Treated Effluent Discharge

Groundwater Risk Assessment

Fir View Tan Y Ffridd Holiday Park

On behalf of

Fir View Tan Y Ffridd Holiday Park

Quality Management

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1 Introduction

1.1 Background

Hydrogeo Limited (Hydrogeo) has been commissioned by Fir View Tan Y Ffridd Holiday Park (The Client) to undertake a Groundwater Risk Assessment for the proposed treated effluent discharge to ground at Fir View Tan Y Ffridd Holiday Park, SY21 0LT, hereafter referred to as The Site. The Grid reference for the Site is SJ116102.

The Site currently comprises a number of static holiday home pitches, with associated access roads, and an undeveloped grassed area. The development proposal consists of an additional 54 static caravans with individual foul connections. These will consist of 45no. 2-bedroom caravans, and 7no. 3-bedroom caravans.

It is proposed that the foul waste water from the development will be discharged to ground following treatment in a package treatment plant.

The objective of this report is to assess the risk posed to environmental and human health receptors from this discharge of treated foul effluent.

This report has been progressed in support of planning application number: PAN-016382 to Natural Resources Wales (NRW) for environmental permitting.

NRW has provided the Client Team with a notice requirement for further information. NRW indicate that extended information must include:

- Geological information, including solid and drift deposits, soil or subsoil characteristics to 3m below the base of the proposed drainage field, with borehole logs;
- Groundwater flow mechanism;
- Direction of groundwater flow;
- Hydraulic gradient;
- Effective porosity of the aquifer;
- Mixing depths;
- Site specific data for the hydraulic conductivity;
- Provide a site specific service / management plan.

1.2 Data Sources &Third Party Information

In completing this assessment, Hydrogeo has utilised the following information:

- British Geological Survey (BGS) online data;
- BGS 1:50,000 Geology Map England and Wales - Sheet 151, Solid & Drift Geology – Welshpool (2008);
- EA – Annex J5 Appendix A: Infiltration Worksheet User Manual v2.0 (2014)
- EA - Groundwater Risk Assessment for Treated Effluent Discharges to Infiltration System v3.0 (2022)

1.3 Site Setting & Description

This section of the report briefly summarises the available geological and hydrogeological information.

Mayglothling Waste Limited have obtained a proposal from specialist treatment plant manufacturer Environmental Wastewater Solutions for a package treatment plant unit.

The Site is located off of the A495 in Glascoed, Welshpool, Postcode S21 0LT. The Site is approximately 4km north of Llanfair Caerinion, and 11km west / northwest of Welshpool.

The Site is located on the southern facing valley slope, north of the Yr Hafesb (River Banwy). The Site falls to the south toward the River Banwy, from an approximate level of 115m above ordnance datum (mAOD) to approximately 100mAOD. The surrounding land rises ot the north toward Bryn y Saethau Settlement at approximately 150mAOD.

The location of the Site is shown in Figure 1-1, with the Site boundaries indicated on an aerial image as Figure 1-2.

Hydrogeo commissioned PM Consultants UK Ltd to carry out a number of topographic survey spot heights for the Site. Surveyed features include the borehole levels, drainage ditch banks, base and water level, and the River Banwy banks, bed and water levels.

The spot heights have been included as Appendix D of this Groundwater Risk Assessment.

1.4 Previous Reporting

The Client Team has supplied Hydrogeo with a previously conducted and submitted Groundwater Risk Assessment produced by Williams Stokes Consulting 14th December 2021.

The previous works consisted of a desk based review of the Site, flows and loads calculations, and percolation testing. This was submitted to Natural Resources Wales for consultation. NRW provided the Client Team with a notice for the requirement of further information as outlined in Section 1 of this report.

Percolation testing was completed by an engineer from Williams Stokes Consulting on 23rd November 2021, which consisted of 4no. Trial Pits advanced down to 2m below ground level. Encountered ground conditions were recorded as “Stoney Clay”.

Percolation testing of the 4no, Trial Pits indicated an average Vρ value of 28, indicating that the ground conditions are suitable for a treated effluent drainage field solution.

Figure 1-1 Site location

Figure 1-2 Site boundary

1.5 Geology

The geology of the Site and surrounding area has been shown on Drawing 1.

Artificial Deposits

The BGS GeoIndex Onshore online viewer and the BGS sheet map 151 does not indicate the presence of any artificial deposits underlying the Site.

Superficial Geology

The BGS GeoIndex Onshore online viewer and BGS sheet map 151 indicates that an area of the site is underlain by Glacial Till Deposits and Alluvium Deposits.

The Alluvium deposits are described by the BGS as “gravel, sand silt and clays”.

The Glacial Till Deposits are described by the BGS as “unsorted and unstratified drift consisting of a mixture of clay, silt sand, gravel and boulders varying in size and shape”.

Bedrock Geology

The BGS GeoIndex Onshore online viewer and BGS sheet map 151 indicates that the site is underlain by bedrock of the Laundry Mudstone Formation, which consists of mudstone, siltstone and sandstone.

The BGS describe the Laundry Mudstone Formation as “Mudstone, silty, grey, weathers buff, bioturbated, thinly interbedded with sandstones (<15cm). The basal meters comprise beds of fine-grained sandstone about 0.5m thick”.

Soil Characteristics

The Site is located across two defined UK Soil Observatory Soilscapes. The northern Site area is classed by the UK Soil Observatory as “Freely draining slightly acid loamy soils”, with the southern Site area classed as “Slowly permeable seasonally wet acid loamy and clayey soils”.

BGS Borehole Records

The BGS GeoIndex Onshore viewer indicates the presence of 1no. borehole record within 1km of the Site. The record is an historic log advanced and installed in November 1950.

The record relates to a groundwater abstraction borehole located approximately 910m west / northwest of the Site at Plas Gwyn. The borehole was advanced to 35.97mbgl.

The borehole log records the encountered ground conditions as “boulder clay overlaying Stoney MARL with layers of Shale and Rock”.

The borehole encountered a groundwater strike at 19.51mbgl, with a rest water level of 3.66mbgl. Pumping of the borehole at 71m^3/day with suction at 34.73mbgl for 3 days resulted in depression to 34.73mbgl. The water level recovered to rest in 6 hours.

1.6 Hydrogeology

Hydrogeological information for the Site and surrounding area has been shown on Drawing 2.

The BGS England and Wales Hydrogeological Map 1 1:625000 scale indicates that the Site is mapped in a region underlain by impermeable rocks, generally without groundwater except at shallow depths.

The BGS 1:625000 Scale Hydrogeological Map describes the geology as “These older rocks, including great thicknesses of shales and greywackes, grits and slates, have been deformed tectonically and are highly indurated. In general they have little or no groundwater except in areas where deep weathering has produced a sub-surface permeable zone in which perched water tables may occur”.

Groundwater

The Laundry Mudstone Formation outcrops over an area as shown in Drawing 1. The outcrop includes the area directly north of the site on elevated grounds which offers recharge to the formation.

Groundwater flow is likely to follow the slope of the topography to the south, with groundwater eventually draining toward and into the River Banwy at the base of the valley.

Groundwater strikes, rest groundwater levels and other additional groundwater details are included in Sections 2 and 3 of this Hydrogeological Risk Assessment.

Groundwater Source Protection Zones

The Lle Geo-Portal for Wales Online viewer indicates that the Site is not located within any Source protection Zones.

Drinking Water Safeguard Zones

The Site is not located within a Drinking Water Safeguarding Zone.

Nitrate Vulnerable Zones

The Lle Geo-Portal for Wales Online viewer indicates that the Site is not located within any Nitrate Vulnerable Zones (NVZ)

Aquifer Designation

The Glacial Till Deposits underlying the Site are designated as a Secondary B Aquifer. The Alluvium deposits underlying the Site are designated as a Secondary A Aquifer.

The underlying bedrock geology of the Laundry Mudstone Formation is designated as a Secondary B Bedrock Aquifer.

1.7 Licensed Abstractions

The closest licensed groundwater abstraction to the Site is located approximately 10.5km northeast of the Site.

This licensed abstraction relates to 2no. boreholes at Trefnanney Water consumers Association for general use relating to secondary category. No additional abstraction details or volumes are given.

1.8 Hydrology

There are two surface water features to the south of the Site. These features include a waterlogged drainage ditch which runs parallel to the A495, along the southern site

boundary hedge line. Further south of the A495 is the River Banwy (Yr Hafesb) that flows west to east past the site. The River Banwy is located at a topographic elevation of 100mAOD.

A number of pond features are marked up-gradient and to the north of the Site surrounding Ywen Fawr. These pond features occur at a topographic elevation of approximately 170mAOD.

2 Site Investigation Works

2.1 Introduction

Hydrogeo attended Site 13th & 14th April 2022, with a consultant supervising Jackson Drilling to advance 3no. monitoring borehole positons (BH1 – BH3) at Site. The boreholes were advanced using rotary open-hole drilling to approximately 6m below ground level (mbgl)

All 3no. boreholes were installed as groundwater monitoring positions to provide groundwater information for this Groundwater Risk Assessment. Installation details at each position is presented within the borehole logs included as Appendix A of this report. BH1 was advanced directly up-gradient of the proposed drainage field location, with BH2 and BH3 advanced downgradient of the proposed drainage field.

A plan showing the positons of the Site boreholes is included as Drawing 1 of this Groundwater Risk Assessment.

2.2 Encountered Ground Conditions

All borehole positions were advanced to 6mBGL, and encountered similar ground conditions, which were generally in line with those mapped by the BGS in Sheet Map 151 Welshpool.

Figure 2-1 - Figure 2-3 present photos of drilling arisings at each of the 3no. borehole positions.

The encountered ground conditions at each position generally consisted of the following: Ground level – 0.24m, slightly clayey TOPSOIL. 0.24m – 4.1m a very cobbly CLAY with sub-rounded to rounded gravels and cobbles of mixed lithologies [GLACIAL TILL], Beneath the Glacial Till deposits was a very weak, slightly silty to silty grey MUDSTONE [LAUNDRY MUDSTONE FORMATION] encountered from 4.1mbgl to the base of the borehole positions at 6mBGL.

Figure 2-1 BH2 Rotary drilling arisings of Laundry Mudstone Formation at 2.9mbgl

Figure 2-2 BH1 Rotary drilling arisings of Glacial Till

Figure 2-3 Arisings of Laundry Mudstone Formation following water strike

2.3 Groundwater

Groundwater was encountered as water strikes during the advancement of rotary open-hole drilling. The Groundwater strikes range from depths of 2.8mbgl (BH2) – 4.1mbgl (BH1). With groundwater strikes occurring toward the base of the Glacial Till deposits, at the contact between the Till and the Laundry Mudstone Formation.

All 3no. borehole positions indicated rises in groundwater from the initial groundwater strike to the final rest water level. The rises seen in groundwater level are likely explained by the pressure caused by the overlying ground, and the area of outcropping Laundry Mudstone Formation at greater topographic elevations to the north of the Site.

Following completion of drilling, boreholes were installed as presented in the borehole logs included as Appendix A of this report. Groundwater levels were recorded prior to leaving Site 14th April 2022. The recorded levels indicated resting groundwater levels of 3.64mbgl (BH1), 1.47mbgl (BH2) and 2.15mbgl (BH3).

Groundwater levels were then measured prior to conducting permeability tests during a subsequent Site visit 27th April 2022. The measured resting groundwater levels were; 3.82mbgl (BH1), 1.63mbgl (BH2) and 2.33mbgl (BH3). The groundwater levels show a decrease of 0.16m and 0.18m.

Table 2-1 presents the groundwater levels recorded across the 2no. Site Visits.

Table 2-1 Groundwater Levels

Groundwater Levels (mbgl)			
Date	**Borehole IDs**		
-	BH1	BH2	BH3
14th April 2022	3.64	1.47	2.15
27th April 2022	3.82	1.63	2.33

Assessment of the groundwater levels, topographic contours and groundwater contours indicates that the groundwater beneath the Site flows to the south, and is in continuity with the River Banwy (Yr Hafesb) which is located directly down hydraulic gradient of the Site.

2.4 Permeability Testing

A consultant from Hydrogeo visited Site 27th April 2022 to conduct permeability tests on the 3no. boreholes (BH1, BH2 & BH3) installed at the Site.

The Permeability tests consisted of rising head and falling head tests using a plastic solid slug in each of the 3no. borehole positions.

The falling head tests were conducted by quickly adding the plastic slug to the borehole base to increase the borehole water level. The time taken for the increased groundwater level to return to its resting level was recorded.

The rising head tests were conducted following the completion of falling head tests, where the plastic slug was quickly removed from the borehole base. This results in a decreased groundwater level. The time taken for the water level to recharge to the resting water level was recorded.

Both the rising and falling head tests were completed at least two times at each borehole position.

At all 3no. borehole positions the falling head test had completed, with the raised water level returning to rest levels before the water level was able to be measured. Therefore all falling head tests were completed within a time of approximately 10 seconds.

The rising head tests at BH1 had also completed before the water level was able to be measured, completing again in an approximate time of 10 seconds.

It is therefore likely that the falling head test results at BH1, BH2 & BH3, as well as the rising head tests at BH1 are representative the permeability of the surrounding borehole gravel filter pack, and are not actually representative of the surrounding aquifer properties.

Rising head tests were completed in both BH2 & BH3, with test 1 and 2 completing in BH2 in 28 minutes 38 seconds and 32 minutes 13 seconds respectively. Rising head tests in BH3 completed in 30 minutes 5 seconds and 31 minutes 26 seconds respectively.

Slug Test analysis of the 4no. rising head tests have been included as Appendix C of this risk assessment.

The analysis was conducted in AquiferWin 32 software using the Hvorslev analysis for determining the hydraulic conductivity of the aquifer.

The Hvorslev analysis has indicated a range of hydraulic conductivities for the underlying geology based upon 2no. rising head slug tests completed in BH2 and BH3. Hydraulic conductivities from the rising head tests range from 4.50x10-7 (BH3 Test 1) to 5.14x10-6 (BH2 Test 1

3 Groundwater Risk Assessment

3.1 Introduction

The proposal for the drainage scheme for the development includes discharging treated effluent to ground via a drainage field.

The EA H1 annex J5: Infiltration Worksheet has been used to assess the risk posed by discharging treated sewage effluent to the underlying geology. The following sections of this report summarise the input values used in modelling and present the results.

Contaminant modelling has been based on ammoniacal nitrogen, with the results of modelling compared with the UK Drinking Water Standard (UK DWS) to determine if the effluent discharge poses a risk to the aquifer groundwater quality and any other water receptors.

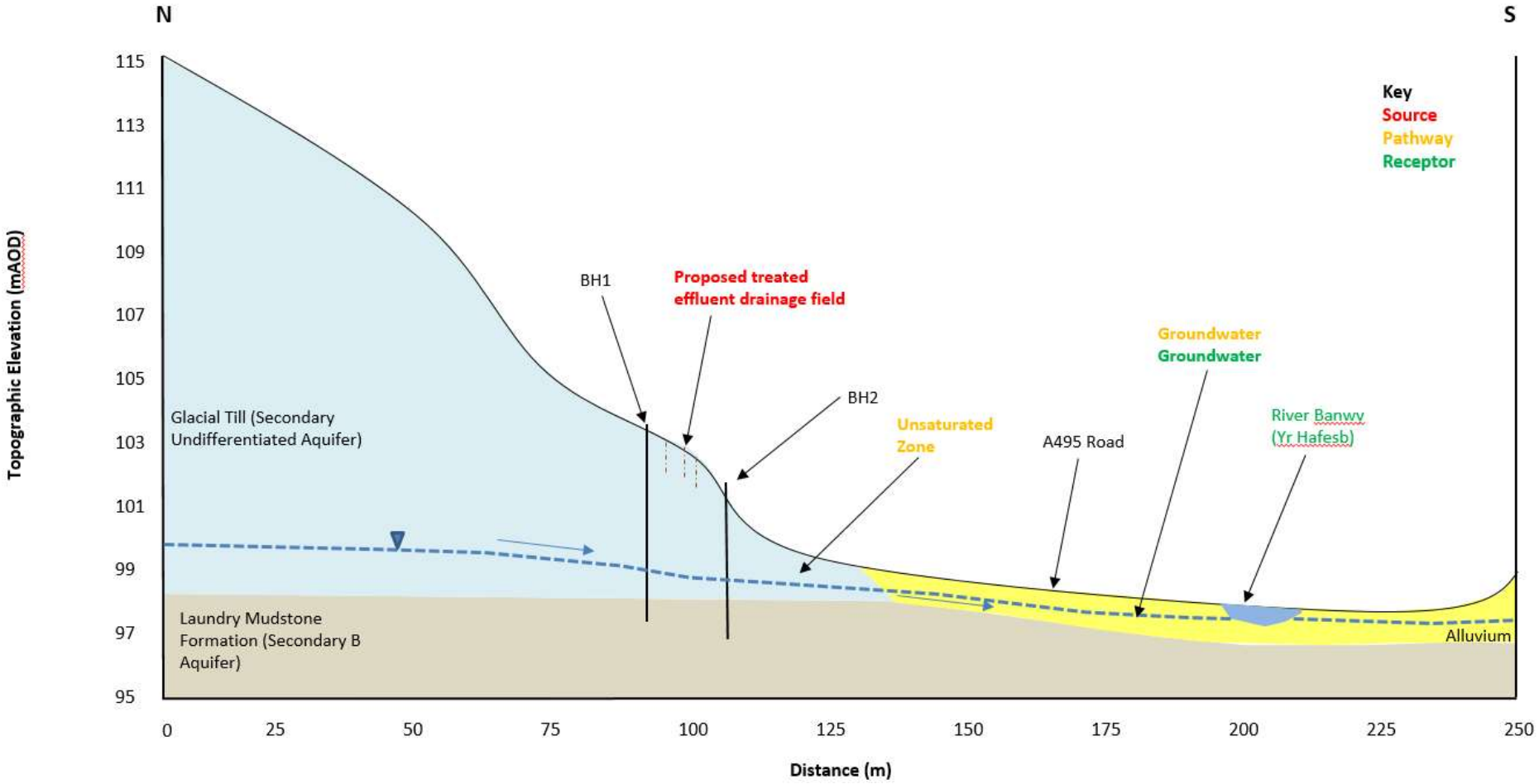
The literature data sources used for modelling are listed below:

- EA – Annex J5: Effluent discharge to groundwater user manual v3.0 (2022);
- EA – Annex J5: Infiltration Worksheet User Manual v2.0 (December 2014);
- BGS historic borehole data (online);
- BGS hydrogeology map Sheet 1: Hydrogeological Map of England and Wales (1:625,000) - 1977;

3.2 Site Conceptual Model

A site conceptual model has been developed based on available site investigation and published data. The model has been shown in Figure 3-1.

Figure 3-1 Site conceptual model



3.3 Source Term

The contaminant ammonia (as ammoniacal nitrogen) has been used in modelling, with the UK DWS for ammoniacal nitrogen set as the Environmental Assessment Level at 0.5mg/l.

The concentration of ammonium in the treated sewage effluent source term has been set at 20mg/l. It is understood that when the package treatment plant is selected it is likely to achieve a concentration no higher than this value.

The proposal at the Site includes the discharge of treated effluent from 54no. caravan plots to a drainage field as shown in the layout plan included as Appendix A.

A maximum total foul water discharge from the propose development has been calculated using the Flows and Loads 4 – Sizing criteria, Treatment Capacity for Sewage Treatment Systems by British Water.

Flows and Loads 4 indicates that the expected loading for the proposed treatment system is 150 litres per person, per day (150L/person/day).

Flows and Loads 4 assumes that a treatment system for a single house with up to and including 3 bedroom shall be designed for a minimum population of 5 people. Therefore the proposed development of 54no. caravans will consist of a maximum population of 270 people.

The proposed development total foul water discharge volume of 14.05m^3/day is expected for the proposed development based upon the annual occupancy calculations of the Site completed by Williams Stokes Consulting.

3.4 Pathway

The treated sewage effluent will be modelled as a zone of approximately 7.5m long in the direction of groundwater flow and 75m long perpendicular to groundwater flow.

Figure 3-2 Proposed Drainage Field Layout

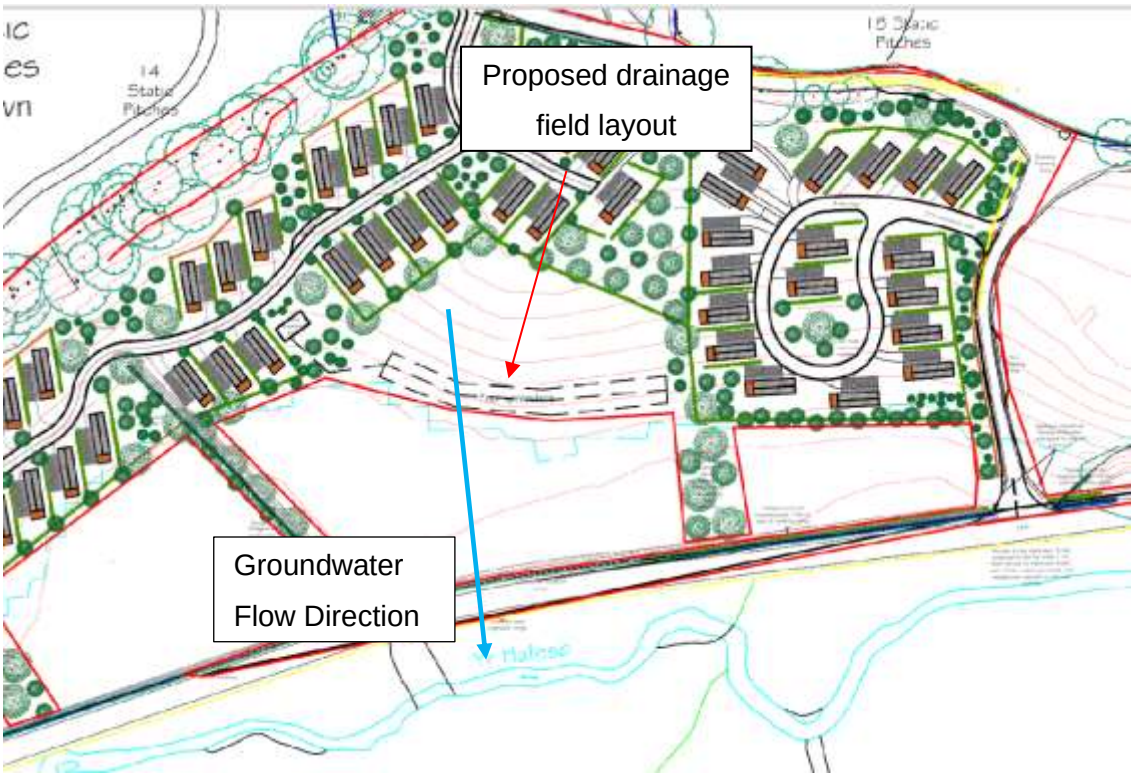


Figure adapted from Proposed Development Plan, supplied to Hydrogeo by the Client Team

The unsaturated zone thickness is based upon the shallowest groundwater strike from the 3no. borehole positions. The shallowest groundwater strike was encountered at BH2 at a depth of approximately 2.8mbgl, therefore the unsaturated zone thickness has been set at 2m, assuming a drainage field thickness of 800mm.

3.5 Receptors

The modelled receptor will be the River Banwy (Yr Hafesb) located approximately 75m down hydraulic gradient of the proposed drainage field location.

A compliance point at the closest environmental receptor has been used which presents the concentration of ammonium at the down hydraulic gradient River Banwy (Yr Haesb)

The underlying Laundry Mudstone Secondary B Aquifer is an environmental receptor. The risk posed to the aquifer has been assessed in the context of the identified groundwater.

The receptors have been shown on the conceptual site model in Figure 3-1.

3.6 Infiltration System

The worksheet input values used for the infiltration system have been listed in Table 3-1.

Table 3-1 Infiltration system input values

Input parameter	Input value	Source	Comment
Concentration of ammoniacal nitrogen	20mg/l	Data Sheet	Assumed maximum concentration from specified package treatment plant.
Number of persons	270	Flows and Loads 4	Values taken from Flows and Loads 4 guidance.
Water use	150litres/ person / day	Flows and Loads 4	Values taken from Flows and Loads 4 guidance.
Percolation rate (Vp)	27.3mm/s	Water Calculations Report - GGP Consult, Oct 2020	Value taken from report.
Discharge Rate	14.05m^3/d	Taken from Williams Stokes Consulting Occupancy Calculations	Discharge based upon expected caravan park occupancy

3.7 Attenuation in Unsaturated Zone

The input values used for attenuation in the unsaturated zone have been listed in Table 3-2.

Table 3-2 Unsaturated zone input values

Input parameter	Input value	Source	Comment
Drainage layer			
Thickness of drainage layer	0.8m	Leaving a minimum of 1.2m above groundwater level.	Previous works and Hydrogeo Site Investigation.
Water-filled porosity	0.325 (fraction)	Literature Value	Hydrogeology Principles and Practice (Hiscock)
Bulk density	1.75g/cm^3	Effluent discharge user manual (H1 Annex J5: Appendix A)	Suggested value.
Half life	730 days	Effluent discharge user manual (H1 Annex J5: Appendix A)	Suggested value - 1 to 2 years.
Soil-water partition coefficient (Kd)	2.0l/kg	Effluent discharge user manual (H1 Annex J5: Appendix A)	Suggested value
Unsaturated zone			

Input parameter	Input value	Source	Comment
Unsaturated zone thickness	2m	Previous works and Hydrogeo Site Investigation	Taken from the shallowest encountered groundwater strike.
Water-filled porosity	0.2	Literature Value	Literature Value
Bulk density	1.75g/cm^3	Effluent discharge user manual (H1 Annex J5: Appendix A)	Suggested value.
Half life	730 days	Effluent discharge user manual (H1 Annex J5: Appendix A)	Suggested value - 2 to 5 years.
Rapid flow	0 (fraction)	n/a	Assumed no rapid flow through unsaturated zone.
Soil-water partition coefficient (Kd)	3.2l/kg	Consim parameters database	Consim parameters database – Glacial Till

3.8 Dilution

The input values used for dilution have been listed in Table 3-3.

Table 3-3 Dilution input values

Input parameter	Input value	Source	Comment
Length of drainage field in direction of groundwater flow	10m	Proposed Development Plan	Included as Appendix A of this Risk assessment
Saturated aquifer thickness	3.2m	Hydrogeo Site Investigation	Taken from Borehole records.
Hydraulic conductivity	0.422m/day	Hydrogeo Slug Testing analysis	Aquiferwin32 calculated Hydraulic Conductivity based on Hydrogeo Slug Test results
Hydraulic gradient	0.016m/m	Site Investigation Monitoring Boreholes	Average hydraulic gradient taken from hydraulic gradient across the drainage field, across up gradient borehole and River, and the down gradient borehole and River
Width of drainage field perpendicular to groundwater flow	80m	Measured from Proposed Development Plan.	Included as Appendix A of this Risk Assessment
Background concentration	0.0mg/l	n/a	Assume zero background concentration of ammoniacal nitrogen.

Input parameter	Input value	Source	Comment
Mixing zone thickness	3.2m	EA Infiltration Worksheet V3.0	Calculated from Infiltration Worksheet V3.0

An informative is highlighted within the model spreadsheet which indicates that the area of the drainage field (Width x Length) is not equal to the area (A) calculated from the infiltration system model. The calculated area (A) is has been calculated using flows and loads 4 and assumes 100% year round capacity. The discharge rate within the infiltration system model has been adjusted accordingly to factor this.

The proposed drainage field is included in the Proposed Development Plan as Appendix A of this report.

3.9 Attenuation in Saturated Zone

The input values used for dilution have been listed in Table 3-4.

Table 3-4 Attenuation in saturated zone

Input parameter	Input value	Source	Comment
Half life	1,850 days	Effluent discharge user manual (H1 Annex J5: Appendix A)	Suggested value - 5 years.
Bulk density	1.75g/cm^3	Effluent discharge user manual (H1 Annex J5: Appendix A)	Suggested value.
Effective porosity	0.325	Literature Value	Hydrogeology Principles and Practice (Hiscock)
Distance to compliance point	75m	QGIS Measurement	Watercourse located down hydraulic gradient of the proposed drainage field.

3.10 Results

The model results have been attached at Appendix B and are presented in in Table 3-5.

The results of the modelling predict that the concentration of ammoniacal nitrogen will fall below the UK Drinking Water Standard (UK DWS) at 63m down hydraulic gradient of the proposed drainage field position.

The concentration of ammoniacal nitrogen at the base of the unsaturated zone below the treated effluent drainage field is predicted to exceed the UK DWS

The model has been used to formulate a compliance point by determining the distance from the treated effluent drainage field at which the concentration of ammoniacal nitrogen will exceed the UK DWS of 0.5mg/l in the groundwater. This distance is 63m from the Site.

Table 3-5 Model results - with degradation

Model parameter	Predicted Amm_N concentration (mg/l)
Concentration at base of unsaturated zone	5.22
Concentration at 65m compliance point	0.492
Concentration at 75m Receptor	0.343

3.11 Sensitivity Analysis

The sensitivity analysis model results have been attached at Appendix C and have been shown in Table 3-6.

Further modelling has been undertaken on a conservative basis in order to form a sensitivity analysis, with degradation occurring only in the dissolved phase within the unsaturated and saturated zones. The model inputs remain the same as for Table 3-1 to Table 3-4,with the degradation option (and therefore half-life values) removed.

Further modelling has been undertaken on a conservative basis in order to form a sensitivity analysis; with no degradation in the unsaturated and saturated zones. The model inputs are the same as for Table 3-1 to Table 3-4, with the degradation option (and therefore half-life values) removed.

The results of the sensitivity analysis predict that the concentration of ammoniacal nitrogen will exceed the UK DWS at the 75m receptor.

The concentration of ammoniacal nitrogen at the base of the unsaturated zone below the treated effluent drainage field is predicted to exceed the UK DWS.

The results of the analysis predicts that the concentration of ammoniacal nitrogen will fall below the UK DWS at the 75m receptor based upon a 1.1mg/l concentration of ammoniacal nitrogen within the treated effluent discharge.

This distance ranges from 345m – 692m as the concentration of ammoniacal nitrogen increases with the treated effluent discharge from 5mg/l – 20mg/l respectively.

Table 3-6 Model results - without degradation in sorbed phase

Model parameter	Predicted concentration (mg/l)
Concentration at base of unsaturated zone	14.3
Concentration at 75m receptor	0.496

Degradation in the dissolved and sorbed phase is expected to occur in the till deposits due to high clay and organic content, therefore the inclusion of this process in the assessment is considered representative.

4 Summary and Conclusions

4.1 Summary

Hydrogeo Limited (Hydrogeo) has been commissioned by Fir View Tan Y Ffridd Holiday Park (The Client) to undertake a Groundwater Risk Assessment for a proposed treated effluent discharge to ground at Fir View Tan Y Ffridd Holiday Park, SY21 0LT (The Site)

The purpose of the risk assessment is to investigate the suitability of the Site for the discharge of treated effluent with respect to the level of potential risk to groundwater.

Site data and modelling input values have been sources from literature and available online resources, and from reporting supplied by the Client Team.

4.2 Groundwater Risk Assessment

The Environment Agency Infiltration Worksheet v3.0 (2022) has been used to predict the concentration of ammonia as ammoniacal nitrogen in the groundwater at a 75m receptor.

The closest sensitive receptor to the site is the River Banwy (Yr Hafesb) which is located approximately 75m down hydraulic gradient of the proposed drainage field location.

A compliance point has been formulated based on the distance from the Site at which the ammonium concentration falls below the UK DWS.

The UK Drinking Water Standard for ammoniacal nitrogen (0.5mg/l) has been used in modelling.

The model predicts that the concentration of ammoniacal nitrogen at the 1,000m down gradient receptor would be 0.325mg/l; falling below the UK Drinking Water Standard (UK DWS)

The compliance point at which the ammonium concentration falls below the UK DWS has been identified at 63m down hydraulic gradient of the Site.

A sensitivity analysis of the model has been undertaken.

Modelling conclusions

Modelling predicts that the concentration of ammoniacal nitrogen will fall below the UK DWS at the 75m down gradient receptor and it is therefore considered that the risk posed

to groundwater dependent receptors from the discharge of treated effluent to ground at the Site is Low

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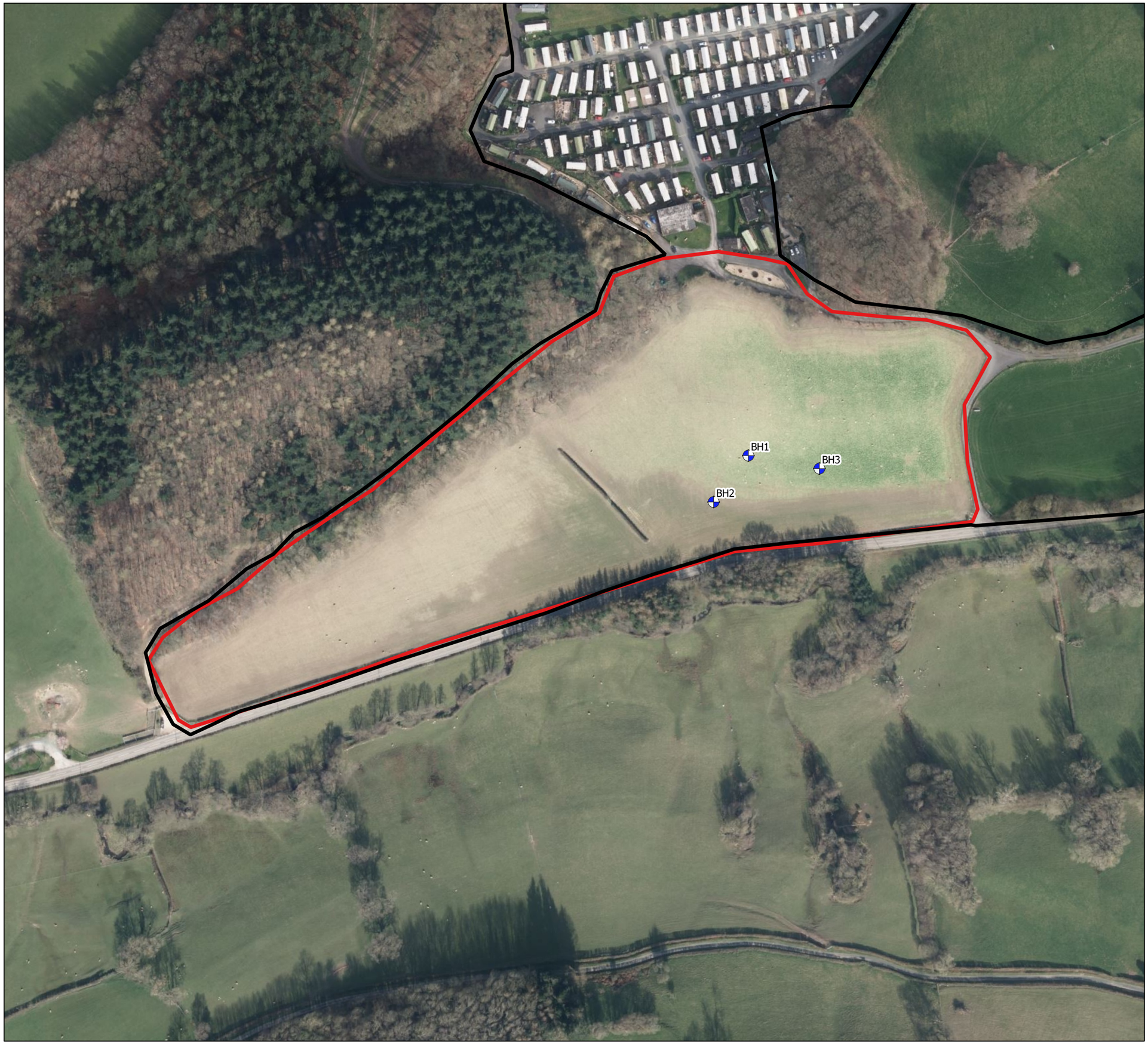
Drawings



HYDROGEO
Groundwater and Environment

HYG1043 - Fir View Tan Y Ffridd Holiday Park

DRAWING 1 Groundwater Monitoring Borehole Locations

KEY

- Wider Site Boundary
- Proposed Development boundary
- Monitoring Borehole Position

0 25 50 75 100 m

N

Date	By	Paper	Scale	Rev
05 2022	SG	A3	1:2000	1

HYDROGEO
Groundwater and Environment

HYG1043 - Fir View Tan Y Ffridd Holiday Park

DRAWING 2 Topogrpahic Contours from PM Consulting Spot Heights

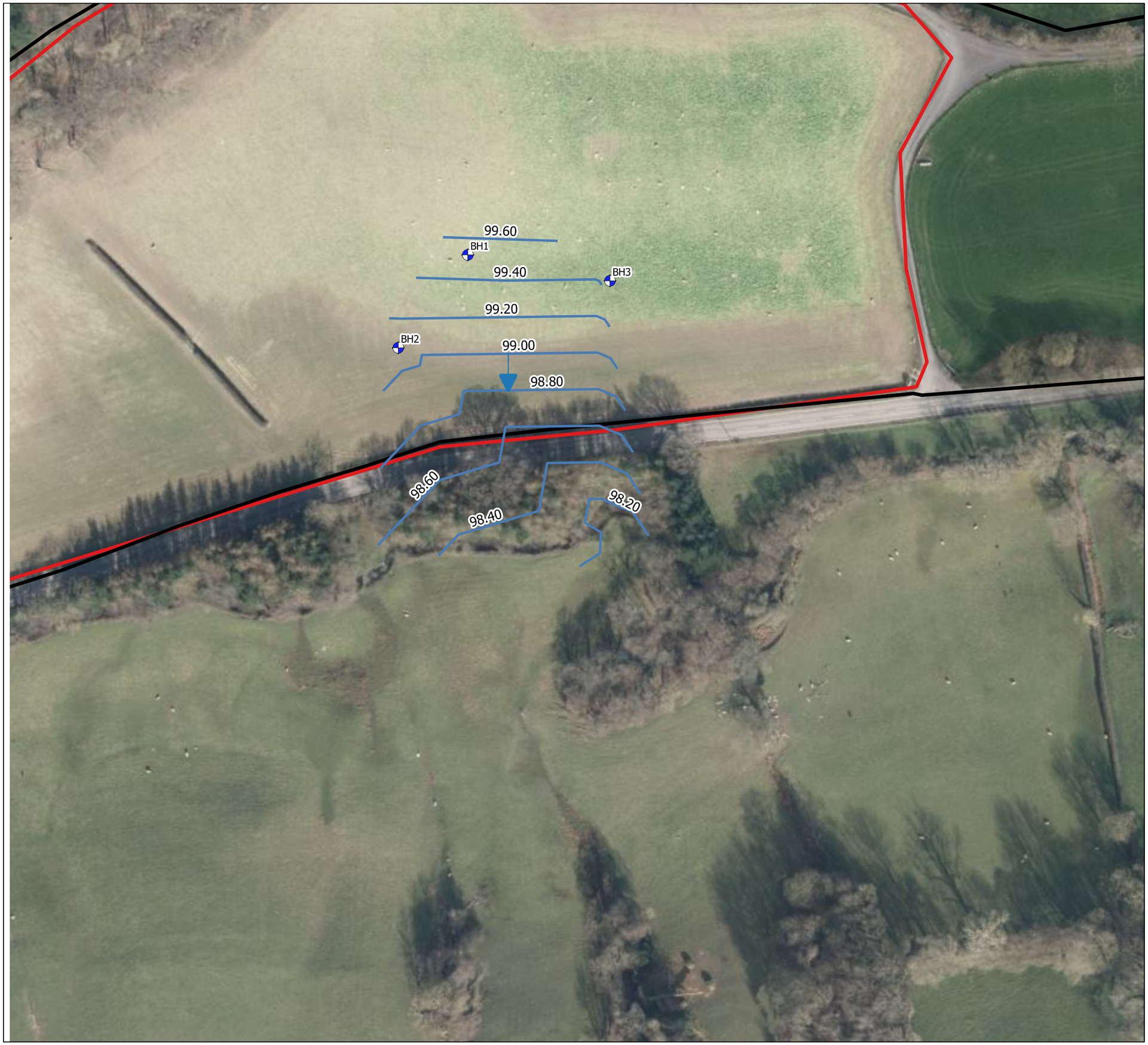
KEY

- Wider Site Boundary
- Proposed Development boundary
- Topographic Contours (mAOD)

20 0 20 m

N

Date	By	Paper	Scale	Rev
05 2022	SG	A3	1:1000	1



HYDROGEO
Groundwater and Environment

HYG1043 - Fir View Tan Y Ffridd Holiday Park

DRAWING 3 Groundwater Contours and Groundwater Flow Direction

KEY

- Proposed Development boundary
- Wider Site Boundary
- Groundwater Contours (mAOD)
- Groundwater flow arrow
- Monitoring Borehole Position

Contains Bing Satellite imagery
© Microsoft [2022]

NOTE: Groundwater Contours are based upon monitoring results 27/04/2022

0 12.5 25 37.5 50 m

N

Date	By	Paper	Scale	Rev
05 2022	SG	A3	1:1000	1

Appendices

Appendix A

Proposed Site Development Plans

0 25 50 100 200

SCALE BAR 1:1250

N

54 total Static Pitches shown

Caravan Park

Track

7 Static Pitches

18 Static Pitches

14 Static Pitches

15 Static Pitches

Caravan Park

A 495

Yr Hafesb

Workings (dis)

A 495

FB

Well

GENERAL NOTES & SPECIFICATIONS

MATERIALS, WORKMANSHIP AND CONSTRUCTION ARE TO CONFORM WITH CURRENT STANDARDS, CODES OF PRACTICE, AGREEMENT CERTIFICATES AND MANUFACTUSERS RECOMMENDED SPECIFICATIONS AND ARE TO FULLY COMPLY WITH THE BUILDING REGULATIONS 1991, RELATED APPROVED DOCUMENTS AND LEGISLATION.

ALL SERVICES ARE TO BE INSTALLED IN ACCORDANCE WITH STATUTORY AUTHORITY REGULATIONS AND BY-LAWS.

SAFETY

STATUTORY INSTRUMENT 2015 No 51 - THE CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015

THE CONTRACTOR IS TO COMPLY WITH THE DUTIES IMPOSED ON HIM BY THE ABOVE REGULATIONS AND LIAISE DIRECTLY WITH THE CDM COORDINATOR AS APPOINTED BY THE CLIENT

IMPORTANT

DO NOT SCALE FROM THIS DRAWING. WRITTEN DIMENSIONS ARE IN ALL CASES TO BE PREFERRED TO SCALED DIMENSIONS. ANY DISCREPANCIES ARE TO BE NOTIFIED TO THE DESIGNER AT ONCE.

RETENTION OF TITLE

OWNERSHIP OF AND COPYRIGHT IN THE DESIGNS SHOWN ON THIS PLAN REMAIN VESTED IN McCARTNEYS LLP. THE CLIENT IS LICENSED TO USE THE DESIGNS FOR THE PURPOSE FOR WHICH THEY WERE PRODUCED ON PAYMENT TO McCARTNEYS LLP OF THE COSTS OF PREPARATION OF THE PLAN AND DESIGNS.

LICENCES

Ordnance Survey
LICENCE No: 100004120. REPRODUCED FROM THE ORDNANCE SURVEY MAP WITH PERMISSION OF THE CONTROLLER OF H.M. STATIONERY OFFICE. PUBLISHED FOR THE PURPOSE OF IDENTIFICATION ONLY AND ALTHOUGH BELIEVED TO BE CORRECT ITS ACCURACY IS NOT GUARANTEED. CROWN COPYRIGHT RESERVED

PROMAP
LICENCE No: 10020449

McCartneys Planning & Survey

39 Broad Street, Newtown,
Powys, SY16 2BQ

JOB:
Extension to Fir View Caravan Park,
Llangyniew, Llanfair Caereinion,
Welshpool, Powys

CLIENT:
Sheehan Holdings

TITLE:
Proposed Site Plan

REVISIONS:	DATE:
A - Landscaping	19.05.2020
B - Landscaping	21.09.2020
SCALES: Plan 1:1250	DATE: April 2020
DRAWN BY: GJ	ORIGINAL SHEET SIZE: A1
DRAWING NUMBER: Ki 5595	1 B

Appendix B

Hydrogeo Borehole Logs

HYDROGEO Ltd

BOREHOLE LOG

Project				BOREHOLE No
HYG1043 Fir View Tan Y ffridd Holiday Park				**BH1**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
HYG1043	13-04-22 13-04-22	103.28		
Contractor				Sheet
Jackson Drilling				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Instrument/ Backfill
Depth	Type No	Test Result						
				103.04		0.24	Slightly Clayey TOPSOIL	
						(3.86)	Very gravelly, cobbly, slightly silty CLAY with sub-rounded to rounded gravels and cobbles of mixed lithologies [GLACIAL TILL]	
			1	99.18		4.10		
						(1.90)	Very weak, silty to very silty grey MUDSTONE. Recovered as a grey / silver sludge [LAUNDRY MUDSTONE FORMATION]	
				97.28		6.00		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:50	Client Mr Christopher Ayre	Method/ Plant Used Geo205	Logged By SG

HYDROGEO Ltd

BOREHOLE LOG

Project				BOREHOLE No
HYG1043 Fir View Tan Y ffridd Holiday Park				**BH2**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
HYG1043	13-04-22 13-04-22	100.37		
Contractor				Sheet
Jackson Drilling				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Instrument/ Backfill
Depth	Type No	Test Result						
				100.07		0.30	Slightly clayey TOPSOIL 0.00 - 5.80	
						(2.50)	Slightly silty, very gravelly and cobbly CLAY. Gravels and cobbles are of mixed lithologies [GLACIAL TILL]	
			1					
				97.57		2.80		
						(3.00)	Weak to very weak slightly silty to very silty grey / silver MUDSTONE. Recovered as a sludge [LAUNDRY MUDSTONE FORMATION]	
				94.57		5.80		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:50	Client Mr Christopher Ayre	Method/ Plant Used Geo205	Logged By SG

HYDROGEO Ltd

BOREHOLE LOG

Project				BOREHOLE No
HYG1043 Fir View Tan Y ffridd Holiday Park				BH3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
HYG1043	14-04-22 14-04-22	101.56		
Contractor				Sheet
Jackson Drilling				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Instrument/ Backfill
Depth	Type No	Test Result						
				101.27		0.29	Slightly clayey TOPSOIL	
						(2.81)		
				98.46		3.10	Weak, very silty grey / silver Mudstone. Recovered as a sludge with pieces of rounded intact Mudstone fragments. [LAUNDRY MUDSTONE FORMATION]	
						(2.90)		
				95.56		6.00		

Boring Progress and Water Observations					
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

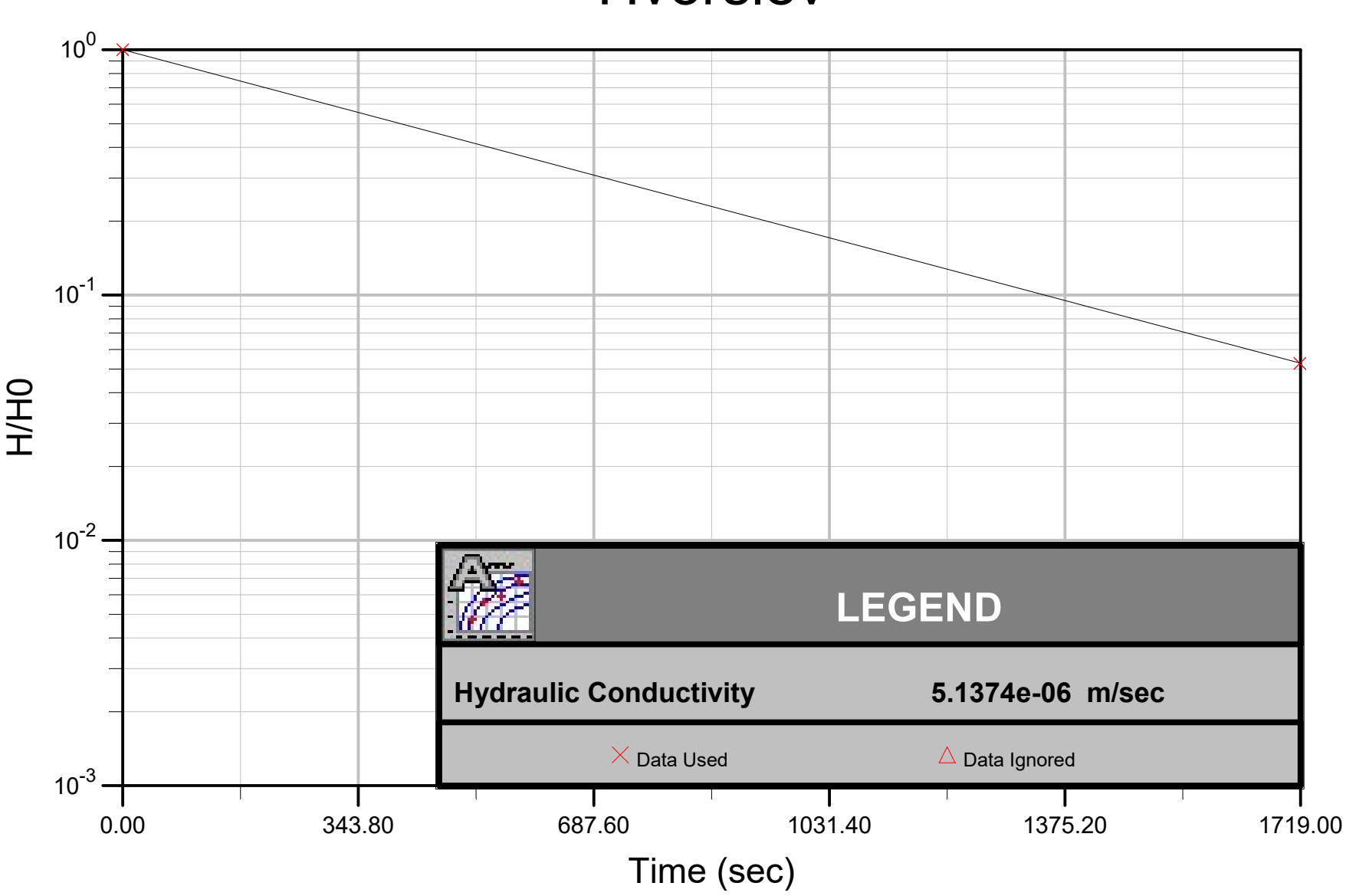
All dimensions in metres Scale 1:50	Client Mr Christopher Ayre	Method/ Plant Used Geo205	Logged By SG

Report ID: AGS4 UK BH || Project: HYG1043 220506 GROUNDWATER MONITORING BOREHOLE LOGS.GPJ || Library: GINT STD AGS 4_171016.GLB || Date: 6 May 2022

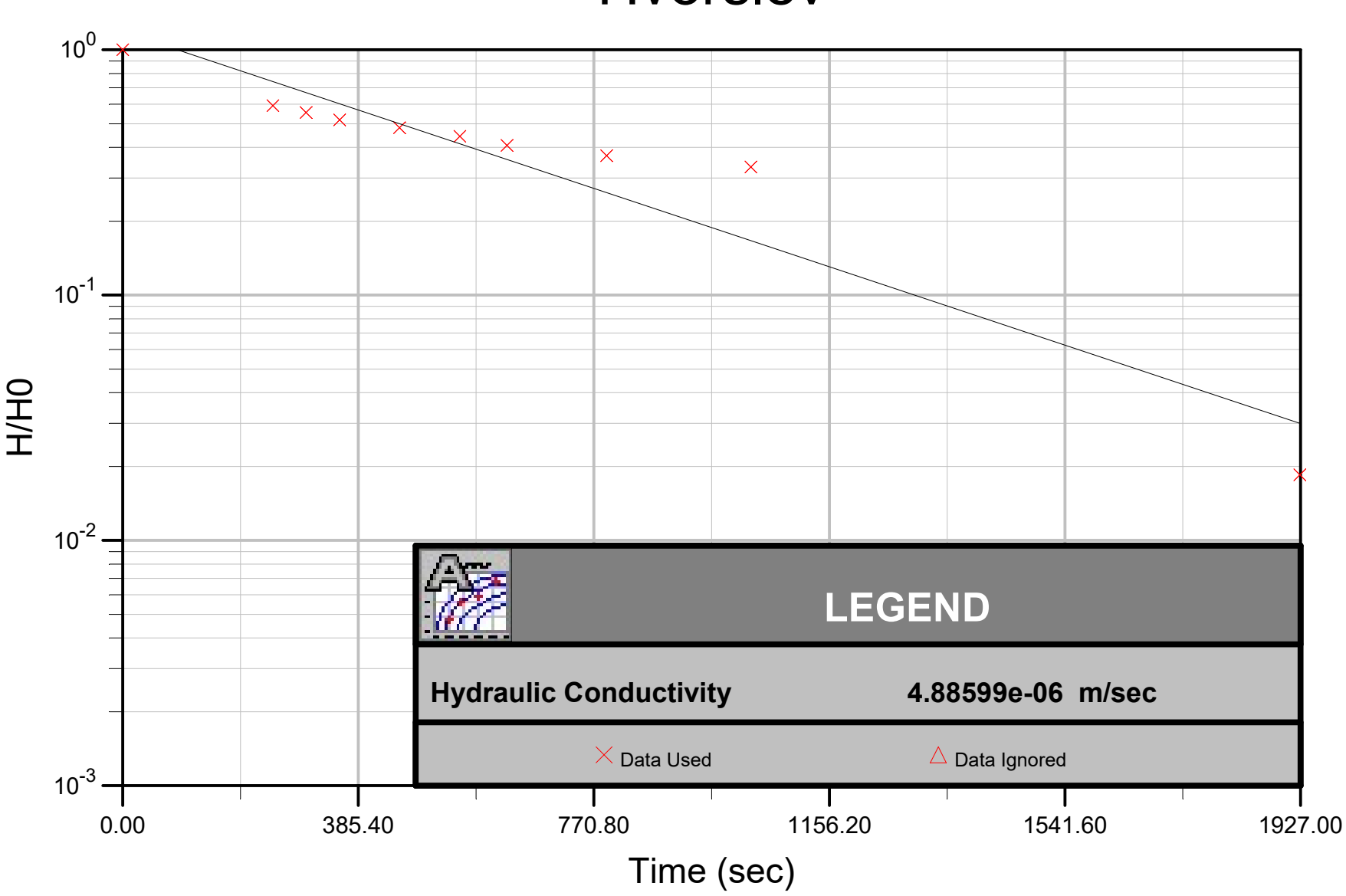
Appendix C

Permeability test results

Hvorslev


10^0
10^{-1}
10^{-2}
10^{-3}
H/H0
0.00
343.80
687.60
1031.40
1375.20
1719.00
Time (sec)
LEGEND
Hydraulic Conductivity
5.1374e-06 m/sec
Data Used
Data Ignored

Hvorslev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10^{-2}
10^{-3}
H/H0
0.00
385.40
770.80
1156.20
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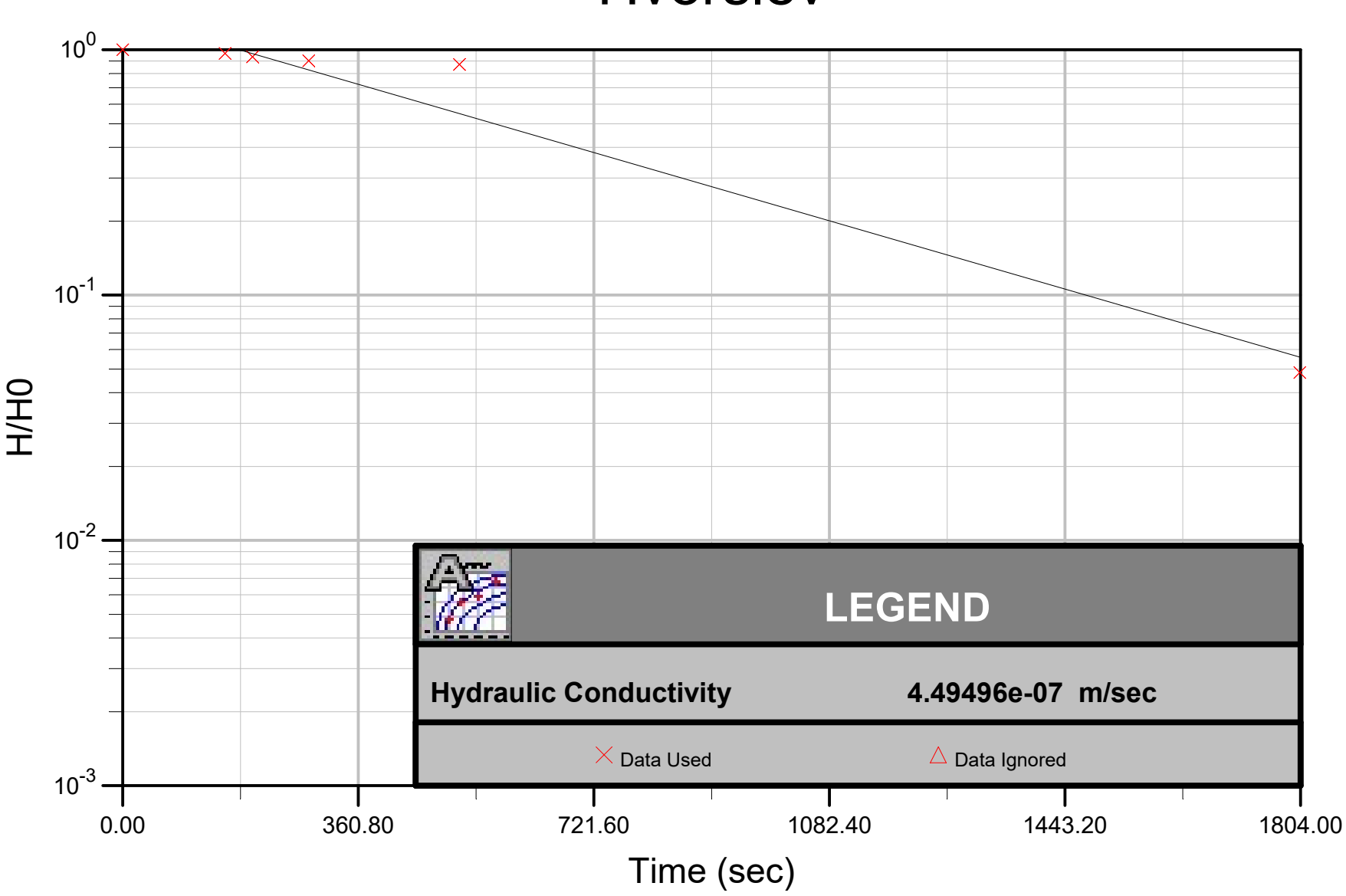
1927.00
Time (sec)
LEGEND
Hydraulic Conductivity
4.88599e-06 m/sec
Data Used
Data Ignored

Hvorslev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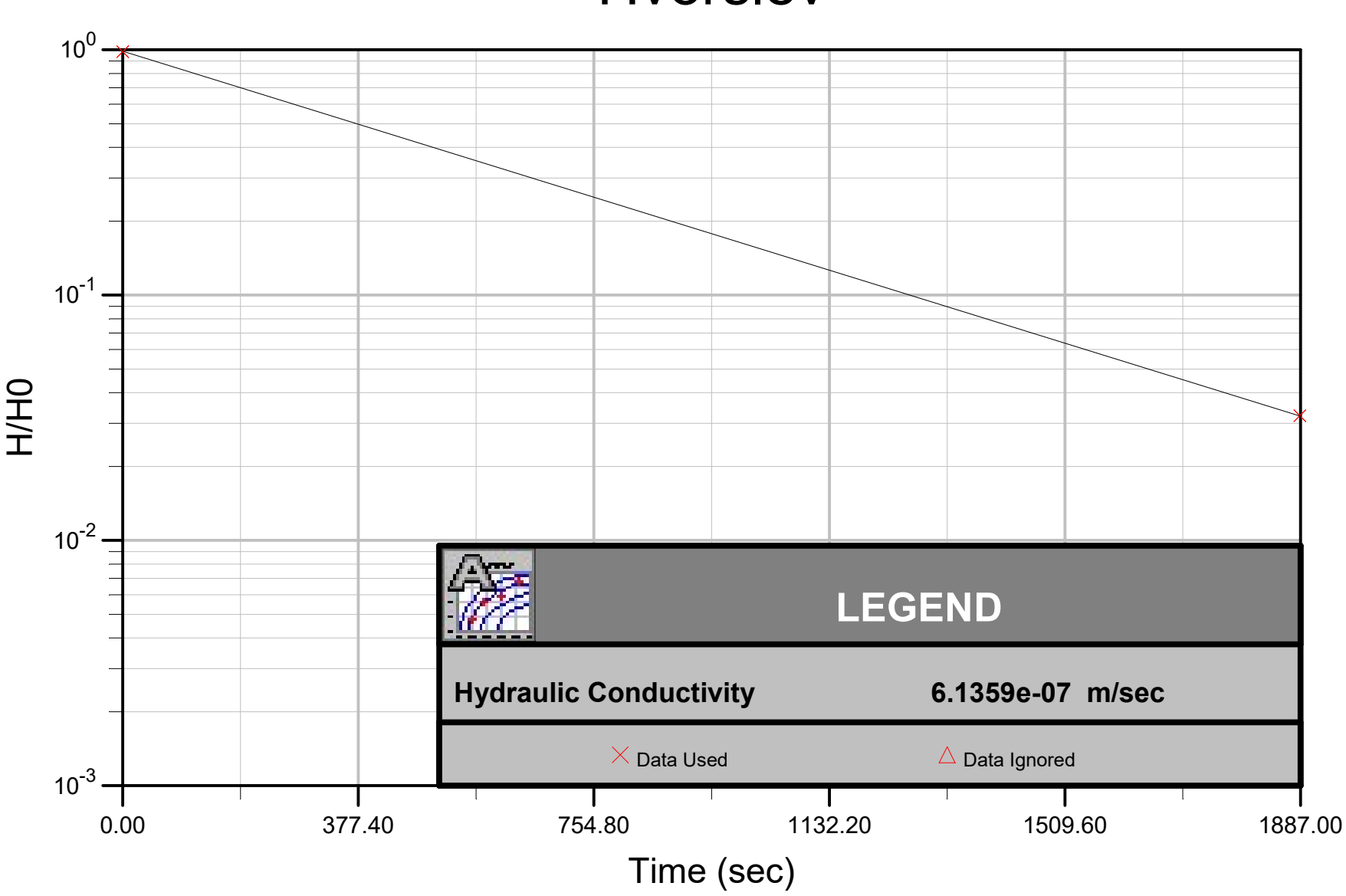
10^{-1}
10^{-2}
10^{-3}
H/H0
0.00
360.80
721.60
1082.40
1443.20
1804.00
Time (sec)
LEGEND
Hydraulic Conductivity
4.49496e-07 m/sec
Data Used
Data Ignored

Hvorslev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10^{-2}
10^{-3}
H/H0
0.00
377.40
754.80
1132.20
1509.60
1887.00
Time (sec)
LEGEND
Hydraulic Conductivity
6.1359e-07 m/sec
Data Used
Data Ignored

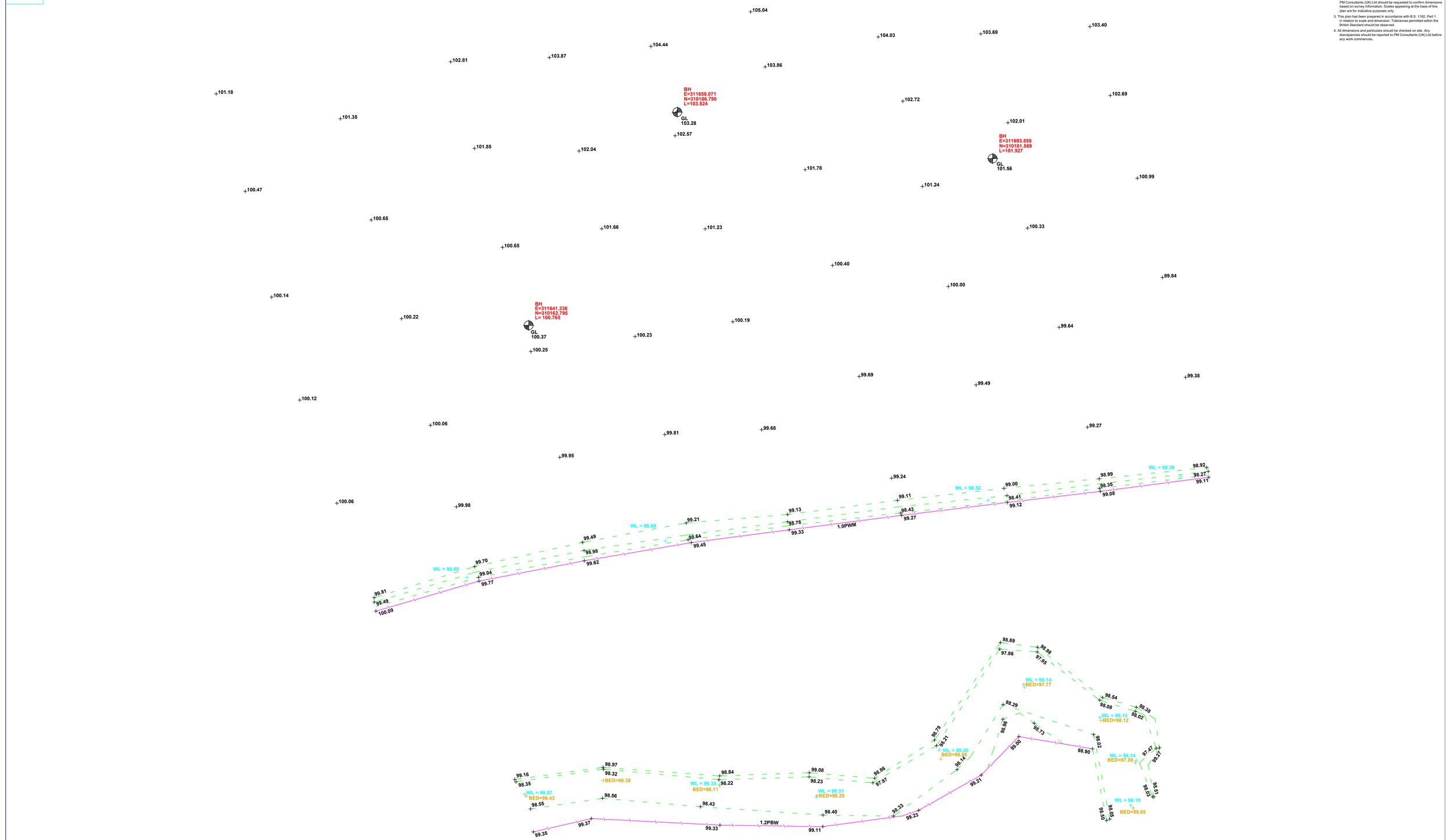
Appendix D

Topographic Survey

A1

Notes:

1. This drawing is copyright and its use or reproduction without the written permission of PM Consultants (UK) Ltd is prohibited
2. Due to unavoidable inaccuracies during the reproduction process these drawings should not be scaled. Where dimensions are critical PM Consultants (UK) Ltd should be requested to confirm dimensions based on survey information. Scales appearing at the base of this plan are for indicative purposes only.
3. This plan has been prepared in accordance with B.S. 1192, Part 1 in relation to scale and dimension. Tolerances permitted within the British Standard should be observed.
4. All dimensions and particulars should be checked on site. Any discrepancies should be reported to PM Consultants (UK) Ltd before any work commences.



KEY

38.32	SPOT LEVEL	TS	TRAFFIC SIGNAL	CONC	CONCRETE	1.0 BR	WALL (WITH DESCRIPTION & HEIGHT)
TAR	TARMAC	TSC	TRAFFIC SIGNAL CONTROLLER	RWP	RAINWATER PIPE	2.0 PR	FENCE (WITH DESCRIPTION & HEIGHT)
FB	FLOWER BED	IC	INSPECTION COVER	SVP	SOIL VENT PIPE		HEDGEROW/TREE CANOPY
H/S	HARDSTANDING	MH	MANHOLE	FW	FOUL WATER		BUILDING LINE
BOL	BOLLARD	MP	MARKER POST	SW	STORM/SURFACE WATER		CHANNEL/KERB LINE
TW	TOP OF WALL	TP	TELEGRAPH POLE	W	WATER/STOP TAP		TOP/BOTTOM OF BANK
RS	ROAD SIGN	LC	LIGHTING COLUMN	STAY	STAYWIRE		SOFT EDGE OR VERGE EDGE
TWL	TOP WATER LEVEL	G	GULLY	SNP	STREET NAMEPLATE		HARD EDGE
IL	INVERT LEVEL	WM	WATER METER				OVERHEAD LINE
FH	FIRE HYDRANT	SV	SLUICE VALVE				GATE
BT	BRITISH TELECOM	ST	STOP TAP				
CATV	CABLE TV	GV	GAS VALVE				
TACT	TACTILE PAVING	FFL	FINISHED FLOOR LEVEL				

N

NOTES:

LEVELS AND CO-ORDINATE GRID ARE RELATED TO GPS SURVEY DATUM DERIVED FROM ORDNANCE SURVEY DATUM VIA OSTN15

ALTHOUGH O.S. CO-ORDINATES ARE SHOWN ON THIS PLAN THE GRID IS TO BE TREATED AS ARBITRARY.

NO SCALE FACTOR HAS BEEN APPLIED TO THE SURVEY THEREFORE THE CO-ORDINATES SHOWN ARE NOT TRUE O.S. CO-ORDINATES.

ISSUE	REVISION	DATE

Job: TOPOGRAPHICAL SURVEY
FIR VIEW, TAN Y FRIDD HOLIDAY PARK
LLANGYNIEW, WELSHPOOL

Scale:	Date:	Drawn By:	Checked By:	Job Ref.
1:200	25/04/22	EH	NM	HG/FVT/001

Client: Hydrogeo Ltd
Waddington House, Unit 4
Llanover Business Centre
Llanover, Abergavenny

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Constructionline A UK GOVERNMENT CERTIFICATION SCHEME
Achilles
BUILDER'S PROFILE

Appendix E

Infiltration Worksheet model (Excel Spreadsheet)