JOLLIFF HOMES

# Crays Barn, Goose Green, Pulborough RH20 2LR

Prepared by New Form Architecture Ltd

March 2025
Jolliff Homes Ltd

# Contents



Stephen Buss Environmental Consulting

# Proposed Development

The land at Crays Barn, Goose Green, Pulborough, RH20 2LR, currently includes a barn that will be demolished. The proposed new development will consist of one four-bedroom detached house and two three-bedroom detached houses.

## Existing Water Demand

There are no records of existing water consumption for the barn, as it shared a meter with other buildings on a neighboring plot. The site is currently supplied with mains water by the local provider, Southern Water.

## Envisaged Potable Water Consumption (New Development)

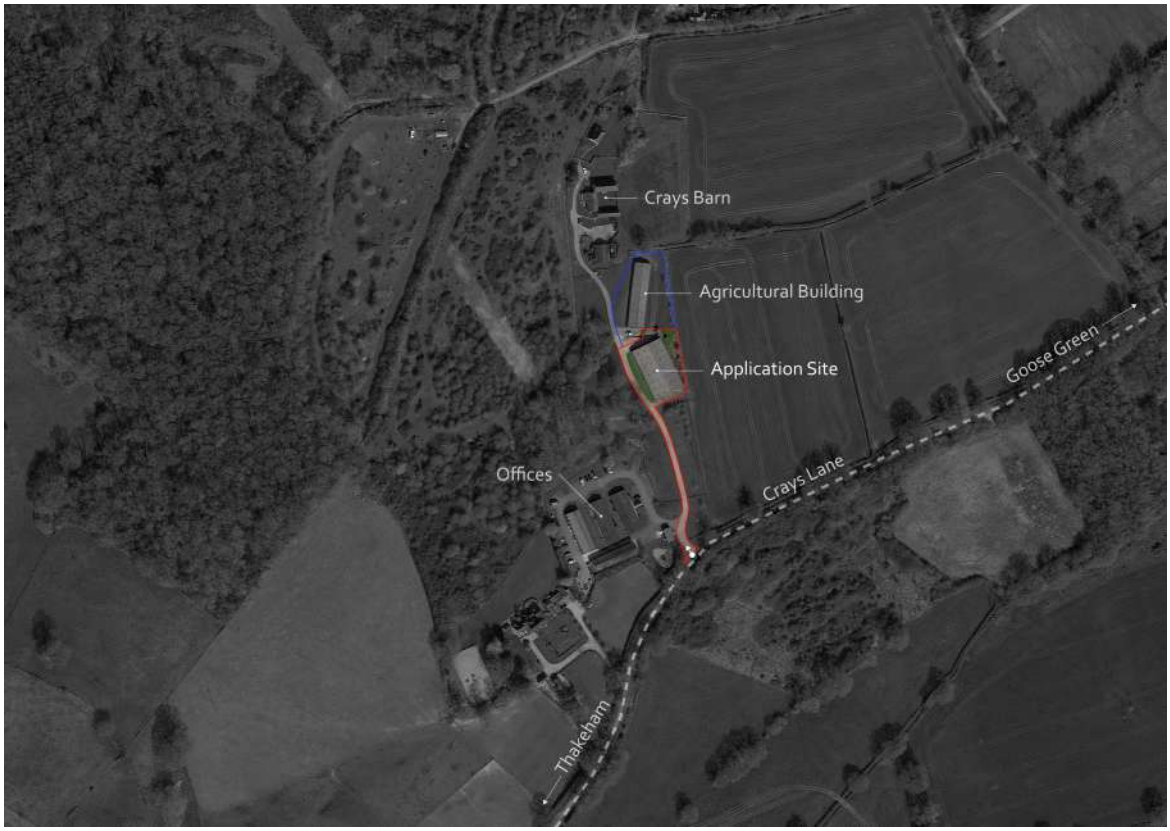
The proposed development will be supplied with water from a borehole water-well system, with a daily demand of 663 liters (0.663 $m^3$) and an annual demand of 241,995 liters (241.995 $m^3$).

Based on the required usage of 85 liters per person per day (l/p/d), the baseline water demand for the proposed development is calculated to be 663 liters (0.663 $m^3$) per day.

| Allowance 85 l/p/p/d | | Bedrooms | est Occupancy | Water Consumption l/d | l/y | Cubic L $l^3$/d | $l^3$/y |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Plot 1 | | 4 | 2.86 | 243.1 | 88,731.50 | 0.2431 | 88.73 |
| Plot 2 | | 3 | 2.47 | 209.95 | 76,631.75 | 0.20995 | 76.63 |
| Plot 3 | | 3 | 2.47 | 209.95 | 76,631.75 | 0.20995 | 76.63 |
| | | | | | | | |
| Total | | | | 663 | 241,995 | 0.663 | 241.995 |

## Water Supply From Boreholes

Two boreholes are proposed for the development, with one already constructed on site to meet the water demand for the new dwellings. The required water supply from the two boreholes is 663 liters per day.




Ariel View of the Existing Application Site


Proposed Site Plan

New
Form
Architecture
your vision delivered

# Water Neutrality Report
# Design & Maintenance Supporting Detail

March 2025

## Contents

## INTRODUCTION

This report has been produced by New Form Architecture Ltd in collaboration with Jolliff Homes. The aim is to demonstrate conclusively that the proposed borehole solution will meet Water Neutrality requirements.

The plan is to achieve Water Neutrality by utilizing two private boreholes. This document outlines the design process and illustrates the anticipated final design for the site, based on existing borehole extractions within a 3KM radius.

It was decided not to apply for an Environment Agency Water Abstraction Licence because the combined extraction from the two wells will remain well below the 20 cubic meter threshold.

## ACHIEVING NEUTRALITY VIA A PRIVATE BOREHOLE

The boreholes are intended to supply the three dwellings without using mains water, thereby achieving "neutrality." This approach has been thoroughly investigated with local geologists and in detail with the appointed drilling company.

## BOREHOLE DESIGN APPROACH

The initial step in any borehole design involves understanding the local geology and the potential for a sustainable water supply. This has been accomplished by commissioning a specialist with local expertise and reviewing data from existing boreholes in the surrounding area.

### Design Considerations

The physical construction of the boreholes has been tailored to suit the geology and expected water quality. The boreholes will feature UVPC lining with a 125mm screen and casing, surrounded by a washed and graded shingle gravel pack that acts as a pre-filter to keep the annulus open and stable. The top section of the boreholes will be sealed to a depth of 10 meters below ground using borehole-grade bentonite to form an impervious seal, protecting the source from unconfined groundwater in the upper geology.

The wellhead will be elevated above ground level to guard against surface runoff or accidental spills, and access will be secured with a lockable and insulated cover.

The control mechanism will prioritize the boreholes as the primary water source for the site, with a mains backup supply for emergencies only. The design includes two boreholes to minimize the risk of service outages, ensuring continuous water supply even during maintenance or repairs.

**Water Treatment**

The water treatment system is designed based on expected water quality (derived from local boreholes) and may be adjusted once the specific water chemistry of the site is confirmed through sampling. Filtration will use inert media whenever possible, minimizing the need for secondary products. The entire system will undergo stress testing and commissioning before use, with Group A & B testing to verify effectiveness.

**Service and Maintenance**

A customised service and maintenance schedule for the two boreholes will be established as part of Invicta Water Treatment Limited's appointment. The following is a typical schedule for a site of this nature, which will be formalized in a Method Statement.

In addition to regular maintenance, Invicta Water Treatment Limited will provide reactive maintenance and emergency services as needed. Working drawings, equipment manuals, service details, and contact information will be stored in the plant room as part of the Water Safety Plan.

**Treatment and Plant Room**

The system will be housed in a custom-built plant room, designed to provide easy access for servicing and maintaining all components. Multiple sample points will be installed to facilitate efficient quality monitoring and testing. The layout will also include space for storing consumables and spare parts, ensuring the system can be maintained effectively.

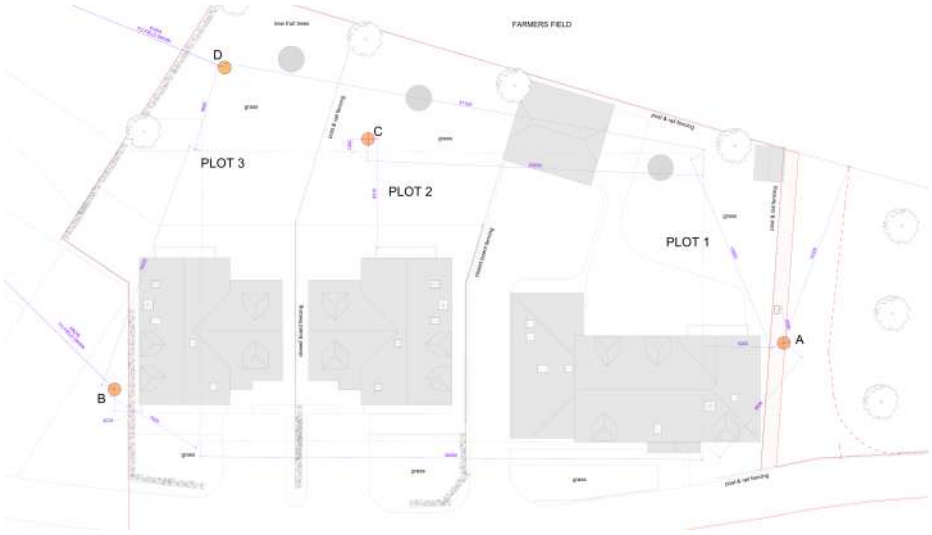
A spare borehole pump will be kept on site to ensure immediate availability in case of failure. The system will feature a regulation-compliant (air-gapped) mains backup, which will automatically fill the storage tank, guaranteeing a continuous water supply to the consumer during any system failures.

Visual warnings will be incorporated into the design to alert consumers to system breakdowns, particularly concerning the ultraviolet treatment, which neutralizes bacteria in the water. The borehole panel and mains backup will also have visual alarms. An LED beacon will be installed within the utility area of each house to ensure warnings are visible in each property. Additionally, a borehole pump failure alarm will be mounted on the outside of the plant room.

## PROPOSED BORHOLE LOCATIONS

A specialist contractor's investigation identified four potential drilling locations on the site. These locations are shown in the image below. Locations C and D have been excluded due to their placement in the gardens of Plots 2 and 3.

Locations A and B are deemed the most suitable for the site, being directly adjacent to the defined plots and providing easy access to the treatment room for maintenance and testing.




## SERVICE AND MAINTENANCE SCHEDULE

A tailored service and maintenance schedule for the two boreholes will be established as part of Invicta Water Treatment Limited's appointment. The following is an anticipated schedule for a site of this nature, which will be formalized in a Method Statement.

In addition to the regular maintenance routine, Invicta Water Treatment Limited will offer reactive maintenance and emergency services if needed. Working drawings, equipment manuals, service details, and contact information will be stored in the plant room as part of the Water Safety Plan.

The booster set will operate on a 'duty assist' basis, providing redundancy in case of a breakdown. Sacrificial media, essential equipment spares, and a spare borehole pump will be stored in the plant room.

Every 6 Months

- Electrical Testing on borehole pump, booster set and shunt pump
- Visual check on particulate filter (replace if necessary)
- Visual check on Ultraviolet & Media filters
- Visual check on compressors and contact tank
- Visual check on storage tank
- Dip sacrificial medias and top up as necessary (PH correction)
- Manually operate mains back up
- Interim water test (targeted to ensure filter efficacy)
- EHO testing (suite to be as EHO instruction, minimum Group A)

Annually

- Electrical testing on borehole pump, booster set and shunt pump
- Replace particulate filter
- Replace all ultraviolet lamps, quartz tubes and seal kits
- Clean contact tank and main storage tank
- Replace seal stack and pistons on filter heads
- Replace seal kits on the compressors
- Dip sacrificial medias and top up as necessary (PH Correction)
- Manually operate mains back up
- Interim water test (target to ensure filter efficacy)
- EHO testing (suite to be as EHO instruction, minimum Group A)

Bi-Annual

- If required, chemical flush of the borehole, down the hole screens, borehole pump and connecting pipework (to clean expected deposits)

5 Yearly

- Replace filter medias

## LONGTERM ACCOUNTABILITY AND REPONSIBILITY

During construction and pre-occupation, accountability and responsibility for the borehole and water quality will sit with Jolliff Homes Ltd. However, once the 3 dwellings are sold it is intended that Jolliff Homes Ltd will be responsible for shared access and shared service and instruct Invicta Water Treatment Limited to carry out the maintenance regime, repairs, testing and servicing for the borehole in perpetuity under a maintenance contract.

**Stephen Buss**
**Environmental Consulting Ltd**

# Water Neutrality Statement, Crays Barn, Goose Green, Pulborough

**Version control log**

| Document number | Date | Issued by | Issued to | Comments |
|---|---|---|---|---|
| 2024-100-003-002 | 28 January 2025 | Steve Buss | Client | First draft |

Client: Jolliff Developments Ltd

Dated: January 2025

www.hydro-geology.co.uk

32 Port Hill Road, Shrewsbury SY3 8SA

Registered in England and Wales number 08595273

# DISCLAIMER

This report has been prepared by Stephen Buss Environmental Consulting Ltd (SBEC) in its professional capacity as hydrogeologist, in a manner consistent with the level of care and skill ordinarily exercised by members of the geological and engineering professions practising at this time, within the agreed scope and terms of contract, and taking account of the manpower and resources devoted to it by agreement with its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole. As with any environmental appraisal or investigation, the conclusions and observations are based on limited data. The risk of undiscovered environmental impairment of the property cannot be ruled out. SBEC cannot therefore warrant the actual conditions at the site and advice given is limited to those conditions for which information is held by SBEC at the time. The findings are based on the information made available to SBEC at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time.

This report is provided to the client addressed above. Should the client wish to release this report to any other third party for that party's reliance, SBEC accepts no responsibility to any third party to whom this report or any part thereof is made known. SBEC accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against SBEC except as expressly agreed with SBEC in writing.

The findings do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

# TABLE OF CONTENTS



## Figures



## Appendices

# 1. Introduction

The site is Crays Barn, Crays Lane, Goose Green, Pulborough RH20 2LR. As part of a proposed housing development for three domestic properties, and to allay issues regarding water neutrality, the water supply is to be provided by one on-site borehole. The water neutrality report by New Form Architecture indicates that the demand for water will be 0.663 $m^3$/day and 242 $m^3$/year.

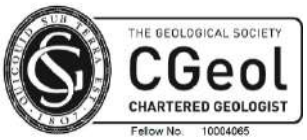
Natural England (2022) believes that groundwater abstraction in the Sussex North water supply zone (WSZ) has a detrimental impact on the Arun Valley SAC, SPA and Ramsar site. The development site, like the whole of Horsham District, is in the SNWSZ. Hence to prevent further deterioration of the SAC, SPA and Ramsar site, Natural England insists that:

> "For every new development, total water use in the Sussex North Water Supply Zone after the development must be equal to or less than the total water-use in the region before the new development."

Hence each new development will need to demonstrate how that development will achieve no net increase in water consumption, by water efficiency measures, offsetting or, in the case of this proposal, not being reliant on groundwater resources that are used for public water supply in the WSZ.

For the desired rate of 0.663 $m^3$/day an abstraction licence is not needed from the Environment Agency. Therefore, this note has been prepared according to the Horsham District Council (HDC) guidance[1] to demonstrate that the borehole is a suitable solution for water neutrality at the development.

This report has been prepared by Dr Stephen Buss MA MSc CGeol. Dr Buss is a UK-based independent hydrogeologist with more than 25 years' consulting experience in solving groundwater issues for the Environment Agency, water companies and other private sector organisations. Dr Buss's CV and publications list is available at www.hydro-geology.co.uk.




[1] https://www.horsham.gov.uk/planning/water-neutrality-in-horsham-district/water-neutrality-and-planning-applications

# 2. Physical Background

## 2.1 Topography and Hydrology

The site is located in the Low Weald, about 2.0 km east of West Chiltington. The national grid coordinate of the borehole is TQ 11358 18040.

Ground elevation at the borehole is about 29.7 m above Ordnance Datum (AOD) according to Environment Agency LIDAR data. The site is on a north-east facing slope which turns into the shallow valley of the Lancing Brook, a tributary of the River Adur. Lancing Brook flows north-east to come to confluence with the River Adur near Dial Post.

There are no designated conservation sites within 3 km of the site. The site is not within a source protection zone.

## 2.2 Geology

Local bedrock is the Weald Clay Formation which comprises thinly-bedded mudstones with subordinate siltstones, and fine- to medium-grained sandstones. The borehole has been drilled to exploit groundwater from within the Weald Clay Formation.

According to the British Geological Survey sheets 318 & 333 (Brighton and Worthing), the geological strata here dip gently to the south or south-west (

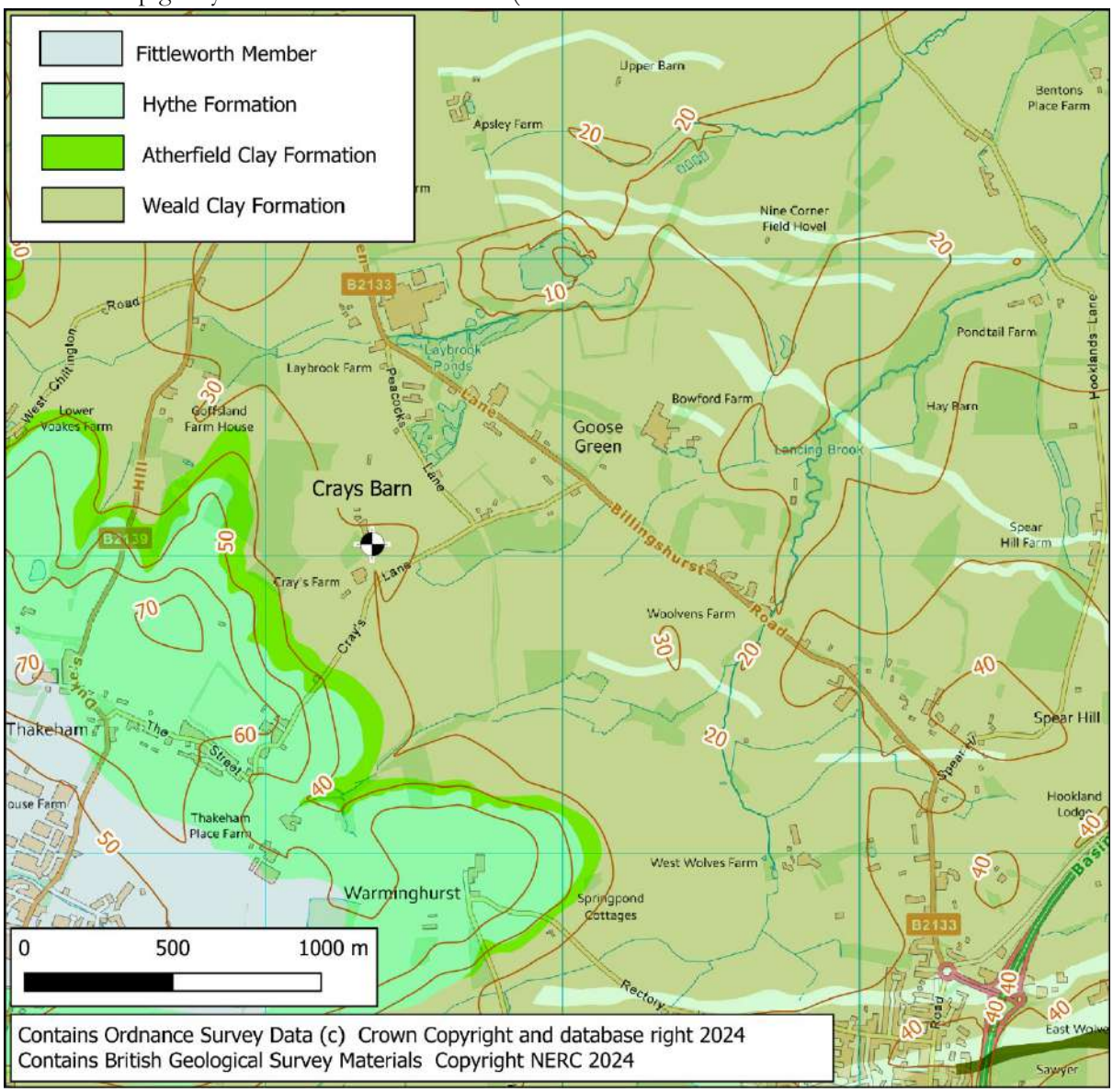



Figure 2.1). Outcrop geology beneath the site comprises Weald Clay mudstones, with thin mapped sandstone units cropping out to the east and north-east. Given the shallow dip of strata, sandstone outcropping to the north-east may pass beneath the site to be intercepted by the borehole. There are no superficial deposits at or near the site.

There are several boreholes to the north and east of the site, also constructed in the Weald Clay, as follows

- Borehole TQ11NW3 (Goffsland Farm) is about 850 m north-west of the site and was drilled to 52.4 m depth in 1915. The geology comprises mostly clay but with occasional layers of sand and "stone" and sandstone.
- Borehole TQ11NW8 (Laybrook Farm) is about 740 m north of the site and was drilled to 36.4 m depth in 1915. The geology comprises mostly clay but with occasional layers of "rock" and "stone".
- Borehole TQ11NW5 (The Ridge) is a disused borehole about 2.1 km south-east of the site and was drilled to 38.8 m depth in 1933. Again, this is mostly clay but with a "hard vein" – presumably a sandstone – at depth.

- Borehole TQ11NW6 (Holmbush House) is a disused borehole about 2.4 km south-east of the site and was drilled to 44.8 m depth in 1933. Mostly clay, but with a 3.3 m bed of "rock" at depth.
- Borehole TQ11NW1 (Hodges Nursery) is about 2.1 km south-east of the site, and was drilled to 45.5 m in 1936. This is a relatively detailed log and shows the presence of several sand, marl, shale and rock bands.

## 2.3 Hydrogeology

The target aquifer beneath the site is the Weald Clay. Clays of the Weald Clay Formation are classified as non-productive strata, but where there are outcrops of sandstones these are classed as a Secondary A aquifer. Young and Lake (1988) summarise the hydrogeology as follows.

> *"Some of the thin limestones and sandy beds in the Weald Clay yield small quantities of groundwater. The water-bearing strata tend to be discontinuous and the natural replenishment is limited. In consequence, even where the initial yield is substantial, it is possible for the pumping rate to diminish with time. Of eleven boreholes for which records are available, the yields ranged from nil to 32 $m^3$/day, with a mean of 17 $m^3$/day. The greatest depth to which any of these boreholes were sunk was 53 m, the shallowest 23 m."*

The logs of several of the boreholes mentioned above report the boreholes' tested yields: TQ11NW5 was successfully tested at 6.5 $m^3$/day, TQ11NW6 at 21.8 $m^3$/day, and TQ11NW1 at 13.1 $m^3$/day (though was reported to be yielding 16.4 $m^3$/day in 1940).

The log of borehole TQ11NW8 indicates that the borehole was drilled in 1915. Whilst no pumping rate is given, measurements of water level were taken in 1940 and 1947, indicating that the borehole was in operation over than time period.

These results indicate that the desired yield of 926 L/day should easily be available from the Crays Barn borehole over the long term.

## 2.4 Groundwater Quality

Young and Lake (1988) summarise the groundwater quality as follows.

> *"The groundwater within the Weald Clay is usually very soft, with a total hardness of the order of 25 to 50 mg/l. Where the limestone strata are intersected, the hardness may be 180 mg/l or more. The chloride-ion concentration may be high, in some cases exceeding 500 mg/l. Iron also presents a problem, with concentrations commonly greater than 0.5 mg/l."*

High chloride and iron concentrations can be readily treated. Ongoing testing by Invicta Water will demonstrate the water quality of the borehole and proposed treatment.

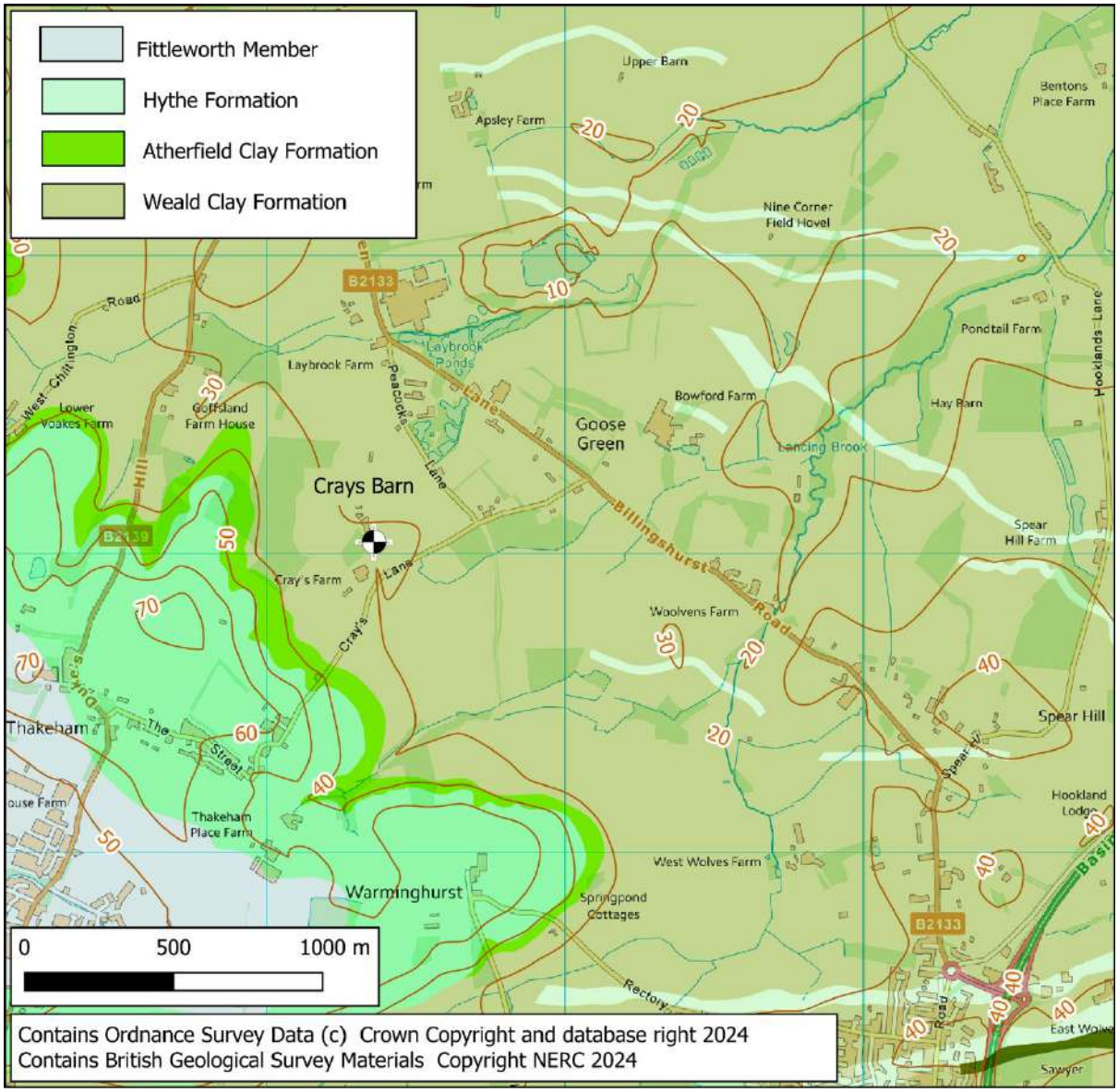



**Figure 2.1: Bedrock geology**

# 3. The Borehole

## 3.1 Construction

The borehole was drilled by Sussex Boreholes between 15 and 22 March 2023. Borehole diameter was 225 mm. 125 mm diameter plain uPVC casing was used to 39 m, then 125 mm slotted casing to the base of the borehole.

The log (Appendix A) indicates that the Weald Clay comprises an upper layer of clay with layers of sandstone to 39 m depth, then sand with layers of sandstone and clay to 66 m depth. A schematic borehole log is shown in Figure 3.1.

## 3.2 March 2024 Test

Shortly after drilling the Crays Barn borehole in March 2024, it was tested at a rate of 9.6 $m^3$/day for two hours, resulting in 27.7 m drawdown. Rest water level was 11.24 m below ground level.

## 3.3 December 2024 Test

A longer duration (10 days) pumping test was undertaken between 10 and 20 December 2024. The average pumping rate was 3.24 $m^3$/day. Rest water level at the start of the test was 16.3 m below ground level.

There was a little rain during the test period, with quite heavy rain throughout the 18 December, though no impact of this is discernible on the water levels (Figure 3.2).

Cooper-Jacob analysis has been undertaken for the drawdown data (Figure 3.3) from the new borehole (Table 3.1).

**Table 3.1: Derived aquifer properties**

| | Method | March test | December test |
|---|---|---|---|
| **Pumping rate ($m^3$/day)** | - | 9.6 $m^3$/day for 2 hours | 3.24 $m^3$/day for 8.5 days |
| **Drawdown at 2 hours (m)** | - | 27.7 m | 5.8 m |
| **Drawdown at max. time (m)** | - | 27.7 m | 11.3 m |
| **Specific capacity ($m^2$/day)** | Pumping rate ÷ max. drawdown | 0.35 $m^2$/day (at 2 hours) | 0.29 $m^2$/day (at 10 days) |
| **Transmissivity ($m^2$/day)** | Cooper-Jacob<br>Theis recovery | - | 0.24 $m^2$/day<br>0.11 $m^2$/day |

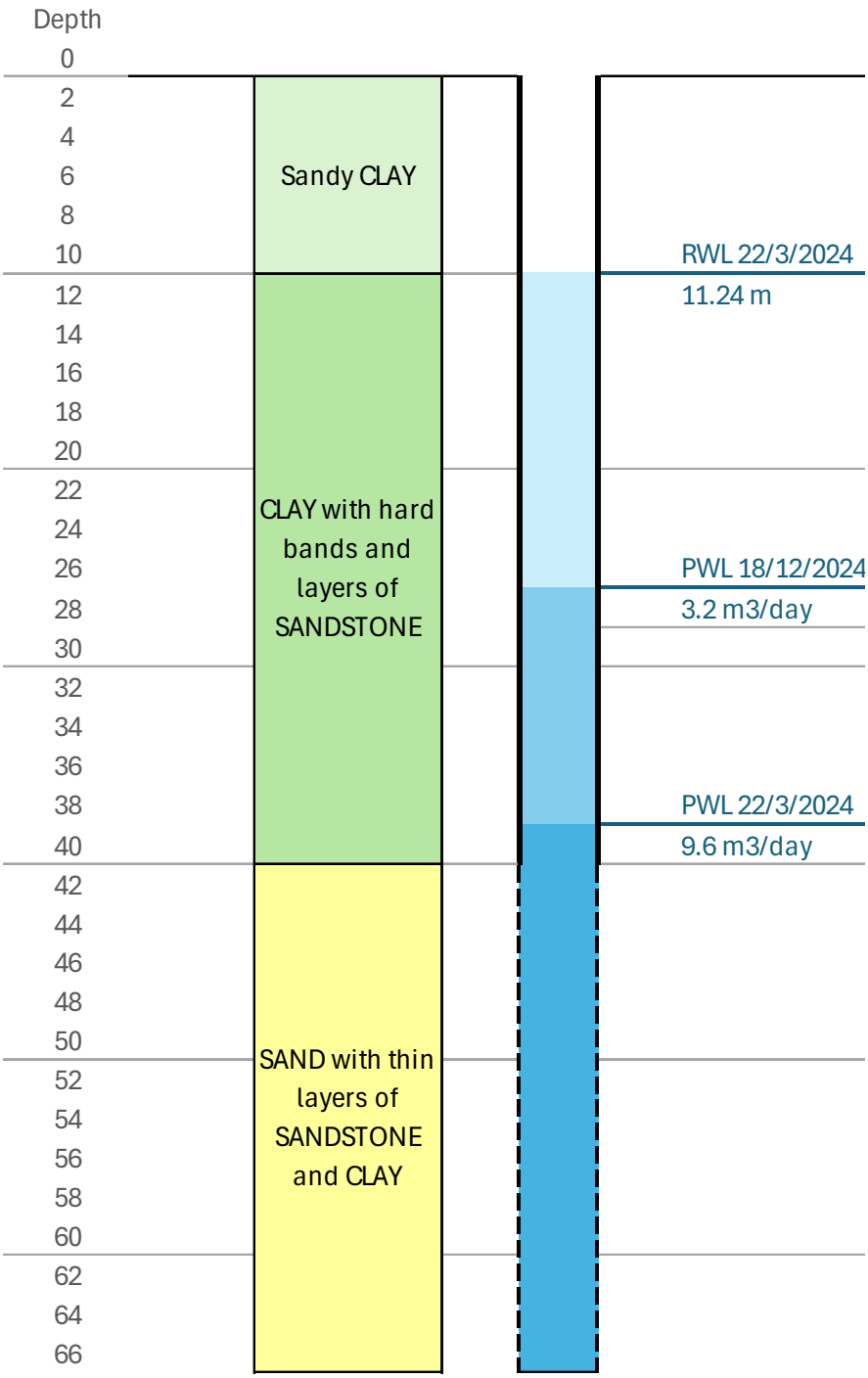



**Figure 3.1: Schematic borehole log**

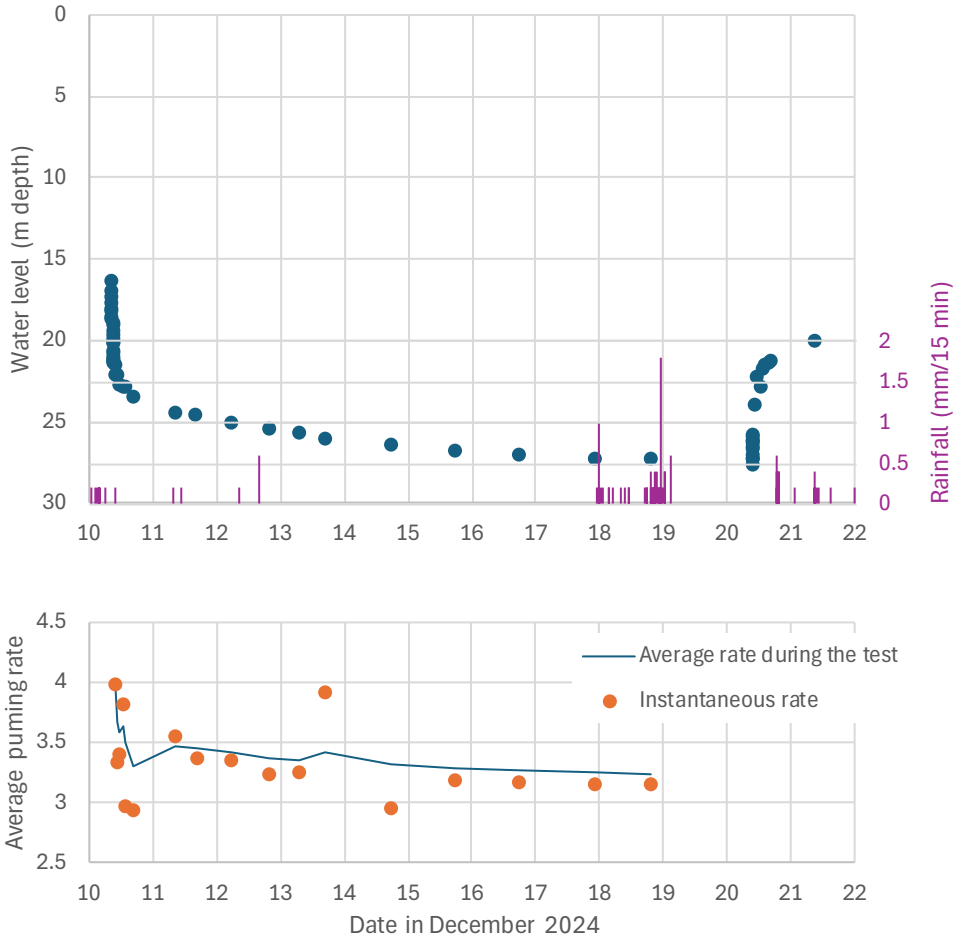



**Figure 3.2: Depth to groundwater, rainfall, and pumping rates**

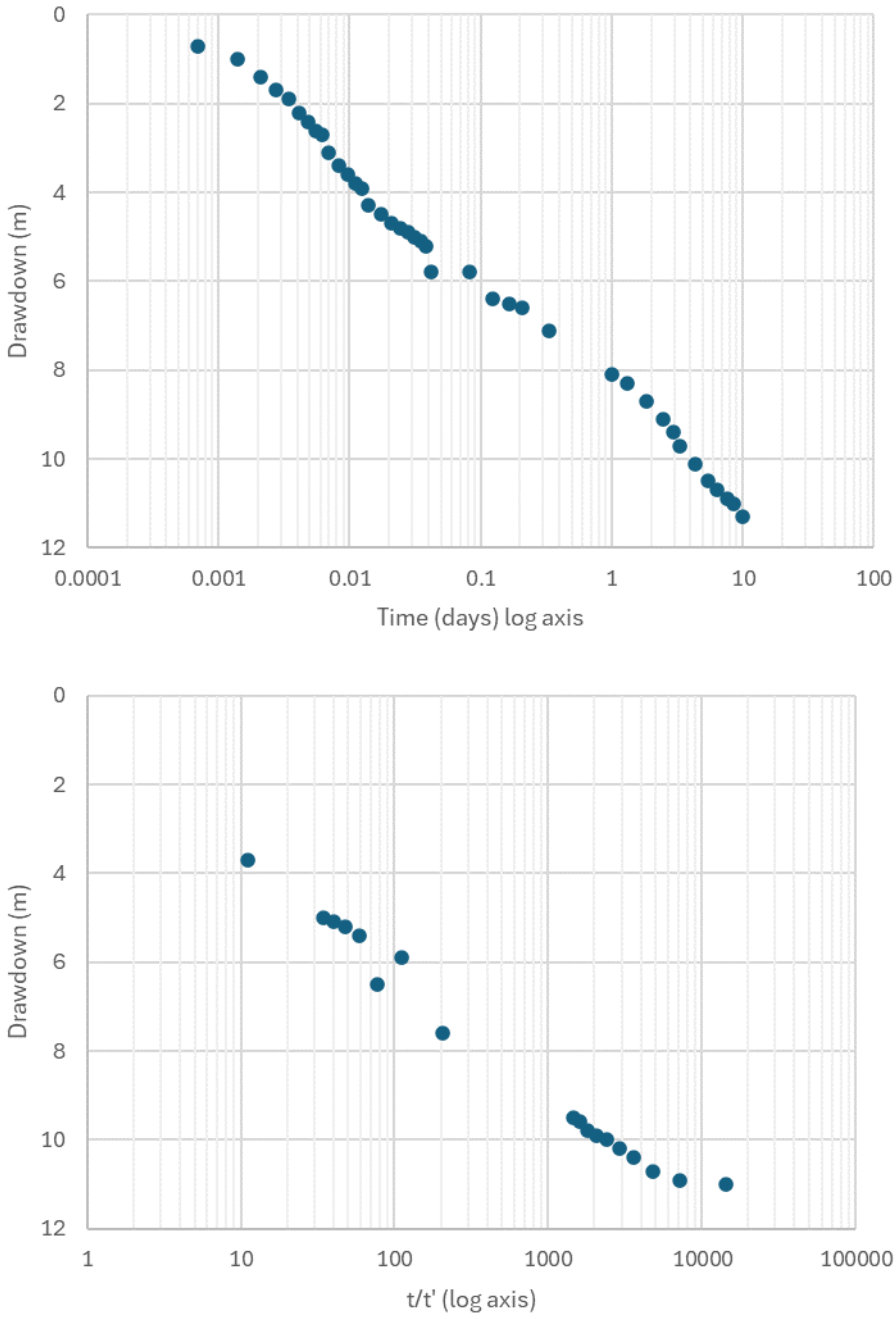



**Figure 3.3: Drawdown on log time scale, for Cooper-Jacob (top) and Theis recovery (bottom) analysis**

# 4. Appraisal

## 4.1 Groundwater Resources

The site borehole has been sited to draw the water supply for the site from the Weald Clay: a source that is not hydrologically connected to the Folkestone Formation aquifer that provides yield to the Sussex North WSZ. Geological strata here dip towards the south or south-west so the outcrop of the sand/sandstone band that is providing groundwater to the borehole is up-dip, to the north-east and away from the Folkestone Formation aquifer. The Hardham abstraction, which supplies the Sussex North WSZ, is about 7.5 km west of the site.

The site is also not in the catchment of the River Arun, which provides hydrological support to the Arun Valley SAC, SPA and Ramsar site. The effect of the proposed abstraction on the water balance of the River Arun will be zero. There are no conservation sites local to the site.

All water to be abstracted is for potable use, at a rate of 0.663 $m^3$/day. This is much less than the rate that the borehole has been proved to be capable of: having sustained a rate of 3.24 $m^3$/day for ten days in December 2024. Other, neighbouring, boreholes have also been proven to be capable of higher rates (Section 2.2).

Figure 4.1 shows the simulated range of potential drawdown (given uncertainty in aquifer parameters) at the borehole over 125 years, using the Theis equation (Krusemann and de Ridder, 1990) for confined aquifers. Drawdown is not expected to exceed 12 m.

## 4.2 Groundwater Quality

Groundwater quality is discussed in full in a report by Invicta Water Treatment (2024).

Water from the borehole was tested in July 2024 by an accredited UKAS PWS Sampler, Stefan Massingham. Lab testing showed that there were exceedances of several water quality parameters (turbidity, iron, manganese, aluminium, sodium, chloride, fluoride, boron, ammonium and total coliforms bacteria). Pesticides and nitrate (common agricultural pollutants) were tested for an the concentrations were well below drinking water standards.

A design for appropriate water treatment is presented in Appendix B, which also references similar schemes that have recently been accepted by HDC. The designed treatment scheme will be capable of treating 5000 litres per day: more than the anticipated demand at the site.

The proposed sampling and testing regime will be undertaken in accordance with Private Water Supplies (England) Regulations 2016, and will likely take into account the contaminants listed above: turbidity, iron, manganese, aluminium, sodium, chloride, fluoride, boron, ammonium and total coliforms.

An Operations and Maintenance manual will be provided on commissioning the treatment system that will include detail on the maintenance, servicing and cleaning of the tanks, water treatment equipment, pumps, all pipework etc for the lifetime of the development along with regularity of servicing/maintenance and clarification what steps will be taken in the event of equipment failure to ensure continuity of supply. The manual will also cover reporting.

## 4.3 Source Protection

Development of a water supply borehole leads to the creation of a default 50 m radius source protection zone (SPZ). Figure 4.2 shows the 50 m radius over Google Earth imagery from March 2022. This image shows that the area is mostly agricultural land, grass, hedges and the access road, except:

- The site, which is outlined in yellow, is currently occupied by a barn but will be occupied by housing, as highlighted in yellow hatching. Sewage effluent from the new houses is to be treated in an on-site package treatment plant and then discharged to the ditch adjacent to Crays Lane, about 100 m south of the borehole, so well outside of the SPZ.

- Parking for Crays Court Commercial units (in the far south-west of the catchment).

Activities that are prohibited within a SPZ1 are potentially very polluting such as landfilling, construction of filling stations or chemical works etc. none of which are anticipated in this environment. Normal domestic and agricultural activities are not prohibited within a SPZ1.

Full details of the activities that are and are not permitted are contained within the Environment Agency's groundwater protection position statements (www.gov.uk/government/publications/groundwater-protection-position-statements) and are frequently updated. These restrictions will be included in the O&M manual for the treatment works.

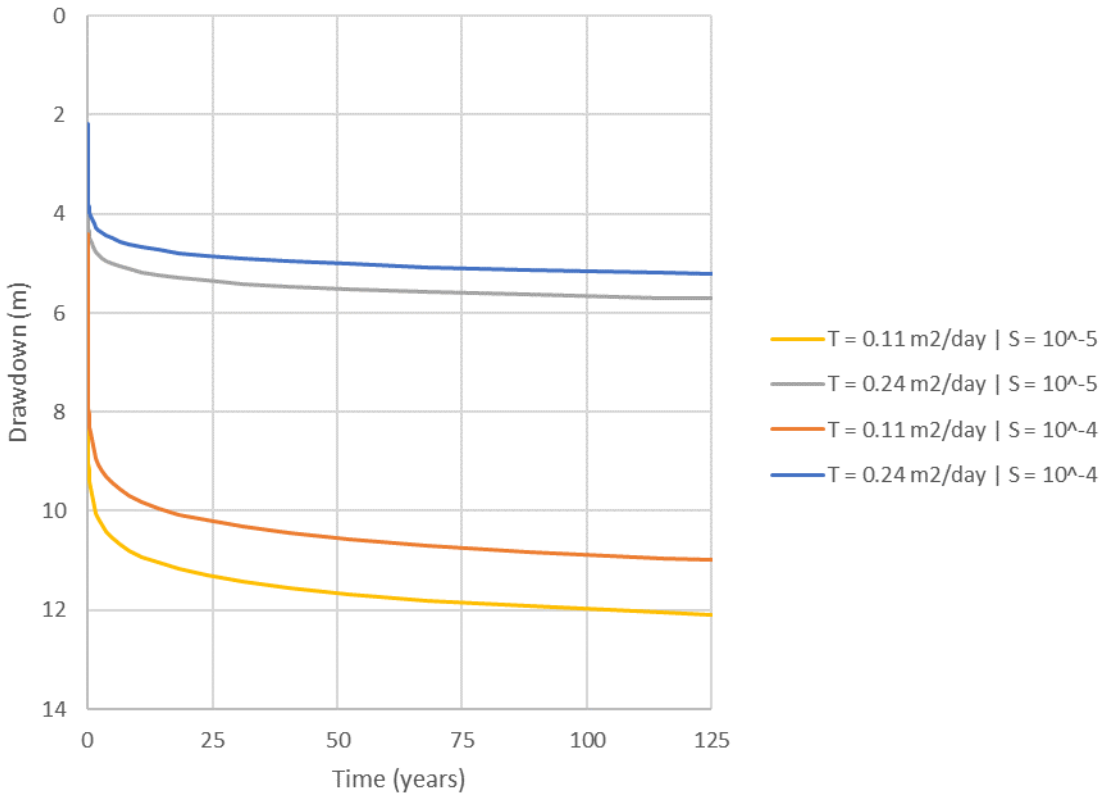



**Figure 4.1: Predicted range of drawdown over 125 years**

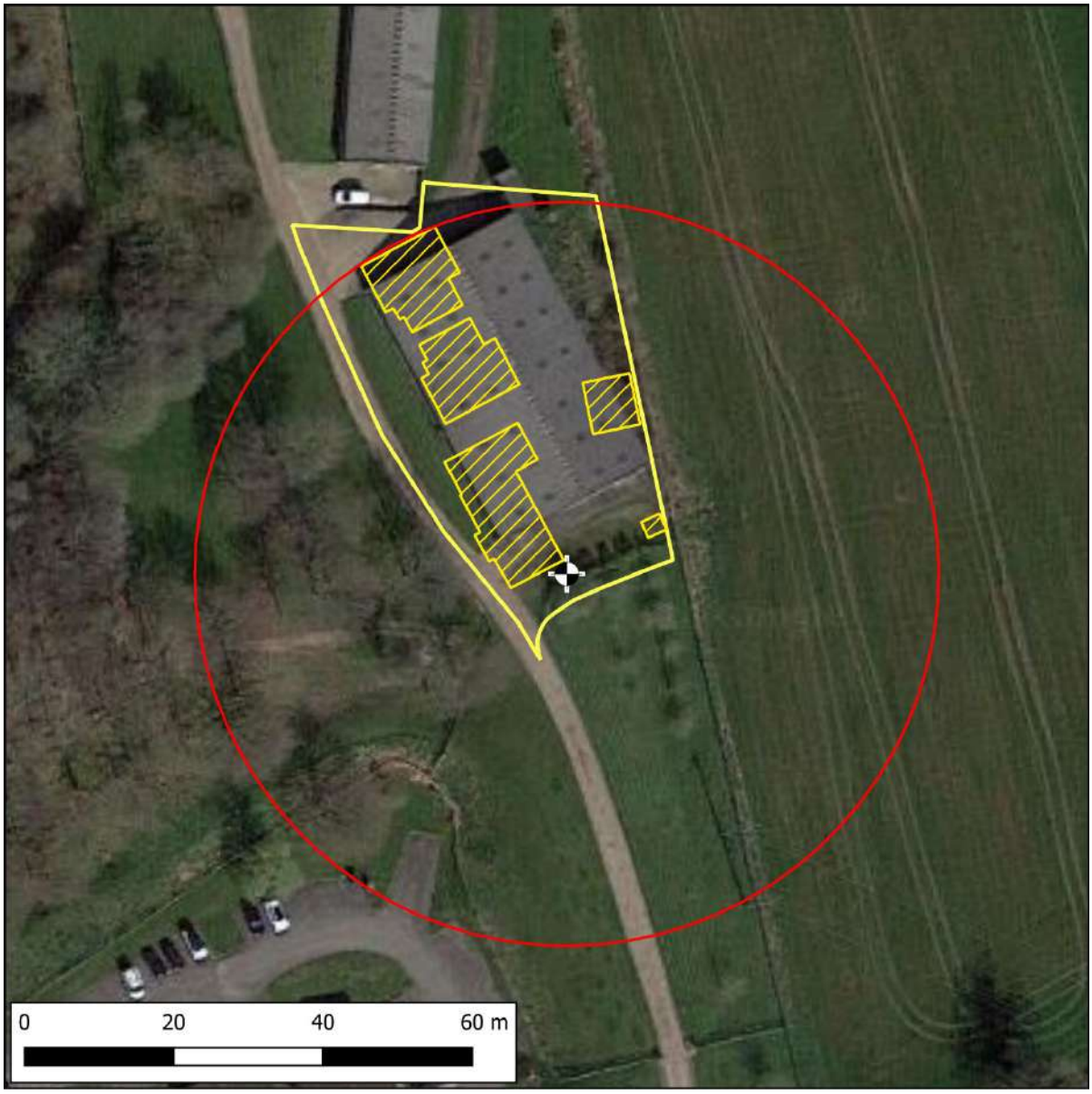



**Figure 4.2: 50 m radius source protection zone around the borehole, with land uses**

White: future outline of proposed house // yellow: nursery parking // aqua: pond

# 5. References

Kruseman, G.P. and de Ridder, N.A., 1990. Analysis and Evaluation of Pumping Test Data Second Edition. ILRI Publication 47.

Natural England, 2022. Natural England's Advice Note regarding Water Neutrality within the Sussex North Water Supply Zone: February 2022 V2