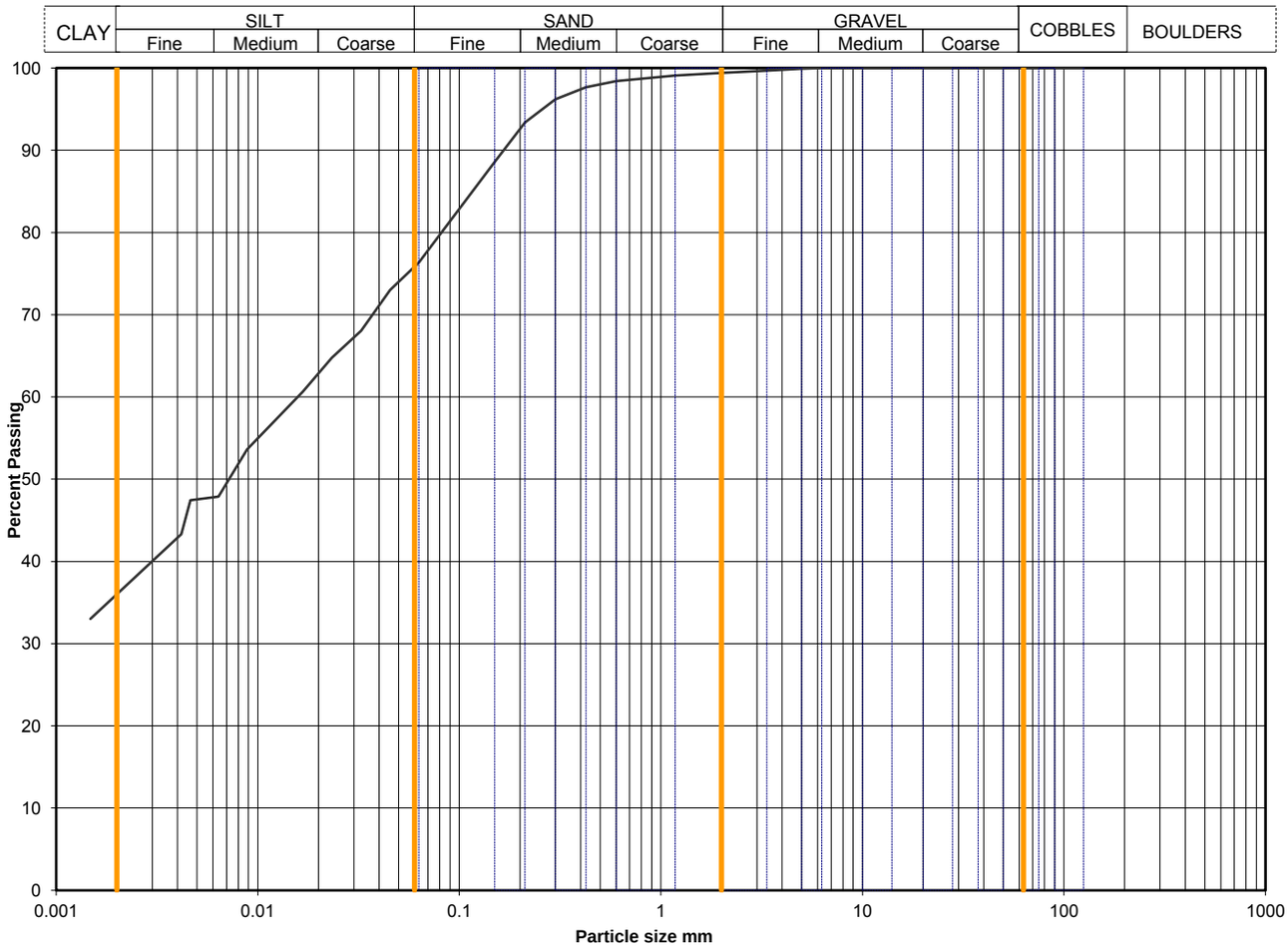
Soil description	Brown slightly sandy slightly gravelly SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	21	21
	Sand	21	21
*<60mm values to aid description only	Silt	35	35
	Clay	23	23

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP305
		Sample Depth (m BGL)	0.5
	A7063-17-20170726114822	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	76
90	100	0.0453	73
75	100	0.0326	68
63	100	0.0234	65
50	100	0.0168	61
37.5	100	0.0089	54
28	100	0.0064	48
20	100	0.0046	47
14	100	0.0042	43
10	100	0.0015	33
6.3	100		
5.0	100		
3.35	100		
2.00	99		
1.18	99		
0.600	98		
0.425	98	2.65 assumed	
0.300	96	Dry mass of sample, kg	
0.212	93		
0.150	89	6.8	
0.063	76		

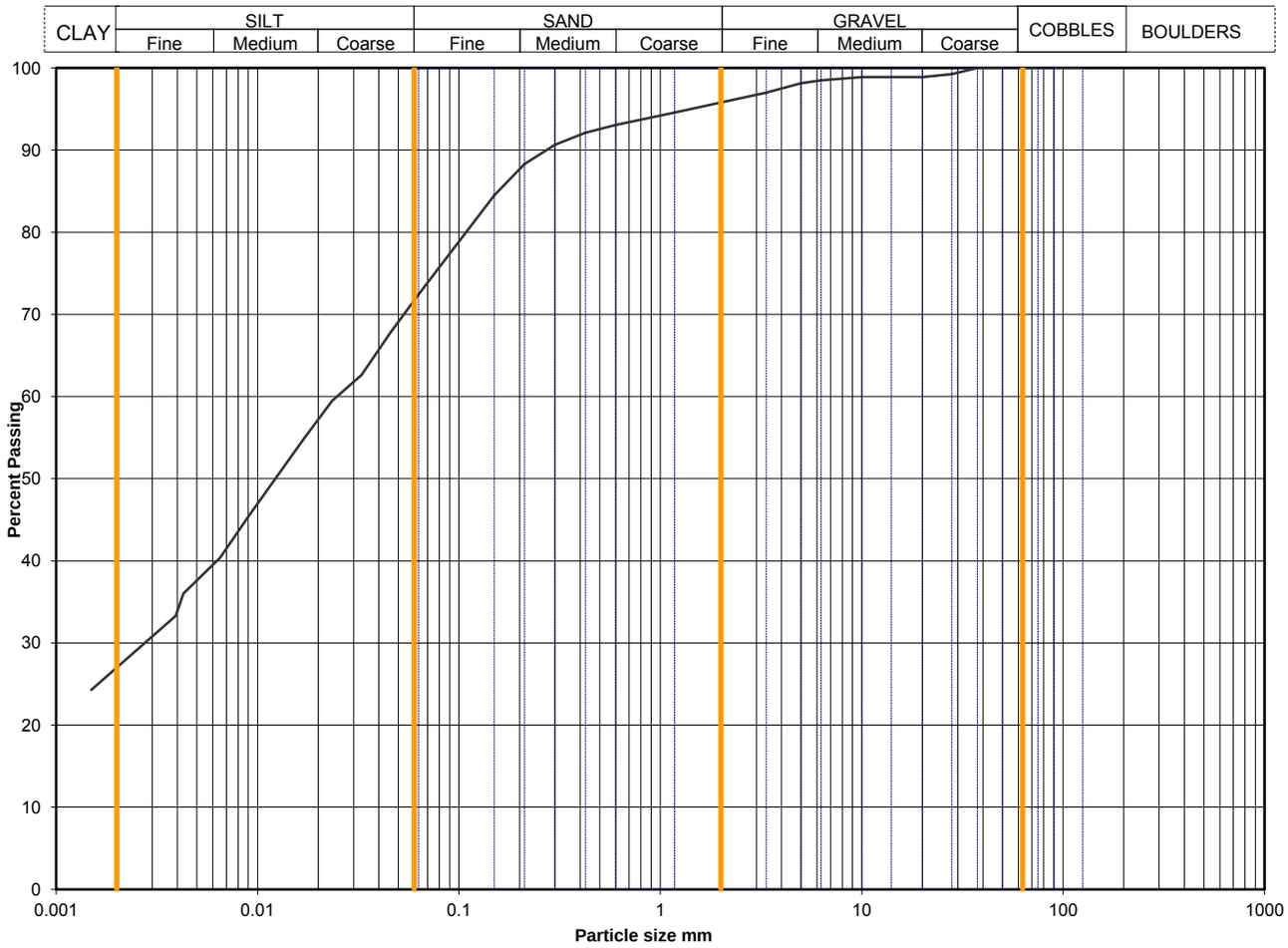
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	1	1
	Sand	23	23
*<60mm values to aid description only	Silt	40	40
	Clay	36	36

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP305
		Sample Depth (m BGL)	3.1
	A7063-17-20170726114950	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0456	68
75	100	0.0329	63
63	100	0.0235	60
50	100	0.0169	55
37.5	100	0.0090	45
28	99	0.0065	40
20	99	0.0043	36
14	99	0.0039	33
10	99	0.0015	24
6.3	98		
5.0	98		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	92	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	88		
0.150	85	8.4	
0.063	72		

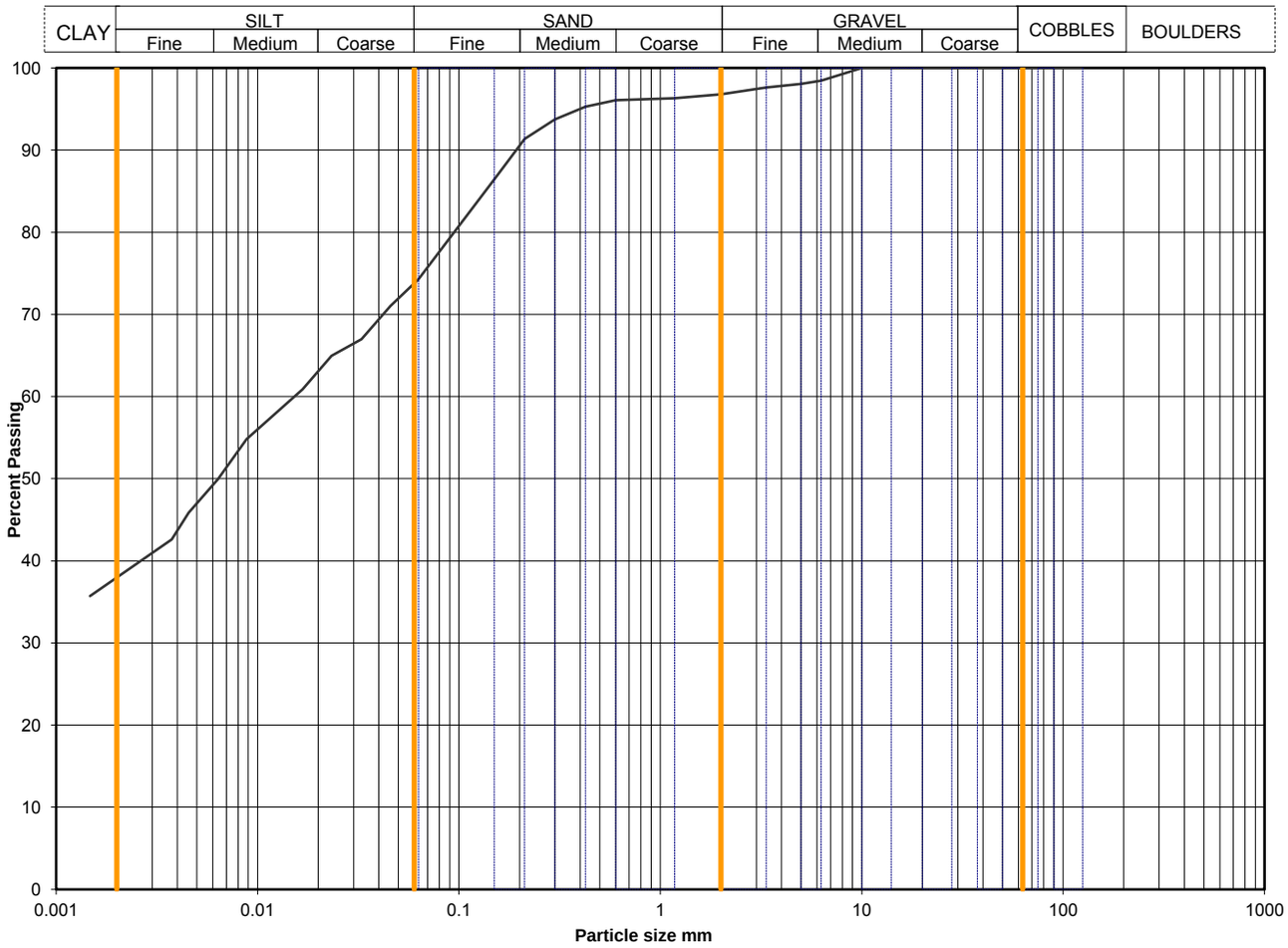
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	23	23
*<60mm values to aid description only	Silt	45	45
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP306
		Sample Depth (m BGL)	0.8
	A7063-17-20170726074554	Sample Type and No	B3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	74
90	100	0.0457	71
75	100	0.0328	67
63	100	0.0234	65
50	100	0.0168	61
37.5	100	0.0088	55
28	100	0.0064	50
20	100	0.0046	46
14	100	0.0038	43
10	100	0.0015	36
6.3	98		
5.0	98		
3.35	98		
2.00	97		
1.18	96		
0.600	96		
0.425	95	2.65 assumed	
0.300	94	Dry mass of sample, kg	
0.212	91		
0.150	86	6.3	
0.063	74		

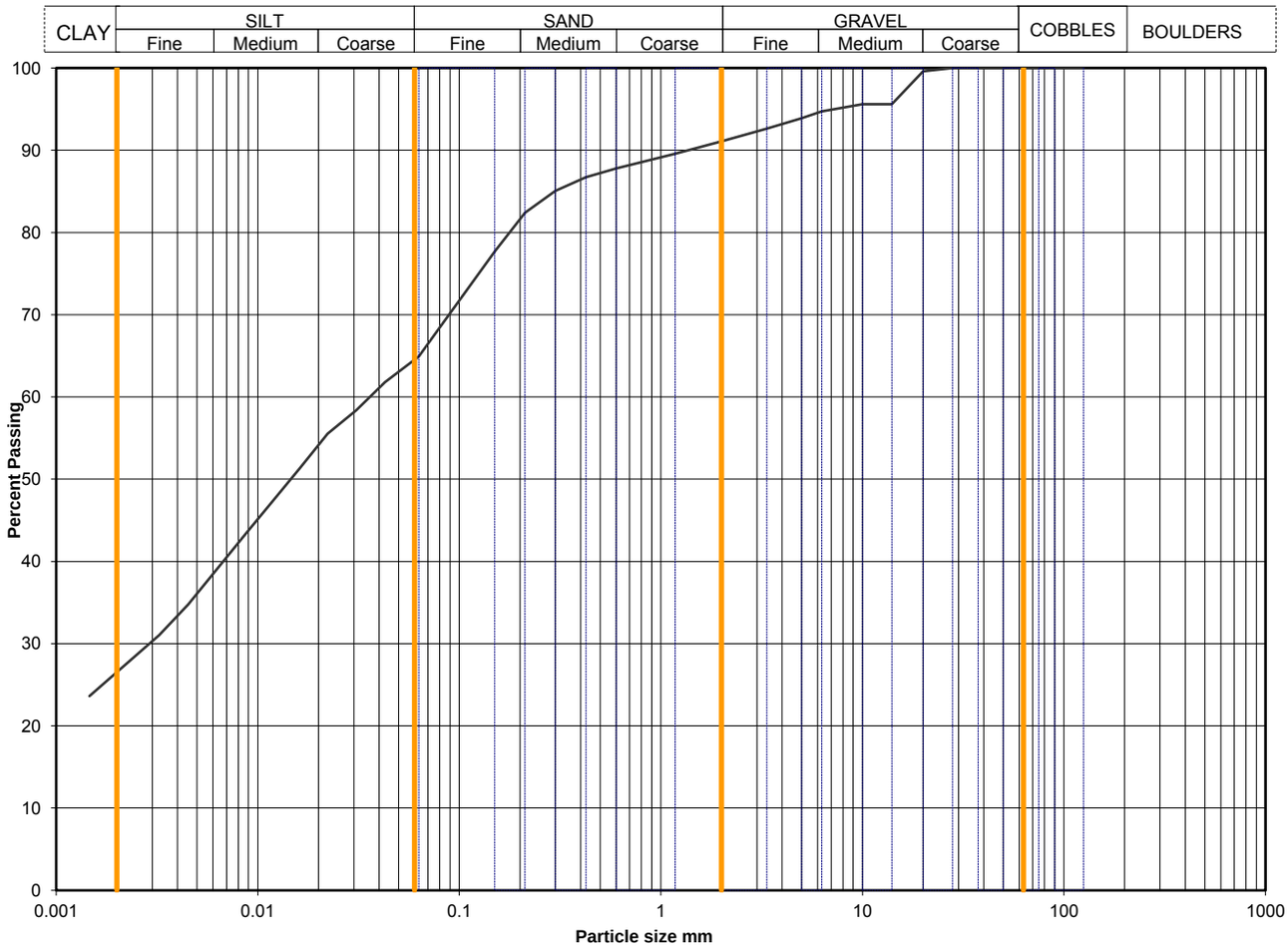
Soil description	Brown slightly sandy slightly gravelly SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	23	23
*<60mm values to aid description only	Silt	36	36
	Clay	38	38

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP306
		Sample Depth (m BGL)	2.2
	A7063-17-20170726074649	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	65
90	100	0.0427	62
75	100	0.0309	58
63	100	0.0222	56
50	100	0.0161	51
37.5	100	0.0087	43
28	100	0.0045	35
20	100	0.0032	31
14	96	0.0015	24
10	96		
6.3	95		
5.0	94		
3.35	93		
2.00	91		
1.18	90		
0.600	88		
0.425	87	2.65 assumed	
0.300	85	Dry mass of sample, kg	
0.212	82		
0.150	78	8.9	
0.063	65		

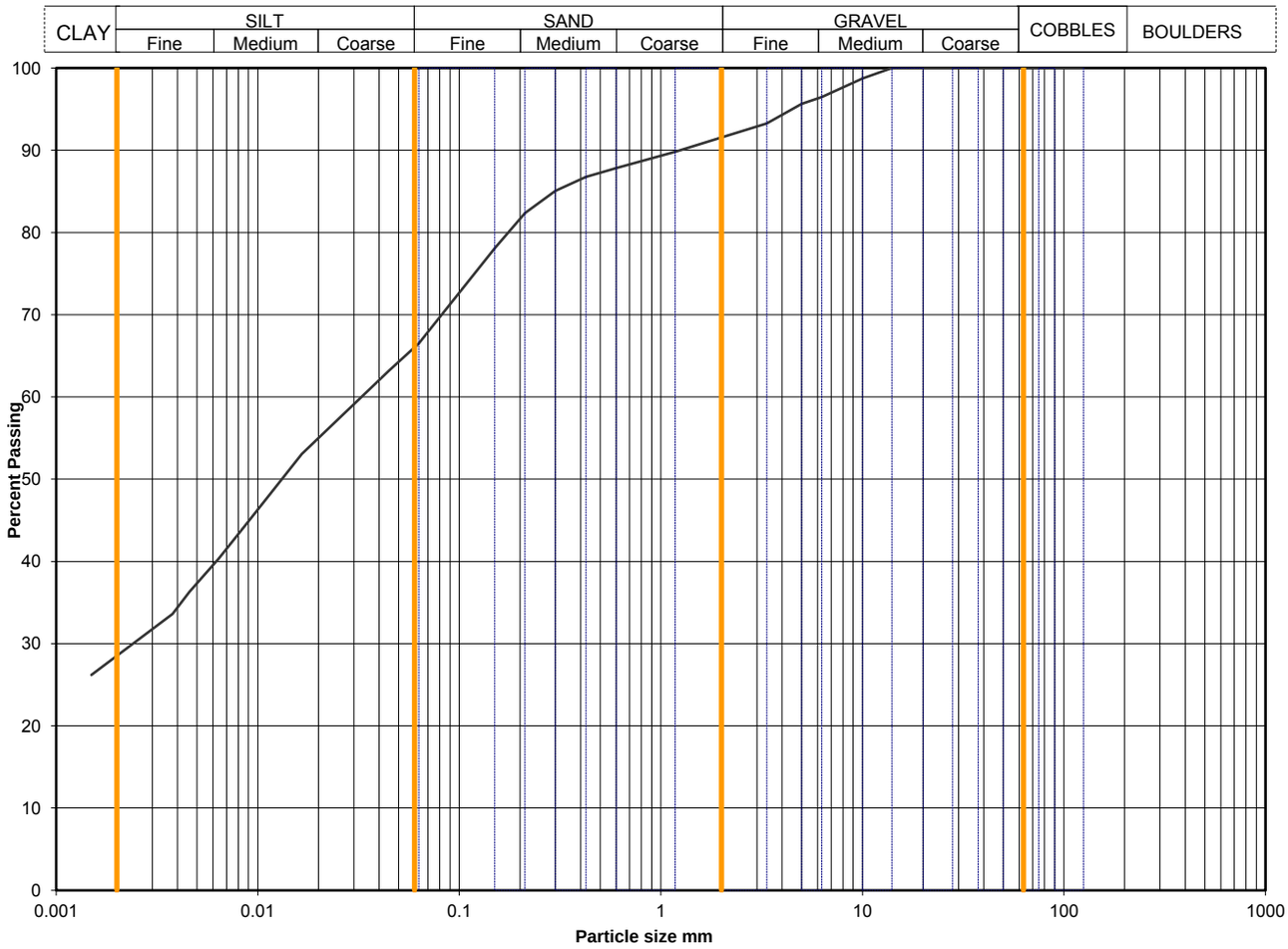
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	9	9
	Sand	26	26
*<60mm values to aid description only	Silt	38	38
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP306
		Sample Depth (m BGL)	3.5
	A7063-17-20170726074721	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	67
90	100	0.0447	63
75	100	0.0321	60
63	100	0.0231	56
50	100	0.0166	53
37.5	100	0.0089	45
28	100	0.0064	40
20	100	0.0046	36
14	100	0.0038	34
10	99	0.0015	26
6.3	96		
5.0	96		
3.35	93		
2.00	92		
1.18	90		
0.600	88		
0.425	87	2.65 assumed	
0.300	85	Dry mass of sample, kg	
0.212	82		
0.150	78	1.9	
0.063	67		

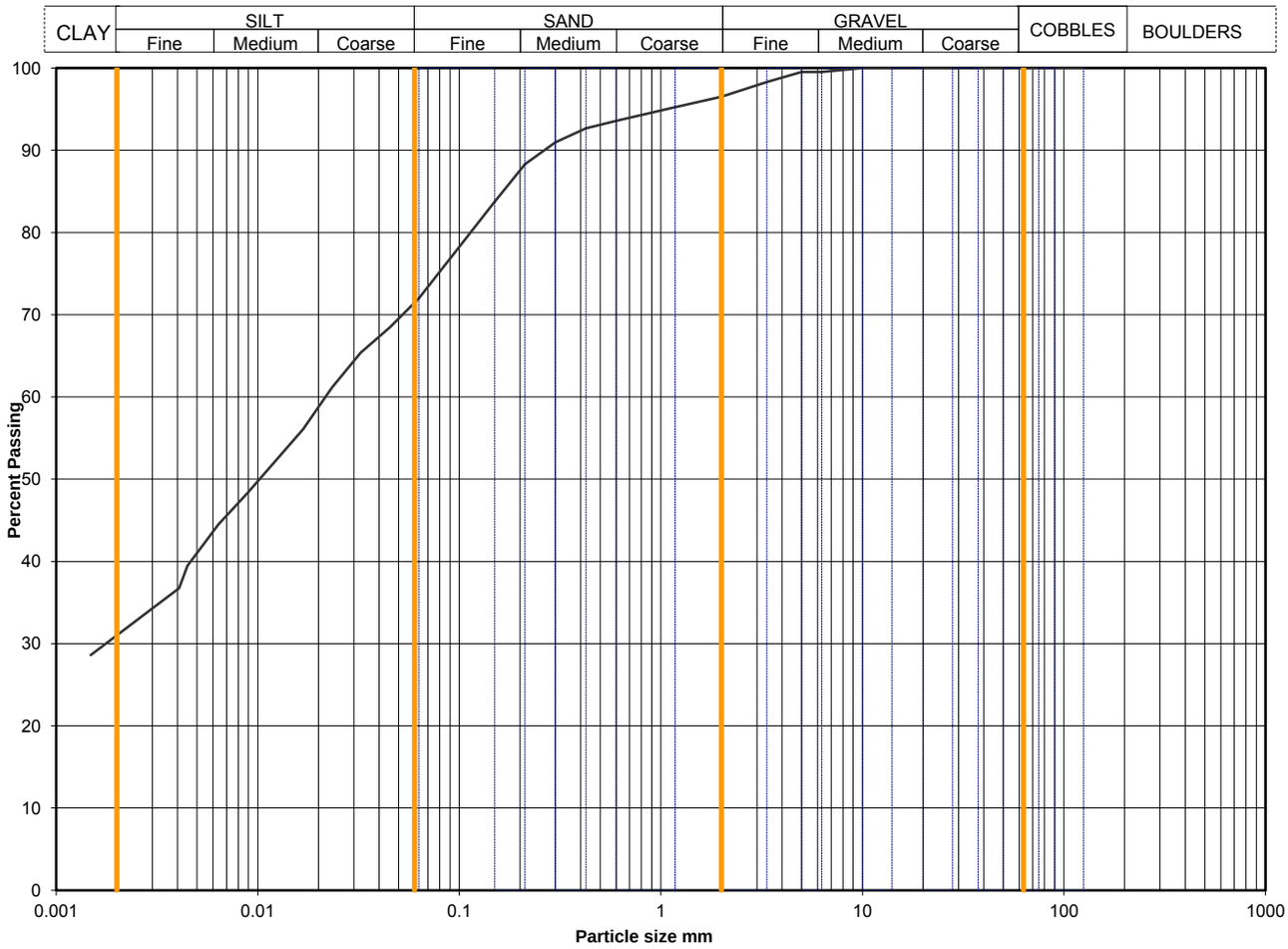
Soil description	Brown slightly sandy slightly gravelly clayey SILT		
Preparation / Pretreatment	Sieve: pre dried, Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	25	25
*<60mm values to aid description only	Silt	38	38
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP307
		Sample Depth (m BGL)	0.6
	A7063-17-20170726081244	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0453	68
75	100	0.0324	65
63	100	0.0233	61
50	100	0.0168	56
37.5	100	0.0089	48
28	100	0.0064	44
20	100	0.0045	39
14	100	0.0041	37
10	100	0.0015	29
6.3	100		
5.0	100		
3.35	98		
2.00	97		
1.18	95		
0.600	94		
0.425	93	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	88		
0.150	84	7.0	
0.063	72		

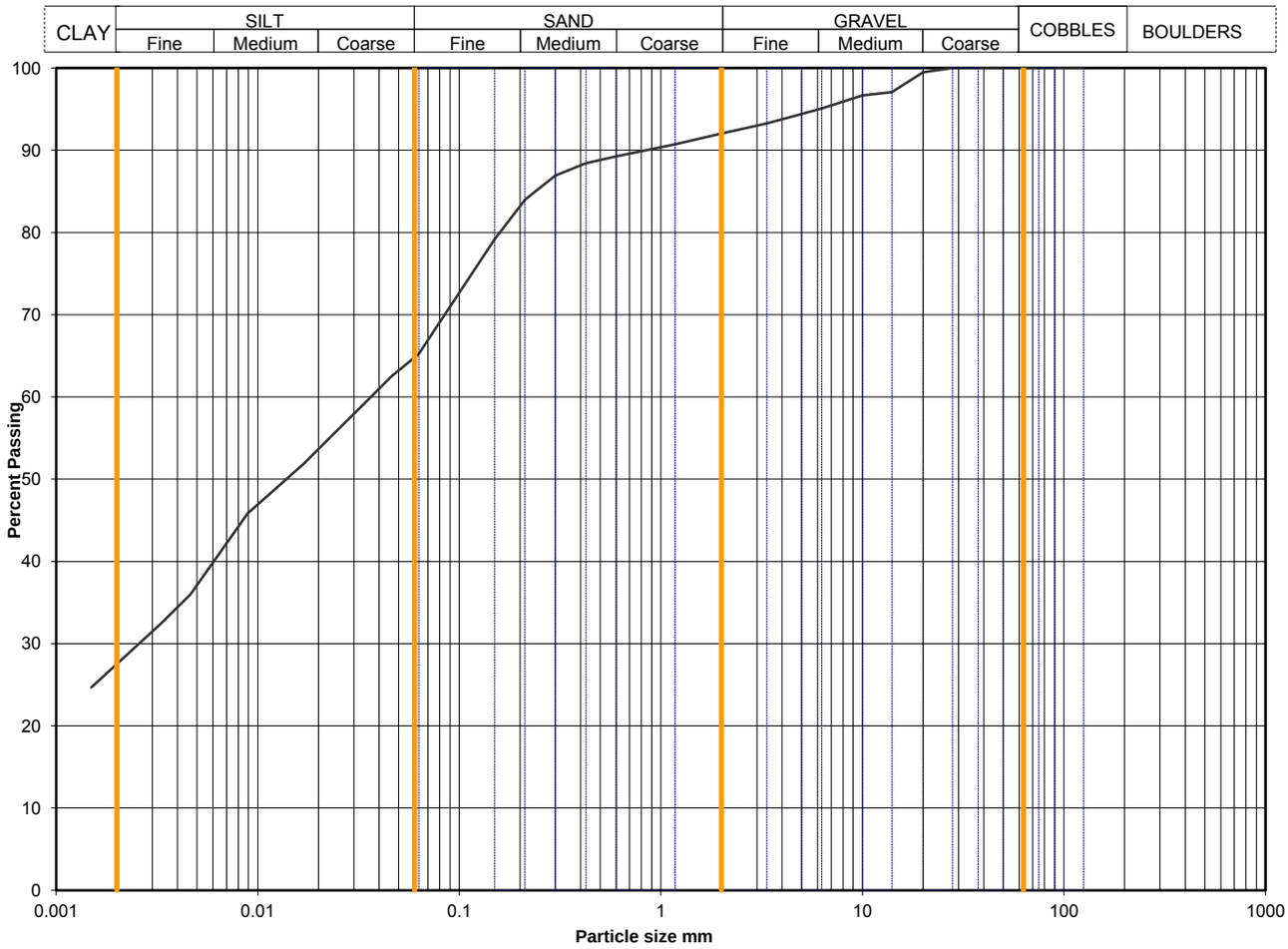
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	25	25
*<60mm values to aid description only	Silt	41	41
	Clay	31	31

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP307
		Sample Depth (m BGL)	3.7
	A7063-17-20170726081414	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	65
90	100	0.0457	62
75	100	0.0328	59
63	100	0.0235	55
50	100	0.0169	52
37.5	100	0.0089	46
28	100	0.0046	36
20	99	0.0033	32
14	97	0.0015	25
10	97		
6.3	95		
5.0	94		
3.35	93		
2.00	92		
1.18	91		
0.600	89		
0.425	88	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	84		
0.150	79	5.7	
0.063	65		

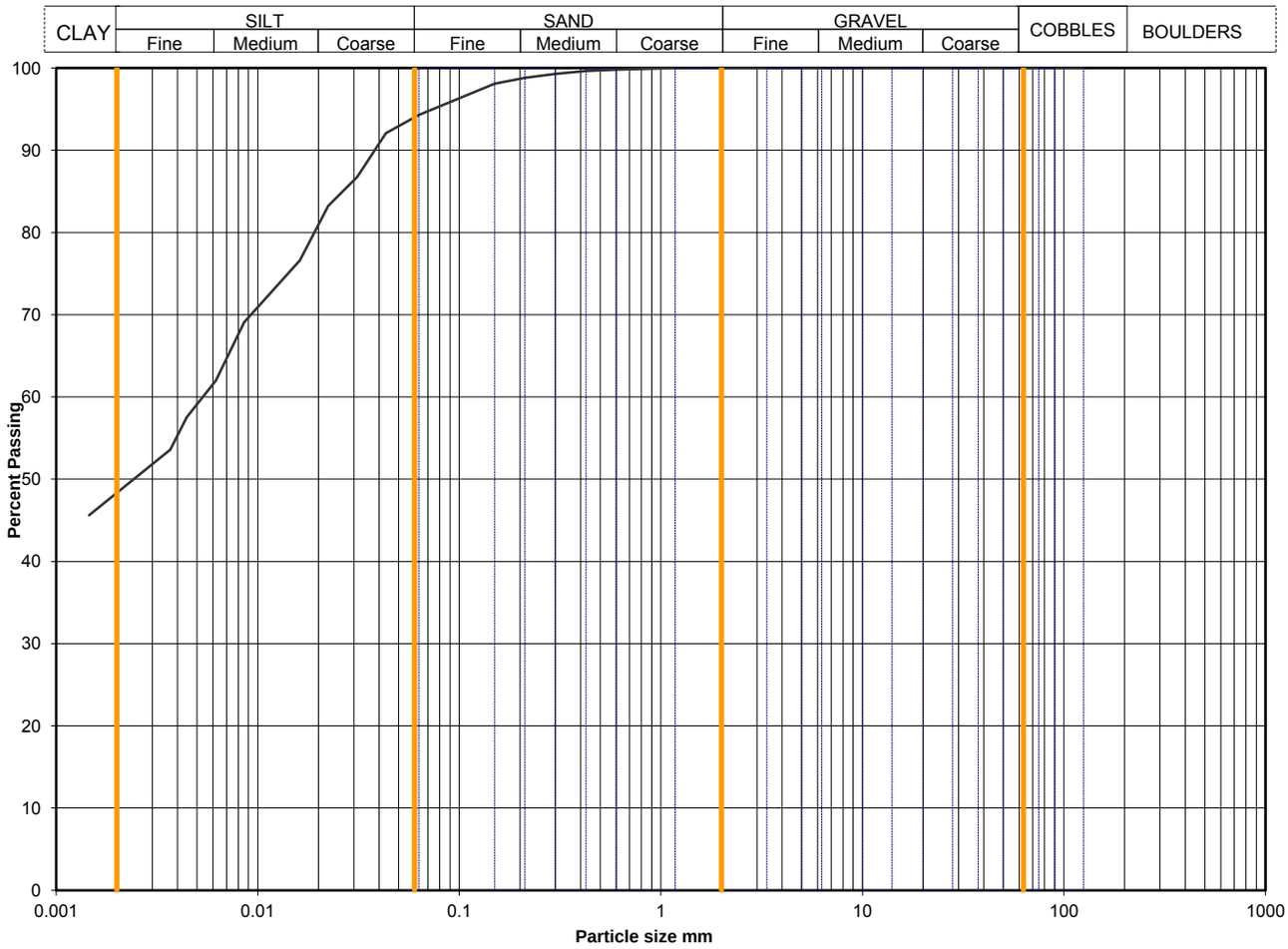
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	27	27
*<60mm values to aid description only	Silt	38	38
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP308
		Sample Depth (m BGL)	0.6
	A7063-17-20170726085211	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	94
90	100	0.0433	92
75	100	0.0312	87
63	100	0.0224	83
50	100	0.0162	77
37.5	100	0.0086	69
28	100	0.0062	62
20	100	0.0044	58
14	100	0.0037	54
10	100	0.0015	46
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	100		
0.425	100	2.65 assumed	
0.300	99	Dry mass of sample, kg	
0.212	99		
0.150	98	2.2	
0.063	94		

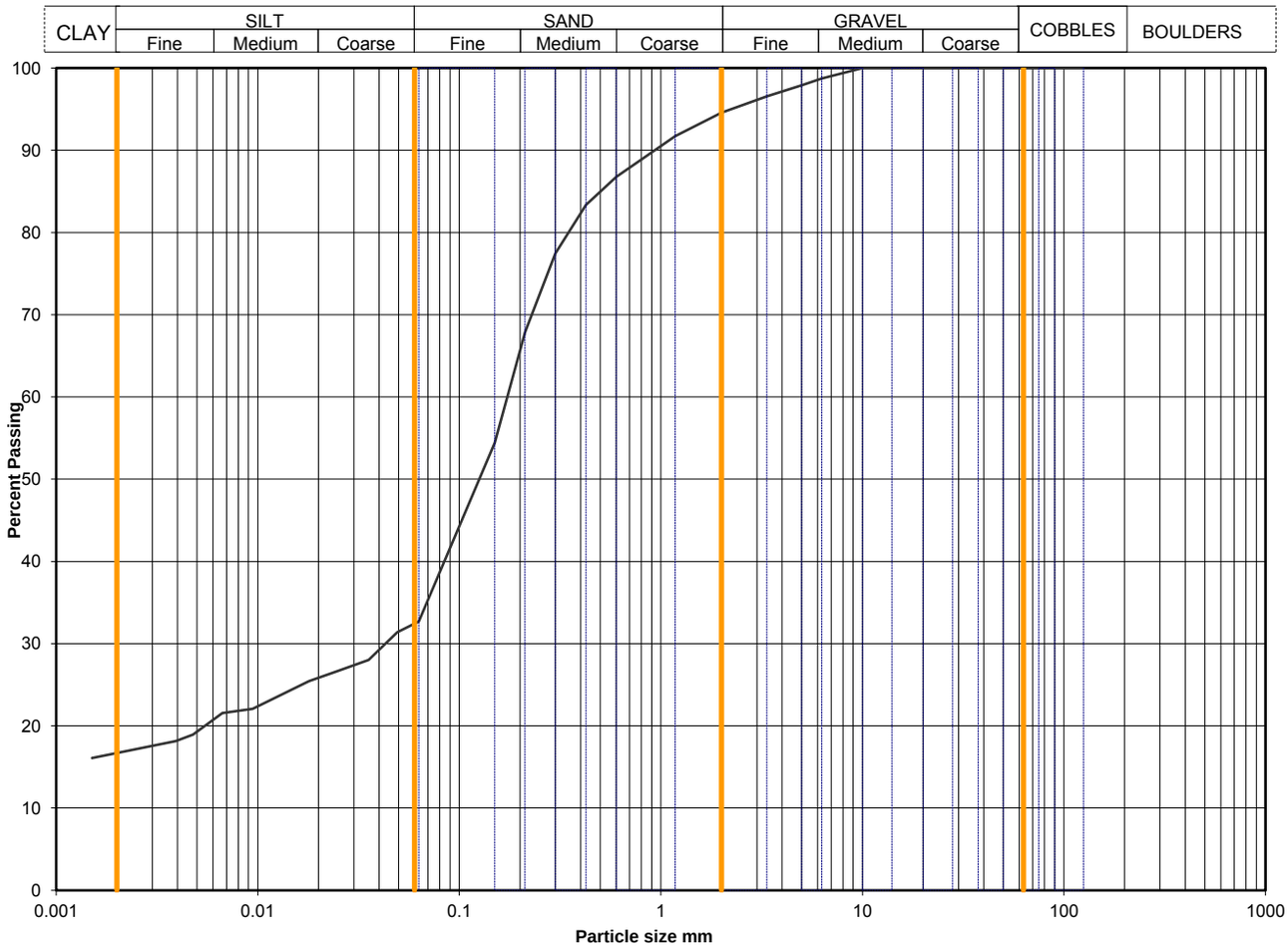
Soil description	Brown slightly sandy clayey SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	6	6
*<60mm values to aid description only	Silt	46	46
	Clay	48	48

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP308
		Sample Depth (m BGL)	1.1
	A7063-17-20170726085304	Sample Type and No	B3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	33
90	100	0.0493	31
75	100	0.0355	28
63	100	0.0252	27
50	100	0.0180	25
37.5	100	0.0094	22
28	100	0.0067	22
20	100	0.0048	19
14	100	0.0039	18
10	100	0.0015	16
6.3	99		
5.0	98		
3.35	97		
2.00	95		
1.18	92		
0.600	87		
0.425	83	2.65 assumed	
0.300	77	Dry mass of sample, kg	
0.212	68		
0.150	54	6.7	
0.063	33		

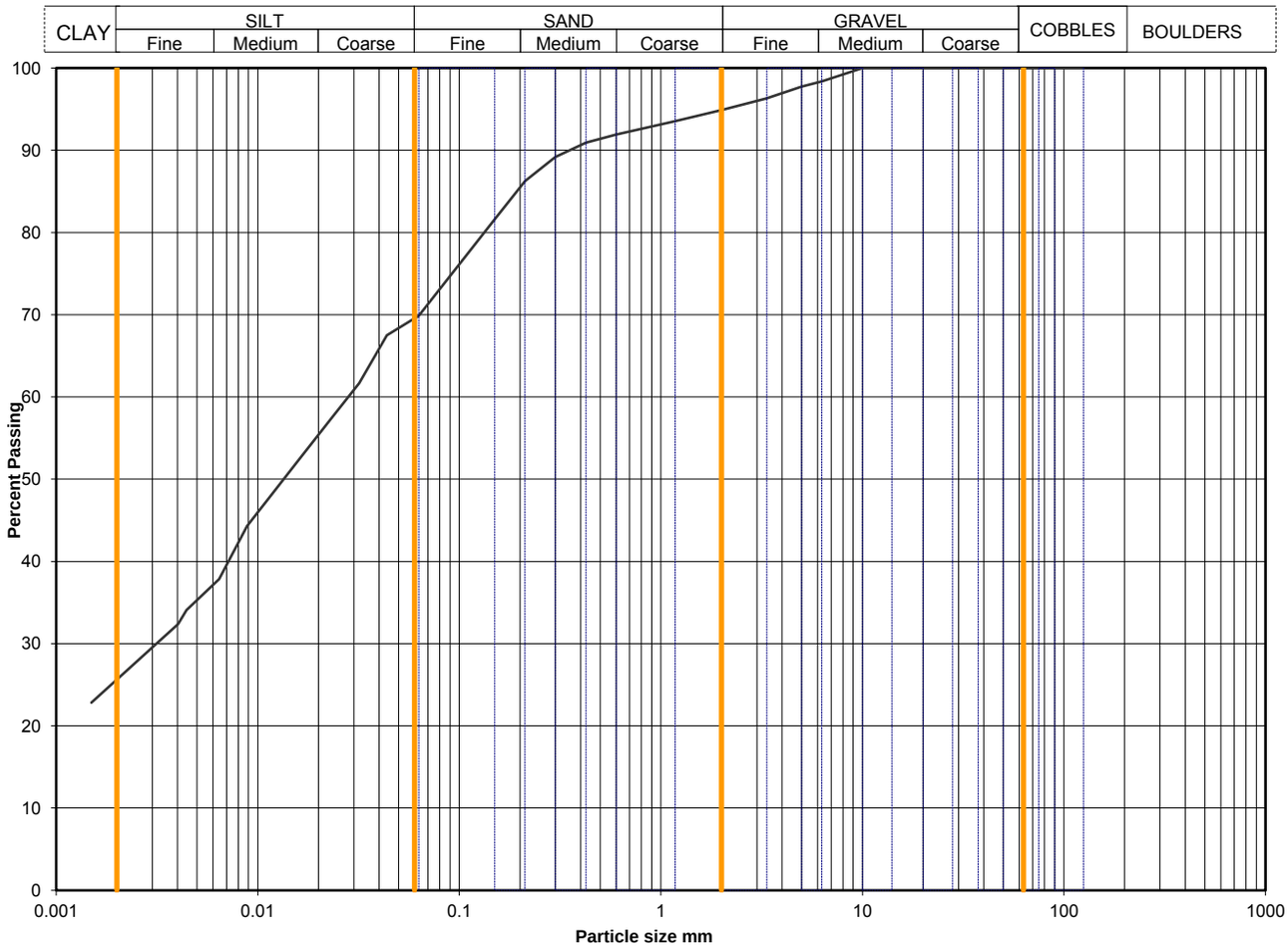
Soil description	Light brown gravelly silty SAND		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	62	62
*<60mm values to aid description only	Silt	16	16
	Clay	17	17

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP308
		Sample Depth (m BGL)	2.6
	A7063-17-20170726085344	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0438	67
75	100	0.0318	62
63	100	0.0230	57
50	100	0.0166	53
37.5	100	0.0089	44
28	100	0.0064	38
20	100	0.0044	34
14	100	0.0040	32
10	100	0.0015	23
6.3	98		
5.0	98		
3.35	96		
2.00	95		
1.18	94		
0.600	92		
0.425	91	2.65 assumed	
0.300	89	Dry mass of sample, kg	
0.212	86		
0.150	82	2.1	
0.063	70		

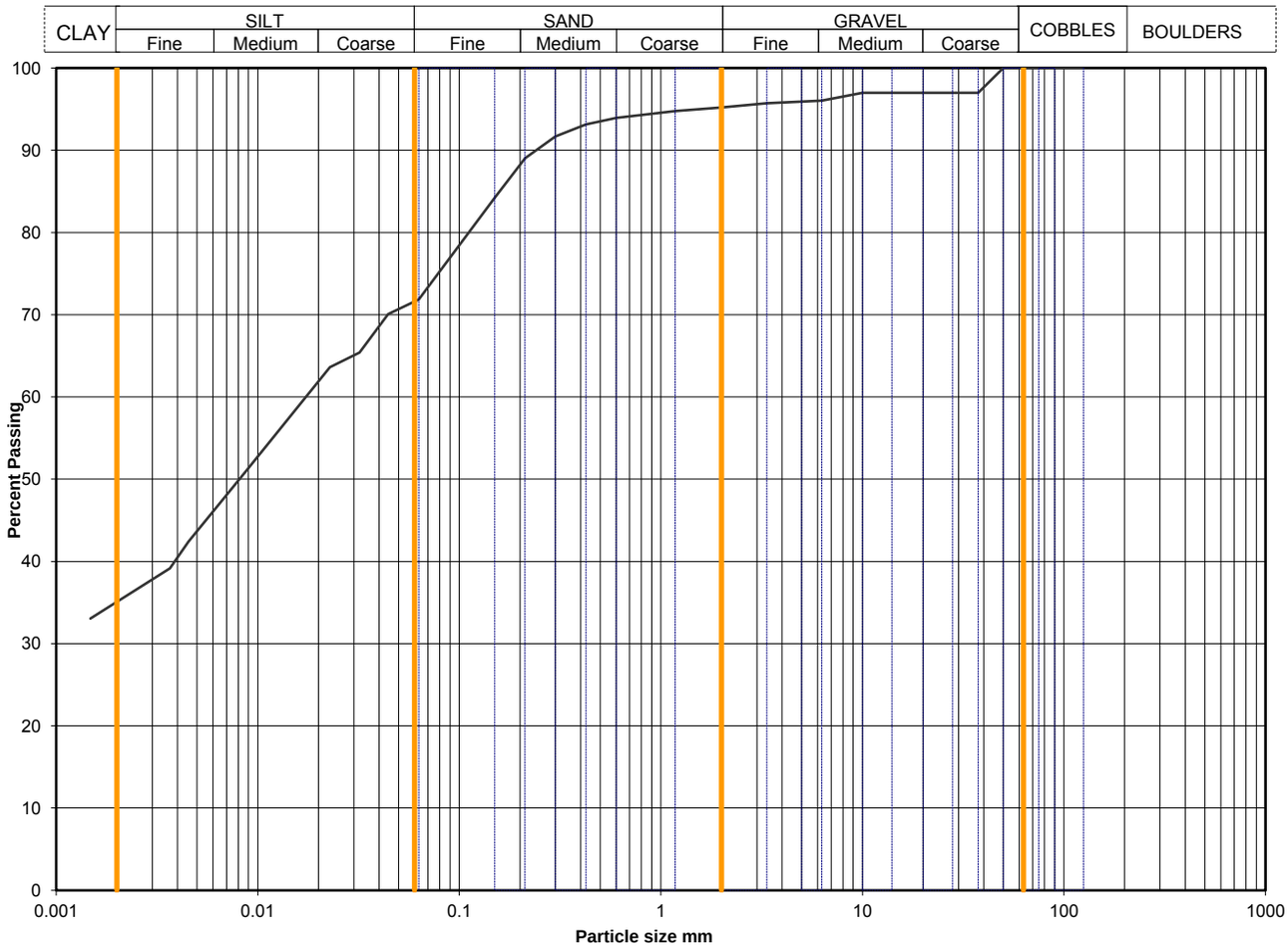
Soil description	Brown slightly sandy slightly gravelly SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	25	25
*<60mm values to aid description only	Silt	44	44
	Clay	26	26

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP309
		Sample Depth (m BGL)	0.5
	A7063-1720170802115514	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0444	70
75	100	0.0320	65
63	100	0.0228	64
50	100	0.0164	59
37.5	97	0.0088	51
28	97	0.0045	42
20	97	0.0037	39
14	97	0.0015	33
10	97		
6.3	96		
5.0	96		
3.35	96		
2.00	95		
1.18	95		
0.600	94		
0.425	93	2.65 assumed	
0.300	92	Dry mass of sample, kg	
0.212	89		
0.150	84	4.7	
0.063	72		

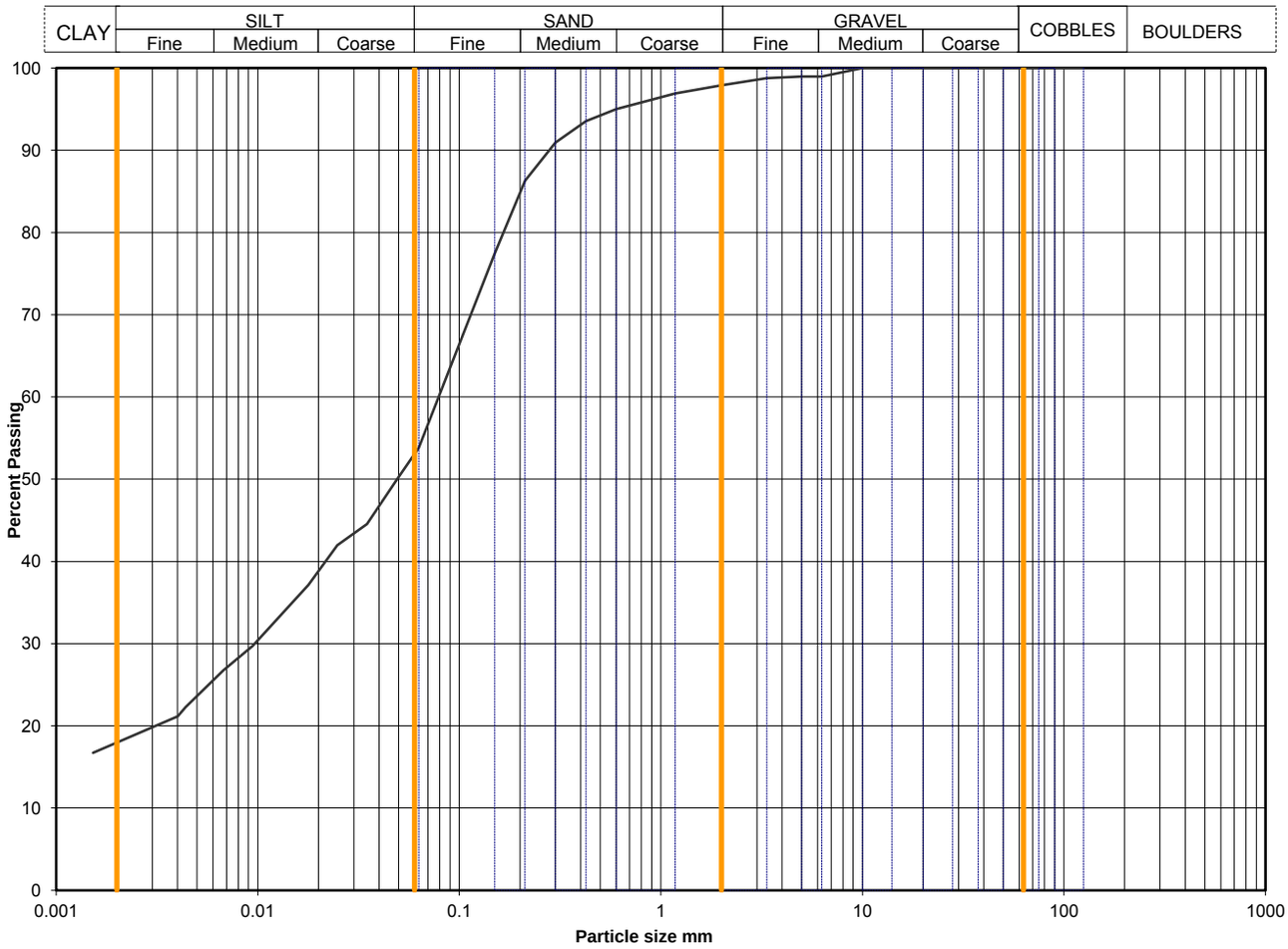
Soil description	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	23	23
*<60mm values to aid description only	Silt	37	37
	Clay	35	35

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP309
		Sample Depth (m BGL)	2
	A7063-1720170802115534	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	54
90	100	0.0483	50
75	100	0.0348	45
63	100	0.0248	42
50	100	0.0179	37
37.5	100	0.0094	30
28	100	0.0067	27
20	100	0.0044	22
14	100	0.0040	21
10	100	0.0015	17
6.3	99		
5.0	99		
3.35	99		
2.00	98		
1.18	97		
0.600	95		
0.425	94	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	86		
0.150	77	1.9	
0.063	54		

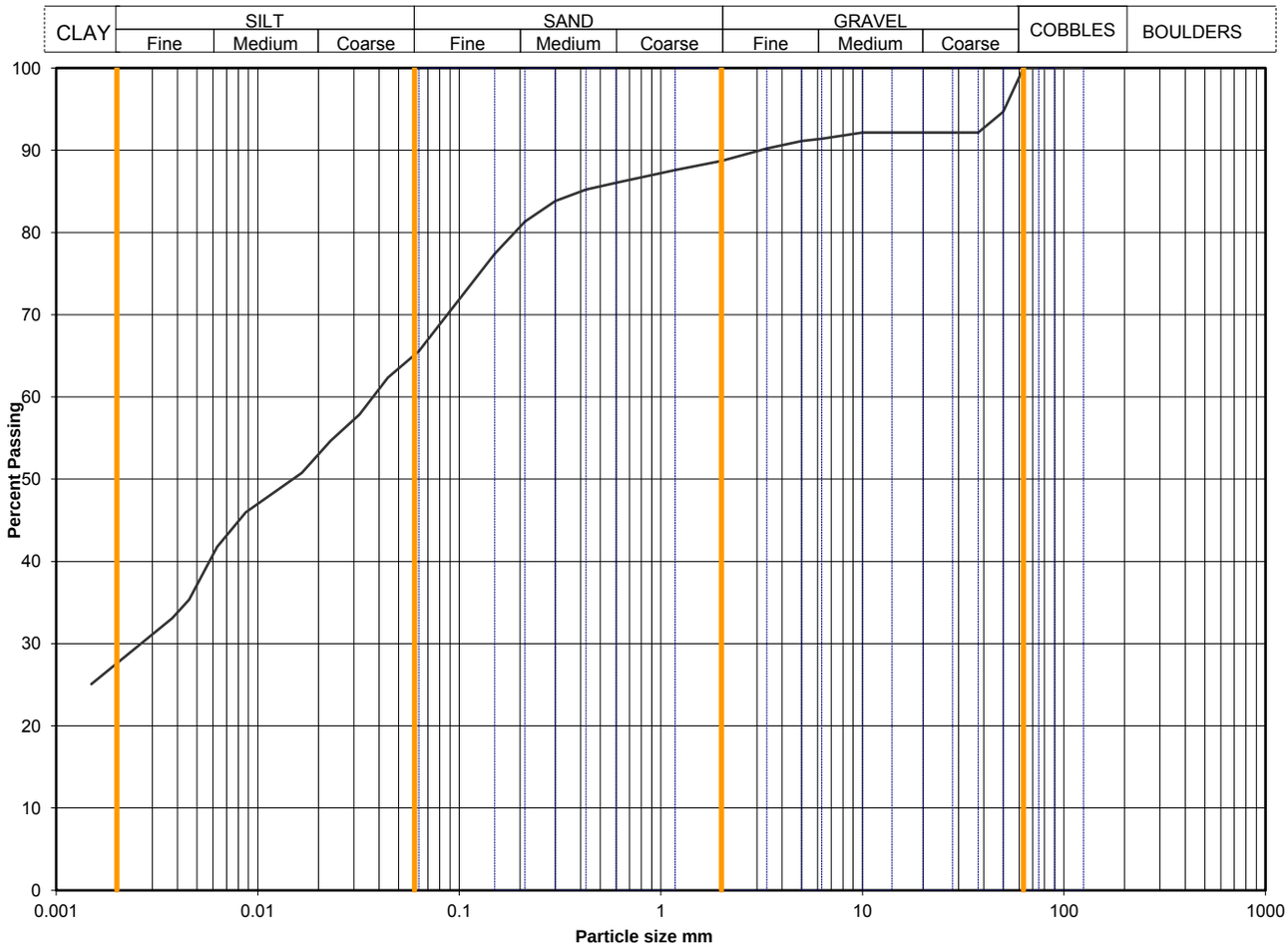
Soil description	Brown slightly gravelly sandy clayey SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	44	44
*<60mm values to aid description only	Silt	36	36
	Clay	18	18

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP309
		Sample Depth (m BGL)	2.6
	A7063-1720170802115543	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	66
90	100	0.0443	62
75	100	0.0320	58
63	100	0.0230	55
50	95	0.0166	51
37.5	92	0.0087	46
28	92	0.0063	42
20	92	0.0046	35
14	92	0.0038	33
10	92	0.0015	25
6.3	91		
5.0	91		
3.35	90		
2.00	89		
1.18	88		
0.600	86		
0.425	85	2.65 assumed	
0.300	84	Dry mass of sample, kg	
0.212	81		
0.150	77	4.9	
0.063	66		

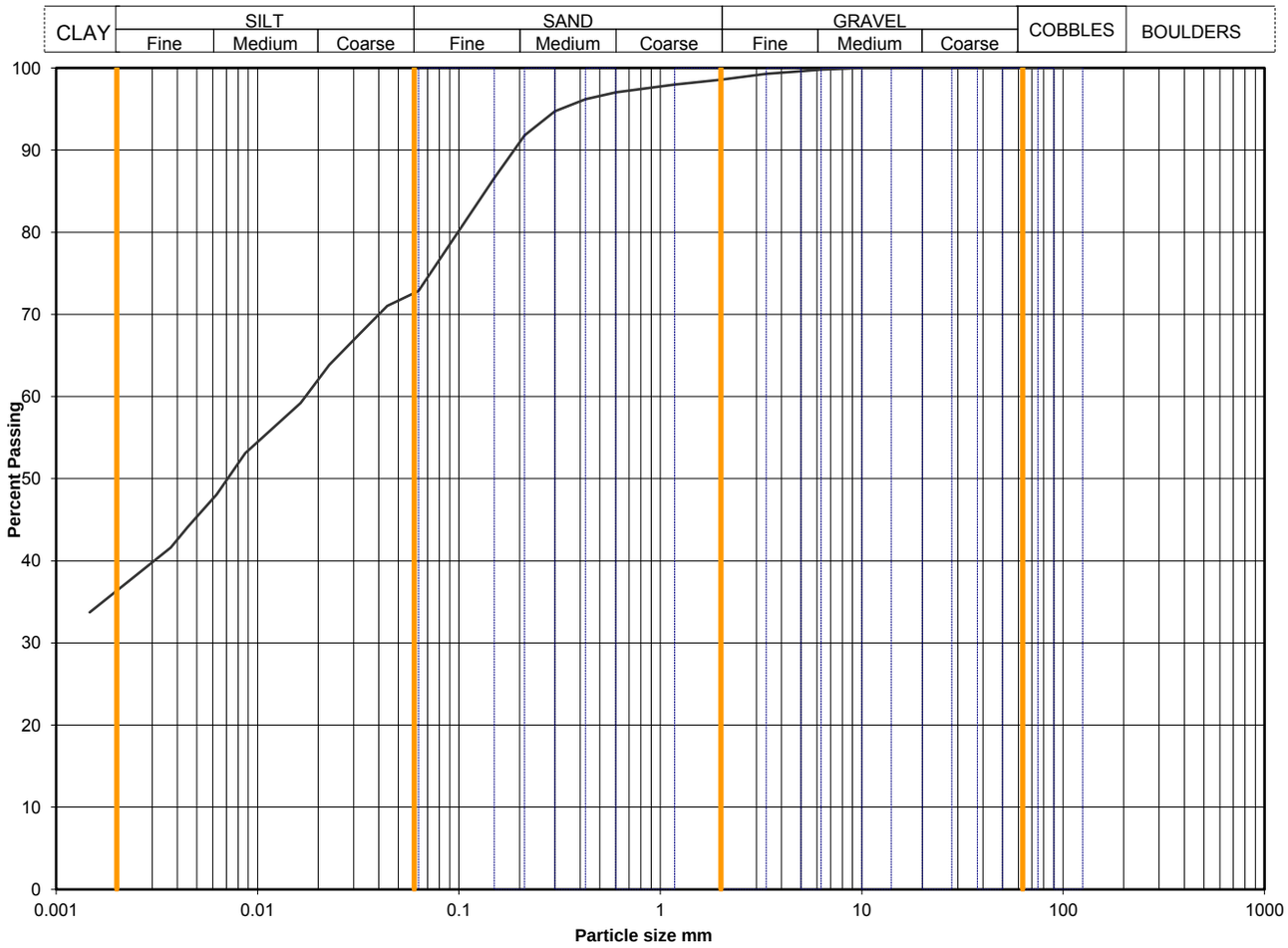
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	11	11
	Sand	23	23
*<60mm values to aid description only	Silt	38	38
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP310
		Sample Depth (m BGL)	0.9
	A7063-17-20170727103527	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	73
90	100	0.0440	71
75	100	0.0316	67
63	100	0.0227	64
50	100	0.0164	59
37.5	100	0.0087	53
28	100	0.0063	48
20	100	0.0045	44
14	100	0.0037	42
10	100	0.0015	34
6.3	100		
5.0	100		
3.35	99		
2.00	99		
1.18	98		
0.600	97		
0.425	96	2.65 assumed	
0.300	95	Dry mass of sample, kg	
0.212	92		
0.150	87	1.4	
0.063	73		

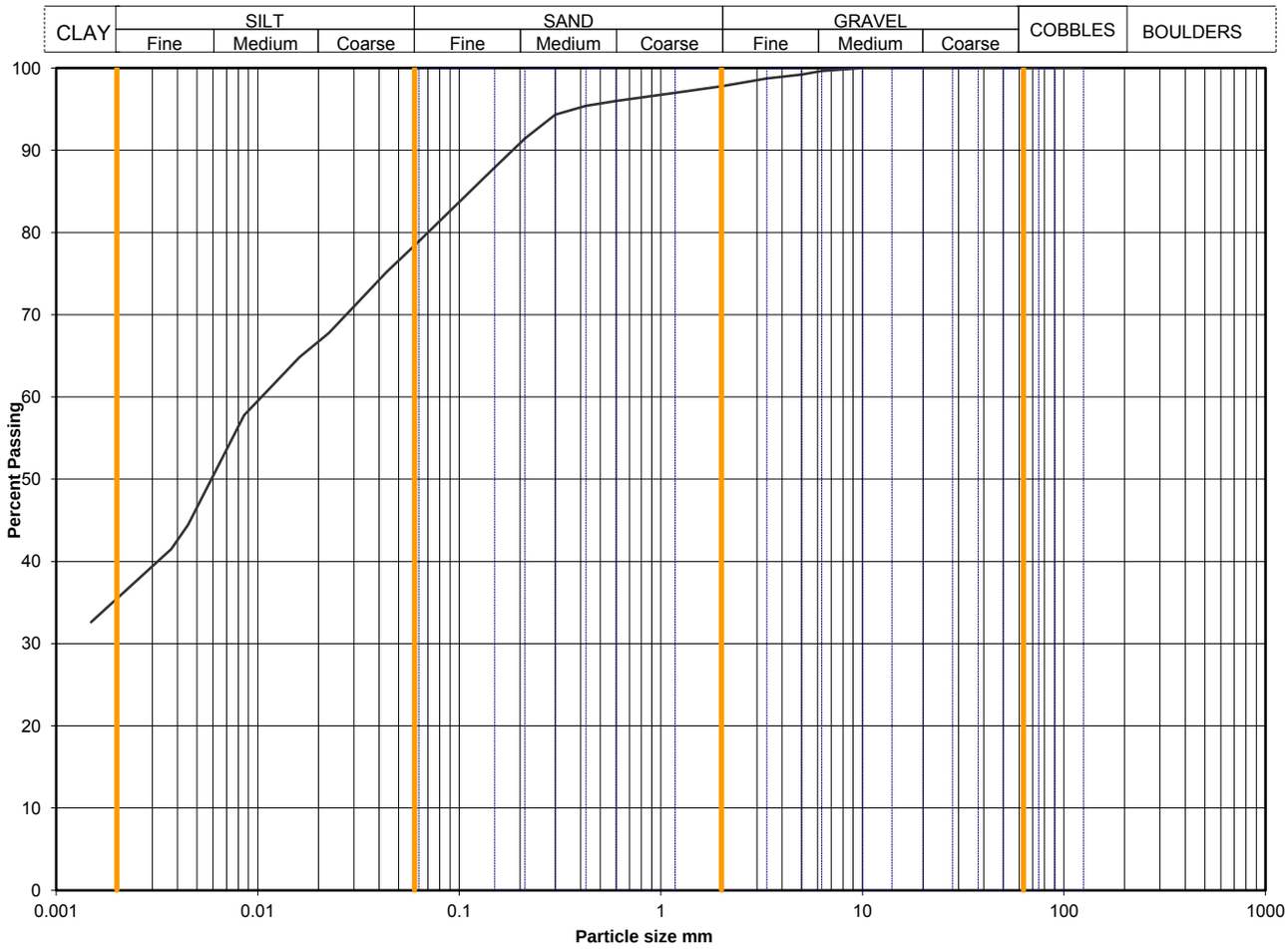
Soil description	Brown slightly sandy slightly gravelly SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	1	1
	Sand	26	26
*<60mm values to aid description only	Silt	36	36
	Clay	36	36

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP310
		Sample Depth (m BGL)	2
	A7063-17-20170727103614	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	79
90	100	0.0436	75
75	100	0.0314	71
63	100	0.0225	68
50	100	0.0161	65
37.5	100	0.0086	58
28	100	0.0062	51
20	100	0.0045	44
14	100	0.0037	41
10	100	0.0015	33
6.3	100		
5.0	99		
3.35	99		
2.00	98		
1.18	97		
0.600	96		
0.425	95	2.65 assumed	
0.300	94	Dry mass of sample, kg	
0.212	91		
0.150	88	1.1	
0.063	79		

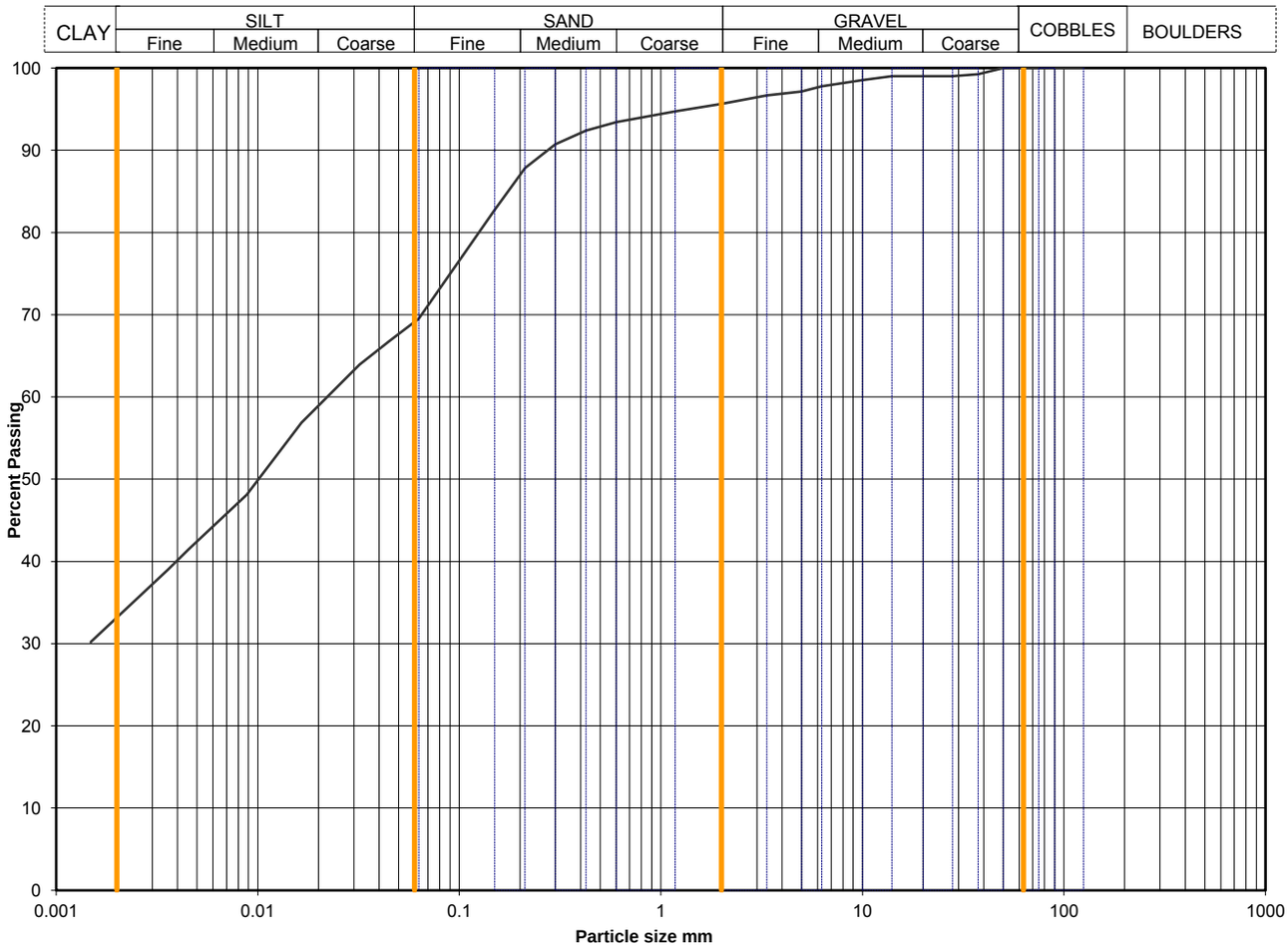
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	19	19
*<60mm values to aid description only	Silt	43	43
	Clay	35	35

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP311
		Sample Depth (m BGL)	0.5
	A7063-17-20170727105146	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0447	67
75	100	0.0320	64
63	100	0.0230	60
50	100	0.0165	57
37.5	99	0.0088	48
28	99	0.0045	41
20	99	0.0036	39
14	99	0.0015	30
10	99		
6.3	98		
5.0	97		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	92	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	88		
0.150	83	9.1	
0.063	70		

Soil description	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	26	26
*<60mm values to aid description only	Silt	36	36
	Clay	33	33

Uniformity Coefficient	**D60 / D10**	Not applicable

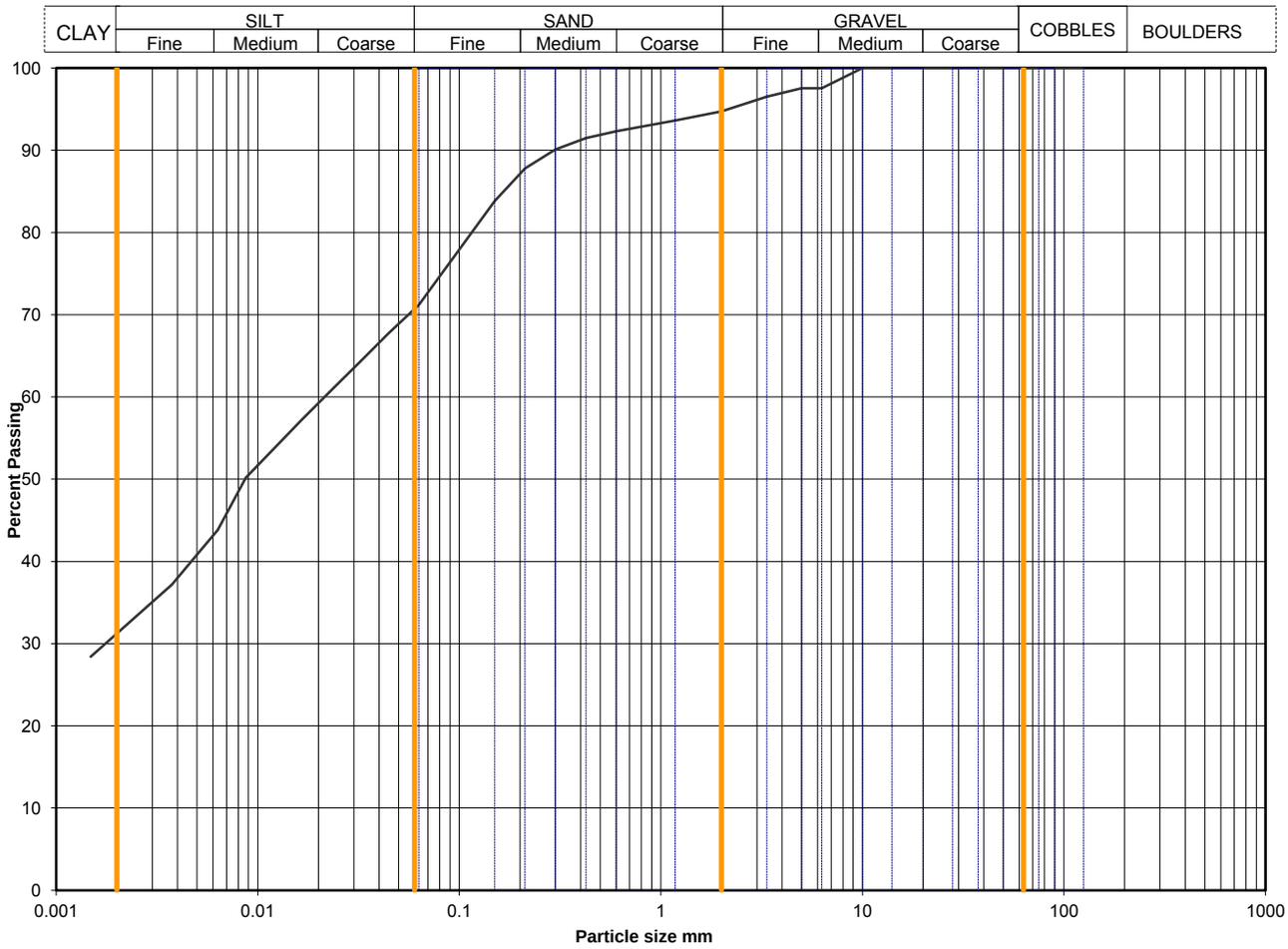
Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

QA Ref SLR 2,9 Rev 2.10 Oct 16	UKAS TESTING 1157	Project No A7063-17	Printed: 14/09/2017 15:52	**Figure** **PSD**
		Project Name WITHERNSEA LONG SEA OUTFALL		

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP311
		Sample Depth (m BGL)	2.8
	A7063-17-20170727105235	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	71
90	100	0.0444	68
75	100	0.0319	64
63	100	0.0229	61
50	100	0.0164	57
37.5	100	0.0087	50
28	100	0.0063	44
20	100	0.0046	40
14	100	0.0037	37
10	100	0.0015	28
6.3	98		
5.0	98		
3.35	97		
2.00	95		
1.18	94		
0.600	92		
0.425	91	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	88		
0.150	84	2.1	
0.063	71		

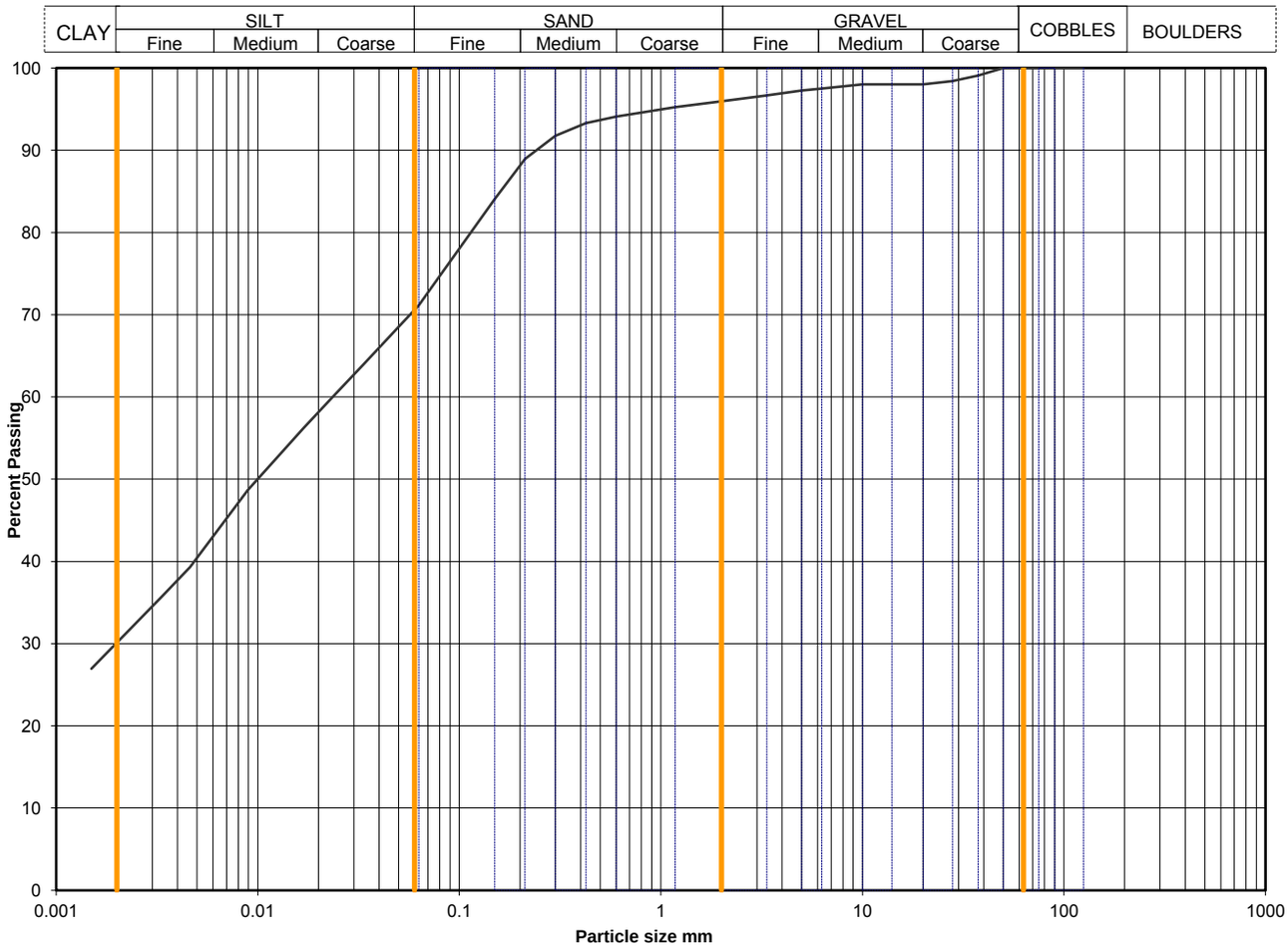
Soil description	Brown slightly sandy slightly gravelly clayey SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	24	24
*<60mm values to aid description only	Silt	40	40
	Clay	31	31

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP312
		Sample Depth (m BGL)	1.2
	A7063-17-20170727110650	Sample Type and No	B3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	71
90	100	0.0454	67
75	100	0.0326	64
63	100	0.0234	60
50	100	0.0168	56
37.5	99	0.0089	49
28	98	0.0046	39
20	98	0.0033	36
14	98	0.0015	27
10	98		
6.3	98		
5.0	97		
3.35	97		
2.00	96		
1.18	95		
0.600	94		
0.425	93	2.65 assumed	
0.300	92	Dry mass of sample, kg	
0.212	89		
0.150	84	9.4	
0.063	71		

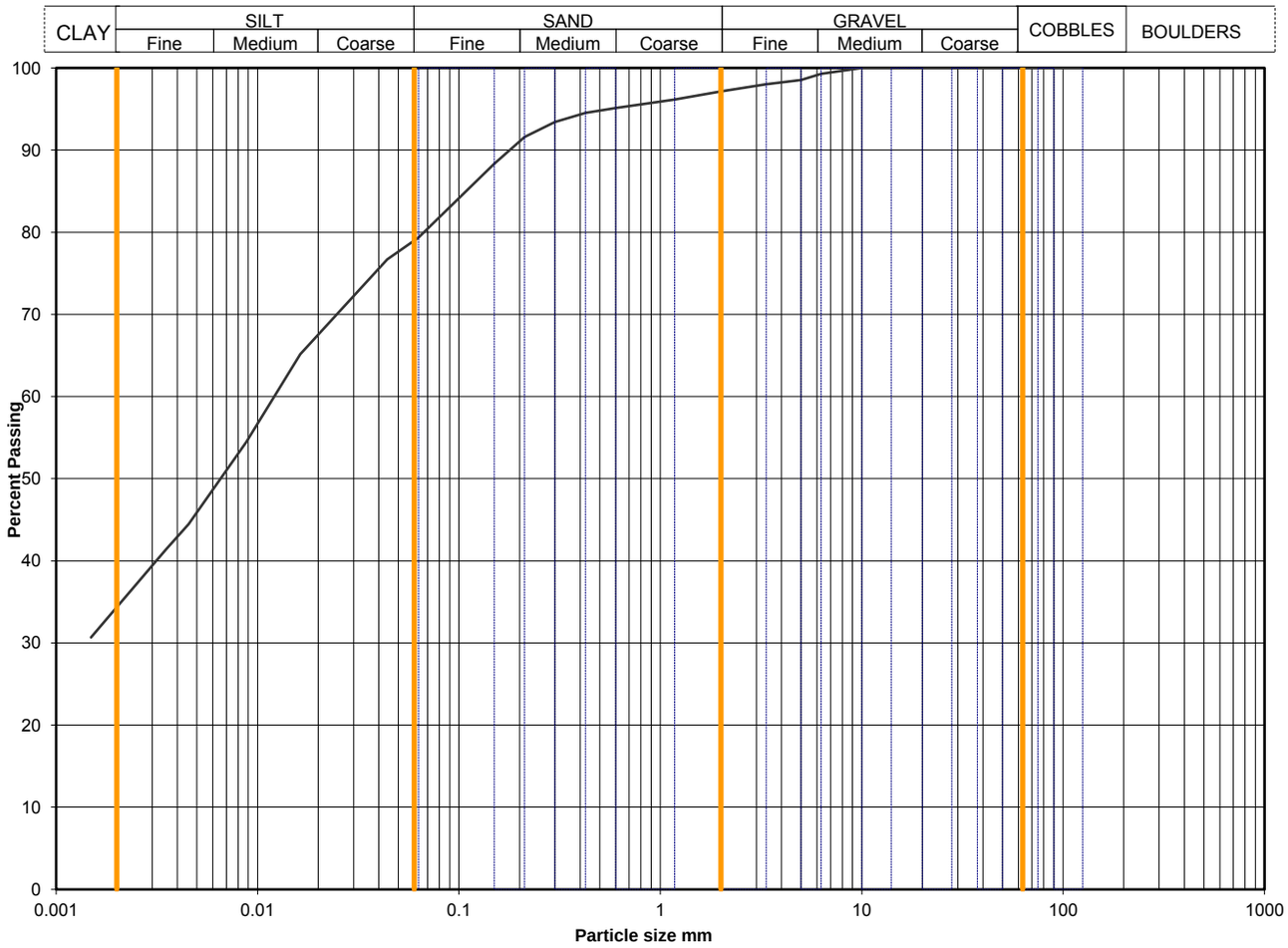
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	25	25
*<60mm values to aid description only	Silt	41	41
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP312
		Sample Depth (m BGL)	2.4
	A7063-17-20170727110716	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	79
90	100	0.0440	77
75	100	0.0316	73
63	100	0.0227	69
50	100	0.0163	65
37.5	100	0.0088	54
28	100	0.0045	44
20	100	0.0035	41
14	100	0.0015	31
10	100		
6.3	99		
5.0	99		
3.35	98		
2.00	97		
1.18	96		
0.600	95		
0.425	95	2.65 assumed	
0.300	93	Dry mass of sample, kg	
0.212	92		
0.150	88	6.8	
0.063	79		

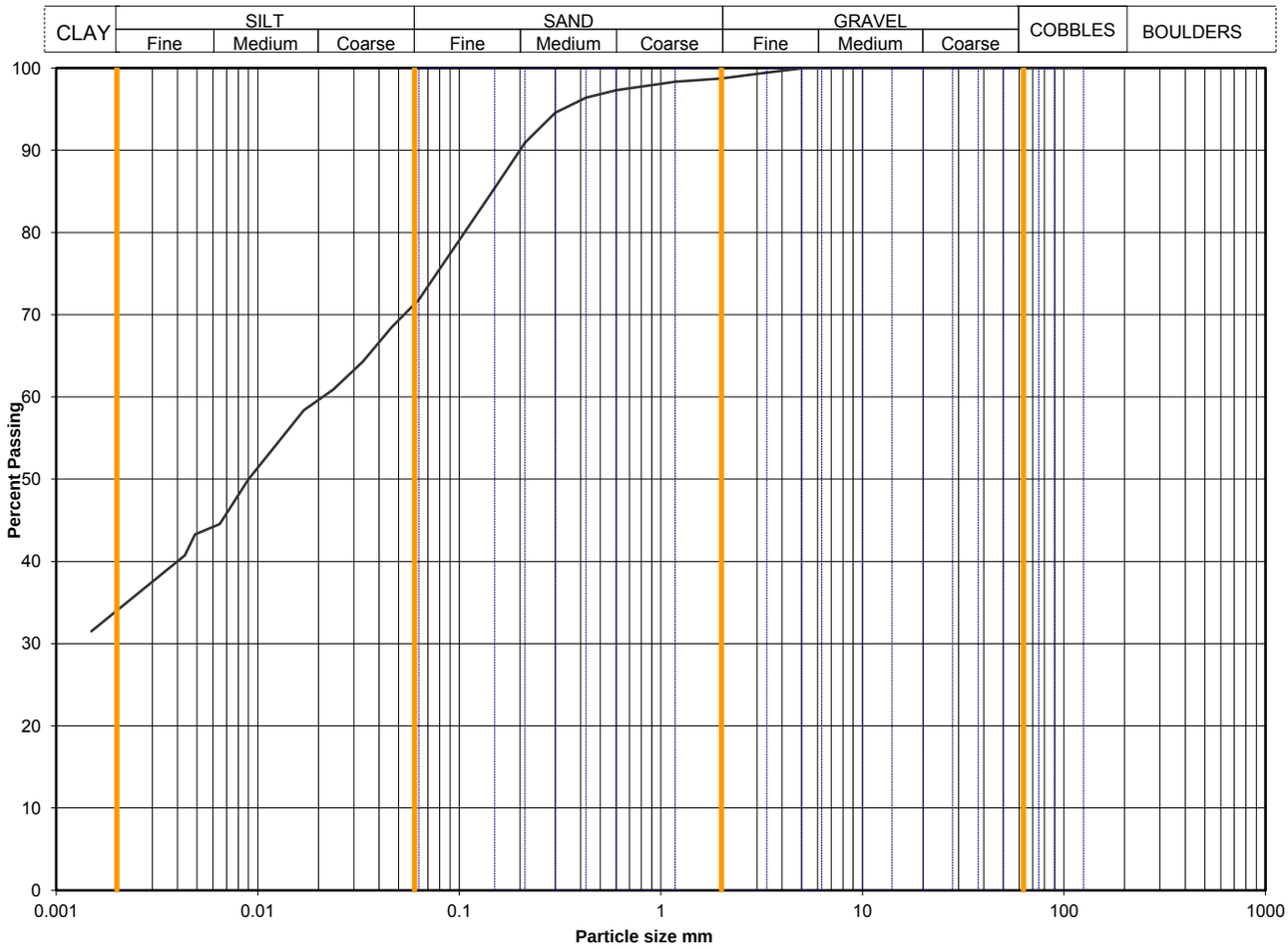
Soil description	Dark brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	18	18
*<60mm values to aid description only	Silt	45	45
	Clay	34	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP313
		Sample Depth (m BGL)	0.5
	A7063-17-20170725103913	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	72
90	100	0.0463	68
75	100	0.0332	64
63	100	0.0238	61
50	100	0.0169	58
37.5	100	0.0090	50
28	100	0.0065	45
20	100	0.0049	43
14	100	0.0043	41
10	100	0.0015	32
6.3	100		
5.0	100		
3.35	99		
2.00	99		
1.18	98		
0.600	97		
0.425	96	2.65 assumed	
0.300	95	Dry mass of sample, kg	
0.212	91		
0.150	85	6.4	
0.063	72		

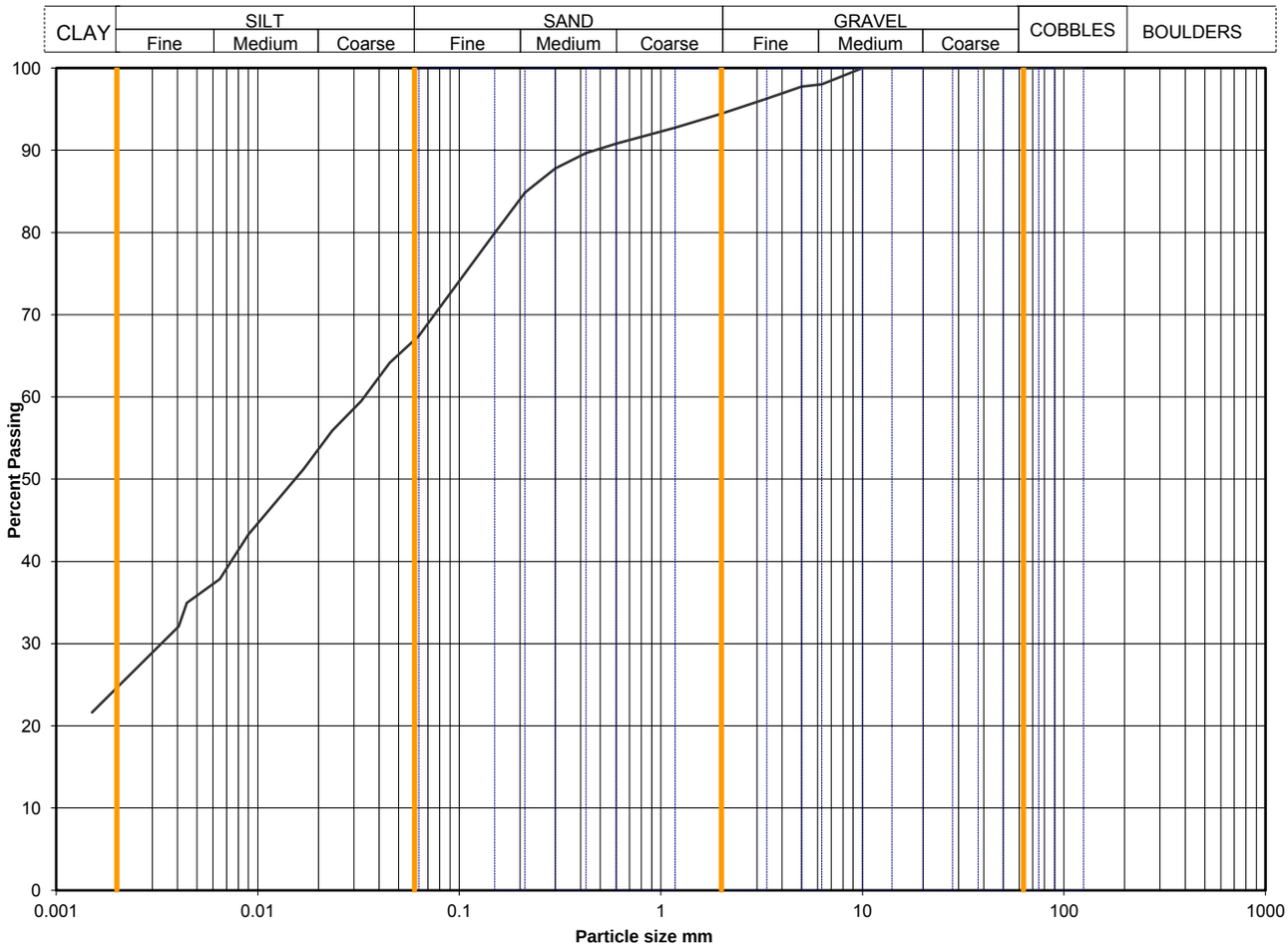
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	1	1
	Sand	27	27
*<60mm values to aid description only	Silt	38	38
	Clay	34	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP313
		Sample Depth (m BGL)	2.2
	A7063-17-20170725104206	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	67
90	100	0.0452	64
75	100	0.0326	59
63	100	0.0234	56
50	100	0.0169	51
37.5	100	0.0090	43
28	100	0.0065	38
20	100	0.0044	35
14	100	0.0040	32
10	100	0.0015	22
6.3	98		
5.0	98		
3.35	96		
2.00	94		
1.18	93		
0.600	91		
0.425	90	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	85		
0.150	80	11.0	
0.063	67		

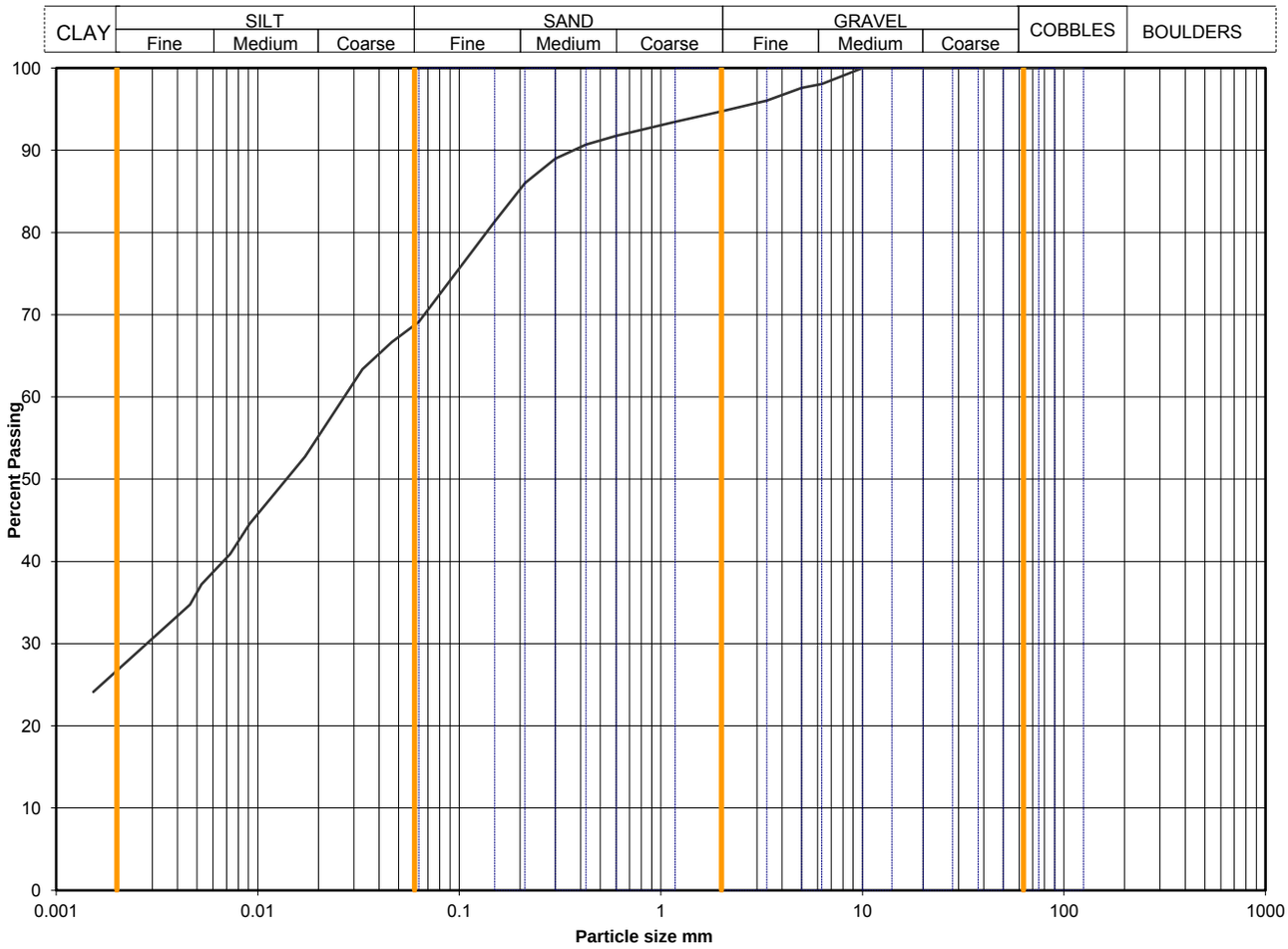
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	6	6
	Sand	27	27
*<60mm values to aid description only	Silt	43	43
	Clay	25	25

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP314A
		Sample Depth (m BGL)	1
	A7063-17-20170725100748	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	69
90	100	0.0463	67
75	100	0.0331	63
63	100	0.0239	58
50	100	0.0172	53
37.5	100	0.0091	45
28	100	0.0073	41
20	100	0.0053	37
14	100	0.0046	35
10	100	0.0015	24
6.3	98		
5.0	98		
3.35	96		
2.00	95		
1.18	93		
0.600	92		
0.425	91	2.65 assumed	
0.300	89	Dry mass of sample, kg	
0.212	86		
0.150	81	1.7	
0.063	69		

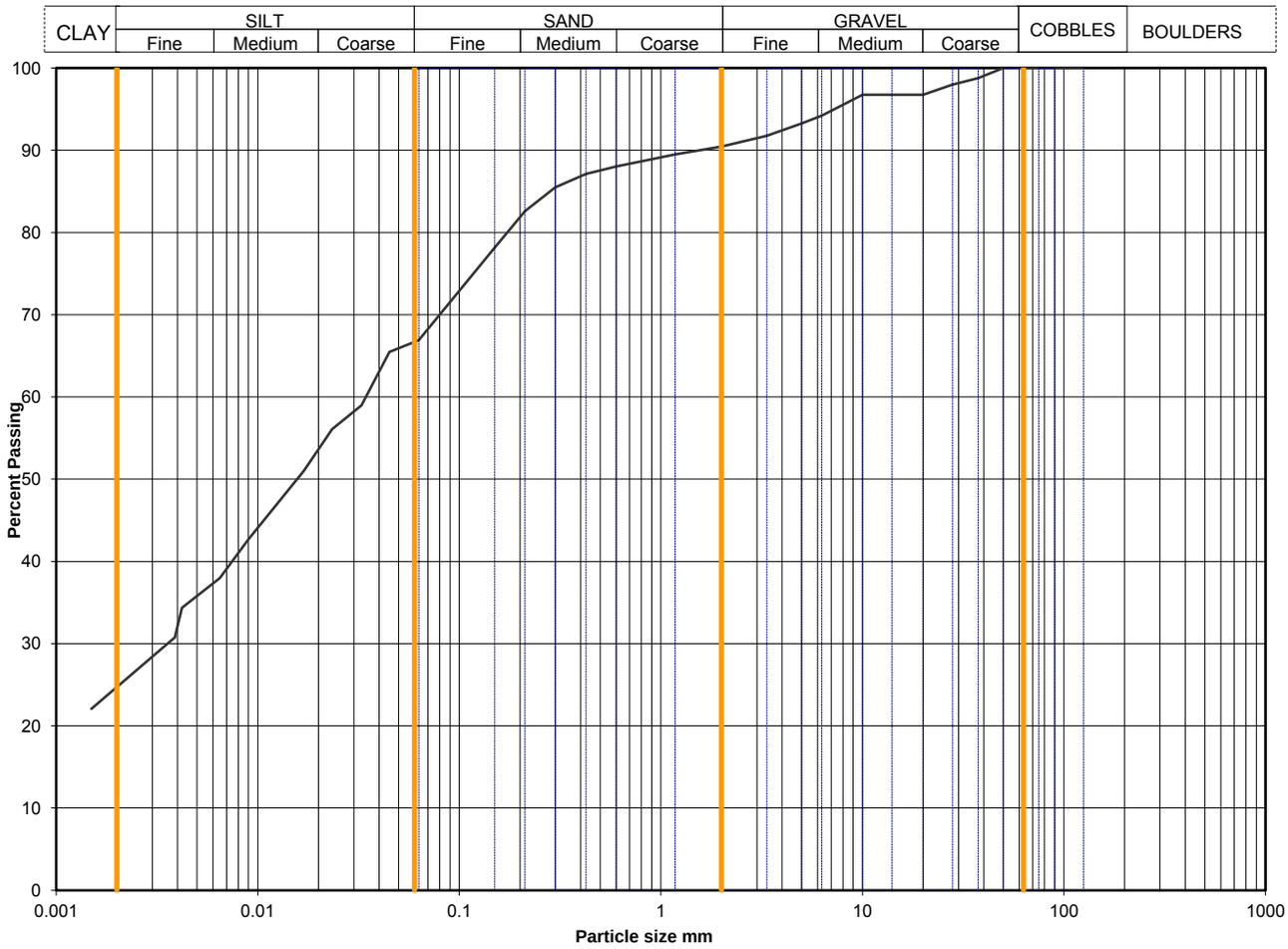
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	26	26
*<60mm values to aid description only	Silt	42	42
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP314A
		Sample Depth (m BGL)	1.8
	A7063-17-20170725100821	Sample Type and No	B3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	67
90	100	0.0450	65
75	100	0.0327	59
63	100	0.0234	56
50	100	0.0169	51
37.5	99	0.0090	43
28	98	0.0065	38
20	97	0.0042	34
14	97	0.0039	31
10	97	0.0015	22
6.3	94		
5.0	93		
3.35	92		
2.00	90		
1.18	89		
0.600	88		
0.425	87	2.65 assumed	
0.300	86	Dry mass of sample, kg	
0.212	83		
0.150	78	7.5	
0.063	67		

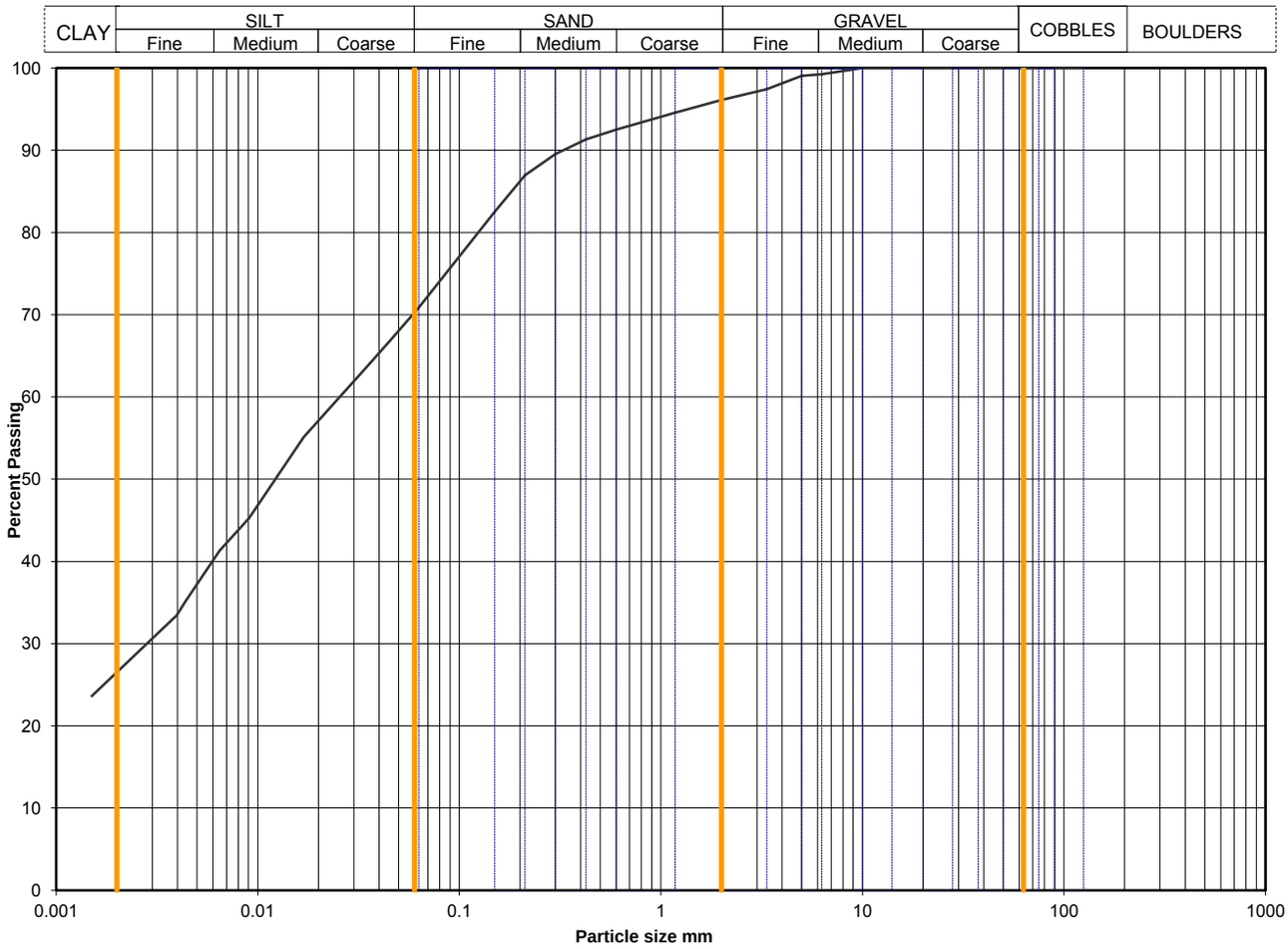
Soil description	Brown slightly sandy slightly gravelly silty CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	10	10
	Sand	24	24
*<60mm values to aid description only	Silt	42	42
	Clay	25	25

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP314A
		Sample Depth (m BGL)	3.1
	A7063-17-20170725100906	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	71
90	100	0.0458	67
75	100	0.0329	63
63	100	0.0236	59
50	100	0.0169	55
37.5	100	0.0090	45
28	100	0.0065	41
20	100	0.0044	35
14	100	0.0040	33
10	100	0.0015	24
6.3	99		
5.0	99		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	91	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	87		
0.150	83	1.7	
0.063	71		

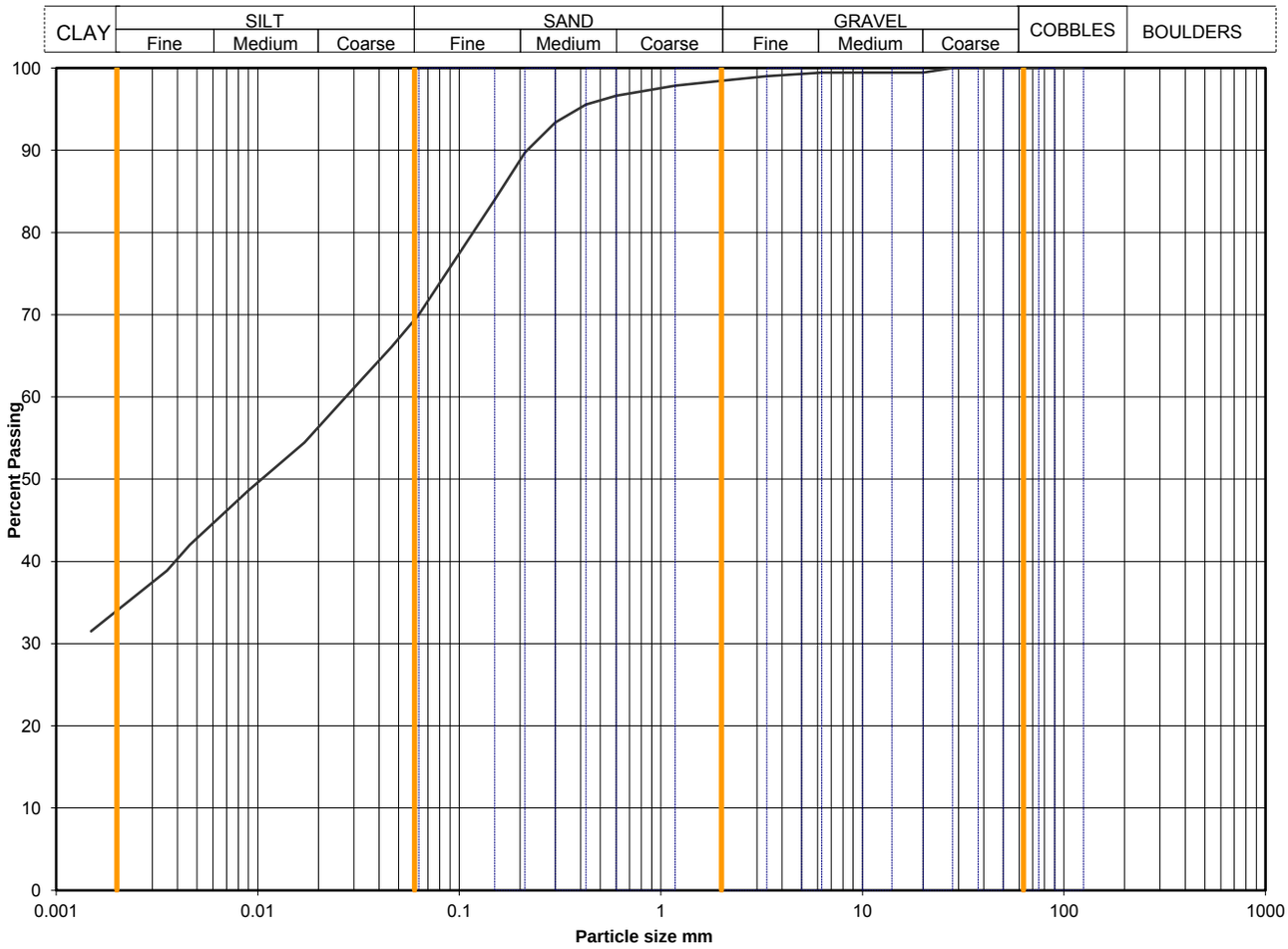
Soil description	Brown slightly sandy slightly gravelly clayey SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	25	25
*<60mm values to aid description only	Silt	44	44
	Clay	27	27

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP315
		Sample Depth (m BGL)	0.4
	A7063-17-20170725090030	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0462	66
75	100	0.0331	62
63	100	0.0238	58
50	100	0.0170	54
37.5	100	0.0090	49
28	100	0.0046	42
20	99	0.0035	39
14	99	0.0015	32
10	99		
6.3	99		
5.0	99		
3.35	99		
2.00	98		
1.18	98		
0.600	97		
0.425	96	2.65 assumed	
0.300	93	Dry mass of sample, kg	
0.212	90		
0.150	84	7.2	
0.063	70		

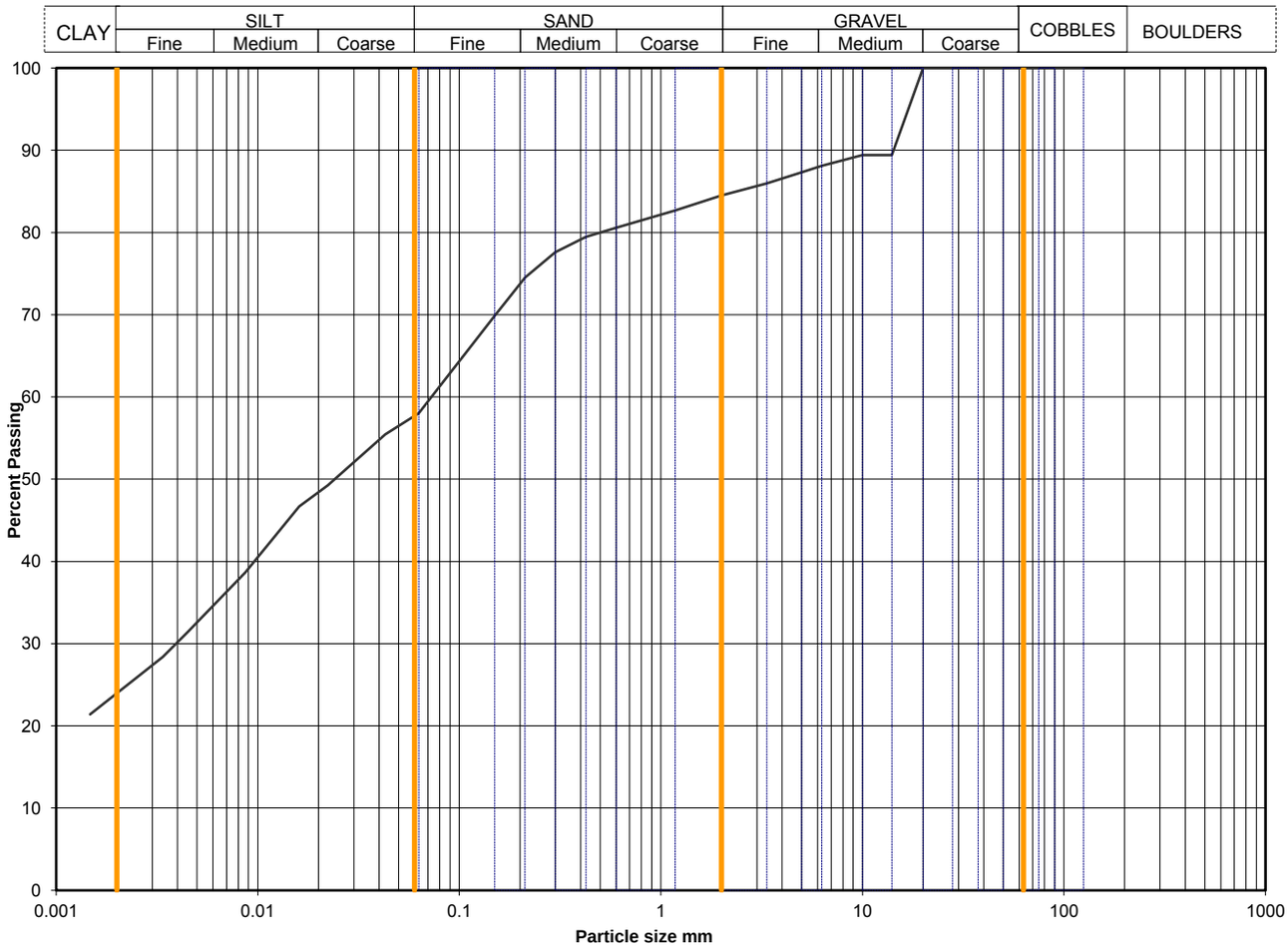
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	28	28
*<60mm values to aid description only	Silt	36	36
	Clay	34	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP315
		Sample Depth (m BGL)	3.8
	A7063-17-20170725090235	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	58
90	100	0.0429	55
75	100	0.0310	52
63	100	0.0223	49
50	100	0.0160	47
37.5	100	0.0087	39
28	100	0.0045	31
20	100	0.0034	28
14	89	0.0015	21
10	89		
6.3	88		
5.0	87		
3.35	86		
2.00	85		
1.18	83		
0.600	81		
0.425	79	2.65 assumed	
0.300	78	Dry mass of sample, kg	
0.212	75		
0.150	70	6.6	
0.063	58		

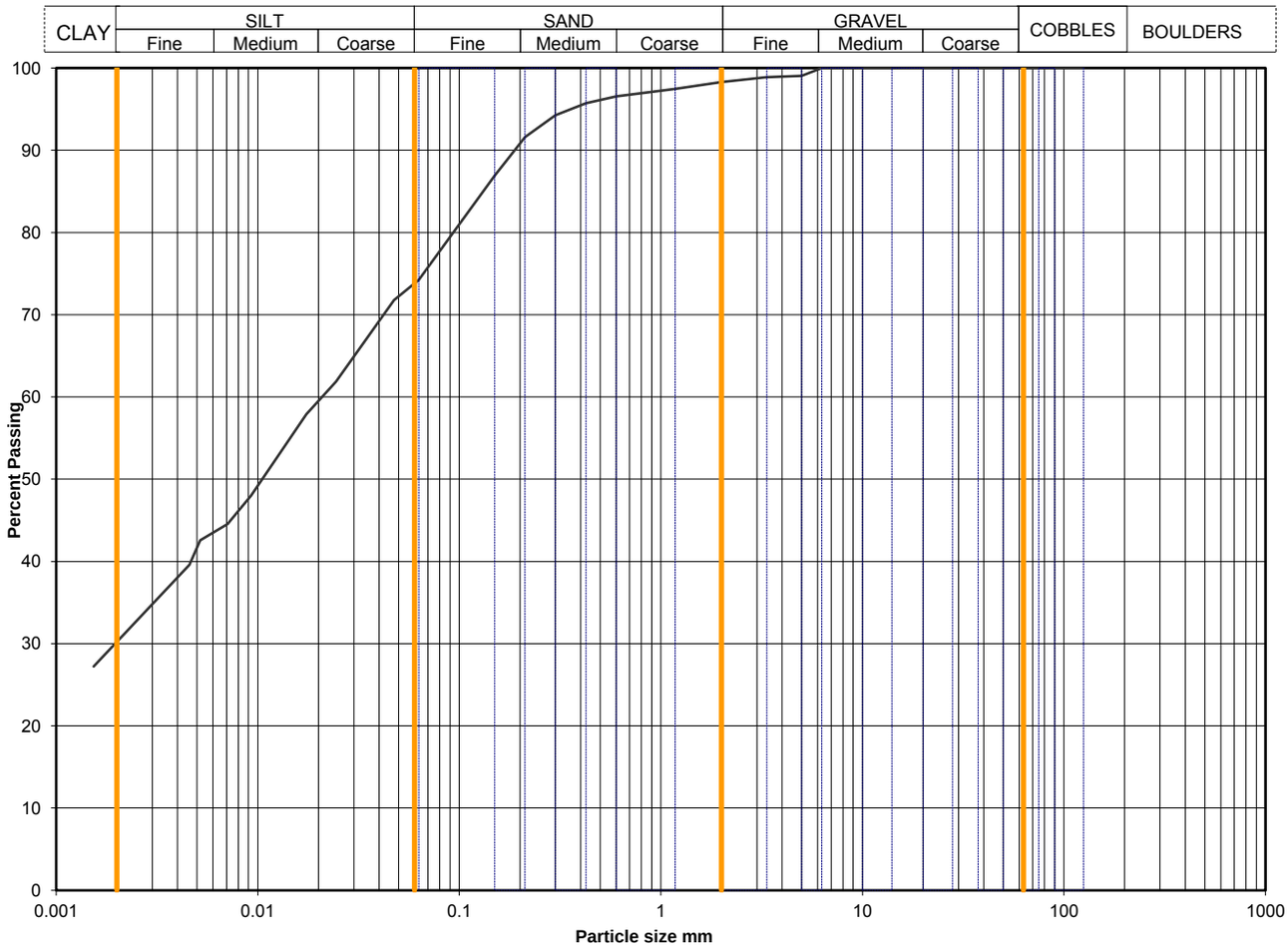
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	15	15
	Sand	26	26
*<60mm values to aid description only	Silt	34	34
	Clay	24	24

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP316
		Sample Depth (m BGL)	1
	A7063-17-20170725090557	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	74
90	100	0.0475	72
75	100	0.0341	67
63	100	0.0244	62
50	100	0.0175	58
37.5	100	0.0093	48
28	100	0.0071	45
20	100	0.0052	43
14	100	0.0046	40
10	100	0.0015	27
6.3	100		
5.0	99		
3.35	99		
2.00	98		
1.18	97		
0.600	97		
0.425	96	2.65 assumed	
0.300	94	Dry mass of sample, kg	
0.212	92		
0.150	87	1.6	
0.063	74		

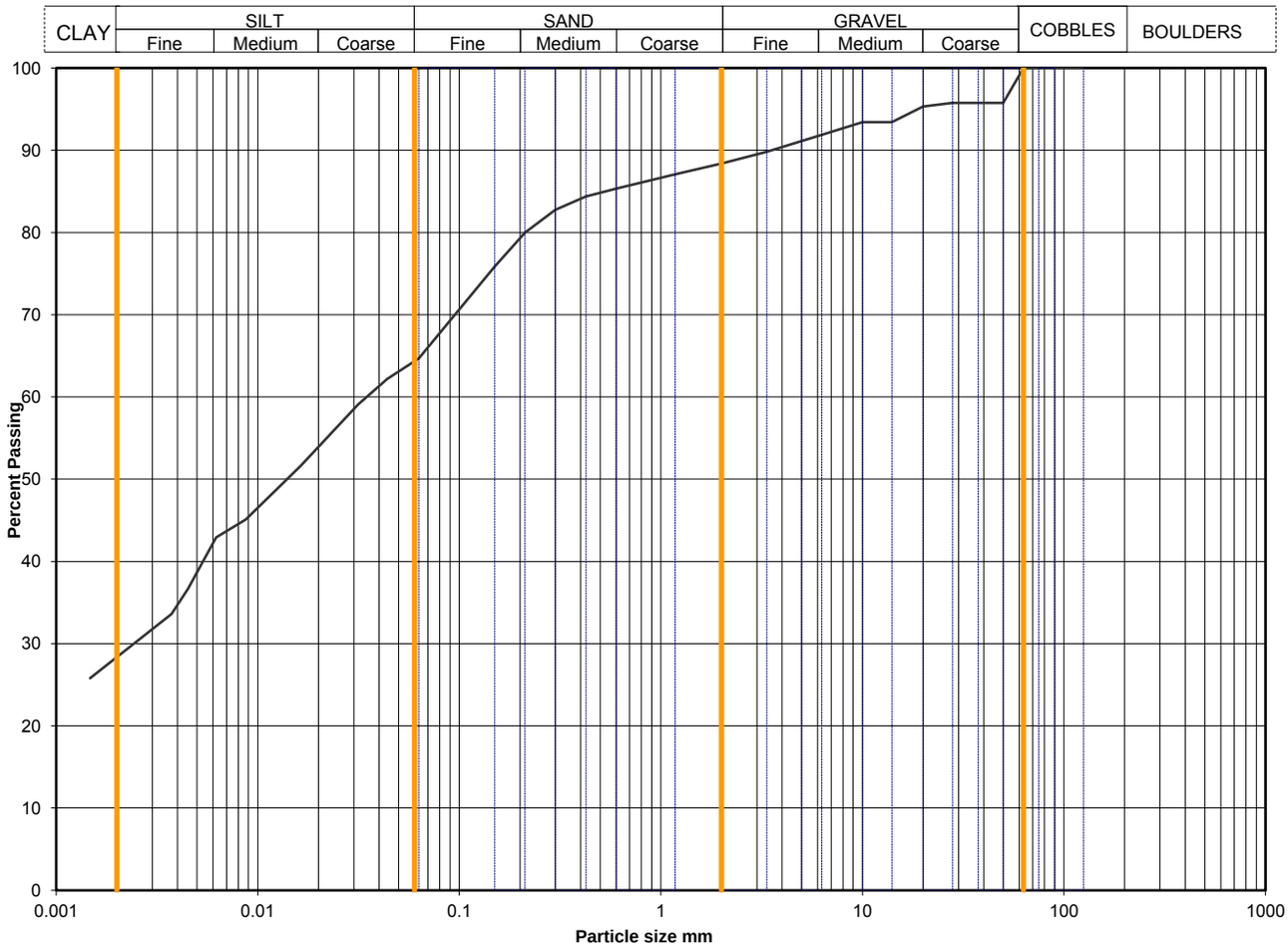
Soil description	Brown slightly sandy slightly gravelly silty CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	24	24
*<60mm values to aid description only	Silt	44	44
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP316
		Sample Depth (m BGL)	2.1
	A7063-17-20170725092058	Sample Type and No	B3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	65
90	100	0.0439	62
75	100	0.0315	59
63	100	0.0227	55
50	96	0.0164	52
37.5	96	0.0087	45
28	96	0.0062	43
20	95	0.0045	37
14	93	0.0037	34
10	93	0.0015	26
6.3	92		
5.0	91		
3.35	90		
2.00	88		
1.18	87		
0.600	85		
0.425	84	2.65 assumed	
0.300	83	Dry mass of sample, kg	
0.212	80		
0.150	76	8.7	
0.063	65		

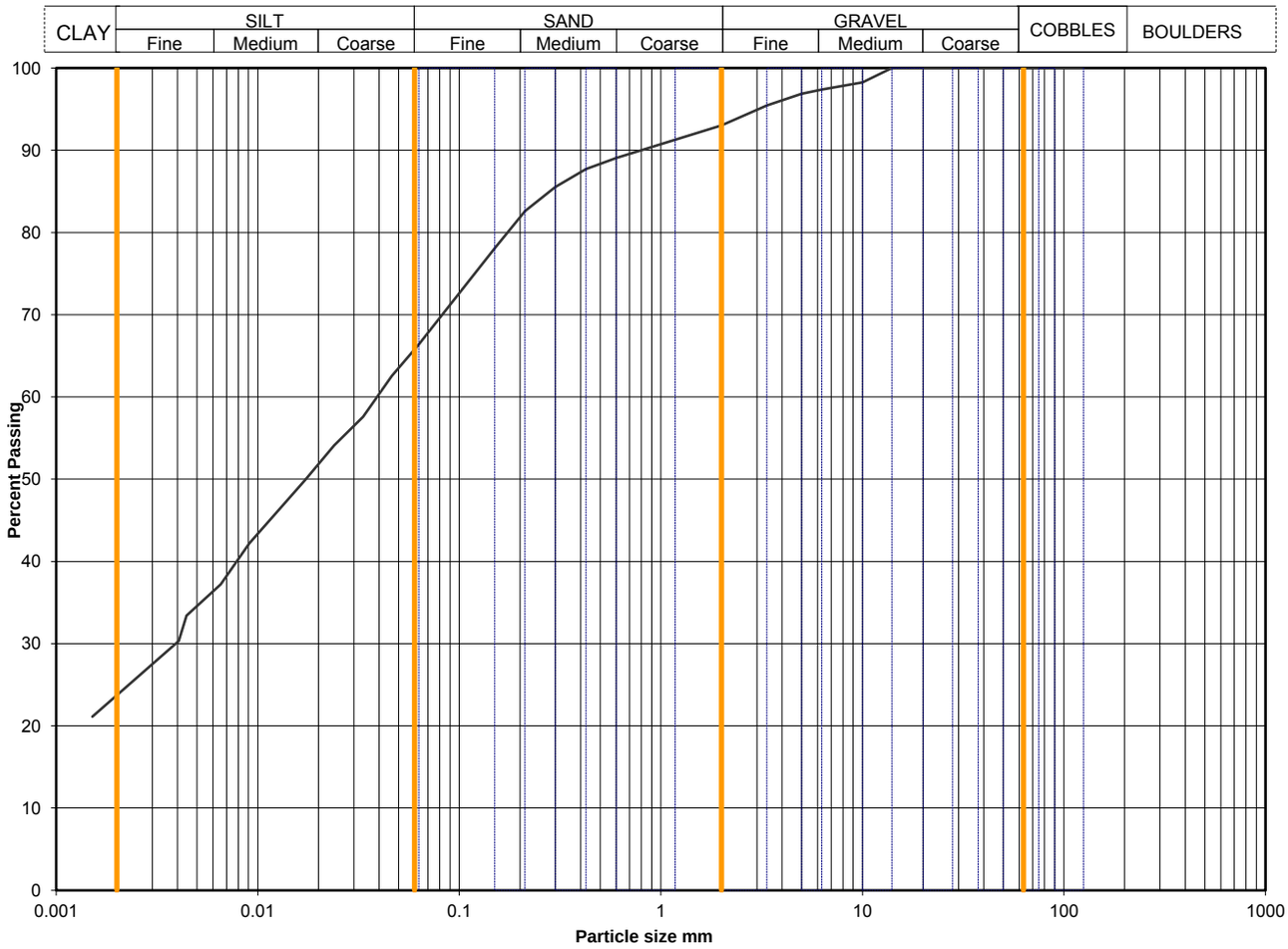
Soil description	Brown slightly sandy slightly gravelly clayey SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	12	12
	Sand	24	24
*<60mm values to aid description only	Silt	36	36
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP316
		Sample Depth (m BGL)	3
	A7063-17-20170725094254	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	66
90	100	0.0463	63
75	100	0.0334	58
63	100	0.0239	54
50	100	0.0172	50
37.5	100	0.0091	42
28	100	0.0065	37
20	100	0.0044	33
14	100	0.0040	30
10	98	0.0015	21
6.3	97		
5.0	97		
3.35	95		
2.00	93		
1.18	91		
0.600	89		
0.425	88	2.65 assumed	
0.300	86	Dry mass of sample, kg	
0.212	83		
0.150	78	7.4	
0.063	66		

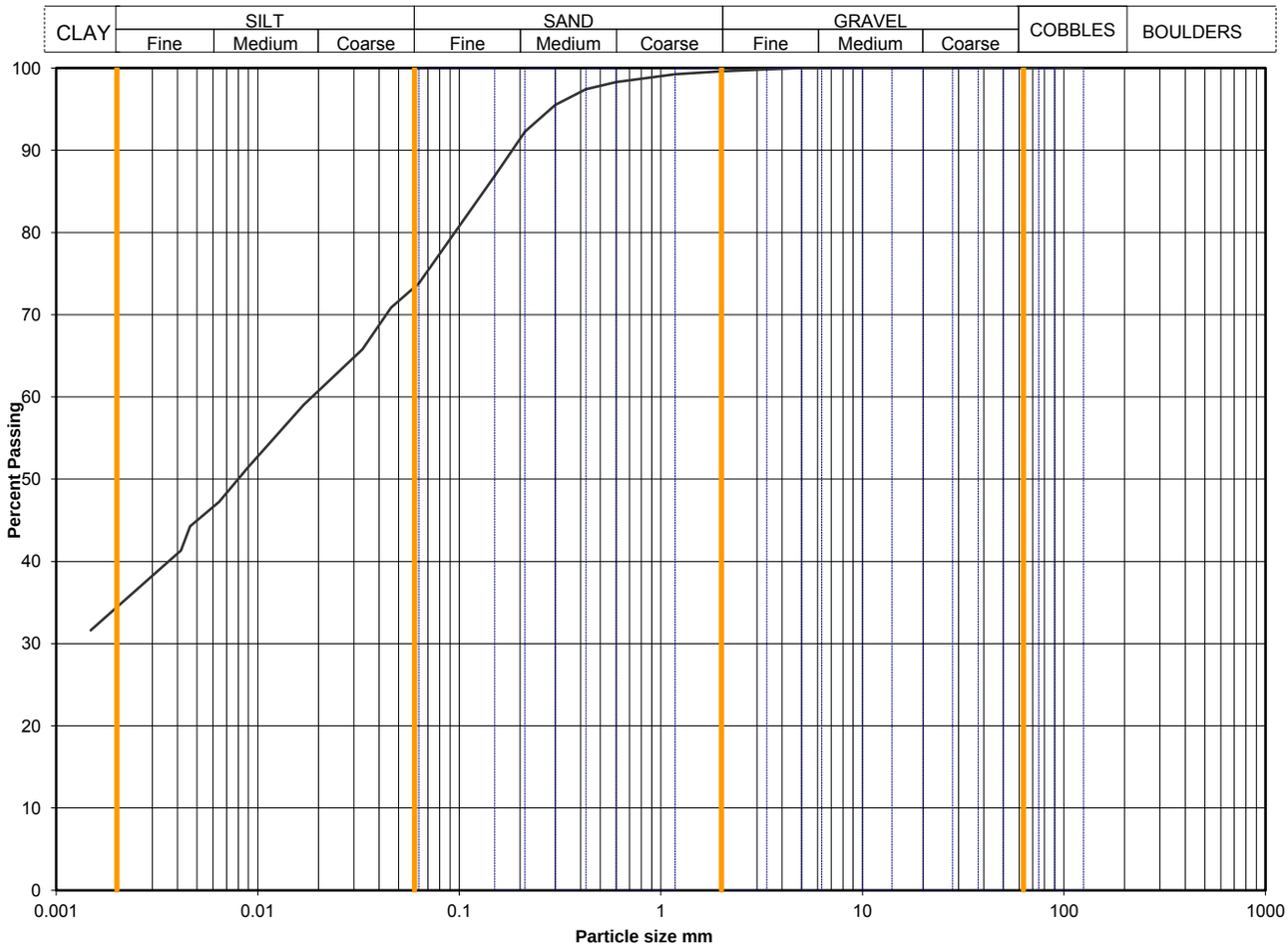
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	27	27
*<60mm values to aid description only	Silt	43	43
	Clay	24	24

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP317
		Sample Depth (m BGL)	1
	A7063-17-20170724071510	Sample Type and No	B3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	74
90	100	0.0459	71
75	100	0.0331	66
63	100	0.0237	62
50	100	0.0169	59
37.5	100	0.0090	51
28	100	0.0064	47
20	100	0.0046	44
14	100	0.0042	41
10	100	0.0015	32
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	99		
0.600	98		
0.425	97	2.65 assumed	
0.300	96	Dry mass of sample, kg	
0.212	92		
0.150	87	1.6	
0.063	74		

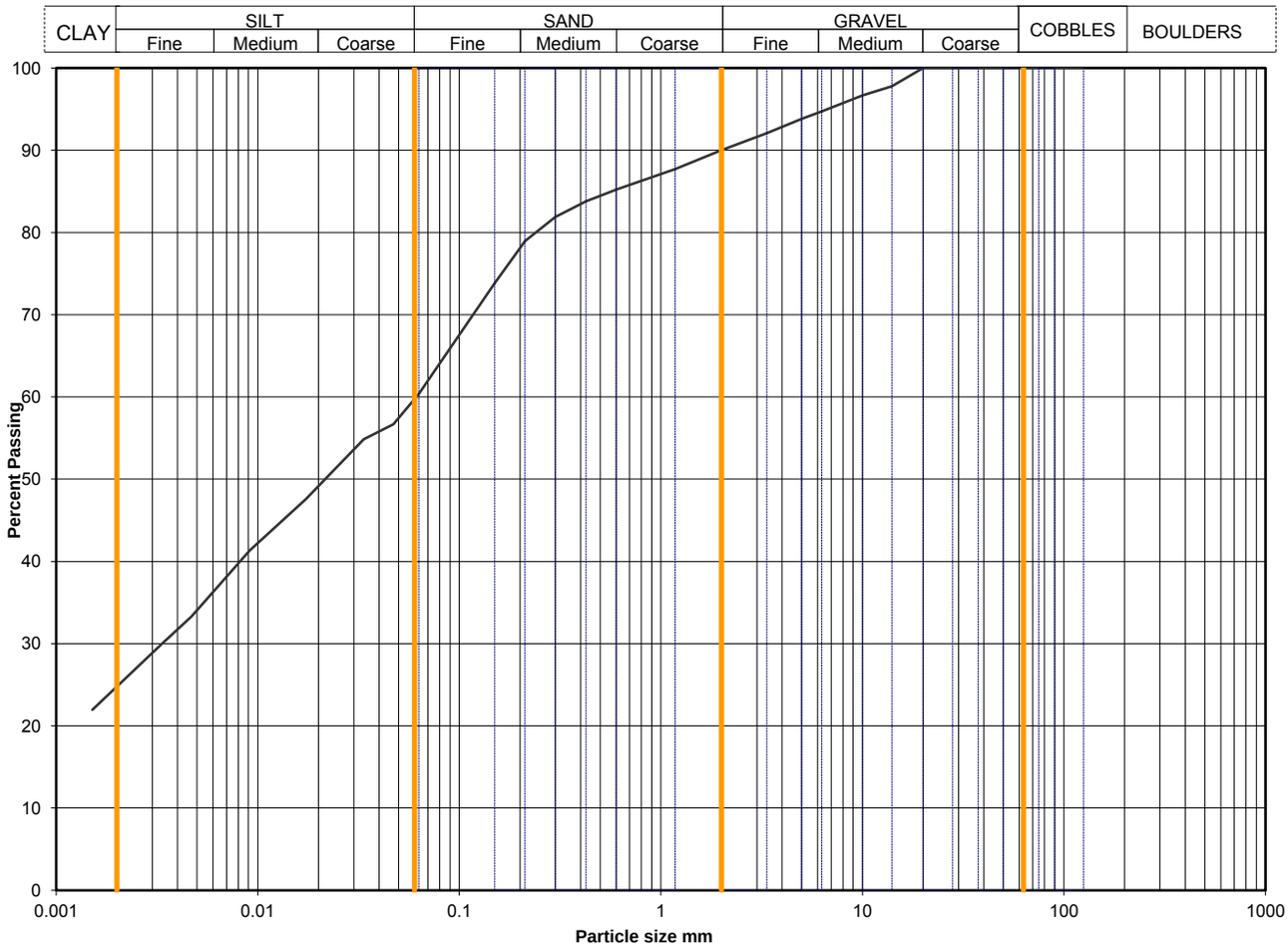
Soil description	Brown slightly sandy clayey SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	26	26
*<60mm values to aid description only	Silt	39	39
	Clay	34	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP317
		Sample Depth (m BGL)	2.9
	A7063-17-20170724071743	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	60
90	100	0.0472	57
75	100	0.0336	55
63	100	0.0241	51
50	100	0.0173	48
37.5	100	0.0091	41
28	100	0.0047	33
20	100	0.0034	30
14	98	0.0015	22
10	97		
6.3	95		
5.0	94		
3.35	92		
2.00	90		
1.18	88		
0.600	85		
0.425	84	2.65 assumed	
0.300	82	Dry mass of sample, kg	
0.212	79		
0.150	74	7.1	
0.063	60		

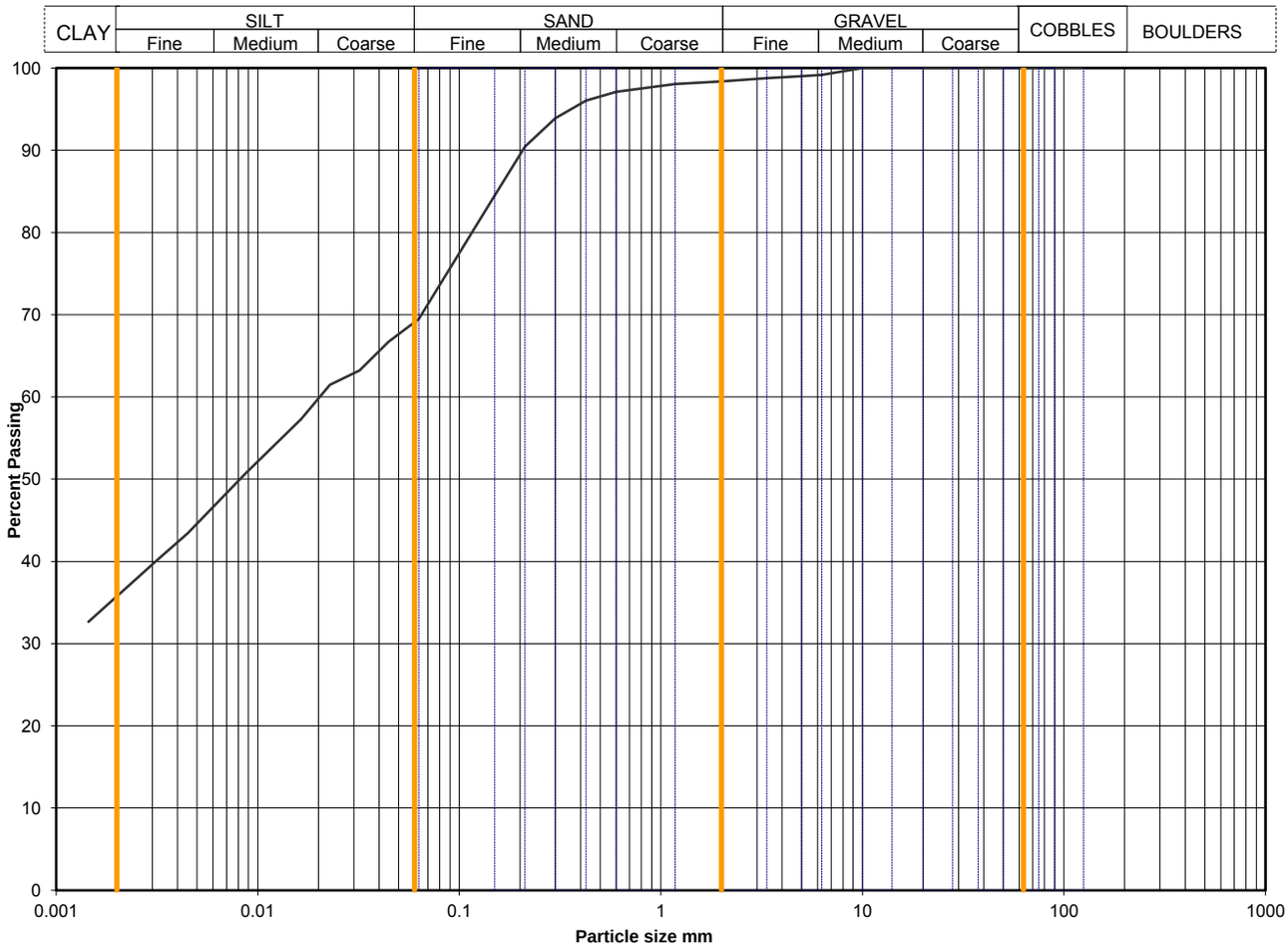
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	10	10
	Sand	30	30
*<60mm values to aid description only	Silt	36	36
	Clay	25	25

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP318A
		Sample Depth (m BGL)	0.6
	A7063-17-20170727113500	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	69
90	100	0.0446	67
75	100	0.0320	63
63	100	0.0228	61
50	100	0.0164	57
37.5	100	0.0087	51
28	100	0.0045	43
20	100	0.0032	40
14	100	0.0014	33
10	100		
6.3	99		
5.0	99		
3.35	99		
2.00	98		
1.18	98		
0.600	97		
0.425	96	2.65 assumed	
0.300	94	Dry mass of sample, kg	
0.212	90		
0.150	84	2.7	
0.063	69		

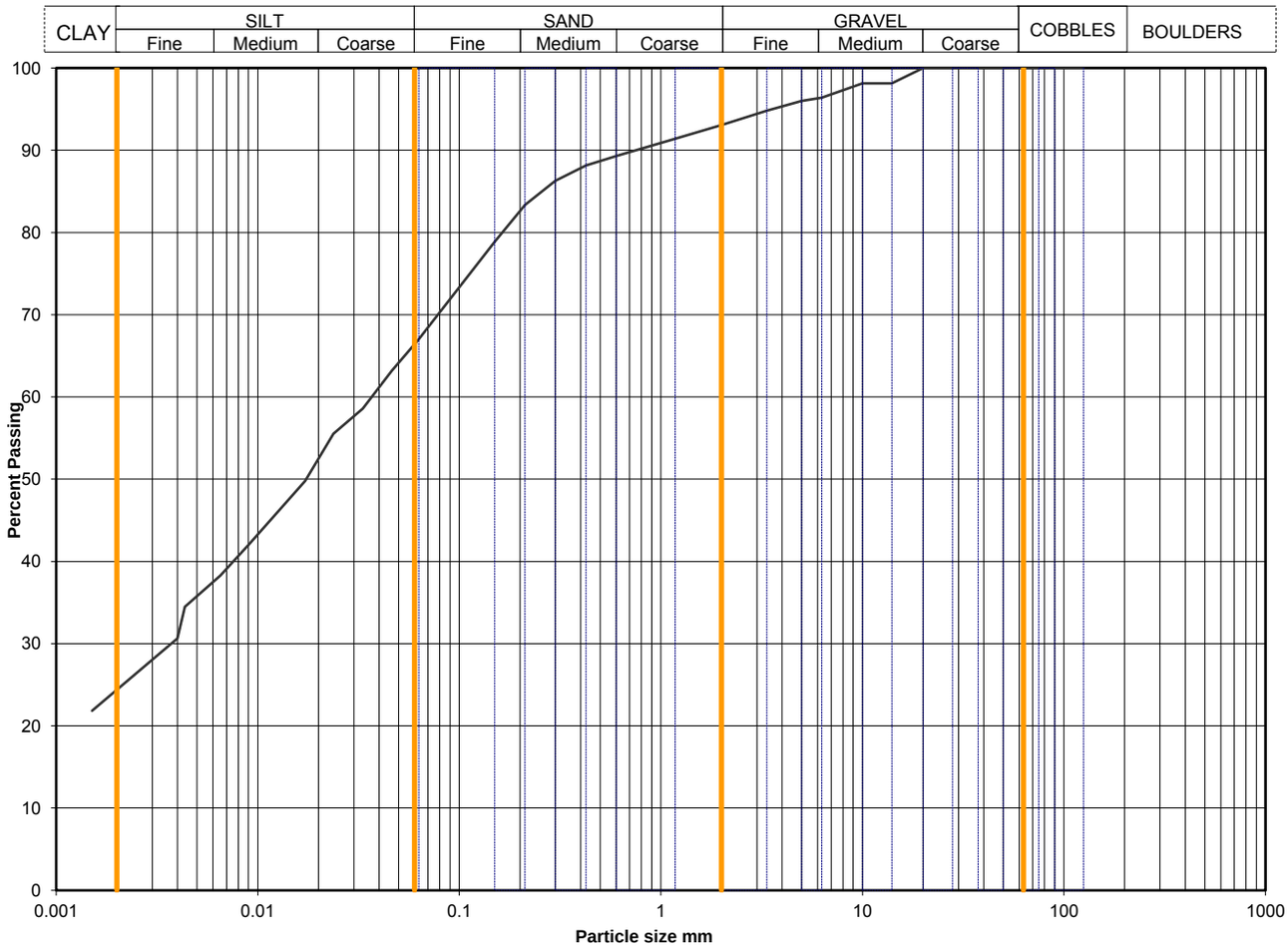
Soil description	Brown slightly sandy slightly gravelly CLAY with occasional rootlets.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	29	29
*<60mm values to aid description only	Silt	34	34
	Clay	36	36

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP318A
		Sample Depth (m BGL)	3.4
	A7063-17-20170727113545	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	67
90	100	0.0462	63
75	100	0.0332	59
63	100	0.0238	56
50	100	0.0172	50
37.5	100	0.0091	42
28	100	0.0065	38
20	100	0.0044	34
14	98	0.0040	31
10	98	0.0015	22
6.3	96		
5.0	96		
3.35	95		
2.00	93		
1.18	91		
0.600	89		
0.425	88	2.65 assumed	
0.300	86	Dry mass of sample, kg	
0.212	83		
0.150	79	8.0	
0.063	67		

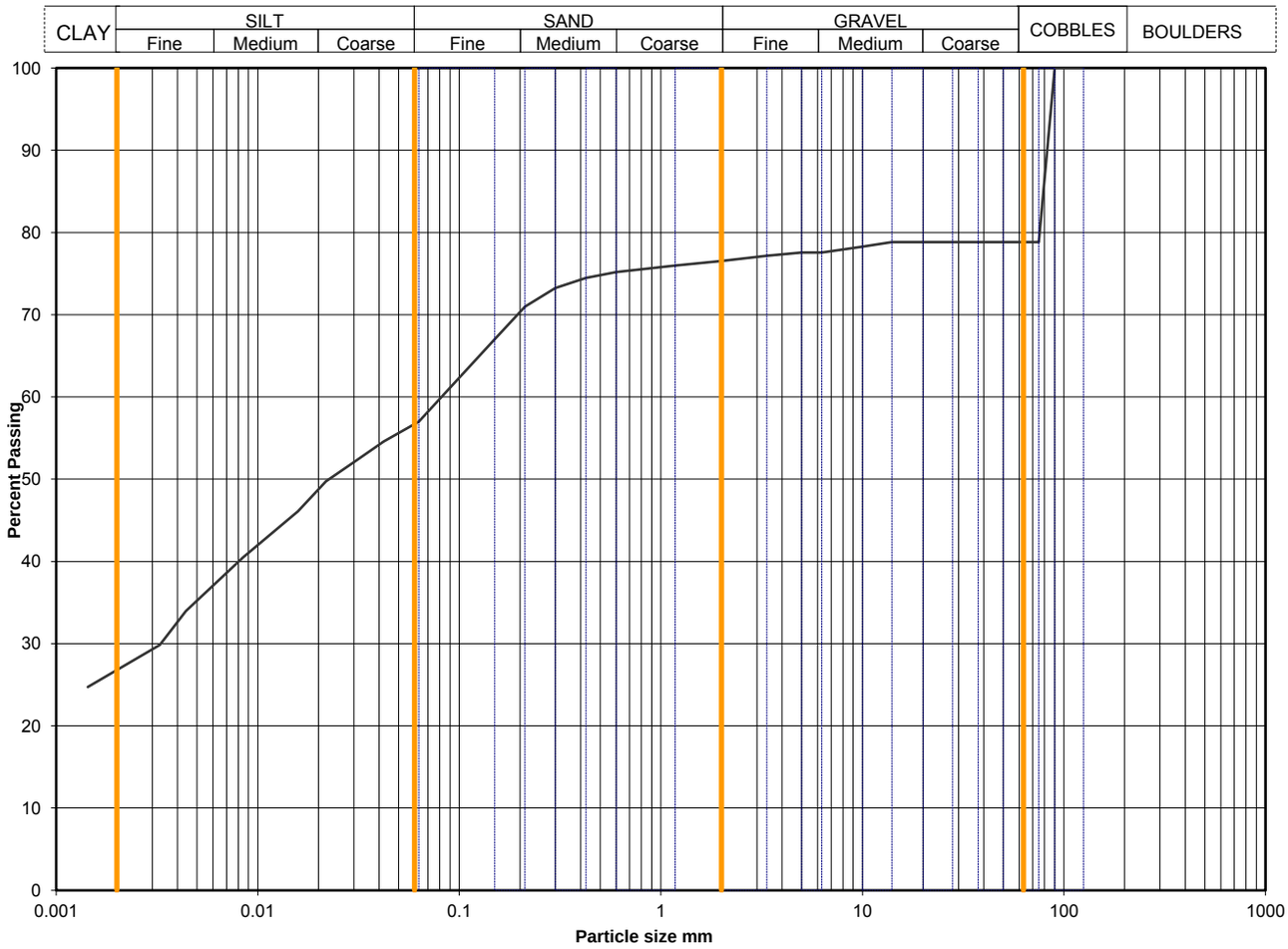
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	26	26
*<60mm values to aid description only	Silt	43	43
	Clay	24	24

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP319
		Sample Depth (m BGL)	0.6
	A7063-17-20170728095801	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	57
90	100	0.0421	55
75	79	0.0303	52
63	79	0.0218	50
50	79	0.0158	46
37.5	79	0.0085	41
28	79	0.0044	34
20	79	0.0033	30
14	79	0.0014	25
10	78		
6.3	78		
5.0	78		
3.35	77		
2.00	77		
1.18	76		
0.600	75		
0.425	74	2.65 assumed	
0.300	73	Dry mass of sample, kg	
0.212	71		
0.150	67	5.1	
0.063	57		

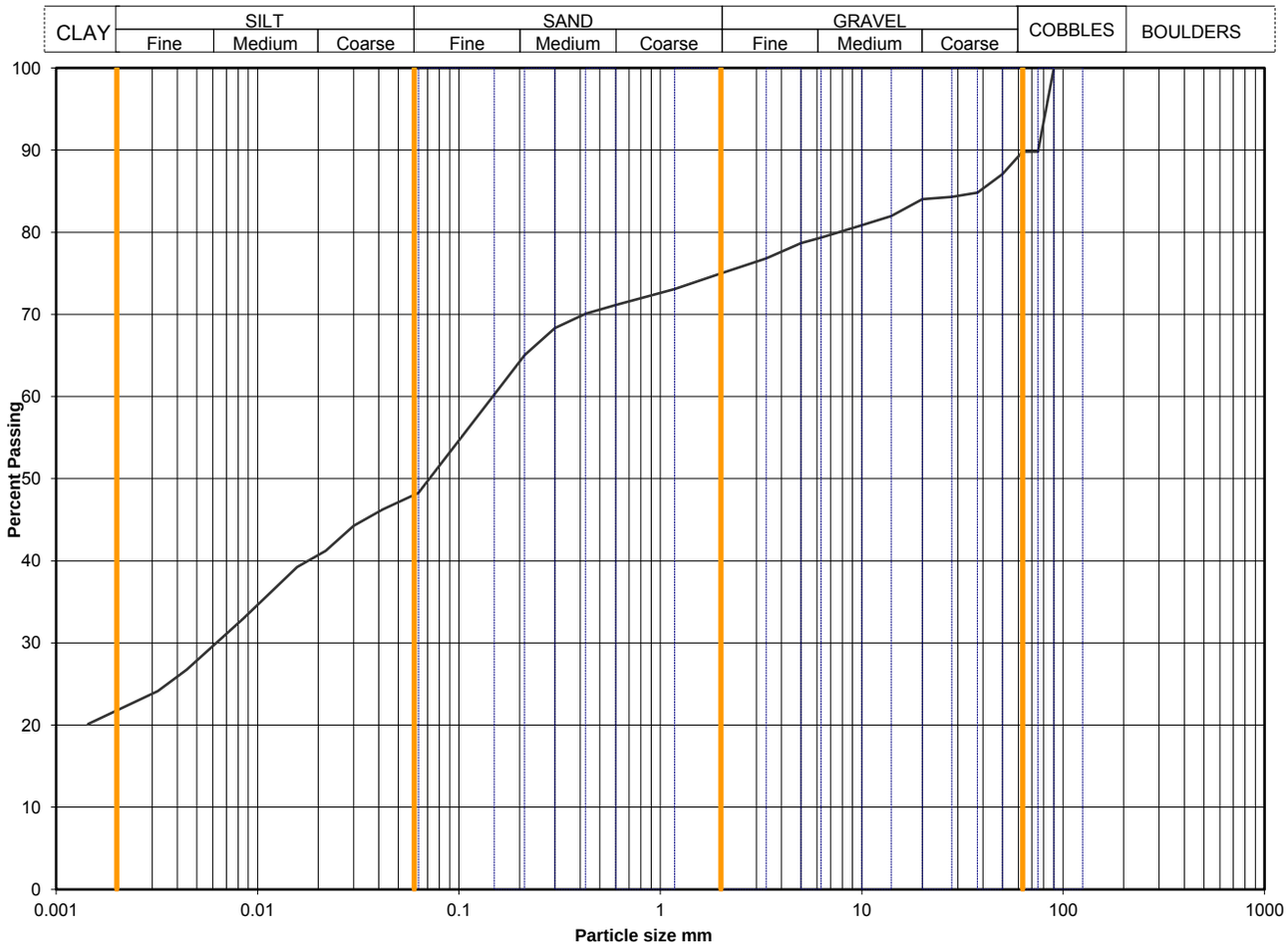
Soil description	Brown slightly sandy slightly gravelly CLAY with one cobble.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	21	0
	Gravel	2	3
	Sand	20	25
*<60mm values to aid description only	Silt	30	38
	Clay	27	34

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP319
		Sample Depth (m BGL)	1.2
	A7063-17-20170728095814	Sample Type and No	B3
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	48
90	100	0.0417	46
75	90	0.0301	44
63	90	0.0218	41
50	87	0.0157	39
37.5	85	0.0085	33
28	84	0.0044	27
20	84	0.0032	24
14	82	0.0014	20
10	81		
6.3	79		
5.0	79		
3.35	77		
2.00	75		
1.18	73		
0.600	71		
0.425	70	2.65 assumed	
0.300	68	Dry mass of sample, kg	
0.212	65		
0.150	60	7.5	
0.063	48		

Soil description	Brown slightly sandy slightly gravelly CLAY with occasional rootlets and one cobble.
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377
Remarks	

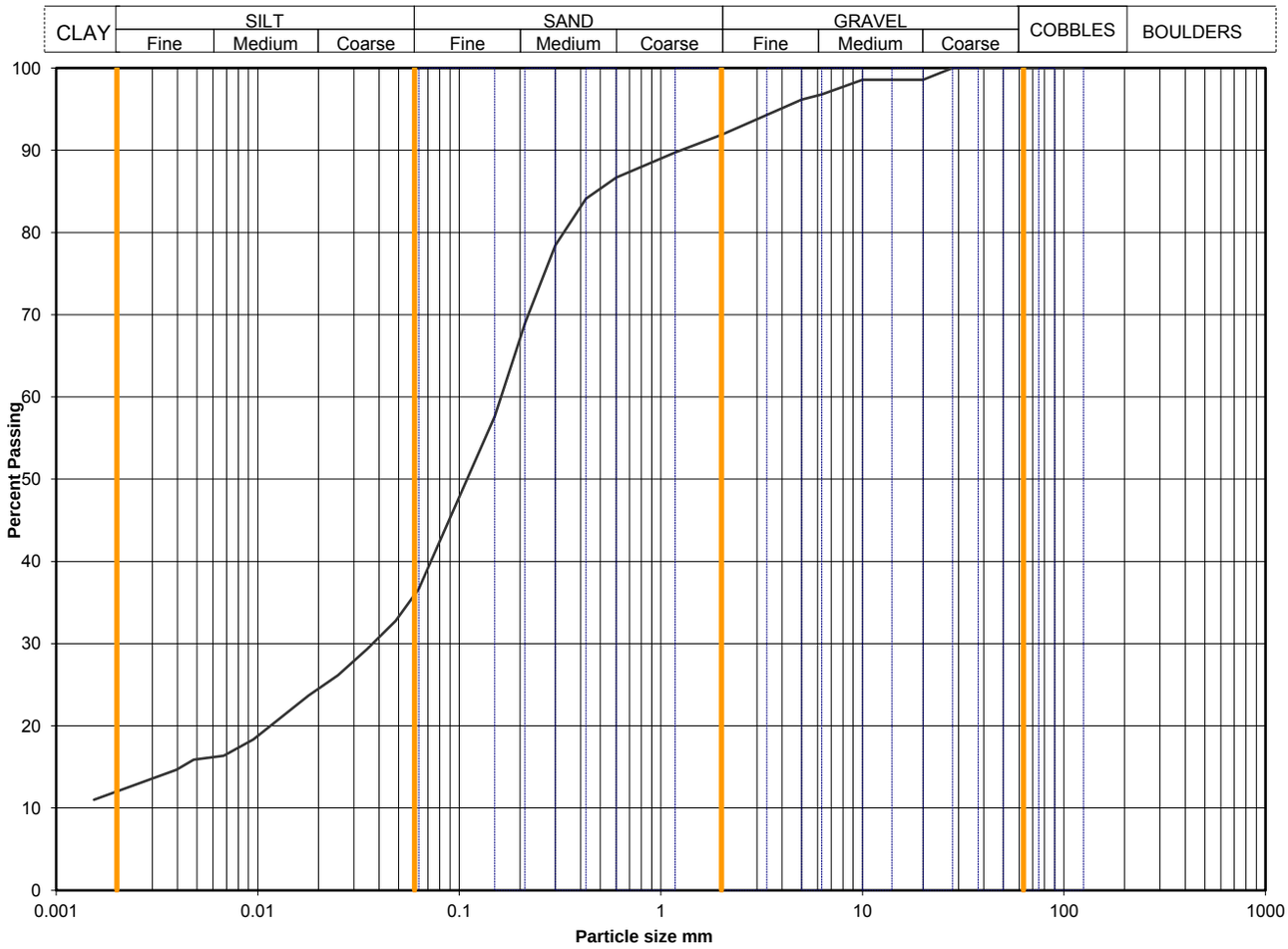
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	10	0
	Gravel	15	17
	Sand	27	30
*<60mm values to aid description only	Silt	27	30
	Clay	22	24

Uniformity Coefficient	D60 / D10	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP319
		Sample Depth (m BGL)	3.6
	A7063-17-20170728102921	Sample Type and No	D7
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	37
90	100	0.0483	33
75	100	0.0348	29
63	100	0.0250	26
50	100	0.0179	24
37.5	100	0.0095	18
28	100	0.0068	16
20	99	0.0048	16
14	99	0.0039	15
10	99	0.0015	11
6.3	97		
5.0	96		
3.35	94		
2.00	92		
1.18	90		
0.600	87		
0.425	84	2.65 assumed	
0.300	78	Dry mass of sample, kg	
0.212	69		
0.150	58	1.1	
0.063	37		

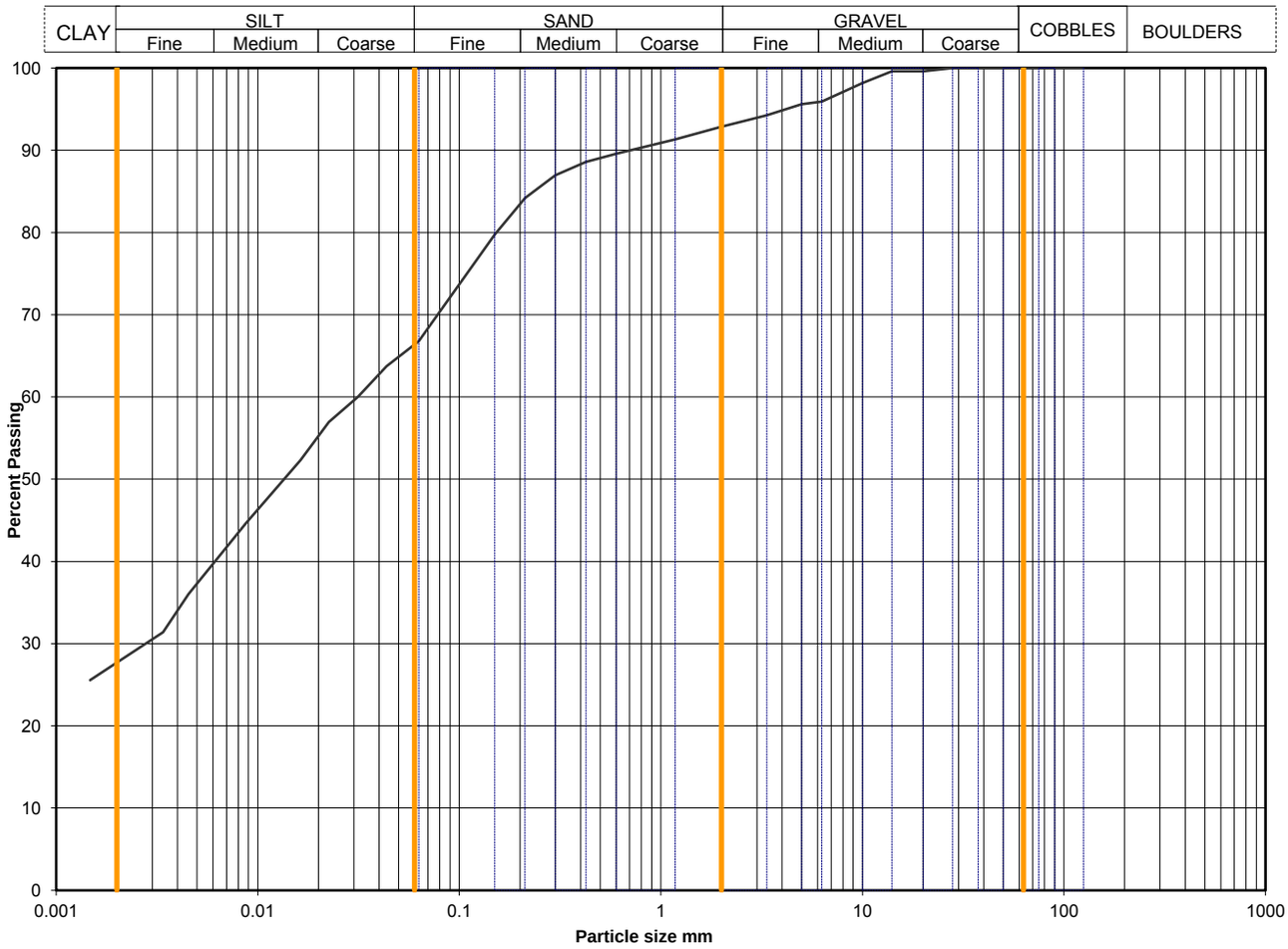
Soil description	Brown slightly gravelly sandy CLAY with occasional rootlets		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	8	8
	Sand	55	55
*<60mm values to aid description only	Silt	25	25
	Clay	12	12

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP319
		Sample Depth (m BGL)	3.9
	A7063-17-20170728103404	Sample Type and No	B8
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	67
90	100	0.0435	64
75	100	0.0314	60
63	100	0.0225	57
50	100	0.0163	52
37.5	100	0.0087	45
28	100	0.0045	36
20	100	0.0034	31
14	100	0.0015	26
10	98		
6.3	96		
5.0	96		
3.35	94		
2.00	93		
1.18	91		
0.600	90		
0.425	89	2.65 assumed	
0.300	87	Dry mass of sample, kg	
0.212	84		
0.150	80	6.7	
0.063	67		

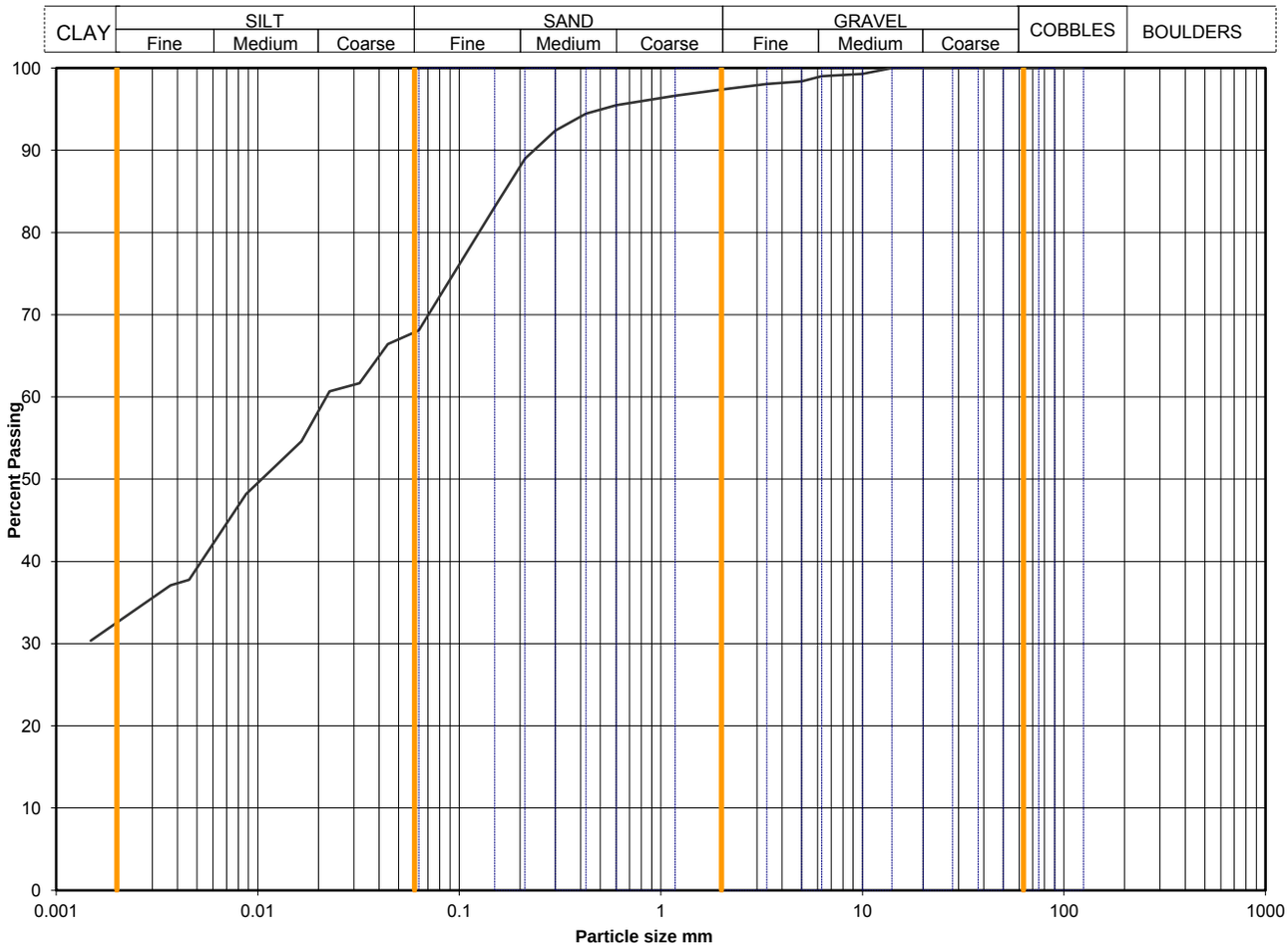
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	7	7
	Sand	26	26
*<60mm values to aid description only	Silt	39	39
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP320
		Sample Depth (m BGL)	0.5
	A7063-17-20170728111143	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	68
90	100	0.0442	66
75	100	0.0320	62
63	100	0.0227	61
50	100	0.0165	55
37.5	100	0.0088	48
28	100	0.0046	38
20	100	0.0037	37
14	100	0.0015	30
10	99		
6.3	99		
5.0	98		
3.35	98		
2.00	97		
1.18	97		
0.600	95		
0.425	94	2.65 assumed	
0.300	92	Dry mass of sample, kg	
0.212	89		
0.150	83	7.5	
0.063	68		

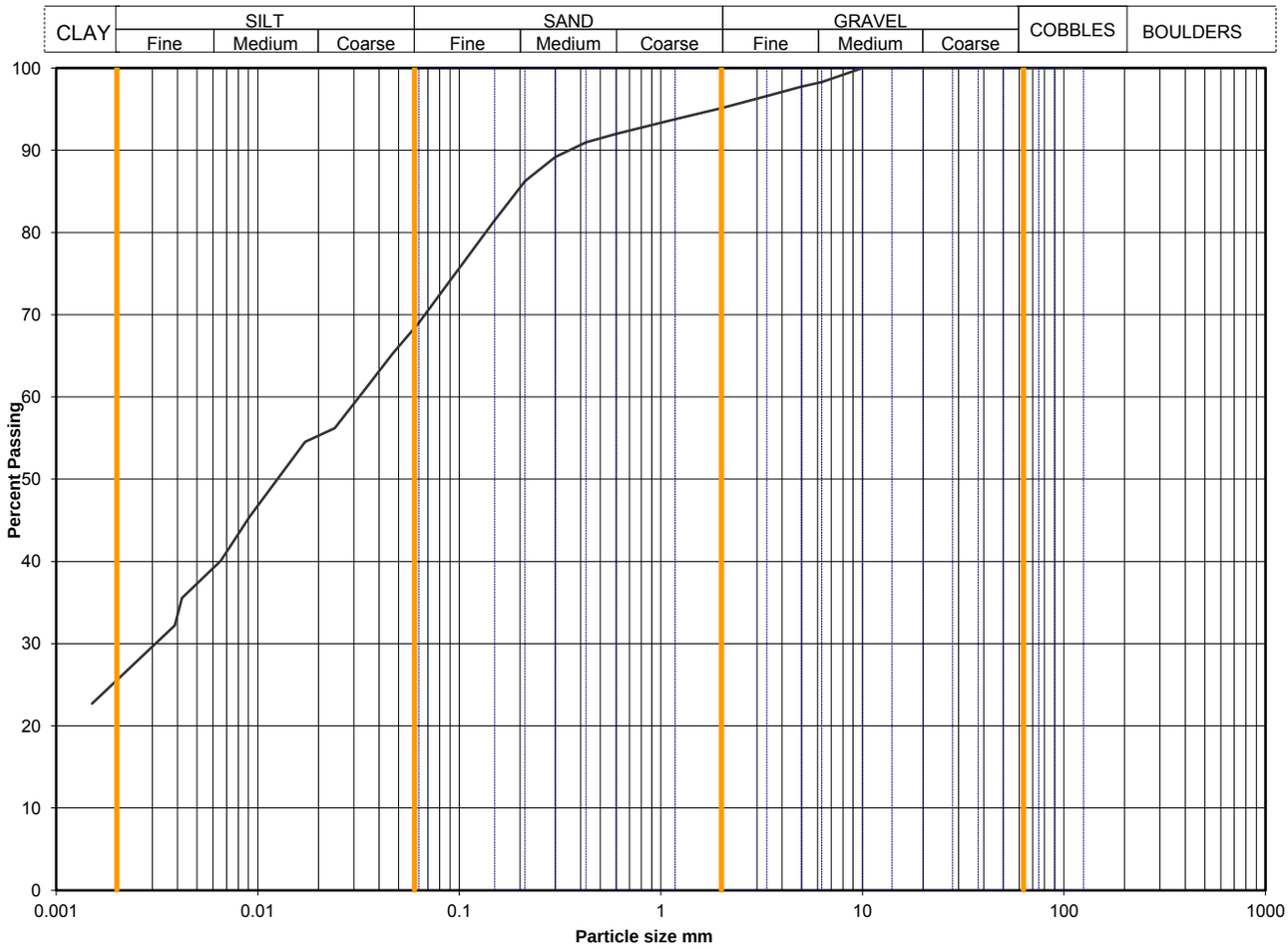
Soil description	Brown slightly sandy slightly gravelly CLAY.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	3	3
	Sand	29	29
*<60mm values to aid description only	Silt	36	36
	Clay	33	33

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP320
		Sample Depth (m BGL)	2
	A7063-17-20170728113644	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	69
90	100	0.0468	65
75	100	0.0336	61
63	100	0.0241	56
50	100	0.0172	55
37.5	100	0.0091	45
28	100	0.0066	40
20	100	0.0042	36
14	100	0.0039	32
10	100	0.0015	23
6.3	98		
5.0	98		
3.35	97		
2.00	95		
1.18	94		
0.600	92		
0.425	91	2.65 assumed	
0.300	89	Dry mass of sample, kg	
0.212	86		
0.150	81	1.9	
0.063	69		

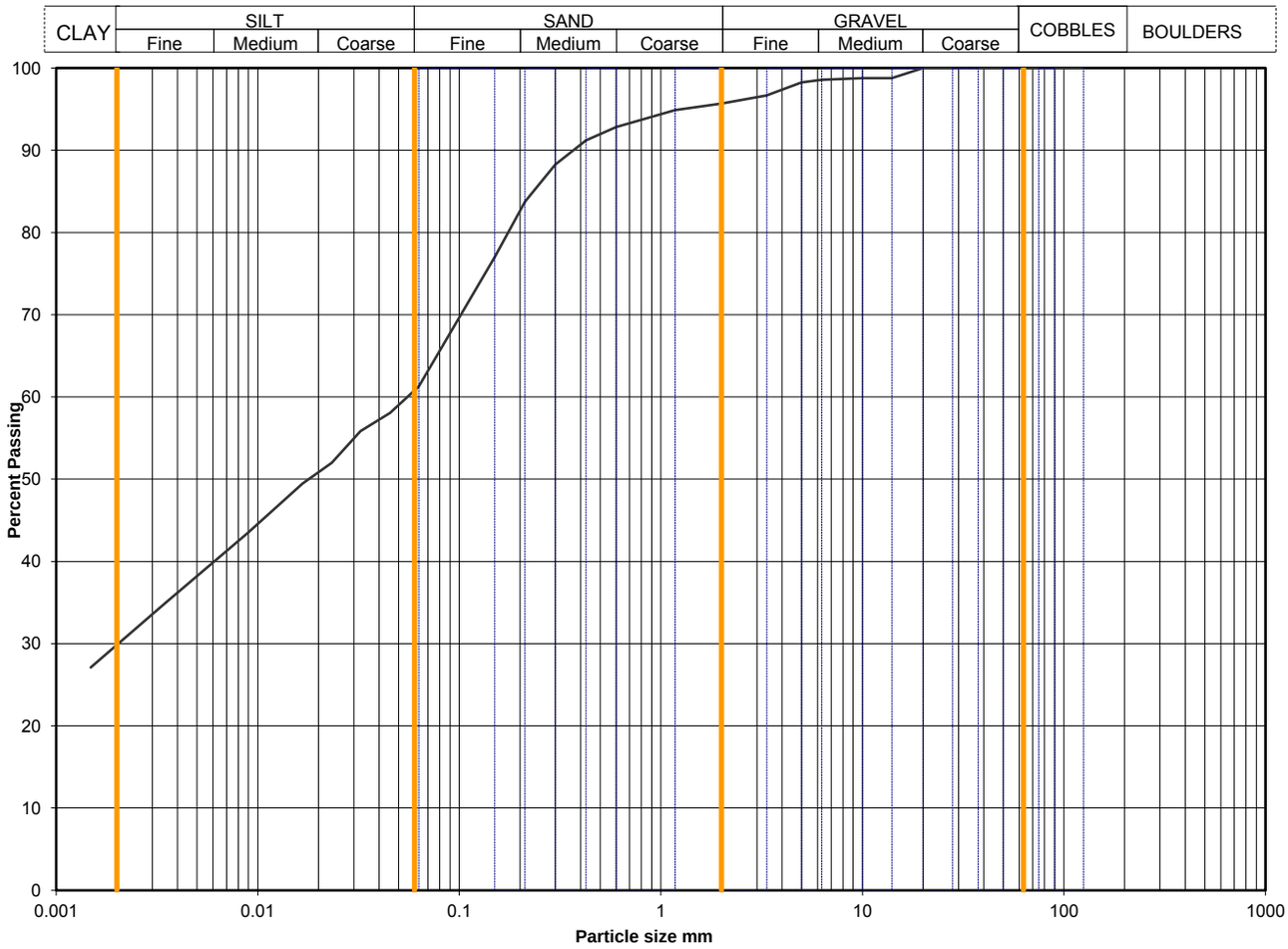
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	26	26
*<60mm values to aid description only	Silt	43	43
	Clay	26	26

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP321
		Sample Depth (m BGL)	1.1
	A7063-17-20170724084550	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	61
90	100	0.0453	58
75	100	0.0324	56
63	100	0.0233	52
50	100	0.0167	49
37.5	100	0.0088	43
28	100	0.0045	37
20	100	0.0035	35
14	99	0.0015	27
10	99		
6.3	99		
5.0	98		
3.35	97		
2.00	96		
1.18	95		
0.600	93		
0.425	91	2.65 assumed	
0.300	88	Dry mass of sample, kg	
0.212	84		
0.150	77	7.6	
0.063	61		

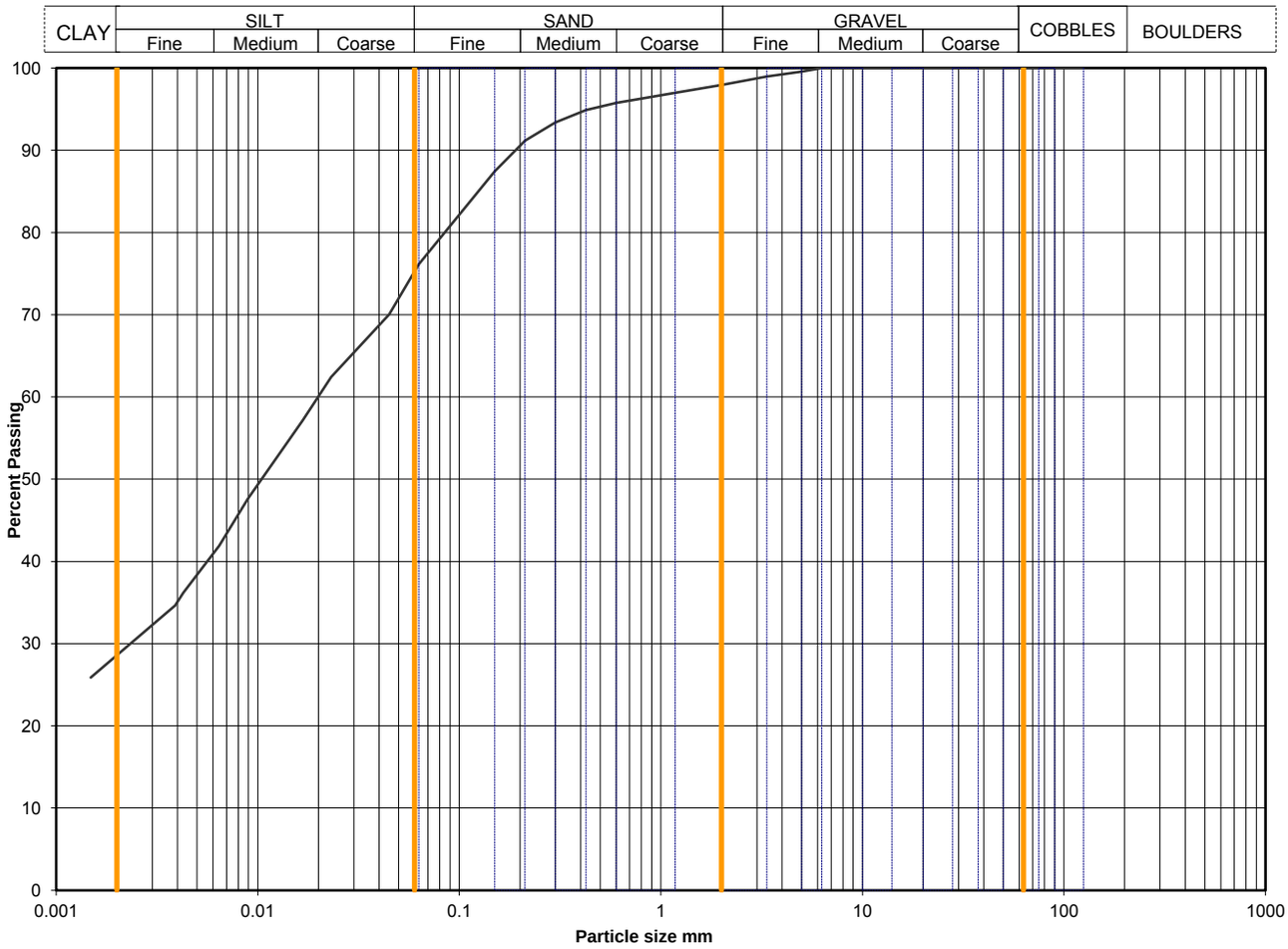
Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	4	4
	Sand	34	34
*<60mm values to aid description only	Silt	31	31
	Clay	30	30

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP321
		Sample Depth (m BGL)	2.1
	A7063-17-20170724084654	Sample Type and No	B4
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	76
90	100	0.0448	70
75	100	0.0322	66
63	100	0.0231	62
50	100	0.0167	57
37.5	100	0.0089	48
28	100	0.0064	42
20	100	0.0043	36
14	100	0.0039	35
10	100	0.0015	26
6.3	100		
5.0	100		
3.35	99		
2.00	98		
1.18	97		
0.600	96		
0.425	95	2.65 assumed	
0.300	93	Dry mass of sample, kg	
0.212	91		
0.150	87	1.4	
0.063	76		

Soil description	Brown slightly sandy slightly gravelly CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	2	2
	Sand	22	22
*<60mm values to aid description only	Silt	48	48
	Clay	29	29

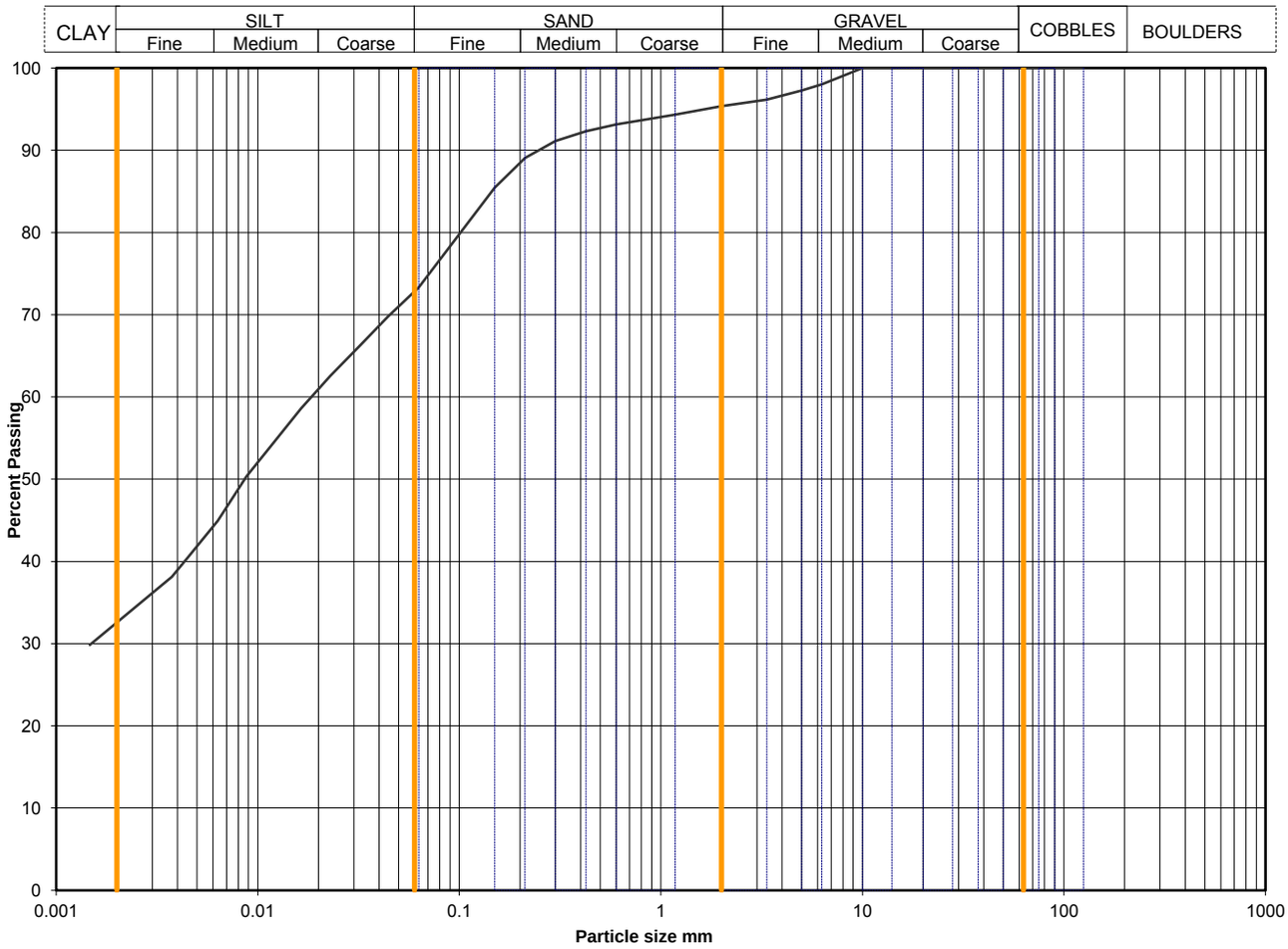
Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP321
		Sample Depth (m BGL)	4
	A7063-17-20170724084752	Sample Type and No	B6
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	73
90	100	0.0443	70
75	100	0.0318	66
63	100	0.0229	63
50	100	0.0164	59
37.5	100	0.0088	50
28	100	0.0063	45
20	100	0.0046	41
14	100	0.0037	38
10	100	0.0015	30
6.3	98		
5.0	97		
3.35	96		
2.00	95		
1.18	94		
0.600	93		
0.425	92	2.65 assumed	
0.300	91	Dry mass of sample, kg	
0.212	89		
0.150	85	2.7	
0.063	73		

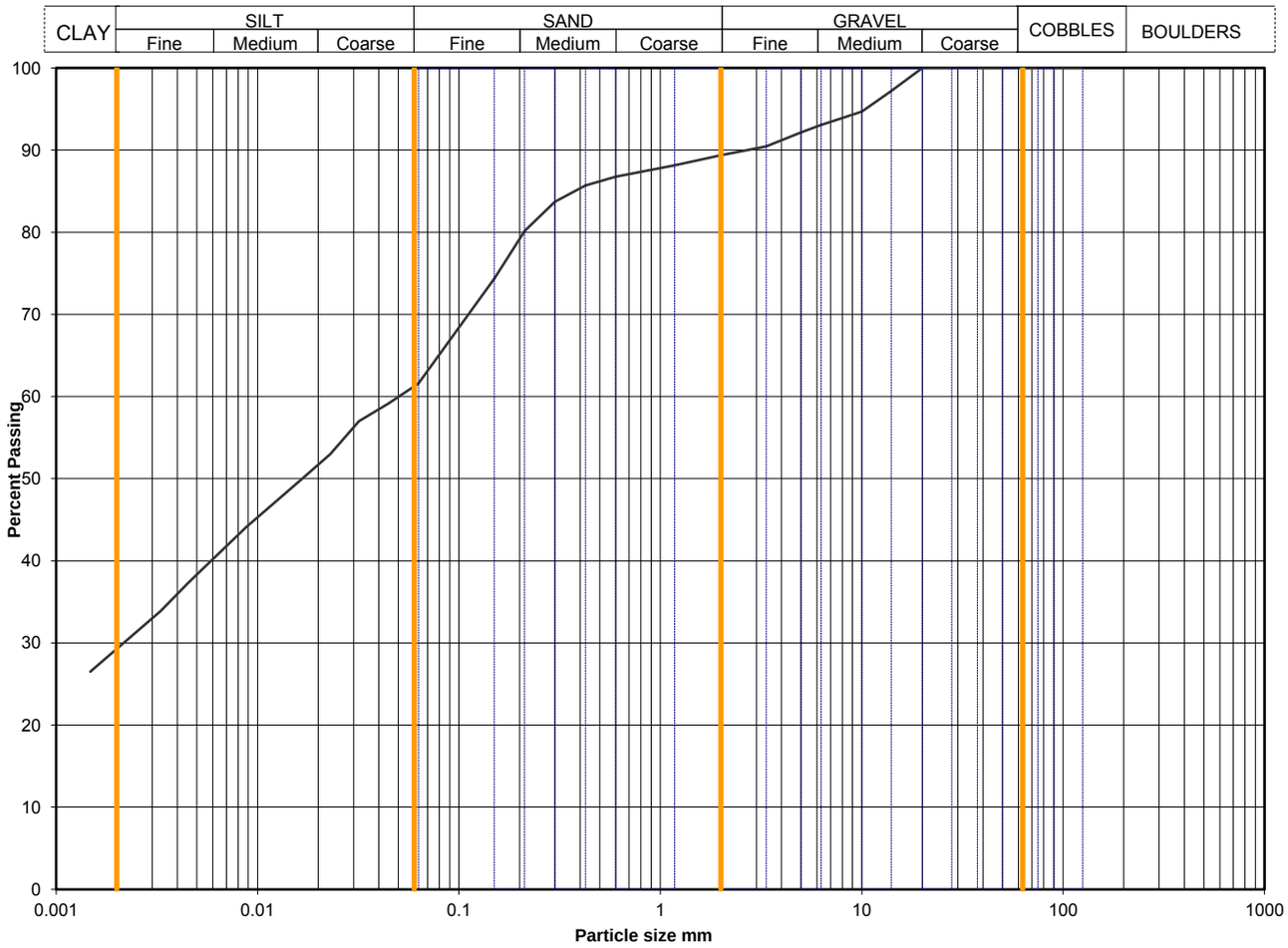
Soil description	Dark brown slightly sandy slightly gravelly clayey SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	22	22
*<60mm values to aid description only	Silt	41	41
	Clay	33	33

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP322
		Sample Depth (m BGL)	1.1
	A7063-17-20170724100924	Sample Type and No	B2
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	62
90	100	0.0446	59
75	100	0.0319	57
63	100	0.0230	53
50	100	0.0165	50
37.5	100	0.0088	44
28	100	0.0045	37
20	100	0.0033	34
14	97	0.0015	26
10	95		
6.3	93		
5.0	92		
3.35	90		
2.00	89		
1.18	88		
0.600	87		
0.425	86	2.65 assumed	
0.300	84	Dry mass of sample, kg	
0.212	80		
0.150	74	1.3	
0.063	62		

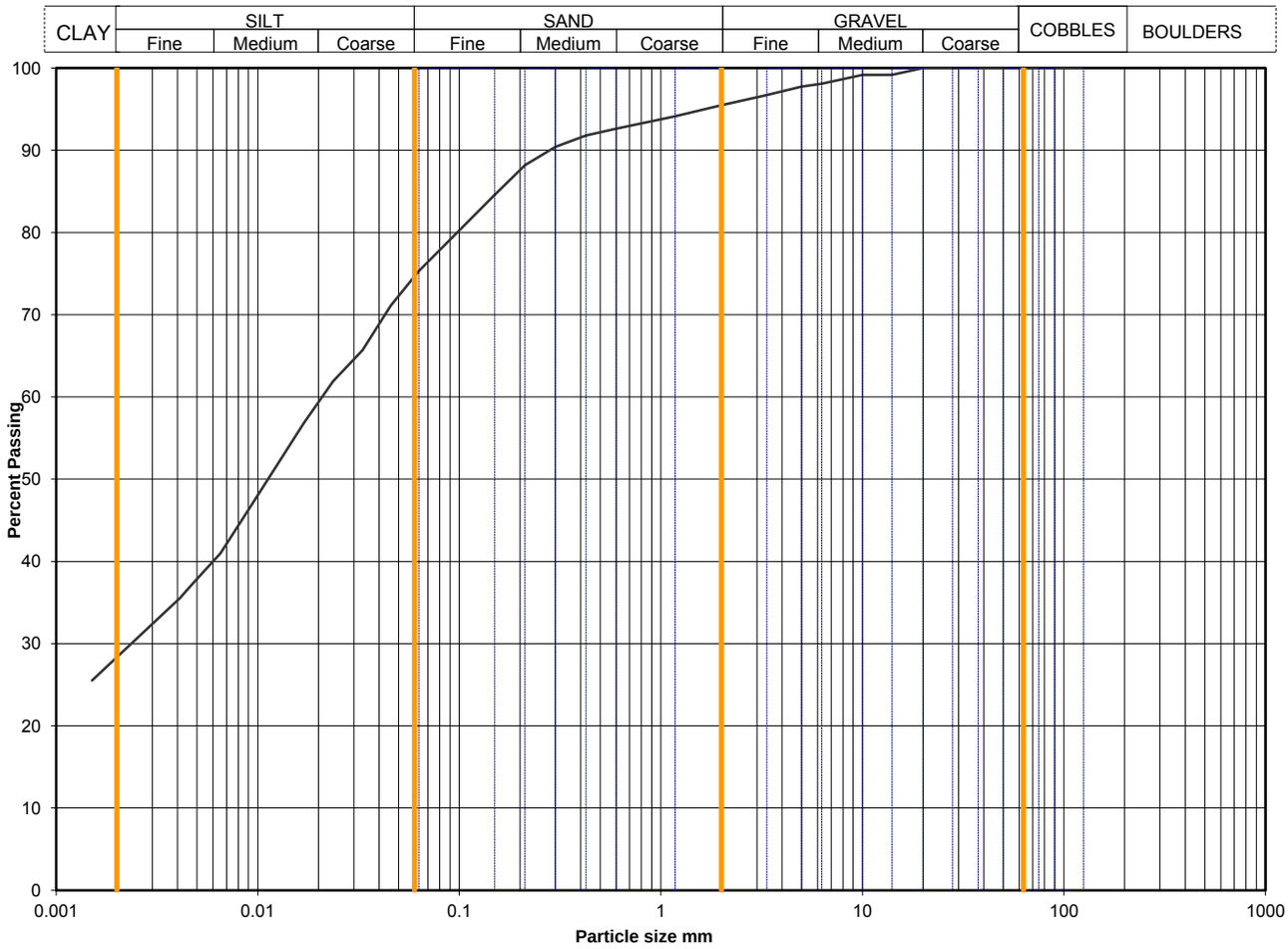
Soil description	Brown slightly sandy slightly gravelly silty CLAY		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	11	11
	Sand	28	28
*<60mm values to aid description only	Silt	32	32
	Clay	29	29

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

Particle Size Distribution Analysis

Sample Details:	SAMPLE ID:	Hole No	TP322
		Sample Depth (m BGL)	2.8
	A7063-17-20170724101025	Sample Type and No	B5
		Specimen Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	75
90	100	0.0458	71
75	100	0.0330	66
63	100	0.0237	62
50	100	0.0170	57
37.5	100	0.0091	46
28	100	0.0065	41
20	100	0.0046	37
14	99	0.0041	36
10	99	0.0015	26
6.3	98		
5.0	98		
3.35	97		
2.00	95		
1.18	94		
0.600	93		
0.425	92	2.65 assumed	
0.300	90	Dry mass of sample, kg	
0.212	88		
0.150	85	1.5	
0.063	75		

Soil description	Brown slightly sandy slightly gravelly SILT		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	5	5
	Sand	20	20
*<60mm values to aid description only	Silt	47	47
	Clay	28	28

Uniformity Coefficient	**D60 / D10**	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS WITHOUT MEASUREMENT OF PORE PRESSURE - SUMMARY OF RESULTS

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Test type	Dia. mm	ó3 kPa	At failure / end of stage Axial strain %	ó1 - ó3 kPa	cu kPa	MODE	Remarks
BH401	6	2.00	2.45	UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.17	1.88	16	UU	104.3	50	10.4	421	211	B	
BH401	14	6.00	6.45	UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.15	1.81	18	UU	102.4	100	19.8	164	82	P	
BH401	22	10.00	10.45	UT	Firm to stiff greyish brown slightly sandy slightly gravelly CLAY with localised softening.	2.08	1.73	20	UU	103.3	200	11.3	29	15	P	
BH401	39	19.00	19.45	UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.06	1.69	22	UU	103.8	400	19.3	282	141	P	
BH402	5	2.00		UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.18	1.9	15	UU	103.2	50	14.9	464	232	P	
BH402	12	6.00		UT	Firm to stiff brown slightly sandy slightly gravelly CLAY	2.18	1.86	17	UU	102.1	100	19.9	132	66	P	
BH402	24	12.00		UT	Very stiff greyish brown slightly sandy slightly gravelly CLAY.	2.18	1.88	16	UU	102.9	250	19.9	258	129	P	
BH402	31	17.00		UT	Firm greyish brown slightly sandy slightly gravelly CLAY with localised softening.	2.08	1.68	24	UU	103.4	350	15.4	113	57	P	
BH402	39	21.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY with chalk fragments.	2.17	1.87	16	UU	103.2	400	19.8	272	136	P	
BH403	6	2.00		UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.15	1.9	14	UU	103.9	50	6.4	692	346	P	
BH403	14	6.00		UT	Very stiff greyish brown slightly sandy slightly gravelly CLAY.	2.19	1.9	15	UU	103.3	100	17.4	413	207	P	
BH403	22	10.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.11	1.75	20	UU	103.4	200	18.9	138	69	P	
BH403	34	16.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.18	1.88	16	UU	103.1	300	19.9	180	90	P	
BH403	46	22.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.94	2.51	17	UU	87.2	450	20.1	281	141	P	
BH404	6	2.00		UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.14	1.86	15	UU	103.3	50	11.4	472	236	B	
BH404	10	4.00		UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.2	1.92	15	UU	102.8	75	19.4	475	238	P	
BH404	14	6.00		UT	Stiff to very stiff greyish brown slightly sandy slightly gravelly CLAY.	2.19	1.9	15	UU	102.3	100	19.9	257	129	P	
BH404	26	12.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.18	1.88	16	UU	103.2	250	19.8	202	101	P	
BH404	34	16.00		UT	Firm to stiff greyish brown slightly sandy slightly gravelly CLAY.	2.11	1.75	20	UU	102.8	300	19.9	128	64	C	
BH404	46	22.00		UT	Firm to stiff brown slightly sandy slightly gravelly CLAY.	2.16	1.85	17	UU	103.8	450	20.1	88	44	P	
BH405	6	2.00		UT	Very stiff greyish brown slightly sandy slightly gravelly CLAY.	2.1	1.81	16	UU	103	50	11.4	445	223	B	
BH405	14	6.00		UT	Firm to stiff greyish brown slightly sandy slightly gravelly CLAY.	2.18	1.86	17	UU	103.3	100	18.9	134	67	P	
BH405	18	8.00		UT	Firm brown slightly sandy slightly gravelly CLAY.	2.14	1.82	18	UU	102.9	150	19.4	82	41	P	
BH405	26	12.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.18	1.89	16	UU	103.6	250	16.3	260	130	P	

General notes: Tests carried out in accordance with BS1377: Part 7: 1990, clause 8 for single stage, clause 9 for multistage tests. Specimens nominally 2:1 height diameter ratio and tested at a rate of strain of 2%/minute, unless annotated otherwise. See individual test reports for further details.

Legend

UU - single stage test (may be in sets of specimens)
UUM - multistage test on a single specimen
suffix R - remoulded or recompacted

ó3 cell pressure
ó1 - ó3 deviator stress
cu undrained shear strength

Mode of failure: P plastic; B brittle; C compound

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS WITHOUT MEASUREMENT OF PORE PRESSURE - SUMMARY OF RESULTS

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Test type	Dia. mm	ó3 kPa	At failure / end of stage: Axial strain %	ó1 - ó3 kPa	cu kPa	MODE	Remarks
BH405	38	18.00		UT	Firm greyish brown slightly sandy slightly gravelly CLAY.	2.19	1.87	17	UU	102.8	350	19.9	121	61	P	
BH405	46	22.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.15	1.83	17	UU	102	450	19.8	203	102	P	
BH406	6	2.00		UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.17	1.91	14	UU	102.8	50	7.9	462	231	B	
BH406	22	10.00		UT	Stiff dark brown slightly sandy slightly gravelly CLAY.	2.18	1.88	16	UU	102.9	200	18.9	215	108	P	
BH406	26	12.00		UT	Stiff dark brown slightly sandy slightly gravelly CLAY.	2.19	1.88	17	UU	103	250	17.4	204	102	P	
BH406	38	18.00		UT	Firm to stiff dark brown slightly sandy slightly gravelly CLAY.	2.16	1.82	19	UU	102.5	350	19.8	208	104	P	
BH407	6	2.00		UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.17	1.87	16	UU	103.3	50	18.9	398	199	P	
BH407	10	4.00		UT	Very stiff brown slightly sandy slightly gravelly CLAY.	2.13	1.83	16	UU	103.3	100	16.3	404	202	P	
BH407	18	8.00		UT	Firm to stiff brown slightly sandy slightly gravelly CLAY.	2.16	1.84	17	UU	102.8	150	19.8	158	79	P	
BH407	30	14.00		UT	Stiff dark brown slightly sandy slightly gravelly CLAY.	2.17	1.86	17	UU	102.5	300	19.4	203	102	P	
BH407	38	18.00		UT	Firm dark brown slightly sandy slightly gravelly CLAY.	2.14	1.81	18	UU	101.9	350	19.4	142	71	P	
BH408	6	2.80		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	2.16	1.88	15	UU	103.7	50	19.8	270	135	P	
BH408	18	8.50		UT	Stiff laminated greyish brown slightly sandy slightly gravelly CLAY.	2.09	1.73	21	UU	102.9	175	18.9	155	78	P	
BH408	24	12.50		UT	Stiff greyish brown slightly sandy slightly gravely CLAY	2.17	1.86	16	UU	104.1	50	19.8	183	92	P	
BH408	31	16.50		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY	2.19	1.88	16	UU	103	300	19.8	231	116	P	
BH408	41	22.50		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY	2.19	1.9	16	UU	101.4	450	19.8	233	117	P	
BH409	6	2.00		UT	Stiff brown slightly sandy slightly gravelly CLAY	2.04	1.71	20	UU	103.4	50	10.4	255	128	B	
BH409	15	6.00		UT	Stiff brown slightly sandy slightly gravelly CLAY.	2.17	1.85	18	UU	103	125	18.9	212	106	P	
BH409	19	8.00		UT	Firm stiff greyish brown slightly sandy slightly gravelly CLAY	2.14	1.83	17	UU	103.5	150	19.7	185	93	P	
BH409	31	14.00		UT	Firm laminated greyish brown slightlty sandy slightly gravel CLAY	2.02	1.61	26	UU	102.5	300	19.9	175	88	P	
BH409	39	18.00		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY with chalk fragments	2.18	1.88	16	UU	103.3	350	19.8	206	103	P	
BH409	51	24.00		UT	Firm greyish brown slightly sandy slightly gravelly CLAY	2.18	1.86	17	UU	91.7	450	19.4	92	46	P	
BH410	3	1.00		U	Firm to stiff dark brown slightly sandy slightly gravelly CLAY.	2.07	1.74	19	UU	69.9	25	19.9	205	103	P	
BH410	9	3.50		U	Firm dark brown slightly sandy slightly gravelly CLAY.	2.12	1.72	24	UU	71.6	100	19.9	83	42	P	

General notes: Tests carried out in accordance with BS1377: Part 7: 1990, clause 8 for single stage, clause 9 for multistage tests. Specimens nominally 2:1 height diameter ratio and tested at a rate of strain of 2%/minute, unless annotated otherwise. See individual test reports for further details.

Legend

UU - single stage test (may be in sets of specimens)	ó3	cell pressure	Mode of failure	P	plastic
UUM - multistage test on a single specimen	ó1 - ó3	deviator stress		B	brittle
suffix R - remoulded or recompacted	*cu*	undrained shear strength		C	compound

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS WITHOUT MEASUREMENT OF PORE PRESSURE - SUMMARY OF RESULTS

Hole No.	Sample No.	Depth (m) from	Depth (m) to	Sample type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	*w* %	Test type	Dia. mm	ó3 kPa	At failure / end of stage: Axial strain %	ó1 - ó3 kPa	*cu* kPa	MODE	Remarks
BH411	8	2.00		U	Firm to stiff dark brown slightly sandy slightly gravelly CLAY.	2.14	1.52	41	UU	71.5	50	19.9	235	118	P	
BH411	13	4.60		U	Firm dark brown slightly sandy slightly gravelly CLAY.	2.17	1.82	19	UU	70.1	100	19.9	96	48	P	
BH411A	6	9.00		U	Firm to stiff brown slightly sandy slightly gravelly CLAY.	2.07	1.69	23	UU	70.3	200	18.1	199	100	C	

General notes: Tests carried out in accordance with BS1377: Part 7: 1990, clause 8 for single stage, clause 9 for multistage tests. Specimens nominally 2:1 height diameter ratio and tested at a rate of strain of 2%/minute, unless annotated otherwise. See individual test reports for further details.

Legend

UU - single stage test (may be in sets of specimens)
UUM - multistage test on a single specimen
suffix R - remoulded or recompacted

ó3 cell pressure
ó1 - ó3 deviator stress
cu undrained shear strength

Mode of failure: P plastic; B brittle; C compound

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

DETERMINATION OF SHEAR STRENGTH BY LABORATORY VANE METHOD - SUMMARY OF RESULTS
(BS 1377 : Part 7 : 1990, clause 3)

Hole No.	Sample				Soil Desription	Moisture Content at test horizon %	Undrained shear strength kPa		Remarks
	No.	Depth (m)		type			Undisturbed	Remoulded	
		from	to						
BH401	18	8	8.45	UT	Firm greyish brown slightly sandy CLAY	11	61	14	
BH406	14	6		UT	Stiff greyish brown slightly sandy slightly gravelly CLAY.	30	150	22	
BH407	26	12		UT	Stiff brown slightly sandy slightly gravelly CLAY.	32	120	33	
BH410	12	6		U	Firm greyish brown slightly sandy slightly gravelly CLAY.	47	48	19	

Notes:

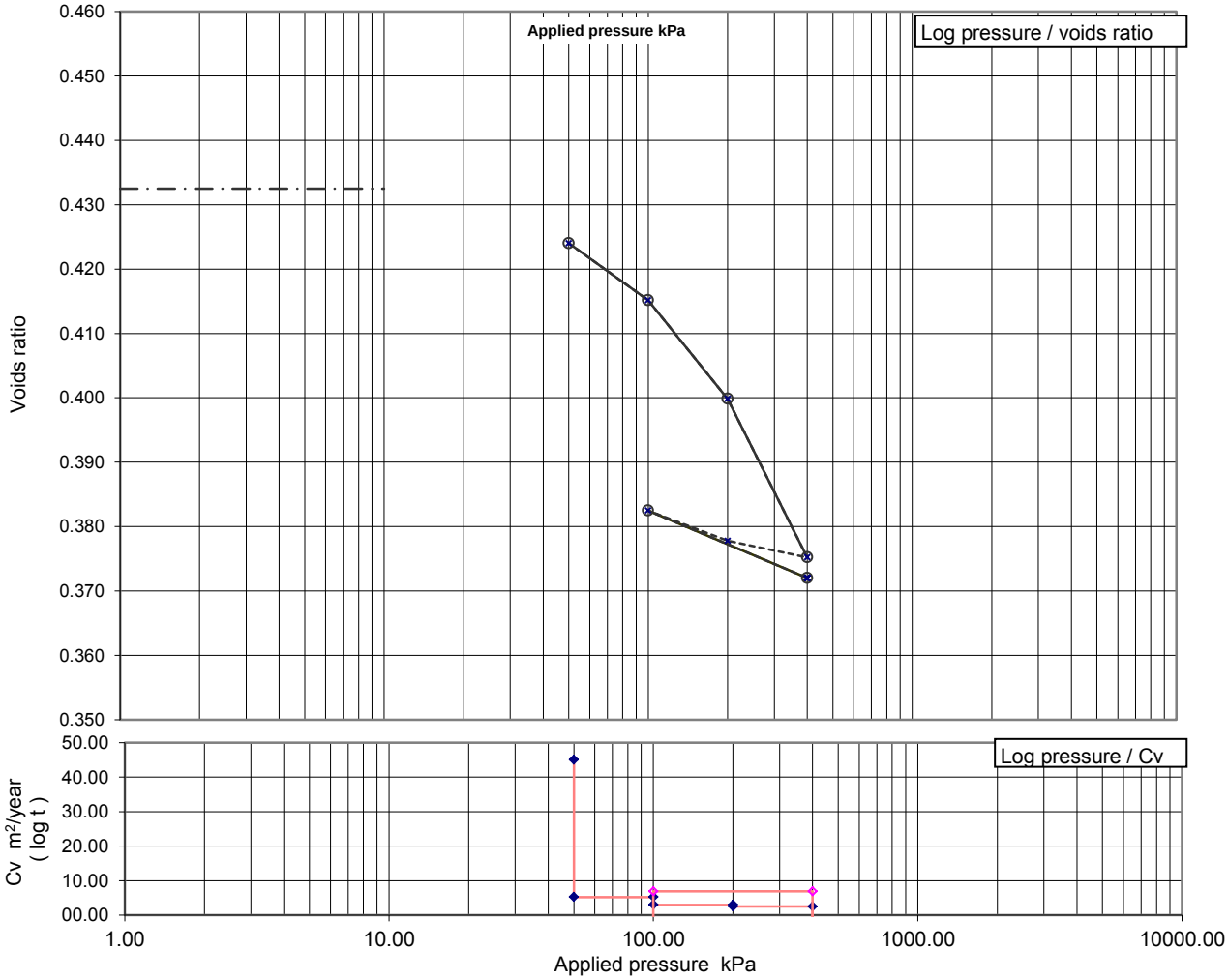
1 Tests carried out in accordance with BS1377 : part 7 : 1990, clause 3

2 Shear strengths given are average of 3 tests unless otherwise stated

3 Tests carried out using 12.7mm x 12.7mm vane

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH401
		Sample Depth (m BGL)	4.00 - 4.45
	A7063-17/0-20170713062456	Sample Type and No	UT10
		Specimen Ref	



Soil description	Firm brown slightly sandy slightly gravelly CLAY.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % — Plastic limit %

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m3
Diameter	74.97		mm
Height	18.90	18.10	mm
Voids ratio	0.432	0.372	
Moisture content	16	15	%
Bulk density	2.14	2.22	Mg/m3
Dry density	1.85	1.93	Mg/m3
Saturation	97	105	%
Average temperature for test	21		oC

Swelling pressure: not measured kPa

Notes :

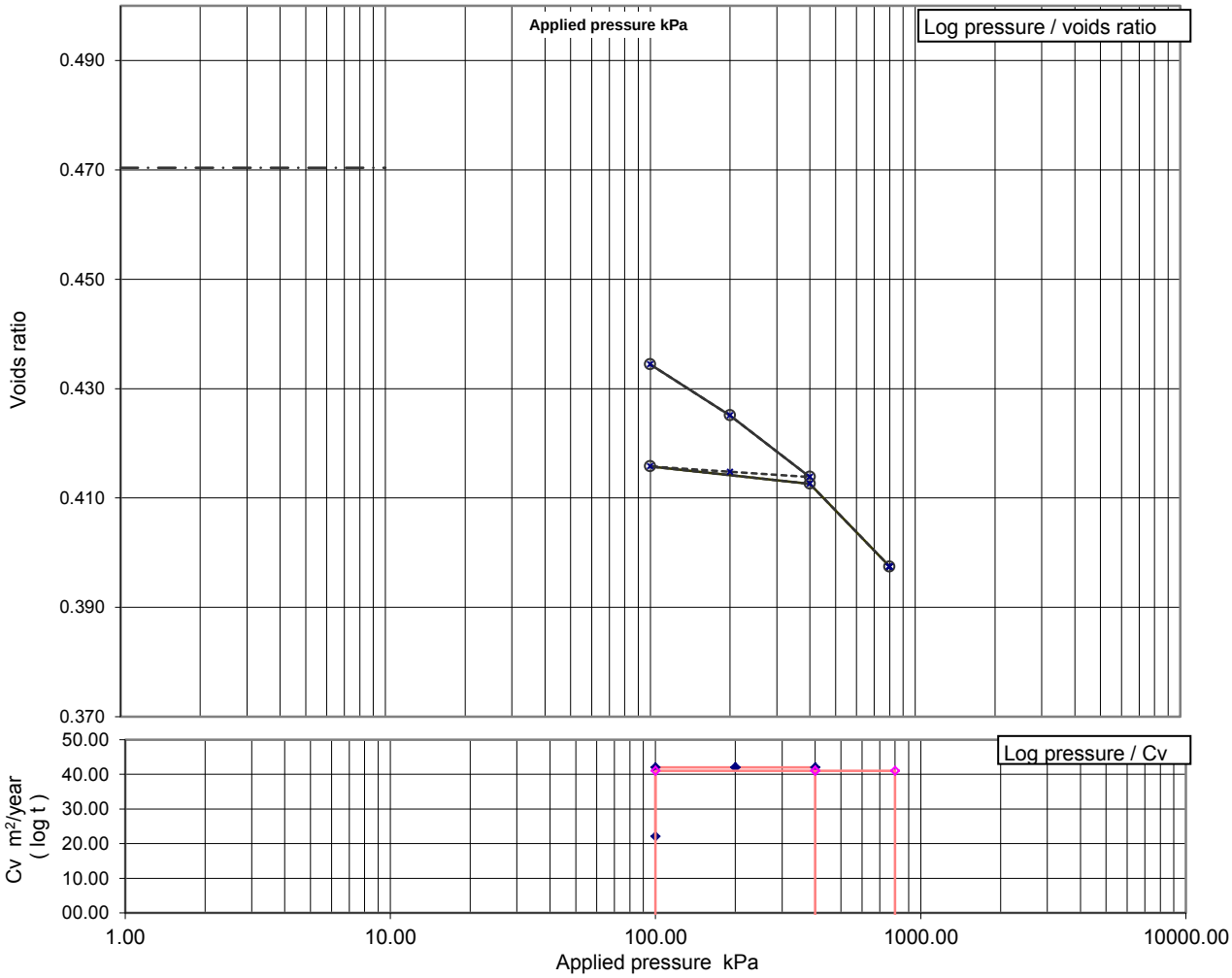
Specimen taken 50 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.4325				
50	0.4240	0.119	45	48	
100	0.4151	0.125	5.2	5.6	
200	0.3998	0.108	3	3.2	
400	0.3752	0.088	2.5	2.7	
200	0.3778	0.009	-	-	
100	0.3825	0.034	-	-	
400	0.3720	0.025	6.9	7.5	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH402
		Sample Depth (m BGL)	10
	A7063-17-20170714054801	Sample Type and No	UT19
		Specimen Ref	



Soil description	Brown slightly sandy SILT.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % — Plastic limit %

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m3
Diameter	74.99		mm
Height	18.92	17.98	mm
Voids ratio	0.470	0.397	
Moisture content	18	16	%
Bulk density	2.12	2.19	Mg/m3
Dry density	1.80	1.90	Mg/m3
Saturation	100	105	%
Average temperature for test	21		oC

Swelling pressure: not measured kPa

Notes :

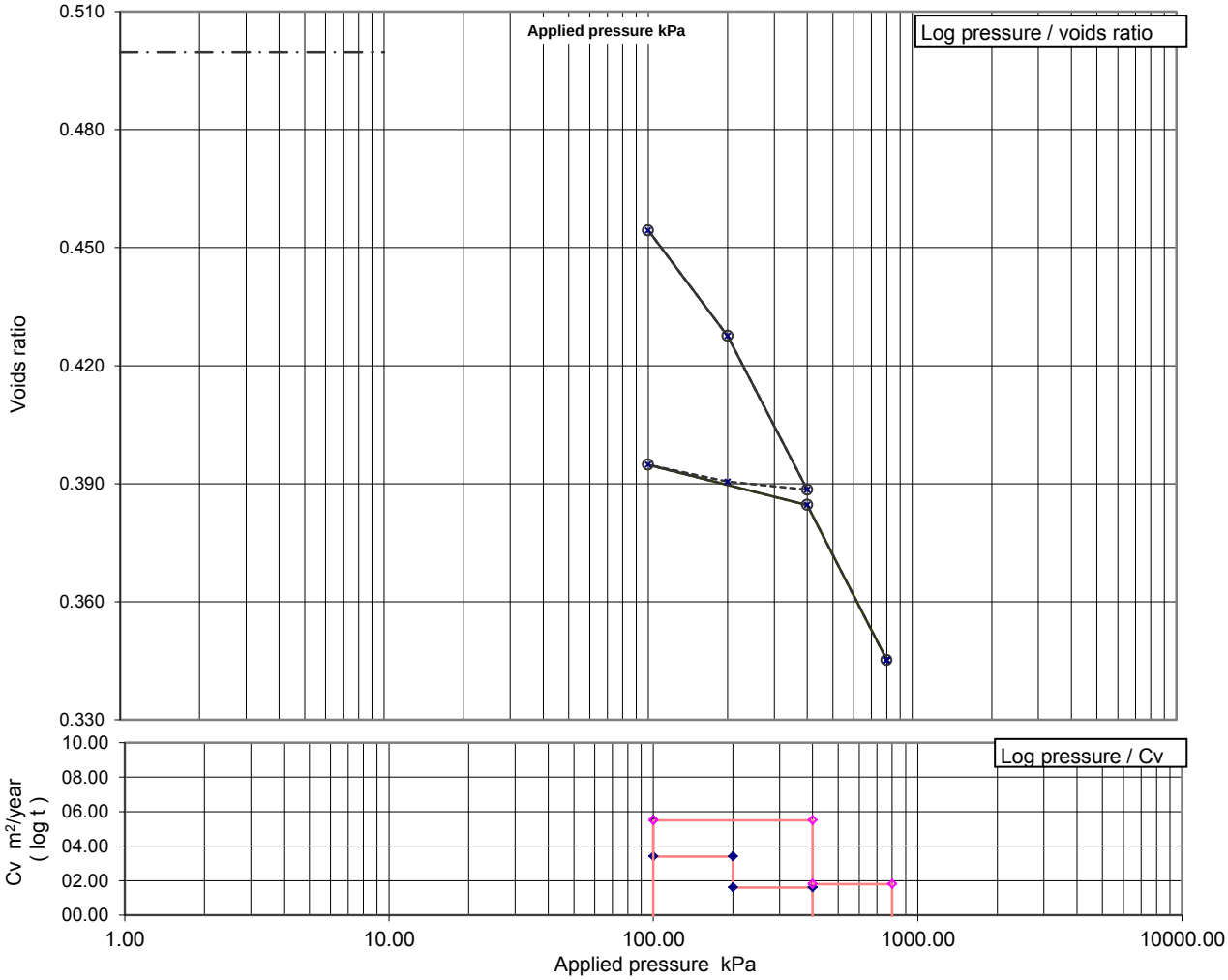
Specimen taken 10 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.4704				
100	0.4344	0.245	22	24	
200	0.4251	0.065	42	45	
400	0.4138	0.040	42	45	
200	0.4148	0.003	-	-	
100	0.4158	0.007	-	-	
400	0.4126	0.008	41	51	
800	0.3974	0.027	41	44	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH403
		Sample Depth (m BGL)	8
	A7063-17/0-20170721011750	Sample Type and No	UT18
		Specimen Ref	



Soil description	Firm brown slightly sandy slightly gravelly CLAY.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % / Plastic limit %

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m3
Diameter	74.98		mm
Height	18.92	16.97	mm
Voids ratio	0.500	0.345	
Moisture content	18	14	%
Bulk density	2.08	2.24	Mg/m3
Dry density	1.77	1.97	Mg/m3
Saturation	94	105	%
Average temperature for test	21		oC

Swelling pressure: not measured kPa

Notes :

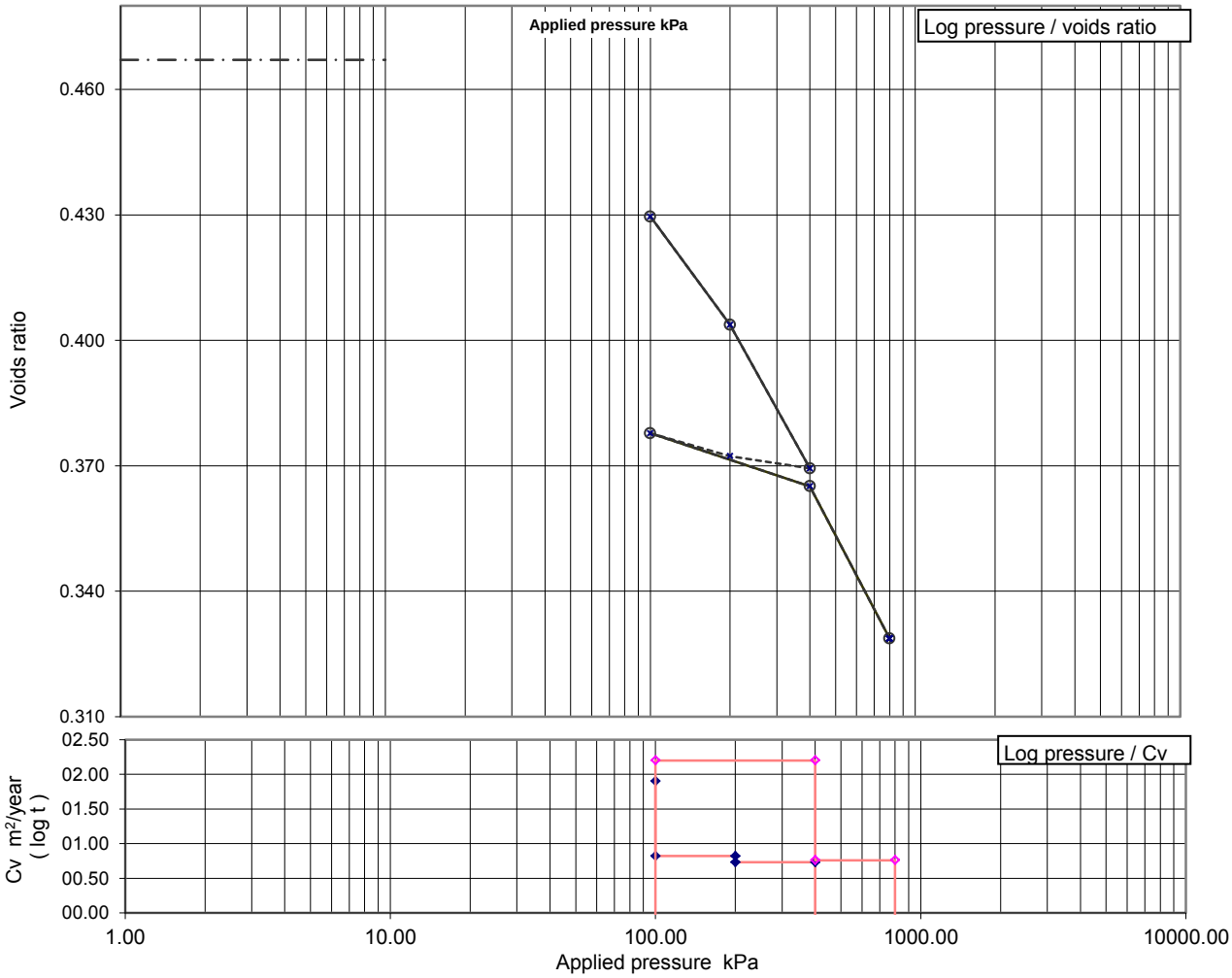
Specimen taken 50 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.4996				
100	0.4543	0.302	5.5	5.7	
200	0.4275	0.184	3.4	3.5	
400	0.3885	0.137	1.6	1.7	
200	0.3905	0.007	-	-	
100	0.3948	0.031	-	-	
400	0.3846	0.024	5.5	5.4	
800	0.3452	0.071	1.8	1.9	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH404
		Sample Depth (m BGL)	8
	A7063-17/0-20170719064533	Sample Type and No	UT18
		Specimen Ref	



Soil description	Firm brown slightly sandy slightly gravelly CLAY.			
Preparation	Undisturbed			
Index properties (if available)	Liquid limit %		Plastic limit %	

	Initial	Final	
Specimen details			
Particle density	2.65	assumed	Mg/m3
Diameter	75.01		mm
Height	18.88	17.10	mm
Voids ratio	0.467	0.329	
Moisture content	17	13	%
Bulk density	2.12	2.25	Mg/m3
Dry density	1.81	1.99	Mg/m3
Saturation	98	105	%
Average temperature for test	21		oC

Swelling pressure: not measured kPa

Notes :

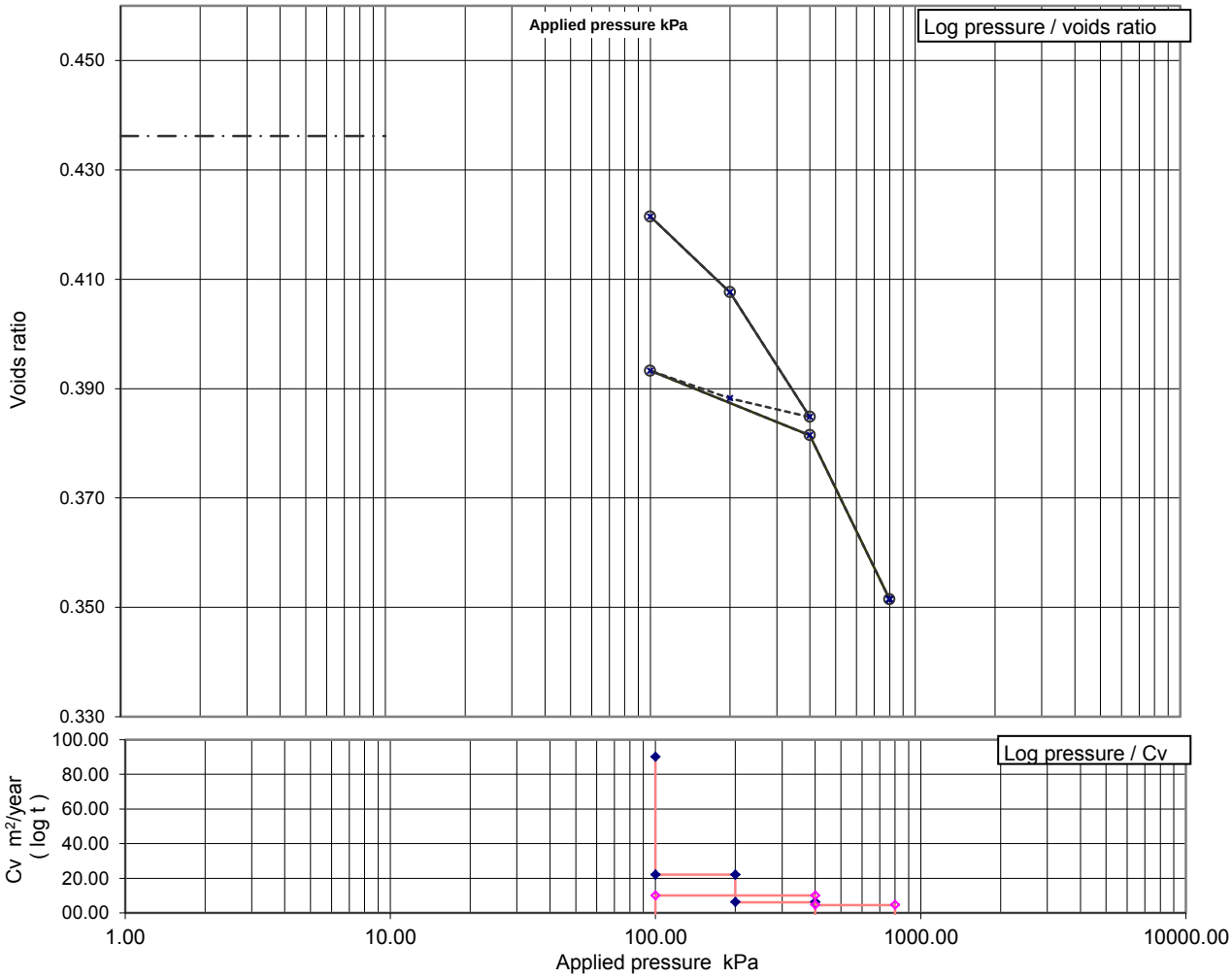
Specimen taken 50 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.4671				
100	0.4296	0.256	1.9	2	
200	0.4037	0.181	0.82	0.87	
400	0.3694	0.122	0.73	0.77	
200	0.3723	0.011	-	-	
100	0.3778	0.040	-	-	
400	0.3651	0.031	2.2	2.4	
800	0.3287	0.067	0.76	0.81	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH405
		Sample Depth (m BGL)	4
	A7063-17/0-20170718113326	Sample Type and No	UT10
		Specimen Ref	



Soil description	Firm brown slightly sandy slightly gravelly CLAY.
Preparation	Undisturbed
Index properties (if available)	Liquid limit %		Plastic limit %	

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m3
Diameter	75.05		mm
Height	18.89	17.78	mm
Voids ratio	0.436	0.351	
Moisture content	15	14	%
Bulk density	2.12	2.23	Mg/m3
Dry density	1.85	1.96	Mg/m3
Saturation	92	105	%
Average temperature for test	21		oC

Swelling pressure: not measured kPa

Notes :

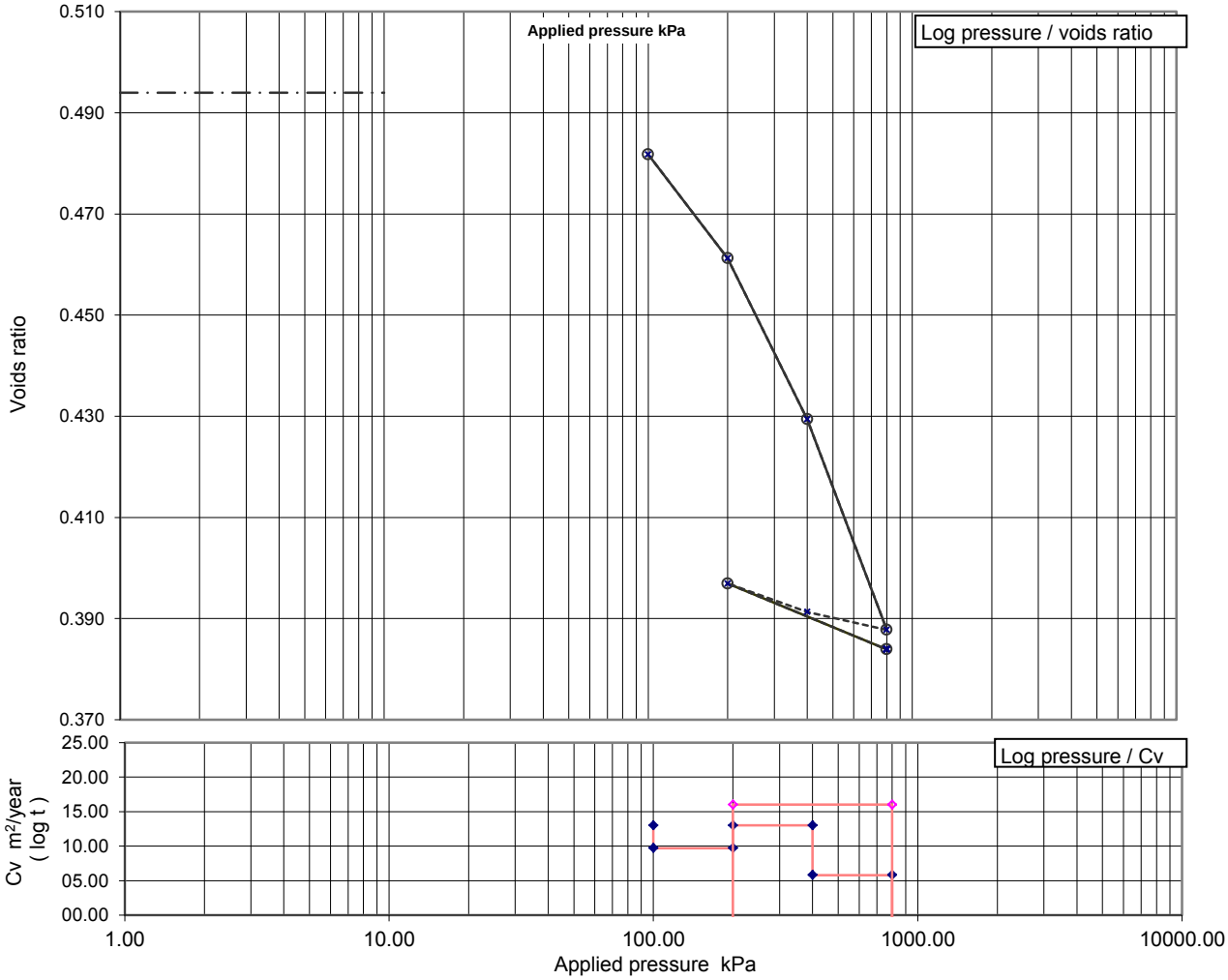
Specimen taken 50 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.4362				
100	0.4214	0.103	90	96	
200	0.4076	0.097	22	23	
400	0.3848	0.081	6.1	6.3	
200	0.3882	0.012	-	-	
100	0.3932	0.036	-	-	
400	0.3815	0.028	10	11	
800	0.3514	0.054	4.5	4.7	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH406
		Sample Depth (m BGL)	4
	A7063-1720170802122815	Sample Type and No	UT10
		Specimen Ref	



Soil description	Firm brown slightly sandy slightly gravelly CLAY.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % [ ] Plastic limit % [ ]

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m3
Diameter	75.02		mm
Height	18.95	17.56	mm
Voids ratio	0.494	0.384	
Moisture content	16	15	%
Bulk density	2.05	2.21	Mg/m3
Dry density	1.77	1.91	Mg/m3
Saturation	85	105	%
Average temperature for test	20		oC

Swelling pressure >50 kPa

Notes :

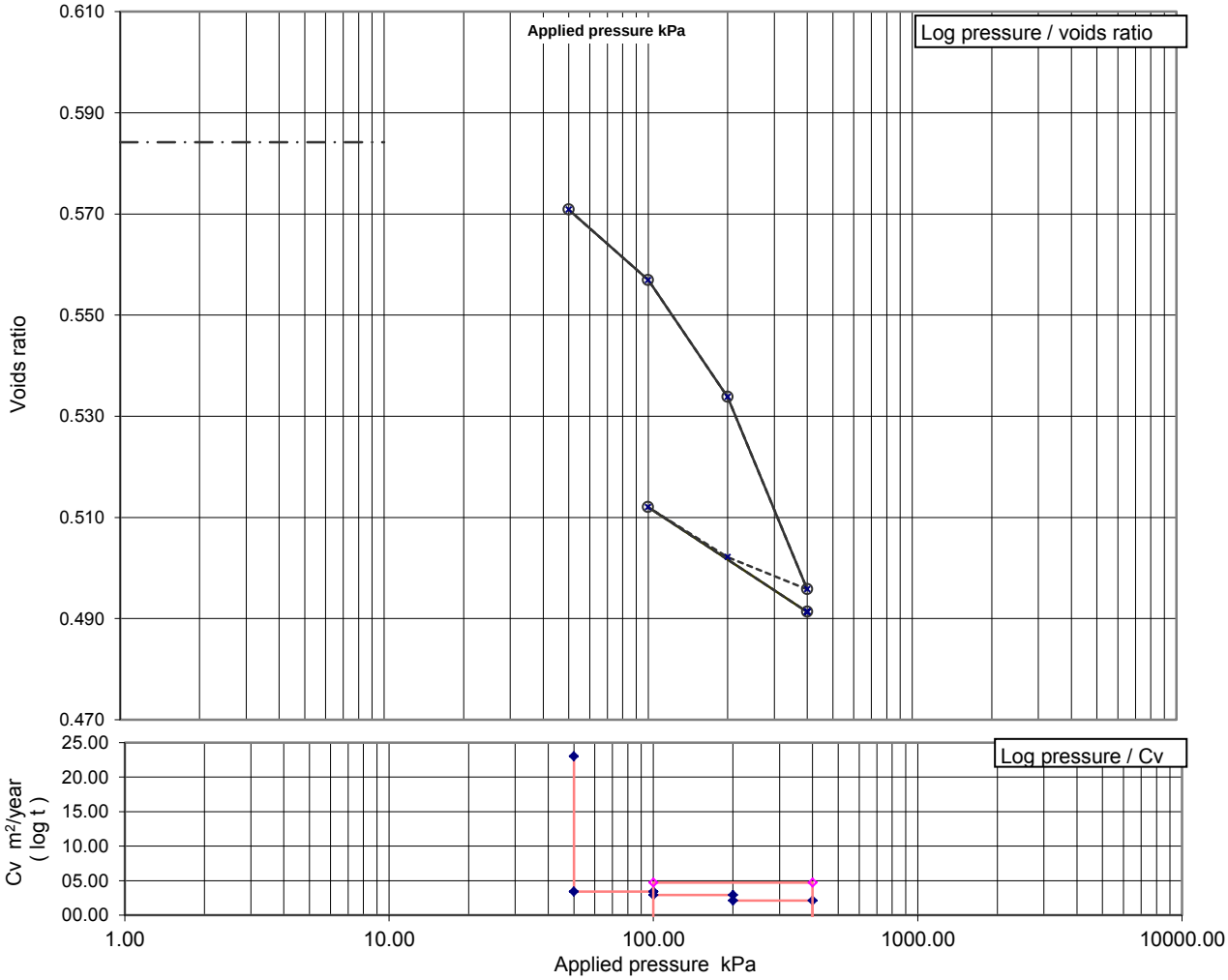
Specimen taken 10 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
50	0.4940				
100	0.4817	0.164	13	14	
200	0.4612	0.138	9.7	10	
400	0.4294	0.109	13	14	
800	0.3878	0.073	5.8	6.1	
400	0.3913	0.006	-	-	
200	0.3969	0.020	-	-	
800	0.3839	0.016	16	17	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH407
		Sample Depth (m BGL)	6
	A7063-17/0-20170727075831	Sample Type and No	UT14
		Specimen Ref	



Soil description	Firm brown slightly sandy slightly gravelly CLAY.
Preparation	Undisturbed
Index properties (if available)	Liquid limit %		Plastic limit %	

Specimen details	Initial	Final	
Particle density	2.70	assumed	Mg/m3
Diameter	75.10		mm
Height	19.12	18.00	mm
Voids ratio	0.584	0.491	
Moisture content	22	19	%
Bulk density	2.07	2.16	Mg/m3
Dry density	1.70	1.81	Mg/m3
Saturation	100	105	%
Average temperature for test	20		oC

Swelling pressure: not measured kPa

Notes :

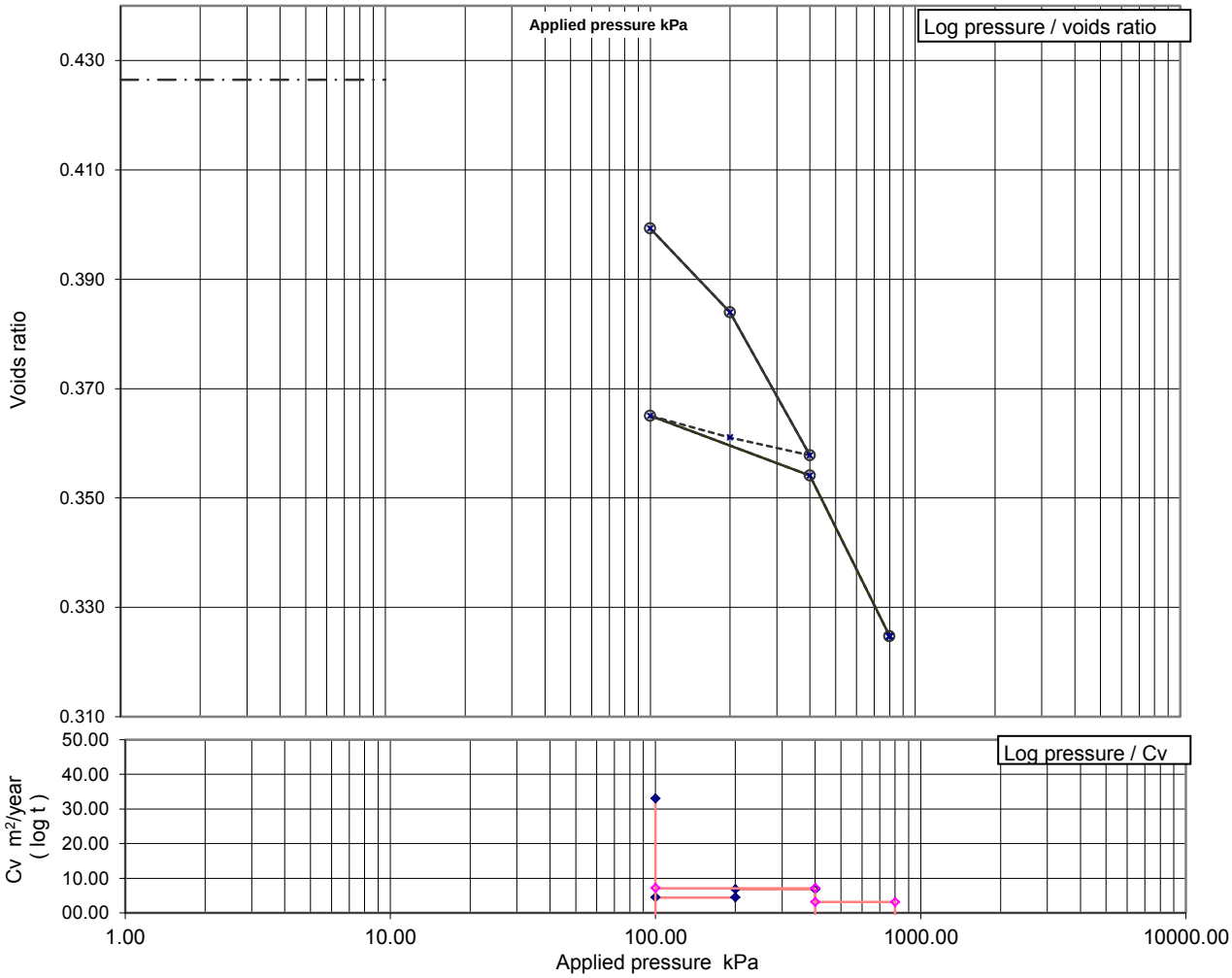
Specimen taken 50 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.5842				
50	0.5708	0.168	23	26	
100	0.5569	0.177	3.4	3.7	
200	0.5338	0.148	2.9	3	
400	0.4958	0.124	2.1	2.3	
200	0.5022	0.021	-	-	
100	0.5120	0.066	-	-	
400	0.4913	0.046	4.7	5.1	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH408
		Sample Depth (m BGL)	4.5
	A7063-17-20170712054030	Sample Type and No	UT10
		Specimen Ref	



Soil description	Firm brown slightly sandy slightly gravelly CLAY.
Preparation	Undisturbed
Index properties (if available)	Liquid limit % / Plastic limit %

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m3
Diameter	75.10		mm
Height	20.13	18.69	mm
Voids ratio	0.426	0.325	
Moisture content	16	13	%
Bulk density	2.15	2.26	Mg/m3
Dry density	1.86	2.00	Mg/m3
Saturation	97	105	%
Average temperature for test	21		oC

Swelling pressure: not measured kPa

Notes :

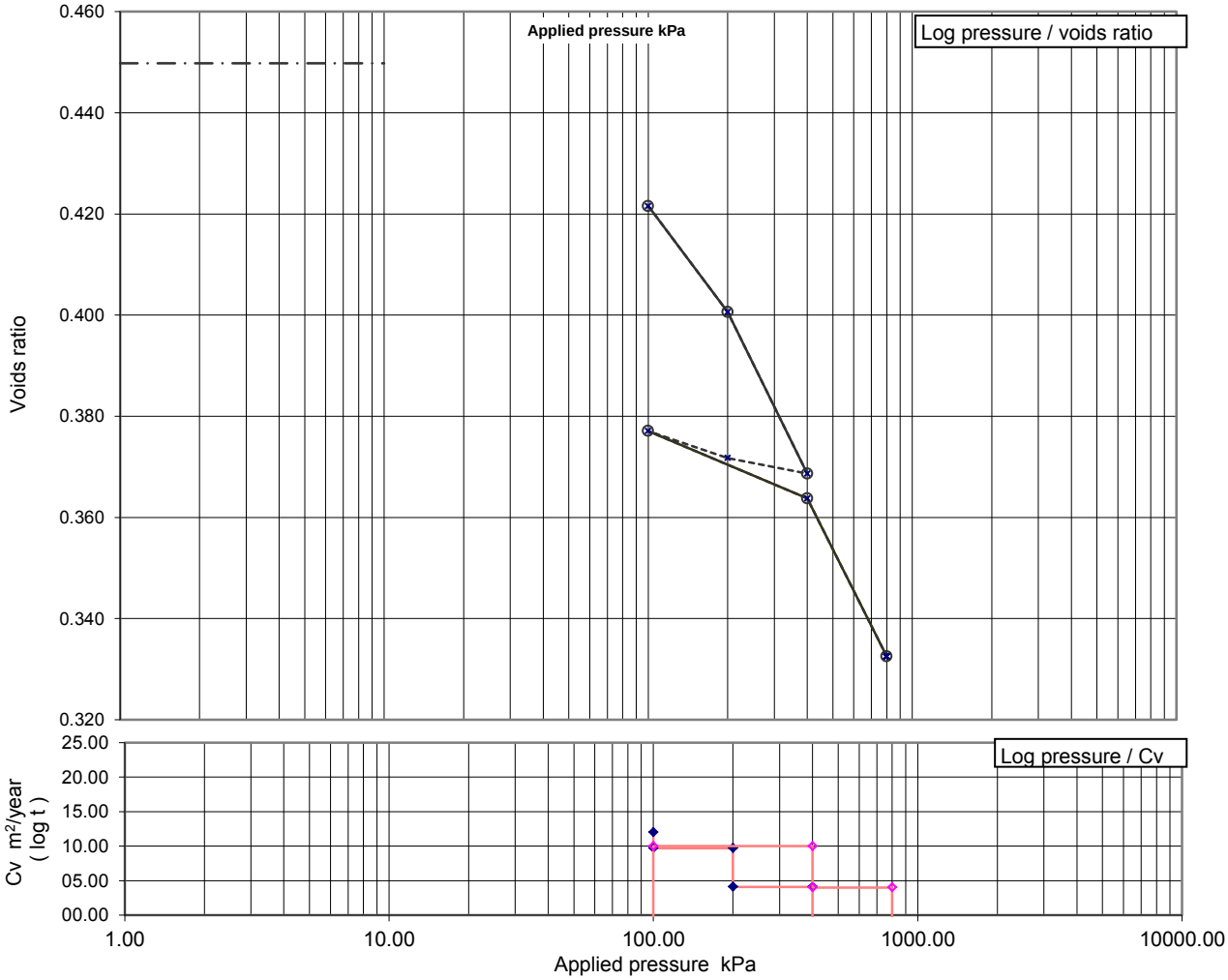
Specimen taken 50 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.4265				
100	0.3993	0.191	33	35	
200	0.3839	0.109	4.4	5.3	
400	0.3578	0.094	6.8	7.2	
200	0.3611	0.012	-	-	
100	0.3650	0.029	-	-	
400	0.3541	0.027	7.1	7.7	
800	0.3247	0.054	3.1	3.3	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Sample Details:	SAMPLE ID:	Hole No	BH409
		Sample Depth (m BGL)	4
	A7063-17/0-20170711123352	Sample Type and No	UT10
		Specimen Ref	



Soil description: Firm brown slightly sandy slightly gravelly CLAY.

Preparation: Undisturbed

Index properties (if available): Liquid limit % | Plastic limit %

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m3
Diameter	75.10		mm
Height	20.14	18.51	mm
Voids ratio	0.450	0.332	
Moisture content	16	13	%
Bulk density	2.11	2.25	Mg/m3
Dry density	1.83	1.99	Mg/m3
Saturation	93	105	%
Average temperature for test	21		oC

Swelling pressure: not measured kPa

Notes :

Specimen taken 80 mm from base of sample

Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/year	Cv (t90, root) m2/year	
0	0.4498				
100	0.4216	0.195	12	13	
200	0.4006	0.147	9.7	10	
400	0.3686	0.114	4.1	4.5	
200	0.3717	0.011	-	-	
100	0.3771	0.039	-	-	
400	0.3637	0.032	10	10	
800	0.3325	0.057	4	4.3	

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

TEST REPORT

UKAS TESTING
1252

Report No. EFS/177905 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 1 sample described in this report were registered for analysis by ESG on 18-Aug-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 25-Aug-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 25-Aug-2017

Tests marked '^' have been subcontracted to another laboratory.
Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. ESG accepts no responsibility for any sampling not carried out by our personnel.

Units :			mg/kg	mg/l	%	pH Units												
Method Codes :			ICPACIDS	ICPWSS	TSBRE1	WSLM50												
Method Reporting Limits :			20	10	0.005													
UKAS Accredited :			Yes	Yes	No	No												
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (acid sol)**	**SO4-- (H2O sol) mg/l**	**Total Sulphur.**	**pH (BS1377)**												
1771996	BH408 B 17 7.50		650	141	0.222	8.4												

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Client Name	**ESG Limited Doncaster**
Contact	Mike Stanley

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**25-Aug-2017**
Report Number	**EFS/177905**
Table Number	**1**

Where individual results are flagged see report notes for status.

Analytical and Deviating Sample Overview

Customer **ESG Limited Doncaster**
Site **A7063-17 Withernsea Long Sea Outfall**
Report No **S177905**

Consignment No S68320
Date Logged 18-Aug-2017
In-House Report Due 25-Aug-2017
Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	MethodID	CustServ	Dep.Opt			ICPACIDS	ICPBRE	ICPWSS	KONECL	KoneNO3	TSBRE1	WSLM50
		Sampled	REPORT A	DO Cl if pH<5.5	DO Mg if SO4(W)>3000	DO NO3 if pH<5.5	SO4-- (acid sol)	Magnesium (BRE)	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Nitrate (BRE 2:1): mg/l	Total Sulphur.	pH (BS1377)
							✓		✓				
CL/1771996	BH408 7.50-8.00	D	D	D	D	D	D	D	D	D	D	D	D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time
Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Where individual results are flagged see report notes for status.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Oven Dried @ < 35°C	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	TSBRE1	Oven Dried @ < 35°C	Determination of Total Carbon and/or Total Sulphur in solid samples by high temperature combustion/infrared detection
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_7905

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1771996	BH408 B 17 7.50	CLAY

TEST REPORT

UKAS TESTING
1252

Report No. EFS/177907 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 1 sample described in this report were registered for analysis by ESG on 18-Aug-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 25-Aug-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 25-Aug-2017

Tests marked '^' have been subcontracted to another laboratory.
Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. ESG accepts no responsibility for any sampling not carried out by our personnel.

Units :			mg/kg	mg/l	%	pH Units												
Method Codes :			ICPACIDS	ICPWSS	TSBRE1	WSLM50												
Method Reporting Limits :			20	10	0.005													
UKAS Accredited :			Yes	Yes	No	No												
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (acid sol)**	**SO4-- (H2O sol) mg/l**	**Total Sulphur.**	**pH (BS1377)**												
1772001	BH402 B 11 5.00		1040	309	0.241	8.3												

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Fax +44 (0) 1283 554422

Client Name	**ESG Limited Doncaster**
Contact	Mike Stanley

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**25-Aug-2017**
Report Number	**EFS/177907**
Table Number	**1**

Where individual results are flagged see report notes for status.

Sample Analysis | **ESG Environmental Chemistry** | **S177907**

Analytical and Deviating Sample Overview

Customer ESG Limited Doncaster
Site A7063-17 Withernsea Long Sea Outfall
Report No S177907

Consignment No S68320
Date Logged 18-Aug-2017
In-House Report Due 25-Aug-2017
Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	MethodID	CustServ	Dep.Opt			ICPACIDS	ICPBRE	ICPWSS	KONECL	KoneNO3	TSBRE1	WSLM50
		Sampled	REPORT A	DO Cl if pH<5.5	DO Mg if SO4(W)>3000	DO NO3 if pH<5.5	SO4-- (acid sol)	Magnesium (BRE)	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Nitrate (BRE 2:1): mg/l	Total Sulphur.	pH (BS1377)
							✓		✓				
CL/1772001	BH402 5.00-5.50	D	D	D	D	D	D	D	D	D	D	D	D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time
Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Where individual results are flagged see report notes for status.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Oven Dried @ < 35°C	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	TSBRE1	Oven Dried @ < 35°C	Determination of Total Carbon and/or Total Sulphur in solid samples by high temperature combustion/infrared detection
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

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Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_7907

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1772001	BH402 B 11 5.00	CLAY

TEST REPORT

UKAS TESTING
1252

Report No. EFS/177908 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 1 sample described in this report were registered for analysis by ESG on 18-Aug-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 25-Aug-2017

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The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 25-Aug-2017

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Units :			mg/kg	mg/l	%	pH Units												
Method Codes :			ICPACIDS	ICPWSS	TSBRE1	WSLM50												
Method Reporting Limits :			20	10	0.005													
UKAS Accredited :			Yes	Yes	No	No												
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (acid sol)**	**SO4-- (H2O sol) mg/l**	**Total Sulphur.**	**pH (BS1377)**												
1772002	BH401 B 17 7.00		564	121	0.281	8.6												

Bretby Business Park, Ashby Road

Burton-on-Trent, Staffordshire, DE15 0YZ

Tel +44 (0) 1283 554400

Fax +44 (0) 1283 554422

Client Name	**ESG Limited Doncaster**
Contact	Mike Stanley

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**25-Aug-2017**
Report Number	**EFS/177908**
Table Number	**1**

Where individual results are flagged see report notes for status.

Analytical and Deviating Sample Overview

Customer **ESG Limited Doncaster**
Site **A7063-17 Withernsea Long Sea Outfall**
Report No **S177908**

Consignment No S68320
Date Logged 18-Aug-2017
In-House Report Due 25-Aug-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	MethodID	CustServ	Dep.Opt			ICPACIDS	ICPBRE	ICPWSS	KONECL	KoneNO3	TSBRE1	WSLM50
		Sampled	REPORT A	DO Cl if pH<5.5	DO Mg if SO4(W)>3000	DO NO3 if pH<5.5	SO4-- (acid sol)	Magnesium (BRE)	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Nitrate (BRE 2:1): mg/l	Total Sulphur.	pH (BS1377)
							✓		✓				
CL/1772002	BH401 7.00-7.50	D	D	D	D	D	D	D	D	D	D	D	D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time

Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

Where individual results are flagged see report notes for status.

 The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Oven Dried @ < 35°C	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	TSBRE1	Oven Dried @ < 35°C	Determination of Total Carbon and/or Total Sulphur in solid samples by high temperature combustion/infrared detection
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_7908

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1772002	BH401 B 17 7.00	CLAY

TEST REPORT

UKAS TESTING
1252

Report No. EFS/177909 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 1 sample described in this report were registered for analysis by ESG on 18-Aug-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 25-Aug-2017

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The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 25-Aug-2017

Tests marked '^' have been subcontracted to another laboratory.
Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. ESG accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.

Units :			mg/kg	mg/l	%	pH Units												
Method Codes :			ICPACIDS	ICPWSS	TSBRE1	WSLM50												
Method Reporting Limits :			20	10	0.005													
UKAS Accredited :			Yes	Yes	No	No												
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (acid sol)**	**SO4-- (H2O sol) mg/l**	**Total Sulphur.**	**pH (BS1377)**												
1772003	BH405 B 21 9.00		803	203	0.241	8.4												

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Client Name	**ESG Limited Doncaster**
Contact	Mike Stanley

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**25-Aug-2017**
Report Number	**EFS/177909**
Table Number	**1**

Where individual results are flagged see report notes for status.

Analytical and Deviating Sample Overview

Customer **ESG Limited Doncaster**
Site **A7063-17 Withernsea Long Sea Outfall**
Report No **S177909**

Consignment No S68320
Date Logged 18-Aug-2017
In-House Report Due 25-Aug-2017
Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	MethodID	CustServ	Dep.Opt			ICPACIDS	ICPBRE	ICPWSS	KONECL	KoneNO3	TSBRE1	WSLM50
		Sampled	REPORT A	DO Cl if pH<5.5	DO Mg if SO4(W)>3000	DO NO3 if pH<5.5	SO4-- (acid sol)	Magnesium (BRE)	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Nitrate (BRE 2:1): mg/l	Total Sulphur.	pH (BS1377)
							✓		✓				
CL/1772003	BH405 9.00-9.50	D	D	D	D	D	D	D	D	D	D	D	D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time
Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Where individual results are flagged see report notes for status.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Oven Dried @ < 35°C	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	TSBRE1	Oven Dried @ < 35°C	Determination of Total Carbon and/or Total Sulphur in solid samples by high temperature combustion/infrared detection
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_7909

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1772003	BH405 B 21 9.00	CLAY

TEST REPORT

UKAS TESTING
1252

Report No. EFS/177910 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 1 sample described in this report were registered for analysis by ESG on 18-Aug-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 25-Aug-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 25-Aug-2017

Tests marked '^' have been subcontracted to another laboratory.
Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. ESG accepts no responsibility for any sampling not carried out by our personnel.

Units :			mg/kg	mg/l	%	pH Units												
Method Codes :			ICPACIDS	ICPWSS	TSBRE1	WSLM50												
Method Reporting Limits :			20	10	0.005													
UKAS Accredited :			Yes	Yes	No	No												
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (acid sol)**	**SO4-- (H2O sol) mg/l**	**Total Sulphur.**	**pH (BS1377)**												
1772004	BH404 D 11 4.50		497	72	0.127	8.7												

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Client Name	**ESG Limited Doncaster**
Contact	Mike Stanley

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**25-Aug-2017**
Report Number	**EFS/177910**
Table Number	**1**

Where individual results are flagged see report notes for status.

Analytical and Deviating Sample Overview

Customer **ESG Limited Doncaster**
Site **A7063-17 Withernsea Long Sea Outfall**
Report No **S177910**

Consignment No S68320
Date Logged 18-Aug-2017
In-House Report Due 25-Aug-2017
Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	MethodID	CustServ	Dep.Opt			ICPACIDS	ICPBRE	ICPWSS	KONECL	KoneNO3	TSBRE1	WSLM50
		Sampled	REPORT A	DO Cl if pH<5.5	DO Mg if SO4(W)>3000	DO NO3 if pH<5.5	SO4-- (acid sol)	Magnesium (BRE)	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Nitrate (BRE 2:1): mg/l	Total Sulphur.	pH (BS1377)
							✓		✓				
CL/1772004	BH404 4.50	D	D	D	D	D	D	D	D	D	D	D	D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time
Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Where individual results are flagged see report notes for status.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Oven Dried @ < 35°C	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	TSBRE1	Oven Dried @ < 35°C	Determination of Total Carbon and/or Total Sulphur in solid samples by high temperature combustion/infrared detection
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_7910

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1772004	BH404 D 11 4.50	CLAY

TEST REPORT

UKAS TESTING
1252

Report No. EFS/177911 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 1 sample described in this report were registered for analysis by ESG on 18-Aug-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 25-Aug-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 25-Aug-2017

Tests marked '^' have been subcontracted to another laboratory.
Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. ESG accepts no responsibility for any sampling not carried out by our personnel.

Units :			mg/kg	mg/l	%	pH Units												
Method Codes :			ICPACIDS	ICPWSS	TSBRE1	WSLM50												
Method Reporting Limits :			20	10	0.005													
UKAS Accredited :			Yes	Yes	No	No												
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (acid sol)**	**SO4-- (H2O sol) mg/l**	**Total Sulphur.**	**pH (BS1377)**												
1772005	BH409 D 33 15.00		819	211	0.223	8.4												

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Client Name	**ESG Limited Doncaster**
Contact	Mike Stanley

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**25-Aug-2017**
Report Number	**EFS/177911**
Table Number	**1**

Where individual results are flagged see report notes for status.

Sample Analysis

ESG Environmental Chemistry

S177911

Analytical and Deviating Sample Overview

Customer ESG Limited Doncaster
Site A7063-17 Withernsea Long Sea Outfall
Report No S177911

Consignment No S68320
Date Logged 18-Aug-2017
In-House Report Due 25-Aug-2017
Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	MethodID	CustServ	Dep.Opt			ICPACIDS	ICPBRE	ICPWSS	KONECL	KoneNO3	TSBRE1	WSLM50
		Sampled	REPORT A	DO Cl if pH<5.5	DO Mg if SO4(W)>3000	DO NO3 if pH<5.5	SO4-- (acid sol)	Magnesium (BRE)	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Nitrate (BRE 2:1): mg/l	Total Sulphur.	pH (BS1377)
							✓		✓				
CL/1772005	BH409 15.00	D	D	D	D	D	D	D	D	D	D	D	D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time

Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Where individual results are flagged see report notes for status.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ICPACIDS	Oven Dried @ < 35°C	Determination of Total Sulphate in soil samples by Hydrochloric Acid extraction followed by ICPOES detection
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	TSBRE1	Oven Dried @ < 35°C	Determination of Total Carbon and/or Total Sulphur in solid samples by high temperature combustion/infrared detection
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_7911

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1772005	BH409 D 33 15.00	CLAY

TEST REPORT

UKAS TESTING
1252

Report No. EFS/178565 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
South Yorkshire
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 1 sample described in this report were registered for analysis by ESG on 09-Sep-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 15-Sep-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 15-Sep-2017

Tests marked '^' have been subcontracted to another laboratory.
Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. ESG accepts no responsibility for any sampling not carried out by our personnel.

Units :			mg/l	%	mg/l	pH Units												
Method Codes :			ICPWSS	ANC	KONECL	WSLM50												
Method Reporting Limits :			10	0.12	1													
UKAS Accredited :			Yes	No	No	No												
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (H2O sol) mg/l**	**Carbonate %**	**Chloride:(2:1)**	**pH (BS1377)**												
1774923	BH406 B 9 3.00		58	10.08	10	8.3												

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Client Name	**ESG Limited Doncaster**
Contact	Neil Cooke

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**15-Sep-2017**
Report Number	**EFS/178565**
Table Number	**1**

Where individual results are flagged see report notes for status.

Sample Analysis

ESG Environmental Chemistry

S178565

Analytical and Deviating Sample Overview

Customer **ESG Limited Doncaster**
Site **A7063-17 Withernsea Long Sea Outfall**
Report No **S178565**

Consignment No S68591
Date Logged 09-Sep-2017
In-House Report Due 18-Sep-2017
Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	Sampled	MethodID	ANC	CustServ	ICPWSS	KONECL	WSLM50
				Carbonate %	REPORT A	SO4-- (H2O sol) mg/l	Chloride:(2:1)	pH (BS1377)
						✓		
CL/1774923	BH406 3.00	D		D	D	D	D	D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time

Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Where individual results are flagged see report notes for status.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ANC	Oven Dried @ < 35°C	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	KONECL	Oven Dried @ < 35°C	Determination of Chloride in Soil using water extraction at the stated water:soil ratio, discrete colorimetric detection
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_8565

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1774923	BH406 B 9 3.00	Brown Gravel CLAY

TEST REPORT

UKAS TESTING
1252

Report No. EFS/178571 (Ver. 1)

ESG Limited Doncaster
Askern Road
Carcroft
Doncaster
South Yorkshire
DN6 8DG

Site: A7063-17 Withernsea Long Sea Outfall

The 7 samples described in this report were registered for analysis by ESG on 09-Sep-2017. This report supersedes any versions previously issued by the laboratory.
The analysis was completed by: 15-Sep-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

On behalf of
ESG :
Tim Barnes

Operations Director
Energy & Waste Services

Date of Issue: 15-Sep-2017

Tests marked '^' have been subcontracted to another laboratory.
Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.
ESG accepts no responsibility for any sampling not carried out by our personnel.

Units :			mg/l	%	mg/l	%	pH Units											
Method Codes :			ICPWSS	ANC	KONECL	ORGMAT	WSLM50											
Method Reporting Limits :			10	0.12	1	0.1												
UKAS Accredited :			Yes	No	No	No	No											
LAB ID Number CL/	**Client Sample Description**	**Sample Date**	**SO4-- (H2O sol) mg/l**	**Carbonate %**	**Chloride:(2:1)**	**Organic Matter %**	**pH (BS1377)**											
1774931	TP303 B 4 2.40		34	9.60	16		8.6											
1774932	TP305 D 1 0.20					3.2												
1774933	TP311 D 1 0.20					3.2												
1774934	TP312 D 1 0.20		24	2.16	6		8.1											
1774935	TP315 B 2 0.40		10	4.08	10		8.0											
1774936	TP320 D 1 0.20					3.7												
1774937	TP322 B 5 2.80		30	4.08	34		8.4											

ESG

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Client Name **ESG Limited Doncaster**

Contact Neil Cooke

A7063-17 Withernsea Long Sea Outfall

Sample Analysis

Date Printed	**15-Sep-2017**
Report Number	**EFS/178571**
Table Number	**1**

Sample Analysis — ESG Environmental Chemistry — S178571

Analytical and Deviating Sample Overview

Customer ESG Limited Doncaster
Site A7063-17 Withernsea Long Sea Outfall
Report No S178571

Consignment No S68591
Date Logged 09-Sep-2017
In-House Report Due 18-Sep-2017
Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	MethodID	ANC	CustServ	ICPWSS	KONECL	ORGMAT	WSLM50
		Sampled	Carbonate %	REPORT A	SO4-- (H2O sol) mg/l	Chloride:(2:1)	Organic Matter %	pH (BS1377)
					✓			
CL/1774931	TP303 2.40-3.00	D	D	D	D	D		D
CL/1774932	TP305 0.20	D		D			D	
CL/1774933	TP311 0.20	D		D			D	
CL/1774934	TP312 0.20	D	D	D	D	D		D
CL/1774935	TP315 0.40-1.00	D	D	D	D	D		D
CL/1774936	TP320 0.20	D		D			D	
CL/1774937	TP322 2.80	D	D	D	D	D		D

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time

Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - **Note: due date may be affected if triggered**
	No analysis scheduled
^	Analysis Subcontracted - **Note: due date may vary**

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Where individual results are flagged see report notes for status.

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ANC	Oven Dried @ < 35°C	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7
Soil	ICPWSS	Oven Dried @ < 35°C	Determination of Water Soluble Sulphate in soil samples by water extraction followed by ICPOES detection
Soil	KONECL	Oven Dried @ < 35°C	Determination of Chloride in Soil using water extraction at the stated water:soil ratio, discrete colorimetric detection
Soil	ORGMAT	Oven Dried @ < 35°C	Acid Dichromate oxidation of the sample followed by colorimetric analysis of the extract
Soil	WSLM50	Oven Dried @ < 35°C	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.

Where individual results are flagged see report notes for status.

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,
- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
  All results on MCERTS reports are reported on a 105ºC dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,
- Results are expressed as mg/kg
- SG is expressed as g/cm^3@ 15^{o}C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile **TR** Denotes Tremolite
CR Denotes Crocidolite **AC** Denotes Actinolite
AM Denotes Amosite **AN** Denotes Anthophylite
NAIIS No Asbestos Identified in Sample
NADIS No Asbestos Detected In Sample

Symbol Reference

^ Sub-contracted analysis.
$$ Unable to analyse due to the nature of the sample
¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols. This may have resulted in deterioration of the sample(s) during transit to the laboratory. Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling
¥ Results for guidance only due to possible interference
& Blank corrected result
I.S Insufficient sample to complete requested analysis
I.S(g) Insufficient sample to re-analyse, results for guidance only
Intf Unable to analyse due to interferences
N.D Not determined **N.Det** Not detected
N.F No Flow
NS Information Not Supplied
Req Analysis requested, see attached sheets for results
Þ Raised detection limit due to nature of the sample
***** All accreditation has been removed by the laboratory for this result
‡ MCERTS accreditation has been removed for this result
§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Sample Descriptions

Client : ESG Limited Doncaster

Site : A7063-17 Withernsea Long Sea Outfall

Report Number : S17_8571

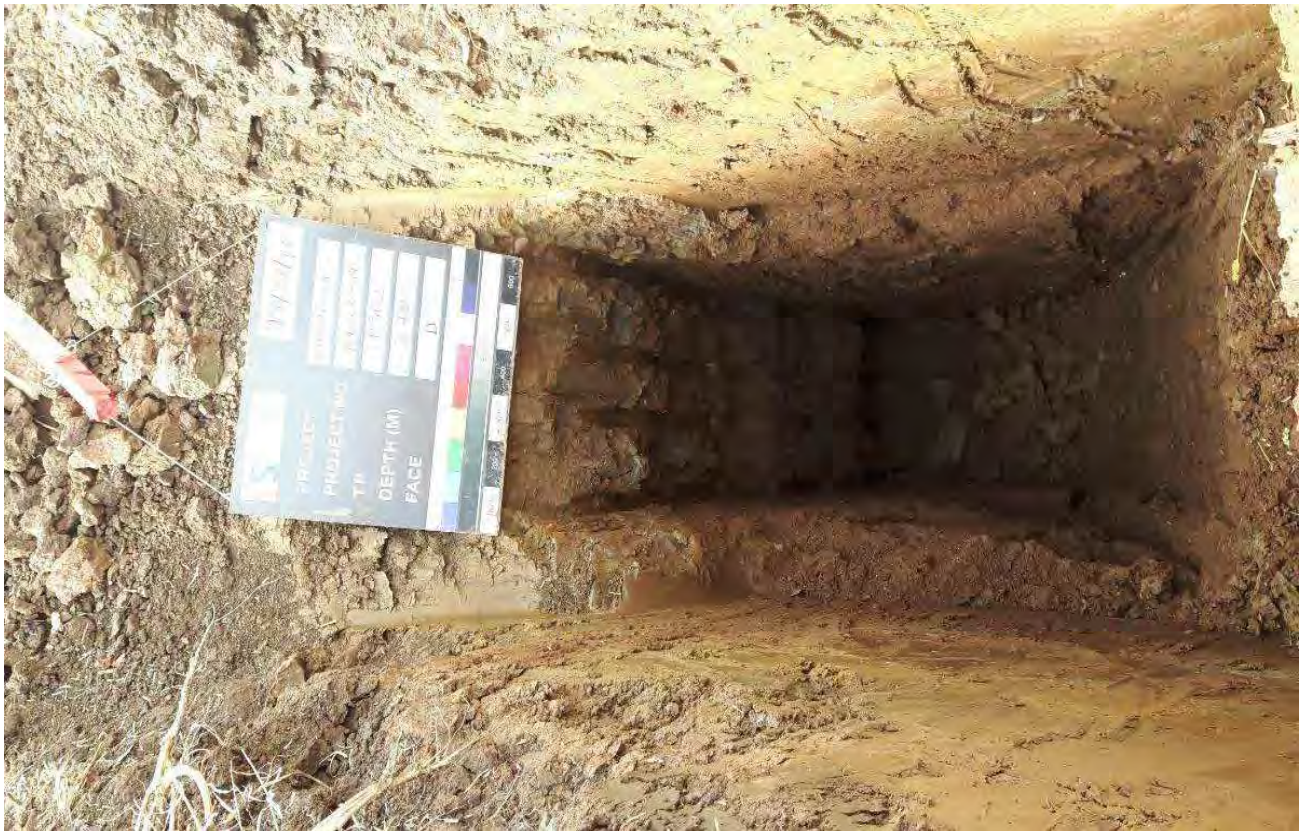
Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1774931	TP303 B 4 2.40	Brown Stone CLAY
CL/1774932	TP305 D 1 0.20	Brown Clay SILT
CL/1774933	TP311 D 1 0.20	Brown Gravel SILT
CL/1774934	TP312 D 1 0.20	Brown Clay SILT
CL/1774935	TP315 B 2 0.40	Brown Clay SILT
CL/1774936	TP320 D 1 0.20	Brown Clay SILT
CL/1774937	TP322 B 5 2.80	Brown Gravel CLAY

APPENDIX D
PHOTOGRAPHS

Trial Pits Plate 1 to 42

Photographs



Notes:	Project	WITHERNSEA LONG SEA OUTFALL GROUND INVESTIGATION	Plate
	Proiect No.	A7063-17	1
	Carried out for	Ward & Burke Construction Limited	

Photographs

Notes:	Project	WITHERNSEA LONG SEA OUTFALL GROUND INVESTIGATION	Plate
	Project No.	A7063-17	2
	Carried out for	Ward & Burke Construction Limited	

Photographs

Notes:	Project	WITHERNSEA LONG SEA OUTFALL GROUND INVESTIGATION	Plate
	Proiect No.	A7063-17	3
	Carried out for	Ward & Burke Construction Limited	

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	Project No.	A7063-17	4
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	Carried out for	Ward & Burke Construction Limited	

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	Carried out for	Ward & Burke Construction Limited	

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	Carried out for	Ward & Burke Construction Limited	

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