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THE IRON LINE, MILLOM

MINING RISK MITIGATION STRATEGY

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Site Address: The Iron Line, Millom, Cumbria, LA18 4LB

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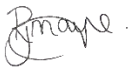
Rachel Mayne BSc (Hons), CGeol, EurGeol, FGS Principal Geotechnical Engineer		03 March 2025

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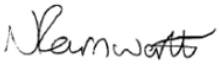
Niall Farnworth BSc (Hons), MCIWEM C.WEM Principal Geo-Environmental Engineer		08 April 2025

CONTENTS

1 Introduction **1**
1.1 Requirements of the Mining Remediation Strategy 2
1.2 Definitions 2
1.3 References 2
1.4 Other Considerations 2
2 Desk Based Mining Risk Assessment **4**
3 Summary of Intrusive Mining Investigation **9**
3.1 Zone 1 Ground Conditions 9
3.2 Zones 3 – 10 Ground Conditions 10
4 Mining Risk Site Model **12**
5 Mining Remedial Works **14**
5.1 Mining Remedial Action 1 – Further Investigation and Assessment of the Ventilation Borehole 14
5.2 Mining Remedial Action 2 – Installation of Geogrid for Road and Hardstanding & Appropriate Foundation Design for Bird Hides 14
5.3 Mining Remedial Action 3 – Watching Brief during Groundworks and Construction 14
5.4 Mining Remedial Action 4 – Undertake Additional Deep Borehole 15
6 Verification & Reporting **16**

FIGURES

Figure 1 – Site Location Plan with Development Zones, site boundary is shown in re 1
Figure 2 – Mining Features 4
Figure 3 – Extract from BGS 1:50,000 mapping (Artificial Ground) 5

TABLES

Table 1 – Summary of Mining Risks and Proposed Actions associated with Development Zone 1 6
Table 2 – Summary of Mining Risks and Proposed Actions associated with Development Zone 3 - 10 7
Table 3 – **Zone 1:** Potential Mining Risk 12
Table 4 – **Zones 3 – 10:** Potential Mining Risk 12

APPENDICES

Appendix A – Drawings

1 INTRODUCTION

This Mining Risk Mitigation Strategy has been prepared by Curtins for Cumberland Council (the Client) to provide guidance with respect to the proposed development site known as The Iron Line, Millom, Cumbria, LA18 4LB. Part of the site is a Site of Special Scientific Interest (SSSI), a Ramsar Site, a Special Protection Area and a Special Area of Conservation which comprises RSPB Hodbarrow and land at the southern side of Redhills Quarry (owned by Cumberland County Council).

The site has been split into distinct sections for the purpose of Curtins Assessments, with a building being proposed in the north of the site in the proposed 'Visitors Centre' comprising erection of visitor centre with café/shop, group room, staff/volunteer, toilet facilities and car park and in Zones 3 – 10, consolidation, repair and installation of interpretive sculpture to Towsey Hole Windmill; refurbishment of existing Tern Island hide; new bird hides, pathways, gateway features and street furniture; enhancement of wildlife habitats; associated landscaping and drainage infrastructure; and maintenance of byway with restricted vehicular access.

- Zone 1: Visitors Centre
  - Proposed New Visitor Centre Building, car parking, roads and infrastructure.
- Zone 3: Towsey Hole Windmill
  - Improvement of existing paths and construction of new paths
- Zone 4: Haverigg Lighthouse & Tern Island Hide
  - Improvement to paths/roads
- Zone 5: Annie Lowther Hide
  - Improvement of existing paths and construction of new paths and bird hide.
- Zone 7: Quarry Hides
  - Improvement to paths/roads and construction of new bird hides.
- Zone 8: Iron Line Railway
  - Improvement to paths/roads
- Zone 9: Iron Line Entrance
  - Improvements to paths/roads
- Zone 10: Mainsgate Road Entrance & Hodbarrow Car Park
  - Improvements to paths/road

The main development is proposed in Development Zone 1, where a Visitors Centre building will be constructed. The remainder of the Development Zones will receive some development such as new roads, paths and hides. The locations of the Development Zones are illustrated in Figure 1.

Figure 1 – Site Location Plan with Development Zones, site boundary is shown in red.

The site has been characterised through a desk-based Phase 1 Geo-Environmental Assessment (Ref. 1), a Phase 2 Ground Investigation for Zone 1 (Ref. 2), a Phase 2 Ground Investigation for Zones 3-10 (Ref. 3), a Mining Risk Assessment (Ref. 4), and a Preliminary Geotechnical Risk Register (Ref. 5).

The site comprises RSPB Hodbarrow which covers the majority of the site, and land to the southern side of the Redhills Quarry (Owned by Cumbria County Council).

A sea wall is present bounding the south of the site, extending from east to west. Heritage and historic structures are present such as the Hodbarrow Lighthouse and Hodbarrow Beacon.

There is a large lagoon located within the southeastern portion of the site, with the majority of the site covered by grassland and tree cover. A footpath extending the entire length of the outer sea wall is present, with several footpaths extending into the RSPB Hodbarrow site to the east.

1.1 Requirements of the Mining Remediation Strategy

The Mining Remediation Strategy is to account for the following;

- Revised risk ratings associated with mining.
- Recommendations for mining risk mitigation/remedial works.
- Recommendations for decommissioning of historic mining features (ventilation borehole).
- Recommendations for Geogrid installation in areas of new paths/roadways and buildings in Zone 3-10.
- Recommendations for a Watching Brief during groundworks and construction.
- Proposals for the verification of remedial measures for Local Authority approval.

1.2 Definitions

In this document the following definitions apply:

Contractor Refers to the appointed contractor responsible for undertaking the remediation works.

Site Manager Refers to a representative of the appointed contractor resident on site.

Engineer Refers to a suitably qualified representative from Curtins, who would not normally be resident on site.

1.3 References

The Mining Remediation Strategy has been prepared with reference to the following existing reports;

- **Reference 1:** Curtins (2023) Phase 1 Preliminary Risk Assessment, The Iron Line, Millom Ref. 080974-CUR-00-XX-RP-GE-001 P03.
- **Reference 2:** Curtins (2025) Phase 2 Ground Investigation, The Iron Line, Millom (Zone 1) Ref. 080874-CUR-XX-XX-RP-GE-00006 P03.
- **Reference 3:** Curtins (2024) Phase 2 Ground Investigation, Millom (Zones 3-10) Ref. 080874-CUR-XX-XX-T-GE-00007 P02
- **Reference 4:** Curtins (2024) Mining Risk Assessment, The Iron Line, Millom Ref. 080874-CUR-XX-XX-T-GE-00005 P02.
- **Reference 5:** Curtins (2025) Preliminary Geotechnical Risk Register, The Iron Line, Millom Ref. 080874-CUR-XX-XX-PP-GELO-00001_P01.

It should be noted that a Remediation Strategy has also been produced for the site:

- **Reference 6:** Curtins (2025) Remediation Strategy, The Iron Line, Millom Ref. 080874-CUR-XX-XX-T-GE-00008 P02

1.4 Other Considerations

1.4.1 Ground Contamination

Numerous risks associated with ground contamination have been identified to date. Contamination risks are outside the scope of this report, remediation measures associated with contamination are detailed under separate Curtins reports as referenced above.

1.4.2 Geotechnical

Ground conditions for the site are complex due to the historical and geographical site setting. Geotechnical risks and recommendations are outside the scope of this report and are detailed under separate Curtins reports as referenced above.

1.4.3 Ecological Considerations

Ecological assessment is outside the scope of Curtins services. Notwithstanding, it is noted that the site is in a sensitive area with respect to ecology. Zone 1 Visitors Centre Building site is located within areas of Priority Lowland Meadow habitats, rare species such as Natterjack Toad are known to be present along with nuisance plant species such as Mares Tail also observed on site. The remainder of the site is located within the RSPB and SSSI, RSPB Hodbarrow.

Greengage's Ecological Impact Assessment Reports should be consulted for ecological constraints and construction mitigation measures.

Specialist ecologist advice should be sought for all construction works.

2 DESK BASED MINING RISK ASSESSMENT

The following information has been taken from the Curtins (2024) Mining Risk Assessment, The Iron Line, Millom (Ref. 080874-CUR-XX-XX-T-GE-00005 P02) (Ref. 4).

Iron mining was undertaken at Hodbarrow Iron Mine on site, with the mine opening in ~1850 and ceased operations in 1968. The Hodbarrow Mine, when operational, was a large iron ore mine which had twice extended its capacity. Firstly, by building the inner sea barrier, and then again through construction of the outer sea barrier to allow them to mine ore which was previously beneath the sea/estuary. This area has since been flooded and is known as the Hodbarrow Lagoon. Online searches suggest that both surface extraction and shallow mining was undertaken, and that subsidence of historic structures (the inner sea wall barrier) occurred as a result of underground mining.

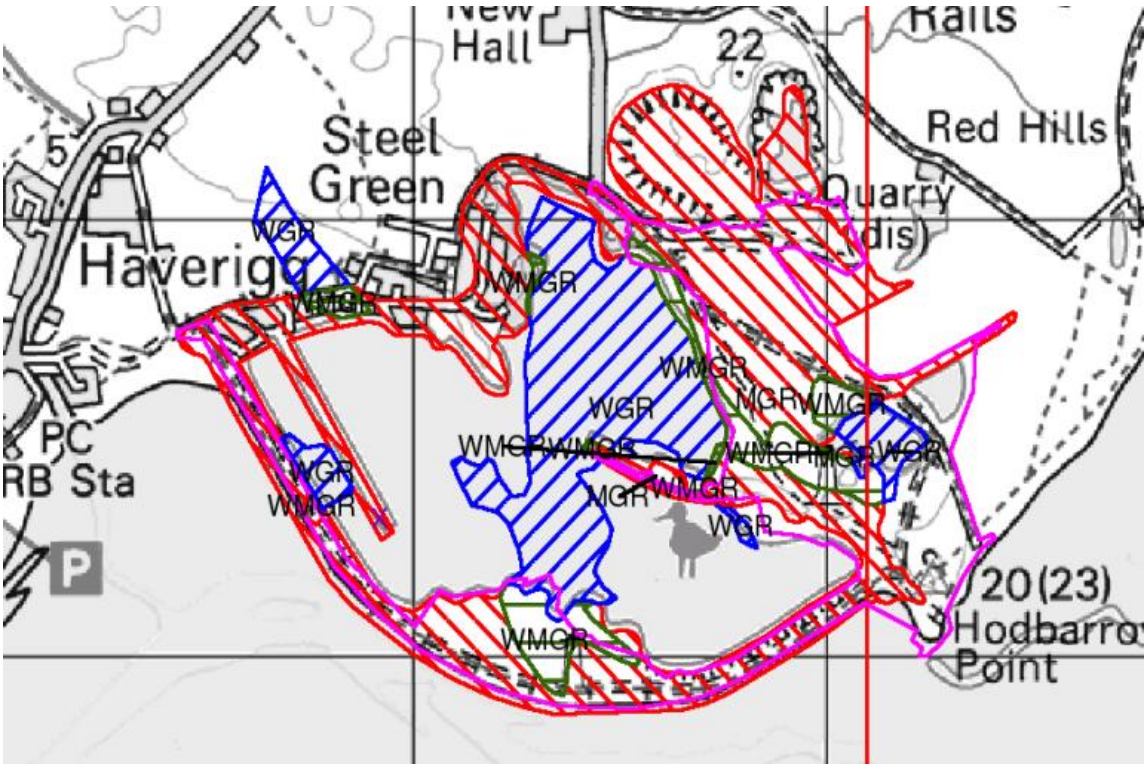
In order to understand the presence of mine entries on site, prior to Intrusive Ground Investigation, Curtins conducted a site walkover along with a visit to the Cumbria Archives to collect the Premise Record Plans from 1866 – 1969, and items from the Millom Discovery Centre from 1862 – 1974; along with conducting a desk-based search.

Figure 2 – Mining Features

***Blue** data from Curtins Phase 1 Envirocheck Mapping*
***Green** data from Curtins Phase 1 Envirocheck data*
data from Northern Mine Research Society interactive map
***Yellow** data from Historical Archive Mapping*
***Orange Shading** showing Ore Body Workings*
***Blue Line** showing Underground Road*
*Approximate Site Boundary in **Red**.*

A total of 122 No. shafts or 'unspecified pits' (a shaft or any extractive process such as a quarry/opencast mine or excavation) are noted to be located within the site boundary, based on various information sources including the Envirocheck, Historical Archive Mapping obtained from the Cumbria Archives and Millom Discovery Centre, and from the Northern Mine Research Society. A number of potential mine entries identified across the data sets above are likely to be duplications, however given the inaccuracies in mapping the exact co-ordinates are unknown. Figure 6 shows the approximate locations of these extracted potential mine entries. It's acknowledged that it is not be possible to investigate every possible shaft due to cost and other constraints such as ecological constraints. Furthermore, the site's proposed use is broadly a continued use with the exception of the visitors centre.

Desk-based study found that the site has been heavily worked with numerous areas of infilled ground, worked ground and Made Ground indicated on mapping, comprising voids and artificial deposits.



Map Colour	Lex Code	Rock Name	Rock Type
	WMGR	Infilled Ground	Artificial Deposit
	WGR	Worked Ground (Undivided)	Void
	MGR	Made Ground (Undivided)	Artificial Deposit

Figure 3 – Extract from BGS 1:50,000 mapping (Artificial Ground)

2.1 Curtins Mining Risk Assessment Summary

Risk assessment was undertaken for each of the development 'Zones' as identified in Section 2.1 using the pertinent mining records and information discussed in previous sections. Curtins drawing titled 'Summary of Historical Iron Mining and Associated Features' is enclosed in *Appendix A* with extracts used within the assessment below.

Development Zone 1 was assessed independently due to the development including new structures. Development Zones 3 – 10 are assessed collectively due to the proposed developments including bird hide structures and improvements to paths and roadways only. Summary of Mining risk established through Curtins Mining Risk Assessment are outlined in Table 3 & 4 below. For further detail the Mining Risk Assessment report should be consulted (Ref. 2).

Development Zones 3 – 10 have been assessed separately but the conclusions summarised collectively due to the proposed developments including improvements to paths and roadways.

Table 1 – Summary of Mining Risks and Proposed Actions associated with Development Zone 1

Scenario	Consequence	Likelihood	Risk in Development Zone 1 (Visitors Centre)	Proposed Action
Underground Mining (probable at deeper depths) ***>30m below rockhead***	Medium	Unlikely	**Low**	• No action required.
Underground Mining (probable at shallow depths) ***<30m below rockhead***	Medium	Low Likelihood	**Moderate/Low**	• An initial ground investigation for initial planning submissions and design purposes, complete rotary open boreholes to determine to determine the presence of voids, broken ground which may be indicative of shallow workings within influencing depths of the proposed structure, boreholes to be advanced to circa 40m bgl. Ground gases should be monitored during borehole advancement due to potential for mine gases. • Dependent on the findings of the ground investigation determine and produce a treatment specification from the ground investigation information. • Dependent on the findings of the ground investigation complete proof drilling and grouting of the proposed development area, relevant to the building footprints and a suitable distance surrounding any building footprints.
Mine entries (shafts and adits)	Medium	Low Likelihood	**Moderate - Low**	• Identify location of the ventilation borehole and decommission in accordance with EA guidance. • A watching brief should be carried out by a geotechnical engineer during groundworks to monitor for evidence of any unrecorded mine entries. Where mine entries are recorded during construction works should be stopped and further risk assessment carried out. A remedial specification and capping measures may then need to be provided.
Mining Geology	Medium	Unlikely	**Low**	• Complete the initial ground investigation to determine the thickness of any Made Ground or

Scenario	Consequence	Likelihood	Risk in Development Zone 1 (Visitors Centre)	Proposed Action
				superficial deposits, and depth to bedrock across the site area.
Mine gas emissions	Medium	Low	**Moderate / Low**	• Complete the initial ground investigation and install ground gas monitoring wells in selected exploratory borehole locations to enable a monitoring programme and gas risk assessment for the site.
Recorded Mining Surface Hazard	Medium	Low Likelihood	**Moderate – Low**	• Complete the initial ground investigation to determine the thickness of any Made Ground or superficial deposits, and depth to bedrock across the site area.

Table 2 – Summary of Mining Risks and Proposed Actions associated with Development Zone 3 - 10

Scenario	Consequence	Likelihood	Risk in Development Zone 3 – 10	Proposed Action
Underground Mining (probable at deeper depths) ***>30m below rockhead***	Medium	Unlikely	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• No specific action required.
Underground Mining (probable at shallow depths) ***<30m below rockhead***	Medium	Low Likelihood	**Zone 3, 4,5, 7, 8, 9 & 10** **Low**	• No specific action required.
Mine entries (shafts and adits)	Medium	Low Likelihood	**Zone 3,4 ,5, 7, 8, 9 & 10** **Moderate – Low**	• Watching brief to be carried out during all groundworks by geotechnical engineer to monitor for evidence of shafts. If any are recorded during construction works should be stopped and further risk assessment carried out. A remedial specification and capping measures may then need to be provided. • New or upgraded roads, paths and features on Zones 3,4,5,7,8,9 & 10 to be underlain with geogrid to provide some mitigation against any shaft collapse. • Within Zone 7 there is a bird hide in close proximity to a potential shaft. Further assessment is recommended, or else consideration should be given to relocating the bird hide away from this shaft, outside of its departure zone and zone of influence.
Mining Geology	Medium	Unlikely	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• No specific action required.

Scenario	Consequence	Likelihood	Risk in Development Zone 3 – 10	Proposed Action
Mine gas emissions	Medium	Low	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• No specific action required.
Recorded Mining Surface Hazard	Medium	Low Likelihood	**Zone 3,4 ,5, 7, 8, 9 & 10** **Moderate – Low**	• Complete the initial ground investigation to determine the presence of any Made Ground aggressive ground and expansivity to be considered.
Surface Mining (open cast workings)	Medium	Unlikely	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• Complete the initial ground investigation to determine the type of Made Ground along with taking environmental samples.

3 SUMMARY OF INTRUSIVE MINING INVESTIGATION

The following sections present a summary of the ground conditions relating to the mining legacy of the Hodbarrow Mine identified during the Curtins intrusive ground investigation(s). Due to the extent of the site and the proposed developments ground conditions have been separated into Zone 1 and Zones 3-10 for Clarity.

3.1 Zone 1 Ground Conditions

Zone 1 Intrusive Ground Investigation comprised:

- 4 No. Window Sample Boreholes,
- 4 No. Trial Pits,
- 4 No. Trial Trenches,
- 3 No. Soakaway Pits,
- 15 No. CBR Tests,
- 5 No. Cable Percussive Boreholes, and,
- 3 No. Rotary Open-Hole Boreholes.

The Rotary Open-Hole Boreholes were specifically designed to characterise deep ground conditions and to identify any broken ground and/or voids within the bedrock, which would indicate evidence of mine workings.

Ground Conditions encountered at the Zone 1 Development Site generally comprised of Made Ground deposits overlying cohesive Glacial Till (with localised granular Glacial Till) superficial deposits. Bedrock comprised of the Red Hills Limestone with localised Low Furness Basel Formation conglomerate.

No evidence of broken ground, voids or loss of flush were encountered during borehole progression through bedrock deposits.

3.1.1 Zone 1: Made Ground

Made Ground was encountered in all exploratory borehole locations from ground level to proven depths ranging between 0.40m and 4.00m bgl (13.00m to 9.40m AOD).

Contamination risks associated with Made Ground are outside of the scope of this report and are discussed within the Remediation Strategy (Reference 6), with ground conditions for Zone 1 further discussed within Reference 2.

3.1.2 Zone 1: Superficial Deposits

Cohesive deposits indicative of Glacial Till was encountered in 10 No. locations. The base of the cohesive Glacial Till was confirmed to depths ranging between 9.00m and 15.00m bgl (5.46m to -1.60m AOD).

Granular deposits were encountered in 4 No. locations, proven to a depth of 14.50m bgl (-0.50m AOD) in CP1-03.

Ground conditions for Zone 1 are further discussed within Reference 2 and Reference 6.

3.1.3 Zone 1: Low Furness Basal Formation

Bedrock deposits indicative of the Low Furness Basal Formation was encountered at 18.0m bgl (-4.60m AOD) in RH 1-02, encountered to a maximum depth of 40.00m bgl (-26.60m AOD). The formation comprised reddish brown conglomerate with lithoclasts of mudstone and sandstone and a reddish brown sand matrix. The base of the deposit was not encountered during the investigation.

No evidence of broken ground, voids or loss of flush were identified.

Ground conditions for Zone 1 are further discussed within Reference 2 and Reference 6.

3.1.4 Zone 1: Red Hill Limestone Formation

Bedrocks deposits consistent with the Red Hill Limestone Formation were encountered from depths ranging between 9.00m to 15.00m bgl (5.46m to -1.60m AOD) to a maximum depth of 40.50m bgl in RBH-03. This deposit was encountered as a grey limestone. The extent of this deposit was not proven during the ground investigation.

No evidence of broken ground, voids or loss of flush were identified.

Ground conditions for Zone 1 are further discussed within Reference 2 and Reference 6.

3.1.5 Zone 1: Obstructions Encountered

Several obstructions were recorded within the Made Ground during the investigation, within DSBH 1-02 at 1.40m bgl (unknown), DSBH 1-03 at 1.80m bgl (tyre), DSBH 1-05 at 4.00m bgl (unknown), TP 1-02 at 1.20m bgl (hard ground, unable to penetrate), SA 1-01 at 1.65m bgl (hard ground, unable to penetrate), and SA 1-03 at 1.00m bgl (hard ground, unable to penetrate).

3.1.6 Zone 1: Groundwater

Groundwater was encountered within 12 No. locations during the ground investigation and was considered likely to be perched water and not representative of an aquifer.

Ground conditions for Zone 1 are further discussed within Reference 2.

3.1.7 Zone 1: Observed Potential Contamination

Visual or olfactory evidence of contamination was observed during the ground investigation.

Contamination risks are outside of the scope of this report and are discussed within the Remediation Strategy (Reference 6).

3.2 Zones 3 – 10 Ground Conditions

Zones 3 – 10 Intrusive Ground Investigation comprised:

- 5 No. Window Sample Boreholes,
- 2 No. Foundation Hand Pits,
- 2 No. Hand Pits,
- 2 No. Soakaway Trial Pits, and,
- 14 No. CBR Tests.

Ground Conditions encountered in Zones 3 – 10 generally comprised Topsoil and/or Made Ground overlying cohesive and granular superficial deposits, with bedrock deposits encountered within 2 No. locations only.

No evidence of broken ground or voids associated with shallow mine workings and mine entries were encountered during the Zones 3 – 10 intrusive ground investigation.

3.2.1 Zones 3 – 10: Topsoil

Topsoil was encountered within 13 No. locations from ground level to a maximum depth of 1.35m bgl.

Ground conditions for Zones 3 – 10 are further discussed within Reference 3.

3.2.2 Zones 3 – 10: Made Ground

Made Ground (both cohesive and granular) was encountered within 15 No. locations from between ground level and 0.22m bgl, with a maximum unproven thickness of 0.98m.

Contamination risks associated with Made Ground are outside of the scope of this report and are discussed within the Remediation Strategy (Reference 6), with ground conditions for Zones 3 - 10 further discussed within Reference 3.

3.2.3 Zones 3 – 10: Superficial Deposits

Cohesive deposits indicative of Glacial Till was encountered in 8 No. locations from depths of between 0.05m to 1.68m bgl, with thicknesses of 0.90m (proven thickness) to 4.86m (unproven final thickness),

Granular deposits indicative of Glacial Till was encountered in 5 No. locations from depths of between 0.07m to 1.35m bgl with thicknesses of 0.20m (proven thickness) to 2.00m (unproven final thickness)

Ground conditions for Zones 3 – 10 are further discussed within Reference 3 and Reference 6.

3.2.4 Zones 3 – 10: Red Hill Limestone Formation

Bedrock weathered to a 'Residual Soil', indicative of the Red Hill Limestone Formation was encountered within DSBH 3-01, SA 3-01 and SA 3-02 only in Zone 3.

It was encountered in DSBH 3-01 and SA 3-02 from a depth of 0.13m to 0.21m bgl, comprising firm reddish brown slightly sandy gravelly to very gravelly clay with cobbles of limestone; and as a reddish brown clayey gravelly cobbly boulders of limestone, with gravel and cobbles of limestone.

Slightly more competent bedrock was encountered within SA 3-01 from a depth of 0.14m bgl, comprising light grey and reddish-brown limestone.

No evidence of broken ground or voids were identified during the ground investigation in Zones 3 – 10.

Ground conditions for Zones 3 – 10 are further discussed within Reference 3 and Reference 6.

3.2.5 Zones 3 – 10: Obstructions Encountered

Obstructions were recorded within DSBH 5-01 in Zone 5 only, at 1.20m bgl as hard compacted ground comprising of gravel and cobbles of slag and clinker, likely representative of mining waste by-product.

3.2.6 Zones 3 – 10: Groundwater

Groundwater was encountered within HP 4-01 in Zone 4 only, at 0.15m bgl, likely representing perched water.

Ground conditions for Zones 3 – 10 are further discussed within Reference 3.

3.2.7 Zones 3 – 10: Observed Potential Contamination

Visual or olfactory evidence of contamination was observed during the ground investigation.

Contamination risks are outside of the scope of this report and are discussed within the Remediation Strategy (Reference 6).

4 MINING RISK SITE MODEL

Updated Mining Risk Assessment has been undertaken for each of the Development Zones, using pertinent mining records along with the findings of the intrusive ground investigations, as summarised in previous Sections. Risks are not assessed for the continued use of areas where no development is proposed.

Development Zone 1 was assessed independently due to the development include a new Visitors Centre Building. Development Zones 3 – 10 are assessed collectively due to the proposed developments including bird hide structures and improvement to paths and roadways only. *Tables 3 and 4* discuss the potential mining risk (PMR) in each zone.

*Table 3 – **Zone 1:** Potential Mining Risk*

PMR	Mining Issue	Receptor	Risk	Risk Mitigation Recommended
1	Deep Underground Mining (recorded or probable at shallow depths)	**Visitors Centre Building**	**Low**	Curtins intrusive ground investigation works to date have not identified any evidence of deep mine workings in the location of the proposed Visitors Centre Building. Additional deep rotary boreholes will be required following the relocation of the Visitor Centre Building.
2	Shallow Underground Mining (probable at deeper depths)	**Visitors Centre Building**	**Low**	Curtins intrusive ground investigation works to date have not identified any evidence of shallow mine workings in the location of the proposed Visitors Centre Building.
3	Mine Entries (shafts and adits)	**Visitors Centre Building**	**Moderate / Low**	Further investigation and consideration of Ventilation Borehole identified on historical mapping in Zone 1, it's location and construction should be confirmed and risk to development further assessed. A residual risk remains associated with the potential for unrecorded mine shafts and a watching brief during ground works and construction is recommended. Where mine entries are recorded during construction works should be stopped and further risk assessment carried out. A remedial specification and capping measures may then need to be provided.
4	Mining Geology	**Visitors Centre Building**	**Low**	The depth to bedrock was variable around Zone 1 (10.00m to 18.00m bgl). Advice should be sought from a piling specialist at an early stage to ensure existing information is suitable for pile design, no ground bearing structures are proposed in Zone 1. Settlement assessments may be required if any ground bearing structures are proposed, to determine if remedial measures are required.

*Table 4 – **Zones 3 – 10:** Potential Mining Risk*

PMR	Mining Issue	Receptor	Risk	Risk Mitigation Recommended
5	Deep Underground Mining (recorded or probable at shallow depths)	**Pathways, roads and bird hides.**	**Low**	The intrusive investigation works did not identify any evidence of shallow mine workings or mining related features, such as voids or broken ground. The proposed development plans for Zones 3 – 10 are for the improvement of existing paths/roads, construction of new paths/roads, and the construction of bird hides. As such, as there are no proposed buildings, the potential risk from deep and shallow underground mining is assessed to be Moderate/Low.
6	Shallow Underground Mining (probable at deeper depths)	**Pathways, roads and bird hides.**	**Low**	

PMR	Mining Issue	Receptor	Risk	Risk Mitigation Recommended
7	Mine Entries (shafts and adits)	**Pathways, roads and bird hides.**	**Moderate**	No evidence of mine entries was identified within the Curtins intrusive ground investigation within Zones 3 – 10, this does not mean the risk does not remain. A residual risk remains associated with the potential for unrecorded mine shafts and a watching brief during ground works and construction is recommended. The central and south east of the site are at highest risk due to extent of possible mine shafts and relic mining features. Geogrid is recommended for installation beneath new paths and road in these areas. Bird hide foundation design should consider the risk of ground instability associated with unrecorded mine shaft collapse through appropriate design mitigation.

5 MINING REMEDIAL WORKS

With reference to the mining risk site model and the potential mining risks detailed in *Tables 3 and 4,* remedial actions are recommended in order for the site to be brought up to a condition that is deemed 'suitable for use':

- **Mining Remedial Action 1:** Further Investigation and Assessment of Ventilation Borehole with Possible Risk Mitigation Measures.
- **Mining Remedial Action 2:** Installation of Geogrid
- **Mining Remedial Action 3:** Watching Brief during Groundworks and Construction
- **Mining Remedial Action 4:** Undertake additional deep rotary borehole
-

It should be noted that the above does not include potential remedial measures associated the underground roadway to the Visitor Centre (Zone 1). This report should be updated following completion of additional investigation.

Mining Remedial Action 1 – Further Investigation and Assessment of the Ventilation Borehole

PMR 3 in *Table 3* identified at the site relates to a historic Ventilation Borehole located within Zone 1, identified on historical mapping. It could present a risk to future site users through collapse or unpermitted access, depending on size, construction and location.

The size, exact location and construction of the Ventilation Borehole is currently unknown. It is recommended that during construction, investigation is carried out to locate the borehole and understand it's construction. The risk can then be further assessed with respect to the proposed development.

Following further assessments measures may need to be put in place to prevent access to the area for future site users or else decommission in accordance with Environment Agency guidance.

5.1 Mining Remedial Action 2 – Installation of Geogrid for Road and Hardstanding & Appropriate Foundation Design for Bird Hides

PMR in *Table* 4 identified at the site relates to the historic mining legacy at the site where there are numerous mine entries located across site with the exact locations of many of the mine entries not known. The central and south eastern zones of the site are at highest risk due to extent of possible mine shafts and relic mining features.

High strength geogrid reinforcement is placed beneath all new roads and pathways in the area outlined in Curtins drawing titled 'Shafts and Relic Mining Features - Area of Highest Risk' enclosed in Appendix A.

Bird hide foundation design must also consider the risk of ground instability associated with unrecorded mine shaft collapse through appropriate design mitigation in high risk areas (e.g. raft foundations and or inclusion of geogrid below build ups).

It's unlikely to be practical to install geogrid across new roads and paths across the whole site so the highest risk areas should be targeted as identified. Notwithstanding, where Mining Remedial Action 3 (Watching brief during groundworks and construction) across the wider site identifies possible relic mining features or unexpected ground conditions, Geogrid or other treatment measures may need to be considered in these areas.

Geogrid reinforcement would provide some mitigation against collapse of hardstanding and structures associated with a local shaft collapse. Geogrid should be designed by a specialist.

5.2 Mining Remedial Action 3 – Watching Brief during Groundworks and Construction

PMR 7 in Table 4 identified at the site relates to a residual risk remaining associated with the potential for unrecorded mine shafts and entries within the site.

The Curtins ground investigations did not encounter any mine entries or shafts, however mine shafts are extensive (across Zones 3-10) and the exact locations of many of the mine entries is not known, a Watching Brief during

groundworks and construction is recommended **Site Wide (Zones 1-10)**, this will aid to mitigate the residual risk and monitor for anything unexpected.

The watching brief should be carried out by an Engineer. It is likely that this can be carried out part time with visits regular visits carried out during groundworks, ensuring presence during 'high risk areas' and activities.

Where mine entries are recorded during groundwork and/or construction, works should be stopped with further risk assessments carried out. A remedial specification and capping measures may then need to be provided.

5.3 Mining Remedial Action 4 – Undertake Additional Deep Borehole

In March 2025, Zone 1 development plans were updated and include moving the Visitors Centre building south (drawing ref. 289-LYR-XX-ZZ-DWG-L-1203). Updated development plans indicate that the proposed structure will now be within 8m of the mine road which may have potential implications for pile design. It is recommended that an additional deep rotary borehole is undertaken in between the proposed structure and mine feature in order to delineate the risk of potential collapse.

6 VERIFICATION & REPORTING

It is recommended that this report is updated following completion of additional ground investigation at the Visitor Centre (Zone 1) to confirm risk associated with the underground roadway.

During Verification site visits shall be undertaken by an appropriately qualified geo-environmental engineer throughout the construction phase to ensure that the requirements of the Mining Risk Mitigation Strategy have been implemented at the site. This includes a part time watching brief during groundworks.

It is anticipated evidence/records of the following will be taken during the below phases of work:

- During general groundworks to monitor for any evidence of shafts or unrecorded mining features.
- During Investigation of the Ventilation Borehole within Zone 1 along with any documentation of completion of any follow on risk mitigation measures which may be required.
- Documentation of the installation of Geo-Grid/ design mitigation beneath new roads, pathways and small structures in the areas specified, along with specification documentation of the Geo-Grid.

All associated documentation pertaining to the above will be supplied to the Engineer and incorporated within a Mining Risk Mitigation Completion Report.

The frequency and timing of visits by Curtins shall be determined following confirmation of the construction phase programme and the chosen protection elements.

A Mining Remediation Completion Report will be required on completion of the works confirming that the mining remedial works have been completed satisfactorily. The report should contain the information described above as well as the following:

- Confirmation that the risk mitigation measures have been undertaken satisfactorily and in accordance with the Mining Remediation Statement.
- Confirmation that the objectives have been achieved (see *Section 5.0).*
- A revised mining risk site model showing no potentially significant mine related risks remain at the site.

APPENDICES

Appendix A – Drawings

Appendix A - Drawings

Legend

- Site Boundary

Mining Constraints

Mine Entries

- Archive
- Envirocheck ECMGS
- Envirocheck Maps
- Northern Mine Research Society

Underground Working

- Ore Body Working
- Underground Road
- Development Areas

Development Zones

0 100 200 300 400 m

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Status	INFORMATION
Project:	**Iron Line, Millom**
Drg Title:	**Summary of Historical Ion Mining and Associated Features**

Scale:	Size:	Issue Date:	Drawn:	Checked:
NTS	**A3**	**17/05/2024**	**JL**	**NF**

Drg No:	Rev:
080874-CUR-XX-XX-DR-GE-80013	**P01**

Site Boundary

Area of Highest Risk_GeoGrid

Mining Constraints

Mine Entries

Archive

Envirocheck ECMGS

Envirocheck Maps

Northern Mine Research Society

Underground Working

Ore Body Working

Underground Road

Google Satellite

0 100 200 m

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Status	INFORMATION
Project:	**Iron Line, Millom**
Drg Title:	**Shafts and Relic Mining Features - Area of Highest Risk'**

Scale:	Size:	Issue Date:	Drawn:	Checked:
See scale bar above	**A3**	**03/03/2025**	**LW**	**NF**

Drg No:	Rev:
080874-CUR-XX-XX-DR-GE-80020	**P01**