Homes England

WEST OF IFIELD

2024/5 Drilling and testing Factual Report

WSP-WATER-REPORT-INT-0003
MAY 2025

CONFIDENTIAL

Homes England

West of Ifield

2024/5 Drilling and testing Factual Report

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. UK0028714.2552

OUR REF. NO. WSP-WATER-REPORT-INT-0003

DATE: MAY 2025

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks				
Date	13/03/2025			
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Signature	Digitally signed by Emiliya.Stoykova@wsp.com DN: cn=Emiliya.Stoykova@wsp.com Date: 2025.05.07 16:41:48 +01'00'			
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Authorised by	Angelo Papaioannou			
Signature	Papaioannou, Angelo (UKAXP011) Digitally signed by Papaioannou, Angelo (UKAXP011) DN: cn=Papaioannou, Angelo (UKAXP011), ou=Active, email=Angelo.Papaioannou@wsp.com Reason: I am approving this document Date: 2025.05.14 12:35:59 +01'00'			
Project number				
Report number	WSP-WATER-REPORT-INT-0003			
File reference				

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Purpose of this report

This report has been produced for the purpose of describing the work carried out during the programme of drilling exploration boreholes and an observation borehole installation for Homes England at their West of Ifield, Crawley site between 21st October 2024 and 4th March 2025. The report is predominantly factual giving an overview of the works undertaken and data collated. In addition, a detailed account of the hydrogeological testing undertaken on the drilled boreholes and installed observation borehole is given. Consideration for exploration/ observation borehole design, test data analysis and interpretations also given within this report.

In summary, two exploratory boreholes were drilled at the Homes England's West of Ifield site during the 2024/5 programme, within the Weald Clay Formation (WCF) and Tunbridge Wells Sand Formation (TWSF) sequence of geological strata. The boreholes were consented with the Environment Agency for a maximum depth of 210 meters below ground level (mbgl) and the final depths were 202.3 mbgl (borehole IE2) and 210.00 mbgl (borehole IE3). Water levels within exploratory boreholes IE2 and IE3 were consistent with historical data from existing boreholes in the area.

Although yields could not be directly measured simple drawdown tests were designed and undertaken during Geocoring on the exploratory boreholes IE2 and IE3 to gather hydrogeological information. Although small diameter exploration boreholes are not ideally suited to pumping tests, limited drawdown constant rate testing at low discharge rates were undertaken to give an indication of possible production yields and to collect formation groundwater for water quality analysis from different aquifer horizons. From drawdown tests the highest yielding aquifer is believed to be the lower part of the Upper Tunbridge Wells Sand Member. For exploration borehole IE2 the natural at rest (unpumped) water level within the aquifer was approximately 4 mbgl. For exploration borehole IE3 even though groundwater levels at depth within the Lower Tunbridge Wells Sand Member are naturally slightly above ground level the aquifer was found to be lower yielding.

Borehole IE3 was selected for development into an observation borehole, based on its location close to the proposed location of the development site's water treatment works, whilst borehole IE2 was backfilled. Once the observation borehole was installed it was tested by deploying a low flow pump in mid-February 2025 and undertaking a 15-hour constant discharge test followed by a recovery test. The test pumping of the observation borehole was not successful in terms of definitively determining yield or hydrogeological parameters, but a sample was collected at the end of the test for a comprehensive full suite of analysis for comparison against drinking water standards. Based on collected data and analysis a minimum yield for a single production borehole targeting the Upper Tunbridge Wells Sand Member of 125 m^3/day is estimated. Although this yield estimate is believed to be a conservative value it does entail associated uncertainty.

Monitoring during the constant rate testing at borehole IE3 did not have any effect on the borehole IE2 approximately 800 meters to the west southwest. Groundwater quality data from the exploration/ observation borehole/s have shown that the aquifer is broadly in line with expectations from previous studies. Based on the information collected during the 2024/5 drilling programme, recommendations have been made to aid any future Homes England production drilling and production programmes.

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1 INTRODUCTION

This section outlines the overall scope of the 2024/5 drilling programme undertaken and the structure of this report.

1.1 SCOPE OF WORK

Homes England is promoting a strategic development of 3,000 homes plus employment area to the West of Ifield, near Crawley in West Sussex. The site is located entirely within the Sussex North Water Resource Zone (SNWRZ) and to satisfy Natural England's position statement on water neutrality, the Proposed Development must demonstrate that water neutrality will be achieved. The evolving water neutrality strategy[1] has identified that it may be possible for water supply requirements to be provided from groundwater using a borehole, or boreholes, capable of sustaining an uninterrupted (i.e., through dry summer periods) supply of approximately 500 m^3/day. The site is underlain by the WCF which overlies the Tunbridge Wells Sand Formation (TWSF), the upper part of which is the Upper Tunbridge Wells Sand Member (UTWSM). The WCF is unlikely to provide sufficient yield and therefore the UTWSM is the likely target aquifer from which abstraction would take place.

The aim of the work was to carry out a drilling and exploration programme that would prove the existence of suitable aquifer strata for water production within the Homes England development area and undertake testing on these units to estimate potential yield and water quality. This exploration programme will inform any future production phase of drilling at the site and contribute towards Homes England fulfilling its water supply strategy requirements.

The work was carried out between 21st October 2024 and 4th March 2025. Two exploration boreholes were drilled, named boreholes IE2 and IE3, and one (borehole IE3) was converted into an observation borehole IE3.

WSP UK Ltd (WSP) was engaged by Homes England to supervise the site works and act as its delegate. During the work the roles as defined under the Construction (Design and Management) Regulations 2015 (CDM 2015) were as follows:

- Client: Homes England Group;
- Principal Designer/ Designer (boreholes)/Client's delegate for supervision of site works: WSP;
- Principal Contractor: Drilcorp Ltd;
- Other contractors:
  - European Geophysical Services (EGS) (geophysical logging of exploration boreholes);
  - ALS Environmental Ltd (water quality laboratory analysis);
  - Ramboll Group Environmental Clerk of Works (ECoW); and
  - Traffic management Sunbelt®.

WSP prepared a Design Risk Management Register (DRMR) and Hazard Plan, as part of the Pre-Construction Information documentation. Prior to the construction phase the Principal Contractor prepared a Construction Phase Plan that provided Risk Assessments and Method Statements (RAMS) for all activities undertaken and addressed aspects identified in the DRMR. In addition,

[1] WSP (10 January 2024) Draft Water Neutrality Strategy

WSP's risk assessment and health and safety plan for the work were in place to ensure awareness of the risks and procedures in place to manage them.

WSP supervised the site on the behalf of the client (Homes England) and had the duty during the project to ensure that the work was carried out according to the proposed RAMS and in accordance with the DRMR. During site activities health and safety, and the implementation of the DRMR was led by the Principal Contractor, the drilling company Drilcorp. The driller's contract is attached within **Appendix A** of this document.

1.2 REPORT STRUCTURE

This report presents the factual data associated with the Homes England programme for 2024/5 and is structured in the following way:

- **Section 2** gives an overview of the exploratory drilling programme undertaken and details of data collected at each exploratory borehole in terms of summary of work, the geology encountered, hydrogeological observations, logging, and the final end state/ design of the hole, i.e., decommissioning or monitoring borehole installation. The chapter summary includes a table with data for each exploratory borehole;
- **Section 3** describes the process involved in the installation of the observation borehole during the works. This includes the methodology and design considerations as well as a description of the final construction;
- **Section 4** gives a detailed account of the hydrogeological testing undertaken on the observation borehole installed;
- **Section 5** briefly describes the water quality analysis collected during the exploratory borehole drilling and during the testing periods; and
- **Section 6** gives a summary of observations, some analysis of data and interpretation and makes recommendations to aid any future production drilling programmes.

The exploratory drilling programme described within **Section 2** of the report is supported by **Appendix A** – the driller's contract and **Appendix B** - daily log sheets; **Appendix C** – detailed geological logs for exploration boreholes; **Appendix D** – core photographs and an **Appendix E** – particle size distribution (PSD) testing results; **Appendix F** - exploration borehole geophysical logging reports. Hydrogeological testing given within Section 4 is supported by **Appendix G** – drawdown test data and pump specification/ curve documentation. Details of the water quality analysis are described within **Section 6** and a water quality data summary is given within **Appendix H** and full laboratory reports are given within **Appendix I**.

2 EXPLORATORY DRILLING

This section details the drilling and testing works undertaken for each exploration borehole in the Homes England's West of Ifield development area. It gives details of the methodology for exploratory drilling and the testing and sampling undertaken. It then presents factual data collected for each exploration borehole drilled. A data summary is given at the end of the section.

2.1 INTRODUCTION

Two locations were identified as target sites for exploration boreholes (**Figure 2.1**) as part of Homes England's exploratory drilling programme for 2024/5 (WSP, 2024a[2]). Reduced from a potential of six locations, two exploration boreholes (IE2 and IE3) were drilled during the final programme. One of these boreholes, IE3 was reamed out to a larger diameter size, for intended eventual use as an observation borehole for future monitoring requirements.

An application for drilling and testing boreholes under the Section WR32 application to register for borehole construction, operation and abstraction for testing was made to the Environment Agency (EA) on the 30th April 2024 for the proposed drilling locations identified within the initial drilling plan. On the 5th May 2024 WSP (WR2024/08) received the 'Consent to Investigate a Groundwater Source' from the EA allowing the drilling and testing at the six originally proposed locations (**Figure 2.1**).

The consent included special conditions for borehole design which were a maximum allowed depth of 210m, a maximum borehole diameter of 350mm, and any borehole installation (production) to be lined by a steel casing, pressure grouted through the WCF and running at least 3 metres into the UTWSM.

2.1.1 METHODOLOGY

Six test bore locations were initially identified and formed the basis of the 2024/5 West of Ifield drilling programme (WSP, 2024a). The locations were selected based on a desk based hydrogeological risk assessment (WSP, 2024b[3]) which highlighted key constraints for borehole locations. Areas of land were selected by WSP for exploration borehole siting at the Homes England West of Ifield site based upon the following key constraints summaried as:

- Proximity to the Crawley Fault, which may impede groundwater flow;
- Depth to target aquifer, which may be 50m shallower in the east of the site than the west;
- Alluvial and river terrace deposits (i.e. areas of ground stability);
- 50 m buffer from watercourses and 10 m buffer from water features (ditches/ponds);
- Flood plain and flood risk areas;
- Existing houses, roads, buried services, historic activities;
- Proposed development infrastructure;

[2] WSP May 2024 Drilling Plan: West of Ifield Groundwater Programme 2024 Ref: WSP-WATER-DRILLING_PLAN-CL-0009

[3] WSP April 2024 Homes England: West of Ifield Development Groundwater Initial Feasibility and Hydrogeological Risk Assessment Ref: WSP-WATER-REPORT-INT-0002

- Access requirements; and
- Development's proposed future water treatment facility location and pipeline routes.

The proposed/ drilled borehole locations are shown on **Figure 2.1**. The final sites (**Figure 2.2**) were selected on the basis that they were:

- in the east of the site where thinner WCF (hence aquifers at shallower depth) were expected (borehole IE2); and
- located suitably within the Homes England development design, notably close to the proposed water treatment facility location (borehole IE3 which was completed as an observation borehole for monitoring).

The general methodology for exploration drilling was, firstly, the drilling at 14 ¾ inch (~375 mm) diameter through superficial deposits and weather bedrock zone into competent ground using polymer mud flush. An 8" (203mm) mild steel casing was then grouted into place to act as a suitable seal against any artesian conditions if encountered at greater depths. The top section of the borehole within the WCF was then drilled 7.5" open hole (~190 mm) using rotary water flush re-circulation drilling technique in which the drilling fluid was used to retain the stability of the well and flush the well cuttings to surface. At a depth of 100 m the methodology of drilling the exploration boreholes was changed to using a Geobore S system (with 140 mm outer diameter) to obtain the cores (100 mm in diameter) required for lithological interpretation. During rotary drilling the logging of arisings was undertaken and during Geoboring cores were collected and described by an onsite WSP geologist. Simple drawdown testing and water sampling were also undertaken. The testing and sampling work carried out during the drilling programme is outlined in **Section 2.1.3**.

At the end of the exploration drilling, boreholes were either decommissioned (borehole IE2) or reamed out to a wider diameter size for observation borehole installation (borehole IE3). The outcome for each borehole is presented in the relevant sections below.

Figure 2.1 - Proposed 2024/5 exploration boreholes

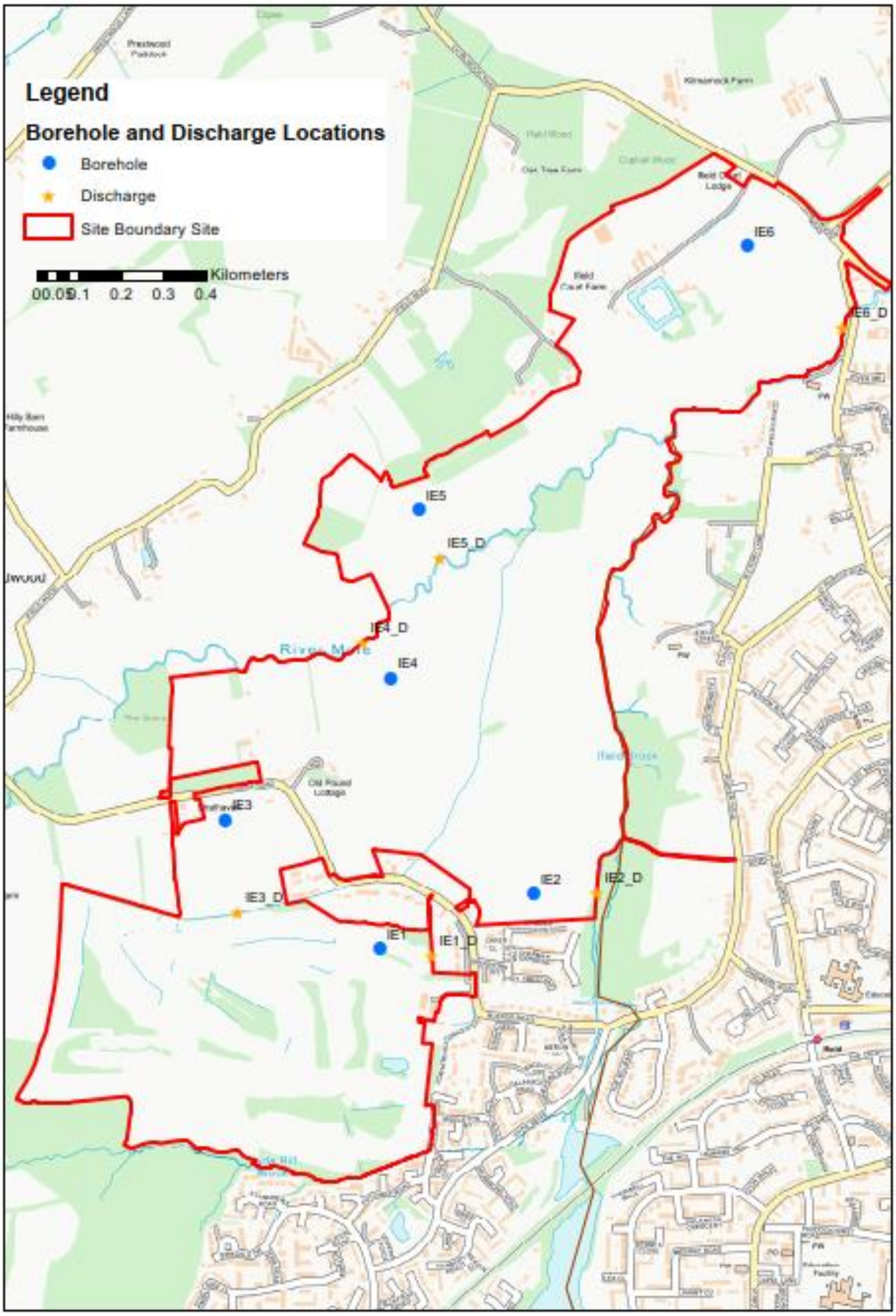
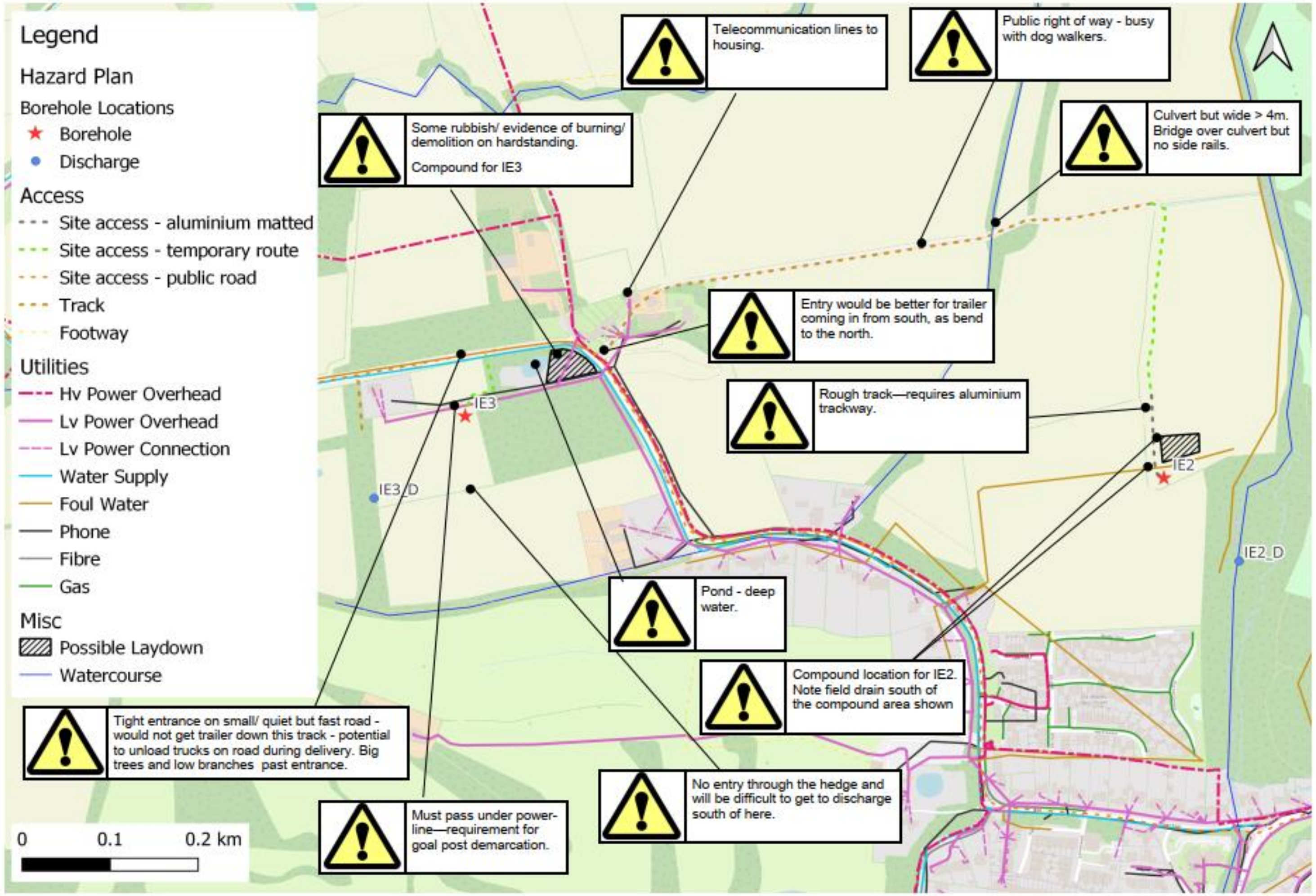


Figure 2.2 - Final 2024/5 exploration borehole locations (taken from the Hazard Plan)



2.1.2 CHANGES TO THE PLANNED WORK

From the proposed target locations, two exploration boreholes were eventually drilled, namely boreholes IE2 and IE3. Borehole IE3 was eventually converted into an observation borehole based on its location close to the proposed future water treatment facility location and therefore the most likely area for a production borehole. The following issues/ changes occurred during the drilling/ installation programme:

- During the logging of geophysics on borehole IE2 on the 5th December 2025 a blockage at 111 mbgl was discovered[4]. The Geobore was run into 111.8 and left in please for the duration of the geophysical logging. Logging was only possible to a depth of 147 mbgl due to further collapse and blockage within the borehole. During the logging of this borehole CCTV images were poor due to borehole conditions;
- There was a security breach during Christmas 2024 break and on return on the 6th Jan 2025 some vandalism on site was discovered;
- The freezing of the rig and hydraulic lines during first week of January 2025 due to extreme weather conditions slowed drilling programme;
- On the 27th January 2025 the drilling reamer got stuck at the bottom of the hole whilst widening the borehole IE3 for observation borehole liner installation. Various attempts to free the reamer were made using various techniques without success and finally the reamer was freed by flushing the hole with compressed air on the 30th January 2025;
- During the logging of geophysics on the 31st January 2025 at the IE3 borehole a blockage at 162 mbgl and a semi-bridge at 132 mbgl were discovered and geophysical logging was only possible to a depth of 132 mbgl. During the logging of this borehole CCTV was poor due to borehole conditions and the field image was run to a depth of 132.0 mbgl only due to the semi-bridged and poor image centralisation at this depth. Other geophysical logs were able to be run to the blockage at 162 mbgl;
- After reaming borehole IE3 and prior to running the intended 7 inch observation casing/ screen it was found that the borehole had collapsed with a blockage at 117.20 mbgl (31st January through to 3rd February 2025). The blockage was cleared several times but after each clearance, subsequent blockages reappeared at approximately 117 mbgl, so the intended sized liner could not be run. Following a discussion with the client and advise from Drilcorp it was decided to install a smaller 2 inch (51 mm) diameter liner and screen with bentonite and gravel pack within the Geobore;
- During the decommissioning and backfilling of borehole IE2 a blockage was discovered at 102.6 mbgl and because of access and logistical issues not allowing for the borehole to be cleared to total depth the borehole had to be backfilled from this depth (see **Section 4**);
- During the Constant Rate Test (CRT) on observation borehole IE3 there were issues with the original pump meaning this test had to be abandoned with the pump being replaced on the 12th Feb 2025 prior to setting up and running a new test;

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[4] The Geobore was run back in to clear the blockage on the 6th December 2025 and left at this depth whilst geophysics probes were run.

- Ground re-instatement, including the of trackway and footpath, was completed 5th April 2025 after a complaint from the Local Authority; and

- During the lifting of matting at borehole IE3 on the 4th March 2025 work was stopped due to the finding of a juvenile gold crested newt under a pad once lifted. A Natural England Low Impact Class License (LICL) for the continuation of the work was obtained and the matting eventually removed on Wednesday 23rd April 2025.

2.1.3 TESTING AND SAMPLING

Tests within the top of the borehole (<100 mbgl), within the WCF were not undertaken since this was not the target aquifer. Tests to this depth were therefore limited to observations of drilling rates and lithological changes through the observation of returned chippings. Rock chip samples were gathered at 5m intervals within the WCF and at a change in stratum[5].

Below approximately 100 mbgl[6] Geocore mud flush drilling was commenced allowing determination of the boundary between the WCF and the underlying target aquifer (UTWSM). Geocore runs were 3m in length and the 100 mm diameter cores were in liners placed in labelled core boxes with the orientation indicated.

During the Geocore drilling process a number of tests were undertaken, largely to assist in determining future decisions on drilling and installing monitoring wells and potential future production size wells. These tests also provided valuable hydrogeological information for developing the conceptual understanding of the aquifer units. The following tests were undertaken at both the exploration boreholes unless otherwise indicated:

- Basic short period drawdown tests;
- CRT on observation borehole IE3;
- Water quality sampling; and
- Borehole geophysics.

2.1.3.1 Basic short period drawdown tests

Basic short period drawdown testing during Geocore drilling was important to identify productive horizons within the borehole. Depths of drawdown testing and water quality sampling were decided based on a 25-meter interval within borehole IE2 and on the encountered strata within borehole IE3. During Geocoring the bore casing would be lifted at discrete points to leave a section of open hole for testing, although the degree of connection to strata above the open section behind the Geobore would be uncertain.

After experience of the testing was gained on borehole IE2 a more focused and longer period of test was used on the sandstone aquifers identified within borehole IE3. Testing was undertaken using a Grundfos 96510159 SQE 3-65 50 Hz pump with a pumping rate of 0.9 l/s (~78 m^3/day). The size of the pump was restricted due to the size of the borehole and Geobore casing and so the achievable discharge rates were low. Before testing, muds were flushed from the borehole and three well volumes of clean water were added before being removed again to partially clear the borehole. Drawdown tests were carried out over the period of one hour for borehole IE2 and 5 hours for

[5] Within the WCF generally no change in lithology, such as iron bands/ limestone/ sandstone units, was identified from the samples collected likely due to mixing of the samples within the borehole whilst travelling to the surface.
[6] Borehole IE2 was Geocored from a depth of 100 mbgl whereas borehole IE3 was Geocored from a depth of 95.93 mbgl since drilling rate increased at this depth and some sandstone units were encountered just above this depth.

borehole IE3, with manual depths to water level being recorded alongside a groundwater level logger that was installed prior to pumping as a backup for data collection.

2.1.3.2 Constant Rate Test on observation borehole IE3

After the installation of the observation borehole IE3 a CRT was run to test both screened aquifers (UTWS and the LTWS). Before testing the borehole was airlifted for 4 hour to develop the borehole. After numerous setup issues a hired 1” submersible pump, with a pumping rate of 0.15 l/s was used to pump the well for approximately 15 hours. The size of the pump was very small due to the final diameter of the observation install (2-inch diameter) and so the achievable discharge rates were very low. Drawdown tests were carried out with manual depths to water level being recorded alongside a groundwater level logger that was installed prior to pumping as a backup for data collection.

2.1.3.3 Water quality sampling

During drawdown tests field water quality parameters were measured generally every 10 minutes from water collected at the end of the discharge pipe. Parameters were measured using a Hanna HI98194 multi-parameter meter and included the following:

- Temperature °C
- pH
- Oxygen Reduction Potential (ORP) mV
- Dissolved Oxygen (DO) %
- Electrical conductivity (EC) µS/cm
- Total Dissolved Solids (TDS) ppm

At the end of the pumping test a water quality sample was collected for laboratory analysis. The water quality analysis suites are summarised in **Table 2.1** below and full laboratory analysis results can be found within **Appendix I**. Water quality analysis was completed by ALS Environmental Ltd laboratory and delivery/ holding times of samples were kept to a minimum[7]. A *Full* suite which includes a comprehensive list of determinands, including microbiological analysis was only completed on the sample taken at the end of the CRT on the installed observation borehole IE3.

[7] Filtered metals were recorded as deviating due to “wrong sample bottle being used” on all borehole IE2 samples and borehole IE3 Test 1 sample. This was due to being unable to filter samples on site due to heavy sediments within the water. Turbidity was noted as deviating on borehole IE2 Test 2 (100-150 mbgl) due to late arrival of samples. Samples were taken on 23rd November 2024 and received by the laboratory on 26th November 2024 and the delay was due to the weekend period. Turbidity was also marked as deviating due to holding time being exceeded in the laboratory for the samples taken from borehole IE2 during Test 3 and Test 4.

Table 2.1 – water quality analysis suites

Suite	Parameters analysed
Basic	Well head parameters, physical properties, major ions, nutrients, boron.
Extended	Well head parameters, physical properties, major ions, nutrients, minor ions, trace elements (metals and metalloids), organics, and PAH (polycyclic aromatic hydrocarbons).
Full	Well head parameters, physical properties, major ions, nutrients, minor ions, trace elements (metals and metalloids), organics (Total Petroleum Hydrocarbons), Polycyclic Aromatic Hydrocarbons (PAH), radioactivity, phenols, vinyl chloride, pesticides, and Volatile Organics Compounds (VOCs).

2.1.3.4 British Geological Survey (BGS) Cores

During the 2024/5 drilling programme wireline Geocore coring was used to obtain cores from 100 to 202.5 mbgl from exploration borehole IE2 and from 95.93 to 210 mbgl from exploration borehole IE3. This amounts to over 216 m of core that was correctly orientated, labelled with depths and stored within wooden core boxes. The cores were described and photographed by a suitably qualified WSP geologist whilst on site (**Appendix C** and **D**).

This set of cores were eventually dispatched to the BGS on the 19th February 2025 as a donation to the BGS National Geological Repository at Keyworth in Nottinghamshire. Digital datasets associated with the cores were also donated to the associated BGS National Geoscience Data Centre (NGDC).

2.1.4 PROGRAMME

The programme of work as it occurred during 2024/5 is shown in **Table 2.2** below. The driller's daily logs are shown within **Appendix B**.

Table 2.2 - Detailed site activity calendar

Date	Activity
21 October 2024	Mobilisation to site
5 November 2024 to 3 December 2024	Drill exploratory borehole IE2
19 November 2024 23 November 2024 27 November 2024 4 December 2024	Testing at exploratory borehole IE2
5 December 2024	Geophysical survey exploratory borehole IE2
6 December 2024 to 11 December 2024	Mobilisation IE3
11 December 2024 to 22 January 2025*	Drill borehole IE3
31 January 2025	Geophysical survey of observation borehole IE3
26 January 2025 to 27 January 2025	Ream out observation borehole IE3

Date	Activity
5 to 12 February 2025	Installation at observation borehole IE3
14 January 2025 24 January 2025 13-14 February 2025	Testing at exploration borehole IE3
17 to February 2025	Borehole GPS survey exploratory borehole IE2 and observation borehole IE3
18 to February 2025	Backfill of IE2
18 to 19 February 2025	Bentonite filling and grouting top of observation borehole IE3
18 to 21 February 2025	Backfilling and grouting exploratory borehole IE2
24 to 27 February 2025	Installation of headworks observation borehole IE3
27 February to 4 March 2025	Demobilise off site

*Includes no site activity over the Christmas period from 20 December to 5 January

2.2 BOREHOLE IE2

2.2.1 LOCATION

Borehole IE2 is located within an agricultural field to the West of Ifield, West Sussex, at National Grid Reference: TQ 24434 37096 (ground surface elevation: 67.39 meters above ordnance datum (mAOD)) seen in **Figure 2.2**. A summary of the drilling works at exploration borehole IE2 is presented below, with an outline of the geology encountered during the drilling of the borehole (**Appendix C**).

2.2.2 SUMMARY OF DRILLING WORKS

The exploratory borehole was drilled from the 5th November 2024 to 3rd December 2024 and the drilling schedule was as follows:

- An inspection pit was dug from 0.00 - 1.20 mbgl;
- Open hole drilling at 14 ¾ inch (~375 mm) diameter from 1.20 mbgl until 21.0 mbgl;
- Permanent 8" casing was installed and grouted in place between ground level and 21.0 mbgl;
- Open hole drilling at 7" 1/2 (~190 mm) diameter was drilled from 21 mbgl until 100.00 mbgl;
- Geobore mud flush drilling from 100 mbgl to the final total depth of 202.50 mbgl.

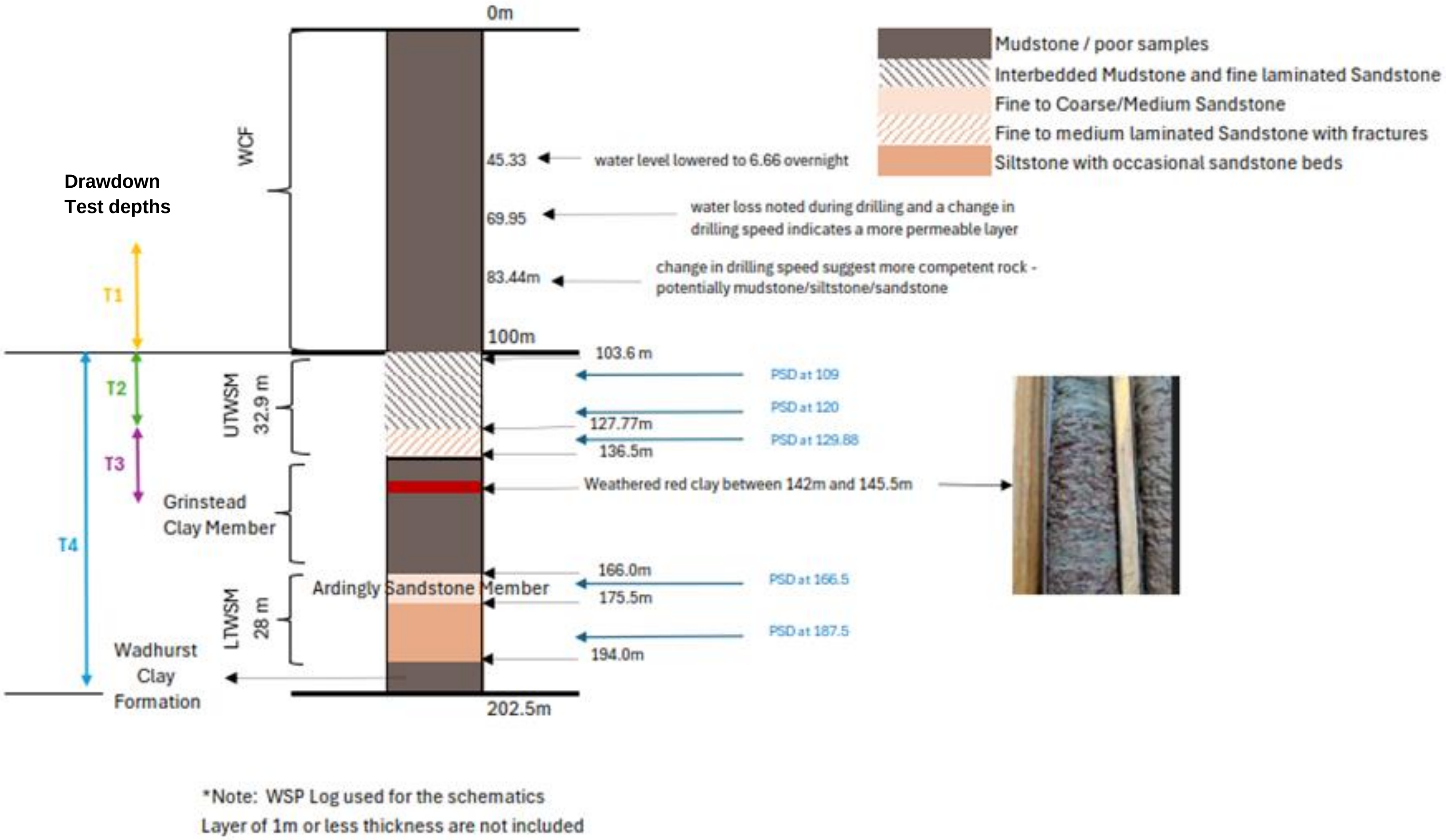
2.2.3 GEOLOGY

The geology encountered whilst drilling the exploratory borehole IE2 is summarised below in **Table 2.3** and a schematic can be seen in **Figure 2-3**. The log has been constructed based on returns during drilling, drillers logs and Geobore core logs. Details of the geology encountered during the drilling of the borehole are given within **Appendix C** and photographs of the cores are within **Appendix D**.

Table 2.3 - Summary Geology of Borehole IE2

Depth from (mbgl)	Depth to (mbgl)	Thickness (m)	Interpreted strata	Geology Encountered
0.00	83.44	83.44	Wealden Clay Formation	Mudstone (from chippings). Generally described as soft to very stiff dark to light grey laminated clay with occasional sandy layers. At 69.95 mbgl onwards, water was lost during drilling which suggests more permeable strata.
83.44	103.60	19.27		A change of drilling speed was recorded at 83.44 mbgl which may indicate more competent strata (mudstone, siltstone, sandstone). At this point the drilling method was open hole to 100 mbgl, collecting chippings only.
103.60	127.77	24.17	UTWSM	Interbedded mudstone and fine laminated sandstone with occasional pebble beds (lignite inclusions) at 108.32 to 108.35; ~115.87 and 120.09 to 120.21 mbgl.
127.77	136.50	8.73		Fine to medium laminated sandstone with fractures with occasional pebble beds (lignite inclusions) at 127.53 to 127.62; ~127.62; 130.24 to 130.26 and 131.0 to 131.7 mbgl.
136.5	142.00	5.50	Grinstead Clay Member (GCM)	Dark grey laminated mudstone
142.00	145.5	3.50		Weathered red clay
145.50	166.00	20.50		Dark grey laminated mudstone
166.00	175.50	9.5	LTWSM (Ardingley Sandstone Member)	Dark grey fine to course sandstone with 2 cm layer of angular clasts on the top boundary.
175.50	194.00	18.5	LTWSM	Dark grey/ brown siltstone with occasional sandstone beds with increasing interbedded siltstones (bioturbated) with mudstones towards the base (below 191.62 mbgl).
194.00	202.5 [End of hole]	8.5	Wadhurst Clay Formation	Dark grey laminated mudstone.

Figure 2-3 - Schematic of encountered strata at borehole IE2



2.2.3.1 PSD testing

PSD tests were scheduled on five samples within borehole IE2. The details of the samples taken for analysis can be seen in **Table 2.4** and the depth locations from which they were taken can be seen schematically on **Figure 2-3**. It should be noted that during sampling the finer sandstone strata units were selectively targeted for sample analysis. The PSD test results can be found in **APPENDIX E**.

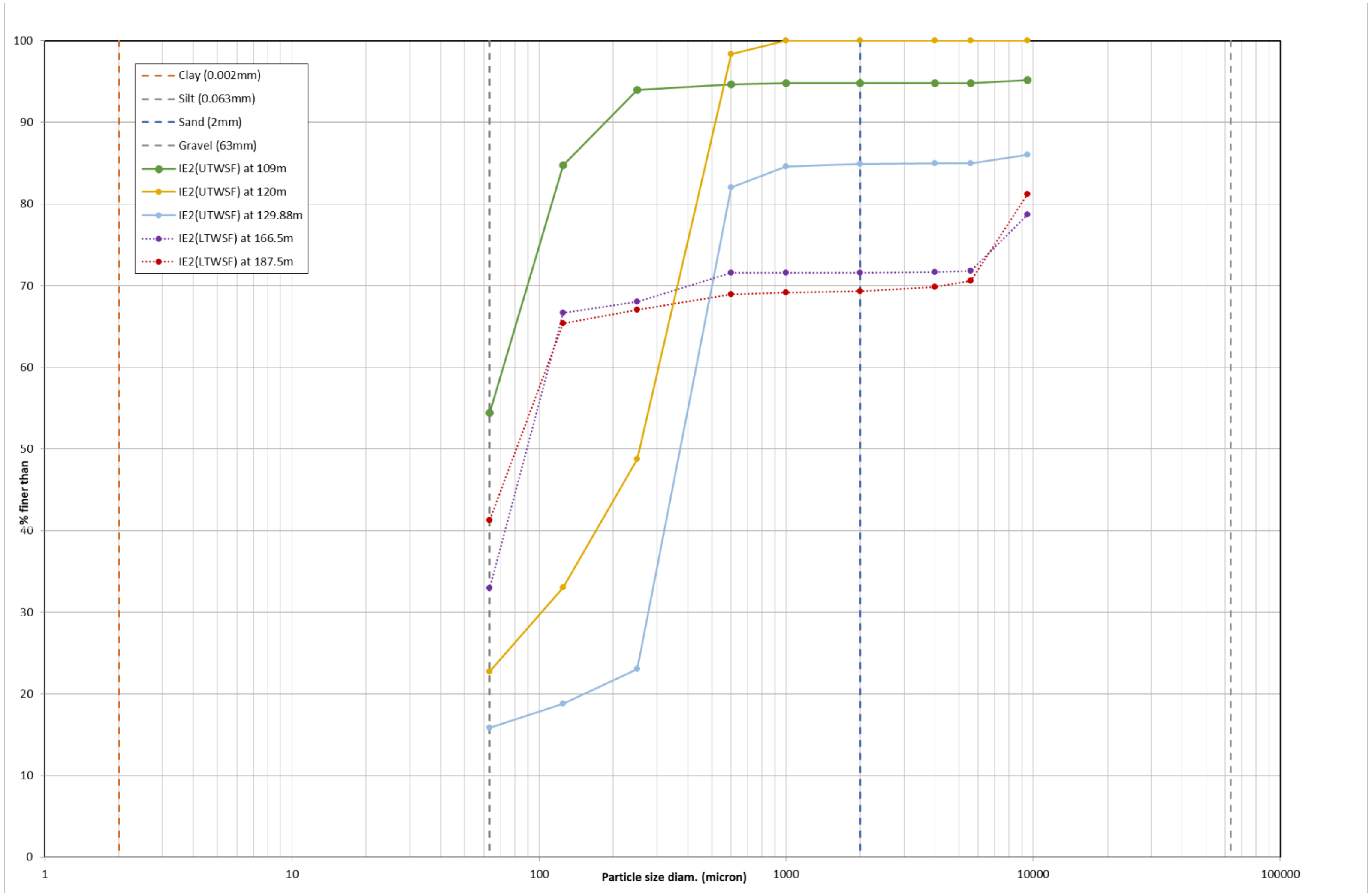
The percentage of cobbles, gravel and sand has been used to plot PSD curves. Silt and clay (less than 63µm) were not tested for, so plots are not fully representative of the finer particle fraction. However, it is evident that silt (and finer) fractions are significant varying from 55% (at 109mbgl) to 16% (at 129.88mbgl). The PSD plots can be used to determine screen slot size and filter pack requirements for future potential production borehole/s.

Table 2.4 – PSD test samples in borehole IE2

Sample depth (mbgl)	Description	Geological layer
109	Light brown silty SAND with stones and vegetation[8]	UTWSM
120	Light brown SAND with vegetation	
129.88	Light brown SAND with vegetation	
166.5	Grey CLAY	LTWSM
187.5	Cream silty SAND with vegetation	

[8] Vegetation refers to organic lignite inclusions within the sandstone sample.

Figure 2-4 – Borehole IE2 PSD plot



Note: The PSD laboratory analysis of borehole IE2 samples only tested to maximum grain size of 9.5mm (9500µm) of which not all samples passed so the graph cannot be taken to 100%. In addition, the analysis did not go below the silt grain size (0.063 µm) so % divisions of sample sizes are not given below this size. The lack of precision given to the results was recognised during the drilling programme and the PSD analysis requested (subcontracted by ALS to Professional Soils Laboratory) on the borehole IE3 samples included the finer fractions.

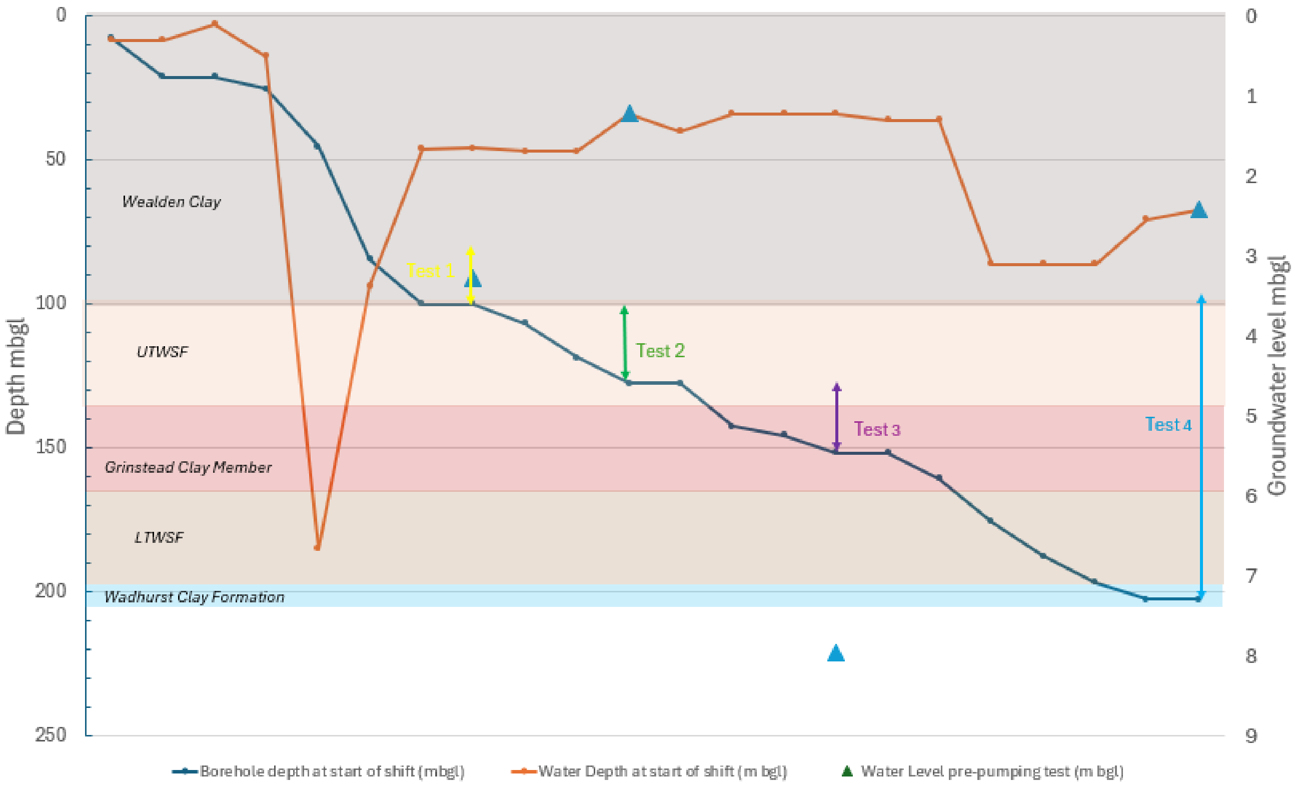
2.2.4 DRILLING FLUID/ WATER LEVELS

Fluid levels (i.e. levels of the drilling mud within the borehole) were recorded at the start and/ or end of the shift. However, this was often recorded whilst drilling with muds and these are likely not to represent real water levels. Similarly, during drilling no major or minor water strikes or seeps could be recorded due to the borehole being drilled with mud in the hole. Fluid levels recorded with depth whilst drilling borehole IE2 are shown within **Figure 2-5,** accompanied with drilling and test depths. Water levels recorded prior to pump drawdown testing (Test 1, Test 2, Test 3 and Test 4) are also marked on this figure, and these are likely to be more representative of the true groundwater level. The general observations can be made from the data collected:

- Fluid levels were generally recorded between 0.30 and 3.10 mbgl;
- A reading of 6.66 mbgl was recorded on the morning of 11th November 2024 whilst at a depth of 45.33 mbgl during the drilling the WCF[9];
- On 12th November (whilst drilling between 66.33 and 84.33 mbgl) it was noted that water was being lost during drilling. A loss of drilling fluid (increased added water usage) was noted below a depth of 69.95 mbgl onwards and an increase in the drilling rate was observed between 67.33 and 69.95 mbgl;
- Fluid levels rose with depth recording a level of 3.37 mbgl at a depth of 84.33 mbgl and 1.7 mbgl at a depth of 100 mbgl;
- The groundwater level of 3.28 mbgl at the start of Test 1 (Geobore open hole from 75 mbgl to 100 mbgl) indicating levels within the lower part of the WCF;
- Slight rise in fluid levels to approximately 1.25 mbgl between a depth of 127.5 mbgl until a depth of 160.5 mbgl was recorded. A similar groundwater level was observed during the start of Test 2 (Geobore open hole from 100 mbgl to 125 mbgl) recording a level of 1.22 mbgl presumably representative of the upper section of the UTWSF;
- A lower groundwater level of 7.95 mbgl was observed during the start of Test 3 (Geobore open hole from 125 mbgl to 150 mbgl) representative of the lower section of the UTWSF and the GCM;
- A drop in fluid levels to approximately to 3.1 mbgl was observed between a depth of 175.5 mbgl until a depth of 196.5 mbgl (the LTWSM), rising to a fluid level of 2.54 mbgl at the bottom of the hole (202.5 mbgl) within the Wadhurst Clay Formation; and
- A groundwater level of 2.42 mbgl was recorded at the start of Test 4 (Geobore open hole full section from 100 mbgl to 202.3 mbgl).

[9] This fluid level was taken within the upper WCF section below the top 8" (203mm) mild steel casing may indicate lower pressures at this depth.

Figure 2-5 – Groundwater and fluid level during drilling borehole IE2



2.2.5 WATER QUALITY SAMPLING

Details of water quality sampling can be found in **Section 6**.

2.2.6 GEOPHYSICAL LOGGING AND CCTV SURVEY

Geophysical logging of the borehole was undertaken between the 5th and 6th of December 2024, by EGS. Natural gamma, resistivity, fluid temperature, electrical conductivity, fluid velocity and CCTV were applied during the survey. Due to high turbidity in the borehole, the imaging on the CCTV was poor and therefore little information about the aquifer was gained from this survey method. The results are presented in **Appendix F**. Due to the constraints outlined in **Section 2.1.2** survey results are limited to the UTWSF and the uppermost portion of the GCM.

The geophysical logging indicates the following:

- Generally, no significant temperature fluctuations were recorded for the length of the borehole recorded (down to a depth of 145.10 mbgl). The temperature increases gradually from approximately from 11.4 to 13 degrees celsius over the length of the logged section. Slight fluctuations within temperature are seen within the top of the GCM from a depth of 135 mbgl to 145.10 mbgl;
- The caliper log indicated small fractures at 114.4 and 134 mbgl with a larger fracture just below 116 mbgl (130 mm in size) aligned with the recording of a pebble bed at this depth. The caliper log also indicates collapse and borehole widening up to a maximum of 300 mm within the upper part of the GCM between 140 and 146 mbgl;
- The acoustic image log gave poor images where centralisation was poor due to bore conditions (i.e. harder formations have a more uniform diameter resulting in improved images). Acoustic

imaging suggests a lack of large open fractures between 115.00 - 127.00 mbgl, although this coincides with a stable fluid velocity profile. Within the top of the UTWSM several horizontal fractures with small apertures are evident on acoustic imaging at 113.20, 114.20, 114.45, 116, 125.00, 126.30 mbgl. Larger aperture horizontal fractures are evident within the base of the UTWSM at 127.45, 128.20, 130.10 - 130.30, 134.00 mbgl;

- Deep and shallow resistivity logs show fluctuations in line with the interbedded nature of the strata, although a slight drop accompanied with a slightly elevated natural gamma reading is observed below 140 mbgl, possibly aligning with the weathered red (brown) clay layers within the upper GCM;
- Electrical conductivity remained relatively stable throughout the length of the borehole dropping gradually from 1140 µS/cm at the top of the borehole to 1080 µS/cm at the base of the logged section;
- The tilt given on the field image log was generally below 1 degree averaging approximately at 0.5[10] degrees. The strike as azimuth varied from generally northwest within the UTWSM through to north or slightly to the northeast within the GCM.

2.2.7 BOREHOLE SUMMARY

Borehole IE2 was drilled to a total depth of 202.5 mbgl (**Table 2.8**) and encountered the WCF, UTWSM, GCM, LTWSM and the top of the Wadhurst Clay Formation. A total of four drawdown tests were undertaken at the base of the WCF, in the upper UTWSM, in the lower UTWSM/ top of GCM and across the bottom 100 m of the borehole. Water quality field parameters were monitored during the testing and water quality samples were taken at the end of each test. A total of five PSD samples were taken targeted upon the finest elements of the sandstone aquifer units. Geophysics for the borehole was incomplete and run to a depth of 145.10 mbgl only due to a blockage of the borehole at this depth. Borehole IE2 was left open and groundwater levels monitored until the drilling and testing of borehole IE3 was completed, after which the borehole was decommissioned (**Section 4**).

2.3 BOREHOLE IE3

2.3.1 LOCATION

Borehole IE3 is located within an agricultural field to the West of Ifield, West Sussex, at National Grid Reference: TQ 23623 37149 (ground surface elevation: 68.15 mAOD) seen in **Figure 2.2**. A summary of the drilling works is presented below, with an outline of the geology encountered during the drilling of borehole (**Appendix C**).

2.3.2 SUMMARY OF DRILLING WORKS

The exploratory borehole was drilled from 11st December 2024 to 22nd January 2024 and the drilling schedule was as follows:

- An inspection pit was dug from 0.00 - 1.20 mbgl;
- Open hole rotary drilling (14” 3/4) was drilled from 1.20 mbgl until 19.50 mbgl;
- Permanent 8” casing was installed and grouted in place between ground level and 19.50 mbgl;

---

[10] This matches closely with a calculated dip value of 0.4 degrees based on the depths to the top of the UTWSM between boreholes IE2 and IE3.

- Open hole drilling at 7” 1/2 (~190 mm) diameter was drilled from 19.50 mbgl until to 95.93 mbgl; and
- Geobore mud flush drilling from 95.93 mbgl to the final depth of 210.00 mbgl.

2.3.3 GEOLOGY

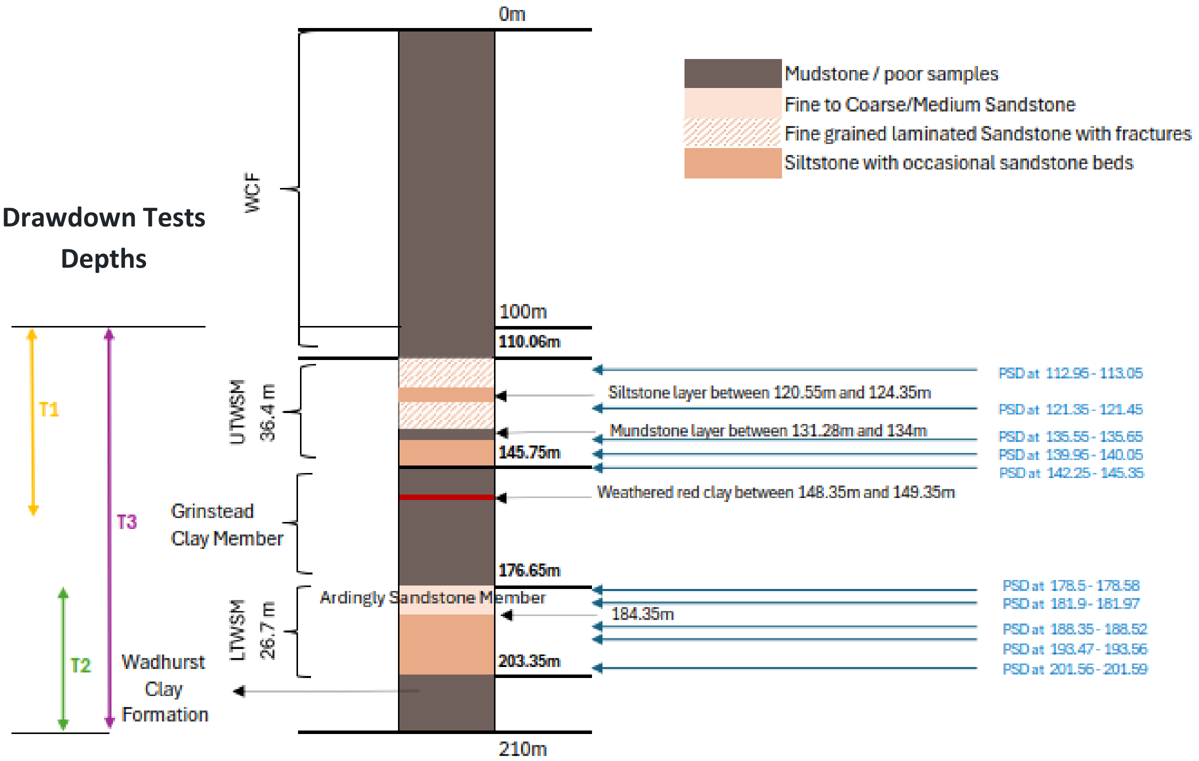
The geology encountered whilst drilling the exploratory borehole is summarised below in Table 2.5 and a schematic can be seen in Figure 2-6

Figure 2-6. The log has been constructed based on returns during drilling, drillers logs and Geobore core logs. Details of the geology encountered during the drilling of the borehole are given within **Appendix C** and photographs of the cores are within **Appendix D**.

Table 2.5 - Summary Geology of Borehole IE3

Depth from (mbgl)	Depth to (mbgl)	Thickness (m)	Interpreted strata	Encountered strata
0.00	110.06	110.06	Wealden Clay Formation	Mudstone (from chippings) Generally described as very stiff grey laminate clay. At 81.70 mbgl drilling slowed and the strata was described as harder grey siltstone.
110.06	120.55	10.49	UTWSM	Fine grained laminated sandstone
120.55	124.35	3.80		Siltstone
124.35	131.28	6.93		Fine grained laminated sandstone
131.28	134.00	2.72		Mudstone
134.00	145.75	11.75		Siltstone with occasional sandstone beds
145.75	148.35	2.60	GCM	Mudstone
148.35	149.35	1.00		Weathered red clay
149.35	176.65	27.30		Mudstone
176.65	184.35	7.70	LTWSM (Ardingley Sandstone Member)	Fine grained sandstone with cross bedding
184.35	203.35	18.82	LTWSM	Siltstone with occasional fine sandstone beds
203.35	210.00	6.65	Wadhurst Clay Formation	Mudstone [End of hole]

Figure 2-6 – Schematic of encountered strata at borehole IE3



*Note: WSP Log used for the schematics
Layer of 1m or less thickness are not included

2.3.3.1 PSD testing

PSD tests were scheduled on ten samples within borehole IE3. The details of the samples can be seen in Table 2.6 and the depth locations from which they were taken can be seen schematically on Figure 2-7

Figure 2-7. It should be noted that during sampling the finer sandstone strata units were selectively targeted for sample analysis. The PSD test results can be found in **Appendix E**.

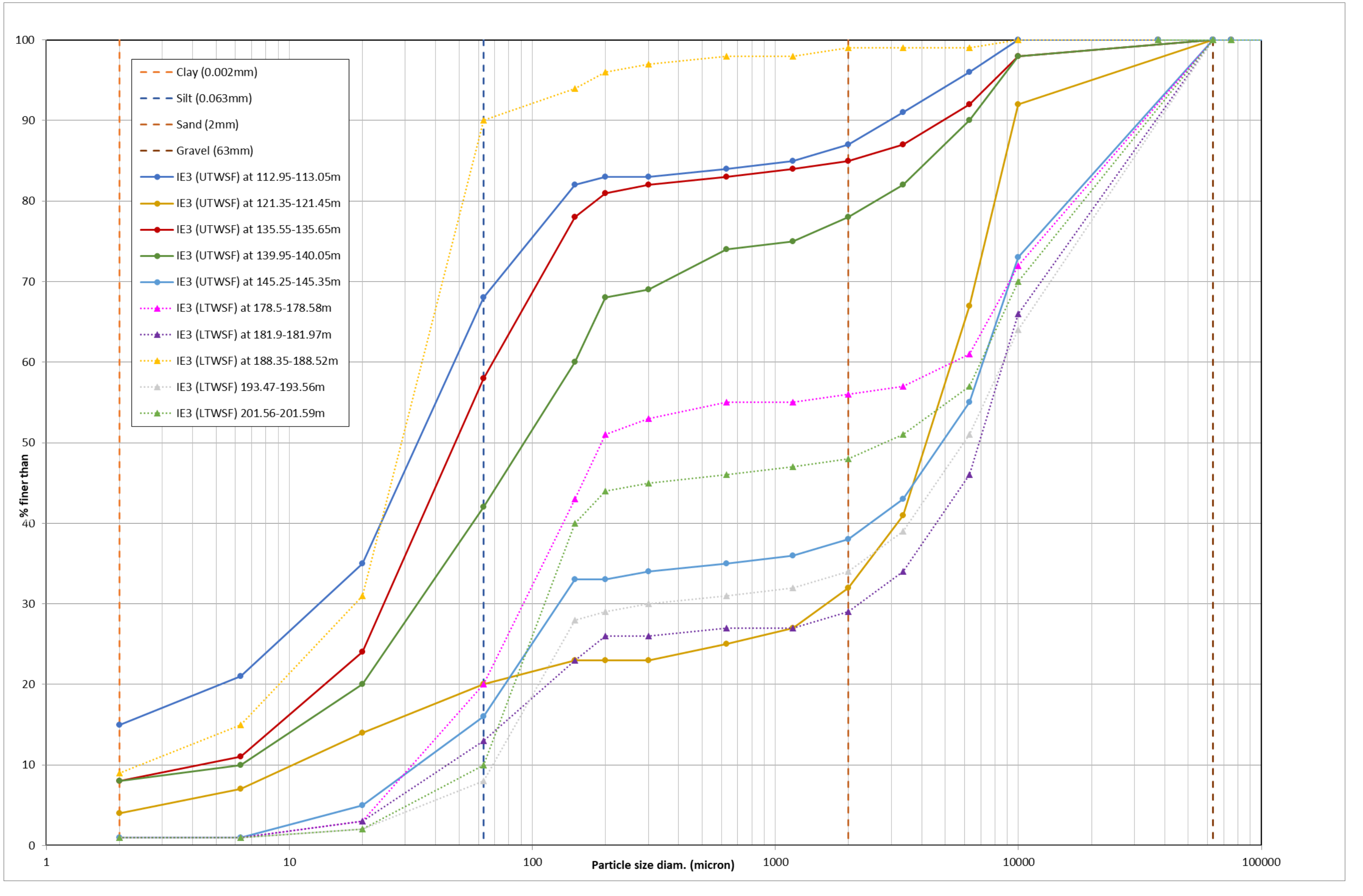
The percentage of cobbles, gravel, sand and fines have been used to plot PSD curves. The PSD curves indicate that the majority of samples are silty, sandy gravel, although there are bands of clay and silt, as described in the geological logs. Very approximately the ranges of percentages for different particle sizes recorded by the laboratory were as follows: the UTWSF contains 4-15% < silt, 15-52% silt, 20-35% sand and 13-68% gravel; whilst the LTWSF has a much wider range for silt and gravel content with 2-9% < silt, 15-36% silt, 15-36% sand and 2-72% gravel.

It should be noted that the samples are described as gravels and given in some cases a very high percentage of gravel sized particles. The laboratory was queried on this, and they stated that: "*When testing on core samples is undertaken in the lab, our technicians will not use excessive force upon the breaking down of the sample*………". This being the case, it is expected that the samples were not broken down into their constituent parts and the data should be treated with extreme caution.

Table 2.6 - PSD test samples in borehole IE3

Sample depth (mbgl)	Description	Geological layer
112.95-113.05	Grey clayey slightly sandy slightly gravelly SILT.	UTWSM
121.35-121.45	Grey clayey sandy GRAVEL.	
135.55-135.65	Grey clayey slightly sandy slightly gravelly CLAY.	
139.95-140.05	Grey clayey very silty very gravelly SAND.	
145.25-145.35	Grey silty very sandy GRAVEL.	
178.5-178.58	Grey silty very sandy GRAVEL.	LTWSM
181.9-181.97	Grey silty sandy GRAVEL.	
188.35-188.52	Grey slightly sandy slightly gravelly SILT.	
193.47-193.56	Grey slightly clayey very sandy GRAVEL.	
201.56-201.59	Grey clayey very sandy GRAVEL.	

Figure 2-7 – Borehole IE3 PSD plot



2.3.3.2 Hydraulic conductivity Analysis based on Grain Size

Hydraulic conductivity can be estimated from grain size using a number of formulas. This uses (the grain diameter for which 60% of the sample is finer) and/ or porosity and/ or $C_{u=} D_{60}/D_{10}$ which is the coefficient of uniformity. The D_{10} and D_{60} information is taken from the PSD curves.

The Hazen formula (1892; 1911) and Beyer (1964) formula uses D_{10} and D_{60}. However, the Hazen formula is only valid for 0.1 mm ≤ D_{10} ≤ 0.6 mm and 1 ≤ C_u ≤ 20 and the Beyer formula is assumed valid for smaller grain sizes where 0.06 mm ≤ D_{10} ≤ 0.6 mm and 1 ≤ C_u ≤ 20. The D_{10} values for the borehole IE3 samples are too small for these formulas to be valid.

$$K_{KC} = C_{KC}\frac{g}{v}\frac{n^3}{(1-n)^2}D_{10}^2$$

The Kozeny-Carmen formula shown above is assumed valid for sediments and solids composed of silt, sand and gravelly sand[11], where K_{KC} is hydraulic conductivity [m/s], C_{KC} is an empirical coefficient equal to 1/180 [dimensionless], g is gravitational acceleration [m/s²], v is kinematic viscosity of water [m²/s] and n is total porosity [dimensionless]. D_{10} is measured in m within the formula. Hydraulic conductivity calculations using the Kozeny-Carmen formula on the samples from borehole IE3 are shown within **Table 2.7**.

For the calculation, porosity has been assumed to be 11%. This is estimated based on porosities of sandstone aquifers (generally 10-30%) and from moisture content tests in borehole IE2 which were between 8.8 and 12% with an average of 10.96%. This is considered to be a conservative estimate. This formula has given a hydraulic conductivity values between 0.00296 and 6.04×10^{-7} m/s (0.1 to 256 m/day). Given the issue highlighted above with samples not being broken down into their constituent parts it is likely that the hydraulic conductivity calculations with a D10 value within **Table 2.7** of less than 0.01 mm are most realistic.

[11] Rosas et al., (2014) Determination of hydraulic conductivity from grain-size distribution for different depositional environments, Ground Water, vol. 52, no. 3, pp. 399-413.

Table 2.7 – Hydraulic conductivity calculations with D10 and D60 values

Sample depth (mbgl)	Geological layer	D10 (mm)	D60 (mm)	Porosity % (assumed)	Hydraulic Conductivity (m/s) Kozeny-Carmen	Hydraulic Conductivity (m/d) Kozeny-Carmen
112.95-113.05	UTWSM	0.001	0.05	11	6.04E-7	0.1
121.35-121.45		0.01	5.1	11	6.04E-5	5.2
135.55-135.65		0.004	0.07	11	9.66E-6	0.8
139.95-140.05		0.0063	0.15	11	2.40E-5	2.1
145.25-145.35		0.038	7.0	11	8.72E-4	75.3
178.5-178.58	LTWSM	0.031	6.3	11	5.80E-4	50.1
181.9-181.97		0.05	8.0	11	0.00151	130.5
188.35-188.52		0.0028	0.033	11	4.73E-6	0.4
193.47-193.56		0.07	9.0	11	0.00296	255.7
201.56-201.59		0.063	7.0	11	0.00240	207.4

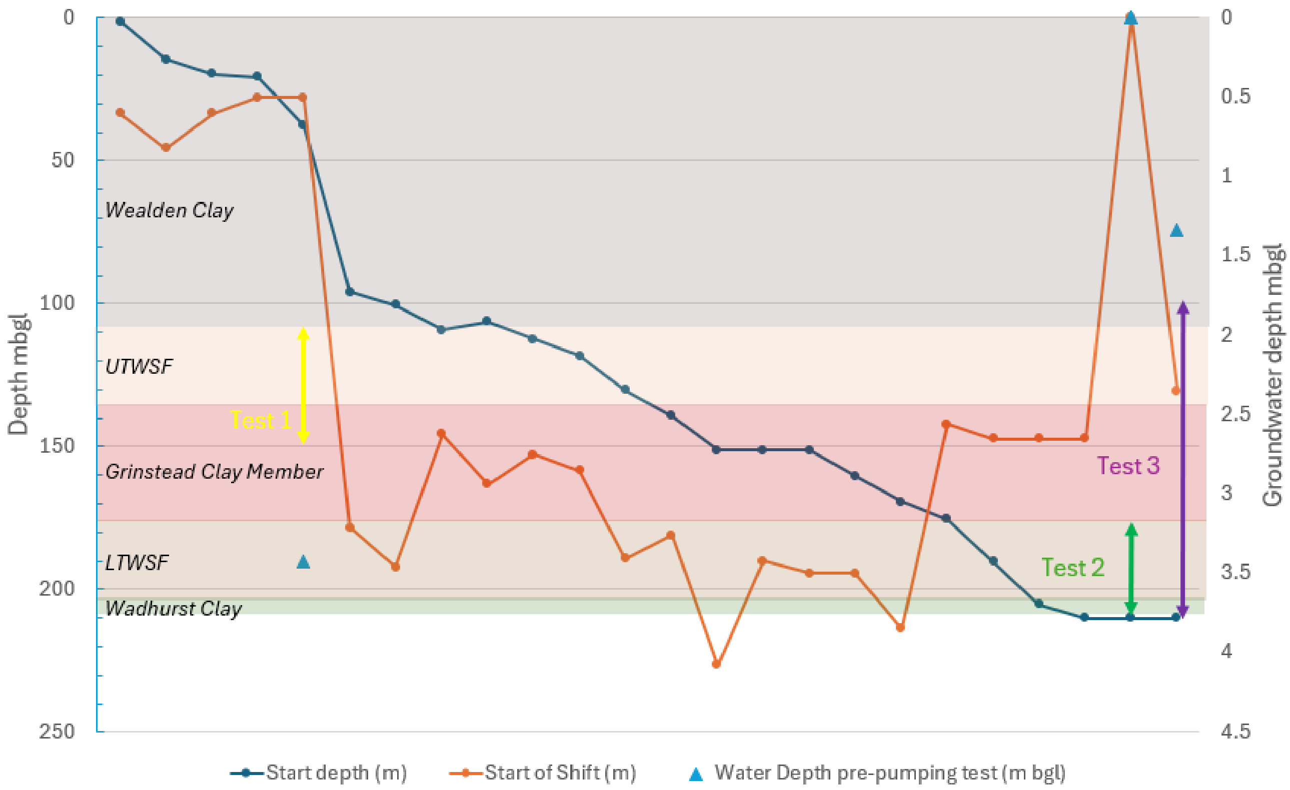
2.3.4 DRILLING FLUID/ WATER LEVELS

Fluid levels (i.e. levels of the drilling mud within the borehole) were recorded in a similar way to that during the drilling of borehole IE2. As with the other borehole during drilling no major or minor water strikes or seeps could be recorded due to the borehole being drilled with mud in the hole. Fluid levels recorded with depth whilst drilling borehole IE3 are shown within **Figure 2-8.** Water levels recorded prior to pump drawdown testing (Test 1, Test 2 and Test 3) are also marked on this figure, and these are likely to be more representative of the true groundwater level. The general observations can be made from the data collected:

- Fluid levels were generally recorded between 0.00 (slightly artesian) and 4.08 mbgl. Fluid levels dropped significantly at the base of the WCF, from 0.5 mbgl to 3.10 mbgl and then recorded a gradual decrease with depth through the UTWSM and GCM. Fluid levels then increased from 3.85 to 2.5 6 mbgl once the LTWSM was reached, before becoming artesian once the borehole was completed at 210 mbgl;

- Fluid levels were noted to gradually fall whilst drilling within the UTWSM and GCM. The lowest fluid level was recorded at 4.08 mbgl, at approximately 151 mbgl within the GCM. This is approximately within the weathered red clay band (148.35 to 149.35 mbgl);
- The groundwater level was recorded at 3.28 mbgl, before the start of the drawdown Test 1 (110 to 155 mbgl) which was measuring levels within the UTWSF and upper part of the GCM;
- Artesian conditions (slight trickle over the casing) were recorded at final depth (210 mbgl) on 23rd January 2025 whilst removing the Geobore to leave an open hole, and on the following morning (24th January 2025) whilst preparing for the second drawdown Test 2 (176 to 210 mbgl); and
- The third drawdown Test 3 was undertaken on the installed observation borehole at IE3 on the 13th and 14th February 2025, followed by a recovery period. The starting groundwater level during Test 3 was at 1.34 mbgl. At the end of the recovery period artesian conditions were noted again (14th February 2025). Artesian conditions were also recorded after the test pumping period, from 15th until the 19th February 2025 (inclusive).

Figure 2-8 – Groundwater and fluid level during drilling borehole IE3



2.3.5 WATER QUALITY SAMPLING

Details of water quality sampling can be found in **Section 6**.

2.3.6 GEOPHYSICAL LOGGING AND CCTV SURVEY

Geophysical logging of the borehole was undertaken on the 31st January 2024, by EGS. Natural gamma, resistivity, fluid temperature, electrical conductivity and fluid velocity were measured during the survey; these results are presented in **Appendix F**. Due to high turbidity in the borehole, the imaging on the CCTV was poor, and therefore, this survey method was abandoned. Due to the constraints outlined in **Section 2.1.2**, survey results are limited to the WCF, UTWSM and the upper half of the GCM.

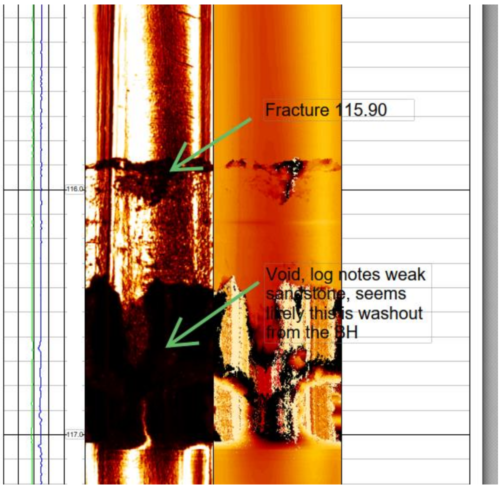
The log indicates the following:

- The WCF comprises predominantly high natural gamma-producing clays and mudstones, which incorporate harder strata (likely interbedded siltstones and more competent mudstones) towards the base, where acoustic transit times are seen to decrease;
- No significant temperature fluctuations were recorded for the length of the borehole (down to a depth of 160.08 mbgl). The temperature increased gradually from approximately 10.2 to 13 degrees celsius over the length of the logged section (approximately 1.5 degree Celsius gradient over the bottom 100 m of the logged borehole);
- Within the measured acoustic depth (down to 132.00 mbgl) voids were recorded at 110.00-110.50,116.40-117.05, 126.10-126.80 and 127.70-128.70 mbgl within the UTWSM. These voids corresponded to a slightly increased fluid velocity;
- The above voids match caliper spikes, ranging from 380 to 520 mm. Additional voids were also identified below the depth of the acoustic survey; measuring large fractures at 132 and 152.5 mbgl and a collapse/void between 155 and 160 mbgl. It should be noted that flushing and the development of the borehole during testing may have artificially enlarged these voids;
- Within the measured acoustic depth, four open horizontal fractures are also measured at 109.75, 111.90, 112.45, 115.90 mbgl. As with the above voids, a slight increase in fluid velocity was observed at these depths;
- Deep and shallow resistivity logs show fluctuations in line with the interbedded nature of the strata with a gradual increase in in resistivity within the WCF, possibly associated with increasing depth, for example a rise in average resistivity is seen below 80 mbgl;
- Electrical conductivity was elevated within the top WCF (1800 µS/cm), and relatively stable until 47 mbgl with a marked boundary at this depth where electrical conductivity starts to decline. A gradual declined toward the base of the survey, through the lower half of the WCF, GCM and the UTWSM to approximately 1250 µS/cm. At a depth of approximately 135 mbgl the rate of electrical conductivity decline increases slightly before stabilising at 1200 µS/cm through to the survey final depth (162 mbgl); and
- The tilt given on the field image log generally varied between 2 and 6 degrees with a gradual increase with depth. There is significant variation in tilt below a depth of 126 mbgl, likely associated with collapse. The strike an azimuth was relatively stable across the length of the surveyed borehole, at approximately 180 degrees indicating a north to south strike of the strata.

From the field image log (**Figure 2-9**) a void was identified at a depth of 116.4 to 117 mbgl

Figure 2-9 – Field image log of fracture and void at 117 mbgl within borehole IE3

(fracture of 100 mm on caliper log). It is likely this area that kept collapsing and causing a blockage within the borehole when the intended 7 inch observation liner/ screen was attempted to be installed between the 31st January through to 3rd February 2025. The core suggests this area was weak sandstone within the UTWSM and the fracture 60 cm above the void is likely to have made the roof of the void more unstable.



2.3.7 BOREHOLE IE3 SUMMARY

Borehole IE3 was drilled to a total depth of 210 mbgl (**Table 2.8**) and encountered the WCF, UTWSM, GCM, LTWSM and the top of the Wadhurst Clay Formation. A total of two drawdown tests were undertaken at the UTWSM/ top of the GCM and across the LTWSM/ top of Wadhurst Clay Formation at the bottom of the borehole. Water quality field parameters were monitored during the testing and water quality samples were taken at the end of each test. A total of ten PSD samples were taken targeted upon the finest elements of the sandstone aquifer units. Geophysics for the borehole was incomplete and run to a depth of 132 only due to a blockage/ restriction of the borehole at this depth. Borehole IE3 was converted into an observation borehole IE3 (**Section 3**), due to the areas preferred location for any future production borehole, and a further longer period pumping test was run upon this installation prior to the headworks being put in place.

Table 2.8 - List of exploratory boreholes drilled during the 2024/5 Homes England Ifield drilling programme

Borehole ID	Easting	Northing	Ground Elevation (mAOD)	Total depth (mbgl)	Strata Drilled	Borehole Drilled End Date	Final Installation or Decommission Summary	Screen interval (mbgl)	Rest Water Level (mbgl) and Date Recorded
IE2	524434	137096	67.39	202.50	WCF, UTWSM, GCM, LTWSM.	3rd December 2024	Backfilled	n/a	2.24 – 4th December 2024
IE3	523623	137149	68.15	210.00	WCF, UTWSM, GCM, LTWSM, Wadhurst Clay Formation	22nd January 2025	Monitoring well 2” (51 mm) uPVC	111.11 - 146.63 mbgl and 177.28 – 192.08 mbgl	Slightly artesian - 15th February 2025

3 OBSERVATION BOREHOLE INSTALLATION

This section outlines the methodology and design of the observation borehole IE3 in terms of design considerations taken from data collected during exploration. Installation details are given with diagrams of the final installed observation borehole.

3.1 METHODOLOGY AND DESIGN

One exploration borehole, IE3, was selected for conversion to observation boreholes during this drilling programme. The primary factor involved in choosing the exploration borehole IE3 location over IE2 was the preferred location of borehole IE3 for any future drilled production borehole based on future development phasing and infrastructure location, i.e. near to the proposed treatment works.

3.1.1 OBSERVATION BOREHOLE IE3 DESIGN CONSIDERATIONS

The borehole IE3 design takes into account the conditions stipulated in the EA Ground Investigation Permit (WR2024/08v3):

- *The maximum depth of the boreholes shall be 210m;*
- *The maximum diameter of the boreholes shall be 350mm;*
- *The boreholes shall be lined with steel casing and pressure grouted through the overlying Weald Clay and at least 3 metres into Tunbridge Wells Sands;*
- *For the test pumping, and the permanent installation, the borehole design should incorporate means for measuring the water level for future inspection purposes and as a means of monitoring the effect of future abstraction proposals on this source; and*
- *The datum of the abstraction borehole shall be levelled by the consent holder to the Newlyn Ordnance Datum.*

The above consent was issued for the installation of a production borehole and it should be noted that the EA clarified on 3rd February 2025[12] that an extension of solid casing of only a 1 meter into the TWSM aquifer units was acceptable for the construction of the observation borehole IE3.

As indicated in **Section 2.3.3**, the geology within borehole IE3 includes the presence of two aquifer units, the LTWSM and the UTWSM, which are separated by the GCM of approximately 30 m thickness. An initial design of the IE3 observation borehole considered the sealing of the GCM using bentonite to minimise any influence of this clay unit to the water quality within the screened aquifers. This however was not possible due to the considerable depth of the formations, the diameter of the hole (which limited the annulus space) and presence of centralisers which could cause an incomplete placing of bentonite or grout at depth. These factors could compromise the future integrity of the observation borehole.

Screening of only one of the two available aquifers was considered as an alternative; however, this option was discarded since it was expected that any future monitoring would be required for both aquifers. As an alternative gravel pack was installed along the entire length of both aquifers as well

[12] E-mail personal communication: WSP with EA Hydrogeology Technical Officer, Kent South London and East Sussex on the 3rd February 2025.

as the intervening GCM, as recommended by the drilling company and this methodology was finally taken forward.

The initial design for the observation borehole IE3 included a total final depth of 210m (to the base of the LTWSM) using 5” (113mm) ID (Internal Diameter) screen/ casing sections. This design however had to be modified due to instability of the borehole. The exploration borehole IE3 was reamed out between the 25th to the 27th January 2025. A collapse occurred at the base of the hole (191 mbgl) during reaming of the borehole and a blockage at 117.20 mbgl prior to running the screen /casing sections. After repeated attempts to clear the blockage, followed by a meeting with the Client on the 3rd February 2025, the final diameter of the observation borehole installation was reduced to 2” (51 mm) to allow for a uPVC type of screen and casing installation within the Geobore (prior to its withdrawal) down to a total depth of 192.8 mbgl. A significantly reduced diameter completion did however compromise the ability to undertake desired test pumping on the borehole (see Section 5.1.1).

3.1.2 OBSERVATION BOREHOLE IE3 CONSTRUCTION

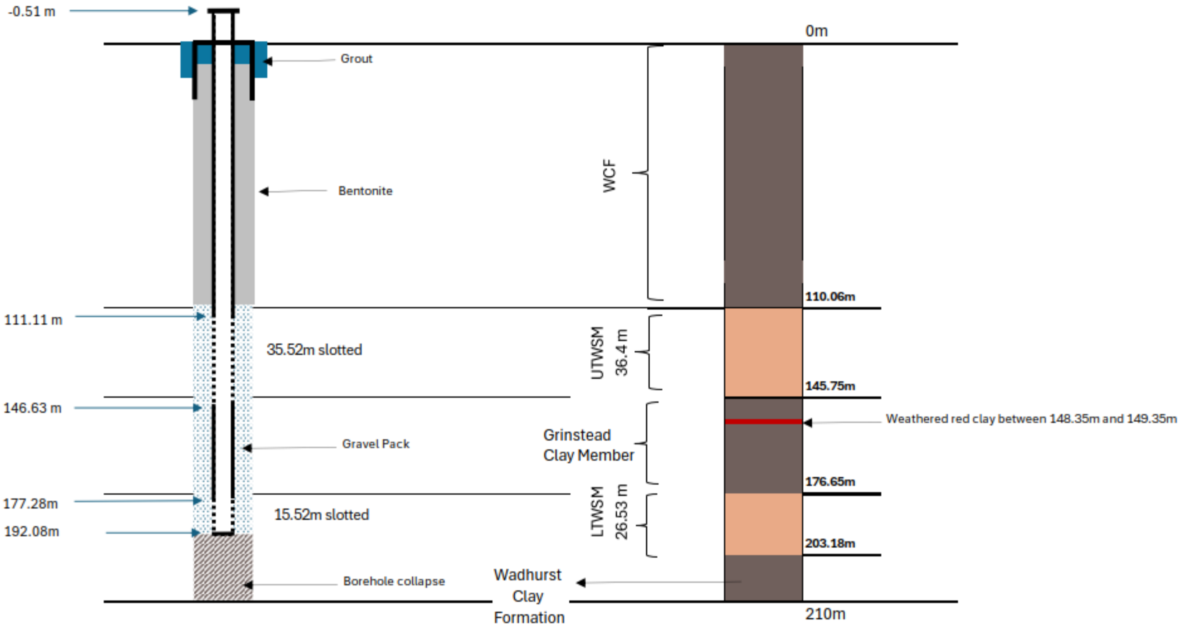
The observation borehole IE3 was installed as follows:

- Installation of screen and casing 2” (51 mm) uPVC to a total depth of 192.8 mbgl:
  - Starting on the 5th February 2025 an end cap was placed at the base of hole;
  - Install 51 mm Geoscreen with 0.5mm slots from 192.80 mbgl to 177.28 mbgl and from 146.63 mbgl to 111.11 mbgl with stabilisers every other length[13]; and
  - Install Geocasing from 177.28 mbgl to 146.63 mbgl and from 111.11 mbgl to 0.5 m above the ground, with 3m tape used on each joint and with stabilisers on every other length;
- Installation of filter pack from 192.80 mbgl to 108 mbgl with a filter pack grain size of 3.15 mm – to 5.6 mm;
- Installation of bentonite pellets from 108 mbgl to 5 mbgl;
- Grouting from 5 mbgl to 0.2 mbgl; and
- Topsoil placing to ground level.

Figure 3-1 shows the end design and installation of the final observation borehole. Despite the difficulties encountered on site, the final design was considered sufficient to obtain meaningful groundwater level data for the combined TWSM aquifer units.

[13] The installed casing began to sink once lowered into place so a bag of sand was placed down the hole to help with stability.

Figure 3-1 – Borehole IE3 Schematics for the Final Design



During the exploration drilling of the borehole IE3 artesian water levels were recorded at depth within borehole IE3. The potential of artesian head was considered prior to commencing of the drilling activities and appropriate 14 ¾ inch (~375 mm) diameter upper casing was installed within the original exploration borehole. The head works were attached to this outer casing to control artesian head (**Figure 3-2**[14]).

The observation borehole headworks completion consisted of a gate valve, pressure gauge and a sample tap and this was secured within a fence as shown on **Figure 3-3**.

[14] Schematic was supplied by the drilling contractor prior to installation.

Figure 3-2 – Borehole IE3 Schematic for the Head Works

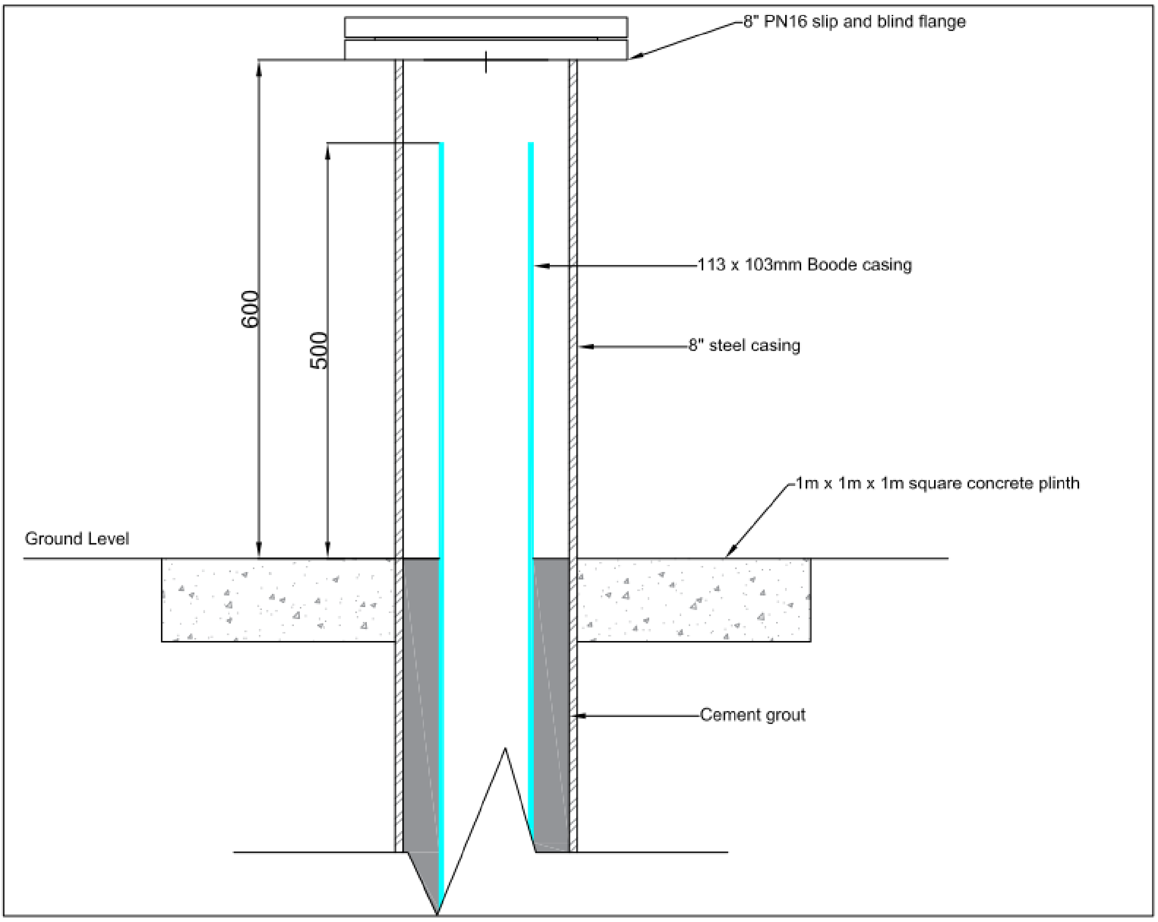


Figure 3-3 - Photographs of the IE3 headworks and fencing

4 BOREHOLE IE2 DECOMMISSIONING

This section outlines the methodology for backfilling and decommissioning borehole IE2.

As indicated in **Section 2.2.3**, the geology within borehole IE2 included approximately 103 m of WCF, followed by two aquifer units, the LTWSM and the UTWSM, which are separated by the GCM of approximately 30 m thickness. The original backfill design involved using bentonite across the non-aquifers (WCF, GCM and Wadhurst Clay Formation) and a gravel pack/ sandstone chipping within the permeable aquifers (UTWSM and LTWSM) as per best practice. The top of the well would be grouted across the permanent casing (to 21 mbgl) with topsoil from surface to 1 mbgl.

However, on 14th February, the borehole was found to have collapsed to 102.58 mbgl with the blockage within the WCF. Due to logistical issues with the rig having been moved away from the borehole IE2 location and deteriorating ground conditions it was decided to backfill with bentonite from the blockage up to the permanent casing and then grout to the surface. The backfilling was completed as followed:

- Between the 18th and 20th February, borehole IE2 was backfilled with bentonite pellets from 102.60 to 21.0 mbgl;
- On 21st February IE2 was grouted from 21.0 mbgl to 0.50 mbgl; and
- On 26th February, the grout was measured at 0.30 mbgl;
- A pit was then dug to 1 mbgl and the casing cutting off at 0.4 mbgl (lowest point accessible for the grinder); and
- Grouted base of pit to 0.2 mbgl and the remaining hole was filled with topsoil to ground level.

Although this was not considered borehole decommissioning best practice under the circumstances this was considered the best option. It is likely that the collapse and/ or squeeze of clays within the GCM would isolate the UTWSM and LTWSM aquifers. The pressures within the two aquifers do not appear to vary greatly and flows within the borehole were not observed. A hydraulic connection within the decommissioned borehole is therefore not believed to be maintained.

5 HYDROGEOLOGICAL TESTING

This section outlines the hydrogeological testing undertaken during the drilling of the IE2 and IE3 exploration boreholes.

5.1 DRAWDOWN/ PUMPING TESTS

5.1.1 INTRODUCTION

To help characterise yields/ productivity of the TWSM aquifers, pump and ancillary equipment were mobilised at both IE2 and IE3 boreholes so that simple drawdown tests could be completed. The EA had consented (under the aforementioned WR2024/08 referenced above) to undertake step tests and constant rate pumping tests on production boreholes for a volume not exceeding 31.5 m^3/hr (over 120 minutes) and 21 m^3/hr (over 24 hours), respectively.

However, after the change of drilling programme to include only exploration drilling and the installation of an observation borehole, the scope of the testing was curtailed to include only simple, short duration drawdown tests. The smaller diameter of the exploration boreholes limited the size of the pump and riser (2 inch – 51 mm diameter) that could be used down the borehole and as such the discharge rate was limited to approximately 0.9 l/s (77.8 m^3/day). Drawdown tests were therefore used to give a broad indication of likely responses to abstractions at this rate and at certain depths. These tests were generally kept to a short duration (1 to 5 hours) to keep to the drilling programme unless tests were undertaken at total depth in which case longer tests were run over extended open hole sections to monitor the combined response across the two (UTWSM and LTWSM) aquifers.

After the installation of the IE3 observation borehole a constant rate pumping test was attempted. The pumping test was not successful, firstly because of the size of the pump that would fit down the borehole, due to the redesign and final reduced diameter install, which limited the discharge rate to only 0.1 l/s (8.6 m^3/day); and secondly because of issues with the pump controller before and during the testing. Issues with the pump controller delayed the testing, caused abortive testing and even when working properly was very difficult to control to establish a constant discharge rate.

5.1.2 METHODOLOGY

The methodology for the drawdown tests for both boreholes IE2 and IE3 was as follows:

- The Geobore was lifted to a designated depth to open up a target response zone for testing (geological units above the base of the Geobore casing are assumed to be effectively cased out);
- Prior to each drawdown test, mud within the borehole was displaced into a surface tank and then the borehole was flushed with clean water[15];
- Pre-test monitoring;
- Drawdown tests were conducted with durations ranging from approximately 1 to 5 hours;
- An *extended* suite sample was taken at the end of each test period; and
- Recovery monitoring if time within the drilling programme allowed.

[15] Best practice and early tests involved flushing the borehole with three x the capacity of the well (well bore volumes), however, due to time constraints, this was not possible with later tests in which the mud was displaced only.

The methodology for the CRT test on observation borehole IE3 was as follows:

- After the installation of the observation borehole was complete the borehole was airlifted for four hours on the 12th February 2025;
- A couple of tests were attempted but failed due to a faulty pump controller;
- On the morning of the 13th February 2025 pre-test monitoring was undertaken and the borehole found to be artesian at a flow rate of 0.036 l/s (3.1 m^3/day);
- An *extended* suite sample was taken before the test period from the artesian flow water;
- The CRT was started at 13:16 pm and after some difficulty to stabilise the pumping rate within the first few minutes a constant discharge of approximately 0.1 l/s was achieved;
- The CRT was run over night into the 14th February 2025 for 15.3 hours;
- A *full* suite sample was taken at the end of the test period; and
- The recovery was monitored to over 70% of total final drawdown.

5.1.3 MONITORING DURING TESTING

During the tests, the following data were recorded at the test borehole:

- Pumping rate and volume extracted (recorded manually according to the schedule given in BS ISO 14686:2003);
- Groundwater levels within the IE3 borehole (recorded manually according to the schedule given in BS ISO 14686:2003 supported by automatic recording at 5 to 15 second intervals);
- Groundwater level at IE2 was measured throughout IE3 drilling and testing; and
- Electrical conductivity, pH, dissolved oxygen concentration, Oxidation Reduction Potential (ORP) and water temperature were recorded using multimeter at the discharge outlet at set intervals.

5.2 BOREHOLE IE2 DRAWDOWN TESTING

Drawdown tests were completed at borehole IE2 between 19th November and 4th December 2024. A calendar of pumping test related activities is provided below in **Table 5.1**.

Table 5.1 - IE2 Pumping test calendar

Test Reference	Date	Response Zone	*Response depth (mbgl)	**Duration of Test (Minutes)	Activity
IE2 Test 1	19th November 2024	Weald Clay Formation	75-100	70	Drawdown test
IE2 Test 2	23th November 2024	Top of the UTWSM	100-125	101	Drawdown test
IE2 Test 3	27th November 2024	Bottom of the UTWSM and the GCM	125-150	60	Drawdown test
IE2 Test 4	4th December 2024	UTWSM, GCM and LTWSM	100-202.5	285	Drawdown test followed by a recovery test

Note: *Response zones relate to the depth between the total depth of the well at the time of the test and the base of the Geobore, which aimed to isolate sections of the aquifer during the test. **Duration is the period of pumping.

5.2.1 BOREHOLE IE2 SETUP

A Grundfos SQE pump, run by a 30KVa generator and inverter, was installed in the test borehole at a depth of 65 mbgl over the four tests. The pump was coupled to a to a 3" Certa-Lok® rising main (32mm diameter alcythene pipeline), supported at surface by a clamp resting upon the Geobore casing (**Figure 5-1**). The rising main was passed over an agricultural field and a short section of forest to the discharge point (**Figure 2.1**). The pump was capable of a discharge of 0.9 l/s (77.8 m^3/day)[16] and although not directly measured this was confirmed by estimating the flow at the discharge point. The discharge location was to the Ifield Brook, approximately 150 m east of IE2 (NGR: TQ245371). Water was discharged directly into the brook, with limited scouring occurring during discharge because of the low flowrate.

Figure 5-1 – Surface setup for drawdown testing

5.2.2 MONITORING DURING TESTING

Monitoring was undertaken solely at IE2 throughout testing. Groundwater levels were measured using an automatic data logger set at 5-15 second intervals and supplemented by manual dips during the test. During each test the pump discharged water was captured in a bucket at set intervals and parameters were measured using a multi-parameter meter for pH, ORP, DO, conductivity, TDS and temperature and these data recorded. Additionally, water samples were collected near the end of each test and sent to the ALS laboratory for analyses.

On the completion of drilling at borehole IE2, a logger was installed and remained in situ between the 6th December 2024 and the 14th February 2025, recording at 5-minute intervals and dipped manually before each download. The logger was installed to gain an understanding of more long-term fluctuations in groundwater level and to measure a response from pumping initiated at borehole IE3.

[16] Grundfos 96510159 SQE 3-65 50 Hz pump curve and data sheet.

The weather was recorded each day, including intense rainfall events although given the nature of the confined deep aquifers and short periods of the test, rainfall was believed to be irrelevant to the tests and were not used to interpret test results.

5.2.3 DRAWDOWN TESTS AND RECOVERY

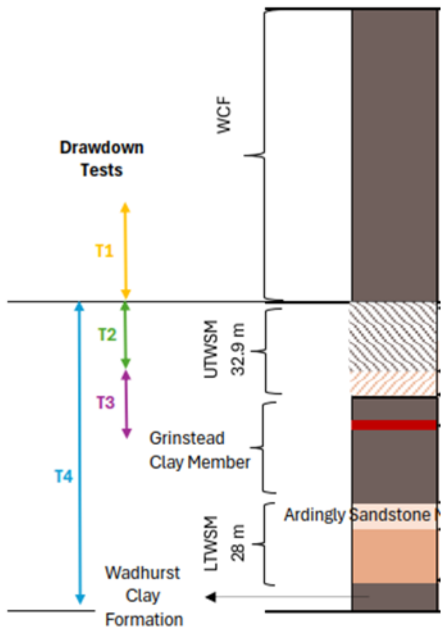
Four drawdown tests were completed between the 19th November 2024 and the 4th December 2024 at borehole IE2 to observe the drawdown and influence of abstracting groundwater from the aquifer and to collect water samples. A summary of these tests is tabulated below in **Table 5-2** and graphs of drawdown and recovery presented in **Figure 5-2** and **Figure 5-3.**

Table 5-2 – Summary of drawdown tests completed at IE2

Test Reference	Start	End	Duration of Pump-ing Test (minutes)	Volume extracted (m^3)	Initial Rest Level (mbgl)	Maximum Drawdown (m)	*Time to Recovery (mins)
IE2 Test 1	19/11/2024 16:00	19/11/2024 17:05	65	3.8	3.28	7.39	Not recorded
IE2 Test 2	23/11/2024 14:39	23/11/2024 16:20	60	5.5	1.22	13.14	Not recorded
IE2 Test 3	27/11/2024 12:20	27/11/2024 13:20	60	3.2	7.95	4.92	Not recorded
IE2 Test 4	4/12/2024 11:00	4/12/2024 16:15	285	15.4	2.42	10.66 (9.41 m after 60 minutes)	56 (80 % recovery)

Note: The rate of abstraction for all tests was at 0.9 l/s.

<u>Drawdown Test Response zones</u>



Drawdown Tests

Figure 5-2 – Borehole IE2 Drawdown Tests

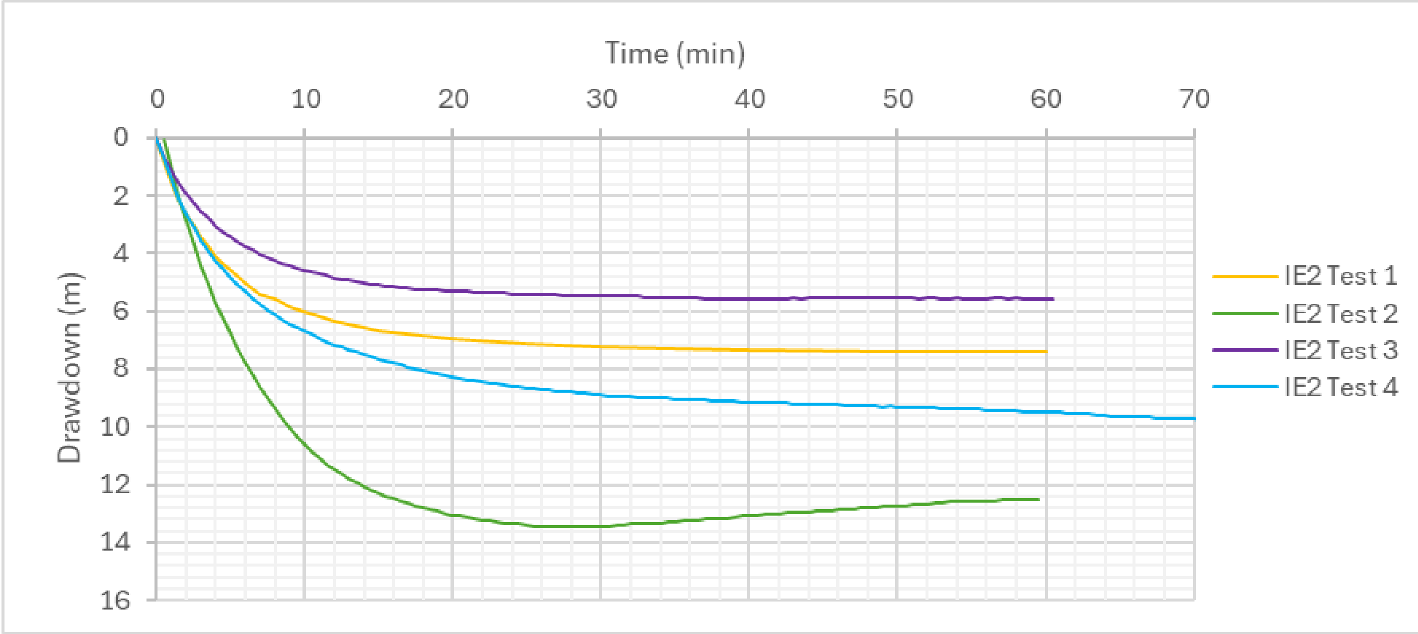
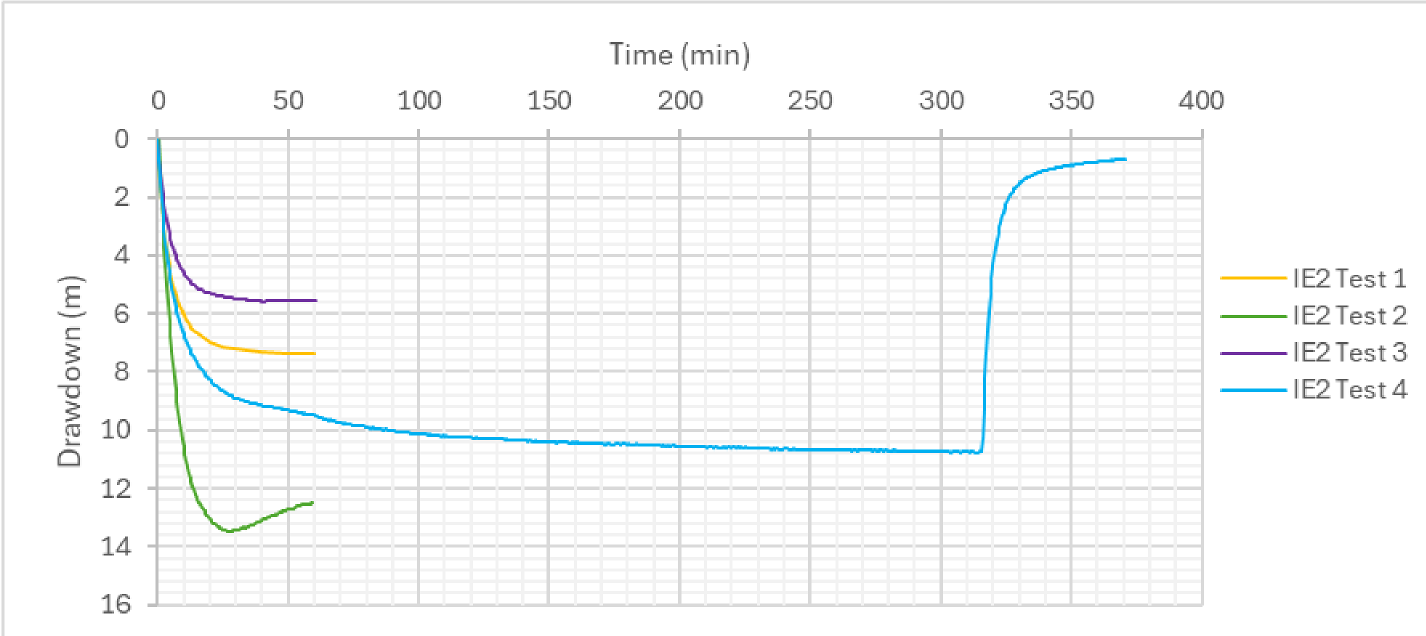


Figure 5-3 – Borehole IE2 Drawdown Tests and Recovery Test Extended



A description and brief interpretation of drawdown (**Figure 5-2**) and recovery test results are provided below:

Borehole IE2 Test 1 – Target Formation: WCF

Once the borehole had been progressed down to 100 mbgl with rotary mud flush through the WCF the Geobore was installed, and a drawdown test of 65 minutes was completed for a response zone between 75 and 100 mbgl. The initial rest water level was 3.28 mbgl and the drawdown increased gradually with a maximum of 7.39 m after 50 minutes. Drawdown appeared to stabilise after 20 minutes (drawdown of 6.97 m).

Borehole IE2 Test 2 - Top of the UTWS

A drawdown test (60 minutes) was completed for the top of the UTWSM (100-125 mbgl). It should be noted that the manual dipped data recorded an impossible rapid drawdown after 30 seconds of the test, however the backup logger data showed more sensible drawdown data which is believed to be valid and has been described here and shown within **Figure 5-2**. The initial rest water level was 1.22 mbgl and the drawdown in groundwater level during the test displayed the steepest decline out of all the tests run on borehole IE2, with the groundwater level dropping to a minimum of 14.7 m (13.48 m drawdown) after 14 minutes. Following the minimum recorded groundwater level, a recovery of levels was recorded, whilst still pumping, rebounding by approximately 1 m to 13.8 mbgl of total drawdown. No significant change in pumping rate was recorded during this period.

Borehole IE2 Test 3 - Bottom of the UTWSM and the GCM

A drawdown test (60 minutes) was completed for the bottom of the UTWSM and the GCM between 125-150 mbgl. The initial rest water level was 7.95 mbgl and the maximum drawdown recorded was 4.92 m after 60 minutes of pumping, showing a more gradual decline in water level than any of the other drawdown tests undertaken.

Borehole IE2 Test 4 – Full section (bottom 100 m) of the borehole

Upon completion of the borehole to a total depth of 202.3 m, the Geobore was lifted to 100 mbgl, which allowed the full response zone to target full geological sequence of the UTWSM, GCM and LTWSM. A longer period drawdown test was run for 300 minutes (5 hours). The initial rest water level was 2.42 mbgl and the maximum drawdown recorded was 10.66 m. The majority of the drawdown occurred within the first 60 minutes of the test at which time the decreasing trend of drawdown flattens off. A very small increased change in gradient of drawdown was observed after 60 minutes and the reasons for this are uncertain, i.e. there was no recorded change in pumping rate, etc.

Following the cessation of abstraction during the borehole IE2 Test 4 a period of recovery was recorded. The recovery data is shown below in **Figure 5-3**. The borehole recovered to 3.56 mbgl within 20 minutes (67% of pre-test water level) and 3.06 mbgl within 56 minutes (79% of total drawdown). The inflow based on the volume of the borehole and rate of water level rise after 20 minutes at the start of the recovery indicates an inflow greater than 0.26 l/s or 22.3 m^3/day. It is important to note that even after 5 hours of pumping the drawdown was still increasing at 0.1 m over the last hour.

5.2.4 SUMMARY AND INTERPRETATION

Drawdown observed during the tests on borehole IE2 were relatively high considering the low pumping rate employed for the tests. This may suggest a limited available yield from the TWSM. However that said, a gradual decrease in drawdown indicates that the aquifer is gaining water from another source, either because the aquifer is leaky (i.e. gaining water from surrounding formations), or because the expanding cone of depression has intercepted a source of recharge[17]. This is an encouraging sign for the borehole as a sustainable water source.

A caveat to the above is that in the case for Test 4 (a longer period test across both aquifers) a significant and prolonged drawdown was observed. This may be reflective of the differences between the two aquifers with the deeper LTWSM displaying a less sustainable signature.

It is also evident though from the drawdown Test 1 that the lower portion of the WCF likely have some productive units, likely sandstone and/or limestone, which are producing groundwater. Although, no geophysics is available to confirm the presence of fractures or productive lenses within the WCF within borehole IE2 other drilling parameters collected suggest these may exist within the base of the WFC.

The drawdown Test 2 completed the top of the UTWSM (100-125 mbgl) displayed the greatest drawdown (13.48 m). Although there is some uncertainty that this test was successfully carried out due to the errors in manual dips and the rebound of the groundwater levels observe within the logger data, the comparatively large and steep drawdown measured suggests relatively lower potential yield within this section of the UTWSM aquifer compared to its lower section. The upper section coincides with the absence of fractures as observed between 115 and 127 mbgl geophysics data.

The reasons for the rebound in drawdown within Test 2 after approximately 30 minutes of pumping is uncertain, although it is noted that borehole IE3 also displayed a similar response whilst testing the UTWSM, so it is believed to be real. The time passed does match with the pumping of approximately one well volume and so storage effects or well development could be responsible, although this is not observed during the testing of any other horizons[18].

Testing at the base of the UTWSM and within the GCM between 125-150 mbgl in borehole IE2 Test 3 observed the lowest drawdown of subsequent tests, measuring a maximum drawdown of 4.92 m indicating higher likely yield from this lower section of the UTWS aquifer. Increased fracturing and a higher frequency of sandstone units within the lower section of the LTWSM has been observed within the retrieved cores and geophysics (**Section 2.2.6**) supports the interpretation that this area may have increased transmissivity.

The full section Test 4 targeting the bottom 100 m) of the borehole UTWSM, GCM and LTWSM, measured a continuing decline in groundwater levels throughout the test with maximum recorded drawdown measured at 10.66 m after 5 hours. Once the pumping had ceased the borehole recovered 79% of its pre-test water level within 56 minutes.

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[17] International Committee of the Red Cross (ICRC), (2020). Technical review practical guidelines for test pumping in water wells.

[18] Another possibility to account for the response observed is the encountered of a recharge boundary, i.e. an aquifer zone with higher hydraulic conductivity, although this is unlikely given the nature of the aquifer and the short period of the test.

Since the drawdown tests were undertaken on a small diameter borehole with a low discharge pumping rate and across multiple aquifer/ non-aquifer horizons no analysis of the drawdown data was attempted. However, the testing at borehole IE2 does demonstrate that across all horizons tested the borehole as drilled, entailing no significant cleansing/development, is capable of yielding in excess of 0.9 l/s (77.8 m^3/ day).

5.3 BOREHOLE IE3 DRAWDOWN TESTING

Drawdown tests were completed at borehole IE3 between 14th November and 14th December 2025. A calendar of pumping test related activities is provided below in **Table 5.3**.

Table 5.3 – Borehole IE3 Pumping test calendar

Test Reference	Date	Response Zone	*Response depth (mbgl)	**Duration of Test (Minutes)	Activity
IE3 Test 1	14th January 2025	UTWSM	110-151	311	Drawdown test
IE3 Test 2	24th January 2025	LTWSM and Wadhurst Clay Member	176-210	300	Drawdown test
IE3 Test 3	13-14th February 2025	UTWSM and upper portion of the LTWSM	Observation borehole installed with screened response zones: 111.11 - 146.63 177.28 - 192.80	1,200	Drawdown test followed by a recovery test

Note: *Response zones relate to the depth between the total depth of the well at the time of the test and the base of the Geobore, which aimed to isolate sections of the aquifer during the test. **Duration is the period of pumping.

5.3.1 BOREHOLE IE3 SETUP

The borehole IE3 setup for drawdown testing was the same as the setup used for borehole IE2 with the same pump installed to a depth of 65 mbgl for borehole IE3 drawdown tests Test 1 and Test 2. The pumping capacity remained unchanged since the first round of testing and was capable of a discharge of 0.9 l/s (77.8 m^3/ day) and although not directly measured this was again confirmed by estimating the flow at the discharge point, with limited scouring occurring in the receptor during discharge because of the low flow rate.

After the installation of the observation borehole at IE3 due to the smaller diameter (2'') of the installed screen and casing Test 3 utilised a Geosub 2 Pump run by a 1 KV generator and inverter. The pump was installed at a depth of 30 m and connected to a 3/8'' sample tube, which led from the borehole unsupported. A controller connected to the pump and generator managed pump rate and converted voltage from AC to variable 300-watt DC. The flow rate was very low and estimated at only 0.08 – 0.10 l/s (6.9 to 8.6 m^3/day). It should be noted that prior to the CRT (Test 3) on the observation borehole at IE3 the borehole was developed by airlifting for approximately 4 hours on the 12th February 2025.

The rising main was passed over a grass field to the discharge point for all tests (**Figure 2.1**). The discharge location was a ditch, approximately 20 m north of borehole IE3 (NGR: TQ236371). The ditch at this location was saturated throughout the investigation and surface flow within the ditch was to the west, then south into an unnamed brook and the consented discharge point. Pumped water was discharged directly into the ditch, with limited scouring occurring during discharge.

5.3.2 MONITORING DURING TESTING

Monitoring was undertaken at both boreholes IE2 and IE3 throughout the testing period. Groundwater levels were measured at borehole IE3 using an automatic data logger set at 15-second intervals and supplemented by manual dips during the testing as had been done during borehole IE2 testing. Similarly, pumped discharge field quality data was again measured and samples taken at the end of the testing. In addition, groundwater level monitoring was also undertaken at borehole IE2, using an automatic data logger set at 5-minute intervals, through the duration of borehole IE3 drilling and testing to measure if groundwater levels within this borehole were impacted.

5.3.3 DRAWDOWN TEST, CONSTANT RATE TEST AND RECOVERY

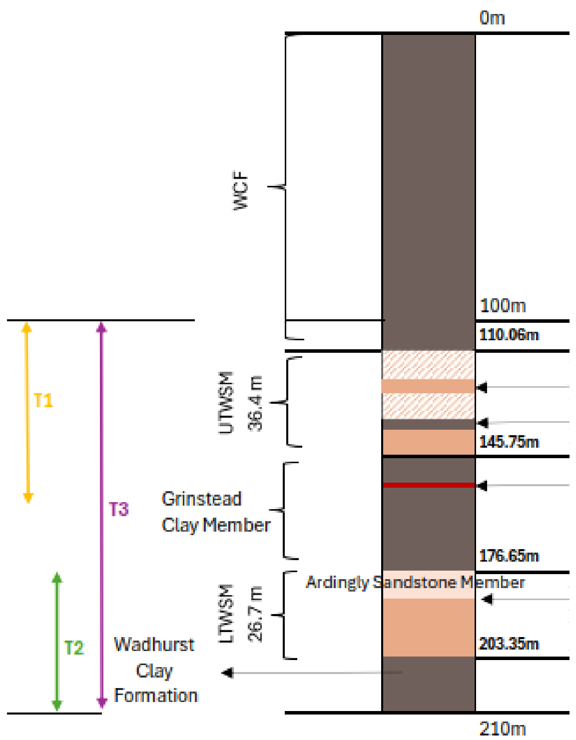
Two drawdown tests and one CRT were completed between the 14th of January 2025 and the 14th of February 2025 at borehole IE3 to observe the drawdown and influence of abstracting groundwater from the aquifer and to collect groundwater samples. A summary of these tests is tabulated below in **Table 5-4** and graphs of drawdown and recovery presented in **Figure 5-4** and **Figure 5-5**.

Table 5-4 – Summary of drawdown and CRT completed at borehole IE3

Test Reference	Start	End	Duration of Pump-ing Test (minutes)	Volume extracted (m^3)	Initial Rest Level (mbgl)	Maximum Drawdown (m)	*Time to Recovery (mins)
IE3 Test 1	14/01/2025 10:00	14/01/2025 15:11	311	16.8	3.42	22.09	Not recorded
IE3 Test 2	24/01/2025 10:00	24/01/2025 15:00	300	16.2	1.22	33.46	213 (89% recovery)
IE3 Test 3	13/02/2025 14:00	14/02/2025 10:00	1,200	5.76 – 7.2	7.95	2.46	N/A

Note: The rate of abstraction for Tests 1 and 2 was at 0.9 l/s; whilst Test 3 was at a rate of 0.08 – 0.10 l/s.

__**Drawdown Test Response zones**__



Drawdown Tests

Figure 5-4 – Borehole IE3 Drawdown Tests

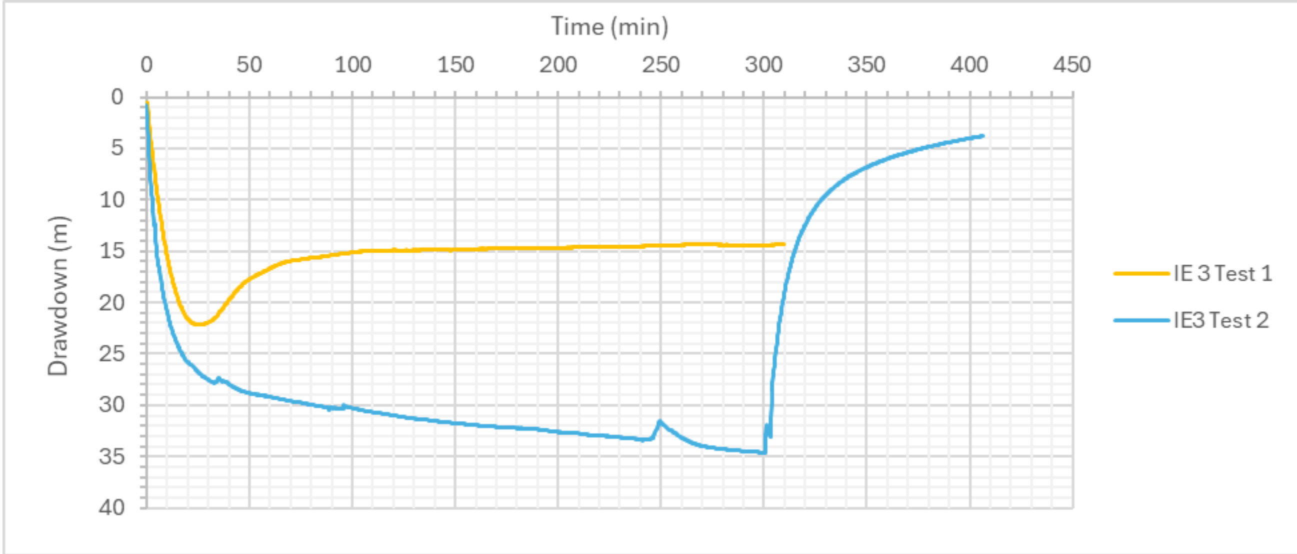
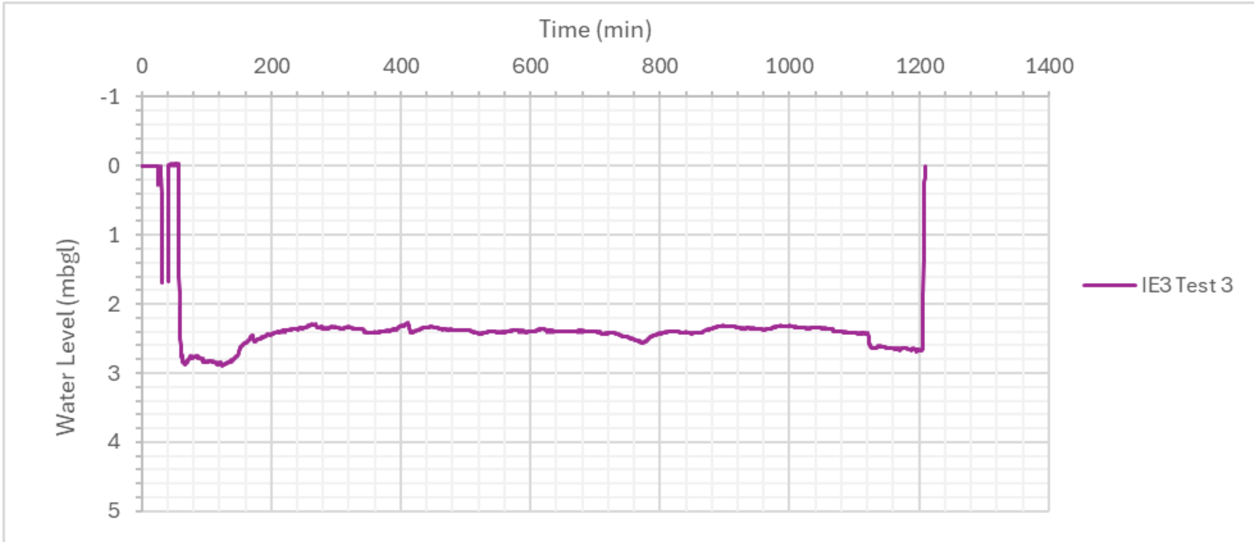


Figure 5-5 – Borehole IE3 Constant Rate Test and Recovery (IE3 Test 3)



A description and brief interpretation of drawdown (**Figure 5-4**), CRT and recovery (**Figure 5-4**) test results are provided below:

Borehole IE3 Test 1 – UTWSM and the top of the GCM

A drawdown test was completed within the UTWSM and the top of the GCM, with the Geobore open across the aquifer between 110 and 151 mbgl. The initial rest water level was 3.42 mbgl and the drawdown in groundwater level during the test displayed a steep decline in groundwater level dropping to a minimum of 24.51 m (22.09 m drawdown) after 30 minutes. Following the minimum recorded groundwater level, a recovery of levels occurred, and groundwater levels continued to rise gradually until the end of the test whilst still pumping, rebounding by approximately 4.14 m to 14.36 mbgl of total drawdown. No significant change in pumping rate was recorded during this period. A recovery test was not undertaken for this test.

Borehole IE3 Test 2 – LTWSM and the top of the Wadhurst Clay Formation

A drawdown test was completed for the LTWSM and the top of the Wadhurst Clay Formation (176-210 mbgl). The borehole was initially very slightly artesian[19] and pumping induced a steeper drawdown than Test 1 with groundwater levels in the borehole falling by nearly a metre a minute for the first 30 minutes. The rate of drawdown steadily became shallower succeeding this initial period. However, water levels in the borehole did not stabilise for the duration of the test and a maximum drawdown of over 34.61 m was recorded. Short duration spikes in drawdown observed in **Figure 5-4** were attributed to the pump generator failing, however these were quickly remedied and its impact on the overall general trend of the data is limited. It is important to note that even after 5 hours of pumping the drawdown was still increasing by approximately 1 m over the last hour.

Following the cessation of abstraction during the borehole IE3 Test 2 a period of recovery was recorded. The recovery data is shown below in **Figure 5-5**. The borehole recovered to 3.78 mbgl after 213 minutes (almost 90% of pre-test water level).

Observation Borehole IE3 Test 3 – CRT on the UTWSM and upper section of the LTWSM

A CRT was undertaken on the observation borehole IE3 Test 3 which has screened sections targeting the aquifer units of the UTWSM (111.11 - 146.63 mbgl) and upper section of the LTWSM (177.28 - 192.80 mbgl). Prior to the test on the 13th February 2025 the borehole was artesian with a measured flow from the top of the borehole of approximately 0.04 l/s (3.46 m^3/d).

Due to the small diameter of the observation borehole installation, a smaller low flow pump was selected for an extended CRT. Pumping at a discharge rate of only 0.08 – 0.10 l/s (up to 8.6 m^3/day) induced an initial sharp drop in water level, but drawdown throughout the remainder of the test ranged from between 2.87 to 2.40 m. The nonlinear variations in water level can be attributed to inconsistent pump rates and although the drawdown data collected during the test could not be used to establish any meaningful hydrogeological parameters, a sample for a *full* suite analysis was collected at the end of the 20 hours of pumping during the test. On completion of pumping, water levels recovered back to artesian within 10 minutes from a low of 2.70 mbgl.

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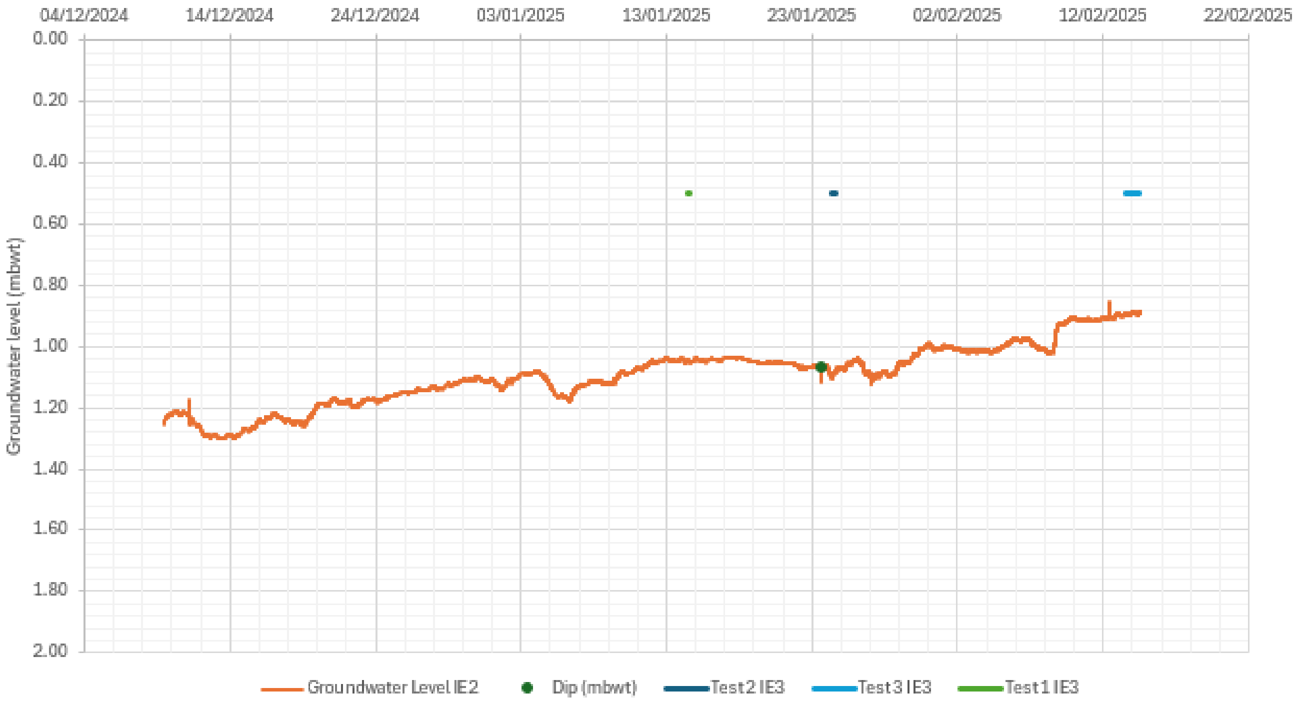
[19] The artesian flow was measured at one cup per minute at the top of the Geobore pipe with a 1.2 m stickup on the 24/01/2025.

Interaction with Borehole IE2 during Borehole IE3 testing

Monitored groundwater level at borehole IE2 did not record a change in level in response to pumping tests at borehole IE3 (**Figure 5-6**). Groundwater levels within borehole IE2 displayed a slow rise of 0.36 m between 9th December 2024 and 14th February 2025. The pump rates employed (0.08 – 1 l/s) and likely duration of the tests at borehole IE3 were therefore insufficient to induce a drawdown or influence on borehole IE2. It is uncertain whether the small rise in groundwater level was due to long term fluctuations in seasonal levels or whether there was another influence, such as the gradual collapse of the hole.

Figure 5-6 – Borehole IE2 monitoring during testing at Borehole IE3



5.3.4 SUMMARY

The drawdown tests designed to focus on the two potential aquifers, the UTWSM (Test 1) and the LTWSM (Test 2), reveal markedly different potential sustainable yields between the two formations. Although the drawdown test on the UTWSM and the top of the GCM (Test 1) was significant (over 20 meters) considering the low pumping rate, groundwater levels did rebound and stabilised, indeed continue to rise until the end of the test (ending in a 14.5 m total drawdown).

Prior to Test 2 on the LTWSM aquifer and the top of the Wadhurst Clay Formation, artesian conditions from the top of the borehole were recorded at approximately 0.04 l/s (3.46 m^3/d). However, the promising artesian flow from this aquifer unit did not translate into sustainable groundwater yields during the drawdown and recovery test. The test recorded the highest drawdown seen during the investigation (34.60 m) and water levels during the 300-minute test did not stabilise, continuing to decline for the duration of the test. Recovery at the end of Test 2 was also slow (213 minutes to recover 89%).

Unfortunately, due to the final small diameter of the installed observation, the small size of the pump utilised for the CRT (Test 3) on the UTWSM and upper section of the LTWSM and low abstraction rate the results were not usable to determine any sensible aquifer properties. The main value of the test was in the long period of purging of the observation borehole prior to obtaining final representative groundwater samples from the aquifers for extensive water quality analysis.

A comparison of drawdown tests conducted at equivalent abstraction rates on equivalent geological horizons, i.e. the UTWSM, between boreholes IE2 and IE3, suggests that the drawdowns within borehole IE2 were less than within borehole IE3. This may be a function of the length of the drawdown test undertaken (i.e., longer at borehole IE3) or it may suggest that borehole IE3 exhibits lower potential yield.

6 WATER QUALITY ANALYSIS

This section outlines water quality results from the 2024/ 2025 drilling and testing programme including water quality field parameter results. Water quality results have been compared to Drinking Water Standards (EC Drinking Water Directive 98/83/EC) and to other reference waters, including the tanker water used on site. A sample of the water which was brought onto site by tanker and used during drilling and to flush the borehole was also collected from the storage browser and analysed. The laboratory analysis results are summarised within tables in **Appendix H** and full laboratory analysis (laboratory test certificates) reports are given within **Appendix I**.

6.1 INTRODUCTION

Water samples were collected at the end of drawdown tests, undertaken during drilling and on the installed observation borehole IE3. During tests field water quality parameters and groundwater samples were measured from water collected at the end of the discharge pipe. During short tests because of the lack of develop time the groundwater samples were found to be very turbid and the filtering of samples for dissolved metal analysis was usually impossible on site.

It should be noted that during initial tests clean water was used to flush and purge the borehole prior to testing after the mud was removed. However, after the first couple of tests due to time constraints it was decided to just flush the borehole with little purging. For the later tests the purge of the borehole was essentially the period of abstraction during the test. Particular attention should be paid to the test length period given within **Table 6.1,** since this gives an idea of how long the borehole was pumped to clean up the water within the borehole and these should be considered when looking at the water quality analysis data.

Given the diameter of the Geobore and volume of the open hole it is estimated that a 200 meter deep borehole would take approximately 100 minutes to purge. This was generally the observation in the field in which the tests with only 60 minutes resulted in turbid water samples which could not be filtered.

The determinands tested for in each water quality analysis suite can be seen in **Table 2.1**. The water quality sample dates taken, depths taken from and water quality testing suites applied can be seen in **Table 6.1**.

Table 6.1 – Testing details and water quality analysis suites

Borehole ID	Date	Target test depth (mbgl)	Test length before sample taken (minutes)	Target aquifer	Suite
IE2	19th November 2024	75 - 100	60	Base of WCF	*Basic*
	23rd November 2024	100 - 125	60	Top of UTWSF	*Extended*
	27th November 2024	125 - 150	60	Bottom of UTWSF and GCM	*Basic*
	5th December 2024	100 – 202 (final depth)	300	Full section (UTWSF, GCM and LTWSF)	*Extended*
IE3	14th January 2025	110 – 155	300	UTWSF	*Extended*
	24th January 2025	176 - 210 (final depth)	300	LTWSF	*Extended*
	13th February 2024	100 – 210** (observation borehole installed)	Borehole flowed undisturbed overnight >12 hours	*Artesian flow sample taken from wellhead (representing bottom aquifer)*	*Extended*
	14th February 2024	100 – 210** (observation borehole installed and final test undertaken)	920	UTWSF and LTWSF	*Full*
Tank water	5th December 2024	n/a		n/a	*Basic*

**The final pumping test in IE3 began on 13th February 2025. However, the pump cut out after ~2 hours. The pump was replaced, and the test was started again in the afternoon of the 13th February 2025 and continued overnight. The final sample was taken on 14th February 2025.

6.2 WATER QUALITY RESULTS

6.2.1 LABORATORY PARAMETERS

Water quality samples were taken at the end of drawdown tests, undertaken during drilling and at the borehole final depth (**Table 6.1**). These were tested for either a *Basic* or *Extended* water quality suite (**Table 2.1**). Prior to the final extended CRT, undertaken on the installed observation borehole IE3, an artesian water was collected for an *Extended* suite analysis and groundwater was collected at the end of the test for a *Full* water quality suite (i.e. a full drinking water quality suite including pesticides/ herbicides, radioactivity and microbial species, etc.).

The analysis data results for samples taken during the 2024/25 drilling programme can be seen within **Appendix H**[20]. The water quality results are compared to Drinking Water Standards (DWS) and concentrations recorded above the DWS can be seen in **Table 6-2** and **Table 6-3** for IE2 and IE3 respectively. The results are discussed in detail below.

A water sample from a storage water browser brought onto site and used during the flushing of the borehole was collected on the 5th December 2024 and tested for the *Basic* suite analysis. This should be reflective of the starting field water quality within the borehole at commencement of tests if pre-development of the borehole had not been undertaken.

This analysis was compared to water quality samples from boreholes IE2 and IE3 to determine whether this may have had an impact on DWS exceedances or elevated concentrations of parameters observed within these samples. No DWS exceedances were recorded within the sample from the water tank. Where elevated concentrations of other parameters were recorded in boreholes IE2 or IE3, the corresponding concentrations within the tank water were not recorded as elevated.

It should be noted that, for PAHs, only benzo(a)pyrene has a DWS. Several other PAHs were recorded above the limit of detection (LoD) including: acenaphthene, benzo(a)anthracene benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene. PAH concentrations reached a maximum for naphthalene (0.152 µg/l). Organic compounds for EPH range organics >C10 - C40 at 977 µg/l from borehole IE2 (100 to 125m) and EPH range organics >C10 - C40 and >C21-C28 borehole IE3 (110m- 151m) at 304 µg/l and 149 µg/l respectively.

It is noticeable that most of the detects for organics was from samples taken within borehole IE2 with samples from all test depths showing some organics. In addition, borehole IE3 also gave detects for some organics for the test run at the shallower test depth (110 mbgl to 151 mbgl) but then the water quality appeared to clean up, possibly due to the longer purging times and/ or artesian conditions that flushed the borehole. Only one detect for naphthalene (0.011 µg/l) was identified within samples collected in the later tests. These detects for organics were attributed to remaining drill-head lubricant within the borehole and has been observed during similar drilling projects.

Within the sample taken from the observation borehole IE3 (Test 3 – screened 110.06 mbgl to 203.18 mbgl) for *full* suite analysis Toluene-d8 (99.3 µg/l), Dibromofluoromethane (116 µg/l) and 4-Bromofluorobenzene (96.9 µg/l) where all detected. No other detects for herbicides and pesticides were observed within this sample. Gross alpha and gross beta radioactivity analysis results also gave non detects, whilst the isotope radon 222 analysis gave a result of 6.4 Bq/l. The permanganate index is an assessment of water quality typically used for drinking waters and gave a result of 2.24 mg/l, below the DWS of 5 mg/l O_2 limit.

[20] All *Basic* and *Extended* water quality suite results are shown with the appropriate *Full* water quality suite determineds. Other results from the *Full* water quality suite can be seen within **Appendix I**.

Table 6-2 – Borehole IE2 water quality parameters recorded above the DWS

Parameter group	Parameter (µg/l)	DWS (µg/l)	Test 1 (75 – 100 mbgl)	Test 2 (100 – 125 mbgl)	Test 3 (125 – 150 mbgl)	Test 4 (100 – 202 mbgl)
Metals (dissolved, filtered)	Aluminium	200	N/A	854	N/A	3650
	Antimony	5	N/A	9.93	N/A	5.31
	Iron (total, unfiltered)	200	N/A	182000	N/A	84000
	Iron	200	14800	488	7570	5710
	Manganese	50	132	17.5	68.7	54.3
	Sodium (dissolved)	200000	286000	245000	298000	288000
Metalloid	Arsenic	10	21.3	19	14.9	11.9
Inorganics	Fluoride	1500	2590	2620	3730	4140
	Nitrite as NO_2	500	986	999	999	516
PAH	Benzo(a)pyrene	0.01	N/A	0.0542	N/A	<0.01

N/A indicates that the analysis was not run because of the type of analysis suite applied to the sample, i.e. a *Basic* suite may not have had certain analysis run.

Table 6-3 – Borehole IE3 water quality parameters recorded above the DWS

Parameter group	Parameter	DWS (µg/l)	Test 1 (110 – 151 mbgl)	Test 2 (176 – 203 mbgl)	Test 3 (Artesian)	Test 4 (110 – 203 mbgl)
Metals (dissolved, filtered)	Aluminium	200	1320	29.7	11.7	<10
	Boron	1000	585	1710	1790	1670
	Iron	200	645	57.2	29.9	<19
	Iron (total unfiltered)	200	55500	1270	2800	N/A
	Sodium (dissolved)	200000	359000	276000	271000	254000
Inorganics	Fluoride	1500	3220	5960	6490	6470

Compound	Ionised ammonia/ ammonium as nitrogen[21]	500	657	414	716	577

*Results not returned by laboratory

6.2.2 SUMMARY

Attention is drawn to the following parameters in the analysis of samples from borehole IE2:

- pH and electrical conductivity were relatively stable across all samples taken at an average of 8.72 and 1.24 mS/cm respectively;
- Turbidity was high with an average of 2153 NTU within the samples taken from the first three tests. This was confirmed by the visual observation of the samples taken in the field at this time. The last test (Test 4 – 100 to 202 mbgl) had a longer borehole development time and gave a reduced turbidity of 694 NTU;
- Elevated dissolved sodium was observed within all samples, averaging 279 mg/l and above the DWS standard of 200 mg/l;
- Chlorides were observed within all samples with an average of 87.4 mg/l, well below the DWS guideline at 250 mg/l. The maximum was observed within the sample taken from the WCF (Test 1 – 75 to 100 mbgl) at 107 mg/l and the lowest from the UTWSM (Test 2 – 100 to 125 mbgl) at 72 mg/l;
- Elevated dissolved metals (Fe and Mn) within most samples were observed often above DWS guideline 0.2 and 0.050 mg/l for Fe and Mn respectively. For example, the dissolved iron concentration for the sample taken from the UTWSM (Test 2 – 100 to 125 mbgl) was 182 mg/l;
- Elevated aluminium within samples from the UTWSM (Test 2 – 100 to 125 mbgl) and the full section (Test 4 – 100 to 202 mbgl) at 0.85 mg/l and 3.65 mg/l respectively, above the DWS guideline of 0.2 mg/l;
- High alkalinity was seen within all samples with the highest occurring in the sample taken from the WCF (Test 1 – 75 to 100 mbgl) at 599 mg/l as CaCO3 and the lowest from the UTWSM (Test 2 – 100 to 125 mbgl) at 510 mg/l as $CaCO_3$ (no DWS guideline);
- Low levels of dissolved Ca (maximum of 11.8 mg/l) within the borehole sample analysis when compared to the imported tanker water (114 mg/l);
- All samples had a level of fluoride higher than the DWS guideline of 1.5 mg/l, with an average of 3.27 mg/l, and the highest within the full section (Test 4 – 100 to 202 mbgl) where the concentration was at 4.14 mg/l;
- Elevated sulphate with an average of 83.2 mg/l for all samples, but well below the DWS guideline of 250 mg/l;
- Elevated arsenic was observed within all samples at a maximum of 21.3 µg/l within the sample taken from the WCF (Test 1 – 75 to 100 mbgl). Although the sample taken on the full section (Test 4 – 100 to 202 mbgl) the concentration was reduced at 11.9 µg/l, all samples taken from the borehole were above the DWS guideline of 10 µg/l;

[21] Ionised ammonia (NH_4^+) and unionized ammonia (NH_3) are both forms of ammonia nitrogen. When measuring ammonia in water, the total ammonia is the sum of both NH_3 and NH_4^+. The term "N ammonia" typically refers to the nitrogen component of ammonia, which can be present in either form. The balance between NH_3 and NH_4^+ depends on factors like pH and temperature. Higher pH levels favour the formation of the more toxic unionised ammonia (NH_3), while lower pH levels favour the ionised form (NH_4^+).

- Barium displayed elevated concentration within the sample taken from the WCF (Test 1 – 75 to 100 mbgl) at 219 µg/l. Also, antimony displayed elevated concentration within the sample taken from the UTWSM (Test 2 – 100 to 125 mbgl) at 9.93 µg/l above the DWS guideline at 5 µg/l. The concentrations of boron were all under the DWS guideline of 1000 µg/l;
- Ionised ammonia/ ammonium as N (ammonia) displayed elevated concentrations above the DWS guideline at 500 µg/l. The highest concentration was within the sample taken from the UTWSM (Test 2 – 100 to 125 mbgl) at 946 µg/l. In addition, nitrite displayed elevated concentrations with all sample concentrations being above the DWS guideline at 500 µg/l with an average of 875 µg/l.

In the analysis of samples from borehole IE3 the following observations are noted:

- pH and electrical conductivity were relatively stable across all samples taken at an average of 8.77 and 1.2 mS/cm respectively;
- Turbidity was relatively high within the sample taken from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl) at 1090 NTU and this was confirmed by the visual observation of the samples taken in the field at this time. However, the sample taken from the LTWSM and the top of the Wadhurst Clay Formation (Test 2 - 177 to 203 mbgl), and the samples taken from the observation borehole, which had a longer borehole development time, gave much reduced turbidity averaging 36.7 NTU;
- Elevated dissolved sodium were observed within all samples, within the sample taken from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl) having the greatest concentration of 359 mg/l and above the DWS standard of 200 mg/l. Other samples taken from the exploration borehole and the observation borehole had lower concentrations at an average of 267 mg/l but still above the DWS;
- Chloride was observed within the sample taken from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl) having the greatest concentration of 215 mg/l, although this is below the DWS guideline at 250 mg/l. Other samples taken from the exploration borehole and the observation borehole had lower concentrations at an average of 23.4 mg/l;
- Elevated total and dissolved Fe concentrations were observed above the DWS guideline 0.2 mg/l at a maximum of 55.5 mg/l for total Fe analysis within the sample taken from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl). The dissolved Fe concentration for this sample was much reduced at 0.65 mg/l and other breaches within the samples were not repeated between total and dissolved analysis indicating that this is a result of the drilling process and entrained solids within the sample. For example, the sample taken during Test 3 on the observation borehole, after a period of purging of the borehole, resulted in a below detection limit result for the analysis of dissolved Fe;
- Elevated aluminium within samples from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl) at 1.32 mg/l, above the DWS guideline of 0.2 mg/l. However, all other samples were below the DWS guideline concentration including those for Test 3 on the observation borehole taken after a period of borehole purging;
- High alkalinity was seen within all samples with the highest observed in the sample taken from the artesian flow from the IE3 observation borehole at 621 mg/l as $CaCO_3$ and the lowest from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl) at 490 mg/l as $CaCO_3$ (alkalinity has no DWS guideline);
- Low levels of dissolved Ca (maximum of 3.4 mg/l) within the borehole sample analysis when compared to the imported tanker water (114 mg/l);

- All samples had a level of fluoride higher than the DWS guideline of 1.5 mg/l, with concentrations appearing to increase with depth. The sample taken from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl) having the lowest concentration of 3.2 mg/l, whilst samples taken from the LTWSM and the top of the Wadhurst Clay Formation (Test 2 - 177 to 203 mbgl) and during the observation borehole testing displayed higher concentrations with an average of 6.3 mg/l;
- Elevated boron with the samples taken from the LTWSM and the top of the Wadhurst Clay Formation (Test 2 - 177 to 203 mbgl) and during the observation borehole testing, displaying an average of 1.7 mg/l for all samples, above the DWS guideline of 1 mg/l;
- Elevated sulphate within sample taken from the UTWSM and the top of the GCM (Test 1 - 110 to 151 mbgl) having a concentration of 104 mg/l, but below the DWS guideline of 250 mg/l;
- All arsenic concentrations within samples, with an average of 2.9 µg/l were below the DWS guideline of 10 µg/l. Barium and antimony concentrations were below their respective DWS guideline at and lower than the concentrations seen within samples taken from borehole IE2;
- Ammonia displayed elevated concentrations above the DWS guideline at 500 µg/l within three samples. The highest concentration was within the sample taken from the artesian flow from the IE3 observation borehole at 716 µg/l. In contrast, nitrite concentrations with all sample concentrations were below the detection limit of <50 µg/l.

6.2.3 TESTING FIELD WATER QUALITY PARAMETERS

Time series of field water quality parameters measured at the discharge point during the testing of boreholes IE2 and IE3 are presented in **Figure 6.1** and **Figure 6.2**. The test depths and times can be seen in **Table 6.1** and **Figure 2-3** and **Figure 2-6**.

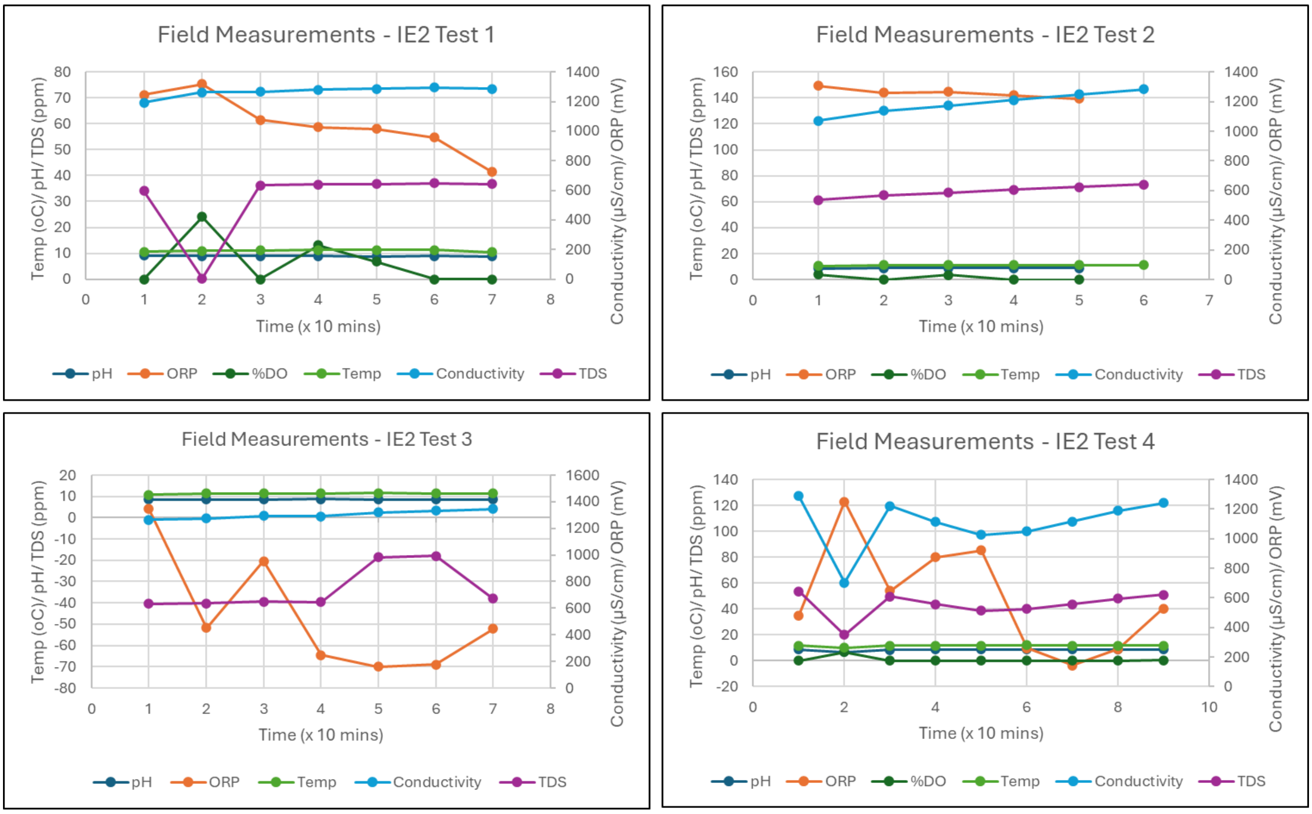
It should be noted that drawdown tests on borehole IE2 were relatively short, with Tests 1 to 3 lasting for only one hour whilst Test 4 lasted for 5 hours. This has impacted field water quality parameter results because stabilisation was only achieved within the last test which was given a long enough time to purge a single well bore volume of water and to significantly reflect aquifer groundwater quality characteristics. The purge water from the bowsered tanker water gave water quality parameters values of the following: pH of 6.8 to 7.13; ORP of 240.4 mV; DO of 85.5 to 77.2 %; conductivity of 786 µS/cm; temperature of 9.17 ºC and TDS of 391 ppm. The reader should also be reminded that the Test 3 on the observation borehole IE3 was pumped at a very slow rate of 0.1 l/s which may be reflected within the field water quality observations.

For the borehole IE2 tests the temperature and pH values were generally stable during testing. pH readings were averaged at approximately 8.8 and temperature was varied between 10.03 and 11.93°C during the tests. Dissolved oxygen fluctuated slightly during the first ten to twenty minutes, then stabilised to zero. During tests within the WCF (Test 1 – 75 to 100 mbgl) at the upper UTWSM (Test 2 – 100 to 125 mbgl) ORP dropped by around 30 and 20 mV respectively.

For longer run tests on the lower UTWSM (Test 3 - 125-150 mbgl) and the full section (Test 4 – 100 to 202 mbgl) the ORP fluctuated during the first 40 minutes of testing before decreasing and then increasing at the end of the test after approximately 60 minutes. This could reflect the purge of a well bore volume, encountering more reducing water at the base of the well before beginning to draw in less reducing groundwater from the aquifer at the end of the test.

Electrical conductivity increased slightly during Tests 1, 2, and 3, from approximately 1100 to just below 1300 µS/cm. During the longer full section test (Test 4 – 100 to 202 mbgl) the electrical conductivity fluctuated at the beginning of the test, before rising to 1241 µS/cm which is consistent with the previous tests. TDS were relatively stable during the drawdown testing with concentrations generally around 600 ppm for all tests. During the longer full section test (Test 4 – 100 to 202 mbgl) the TDS rose from 513 ppm after 50 minutes to 621 ppm after 90 minutes at the end of the test.

Figure 6.1 - Water temperature, ORP, electrical conductivity, pH, TDS and DO concentrations measured at the well head during pumping tests at borehole IE2



The time series of water quality data measured at the borehole IE3 were for a longer test period than at borehole IE2, that is Test 1 covering the UTWSM and the top of the GCM (110 - 151 mbgl) and Test 2 covering the LTWSM and the top of the Wadhurst Clay Formation (177 - 203 mbgl) were for 5 hours and the final Test 3[22] duration was over 15 hours. This provided more time for field water quality parameters to stabilise than was the case for borehole IE2 tests. It should be noted that Test 3 was also conducted on the installed observation borehole that pumped groundwater from the screened aquifers within the borehole.

During borehole IE3 tests the pH readings were averaged at approximately 8.5 but rose during the tests from 7.36 (Test 1) at the start of the tests to over 9 during later time of the tests. Temperature was generally stable during all test periods. DO generally decreased during the tests, for example during Tests 1 and 2 it decreased from 2.81% to 1.78% and from 20.3% to 16% respectively.

During Tests 1 and 2 the parameters of ORP, electrical conductivity and TDS displayed a period of change before stabilisation as the borehole was purged and formation groundwater was drawn into the borehole. During Test 1 on the UTWSM and the top of the GCM (110 - 151 mbgl) both electrical

[22] It should be noted that during Test 3 the pump cut out after 30 minutes and had to be replaced. The final test 3 ran through the night and therefore water quality parameters were not measured during this period.

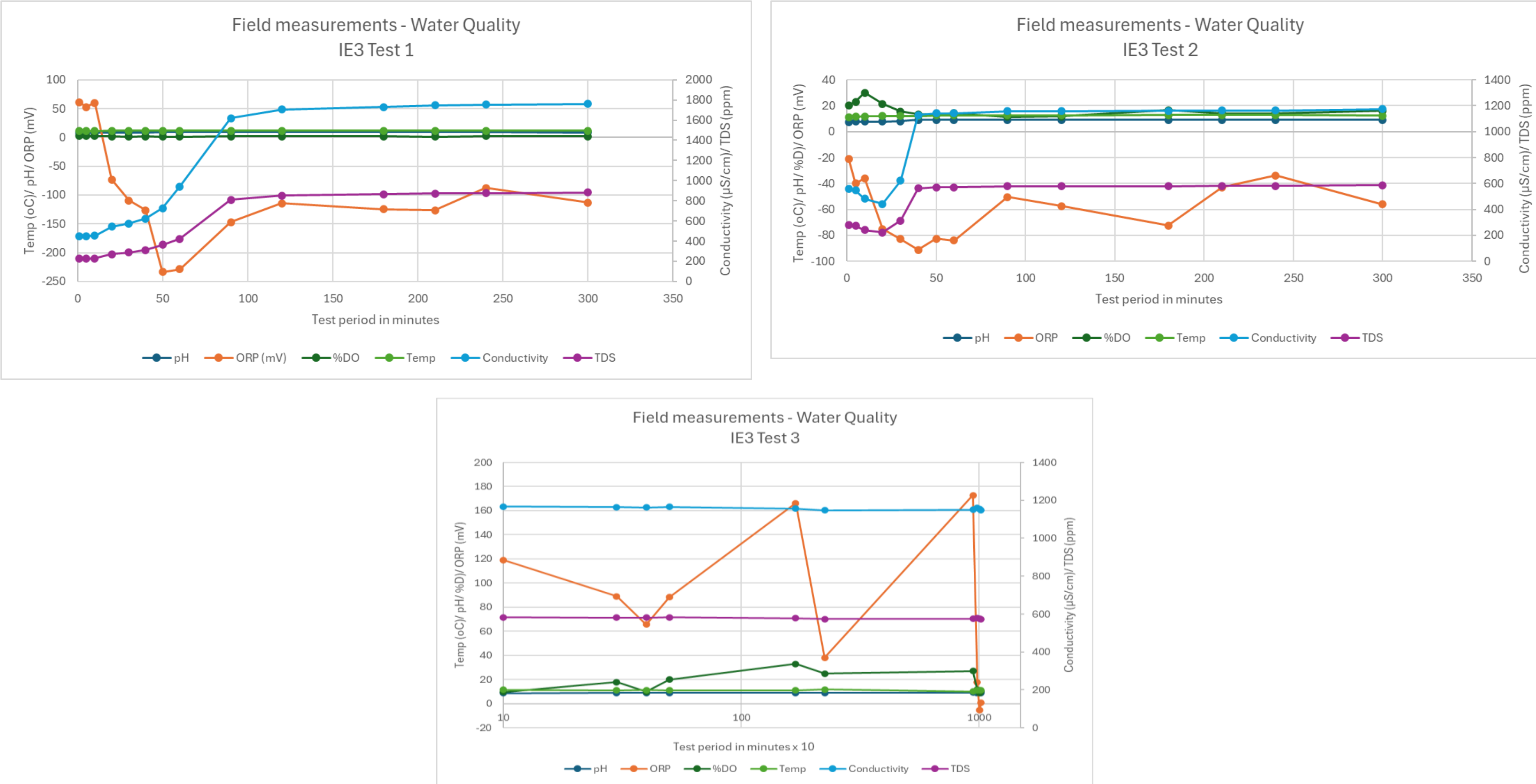
conductivity and TDS show significant increases before stabilising after 100 minutes of pumping at 1761 µS/cm and 881 ppm respectively. Similarly, during Test 2 on the LTWSM and the top of the Wadhurst Clay Formation (177 - 203 mbgl), both electrical conductivity and TDS show significant increases before stabilising after only 40 minutes of pumping at 1173 µS/cm and 586 ppm respectively.

ORP displayed a more complex pattern of change in response to purging of the borehole and stabilisation. During Test 1 and 2 ORP first displayed a drop to -233.6 mV after 50 minutes of pumping and -91.3 mV after 40 minutes of pumping respectively, before rising again and stabilising. Stabilisation was at around 120 mV after 120 minutes during Test 1 and at approximately -52 mV after 90 minutes of pumping during Test 2.

During Test 3 it is noticeable that generally field water quality parameters were much more stable than during previous tests. For example, pH averaged around 9; electrical conductivity ranged from 1148 to 1167 µS/cm and TDS averaged around 579. This may be due to the period of purging of the borehole and periods of pre-testing pumping that occurred before the Test 3 as well as the very low flow rates deployed.

During Test 3 greater fluctuations in DO were observed with initial higher readings (30%) dropping to 8.7% later on in the test. In addition, during Test 3 the ORP displayed an apparent decreasing trend from 187 mV at the test start to close to zero by the end of the test, but again with some wide fluctuations to 166.2 mV and 172.7 mV after 170 minutes and 945 minutes of the test, the reasons of which are uncertain.

Figure 6.2 - Water temperature, ORP, electrical conductivity, pH, TDS and DO concentrations measured at the well head during pumping tests at borehole IE3



6.2.4 COMPARISON WITH LOCAL OTHER WATER QUALITY

The sample analysis taken from the observation borehole IE3 (Test 3 – screened 110.06 mbgl to 203.18 mbgl) for *full* suite analysis is considered the most representative and comprehensive analysis for the groundwater within the two aquifers, the UTWSM and the LTWSM. A brief comparison of some of the key determinands (**Table 6-4**) has been undertaken against the groundwater quality results from the local Newstead Farm and Eskimo Ice boreholes as described within (WSP, 2024b) [23].

Table 6-4 – Ifield observation borehole IE3 groundwater quality comparison with local boreholes

Parameter group	Parameter	DWS (µg/l)	Ifield Borehole (µg/l)	Eskimo Ice (µg/l)	Newstead Farm (µg/l)
Major Ions	Chloride	250000	23200	23540	18255
	Sodium (dissolved)	200000	254000	186000	247850
	Alkalinity, Total as $CaCO_3$	N/A	593000	361200	474100
Inorganics	Fluoride	150	6470	7500	1928.5
	Boron	N/A	1670	N/A	1082

The following observations are made:

- The alkalinity is higher within the Ifield observation borehole IE3 sample at a concentration of 593 mg/l compared to the Eskimo Ice and Newstead Farm boreholes, 361mg/l and 471 mg/l respectively;
- Boron is higher within the Ifield observation borehole IE3 (1.67 mg/l) when compared to the Newstead Farm borehole (1.08 mg/l);
- Fluoride concentration is comparable between the Ifield observation borehole (6.47 mg/l) and the Eskimo Ice borehole (7.50 mg/l), both results being much greater than that recorded within the Newstead Farm borehole (1.93 mg/l);
- Sodium concentration is comparable between the Ifield observation borehole (2.54 mg/l) and the Newstead Farm borehole (2.48 mg/l), both results being greater than that recorded within the Eskimo Ice borehole (1.86 mg/l); and

[23] WSP April 2024 Homes England: West of Ifield Development Groundwater Initial Feasibility and Hydrogeological Risk Assessment Ref: WSP-WATER-REPORT-INT-0002

- Chloride concentration is comparable between the Ifield observation borehole (23.2 mg/l) and the Eskimo Ice borehole (23.5 mg/l), both results being greater than that recorded within the Newstead Farm borehole (18.3 mg/l).

6.2.5 WATER QUALITY INTERPRETATIONS

Water quality data from recently drilled exploration, small diameter boreholes or observation boreholes should be treated with caution because the conditions of abstraction are not as well controlled from those of installed and tested production boreholes. Even so, some broad interpretations from the data can be inferred, particularly from the final IE3 observation borehole sample taken after an extended pumping period. Overall, the water quality data are broadly comparable to those anticipated from other available local borehole data. There is the suggestion of slight variations in water quality between the UTWSM and the LTWSM for field parameters and water quality data.

The measured field parameters of redox conditions, DO % levels and pH are consistent with confined aquifer conditions and redox measurements suggest a slightly reducing environment. Sodium and alkalinity are higher (254 mg/l and 593 mg/l respectively) than expected from available local water quality data accompanied by a consistently high pH across all samples. Alkalinity may impose noticeable aesthetic (taste, odour, feel) character to the water that affect water wholesomeness and scaling issues.

Fluoride and boron levels are confirmed as being elevated (6.47 mg/l and 1.67 mg/l respectively) above DWS guidelines and broadly in line with expectations. High fluoride is unusual and most groundwaters have low or acceptable concentrations of fluoride (<1.5 mg/l). Chloride levels are at 23.2 mg/l and similar to available local water quality data, particularly the Eskimo Ice borehole which was largely completed within the WCF. A sensitive palate can detect chlorides in drinking water as a distinctly salty taste at concentrations as low as 150 mg/l and the influence of the formations producing this element into the groundwater would have to be considered in any production.

All of the above indicates a relatively static groundwater regime in which the water within the aquifer has had sufficient time to equilibrate with the aquifer rock. There is some evidence that fluoride concentrations within groundwater are increasing with depth, although more data would need to be collected to confirm this.

Any anthropogenic contaminants within the groundwater samples, such as organics and high metal concentrations, such as As, Al, An, Mn and Fe, above DWS guidelines, have been interpreted to be due to the exploration drilling process, poor borehole development and the turbid water samples collected. As such, these are not reflective of the natural groundwater quality. The aquifer water bodies are confined and far from any recharge source and it is not surprising that no anthropogenic contaminant signatures, such as nitrate, herbicides and/ or pesticides were identified. Nitrite concentrations were found to be elevated within the exploration borehole IE2 at an average of 875 µg/l and above the DWS guideline of 500 µg/l and the reason for this is uncertain. This observation was not repeated within the exploration borehole IE3 in which it was not detected within any samples.

In addition, ammonia displayed elevated concentrations above the DWS guideline at 500 µg/l within both exploration borehole samples, with the highest concentration being measured within the sample taken from the artesian flow from the borehole IE3 observation borehole at 716 µg/l. The source of this is uncertain, although deep boreholes may contain high levels of ammonia due to the biological reduction of nitrates. Elevated ammonia over 1500 µg/l can lead to taste and odour problems.

In summary, even after exploration there is still uncertainty regarding the quality of groundwater, although it is broadly in line with expectations prior to the drilling programme. Any future source of water from the aquifer/s is likely to require treatment to reduce the fluoride and boron levels to below the required standard, as well as treatment for elevated sodium and alkalinity. Any final treatment requirements will be based on the results of testing during any future production well drilling programmes.

7 SUMMARY AND RECOMMENDATIONS

This section gives a summary to the observations made during the Homes England West of Ifield 2024/25 exploration drilling programme and gives recommendations in terms future works. However, it should be stressed that the drilling programme to date was an exploration phase based on limited tests and data. Any recommendations are therefore only based upon indicative estimates to potential aquifer yields and groundwater quality. A true understanding of the potential aquifer conditions can only be established after the installation of a well designed production borehole/s and appropriate testing and sampling of the borehole/s.

7.1 SUMMARY OF GENERAL OBSERVATIONS

7.1.1 OBSERVATIONS FROM THE EXPLORATION DRILLING PROGRAMME

The following observations from the exploration drilling programme can be made:

- The exploratory drilling has confirmed the depth of the UTWSM aquifer broadly in line with expectations at between 103 and 110 mbgl for boreholes IE2 and IE3 respectively, slightly shallower than anticipated. In addition, the GCM, the LTWSM and the top of the Wadhurst Clay Formation were also confirmed below the site all within the consented exploratory drilling depth of 210 mbgl. Although the dip of the aquifer strata is very shallow in line with expectations, the strike is suggested to be more along a north to south line as opposed to the northeast to southwest line as indicated by surface geology[24];
- Geological logging and testing of the TWSM aquifer have confirmed that the aquifer is generally an interbedded silt to very fine-grained sandstone of relatively low yield. The UTWSM aquifer is approximately 34 m thick, which is significantly thinner than expected, of which approximately 20 m is described as a sandstone within geological logs. The LTWSM aquifer is approximately 27 m, broadly in line with the anticipated thickness, and although the Ardingly Sandstone Member within the top of the LTWSM is generally a courser grained sandstone, overall only approximately 14 m is described as a sandstone. There is some evidence from geological logs to suggest that the UTWSM is more fractured than the LTWSM although this is difficult to confirm because of the difficulties encountered in obtaining a full geophysical profile across the full length of the exploration boreholes for comparisons to be made;
- Although data for groundwater levels were measured within the two exploration boreholes during exploratory drilling, due to the drilling conditions these are difficult to interpreted. Indications are however, that they are broadly similar across the same strata and that hydraulic gradients are very low leading to a static groundwater body;
- Although the measured groundwater levels/ artesian flows measured within/ from the two aquifers during drilling indicate that they are slightly higher within the LTWSM than within the UTWSM, although this does not appear to be great enough to generate substantial flow between the aquifers. This interpretation is made from the stable temperature gradients established within the boreholes observed during geophysical logging. Areas within the borehole of larger fractures identified during logging also did not record any notable fluctuations in fluid velocity, temperature or electrical conductivity typical of water producing horizons;

[24] The UTWSM was primarily deposited in fluvial (river)/ deltaic environment. This depositional environment reflects a dynamic system influenced by both fluvial processes and periodic changes in sedimentation conditions and as such local variations in dip and strike are to be expected.

- Although the upper boundary of the UTWSM has been identified within the exploration boreholes it is possible that the lower WCF contains water bearing units which may produce additional yield. At the base of the WCF drilling it was noted that water was being lost during drilling, and this could indicate a more permeable layer or fracturing. In addition, the deep and shallow resistivity borehole IE3 log shows a gradual increase in in resistivity within the bottom 20 m of the WCF. That having been said, the EA appear keen to case out the WCF in any borehole completion as consented to date and may not wish to entertain any targeting within the lower part of this formation; and
- The geological core descriptions reflect the interbedded and very fine-grained nature of the sandstone units of the aquifer which incorporate significant silt fractions. The fine-grained nature of the aquifer means that careful consideration to screen slot sized and filter pack specification against various aquifer strata would be required within any future production borehole.

7.1.2 OBSERVATIONS FROM THE DRAWDOWN TESTING PROGRAMME

The following observations from the drawdown testing programme and the analysis of associated data can be made:

- Drawdown tests on borehole IE2 were of short duration and not set across a specific aquifer response zone and accordingly the resultant data should be treated with caution. However, from the drawdown data there is the suggestion that the bottom 25 m of the WCF does display a yield of groundwater and that the lower section of the UTWSM appears to be more productive than the upper section;
- Drawdown tests on borehole IE3 were conducted for longer durations and set across the specific UTWSM and LTWSM aquifer response zones and are therefore considered the best data upon which to base aquifer yield estimates;
- Although the rebound effect in the drawdown curve seen within the tests on the UTWSM is not fully understood, the response and stabilisation of drawdown does indicate a possible recharge source of groundwater and that the aquifer's yield for the tested section is probably greater than the pumped discharge rate, i.e. 0.9 l/s (77.8 m^3/day);
- In contrast the drawdown tests on the LTWSM showed the greatest drawdown which did not stabilise and it appears that, even though this aquifer is slightly artesian, this groundwater resource is not sustainable at the test abstraction rates;
- Although the literature suggests that the LTWSM can supply greater yields than the UTWSM, this is not born out by the drawdown data collected. It is perhaps not unsurprising given that a recharge source for the aquifer at this location is not available given its depth, distant from any outcrop (over 8 km) and which is limited in extent;
- No geophysics information is available for the LTWSM to validate the presence of water producing fractures; though core samples suggest that there are sandstone and limestone units within this aquifer, with fracturing and likely voiding (indicated by core loss) measured throughout. However, given the continuous drawdown measured during drawdown tests it is likely that these fractures are largely local to the immediate vicinity of the borehole and are not connected to larger more productive areas of the aquifer. However, another potential reason could be that the borehole was not sufficiently developed/ purged to open possible groundwater flow pathways (fractures) sufficiently;
- The hydraulic conductivity analysis based on grain size given within **Section 2.3.3.2**. Hydraulic conductivity (k) indicates how easily water can move through the pore spaces in the aquifer

material and is influenced by the size and connectivity of these pores. Although the results shown in **Table 2.7** should be treated with caution using a realistic D10 value around 0.01 mm for the UTWSM aquifer gives a k value of 5.2 m/day. If the UTWSM contained 20 meters of yielding sandstone within a borehole then this may equate to over 100 m^3/day;

- Pumping test data can be analysed using various analysis to calculate hydrogeological parameters, such as transmissivity[25]. However, the tests completed on the exploration boreholes were called drawdown tests because of the limitation of the test's conditions and this method of analysis should be treated with caution. Even so analysis indicates that the sandstone strata across the UTWSM and LTWSM aquifers has a potential yield more than 100 m^3/day; and
- Test recovery data is the best data to indicate hydraulic permeability of the aquifer because it represents the natural state within the aquifer as the borehole fills back up with groundwater. The recovery analyses of data from tests indicate a potential yield in excess of 100 m^3/day across the two aquifers and that the LTWSM aquifer has a lower transmissivity than the UTWSM. After drawdown tests the slow recovery of groundwater levels is reflective of a relatively low yielding aquifer, i.e. 80% recovery for the Test 2 on the LTWSM within borehole IE2 over almost a period of an hour.

7.1.3 OBSERVATIONS FROM WATER QUALITY DATA

The following observations from the water quality field parameters and laboratory analysis data can be made:

- Water quality data is broadly comparable to those anticipated from other available local borehole data, although sodium and alkalinity appear to be slightly higher than expectations;
- Redox measurements and measured field parameters are consistent with confined aquifer conditions and a slightly reducing environment. Ammonia concentrations were found to be elevated above the DWS guideline of 500 µg/l and may be associated with a reducing environment although this needs to be confirmed with further research;
- Fluoride and possibly boron levels are confirmed as being elevated at concentrations above DWS guidelines and broadly in line with expectations;
- No anthropogenic contaminants within the groundwater from the aquifers were identified outside of those that could be attributed to the drilling process.

7.2 POTENTIAL AQUIFER YIELD

A true estimate of yield is extremely difficult to determine from exploratory drilling. However, even given the limitations of the testing undertaken the UTWSM aquifer appears to be capable of supplying 0.9 l/s (77.8 m^3/day) for a drawdown of approximately 20 m within the boreholes tested. If we assume an increase to drawdown by 3 times to 60 mbgl and conservatively estimate that the yield will increase by a third, then the potential yield could be 104 m^3/day.

In addition to this, any future production borehole will have a larger diameter and have the potential to produce more water. However, the increase in yield is not proportional to the increase in diameter. For example, doubling the diameter of a water well's casing might only increase its overall

[25] The transmissivity of an aquifer is the product of hydraulic conductivity and the saturated thickness of the aquifer. A higher transmissivity indicates a greater capacity to transmit water which generally correlates with a higher yield.

yield by about 10%[26]. If any future production borehole diameters were 3 times the diameter of the Ifield exploration boreholes, i.e. approximately 340 mm in diameter, then yield may increase by approximately 20% to 125 m^3/day.

The estimated yield for one production borehole of 125 m^3/day is a conservative value and likely lower estimate, particularly as any production borehole would be 'properly' designed and developed, but this value is generally in line with what may be expected from a secondary aquifer and consistent with expectations (WSP, 2024b) [27] and the literature. Jones et al, 2000 states that *yields are generally less than 400 m^3/d, and often less than 100 m^3/d, although significantly higher yields have been obtained on occasions*.

7.3 GROUNDWATER QUALITY

After testing during the 2024/2025 drilling programme there is more certainty regarding the quality of groundwater within the aquifers below the Homes England's West of Ifield site. There is strong evidence of higher chloride concentrations within WCF and the GCM and other mudstones.

Within the UTWSM aquifer groundwater itself alkalinity appears to be high and may impose a noticeable aesthetic (taste, odour, feel) character to the water that affect water wholesomeness and scaling issues. Any future source of groundwater from the aquifer/s is likely to require treatment to reduce the fluoride levels to below the required standard. Boron levels may be higher within the deeper LTWSM aquifer, but below the DWS guideline value within the UTWSM. Treatment for elevated sodium may also be required as elevated levels may impose noticeable aesthetic (taste, odour, feel) character to the water that affect water wholesomeness and therefore may also require treatment before domestic use. In addition, there is an indication that ammonia concentrations may be elevated over DWS guideline values, leading to taste and odour problems and require treatment.

7.4 RECOMMENDATIONS

After the exploratory 2024/5 programme at the Homes England's West of Ifield site the understanding of the geology and hydrogeology has been advanced and will aid any future exploitation of the groundwater aquifers beneath the Proposed Development site. With the future requirement to supply the yield of 500 m^3/d of groundwater the following is recommended:

- Current data suggests that the best target aquifer beneath the site is the UTWSM. The LTWSM is not recommended based on its depth and the issues associated with borehole stability at depth as well as a poor indication of yield and suspect sustainability;
- The conservative estimated of yield for one production borehole at the site of 125 m^3/day indicates that three to four production boreholes within the UTWSM aquifer across the site will be required to meet requirements of 500 m^3/day. That said, this is likely to be a worst-case scenario and less production boreholes than this may be required;
- The WCF should be cased and grouted to prevent undesirable effects on quality, particularly in terms of higher chloride concentrations, of proposed groundwater abstraction from the target UTWSM;
- Groundwater will require treatment/ blending before domestic use to comply with DWS guidelines, namely for alkalinity, sodium, fluoride and possibly boron and ammonia;

[26] https://www.brownandcoxinc.com/water-well-diameter-why-bigger-isn-t-always-better
[27] WSP April 2024 Homes England: West of Ifield Development Groundwater Initial Feasibility and Hydrogeological Risk Assessment Ref: WSP-WATER-REPORT-INT-0002

- Production boreholes should be appropriately screened across the target aquifer, and possibly accompanied with suitable filter pack, based on PSD analysis to maximise the borehole's development and potential yield whilst minimising turbidity generation;
- The geological rock cores from the exploratory 2024/5 programme at the Homes England's West of Ifield site were provided to the BGS National Geological Repository and are available for study to aid any future drilling programmes;
- The poorly sorted and fine-grained PSD characteristics observed within the target aquifers will make objective screen slot size and filter pack specification challenging, whilst trying to balance optimised yield and minimal turbidity generation objectives for any future production borehole development. Further analysis and research on PSD characteristics of the aquifer will be required. Given the interbedded nature of the aquifer a gauze/ geotextile wrap around the screen (generally a minimum of 0.5 mm screen size commercial available) will likely be required across the finer geology sections of borehole to reduce turbidity issues;
- Following any future production borehole/s installation a programme of testing should be undertaken to determine the likely long term sustainable yield from the borehole/s. This will be a conditional requirement relating to any abstraction licensing for production borehole development and operation; and
- Given the number of production boreholes likely to be required across the site careful management of the aquifer resource and its sustainability in the long term would be required after appropriate siting and testing of production boreholes. That said, if a wellfield is to be developed, given the nature of the yield and hydraulic conductivity of the aquifer, a narrow cone of depression may be expected, and as such it may be that significant spacing between each production borehole would not be necessary. If so, this will lower the cost of interconnecting pipelines to any future treatment plant.

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Appendix A

DRILLER'S CONTRACT

Appendix B

DRILLERS DAILY LOG SHEETS

Appendix C

DETAILED GEOLOGICAL LOGS FOR EXPLORATION BOREHOLES

Appendix D

CORE PHOTOGRAPHS

Appendix E

PARTICLE SIZE DISTRIBUTION TEST RESULTS

Appendix F

EXPLORATION BOREHOLE GEOPHYSICAL LOGGING REPORTS

Appendix G

DRAWDOWN TEST DATA AND PUMP SPECIFICATION/ CURVE

Appendix H

DETAILED WATER QUALITY DATA SUMMARY

	Lab sample ID	241121-54	241126-51	241129-48	241207-48	250115-54	250125-35	250215-63	250215-64			241207-48	
	Date collected	19/11/2024	23/11/2024	27/11/2024	05/12/2024	14/01/2025	24/01/2025	13/02/2025	14/02/2025			05/12/2024	
	Activity at time of sample collection	Exploratory Borehole IE2 Test 1 (75-100 mbgl)	Exploratory Borehole IE2 Test 2 (100-125 mbgl)	Exploratory Borehole IE2 Test 3 (125-150 mbgl)	Exploratory Borehole IE2 Test 4 (100-202 mbgl)	Exploratory Borehole IE3 Test 1 (110-151 mbgl)	Exploratory Borehole IE3 LTWS 176- 203m	Observation Borehole IE3 (Artesian)	Observation Borehole IE3 110-203m	Eskimo Ice borehole	Newstead Farm	Ifield tank water	EC Drinking Water Directive 98/83/EC
Parameter	Unit												
Temperature	°C									14.36	14.63		
pH	pH units	8.71	8.7	8.73	8.74	8.64	8.81	8.83	8.81	8.91	9.0575	7.75	6.5 - 9.5
Electrical conductivity	µS/cm	1240	1200	1250	1250	1610	1050	1070	1050	817	1008.95		2500
ORP	mV	77	103	142	121	105	112	110	113				
Acenaphthene (aq)	µg/l		0.0277		0.222	<0.005	<0.005	<0.005	<0.005				
Acenaphthylene (aq)	µg/l		<0.025		<0.025	<0.005	<0.005	<0.005	<8				
Alkalinity, Bicarbonate as CaCO3	µg/l	567000	492000	534000	530000	469000	556000	556000	551000			237000	
Alkalinity, Carbonate as CaCO3	µg/l	32500	17900	32000	33000	23500	43000	65600	42200			<3000	
Alkalinity, Total as $CaCO_3$	µg/l	599000	510000	566000	563000	492000	599000	621000	593000	361200	474100	237000	-
Aluminium (diss.filt)	µg/l		854		3650	1320	29.7	11.7	<10	27.38	16.2		200
Anthracene (aq)	µg/l		<0.025		<0.025	<0.005	<0.005	<0.005	<0.005				
Antimony (diss.filt)	µg/l		9.93		5.31	1.44	<1	<1	<1		<1		5
Apparent Colour	mg/l Pt/Co		6730		3560	3390	143	316	107				
Arsenic (diss.filt)	µg/l	21.3	19	14.9	11.9	4.11	0.631	4.17	2.88		<1	0.556	10
Barium (diss.filt)	µg/l	219	37	103	86.4	40.7	20.9	26.9	28.6		19.08	34.7	
Benzene	µg/l		<1		<1	<1	<1	<1	<1		<0.1		1
Bromide	µg/l		216		266	813	97	65	74		56.755		-
Chromium, Hexavalent	µg/l		<30		<30	<30	<30	<30	<30				
Chromium, Trivalent	µg/l		<30		<30	<30	<30	<30	<30				
Cyanide, Total	µg/l		<50		<50	<50	<50	<50	<50		2.75		50
Carbon dioxide, dissolved	µg/l		4310		3850	3950	3990	3570	3760				-
EPH Band >C10-C12 (aq)	µg/l		<500		<500	<100	<100	<100	<100				
EPH Band >C12-C16 (aq)	µg/l		<500		<500	<100	<100	<100	<100				
Boron (diss.filt)	µg/l	710	506	736	937	585	1710	1790	1670		1082	47.3	1000
Cadmium (diss.filt)	µg/l		<0.08		<0.08	<0.08	<0.08	<0.08	<0.08	0.01	<0.01		5
Chromium (diss.filt)	µg/l		2.23		8.97	1.92	1.77	1.83	<1	<500	0.59		50
Cobalt (diss.filt)	µg/l		0.606		3.29	<0.5	<0.5	<0.5	<0.5		<1		
Copper (diss.filt)	µg/l		4.97		5.19	2.06	0.619	0.921	<0.3	0.575	2.6525		2000
Calcium (Dis.Filt)	µg/l	8590	11800	6070	4140	3460	1670	1430		<1000	1796.5	114000	
Chloride	µg/l	107000	72000	84600	86100	215000	22600	24400	23200	23540	18255	39000	250000
Chrysene (aq)	µg/l		<0.025		<0.025	0.0546	<0.005	<0.005	<0.005				
Benzo(a)anthracene (aq)	µg/l		<0.025		<0.025	0.0243	<0.005	<0.005	<0.005				
Benzo(b)fluoranthene (aq)	µg/l		0.0627		<0.025	0.0688	<0.005	<0.005	<0.005				
Benzo(k)fluoranthene (aq)	µg/l		<0.025		<0.025	0.0948	<0.005	<0.005	<0.005				
Benzo(a)pyrene (aq)	µg/l		0.0542		<0.01	0.0537	<0.002	<0.002	<0.002				0.01
Dibenzo(a,h)anthracene (aq)	µg/l		<0.025		<0.025	0.0702	<0.005	<0.005	<0.005				
Benzo(g,h,i)perylene (aq)	µg/l		0.0535		<0.025	0.0919	<0.005	<0.005	<8				
Conductivity @ 20 deg.C	mS/cm	1.24	1.2	1.25	1.25	1.61	1.05	1.07	1.05			0.634	
Dissolved solids, Total (meter)	µg/l	984000	760000	979000	718000	1230000	823000	820000	806000			483000	-
Ionised Ammonia/ Ammonium as N	µg/l		946		874	657	414	716	577				500

	Lab sample ID	241121-54	241126-51	241129-48	241207-48	250115-54	250125-35	250215-63	250215-64			241207-48	EC Drinking Water Directive 98/83/EC
	Date collected	19/11/2024	23/11/2024	27/11/2024	05/12/2024	14/01/2025	24/01/2025	13/02/2025	14/02/2025			05/12/2024	
	Activity at time of sample collection	Exploratory Borehole IE2 Test 1 (75-100 mbgl)	Exploratory Borehole IE2 Test 2 (100-125 mbgl)	Exploratory Borehole IE2 Test 3 (125-150 mbgl)	Exploratory Borehole IE2 Test 4 (100-202 mbgl)	Exploratory Borehole IE3 Test 1 (110-151 mbgl)	Exploratory Borehole IE3 LTWS 176- 203m	Observation Borehole IE3 (Artesian)	Observation Borehole IE3 110-203m	Eskimo Ice borehole	Newstead Farm	Ifield tank water	
Parameter	**Unit**												
EPH Range >C10 - C40 (aq)	µg/l		977		<500	304	<100	<100	<100				
EPH Band >C16-C21 (aq)	µg/l		<500		<500	<100	<100	<100	<100				
EPH Band >C21-C28 (aq)	µg/l		<500		<500	149	<100	<100	<100				
EPH Band >C35-C40 (aq)	µg/l		<500		<500	<100	<100	<100	<100				
EPH Band >C28-C35 (aq)	µg/l		<500		<500	<100	<100	<100	<100				
Fluoride	µg/l	2590	2620	3730	4140	3220	5960	6490	6470	7500	1928.5	<500	1500
GRO >C7-C8	µg/l		<10		<10	<10	<10	<10	<10				
GRO >C5-C6	µg/l		<10		<10	<10	<10	<10	<10				
GRO >C6-C7	µg/l		<10		<10	<10	<10	<10	<10				
GRO >C8-C10	µg/l		<10		<10	<10	<10	<10	<10				
GRO >C10-C12	µg/l		<10		<10	<10	<10	<10	<10				
GRO >C5-C12	µg/l		<50		<50	<50	<50	<50	<50				
Mercury (diss.filt)	µg/l		<0.01		<0.1	<0.01	<0.01	<0.01	<0.01		<0.01		1
Iron (Tot. Unfilt)	µg/l		182000		84000	55500	1270	2800	N/A				200
Hardness, Total as $CaCO_3$ unfiltered	µg/l		126000		59200	31200	6720	10900	7350	<3730	5718.5		
Lead (diss.filt)	µg/l		1.18			0.969	0.212	0.448	0.279	0.896	0.59825		10
Lithium (diss.filt)	µg/l		2.36		2.99	1.83	<1	1.53	1.09		<100		
Manganese (diss.filt)	µg/l	132	17.5	68.7	54.3	11.6	12	10.1	3.18	<10000	14.01	<3	50
Molybdenum (diss.filt)	µg/l		21.2			6.17	<3	6.37	<3		<3		
Nickel (diss.filt)	µg/l		4.04		8.14	1.41	1.11	1.38	<0.4	9.08	1.65		20
Phosphorus (diss.filt)	µg/l		198		219	60.4	321	280	306				
Selenium (diss.filt)	µg/l		1.14		<1	<1	<1	<1	<1		<1		10
Magnesium (Dis.Filt)	µg/l	1780	1540	1270	1060	693	323	319	299	<300	300	4270	
Potassium (Dis.Filt)	µg/l	3400	3090	3290	2650	2160	1070	1740	1530	740	910.7	4240	
Iron (Dis.Filt)	µg/l	14800	488	7570	5710	645	57.2	29.9	<19			<19	200
Nitrogen, Kjeldahl	µg/l		41900		27600	1790	<1000	1730	1140				
Nitrate as NO_3	µg/l	1480	4610	869	1340	653	<300	<300	<300			33100	50000
Nitrogen, Total	µg/l		43300		28100	1940	<1000	1730	1140				
Nitrite as NO_2	µg/l	986	999	999	516	<50	<50	<50	<50			75	500
Naphthalene (aq)	µg/l		0.065		0.152	<0.01	<0.01	0.0111	<8				
Fluoranthene (aq)	µg/l		0.134		0.0526	0.0251	<0.005	<0.005	<8				
Phenanthrene (aq)	µg/l		0.0716		0.0751	0.0117	<0.005	<0.005	<0.005				
Fluorene (aq)	µg/l		0.0442		0.115	0.0067	<0.005	<0.005	<0.005				
Pyrene (aq)	µg/l		0.247		0.0789	0.0435	<0.005	<0.005	<0.005				
Indeno(1,2,3-cd)pyrene (aq)	µg/l		0.0379		<0.025	0.0741	<0.005	<0.005	<0.005				
PAH, Total Detected USEPA 16 (aq)	µg/l		0.797		0.696	0.619	<0.082	<0.082	<0.082				-
pH	pH Units	8.71	8.7	8.73	8.74	8.64	8.81	8.83	8.81	8.91	9.0575	7.75	6.5 - 9.5
Redox potential	mV	77	103	142	121	105	112	110	113			77	
Silica	µg/l		8500		6800	7000	7340	7240	7460	7660	7846		-
Organic Carbon, Total	µg/l	12200	16100	8530	8280	<3000	<3000	<3000	<3000			<3000	No abnormal change
Methyl tertiary butyl ether (MTBE)	µg/l		<1		<1	<1	<1	<1	<1				
Ethylbenzene	µg/l		<1		<1	<1	<1	<1	<1				
m,p-Xylene	µg/l		<1		<1	<1	<1	<1	<1				

	Lab sample ID	241121-54	241126-51	241129-48	241207-48	250115-54	250125-35	250215-63	250215-64			241207-48	EC Drinking Water Directive 98/83/EC
	Date collected	19/11/2024	23/11/2024	27/11/2024	05/12/2024	14/01/2025	24/01/2025	13/02/2025	14/02/2025			05/12/2024	
	Activity at time of sample collection	Exploratory Borehole IE2 Test 1 (75-100 mbgl)	Exploratory Borehole IE2 Test 2 (100-125 mbgl)	Exploratory Borehole IE2 Test 3 (125-150 mbgl)	Exploratory Borehole IE2 Test 4 (100-202 mbgl)	Exploratory Borehole IE3 Test 1 (110-151 mbgl)	Exploratory Borehole IE3 LTWS 176- 203m	Observation Borehole IE3 (Artesian)	Observation Borehole IE3 110-203m	Eskimo Ice borehole	Newstead Farm	Ifield tank water	
Parameter	**Unit**												
o-Xylene	µg/l		<1		<1	<1	<1	<1	<1				
True Colour	mg/l Pt/Co		130		290	<50	2.6	<5	<5				
Total EPH (C6-C40) (aq)	µg/l		977		<100	304	<100	<100	<100				
Strontium (tot.unfilt)	µg/l		403		215	135	43.4	59.5			25.94		
Uranium (diss.filt)	µg/l		1.32		0.808	<0.5	<0.5	<0.5	<0.5		<0.5		
Zinc (diss.filt)	µg/l		9.76		61	22.8	9.2	9.83	6.25	2.88	27.425		
Silver (diss.filt)	µg/l		<0.5			<0.5	<0.5	<0.5	<0.5	<1000	<1		
Sodium (Dis.Filt)	µg/l	286000	245000	298000	288000	359000	276000	271000	254000	186000	247850	24500	200000
Sulphate	µg/l	97600	82100	83800	69400	104000	6400	6600	6900		36255	40500	250000
Total Oxidised Nitrogen as NO_3	µg/l	2810	5960	2220	2030	653	<300	<300	<300			33200	-
Total Oxidised Nitrogen as N	µg/l		1340		459	147	<100	<100	<100	<200	<200		
Sulphide	µg/l		<10		<10	<10	22.9	<10	<10		17.65		
Silicon (diss.filt)	µg/l		3850		6800	4710	3290	2880	3040				
TPH / Oil & Greases	µg/l		<2000		<1000	<5000	<1000	<1000	<1000				
Solids, Total	µg/l		5430000		3320000	2140000	748000	882000	785000				
Suspended solids, Total	µg/l		1760000		81400	686000	19800	129000	59100				-
Turbidity	ntu	1170	1790	3500	694	1090	38.2	36.7	35.3			1.21	Acceptable, no abnormal change
Toluene	µg/l		<1		<1	<1	<1	<1	<1				
Sum of detected Xylenes	µg/l		<2		<2	<2	<2	<2	<2				
Sum of BTEX	µg/l		<5		<5	<5	<5	<5	<5				

Note: diss.filt = Dissolved filtered samples although all samples except the borehole IE3 *Full* suite sample could not be filtered because of turbid samples.

tot.unfilt = total unfiltered samples

aq = Aqueous / settled sample

Appendix I

WATER QUALITY LABORATORY REPORTS

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