

**ASSESSMENT OF THE POTENTIAL IMPACT OF  
PROPOSED SAND & GRAVEL EXTRACTION  
UPON GALE MOSS**

**Report Reference: 3373/AOP  
FINAL  
August 2022**

**Report prepared for:**

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### GENERAL NOTES

Title of report: Hydrogeological impact assessment

Site: Gale Moss Quarry

Report ref: 3373/AOP

Date: August 2022

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## CONTENTS

|       |   |    |
|-------|---|----|
| 1     | INTRODUCTION .....                                | 1  |
| 1.1   | Background .....                                  | 1  |
| 1.2   | Location .....                                    | 1  |
| 1.3   | Scope of assessment .....                         | 1  |
| 1.4   | Data sources .....                                | 1  |
| 1.5   | Methodology .....                                 | 2  |
| 2     | BASELINE CONDITIONS.....                          | 3  |
| 2.1   | Current and historical site use .....             | 3  |
| 2.2   | Landform.....                                     | 3  |
| 2.3   | Hydrology.....                                    | 4  |
| 2.3.1 | Watercourses.....                                 | 4  |
| 2.4   | Geology .....                                     | 4  |
| 2.4.1 | Regional .....                                    | 4  |
| 2.4.2 | Local geology .....                               | 4  |
| 2.5   | Hydrogeology .....                                | 5  |
| 2.5.1 | Groundwater levels .....                          | 5  |
| 2.5.2 | Aquifer designations .....                        | 6  |
| 2.6   | Gale Moss .....                                   | 6  |
| 2.6.1 | The M61 Motorway .....                            | 6  |
| 2.7   | Conceptual hydrogeology .....                     | 7  |
| 3     | THE PROPOSED DEVELOPMENT.....                     | 8  |
| 3.1   | Operational phase .....                           | 8  |
| 3.2   | Proposed restoration .....                        | 8  |
| 4     | ASSESSMENT OF IMPACTS UPON GALE MOSS .....        | 9  |
| 4.1   | Overview.....                                     | 9  |
| 4.2   | Potential impacts during mineral extraction ..... | 9  |
| 4.2.1 | Groundwater levels .....                          | 9  |
| 4.2.2 | Surface water .....                               | 9  |
| 4.2.3 | Water quality .....                               | 9  |
| 4.3   | Potential impacts following restoration.....      | 9  |
| 5     | SUMMARY AND CONCLUSIONS.....                      | 10 |

## TABLES

|   |   |
|---|---|
| 3373/AOP/T1: Summary of borehole details..... | 5 |
|---|---|

## DRAWINGS

|             |  |
|-------------|--|
| 3373/AOP/01 | Site location                                  |
| 3373/AOP/02 | Ground contours and former extent of Gale Moss |
| 3373/AOP/03 | Water features                                 |
| 3373/AOP/04 | Bedrock and superficial geology                |

|             |   |
|-------------|---|
| 3373/AOP/05 | Drainage features                           |
| 3373/AOP/06 | Borehole locations and groundwater contours |
| 3373/AOP/07 | Groundwater hydrographs                     |

## APPENDICES

|             |                  |
|-------------|------------------|
| 3373/AOP/A1 | Water level data |
|-------------|------------------|

## 1 INTRODUCTION

### 1.1 Background

Outline planning permission exists for the construction of industrial units on an engineered platform at a site known as Gale Moss, Chorley. The site of the proposed development is situated above sand and gravel deposits. Prior extraction is required so that the mineral is not sterilised by the industrial development.

Sand and gravel would be extracted from above the watertable, always ensuring a 1 m standoff via the use of regular groundwater level monitoring. The Mineral Planning Authority has raised concerns regarding potential of the proposed mineral extraction to impact nearby peat deposits at Gale Moss. Hafren Water has been commissioned to undertake an assessment of this issue, the results of which are provided herein.

### 1.2 Location

The Application Area (the site) is located to the east of Chorley, Lancashire, immediately to the northeast of Junction 8 of the M61 Motorway (*Drawing 3373/AOP/01*). The site's grid reference is SD 59058 19763. It is bound to the north by agricultural fields, the low-lying areas of which comprise Gale Moss. The eastern boundary is formed by the Leeds-Liverpool canal and the southern boundary by the A647. The M61 Motorway parallels the western boundary. The site is accessed from the A647 via a roundabout. The location of the site is shown on *Drawing 3373/AOP/01*.

### 1.3 Scope of assessment

The objectives of the investigation are as below:

- Determination of baseline conditions of the water environment at the site and its environs
- Identification of potential impacts of the proposed development upon Gale Moss
- Assessment of the magnitude and significance of potential impacts and areas of peat
- Derivation of appropriate mitigation measures for any identified potential impacts, if required

### 1.4 Data sources

The characteristics of the water environment and near-surface deposits have been investigated with the use of existing published data and reports, site data, experience of other sites in broadly similar settings and a walkover survey (21<sup>st</sup> July 2022). The data sources used in the investigation are:

#### British Geological Survey (BGS)

- 1:50,000 scale geological map for Wigan, Solid and Drift, Sheet 84, and digital on-line mapping
- Geological borehole logs

#### Mineral Planning Group

- Site plans
- Mineral investigation borehole logs
- Groundwater monitoring data
- Supporting statement, Gale Moss. Document reference 305/2-R2.2
- Proposed extraction plan
- Topographical survey
- Restoration plan

#### Walkover survey

- Discussion with farmer, visiting of all water features and direct observations of landform and near-surface deposits (21<sup>st</sup> July 2022)

### **1.5 Methodology**

Baseline conditions of the water environment were defined by the collation and analysis of existing data and field observations obtained during the site visit. The current status of Gale Moss has been assessed and then the potential impacts of the proposed mineral extraction upon it assessed.

## 2 BASELINE CONDITIONS

### 2.1 Current and historical site use

The site occupies approximately 9.9 hectares (ha) and currently consists of agricultural land, which is used predominantly for cattle grazing and the production of grass for animal fodder.

### 2.2 Landform

The Application Area is located between 87–93 metres Above Ordnance Datum (mAOD), with higher elevations in the south and southeast of the site. Within the site ground elevations decrease to the north and west, where they fall to the headwaters of the River Chor.

A sharp break of slope exists within the area of proposed mineral extraction, where elevations decrease rapidly by approximately 1.5 m. The site is lower in elevation than the M61 Motorway which has embankments approximately 6m in height.

Gale Moss, which abuts the northwest of the site, is characterised by its level nature. This conforms with its method of development. The extent of the moss can be defined by the use of ground contours. Ground elevations within the site, Gale Moss and the surrounding area, derived from LiDar data, are shown on *Drawing 3373/AOP/02*.

The area of low relief to the northwest of the site, which coincides with the presence of peat deposits at surface (see below) has been taken to define the boundary of Gale Moss.

Ground contours within the site and Gale Moss have been modified, principally by works associated with the M61 Motorway, the construction of which was completed in 1969. Spoil from the motorway was deposited within the Application Area to the west of the proto-River Chor. Direct observation indicates that approximately 2 m of material was deposited on the ground surface.

Ground elevations in the section of Gale Moss to the east of the motorway and immediately to the north of the site reportedly increased for several years following the completion of the motorway. This can be seen in the ground contours (see *Drawing 3373/AOP/02*) and by direct observation on the ground.

It is considered that the 'weight' of the motorway carriageway displaced the peat, which acted as a plastic medium. The observed changes to ground contours have had an impact on the hydrology of Gale Moss, as discussed in Section 2.6 below.

## 2.3 Hydrology

### 2.3.1 Watercourses

The site is located within the catchment of the River Chor. The headwaters of the river form the northern and western boundaries of the site. It rises in former quarry, located 500 m to the east of the site and then flows westwards; where it is culverted beneath the Leeds-Liverpool Canal. It then flows broadly southwestwards, paralleling the northern site boundary before turning southwards. The channel of the watercourse comprises a well-maintained ditch in the vicinity of the site.

The configuration of watercourses and drains is shown on *Drawing 3373/AOP/03*.

The watercourse enters a 1.2 m diameter culvert (48") and continues to flow southwards, beneath the A647 road. The flow at this location was estimated to be 30 l/sec at the time of the site visit.

A network of ditches and buried pipes exists in Gale Moss, immediately to the north of the site. The largest open ditches are historical features, with the two largest oriented north-south and west-east. Smaller ditches feed into the larger ones and the network has drained Gale Moss effectively for a prolonged period.

Only the southeastern corner of the peat area is near to the extraction boundary. The drains flow away from the peatland.

## 2.4 Geology

### 2.4.1 Regional

The bedrock within the western section of the Application Area comprises the Rossendale Formation, which consists of sandstones, siltstones and mudstones. The Lower Haslington Flags are present in the east and consists of sandstones. The two geological units are separated by a minor geological fault.

The most widely developed superficial deposits within the region comprise Quaternary-age Peat, Glaciofluvial Deposits and Head. The economic mineral at the site is the Glaciofluvial sand and gravel. Bedrock and superficial deposits in the vicinity of the site are shown on *Drawing 3373/AOP/04*.

### 2.4.2 Local geology

Details of the geology in the Application Area and its immediate vicinity have been derived principally from four mineral evaluation boreholes and direct observation. Boreholes BH1 and



BH2 are located within the proposed extraction area (see *Drawing 3373/AOP/06*); BH1 is close to the eastern site boundary and BH2 is more central. BH3 is at the western extent of the site boundary, whilst BH4 is in the south.

Superficial deposits cover the whole of the site and its surrounds. Topsoil is proven to be 0.4 m thick at BH1 and BH2, however in the central and southern areas sand and gravel was observed at surface. Sand and gravel occurs beneath the topsoil and is proven to 7 m below ground level (mbgl) at BH1 and 6.5 mbgl at BH2.

Peat occurs to the northwest of the site and overlies the sand and gravel. There are no records of peat in any of the borehole logs on-site. During the site visit peat was observed in the deep west-east oriented ditch, where it was observed to be highly dessicated. Geological logs are available in the BGS Geology of Britain viewer website. The majority of data are for site investigation boreholes drilled at the time of design of the M61 Motorway. The data quality is poor but peat thicknesses of 5.66 m and 10.36 m are indicated where the motorway crosses Gale Moss (BGS borehole reference SD51NE42 and 43 respectively). These boreholes were located approximately 150 m to the northwest of the site boundary.

## 2.5 Hydrogeology

### 2.5.1 Groundwater levels

Groundwater levels within the site are known from four monitoring boreholes. Their details are summarised below in *Table 3373/AOP/T1*.

| 3373/AOP/T1: Summary of monitoring boreholes |           |               |                  |                         |             |
|--|-----------|---------------|------------------|-------------------------|-------------|
| Borehole ID                                  | Depth (m) | Screen (mbgl) | Elevation (mAOD) | Groundwater level range |             |
|  |           |               |                  | mbgl                    | mAOD        |
| 1  | 7         | 4-7           | 92.5             | 2.63-3.12               | 89.38-89.87 |
| 2  | 6.5       | 3.5-6.5       | 91.5             | 3.21-3.28               | 87.62-88.29 |
| 3  | 7         | 4-7           | 89.2             | 1.18-1.98               | 87.22-88.02 |
| 4  | 7         | 4-7           | 90.1             | 1.74-2.97               | 87.13-88.36 |

The watertable is approximately 88–89 mAOD on the southern boundary of the site, and 84–85 mAOD towards the northern boundary.

The locations of the monitoring boreholes are shown on *Drawing 3373/AOP/06*. Groundwater level data is included as *Appendix 3373/AOP/A1*.

Hydrographs shown on *Drawing 3373/AOP/07* show data from the four groundwater monitoring boreholes from April 2021 to July 2022. These indicate the groundwater levels are relatively constant and they have not fluctuated much, as the groundwater depth range is less than a metre. Inferred groundwater contours, based on data from July 2022 are shown on *Drawing 3373/AOP/06*. The inferred groundwater flow direction is towards the River Chor.

### 2.5.2 Aquifer designations

The strata within the Application Area are designated as a 'Secondary A Aquifer'. This is defined as "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers".

## 2.6 Gale Moss

Gale Moss is the name given to a low-lying area of peatland, which is situated to the east of Chorley and borders the north of the site. The integrity of the peat has been degraded and its hydrology modified significantly over a prolonged period, due to several factors, as discussed below.

### 2.6.1 The M61 Motorway

The M61 Motorway, which was completed in 1969, bisects the pre-existing moss. (See drawing *Drawing 3373/AOP/02*.) The carriageway is elevated on a causeway, which was formed of large quantities of rock, overlain by fill (pers comms with farmer). The presence of the motorway has had two major influences on the integrity of the moss and has modified extensively its natural, pre-existing hydrology:

- a) The physical presence of the motorway and associated drainage. The elevated nature of the motorway has prevented the pre-existing movement of water within the moss; it represents a complete barrier to the movement of near-surface water across Gale Moss. Water management will have intercepted water from large areas and diverted it to new routes. Furthermore, the large impermeable surface of the carriageway will have significantly increased the volumes of rainfall-derived water within the local water environment.

It can be inferred that the 'weight' of the carriageway has caused distortion of the peat, resulting in the raising of ground elevations by several metres in the section of the moss immediately to the north of the site. The increase in elevation of the peat by several metres will have led to a reduction of water availability in the affected area and also have an indirect impact on downstream areas of Gale Moss.

- b) Drainage. The historical deep drainage ditches installed within Gale Moss and the more recently installed perforated drains have led to significant drying-out of the peat. The effectiveness of drainage measures can be observed in the banks of the deep ditches.

## **2.7 Conceptual hydrogeology**

The sand and gravel is water-bearing and proven to be at least 5–6 m thick. It is assumed that the superficial and bedrock deposits are hydraulically connected. Groundwater flow direction within the site is towards the River Chor, which is thus assumed to represent the egress point for groundwater locally.

The headwaters of the River Chor form the northern and western boundary of the proposed extraction area. The depth of the channel of the watercourse is such that the superficial deposits within the site are hydraulically isolated from the peat of Gale Moss to the north.

The Moss is up-hydraulic gradient of both surface water and groundwater within the Application Area. Due to the relative elevations and hydraulic separation of the sand and gravel within the site and the peat of Gale Moss, the potential for the proposed mineral extraction to impact upon the hydrology of the peat is considered to be insignificantly small.

### **3 THE PROPOSED DEVELOPMENT**

#### **3.1 Operational phase**

The proposed prior extraction would be undertaken in three phases, starting in the east and progressing westwards. The northern area would be used for storage of plant and equipment, stockpiling of materials and soil storage and would not be worked. Mineral extraction would not take place in the area west of the River Chor. Soil stripping would be phased, with stripped soils being stored in the northern area and retained for subsequent use in restoration.

The proposed mineral extraction would take place entirely above the watertable, with the maximum depth of working being such as to minimise the potential for impact upon the extant water environment.

The east to west oriented watercourse would be culverted along a short stretch to allow plant and machinery to cross to the northern area (where no extraction would take place).

A 10 m standoff from the limits of mineral extraction to all watercourses would be retained.

#### **3.2 Proposed restoration**

The prior extraction restoration scheme aims to return the site to agricultural usage, with features that would generate a net gain in biodiversity. However, the restoration of the site has also been designed to be conducive to the implementation of the future industrial development, by creating a generally level area with no major topographic features, whilst assimilating the landform into its surroundings.

## **4 ASSESSMENT OF IMPACTS UPON GALE MOSS**

### **4.1 Overview**

For the reasons discussed above Gale Moss is a very degraded feature in relation to its natural, original condition. Significant modification of the local water environment, over a prolonged period, has led to its drying out and a presumable decrease in ecological interest. The drainage is exacerbated by the extensive development that has occurred upon it, most notably the M61 and associated road network.

### **4.2 Potential impacts during mineral extraction**

#### 4.2.1 Groundwater levels

Prior extraction will create a temporary void space adjacent to the moss. As all the proposed mineral extraction would be above the watertable there will be no discernible impact on the local groundwater regime. There can thus be no potential for impact on groundwater beneath Gale Moss.

#### 4.2.2 Surface water

Gale Moss is situated upstream of the proposed development, with respect to surface water flow. As all of the watercourses will be unaffected by the mineral extraction there is not anticipated to be potential for impact on surface water in the vicinity of the moss.

#### 4.2.3 Water quality

It is possible that contaminants could enter the extraction area. However, robust measures will be implemented to prevent this occurrence. In the unlikely event that contaminants were deposited on the ground emergency response procedures would be actioned to contain and then remove them from site.

The prevailing groundwater and surface water regimes are such that water movement is away from Gale Moss. Consequently, there is not considered to be any potential for contamination to enter the Moss.

### **4.3 Potential impacts following restoration**

After completion of mineral extraction restoration works will be undertaken to return the land to agricultural use at pre-existing ground levels.

Due to the hydraulic separation of the site from Gale Moss, and in particular its situation with regard to surface water flow direction, there is not considered to be any potential for adverse impact upon Gale Moss, post-restoration.

## 5 SUMMARY AND CONCLUSIONS

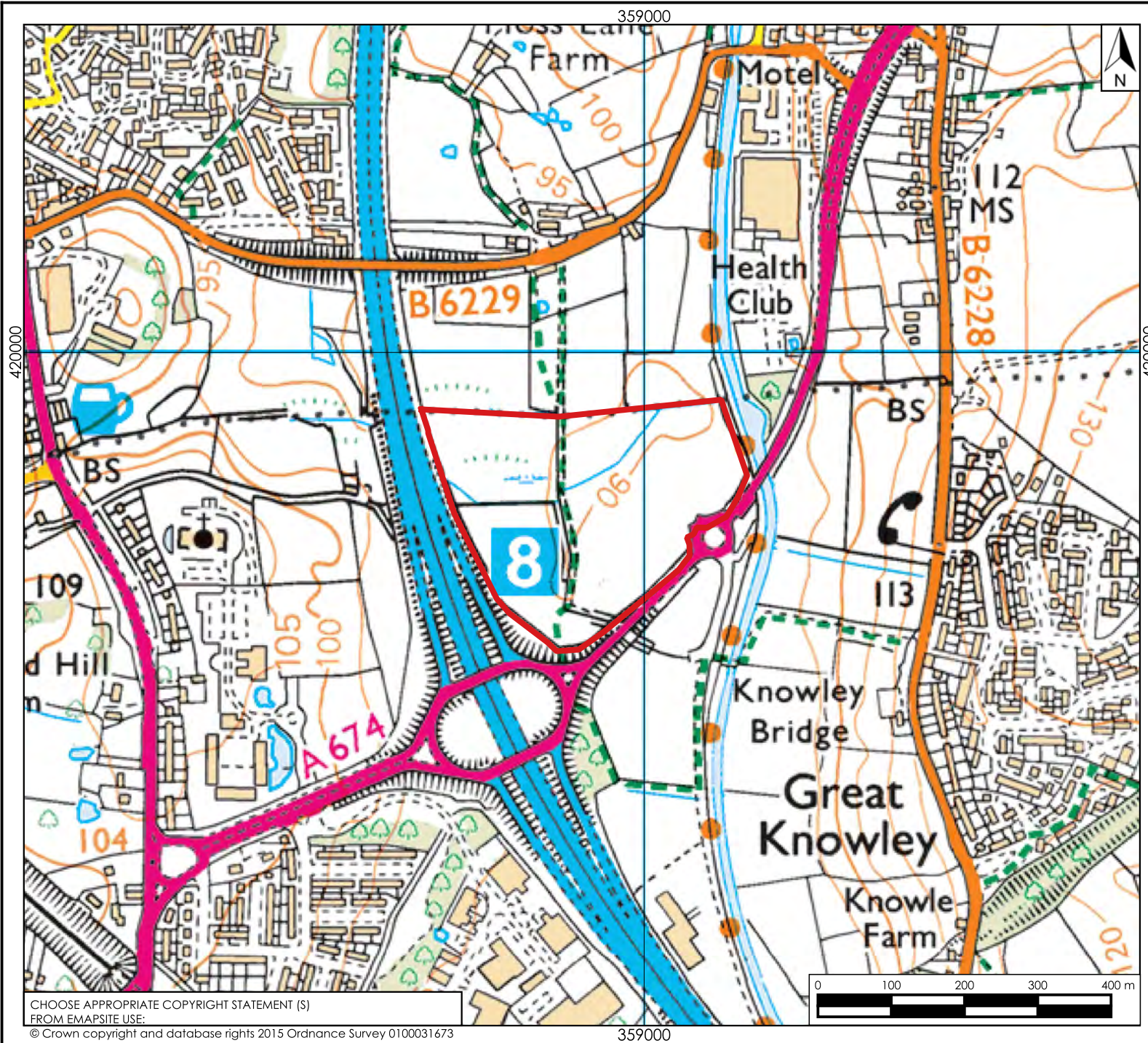
- 5.1 An assessment has been undertaken of the potential for proposed prior extraction of mineral to impact upon an area of low-lying peat known as Gale Moss.
- 5.2 The investigation included the collection and assessment of a range of data, a walkover survey and discussion with the farmer, who has known the land for more than 60 years.
- 5.3 Gale Moss has been affected significantly due to several factors over a prolonged period. These include:
- the presence of an effective network of ditches and drains, which have led to significant dessication of the peat
  - direct and indirect impacts of the presence of the M61 Motorway, which parallels the western site boundary
- 5.4 Mineral extraction would be undertaken entirely above the watertable. There would thus be very limited potential for impact upon the extant water environment.
- 5.5 The headwaters of the River Chor separate the site from Gale Moss. This effectively forms a hydraulic 'barrier' between the two areas and prevents the effects of any small change in surface water hydrology at the site being experienced at Gale Moss.
- 5.6 Gale Moss is situated upstream of the Application Area. Therefore any potential impacts, which occurred to surface water, whether quality or quantity, would not impact upon Gale Moss.
- 5.7 Based upon the assessment it is concluded that the proposed mineral extraction will not cause any impact upon Gale Moss. Consequently mitigation measures would not be required.

**DRAWINGS**

**APPENDIX 3373/AOP/A1**

**Water level data**





Legend  
— Site Boundary

Scale correct at A4

|         |                        |               |
|---------|------------------------|---------------|
| Client  | Mineral Planning Group |               |
| Title   | Site Location          |               |
| Project | Gale Moss              |               |
| Drawing | 3373/AOP/01            | Version 1     |
| Date    | July 2020              | Scale 1:7,500 |

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- Legend
- Site boundary
  - Contours 1m interval
  - Former extent of Gale Moss
  - Gale Moss unknown extent

Scale correct at AB

Client Mineral Planning Group

Title Ground Contours and Former Extent of Gale Moss

Project Gale Moss

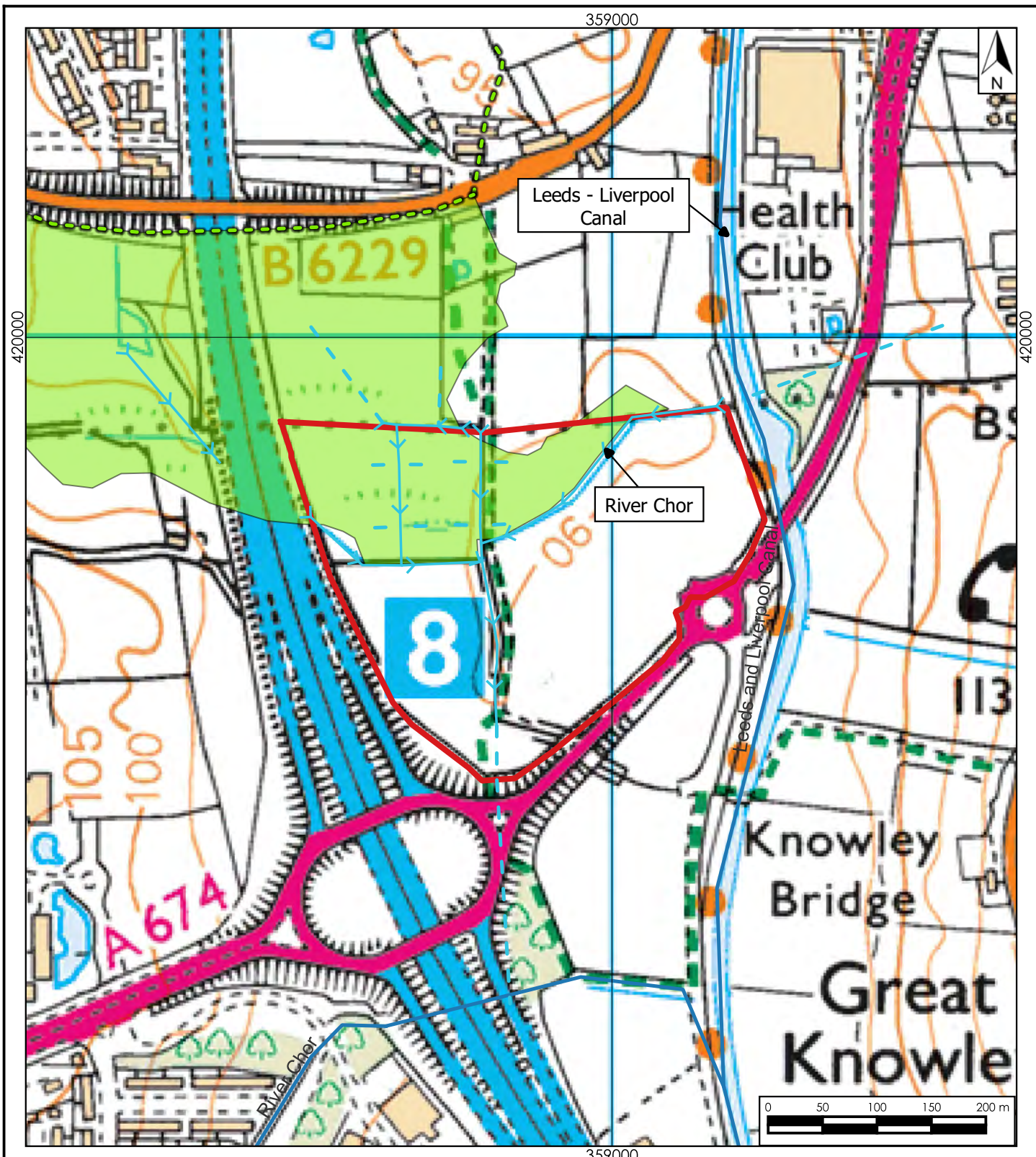
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| Drawn 3373/AOP/02 | Versic 1 |
|-------------------|----------|

|                |               |
|----------------|---------------|
| Date July 2022 | Scale 1:4,000 |
|----------------|---------------|

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Legend

- Red Line Boundary
- Watercourse
- - - Pipeline (Underground)
- > Drainage
- Former Extent of Gale Moss
- - - Gale Moss Unknown extent

Scale correct

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Client Mineral Planning  
Group

Title Water Features

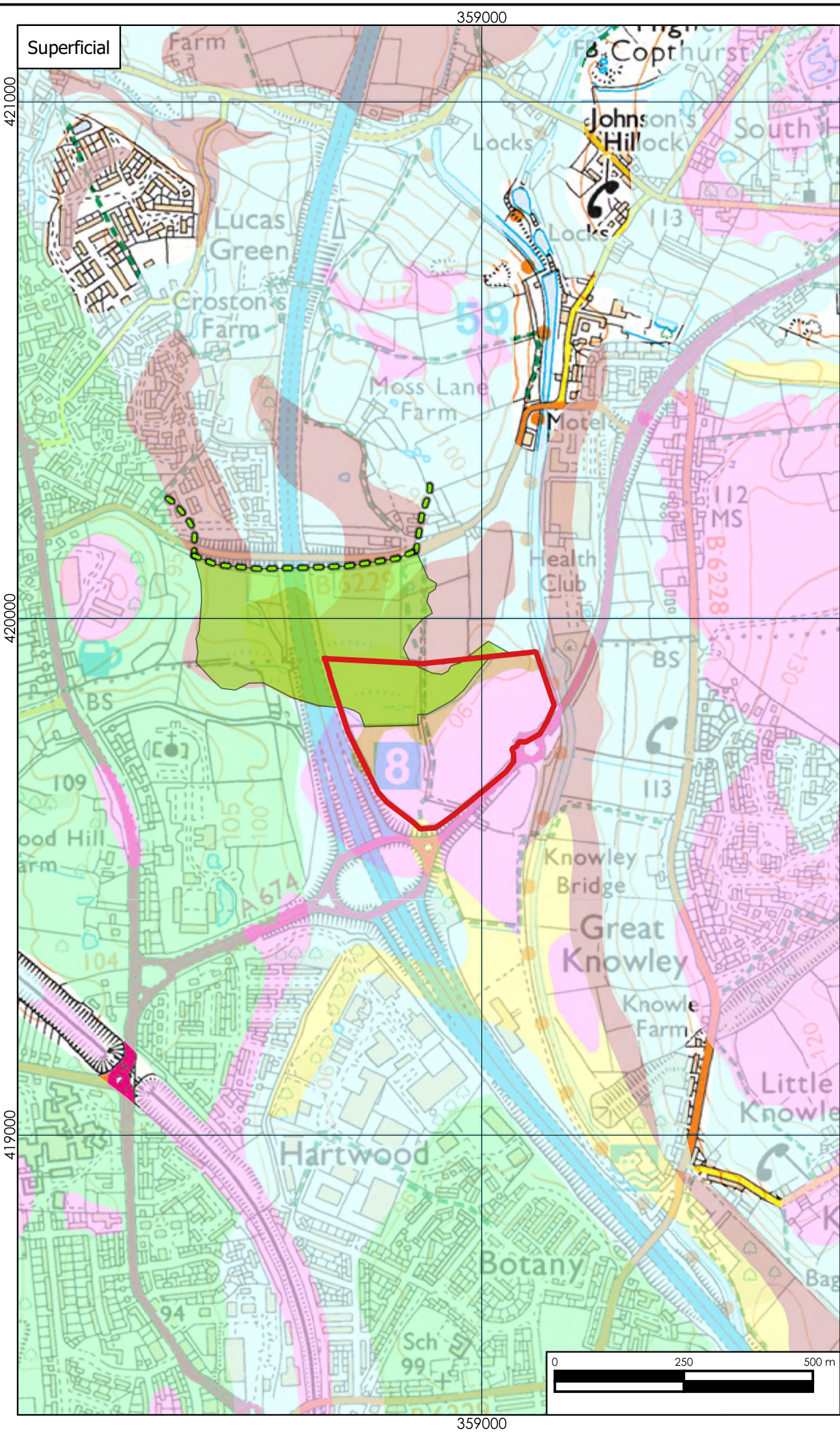
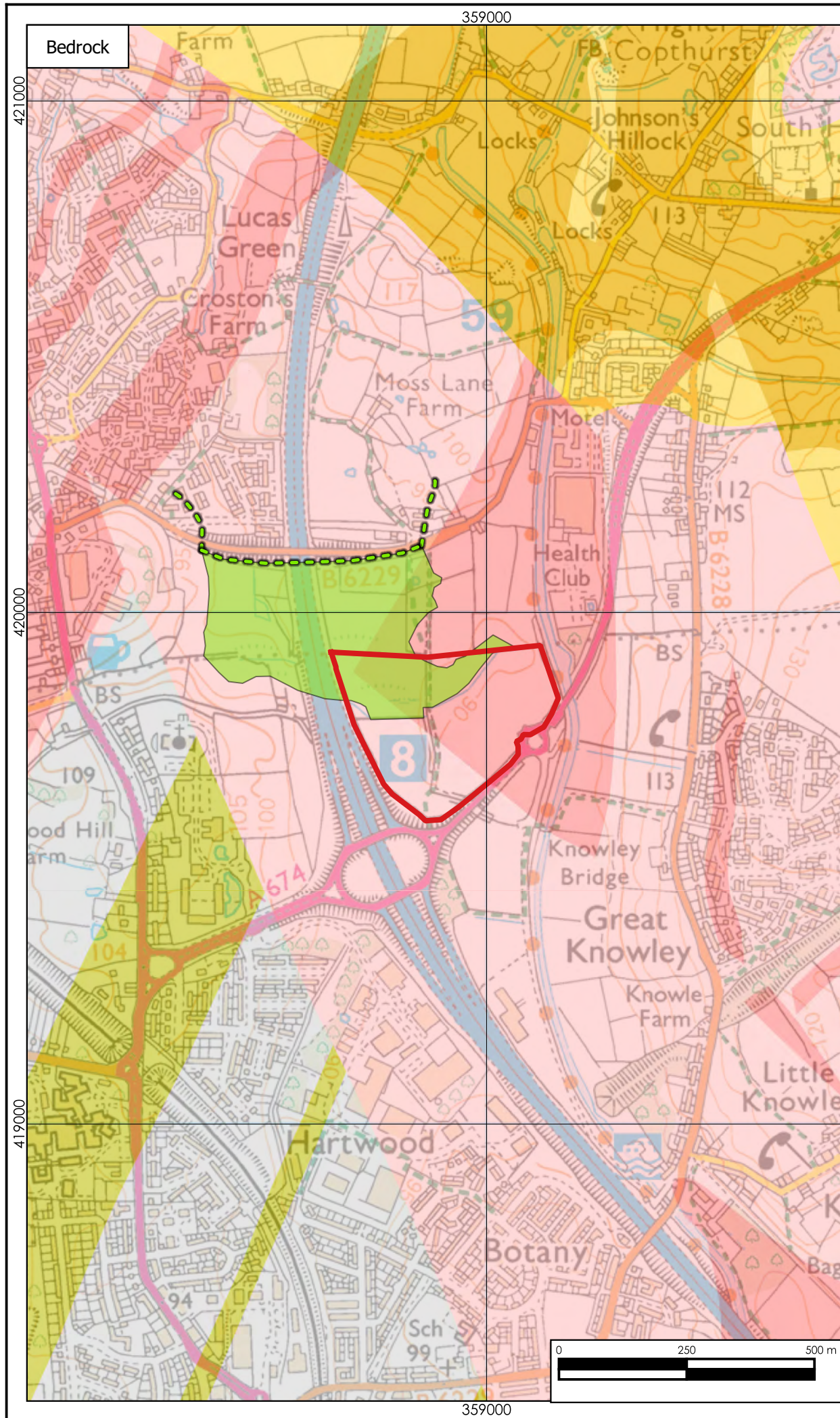
Project Gale Moss

Drawn 3373/AOP/03

Version 1

Date July 2022

Scale 1:5,000



**Legend**

- Site Boundary
- Former Extent of Gale Moss
- Gale Moss Unknown extent

**Superficial Deposits Key**


- Glaciofluvial Deposits
- Peat
- Head
- Glacial Deposits
- Till
- Alluvium

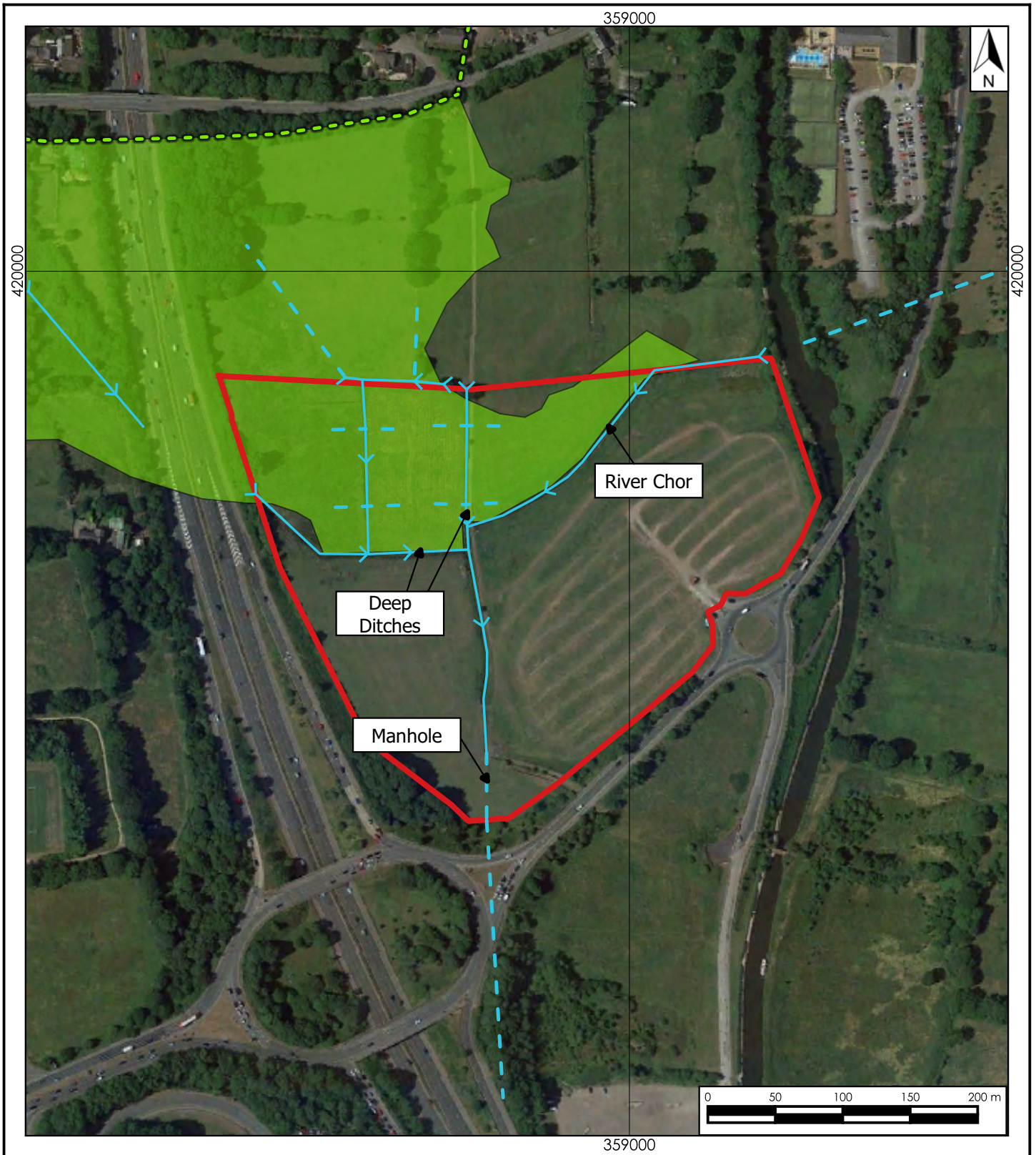
**Bedrock Geology Key**

- Brooksbottom Grit - Sandstone
- Lower Haslingden Flags - Sandstone
- Marsden Formation - mudstone - siltstone - sandstone
- Ousel Nest Grit - sandstone
- Pennine Lower Coal Measures Formation - mudstone - siltstone - sandstone
- Rossendale Formation - mudstone - siltstone - sandstone

Scale correct at A8

|         |                                 |                |
|---------|---------------------------------|----------------|
| Client  | Mineral Planning Group          |                |
| Title   | Bedrock and Superficial Geology |                |
| Project | Gale Moss                       |                |
| Drawn   | 3373/AOP/04                     | Versic 1       |
| Date    | July 2022                       | Scale 1:10,000 |


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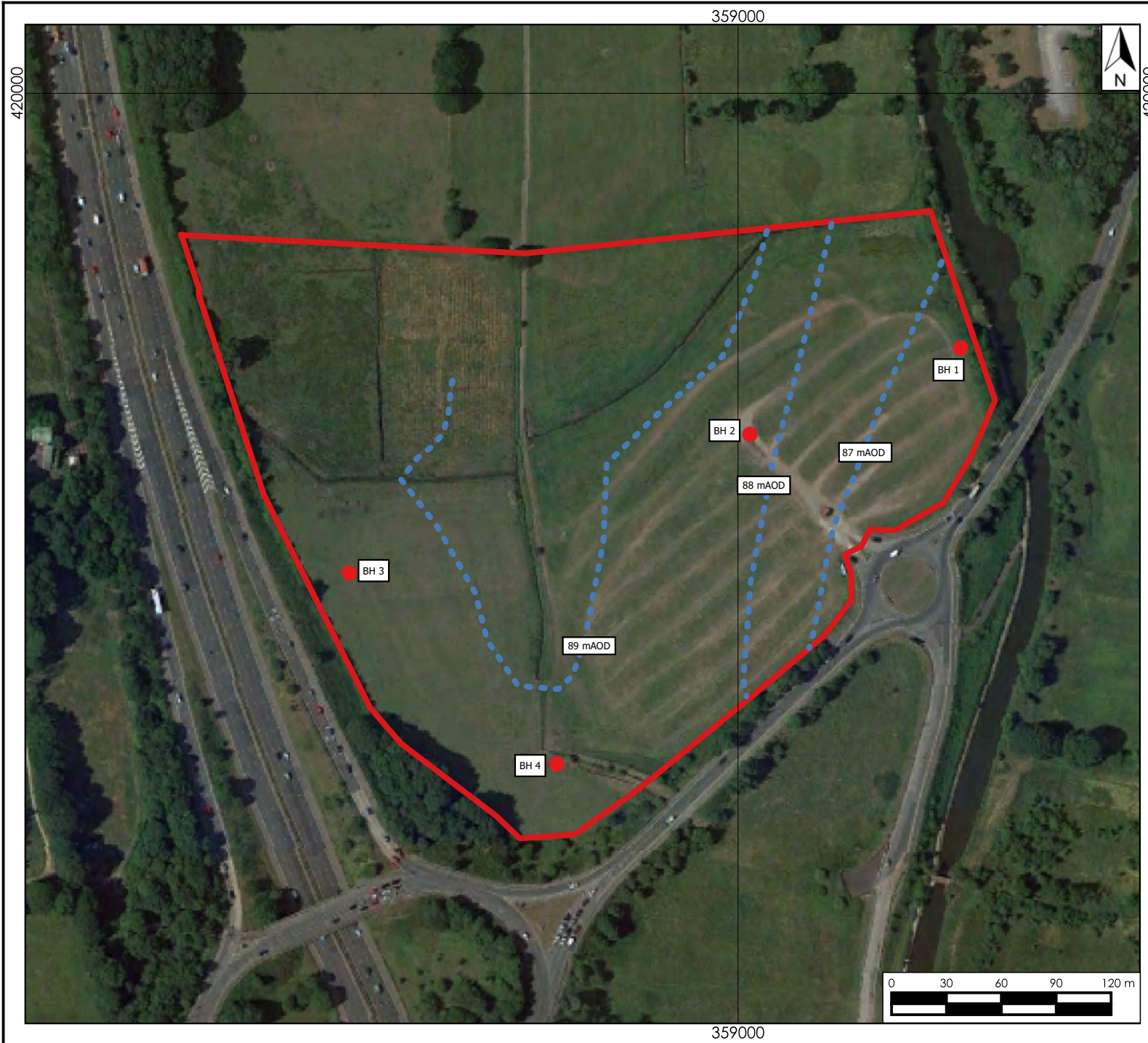


Legend

- Red Line Boundary
- - - Pipeline (Underground)
- Drainage
- Former Extent of Gale Moss

Scale correct

|  |                               |                         |               |  |
|--|-------------------------------|-------------------------|---------------|--|
|  <p>environmental water management</p> <p>Barkers Chambers • Barker Street •<br/>Shrewsbury • Shropshire • SY1 1SB</p> | Client Mineral Planning Group | Title Drainage Features |               |  |
|  |                               | Project Gale Moss       |               |  |
|  |                               | Drawn 3373/AOP/05       | Version 1     |  |
|  |                               | Date Jul 2022           | Scale 1:4,000 |  |



- Legend
- Site Boundary
  - - - GW contours

Scale correct at

Client Mineral Planning Group

Title Borehole Locations and Groundwater Contours

Project Gale Moss

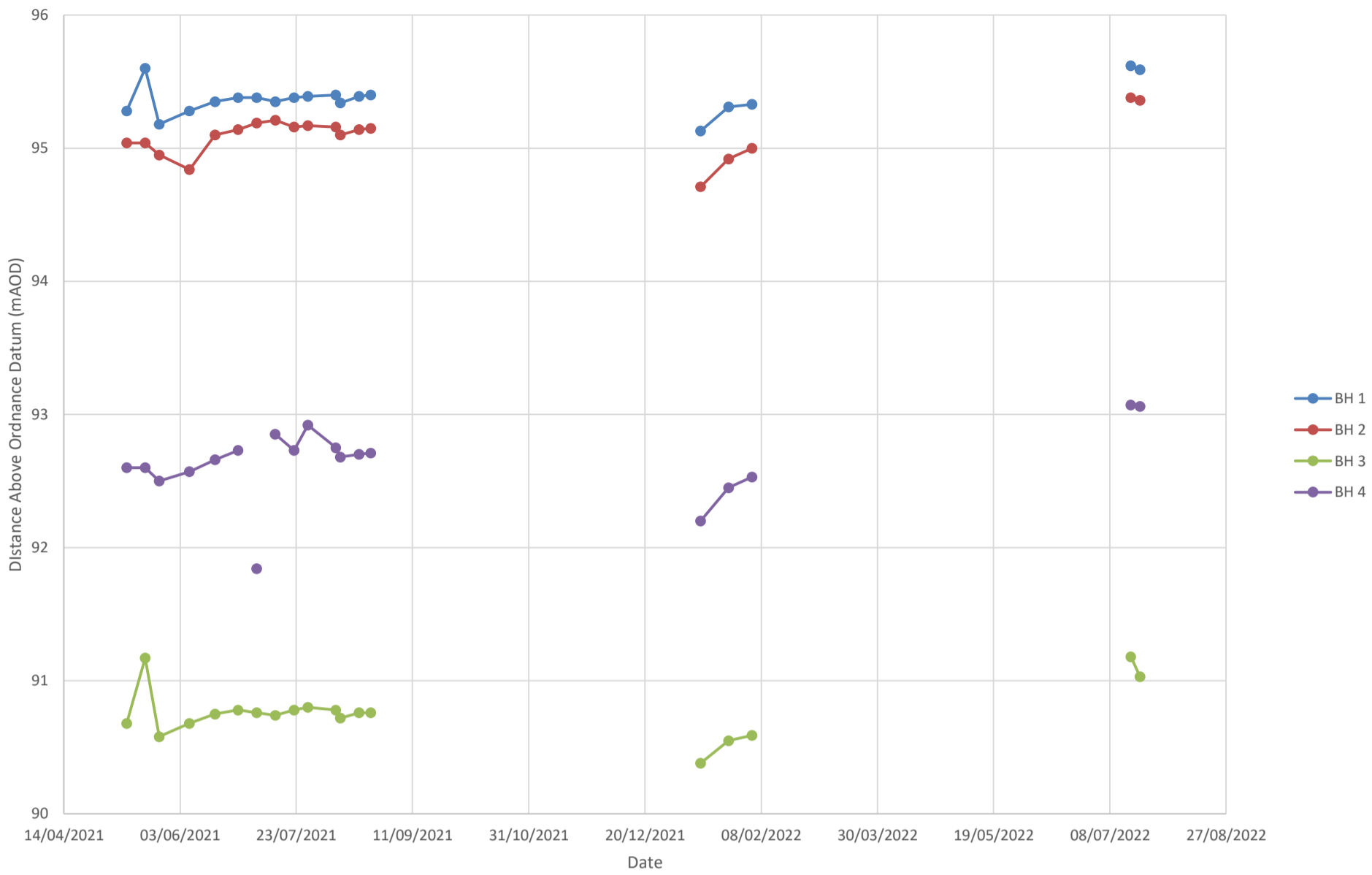
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|-------------------|----------|

|                |               |
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| Date July 2022 | Scale 1:3,000 |
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### Groundwater Hyrdographs mAOD



### Groundwater Hydrograph mBGL

