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environmental water management

HORN CRAG QUARRY

HYDROGEOLOGICAL ASSESSMENT

Report Reference: 3080/HIA
Version D1 (updated)
September 2023

Report prepared for:

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GENERAL NOTES

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Site: Horn Crag Quarry

Report ref: 3080/HIA

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Draft version D1	14/01/21	MPG Ltd
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https://hafrenw.sharepoint.com/sites/HafrenWater/Shared Documents/General/Projects/Horn Crag Quarry (3080)/Reports/HIA/Draft/3080_HIA_D1 updated (Sep 23).docx

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1 INTRODUCTION

1.1 Background

Horn Crag Quarry is located 7.2 km southeast of Skipton and 1.7 km northeast of Silsden, West Yorkshire (*Drawing 3080/HIA/01*). The quarry, which was last worked some 30 years ago, is located on an outcrop of Carboniferous sandstone. The sandstone comprises the economic mineral at the site.

A D Calvert Architectural Stone Supplies Ltd (Calverts) proposes to re-open the site to extract dimension stone. A private water supply exists adjacent to the quarry, which utilises a catchpit. The proposed mineral extraction area potentially lies within the catchment of the water supply.

1.2 Scope of work

A hydrogeological assessment was submitted to support a Planning Application to re-open the quarry (Horn Crag Quarry, Hydrogeological Assessment, Reference 3080/HIA, Final, Hafren Water, January 2021). Planning Permission was refused on several grounds. Comments were subsequently received from the Environment Agency (EA), the most recent of which were included in a letter dated 19th May 2023 (EA reference RA/2023/145760/01-L01). The letter stated the EA's objection to the proposals; the reasons for their stance were provided and ways of overcoming the objections were itemised, viz:

a) Acknowledge the presence of a spring supply with a default SPZ of 50 m

b) Mitigation measures to protect the spring are to be proposed (*Drawing 3080/HIA/06*)

c) Continue monitoring groundwater levels at the old borehole to establish groundwater level variations, this will be particularly important in the winter

The three issues are all addressed in this updated assessment, and are supported by additional data and comments, where necessary.

1.3 Landform

The quarry is located on an extensive area of elevated land, at an altitude of between 250 and 270 metres Above Ordnance Datum (mAOD). A steep escarpment exists to the west of the site and the ground level decreases westwards towards a small watercourse. Ground levels also decrease from the highest point within the site, to the north, south and east.

Rock faces representing the former quarry exist immediately to the west of the highest elevations. Large volumes of waste rock and rubble material, associated with processing of material derived from within the site, exists along the majority of the western site boundary.

2 HYDROLOGY

2.1 Surface water features

The only significant watercourse near the site is a small, southwards flowing stream, Fish Beck, which is located 150 m to the west of the quarry (*Drawing 3080/HIA/02*). It is culverted beneath Fishbeck Farm and, after re-emerging, flows westwards before discharging into Silsden Reservoir.

2.2 Wells and springs

No wells or springs are indicated within 500 m of the quarry, according to current Ordnance Survey (OS) mapping. However, historical OS maps indicate the presence of such features and these are shown on *Drawing 3080/HIA/02*. One spring has been identified within the quarry, located close to the access track. The spring is situated at an elevation of approximately 232 mAOD and located at the western margin of the mapped outcrop of the sandstone.

A water collection chamber is located close to the western site boundary, at an elevation of 228.3 mAOD. Two manholes are present at this location. The first contains a collector pipe that receives water from the historical waste tip on the western boundary of the site. A 50 mm egress pipe, fitted with a filter, is located close to the base of the chamber, which conveys water westwards. The water passes to a second chamber, in which it is filtered, before it is presumably piped to several properties.

It is noted that the spring is not a registered private water supply. Furthermore, it is understood that the original agreement to supply water from the spring has lapsed.

3 GEOLOGY AND HYDROGEOLOGY

3.1 Geology

The quarry is located in an area underlain by the Carboniferous Millstone Grit Group (MGG). This formation comprises fine to coarse-grained sandstones, interbedded with grey siltstones and mudstones. Subordinate mudstones, claystones, coals and seatearths are also present within the sequence (*Drawing 3080/HIA/03*).

The strata in the vicinity of the quarry lie within the Silsden Formation, a subdivision of the MGG.

BGS mapping (*Drawing 3080/HIA/03*) records several named sandstone units, specifically the Nesfield Sandstone (NS), which crops out to the west of the quarry, the Middleton Grit (Mn), which is worked at the quarry, and Brocka Bank Grit (BB), to the east of the quarry. A cross-section reproduced from the 1:50,000-scale geological map for Bradford (Sheet 69) illustrates the relationship between the units (*Drawing 3080/HIA/05*).

The BGS map records dips to the ESE of the site of between 6 and 9 degrees and shows that the area is heavily faulted. However, observation within the site shows that within the former quarry the beds are inclined northwards, with a dip of 10–15 degrees.

Five mineral evaluation boreholes were drilled in 2019 and summary information from these are provided in *Table 3080/HIA/T1*. A sixth borehole ('Old') is also present, for which no geological information has been presented.

3080/HIA/T1: Borehole data							
ID		BH1	BH2	BH3	BH4	BH5	OLD
Easting		405252	405369	405350	405415	405350	405344
Northing		447993	447902	448073	448057	448073	447980
Ground level	(mAOD)	242.25	250.5	255.5	254	259.75	256.9
Depth	(mbgl)	14.4	21.53	30.03	18.00	15.00	
Base SST	(mbgl)	12.19	20.04	>30.03	16.2	12.7	
	(mAOD)	230.06	230.46	<225.47	237.8	247.05	
Top mudstone	(mbgl)	13.57	20.04	-	16.2	-	
	(mAOD)	230.06* 228.68**	230.46	-	237.8	-	
Groundwater level at completion (July 2019)							26/10/20
Depth	(mbgl)	12.30	11.10	10.60	8.60	11.60	18.0
Elevation	(mAOD)	229.95	239.4	244.9	245.4	248.15	238.9
* Siltstone present between the sandstone and mudstone in BH1 ** Top of mudstone							

The sandstone is described as fine to coarse-grained and heavily fractured in places. Several siltstone bands occur within the sequence. In boreholes BH1 and BH4 a siltstone horizon exists between the base of the sandstone and an underlying dark grey to black mudstone. In BH5 the base of the sandstone is more gradational into the underlying siltstone.

The base of the sandstone was not encountered in BH3.

3.2 Hydrogeology

The MGG is classified by the Environment Agency as a Secondary 'A' aquifer. The sandstones are well-cemented and groundwater flow is considered to occur predominantly through fractures, with little interaction with the matrix.

There are no details available on the hydraulic parameters of the specific sandstone units at the quarry.

One-off groundwater level measurements were taken in the boreholes completed in July 2019 and are reported in *Table 3080/HIA/T1*. It is understood that the water levels were allowed to recover after borehole completion and are considered therefore to be representative of a true rest water level. Measurements in the Old borehole were made from October 2020 onwards and elevations of between 237.97 and 239.27 mAOD were recorded. Data from the 'Old' borehole are provided in *Table 3080/HIA/T2*.

3080/HIA/T2: Groundwater levels (Old borehole)		
Depth (m below top of borehole casing) 257.06 Ground level 256.9		
Date	**Depth (m)**	**Depth (mAOD)**
26/10/2020	18	239.06
18/10/2021	19.09	237.97
15/11/2021	18.55	238.51
13/12/2021	18	239.17
27/01/2022	18.42	238.64
01/03/2022	17.79	239.27
25/09/2023	18.81	238.25

The range of recorded groundwater level variations is small, being 1.3 m. There is no discernible temporal trend within the data.

Groundwater levels are not always within the sandstone unit and in BH1 it lies within the underlying siltstone. Despite the difference in lithology in which the groundwater level was

measured, it is considered that the data represent a contiguous level, due to the extensive fracturing reported in both the sandstone and siltstone.

Groundwater contours are shown on *Drawing 3080/HIA/04* and indicate westerly groundwater flow towards a topographic low on the western site boundary. Water egress is evidenced at this point by an area of waterlogged ground within the site boundary and 'reed-like' vegetation emanating from it, down-gradient to the west. The spring collector is located in this area.

It is noted that the area beneath the boggy ground and spring collector is not situated above sandstone. Furthermore, the large amount of historical rock waste at this location, and to its east, is considered highly likely to have modified the pre-quarrying water environment significantly.

The groundwater within the sandstone and siltstone is considered to be perched on the underlying mudstone unit. Groundwater flow is westwards and appears to drain into the mineral spoil heaps present to the west of the site. No spring discharges from the sandstone are indicated on current or historic Ordnance Survey maps. However, one spring has been identified during site surveys, located in the southwest corner, possibly associated with some of the geological faults mapped by the BGS.

4 PROPOSED DEVELOPMENT

It is proposed to extract mineral from the site, extending the former quarry void eastwards. The maximum depth of extraction would be such that the base of the quarry remains at least 1 m above the groundwater level. The depth limit is set so as not to modify the existing groundwater flow pattern and thereby to ensure that there is no adverse impact upon the private water supply.

Processing of materials will be limited to crushing and screening of unsuitable overburden material and will only be undertaken as and when necessary; it will not be a continuous process.

5 RISK ASSESSMENT

A proportion of the re-opened quarry will be located within the catchment of a private water supply located to the west of the site. The works have the potential to impact upon this water supply in terms of water volume and quality. These are discussed below.

5.1 Water volume

All mineral extraction would be undertaken above the watertable. Consequently, impacts to the existing groundwater flow regime or groundwater levels are not predicted. There is consequently not considered to be any potential for impact upon the volume of water received at the spring collector and mitigation measures are therefore not proposed.

5.2 Water quality

The operation of fixed and mobile plant within the quarry has the attendant potential to impact upon water quality. The safeguarding of water quality is recognised by the Applicant as being of paramount importance to the effective operation of the quarry.

The principal materials that are likely to be utilised and stored on-site, which have potential to enter the external water environment, are diesel and hydraulic oil. These occur both within mobile plant and also in storage facilities (eg fuel tanks etc).

Mineral extraction and processing is likely to generate fines, which may be mobilised by rainfall-derived surface water. The operation of mobile processing plant can exacerbate their generation and movement.

The means of mitigating these risks are discussed below.

6 PROPOSED ACTIONS

Actions are proposed, based upon the outcome of the assessment, which will safeguard the private water supply and the wider water environment. The comments below address the three issues raised by the EA in their letter of 19th May 2023 (EA reference RA/2023/145760/01-L01).

6.1 Presence of a spring

The existence of a spring, which is purportedly used as a water supply for several properties, is recognised.

6.2 Mitigation measures to protect the water source

Chemical and fuels

The following measures are proposed:

- There will be no activities involving potentially contaminating materials, such as storage of fuel and oil, within 50 m of the collector
- Neither mineral extraction to within a 75 m radius of the spring, nor mineral extraction below 240 mAOD, will be undertaken until groundwater monitoring has been completed over two winter periods
- Storage of potentially contaminating materials should preferably be kept off the sandstone, possibly in the southwest corner of the site, where the ground is underlain by mudstone. All potentially contaminating materials will be stored in accordance with best practice. Fuel tanks will be bunded and refuelling of plant will be undertaken, where feasible, on hardstanding. No refuelling of mobile plant should be undertaken within the mineral extraction area
- In the unlikely event of a pollution incident occurring, absorbent materials within spill kits would be deployed to contain the incident. The resultant contaminated material would be disposed of at a suitable facility. Site personnel will be trained in the correct usage of spill kits

The proposed measures are illustrated on *Drawing 3080/HIA/06*.

Suspended solids

This will be managed by both prevention and management. Any sources of dust/silt, such as crushing and screening, will be minimised and located in areas distant from the spring collector. Surface water management measures, including the construction of low berms to

channel water away from areas of high mobile plant movement, and wedge pits, will be incorporated into site housekeeping measures. These will serve to reduce the mobilisation and transport of fines.

After the completion of mineral extraction all sources of contamination will be removed from the site, hence the long-term, residual risk to the water environment is considered to be insignificantly small.

6.3 Groundwater level monitoring

The 'Old' monitoring borehole is operational and would be used to monitor groundwater levels regularly. Monitoring will establish natural temporal groundwater variation and provide information to suitably control the elevation of the base of the working area.

Two new groundwater monitoring boreholes will be installed between the existing ('Old') borehole and the spring collection chamber. The boreholes will be completed using 50 mm diameter plastic pipe, slotted at its base. The proposed locations of the boreholes are shown on *Drawing 3080/HIA/06*.

7 SUMMARY AND CONCLUSIONS

7.1 An update of the previously completed assessment of the water environment in the vicinity of Horn Crag Quarry has been undertaken. The updated assessment addresses comments received from the EA in their letter of 19th May 2023 (EA reference RA/2023/145760/01-L01).

The further assessment included a visit to view the configuration of the site, its setting within the local water environment and water features, with particular focus on the private water supply.

7.2 The principal water-related issue at the site is the presence of a spring collector located just within the western site boundary. Concern has been expressed regarding the potential of the proposed quarry re-opening to impact upon the continued viability of the water supply. The existence of a spring, which is used as a private water supply, is recognised.

7.3 Groundwater level records and geological data from on-site boreholes have been used to further develop the pre-existing understanding of the conceptual hydrogeology of the quarry and its environs.

7.4 An area of waterlogged ground exists in the west of the site. It is considered that this represents an egress point of groundwater from the sandstone. However, it is highly likely that the natural (ie pre-quarrying) water environment has been modified significantly by the presence of large volumes of rock waste, which are present along the majority of the western site boundary.

7.5 Based upon review of the recorded groundwater levels and geology, it is considered that the sandstone and siltstone strata beneath the site act as a single, interconnected aquifer, in which fracture flow predominates.

7.6 Data from the 'Old' borehole indicates the constancy of groundwater elevations and their small temporal range from 26th October 2020 to date.

7.7 The proposed development has the potential to impact upon the extant water environment in terms of water volume and water quality. These were assessed using site-specific data and comparison with other sites in similar settings. Measures are proposed that will mitigate any adverse impacts.

7.8 All mineral extraction will be undertaken above the watertable. Consequently, impacts to the existing groundwater flow regime or groundwater levels are not predicted.

7.9 Impacts upon water quality may potentially occur due to the accidental release of contaminants, or the generation and subsequent mobilisation of fines. Potential impacts would be mitigated by identifying a suitable location for storage tanks, limiting the area allocated for refuelling and by the adoption of best practice methods and good site housekeeping measures.

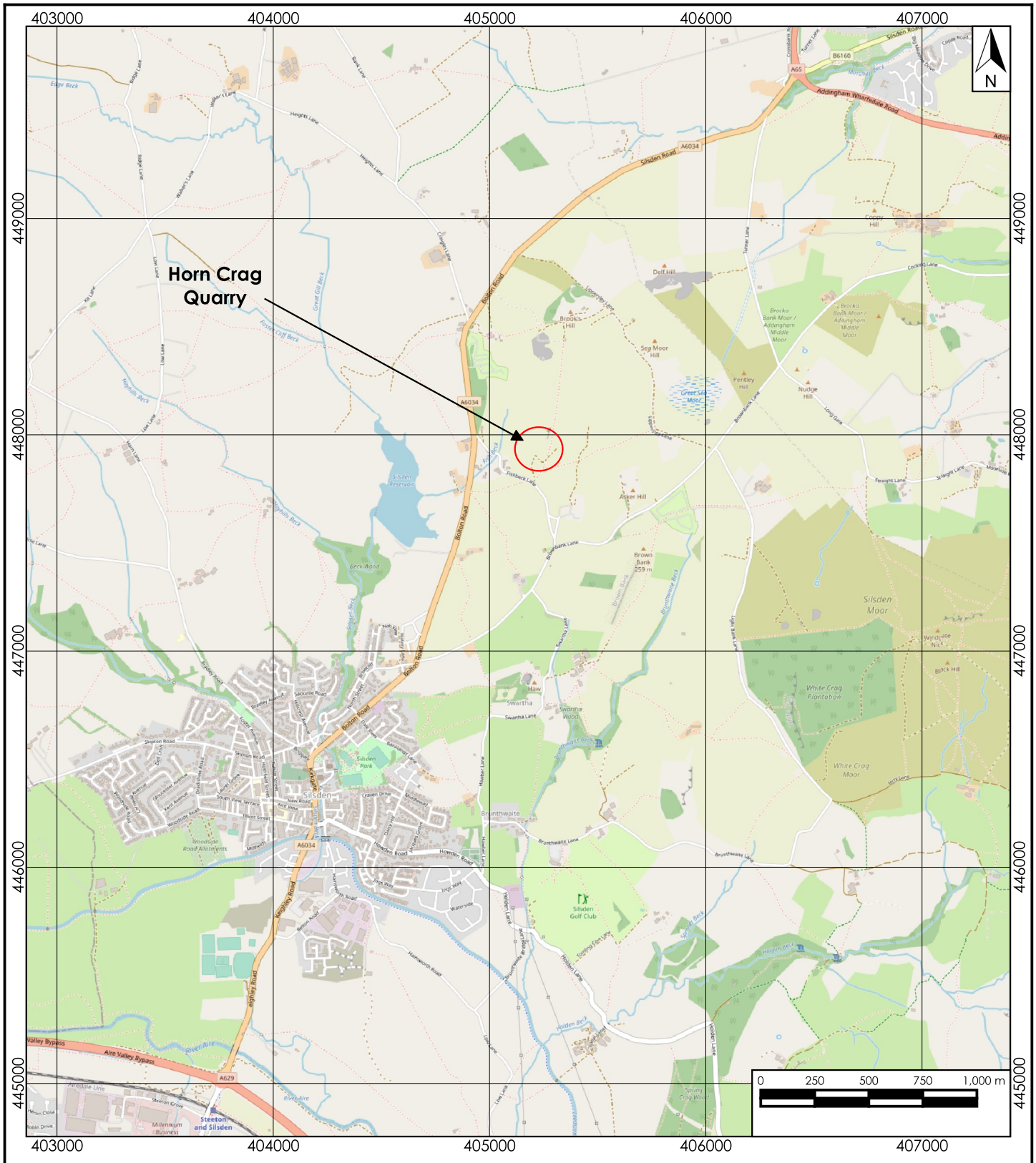
7.10 Robust spill response measures will be incorporated into the systems of working at the quarry.

7.11 It is proposed to install two new groundwater monitoring boreholes, between the 'Old' borehole and the spring collector. Groundwater levels will be recorded within them, and the 'Old' borehole, to monitor long-term groundwater behaviour.

7.12 The relatively slow rate of site development is such that a prolonged period will exist before mineral extraction reaches its final proposed depth. This provides the opportunity to accumulate a long run of groundwater level data.

7.13 It is concluded that the proposed works will not impact adversely upon either the spring collector water supply or the wider water environment.

DRAWINGS



Scale correct at A4

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Client	Mineral Planning Group Ltd.
Title	Site Location
Project	Horn Crag Quarry
Drawing	3080/HIA/01
Version	1
Date	Oct 2023
Scale	1:25,000

Key

- Issue
- Spring
- Well

Scale correct at A4

Client	Mineral Planning Group Ltd.
Title	Water features
Project	Horn Crag Quarry
Drawing	3080/HIA/02
Version	1
Date	Oct 2023
Scale	1:4,000

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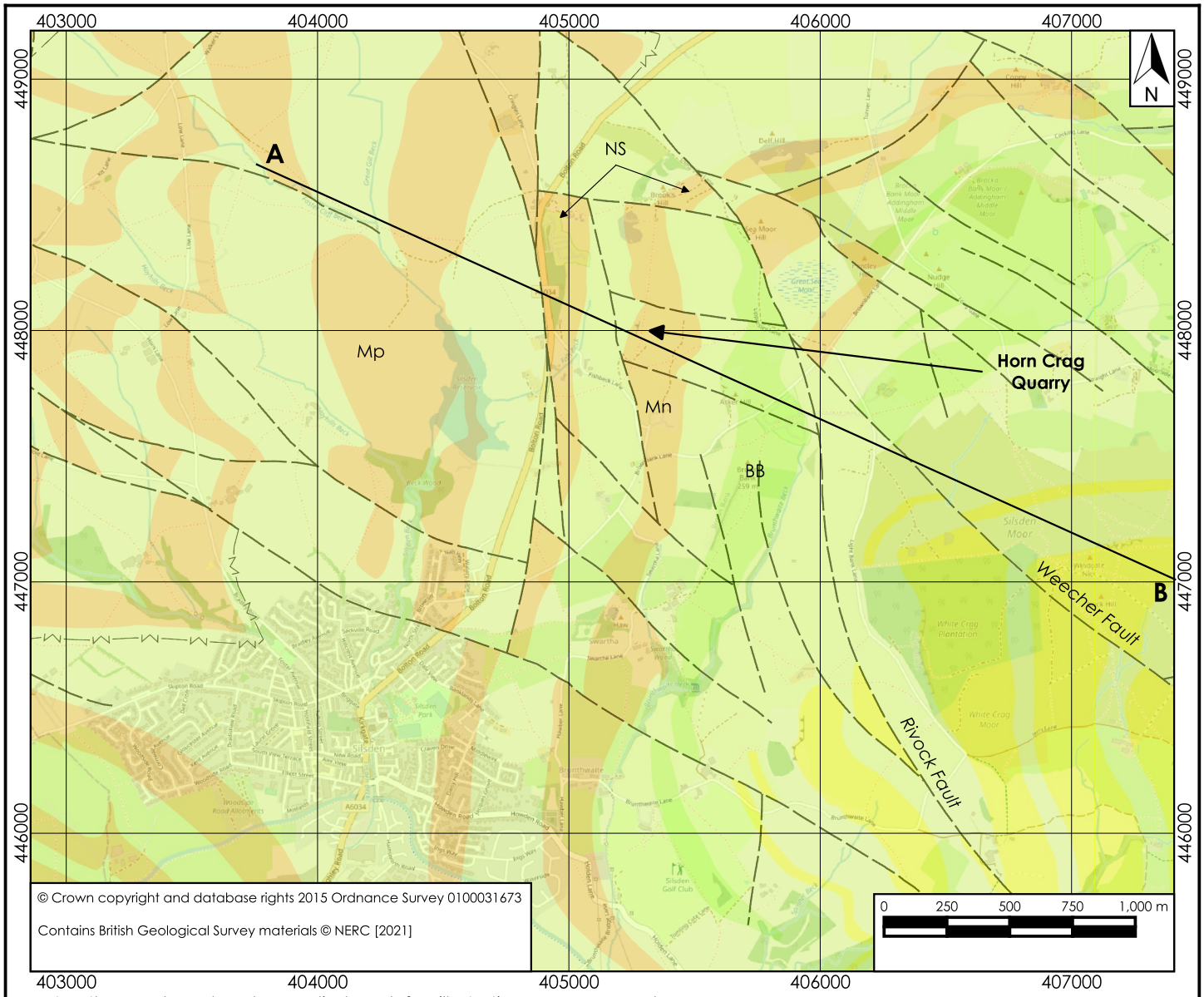
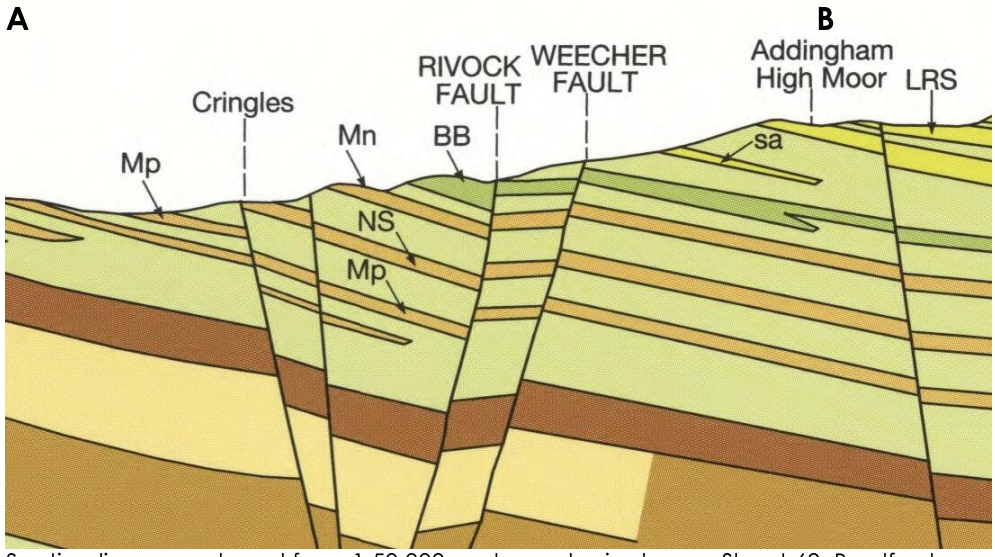


Note: the geology has been displayed for illustrative purposes and boundaries may not be accurate at the scale displayed.

Legend

Geological key

- sandstone
- sandstone (eg BB)
- sandstone (eg. NS & Mp)
- mudstone, shale



Section line reproduced from 1:50,000-scale geological map, Sheet 69, Bradford

Scale correct at A4

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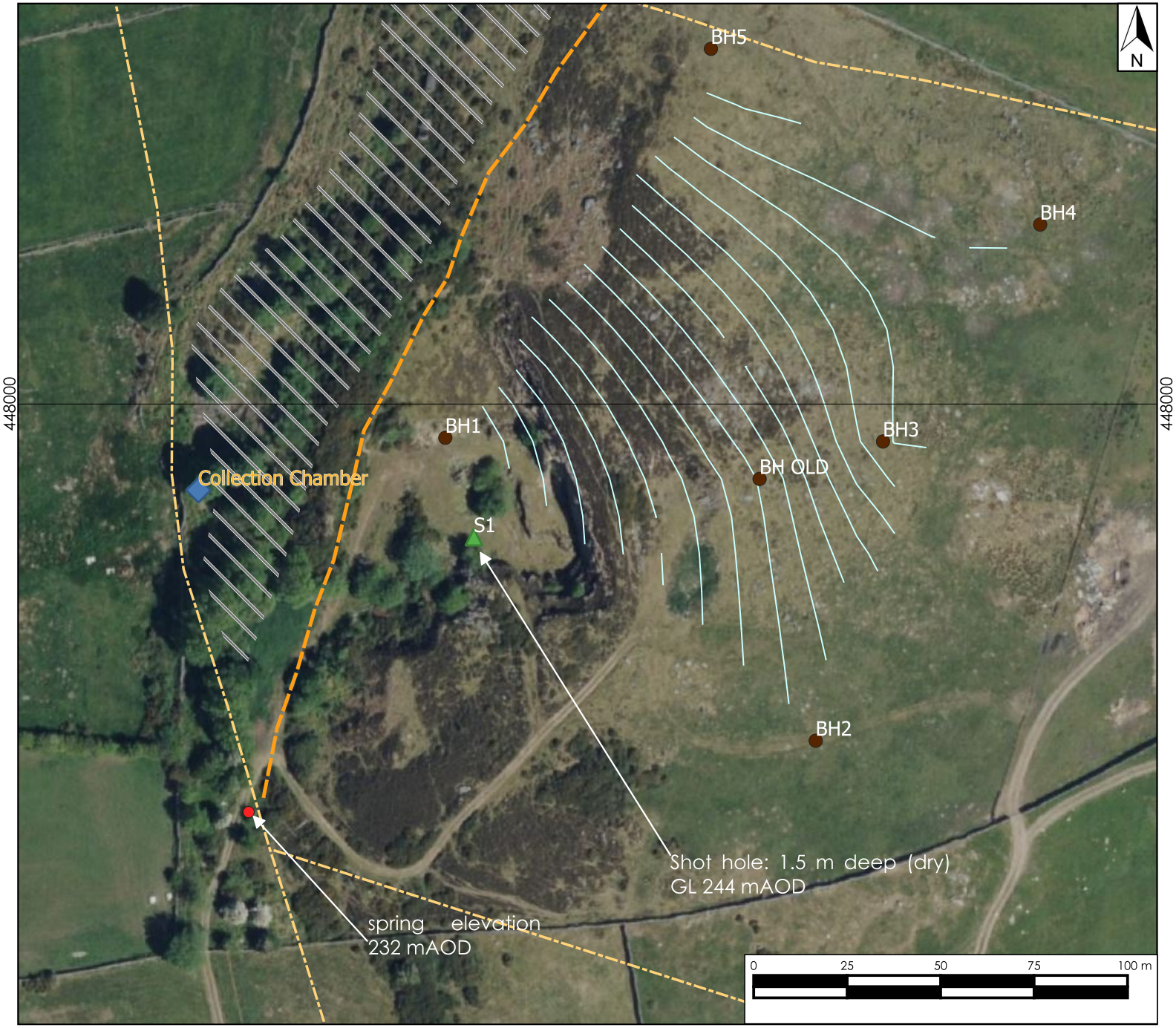
Client	Mineral Planning Group Ltd.
Title	Geology
Project	Horn Crag Quarry
Drawing	3080/HIA/03
Version	1
Date	Oct 2023
Scale	1:25,000



Key

GWL

Boreholes

Borehole

Shot hole

Borehole Locations copy

PWS

Springs

Spring

Rock Waste (indicative)

Outcrop of base of sandstone (BGS mapping)

BGS Faults

Scale correct at A4

Client	Mineral Planning Group Ltd.
Title	Groundwater level July 2019 (Old BH-September 2023)
Project	Horn Crag Quarry
Drawing	3080/HIA/04
Version	1
Date	Oct 2023
Scale	1:1,500

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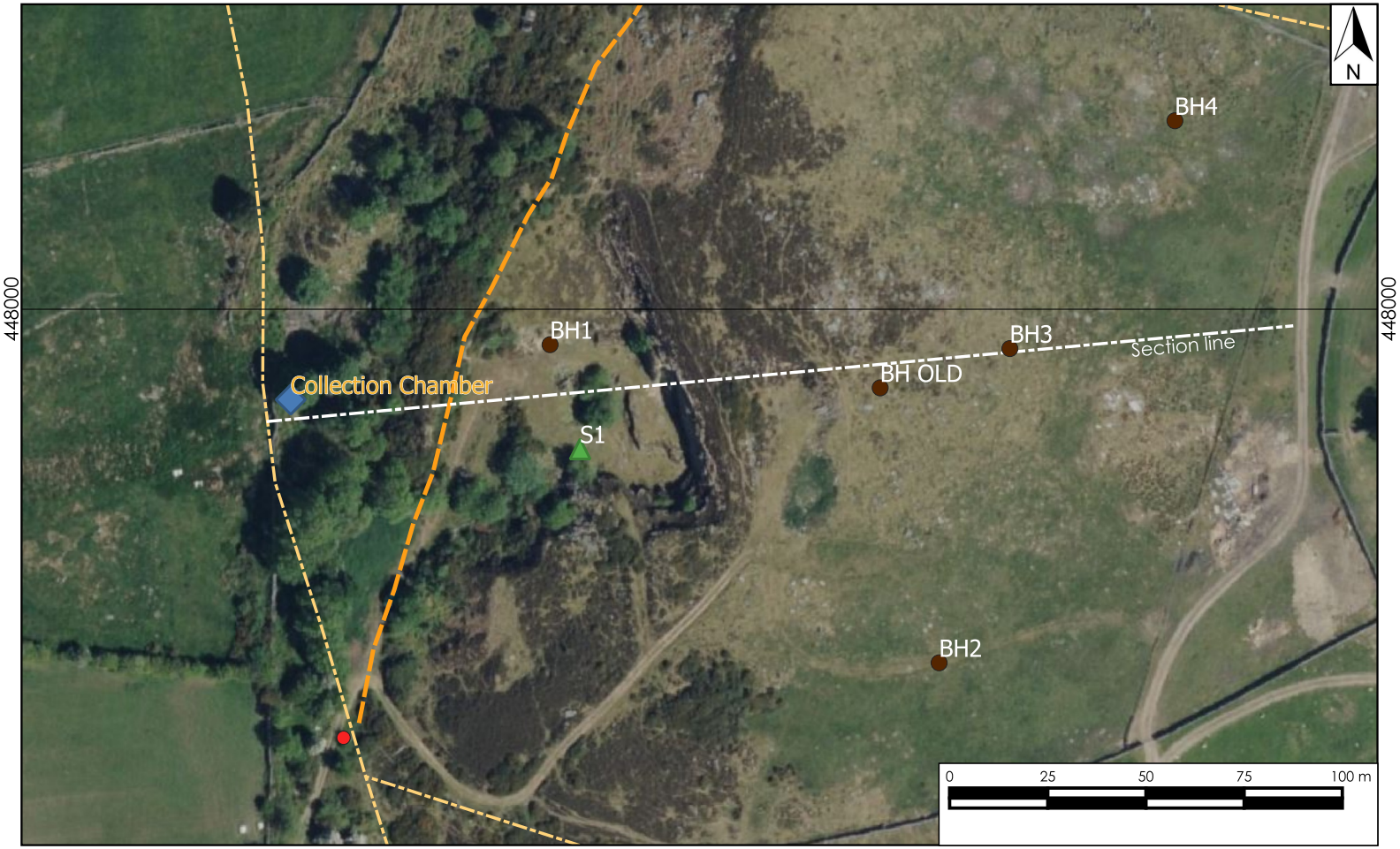

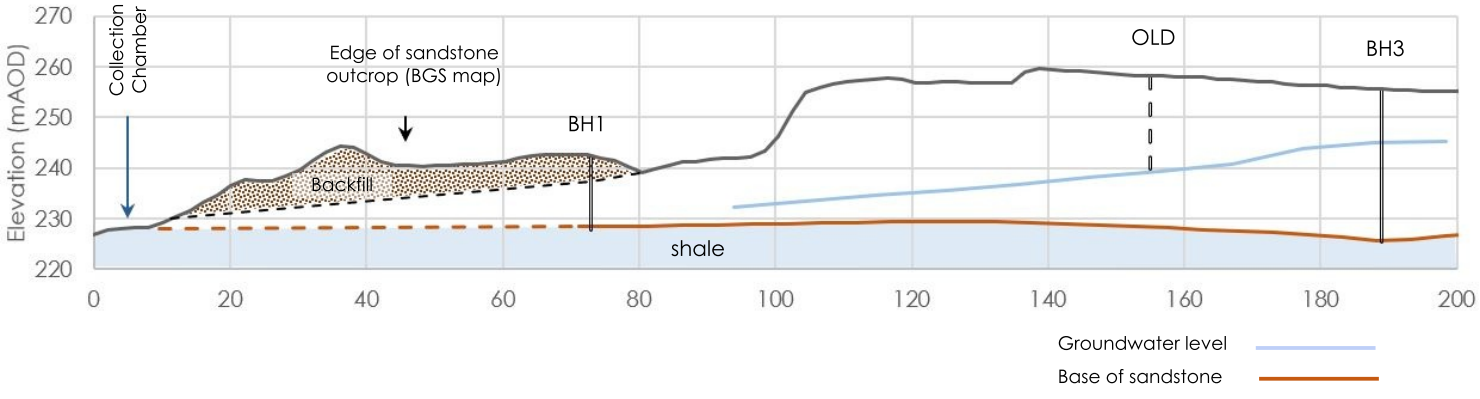

Key

Boreholes

- Borehole
- Shot hole

Borehole Locations

- PWS

Springs

- Spring
- Outcrop of base of sandstone (BGS mapping)
- BGS Faults

Scale correct at A4

Client	Mineral Planning Group Ltd.
Title	Cross section
Project	Horn Crag Quarry
Drawing	3080/HIA/05
Version	2
Date	Oct 2023
Scale	1:1,700

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Key

Boreholes

- Borehole
- Shot hole
- Future Monitoring Borehole (BH1,BH2...)

Borehole Locations

- PWS

Springs

- Spring
- Base sandstone at outcrop (BGS)
- BGS Faults

Scale correct at A4

Client	Mineral Planning Group Ltd.
Title	Proposed Mitigation Measures
Project	Horn Crag Quarry
Drawing	3080/HIA/06
Version	2
Date	Oct 2023
Scale	1:1,700

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