FWS Geological & Geo-Environmental Consultants

SIRIUS MINERALS PLC - DISCHARGE OF PLANNING CONDITIONS FOR PLANNING APPLICATION NYM/2014/0676/MEIA, NORTH YORKSHIRE POLYHALITE PROJECT

CONDITION	NYMNPA 46
REPORT	REMEDIAL ACTION PLAN
SITE	PHASE 4 WORKS AT WOODSMITH MINE, NORTH YORKSHIRE
DOCUMENT NUMBER	40-FWS-WS-70-PL-0009Rev1

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APPENDICES

REMEDIAL ACTION PLAN FOR THE PHASE 4 WORKS AT WOODSMITH MINE, NORTH YORKSHIRE

1 INTRODUCTION

1.1 General Background

This document has been prepared on behalf of Sirius Minerals plc and provides the Remedial Action Plan for the Phase 4 Works at the Doves Nest Farm Minesite (Phase 4 Works). This is required to satisfy Condition 46 of the North York Moors National Park Authority (NYMNPA) planning permission NYM/2014/0676/MEIA.

This document details the remedial actions required should monitoring, undertaken in accordance the Ground and Surface Water Monitoring Scheme for the Phase 4 Works (Ref. 1), identify breaches of the defined Trigger Values. The scope of the Phase 4 Works is detailed in Section 1.3.

Subsequent revisions of this document will be issued to present the Remedial Action Plan to be adopted for future phases of the development, dates of which are to be confirmed.

1.2 Objectives

The purpose of this document is to:-

- Provide a list of individuals (and their contact details) who are responsible for identifying and investigating a Trigger Value breach;
- Provide a procedure for investigating and escalating a Trigger Value breach, and for informing the appropriate regulator (the Environment Agency);
- Provide a list of individuals and organisations to be informed in the event of a breach or a confirmed departure from the established baseline;
- Detail actions to protect the environment in the event of a suspected or confirmed environmental incident or departure from the established baseline.

1.3 Phase 4 Works

This report presents the Remedial Action Plan that relates to the Phase 4 Works. The works completed prior to and as part of Phase 4, comprise the following, as shown on Arup Drawing 40-ARI-WS-71-CI-DR-1082:-

Phase 1 to 3 Works

- General site clearance and construction of an acoustic fence / environmental barrier, installation of fencing, gates and security demolition of all farm buildings and sheds, and localised tree and scrub clearance;

- Construction of the site road, a site compound and the Welfare Access Road;
- Construction of the Tiered Shaft Platform Area and Platform for the Construction Welfare Facility, Parking Area and Concrete Batching Plant, as shown on Arup Drawing 40-ARI-WS-71-CI-DR-1082;
- Construction of temporary and permanent soil mounds, as shown on Arup Drawing 40-ARI-WS-71-CI-DR-1082;
- Construction of surface water drainage including; a temporary surface water attenuation pond and wetland in the southern area, and a silt removal facility, three permanent attenuation ponds and two wetland areas in the north-eastern area, as shown on Arup Drawing 40-ARI-WS-71-CI-DR-1082;
- Construction of the drilling platform and lagoon area for the groundwater reinjection well as shown in Arup Drawing 40-ARI-WS-71-CI-DR-1082;
- Installation of dewatering wells around the perimeter of the Tiered Shaft Platform (Arup Drawing 40-ARI-WS-71-CI-DR-1081), including commencement of dewatering, where necessary, to maintain groundwater levels at 3m below shaft platform level (bspl).

Works to be Completed as Part of Phase 4

- Operation of the concrete batch plant;
- Installation, commissioning and operation of the bentonite plant;
- Installation of concrete guide walls (excavate to -3.5m and concrete wall down to -1.5 to - 1.75 m);
- Mobilisation to site of diaphragm walling equipment (cutters, cranes, workshops etc.);
- Diaphragm wall construction to -60m below ground level at the Production, Service and Mineral Transport System shafts;
- Limited continuation of earthworks to create an area for future storage of spoil.

1.4 Compliance with Conditions

Table 1 sets out the wording of Planning Condition 46 to Planning Consent Ref No. NYM/2014/0676/MEIA and details where the relevant material, to comply with this condition, has been provided within this report:-

Table 1 - Summary of Planning Condition 46 and Where Relevant Details Are Provided In This Report

NYMNPA Condition 46	Compliance with Condition 46
The scheme shall include: -	
Details of the number, type and location of monitoring points;	Section 3
A protocol for the removal and replacement of any existing monitoring points;	Section 4
Details of the frequency of monitoring during construction and operation;	Section 3.2.3, 3.3.4, 3.4.4, 3.5.3 and 3.6.4
A list of the ground and surface water determinands to be tested for;	Section 3.4.3, 3.5.6 and 3.6.3
Monitoring of ground water levels and spring flows;	Section 3.3.3 and 3.5.4
Monitoring of surface water quality including sediment, BOD, ammonia, pH;	Section 3.6.3
Geomorphology in Sneaton Thorpe Beck	Section 3.6.6
A list of SAC/SSSI habitat measures to be tested for;	Section 3.7.2
Groundwater quality and level triggers;	Section 3.35 and 3.4.5
Surface water quality triggers;	Section 3.6.5
Surface water geomorphology triggers;	Section 3.6.6
SAC/SSSI habitat triggers	Section 3.7.4
Monitoring of groundwater quality against groundwater triggers;	Section 3.4.5
A scheme for periodic review and refinement of the monitoring regime to take account of any approved changes to site layout/design, construction methods and monitoring data;	Section 5
A protocol for notifying the MPA of any breach of the Trigger Values, including the timing of any such notification;	Section 5
Details of the method and frequency with which monitoring results will be shared with the MPA, Natural England and the Environment Agency;	Section 5
The approved scheme shall thereafter be implemented in full, with monitoring continuing in accordance with the approved scheme until such time that it is agreed in writing by the MPA in consultation with Natural England and the Environment Agency that monitoring may cease.	Section 5

2 RESPONSIBILITIES AND CONTACTS

2.1 Parties Responsible for Identifying and Investigating a Trigger Value Breach

Table 2 presents the details of the individuals and their contact information for the parties responsible for identifying and investigating a Trigger Value breach.

Table 2 - Parties Responsible for Identifying and Investigating a Trigger Value Breach

Contact Name	Position	Company	Contact Details	Responsibility
Robert Staniland	Environment Manager	Sirius Minerals	7-10 Manor Court Manor Garth Scarborough YO11 3TU +44 7775585456	Coordination of Environmental Activities within the Development
Chris West	Operation / Delivery Manager	North Midland Construction PLC	Nunn Close Huthwaite Sutton In Ashfield NG17 2HW 07970 136524	Site Preparation Contract Management
Chris Davis	Project Manager	North Midland Construction PLC	Nunn Close Huthwaite Sutton In Ashfield NG17 2HW 07712 324723	Coordination of Site Works and Implementation of Remedial Actions
Selina Morson	Environmental Manager	North Midland Construction PLC	Nunn Close Huthwaite Sutton In Ashfield NG17 2HW 01623 515008	Coordination of Environmental Activities within the site
Chris Davis	Project Manager	North Midland Construction PLC	Nunn Close Huthwaite Sutton In Ashfield NG17 2HW 01623 515008	Coordination of Temporary Dewatering Programme
TBC	Project Manager	AMC UK (TBC)	AMC UK LTD. c/o Rödl & Partner 170 Edmund Street Birmingham B3 2HB	Coordination of Shaft Sinking and Batching Plant Facilities.
TBC	Environmental Engineer	TBC	TBC	Coordination and reporting on monitoring and advising and recording of remedial actions

2.2 Parties to be Informed in the Event of a Breach/Departure from Baseline Conditions

In accordance with Condition 46 of planning permission NYM/2014/0676/MEIA, Table 3 presents those individuals and organisations who are to be informed in the event of a breach or a confirmed departure from the established baseline conditions:-

Table 3 Parties to be Informed in the Event of a Breach/Departure from Baseline Conditions

Contact Name	Position	Company/ Regulatory Body	Contact Details
Mark Hill	Head of Development Management	North York Moors National Park Authority	The Old Vicarage Bondgate Helmsley York North Yorkshire YO62 5BP
Nick Pedder	Planning Liaison officer	Environment Agency	Lateral 8 City Walk Leeds LS11 9AT
TBC	Natural England representative	Natural England	TBC
Robert Staniland	Environment Manager	Sirius Minerals	7-10 Manor Court Manor Garth Scarborough YO11 3TU
TBC	Director of Operations	Phase 4 Contractor TBC	TBC
TBC	Project Manager	AMC UK (TBC)	AMC UK LTD. c/o Rödl & Partner 170 Edmund Street Birmingham B3 2HB

3 PROCEDURE FOR EVALUATING BREACHES IN TRIGGER VALUES

3.1 General

A Ground and Surface Water Monitoring Scheme (Ref. 1) has been prepared that details the monitoring requirement for the Phase 4 Works. That document details the groundwater, spring water, surface water and ecological monitoring to be undertaken to identify if physical or chemical impacts are occurring from the Phase 4 Works.

The Ground and Surface Water Monitoring Scheme (Ref. 1) details the Control and Compliance Trigger Values that the monitoring data will be assessed against.

Where a breach of the Control and Compliance Trigger Values occurs, the following four stage procedure will be carried out to evaluate and record the remedial actions required:-

- Stage 1 - Inspection / Monitoring Appraisal
- Stage 2 - Consultation with Project Manager and Planning of Remedial Actions
- Stage 3 – Implementation of Remedial Actions
- Stage 4 – Reporting

The following sections detail the specific assessment procedures that will be undertaken, with regard to the individual groundwater, spring, ecological and surface water monitoring programme, and the remedial actions that will be considered.

Section 4 presents details of the reporting procedures that will be adopted to record the assessment, design and implementation of the remedial actions determined necessary.

Section 5 presents details of the timescale of the reporting to the relevant parties identified in Section 2.2.

3.2 Environmental Groundwater Level Evaluation

3.2.1 Groundwater Levels Assessment Procedure

Appendix 1.1, presents the procedure for assessing breaches of groundwater level (GWL) Control and Compliance Trigger Values at the environmental groundwater level monitoring points during the Phase 4 Works. It presents a summary of the sequence of activities and respective timescales for each stage, for which details are provided below.

3.2.2 Monitoring Appraisal

The purpose of the groundwater level monitoring strategy is to detect physical effects during the Phase 4 Works on groundwater levels within the Secondary A Aquifers that could impact on the hydrogeologically supported flora within the Spring Flush and flows from Moorside Farm spring water supply (MF2) and from Soulsgrave Farm Spring. In the event of an adverse impact being detected, the objective of this appraisal is to determine the cause, so that appropriate remedial measures can then be adopted should the impacts be attributable to groundwater level changes induced by the Phase 4 Works.

Groundwater levels will be monitored in the Moor Grit and Scarborough aquifers using the series of monitoring wells, aligned north to south between the Shaft Platform development and the Spring Flush and Moorside Farm target receptors, as listed in Table 4 and shown on Drawing 1433DevOD283 Appendix 2. Groundwater levels will also be measured within the superficial deposits in the Spring Flush area using the series of monitoring wells as listed below and shown on Drawing 1433DevOD283 Appendix 2, to identify potential variations in the soil moisture conditions in comparison with the baseline conditions.

Table 4 - Environmental Groundwater Level Monitoring Locations

Monitoring Well	Historical BH No.	NGR Coordinates	Purpose
GW132 GW132B GW132C GW132D GW132E	HG112 HG112B HG112C HG112D HG112E	488933.66, 504800.88 488940.91, 504799.24 489042.06, 504807.25 489038.61, 504798.07 489035.65, 504791.81	Monitor potential changes in the groundwater levels within the Superficial deposits within the Spring Flush and Moorside Farm Spring target receptors.
GW122A (SAC1) GW124 (SAC3) GW125 (SAC4) GW129 (SAC5) GW118 GW130 (SAC6) GW131 (SAC7) GW116 (SAC8) GW133A	HG105A -- -- -- HG122 -- -- -- HG111A	489138.52, 505493.71 489184.48, 505377.01 489215.70, 505221.78 489219.39, 505118.00 489229.54, 505094.83 489236.10, 504928.69 489246.93, 504815.46 489270.51, 504711.77 489211.10, 504706.07	Monitor potential changes in the groundwater levels within the Moor Grit between the shaft platform development and the Spring Flush and Moorside Farm Spring target receptors.
GW126A GW117 GW139	HG108A -- HG5	489132.71, 505164.63 489236.66, 505102.82 489240.44, 504965.21	Monitor potential changes in the groundwater levels within the Scarborough Formation between the shaft platform development and the Spring Flush and Moorside Farm Spring target receptors.
GW112	HG119	489843.00, 504759.00	Monitor potential changes in the groundwater levels within the Scarborough Formation between the shaft platform development and Soulsgrave Farm Spring.

Manual dip groundwater levels will be measured and diver data loggers downloaded on a weekly basis. The results will be compared with baseline data and the Control and Compliance Trigger Values to identify any breaches.

3.2.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of either GWL Control or Compliance Trigger Values will be evaluated by the Environmental Engineer in consultation with the Project Manager to determine the cause of the breach and the appropriate course of remedial action that will be taken.

A breach of the GWL Control or Compliance Trigger Values for individual boreholes will be assessed in conjunction with the rainfall data for the preceding period, to ascertain whether the breach is due to natural climatic conditions or as a result of the Phase 4 Works.

The Recorded breach will be classed as either:-

- A natural (non-site related) breach of the GWL Control or Compliance Trigger Value, caused by natural variations in rainfall (i.e. low rainfall).
- A breach of the GWL Control or Compliance Trigger Value, caused by the Phase 2 to 4 Works.
- A breach of the GWL Control or Compliance Trigger Value, caused by non-Phase 2 to 4 related offsite works.

Where the breach is found to be caused by natural climatic conditions or non-Phase 2 to 4 related works, they will be recorded as such for any required subsequent review, and no further remedial actions will be required.

The remedial actions will be designed specific to the degree in exceedence (i.e. physical change in groundwater levels), the location where the breach was recorded, and the likely cause of this breach.

3.2.4 Implementing Remedial Actions

Where remedial actions are specified by the Environmental Engineer, related to a breach in either GWL Control or Compliance Trigger Values, they will be advised to the Director of Operations, the Environment Manager and the Regulators (as detailed in Section 2.2), and implemented by the Project Manager.

Remedial actions for a breach of GWL Control Trigger Values may include, but not be limited to, the installation of a re-infiltration trench into the Moor Grit and / or Scarborough aquifers.

Remedial actions for a prolonged breach of the GWL Compliance Trigger Value will be considered in association with breaches of any spring flow (SpWF) Control or Compliance Trigger Values (Section 3.7) or Ecology Control or Compliance Trigger Values (Section 3.9). They may include, but not be limited to, the above remedial actions, but may also include supply of tankered water to Moorside Farm or Soulsgrave Farm and injection of waters into the Moor Grit aquifer to support the Spring Flush.

3.3 Construction Works Groundwater Level Evaluation

3.3.1 Groundwater Levels Assessment Procedure for Dewatering

Appendix 1.1, presents the procedure for assessing breaches of GWL Control and Compliance Trigger Values at the groundwater level monitoring points during the Phase 4 Works associated with the dewatering works. It presents a summary of the sequence of activities and respective timescales for each stage, for which details are provided below.

3.3.2 Monitoring Appraisal

Groundwater level monitoring will be carried out at the wells listed in Table 5, supplemented with monitoring the dewatering well array, where possible, prior to commencement and throughout the dewatering operations. This monitoring will be undertaken on a daily frequency to demonstrate when temporary dewatering is required to maintain groundwater levels at the shaft locations below the maximum permitted water levels, as detailed below. Dewatering GWL Control Trigger Values are proposed to indicate when dewatering should be implemented to maintain water levels below the maximum permissible Dewatering GWL Compliance Trigger Values.

Table 5 - Dewatering Works Groundwater Level Monitoring Locations

Shaft Location	Temporary Monitoring Well	NGR Coordinates	Purpose
Production	BH505 BH507 BH520	489272.5, 505422.8 489305.4, 505457.3 489318.0, 505422.0	Monitor changes in groundwater levels in relation to the dewatering Control and Compliance Trigger Values
Service	HG135 BH521 BHSS2	489335.7, 505348.0 489292.0, 505328.0 489340.8, 505315.6	Monitor changes in groundwater levels in relation to the dewatering Control and Compliance Trigger Values
MTS	HG116 BH515 BH522	489206.5, 505526.0 489400.2, 505469.1 489388.0, 505456.0	Monitor changes in groundwater levels in relation to the dewatering Control and Compliance Trigger Values

Manual dip groundwater levels will be measured and diver data loggers downloaded on a daily basis. The results will be compared with the Dewatering GWL Control and Compliance Trigger Values to identify any breaches.

3.3.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of any Dewatering GWL Control and Compliance Trigger Values will be notified by the Dewatering Contractor at the end of each day to the Environmental Engineer, Sirius Minerals and AMC UK Ltd with recommendations on the appropriate course of remedial action that will be taken.

A breach of the Dewatering GWL Control and Compliance Trigger Values for individual boreholes will be assessed in conjunction with the rainfall data for the preceding period, to determine what amendment to operation of the dewatering system is necessary to maintain groundwater levels at the shaft locations below the Dewatering GWL Control Trigger Values.

Where a breach in the Dewatering GWL Compliance Trigger Value is identified, this condition shall be notified to Environmental Engineer, Sirius Minerals and AMC UK immediately, so that an appropriate course of action can be adopted in respect of the diaphragm wall trenching operations.

3.3.4 Implementing Remedial Actions

Where remedial actions are proposed by the Dewatering Contractor, related to a breach in the Dewatering GWL Control and Compliance Trigger Values, they will be advised to the Director of Operations, the Environment Manager and the Environmental Engineer and implemented by the Dewatering Contractor accordingly.

Remedial actions for a breach may include, but not be limited to, the increased pumping from the dewatering well arrangement.

3.4 Groundwater Quality General Construction Activities

3.4.1 Groundwater Quality Assessment Procedure

Appendix 1.2 presents the procedure for assessing breaches of groundwater quality (GWQ) Control and Compliance Trigger Values at the groundwater quality monitoring points, during

the general construction activities undertaken as part of the Phase 4 Works. It presents a summary of the sequence of activities and respective timescales for each stage, for which details are provided below.

3.4.2 Monitoring Appraisal

The purpose of the monitoring strategy is to detect chemical impacts on groundwater quality within the Secondary A Aquifers during the Phase 4 Works. In the event of an adverse impact being detected, the objective of this appraisal is to determine the cause, so that appropriate remedial measures can be adopted, should the impacts be attributable to pollution emanating from the Phase 4 Works. As detailed in the Hydrogeological Risk Assessment (Ref 3), the principal potential causes of pollution are hydrocarbon and salt pollution by construction surface water runoff in the vicinity of the tiered Shaft Platform, and platform extension, the working platform and compound areas that could infiltrate into the Moor Grit and Scarborough aquifers.

Groundwater quality sampling will be undertaken at locations up hydraulic gradient of the receiving aquifer and locations down hydraulic gradient within that aquifer of the potentially polluting activities associated with the Phase 4 works at the monitoring locations listed in Tables 6 and 7. Water quality at each location will be assessed individually, as well as in relation to their up and down gradient positions to the Shaft Platform, Access Roads and Compound Area.

Table 6 - Groundwater Quality Monitoring Locations for Shaft Development Platform and Screening Bund

Monitoring Well		NGR Coordinates	Reason
GW101 GW124 (SAC3) GW125 (SAC4)	-- -- --	489152.62, 505656.51 489184.48, 505377.01 489215.70, 505221.78	Monitor changes in the groundwater quality within the Moor Grit up gradient of the development areas
GW101A GW126A GW117	-- HG108A --	489152.93, 505650.83 489132.71, 505164.63 489236.66, 505102.82	Monitor changes in the groundwater quality within the Scarborough Formation up gradient of the development areas
GW139A	HG5A	489243.50, 504952.90	Monitor changes in the groundwater quality within the Cloughton Formation up gradient of the development areas
GW103	--	489342.55, 505678.83	Monitor changes in the groundwater quality within the Moor Grit down hydraulic gradient of the tiered Shaft Platform.
GW105	--	489449.41, 505667.32	Monitor changes in the groundwater quality within the Scarborough Formation down hydraulic gradient of the tiered Shaft Platform.
GW137 GW106 GW108	HG2 -- --	489498.55, 505506.42 489559.62, 505668.15 489658.09, 505397.27	Monitor changes in the groundwater quality within the Cloughton Formation down hydraulic gradient of the tiered Shaft Platform.

Table 7 - Groundwater Quality Monitoring Locations for Working Platform, Access Road and Compound Area

Name		NGR Coordinates	Reason
GW129 (SAC5) GW130 (SAC6)	-- --	489219.39, 505118.00 489236.10, 504928.69	Monitor changes in the groundwater quality within the Moor Grit up gradient of the development areas
GW117	--	489236.66, 505102.82	Monitor changes in the groundwater quality within the Scarborough Formation up gradient of the development areas
GW139A	HG5A	489243.50, 504952.90	Monitor changes in the groundwater quality within the Cloughton Formation up gradient of the development areas
GW109 GW140	-- HG120	489610.08, 505119.60 489606.05, 505068.86	Monitor changes in the groundwater quality within the Scarborough Formation down hydraulic gradient of the areas access road and site compound.
GW138	HG4	489496.28, 505206.94	Monitor changes in the groundwater quality within the Cloughton Formation down hydraulic gradient of the areas access road and site compound.

Analytical testing in the field will consist of pH, temperature, electrical conductivity and total dissolved solids. Samples will be analysed at a laboratory for:-

- pH,
- Conductivity,
- Chloride,
- Total Petroleum Hydrocarbons (C10 – C40).

Groundwater samples will be taken on a monthly basis and the results of laboratory testing will be available one week after sampling. The laboratory results will be compared with baseline data and the GWQ Control and Compliance Trigger Values to identify any breaches.

3.4.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of any GWQ Control and Compliance Trigger Values and the findings of the construction works inspection will be evaluated by the Environmental Engineer in consultation with the Project Manager to determine the cause of the breach and the appropriate course of remedial action to be taken.

A natural (non-site related) breach of the GWQ Control Trigger Values in the up hydraulic gradient boreholes may require an adjustment of the Control Trigger value, in line with the revised baseline conditions, as described in the Ground and Surface Water Management Scheme (Ref. 1), and records of any changes and reasons for those changes will be kept for any subsequent required review.

The remedial actions will be designed specific to the determinand that has been exceeded, the location where the breach was recorded, and the likely cause of this breach in either the GWQ Control or Compliance Trigger Values.

3.4.4 Implementing Remedial Actions

Where remedial actions are specified by the Environmental Engineer, related to a breach in either the GWQ Control or Compliance Trigger Values, they will be advised to the Director of Operations, the Environment Manager and the Regulators (as detailed in Section 2.2), and implemented by the Project Manager.

Remedial actions for a breach of GWQ Control Trigger Values may include, but not be limited to, temporarily increasing monitoring frequency to weekly, remediation of spillage site and a change in site construction practices as detailed in the Construction Environmental Management Plan (CEMP) to prevent future re-occurrence of construction related pollution.

Where the breach of the GWQ Compliance Trigger Value occurs down hydraulic gradient of the site, remedial actions may include modelling and installation of additional groundwater monitoring wells to evaluate the magnitude of impact at the site boundary and at the nearest down hydraulic gradient receptor. If the results of that modelling and additional monitoring show that an adverse impact is occurring in breach of the Compliance Trigger Value at the groundwater receptor, then groundwater remediation of the pollution source will be considered.

3.5 Groundwater Quality Diaphragm Walling Operations

3.5.1 Groundwater Quality Assessment Procedure

Appendix 1.2 presents the procedure for assessing breaches of groundwater quality (GWQ) Control Trigger Values at the groundwater quality monitoring points and at the discharge holding tank from the temporary dewatering system, during the Diaphragm Walling Operations. It presents a summary of the sequence of activities and respective timescales for each stage, for which details are provided below.

3.5.2 Monitoring Appraisal

General

The purpose of the monitoring strategy is to detect chemical impacts on groundwater quality within the Secondary A Aquifers during the Phase 4 Works Diaphragm Walling Operations. In the event of an adverse impact being detected, the objective of this appraisal is to determine the cause, so that appropriate remedial measures can be adopted, should the impacts be attributable to slurry migration pollution emanating from the Phase 4 Works Diaphragm Walling Operations. As detailed in the Hydrogeological Risk Assessment (Ref 3), the principal potential causes of pollution are sodium bicarbonate and sodium polyacrylate within the slurry that could infiltrate into the Moor Grit and Scarborough aquifers, and sodium bicarbonate, sodium polyacrylate and bentonite entering Sneaton Thorpe Beck either by accidental spillages or via discharge from the dewatering wells.

Proximal and Distal Groundwater Quality Monitoring Points

Groundwater quality monitoring will be undertaken in real-time utilising in borehole data loggers located in a perimeter around each shaft to detect slurry losses to the Secondary A

aquifers, and by visual inspection of the discharges from a holding tank containing the extracted water from the dewatering wells prior to discharge.

The provisional monitoring locations are shown on AMC Drawing 40-AMC-WS-10-CI-DR-0001.

The boreholes installed to monitor for slurry losses from the diaphragm walling operations will monitor in real-time for:-

- pH;
- Conductivity;
- Salinity
- Total dissolved solids
- Resistivity
- Density
- Dissolved oxygen
- Oxidative Redox potential

Assessment Control Trigger Values will be determined once baseline data has been obtained from real time monitoring prior to commencement of the Diaphragm Walling operations, as detailed in Ref. 1.

Monitoring of Pumped Dewatering Discharge

Water from the temporary pumped dewatering well system that discharges to a holding tank and from individual monitoring ports on the dewatering wells will be visually monitored for evidence of turbidity, as detailed in Ref. 1

Visual monitoring will first be carried out of the water quality within the holding tank. Where evidence of bentonite slurry is observed in the holding tank, samples will be taken from the monitoring ports installed on each of the groundwater abstraction wells. Should evidence of bentonite be observed, the following procedures will be implemented:

1 A sample will be taken from the sampling tap of each active well to identify the source of the bentonite.
2 The affected well or wells will be temporarily isolated and the discharge from the dewatering system monitored to confirm that the flow is now free from bentonite.
3 In the event that flow remains contaminated with bentonite step 1 will be repeated.
4 Turbid water held in the holding tank will be pumped to the site-wide surface water drainage system to discharge via to on-site facilities for removal of silt.
5 The affected well or wells will be restarted once corrective action has been taken to prevent bentonite losses from the D-wall trench.

3.5.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of any GWQ Control Trigger Values and the findings of the construction works inspection will be evaluated by AMC and the Environmental Engineer in consultation with the Project Manager to determine the cause of the breach and the appropriate course of remedial action to be taken. Where the groundwater quality determined in the proximal and distal wells or turbidity is identified in the dewatering holding tank, that is indicative of

evidence of slurry fluid losses into the aquifer system, mitigation measures will be implemented in accordance with AMC's slurry loss contingency plan.

A natural (non-site related) breach of the GWQ Control Trigger Values may require an adjustment of the Control Trigger value, in line with the revised baseline conditions, as described in the Ground and Surface Water Management Scheme (Ref. 1), and records of any changes and reasons for those changes will be kept for any subsequent required review. Similarly changes in the indicator parameter conditions can also arise not from slurry loss but due to normal changes in pH conditions associated with the introduction and hardening of the below ground concrete used in the diaphragm wall construction. As such, consideration of concreting conditions will be necessary when evaluating the real time indicator results against the Control trigger Values.

The remedial actions will be designed specific to the evidence of slurry pollution identified, the location where the breach was recorded, and the likely cause of this breach in either the GWQ Control or Compliance Trigger Values.

3.5.4 Implementing Remedial Actions

Where remedial actions to mitigate slurry loss are considered appropriate by AMC and the Environmental Engineer, related to a breach in the GWQ Control Trigger Values, they will be advised to the Environment Manager (as detailed in Section 2.2), and implemented by the Project Manager.

Remedial actions for a breach of GWQ Control Trigger Values may include, but not be limited to, adjustment of the slurry blend by introduction of additive LTA 3, sand, rock waste, concrete to seal up zones of high permeability, or temporarily increasing the monitoring array to include additional boreholes around the perimeter of the site to determine the extent and direction of groundwater quality impacts..

3.6 Spring Water Flow Rates

3.6.1 Spring Water Flow Rate Assessment Procedures

Appendix 1.3 presents the procedure for assessing breaches of spring flow (SpWF) Control and Compliance Trigger Values, during the Phase 3 Works. It presents a summary of the sequence of activities and respective timescales for each stage, for which details are provided below.

3.6.2 Monitoring Appraisal

The purpose of the spring water monitoring strategy is to detect physical impacts on the spring flows, emanating from Soulsgrave Farm Spring and Moorside Farm Spring, during the Phase 4 Works. In the event of an adverse impact being detected, the objective of the appraisal is to determine the cause, so that appropriate remedial measures can be adopted should the impacts be attributable to the Phase 4 Works.

The spring flowrate monitoring will be undertaken at Soulsgrave Farm Spring and Moorside Farm Spring at a monthly frequency in the pre commencement stage; weekly through the Phase 4 Works and for one month afterwards.

The flow rate monitoring will be compared with baseline data, and the SpWF Control and Compliance Trigger Values derived from baseline data for each individual month.

3.6.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of either SpWF Control or Compliance Trigger Values will be evaluated by the Environmental Engineer in consultation with the Project Manager to determine the cause of the breach and the appropriate course of remedial action that will be taken.

A breach of the SpWF Control or Compliance Trigger Values for Moorside Farm Spring and Soulsgrave Farm Spring will be assessed in conjunction with the rainfall data and groundwater level data for the preceding period, to ascertain whether the breach is due to natural conditions or as a result of the Phase 4 Works.

A breach will be classed as either:-

- A natural (non-site related) breach of the SpWF Control / Compliance Trigger Value, caused by natural variations in rainfall (i.e. low rainfall).
- A breach of the SpWF Control / Compliance Trigger Value caused by the Phase 4 Works.

Where the breach is found to be natural, it will be recorded as such for any required subsequent review, no further remedial actions will be required.

The remedial actions will be designed specific to the degree of exceedence (i.e. physical change in flow rate), the location where the breach was recorded, and the likely cause of this breach.

3.6.4 Implementing Remedial Actions

Where remedial actions are specified by the Environmental Engineer, related to a breach in Trigger Values, they will be advised to the Director of Operations, the Environment Manager and the Regulators (as detailed in Section 2.2), and implemented by the Project Manager.

Remedial actions for a breach of SpWF Control Trigger Values may include, but not be limited to, installation of an infiltration trench into the Moor Grit and or Scarborough aquifers.

Remedial actions for a prolonged breach of the SpWF Compliance Trigger Values will be considered in association with breaches of any Environmental GWL Control or Compliance Trigger Values or Ecological Control or Compliance Trigger Values (Section 3.9). Such remedial actions may include, but not be limited to, the above remedial actions, supplemented by the provision of a temporary supply of tankered water to Moorside Farm or Soulsgrave Farm.

3.7 Spring Water Quality

3.7.1 Spring Water Quality Assessment Procedure

Appendix 1.4 presents the procedure for assessing breaches of spring water quality (SpWQ) Control and Compliance Trigger Values during the Phase 4 Works. It presents a summary of the sequence of activities and respective timescales for each stage, for which details are provided below.

3.7.2 Monitoring Appraisal

The purpose of the spring water quality monitoring strategy is to detect chemical impacts on Soulsgrave Farm Spring and to Moorside Farm Spring during the period of the Phase 4 Works. In the event of an adverse impact being detected, the objective of the appraisal is to determine the cause, so that appropriate remedial measures can be adopted should the impacts be attributable to the Phase 4 Works.

The spring water quality monitoring of Moorside Farm Spring and Soulsgrave Farm Spring will be undertaken monthly in the pre commencement stage and weekly through the Phase 4 Works and for one month afterwards.

The laboratory results will be compared with the baseline and SpWQ Control and Compliance Trigger Values.

3.7.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of any SpWQ Control and Compliance Trigger Values will be evaluated by the Environmental Engineer in consultation with the Project Manager to determine the cause of the breach and the appropriate course of remedial action that will be taken.

A breach of the SpWQ Control and Compliance Trigger Value for Moorside Farm Spring and Soulsgrave Farm Spring will be assessed in conjunction with the rainfall data and groundwater quality data for the preceding period, to ascertain whether the breach is due to natural conditions or is as a result of the Phase 4 Works.

A natural (non-site related) breach of the Control Trigger Values in the spring water quality may require an adjustment of the SpWQ Control Trigger Value, in line with the revised baseline conditions, as described in the Ground and Surface Water Management Scheme (Ref. 1), and records of any changes and reasons for those changes will be kept for any subsequent required review.

The remedial actions will be designed specific to the determinand that has been exceeded, the location where the breach was recorded, and the likely cause of this breach in SpWQ Control/Compliance Trigger Values.

3.7.4 Implementing Remedial Actions

Where remedial actions are specified by the Environmental Engineer, related to a breach in SpWQ Control and/or Compliance Trigger Values, they will be advised to the Director of Operations, the Environment Manager and the Regulators (as detailed in Section 2.2), and implemented by the Project Manager.

Remedial actions for a breach of SpWQ Control Trigger Values may include, but not be limited to, remediation of spillage site / pollution source and a change in site practices, detailed in the Construction Environmental Management Plan (CEMP), to prevent re-occurrence, future spillages / pollution.

Remedial actions for a prolonged breach of the SpWQ Compliance Trigger Value may include provision of a temporary supply of tankered water to Moorside Farm and remediation to the groundwater source supplying the spring, as set out in Section 3.2.4.

3.8 Surface Water Quality and Geomorphology

3.8.1 Surface Water Quality and Geomorphology Assessment Procedures

Appendix 1.5 presents the procedure for assessing breaches of surface water quality (SWQ) Control and Compliance Trigger Values during the Phase 4 Works. It presents a summary of the sequence of activities and respective timescales for each stage, for which details are provided below.

The assessment of geomorphological impacts on Sneaton Thorpe Beck is to be undertaken in a qualitative manner. Although no Control Trigger Values are set, the requirement to adopt remedial actions will be determined by comparison to observations made identifying variation from the baseline geomorphological conditions, to be determined during the pre-commencement monitoring.

3.8.2 Monitoring Appraisal

The purpose of the surface water quality (SWQ) and geomorphological monitoring strategy is to detect chemical and physical impacts on Sneaton Thorpe Beck during the period of the Phase 4 Works. In the event of an adverse impact being detected, the objective of the appraisal is to determine the cause, so that appropriate remedial measures can be adopted, should the impacts be attributable to the Phase 4 Works.

Surface Water Quality

Monitoring up and down stream of the surface water drainage outfall points will be undertaken as summarised in Tables 8 and 9 and shown in Drawing 1433DevOD282 (Appendix 2):-

- Surface drainage discharge points from key outfalls from the construction works denoted OF2, OF5, OF7 and OF8, to monitor the water quality from the works area prior to discharge to Sneaton Thorpe Beck;

Table 8 - Surface Water Quality Monitoring Locations – Outfalls

Monitoring Location	Coordinates	Monitoring
OF2	499621, 505388	Outfall from Silt Removal Facility
OF5	499497, 504743	Outfall from Reinjection Well Platform
OF7	499629, 505517	Outfall from Groundwater Drainage Layer
OF8	499583, 505078	Outfall from Working Platform post Attenuation Pond and Wetland

- Downstream Sneaton Thorpe Beck (STB1, STB2, STB3, and STB4A) to monitor the water quality and impacts on stream geomorphology of surface drainage discharges (STB2 and STB1) downstream of the Phase 4 works and exiting the development site.

Table 9 - Surface Water Quality Monitoring Locations – Sneaton Thorpe Beck

Monitoring Location	Coordinates	Monitoring
STB1	499621, 505388	Sneaton Thorpe Beck
STB2	499497, 504743	Sneaton Thorpe Beck Off Site
STB3	499629, 505517	Drain Tributary to Sneaton Thorpe Beck
STB4A	499583, 505078	Outfall Wetland

The surface water quality monitoring will be undertaken weekly through the Phase 4 Works and for one month afterwards.

Analytical testing in the field will consist of pH, temperature, electrical conductivity, total dissolved solids, turbidity and visual inspection of the monitoring locations. Samples will be analysed at a laboratory for:-

- pH,
- Conductivity,
- Suspended Solids,
- Biological Oxygen Demand,
- Free ammonia (NH_3),
- Chloride,
- Total Petroleum Hydrocarbons (C10 – C40).

SWQ Control and Compliance Trigger Values are presented in Ref. 1. A SWQ Control Trigger Value will be derived for turbidity based on the initial three months monitoring data.

The surface water drainage system will be inspected on a daily basis to ensure that it is in good working order. This will include, as appropriate, inspection of the swales, filter drains and associated catch pits, ponds, oil separators and silt fences. Any visible impact on the surface water courses will be identified and considered in conjunction with the field turbidity readings and their respective background concentrations, such as cloudy discharge due to suspended solids.

The monitoring will be assessed by consideration of the construction activities, as determined from a visual site inspection of the operations, and the meteorological conditions, to identify the cause of a specific breach.

Geomorphology

A baseline geomorphological survey of the full length of Sneaton Thorpe Beck, which may be impacted by the works, will be undertaken at the end Phase 2 Works/beginning of the Phase 3 Works, and again at the end of the Phase 4 Works. The extent of this survey will be from its source to its confluence with Rigg Mill Beck (approximately 4 km in total), including the tributary to the west, as shown on Drawing 1433DevOD282.

Geomorphological stream surveys will also be undertaken at weekly intervals during Phase 4 works at two downstream locations (STB01 and 02) on Sneaton Thorpe Beck , which will entail the geomorphological survey of a 100 m long section of the stream banks at these locations. At

STB02 the survey will cover a 100 m reach on both Sneaton Thorpe Beck and of the western tributary, as shown on (Drawing 1433DevOD282).

The construction phase monitoring will be assessed by comparison with the pre-commencement baseline geomorphological conditions to establish evidence of erosion, geotechnical failure, sediment accumulation, vegetation changes, and pollution/discolouration, for which remedial actions to mitigate these changes should be considered.

3.8.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of the any SWQ Control and Compliance Trigger Values, changes in geomorphological conditions and the findings of the inspection will be evaluated by the Environmental Engineer in consultation with the Project Manager to determine the cause of the breach and the appropriate course of remedial action that will be taken.

The remedial actions will be designed specific to the cause and form of the breach in terms of pollution, erosion, siltation or adverse impact where the breach has been recorded.

3.8.4 Implementing Remedial Actions

Where remedial actions are specified by the Environmental Engineer, related to either a breach in SWQ Control or Compliance Trigger Values or to an adverse change in the stream's geomorphological conditions, they will be advised to the Director of Operations, the Environment Manager and the Regulators (as detailed in Section 2.2), and implemented by the Project Manager.

A natural (non-site related) breach of the SWQ Control Trigger Value may require an adjustment of the SWQ Control Trigger value, in line with the revised baseline conditions, as described in the Ground and Surface Water Management Scheme (Ref. 1).

Remedial actions for a breach of SWQ Control Trigger Values or due to an adverse change in the geomorphology of the stream may include, but not be limited to, maintenance or extension to swales, addition of check dams and silt fencing, clearance of filter drains and associated catch pits, implementation of silt fences, maintenance of ponds, and maintenance of oil separators.

Remedial actions for a breach of the Compliance Trigger Value or due to an adverse change in the geomorphology of the stream may include, but not be limited to, the above remedial actions, but may also include implementation of additional emergency surface water management measures including the use of additional hay/heather bales, environmentally friendly coagulant, silt busters and silt fences to reduce silt migration, the use of absorbent spill pads and booms to contain and absorb hydrocarbon contamination, and temporarily closing the penstock in the attenuation pond.

3.9 Ecology

3.9.1 Ecological Assessment Procedure

The following sections present the procedure that will be adopted for assessing breaches of the Ecological Control Trigger Values (Ref. 1) during the Phase 4 Works. It presents a summary of

the sequence of activities and respective timescales to assess the Ecological Trigger Values and to implement the remedial actions required.

3.9.2 Monitoring Appraisal

The objective of the ecological monitoring is to determine whether the Phase 3 Works are impacting on the groundwater dependant flora in the Spring Flush. Any changes in the habitat or its diversity in this area will be compared to changes in the groundwater levels and spring flow rates monitored at Moorside Farm Spring to determine whether these changes in habitat conditions are related to hydrogeological changes.

A series of ten fixed monitoring locations for quadrat sampling will be monitored for change in National Vegetation Classification (NVC), change in percentage cover of the key indicator species and colonisation by new species.

A baseline survey will be undertaken in August or September 2017. Surveys will be undertaken in August or September for each subsequent construction year.

3.9.3 Consultation with Project Manager and Planning Remedial Actions

The recorded breach of any Ecological Control Trigger Values will be evaluated by the Environmental Engineer in consultation with the Project Manager to determine the cause of the breach and the appropriate course of remedial action that will be taken.

A breach of the Ecology Control Trigger Values for the Spring Flush will be assessed in conjunction with the rainfall data, groundwater level and quality data and the spring flow rate and quality data for the preceding period, to ascertain whether the breach is due to natural conditions or as a result of the works at Woodsmith Mine.

The remedial actions will be designed to mitigate the specific Ecological Control Trigger Value that has been exceeded.

3.9.4 Implementing Remedial Actions

Where remedial actions are specified by the Environmental Engineer, related to a breach in Ecological Control Trigger Values, they will be advised to the Director of Operations, the Environment Manager and the Regulators (as detailed in Section 2.2), and implemented by the Project Manager.

Remedial actions may include, but not be limited to, installation of an infiltration trench into the Moor Grit, injection of waters into the superficial deposits, Moor Grit or Scarborough aquifers to support the Spring Flush and replanting of specific vegetation.

4 REPORTING

All breaches in Groundwater Level, Spring Flow, Spring Water Quality and Surface Water Quality Control and Compliance Trigger Values or visually identified impacts observed and remedial actions implemented will be reported on a weekly basis during the Phase 4 Works and for one month thereafter by the Environmental Engineer. Breaches in Ground Water Quality

Control and Compliance Trigger Values and remedial actions implemented will be reported on a monthly basis during the Phase 4 Works and for one month thereafter by the Environmental Engineer.

That report will detail the breach that occurred, the weekly construction activities and meteorological conditions preceding the breach, the results of the site inspection/monitoring, the established cause of the breach in Trigger Values and the remedial action specified together with the timescale for it to be implemented.

Where Control or Compliance Trigger Value breaches are identified associated with the Phase 4 Works, the completed proforma will be issued to those identified in Section 2.2 within 48 hours of receipt of the laboratory results. Where visual evidence of adverse impacts associated with the Phase 4 Works are identified, the inspection report and remedial action specified will be issued to those identified in Section 2.2 within 24 hours, in respect to spring flows providing domestic water supplies and 48 hours of that breach for all other receptors.

On completion of the Remedial Action, a record of the measures implemented and their effectiveness will be recorded and issued to the relevant parties. The Project Manager will provide a copy of the report to those identified in Section 2.2 to the timescales presented in Section 4.2.6.

5 TIMESCALES

Environmental Remedial Actions

A cumulative report detailing the assessment of monitoring and inspection results for groundwater level, spring flow and water quality, and surface water quality and geomorphology, recording any breaches in Control and Compliance Trigger Values or visually identified impacts observed and remedial actions to be implemented will be issued on a weekly basis. The reports will be issued to the relevant regulators listed in Section 2.2 where a breach in Trigger Value or an impact is visually observed.

Control Trigger Value breaches will be investigated within one week and the remedial action required implemented within two weeks of receipt of the monitoring results reporting the breach. Where a cloudy discharge or elevated turbidity readings exceed the Control Trigger Value, remedial action will be implemented within 48 hours.

Compliance Trigger Value breaches for spring fed domestic water supplies will first be re-investigated within 24 hours of the breach. Subject to the findings of that monitoring, remedial action, in the form of providing a temporary tankered water supply, will be initiated within 24 hours of the breach and the requirement to introduce a long term design solution initiated within one month.

Compliance Trigger Value breaches for surface water will be investigated within 48 hours and the remedial action initiated within one week. Compliance Trigger Value breaches for groundwater will be investigated within one week, and remedial action initiated within 1 month. Changes to site practices will be implemented within one week.

Dewatering Remedial Actions

A summary report for groundwater levels in the shaft platform area will be prepared by the Dewatering Contractor on a daily basis. This will detail the assessment of monitoring results, recording any breaches in Trigger Values and remedial actions to be implemented.

Control Trigger Value breaches will be addressed by the Dewatering Contractor within one day by increasing the rate of dewatering.

Sirius Minerals Plc and the Contractor will be advised by the Dewatering Contractor of a breach of Compliance Trigger Value within one day, and remedial action including increasing the rate of dewatering will be implemented as necessary.

Groundwater Quality Diaphragm Wall Remedial Actions

A summary report for groundwater quality conditions, indicative of slurry losses from the diaphragm trenching operations will be prepared by AMC on a daily basis. This will detail the assessment of monitoring results, recording any breaches in Trigger Values and remedial actions to be implemented.

Control Trigger Value breaches will be addressed by AMC within the day of occurance by amending the slurry mix design and by implementing additional monitoring, if necessary.

Sirius Minerals Plc will be advised by AMC of a breach of Control Trigger Values within one day, and remedial action implemented, as necessary.

C BELL
ASSOCIATE DIRECTOR

R IZATT-LOWRY
DIRECTOR

6 REFERENCES

1 FWS Consultants Ltd. 2017. Ground and Surface Water Monitoring Scheme for Woodsmith Mine (1433DevOR206)

2 FWS Consultants Ltd, 2016. Hydrogeological Baseline Report for the Doves Nest Farm Minesite, North Yorkshire 2012 to 2016 (1975OR01)

3 FWS Consultants Ltd. 2017. Hydrogeological Risk Assessment For The Phase 4 Works At Woodsmith Mine, North Yorkshire (1433DevOR205)

4 ESI Ltd, 2016. York Potash: Groundwater Model Update and Simulation of the Phase three Preparatory Works, Report No. 61415R6

APPENDIX 1

APPENDIX 1.1 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR GROUNDWATER LEVELS

APPENDIX 1.2 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR GROUNDWATER QUALITY

APPENDIX 1.3 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR SPRING FLOW RATE

APPENDIX 1.4 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR SPRING WATER QUALITY

APPENDIX 1.5 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR SURFACE WATER QUALITY AND GEOMORPHOLOGY

APPENDIX 1.1 – PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH OF GROUNDWATER LEVELS

ENVIRONMENTAL			
Procedure	**Responsibility**	**Control Trigger Value Breach**	**Compliance Trigger Value Breach**
		Groundwater Levels at BHs	**Groundwater Level at HG111A**
Monitoring	Environmental Engineer	A review of the construction activities within the area of the shaft platform and the meteorological conditions, up to and during the period of breach. An assessment will be made to determine if the breach of ground water level Control Trigger Value is a caused by : natural climatic variation due to seasonal low rainfall, the Phase 3 Works, or a non Phase 3 related cause.	A review of the construction activities within the area of the shaft platform and the meteorological conditions, up to and during the period of breach. An assessment will be made to determine if the breach of ground water level Compliance Trigger Value is a caused by : natural climatic variation due to seasonal low rainfall, the Phase 3 Works, or a non Phase 3 related cause.
Consultation with Project Manager and Planning Remedial Actions	Environmental Engineer/ Project Manager	Evaluate findings of monitoring in conjunction with meteorological data, spring flow rates, groundwater levels in the superficial deposits and ecological monitoring, to determine the cause and effects of the change in baseline conditions. Where the cause is due to natural climatic conditions, record that this change in baseline conditions and accommodate for this change in subsequent reviews. Where the cause of the breach in Control Trigger Values is due to impacts of the Phase 3 works design an appropriate course of remedial action, if required.	Evaluate findings of monitoring in conjunction with meteorological, spring flow rates, groundwater levels in the superficial deposits and ecological monitoring, to determine the cause and effects of the change in baseline conditions. Where the cause is due to natural climatic conditions, record that this change in baseline conditions and accommodate for this change in subsequent reviews. Where the cause of the breach in Compliance Trigger Values is due to impacts of the Phase 3 works, design an appropriate course of remedial action, if required.
Implementing Remedial Actions	Project Manager/ Environmental Manager/ Environmental Engineer	If the change in the groundwater level below the Control Trigger value has arisen from an adverse impact by the Phase 3 works, details of the Remedial Actions necessary to prevent continued adverse impact will be specified. Such measures may include installation of recharge trenches.	If the change in the groundwater level below the Compliance Trigger value has arisen from an adverse impact by the Phase 3 works, details of the Remedial Actions necessary to prevent continued impact will be specified. Such measures may include installation of recharge trenches, the provision of tankered water to Moorside Farm and the injection of water into the Superficial deposits, Moor Grit or Scarborough Formation.
Reporting	Environmental Engineer	Report to include details of breach, monitoring, and remedial actions	Report to include details of breach, monitoring, and remedial actions
Timescale		1 week to identify the cause and design and implement any remedial actions required.	1 week to identify the cause and design and implement any remedial actions required in relation to restoring domestic spring water supplies. 1 month to identify the cause and design and initiate implementation of any remedial actions required in relation to mitigating impacts on flora in the Spring Flush area of Ugglebarnby Moor.
DEWATERING			
Procedure	**Responsibility**	**Control Trigger Value Breach**	**Compliance Trigger Value Breach**
		Groundwater Levels at BHs <4 m bspl	**Groundwater Levels at BHs <3 m bspl**
Monitoring	Dewatering Contractor	Review monitoring data and construction progress	Review monitoring data and construction progress
Consultation with Project Manager and Planning Remedial Actions	Dewatering Contractor/ Project Manager		Inform Sirius Minerals and Contractor
Implementing Remedial Actions	Project Manager/ Dewatering Contractor	Increase dewatering pumping rates	Increase dewatering pumping rates.
Reporting	Environmental Engineer	Report dewatering rates	Report dewatering rates
Timescale		1 day	1 day

APPENDIX 1.2 – PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH OF GROUNDWATER QUALITY

GENERAL CONSRUCTION					
Procedure	**Responsibility**	**Control Trigger Value Breach**		**Compliance Trigger Value Breach**	
		Groundwater Quality at Up Hydraulic Gradient BHs	**Groundwater Quality at Down Hydraulic Gradient BHs**	**Groundwater Quality at Up Hydraulic Gradient BHs**	**Groundwater Quality at Down Hydraulic Gradient BHs**
Monitoring	Environmental Engineer	A review of activities up hydraulic gradient of the shaft platform or site compound, as appropriate, will be undertaken to identify potential sources of contamination impacting on baseline groundwater quality.	A review of the construction activities within the catchment area to the shaft platform or site compound, as appropriate, will be undertaken considering the data up to and during the period of breach and of the meteorological conditions during the period of the breach. A visual inspection of the ongoing construction works will be carried out. Inspection of oil separators will be undertaken for hydrocarbon breaches. The visual inspection will include observations on evidence of chemical, salt, hydrocarbon spillages and leakage.	A review of activities up hydraulic gradient of the shaft platform or site compound, as appropriate, will be undertaken to identify potential sources of contamination impacting on baseline groundwater quality.	A review of the construction activities within the catchment area to the shaft platform or site compound, as appropriate, will be undertaken considering the data up to and during the period of breach and of the meteorological conditions during the period of the breach. A visual inspection of the ongoing construction works will be carried out. Inspection of oil separators for hydrocarbon breaches will be undertaken. The visual inspection will include observations on evidence of chemical, salt, hydrocarbon spillages and leakage.
Consultation with Project Manager and Planning Remedial Actions	Environmental Engineer/ Project Manager	Evaluate findings of monitoring to determine the cause of the change in baseline groundwater quality and design the appropriate course of remedial action, if required.	Evaluate findings of monitoring to determine the cause of the change in groundwater quality and design the appropriate course of remedial action, if required.	Evaluate findings of monitoring to determine the cause of the change in baseline groundwater quality and design the appropriate course of remedial action if required.	Evaluate findings of monitoring to determine the cause of the change in groundwater quality and design the appropriate course of remedial action if required.
Implementing Remedial Actions	Project Manager/ Environmental Manager/ Environmental Engineer	Continued monitoring of BHs to monitor plume movement through site. Consideration of up hydraulic gradient contamination in assessing down hydraulic gradient groundwater. Increase in monitoring frequency until levels return to baseline.	Remediation of site spillages Maintenance clearance of filter drains to the shaft platform areas, maintenance of oil separator, maintenance of construction vehicles Changes to working practices (CEMP). Increase in monitoring frequency until levels return to baseline.	Continued monitoring of BHs to monitor plume movement through site and installation of additional groundwater monitoring wells, where appropriate. Consideration of up hydraulic gradient contamination source in assessing down hydraulic gradient groundwater quality. Increase in monitoring frequency until levels return to baseline.	Remediation of site spillages Maintenance clearance of filter drains to the shaft platform areas, maintenance of oil separator, maintenance of construction vehicles Changes to working practices (CEMP). Modelling and installation of additional groundwater monitoring wells to demonstrate that there is no impact occurring at the site boundary and the nearest down hydraulic gradient water supply receptor. If the results of that modelling or monitoring of additional boundary monitoring wells show that an impact on the groundwater is occurring then remediation of the groundwater pollution will be considered. Increase in monitoring frequency until levels return to baseline.
Reporting	Environmental Engineer	Report to include details of breach, monitoring, and remedial actions		Report to include details of breach, monitoring, and remedial actions	
Timescale		1 week to identify the cause and design and implement any remedial actions required.		1 week to identify the cause, 1 week to implement changes determined necessary to site practices and 1 month to design and initiate implementation of any pollution clean-up remedial actions required.	

Diaphragm Walling Operations		
Procedure	**Responsibility**	**Control Trigger Value Breach**
Monitoring	Contractor	A review of diaphragm walling operations will be undertaken to identify potential sources of contamination impacting on groundwater quality.
Consultation with Project Manager and Planning Remedial Actions	Environmental Engineer/ Project Manager/ Contractor	Evaluate findings of monitoring to determine the cause of the change in groundwater quality and design the appropriate course of remedial action if required.
Implementing Remedial Actions	Project Manager/ Environmental Manager/ Environmental Engineer / Contractor	Remediation of site spillages Adjustment in slurry composition if required in accordance with AMC's slurry loss contingency plan. Isolation of dewatering well discharges. Increase frequency on monitoring in perimeter wells down hydraulic gradient to monitor for impacts on groundwater quality moving off site. Only if impacts are observed at the site boundary will further amendment to the Diaphragm Walling operations be necessary.
Reporting	Environmental Engineer	Report to include details of breach, monitoring, and remedial actions
Timescale		1 hour for contractor to report presence of slurry within dewatering well discharges, or evidence of slurry losses. 1 day to identify the cause and implement changes determined necessary to site practices.

APPENDIX 1.3 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR SPRING FLOW RATE

Procedure	**Responsibility**	**Control Trigger Value Breach**	**Compliance Trigger Value Breach**
		Spring flow rates	**Spring flow rates**
Inspection	Environmental Engineer	A review will be carried out of the construction activities that have been undertaken within the area of the shaft platform and the meteorological conditions, up to and during the period of breach. An assessment will be made to determine if the physical change that has been recorded in the spring flow rate at either Moorside Farm Spring or Soulsgrave Farm Spring is a natural variation due to seasonal low rainfall, or an impact caused by the Phase 3 Works.	A review will be carried out of the construction activities that have been undertaken within the area of the shaft platform and the meteorological conditions, up to and during the period of breach. An assessment will be made to determine if the physical change that has been recorded in the spring flow rate at either Moorside Farm Spring or Soulsgrave Farm Spring is a natural variation due to seasonal low rainfall, or an impact caused by the Phase 3 Works.
Consultation with Project Manager and Planning Remedial Actions	Environmental Engineer/ Project Manager	Evaluate findings of monitoring to determine the cause of the change in baseline conditions, in association with the groundwater level and ecological monitoring, and design the appropriate course of remedial action, if required.	Evaluate findings of monitoring to determine the cause of the change in baseline conditions, in association with the groundwater level and ecological monitoring, and design the appropriate course of remedial action, if required.
Implementing Remedial Actions	Project Manager/ Environmental Manager/ Environmental Engineer	If the change in the baseline data below the Control Trigger value has arisen from an adverse impact by the Phase 3 works the Remedial Actions to prevent continued impact will be specified. Such measures may include installation of recharge trenches into the Moor Grit and Scarborough aquifers.	If the change in the baseline data below the Compliance Trigger value has arisen from an adverse impact by the Phase 3 works, the Remedial Actions to prevent continued impact will be specified. Such measures may repeat monitoring within 24 hours to confirm if the breach conditions are sustained. Subject to which, provision will be made for a temporary tankered water supply to Moorside Farm and Soulsgrave Farms supplemented, where necessary, with the long term solution designed and implemented that may comprise installation of a recharge trench or well system to sustain spring flows, as necessary.
Reporting	Environmental Engineer	Report to include details of breach, monitoring, and remedial actions.	Report to include details of breach, monitoring, and remedial actions
Timescale		1 week to identify the cause and 1 month to undertake the design and implement remedial actions required.	Within 24 hours of repeat follow up monitoring confirming that a Compliance Trigger Value breach is being caused by the Phase 3 works to identify the cause and to provide a tankered interim water supply, if necessary, and within 1 month to design and initiate implementation of any re-infiltration remedial actions required.

APPENDIX 1.4 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR SPRING WATER QUALITY

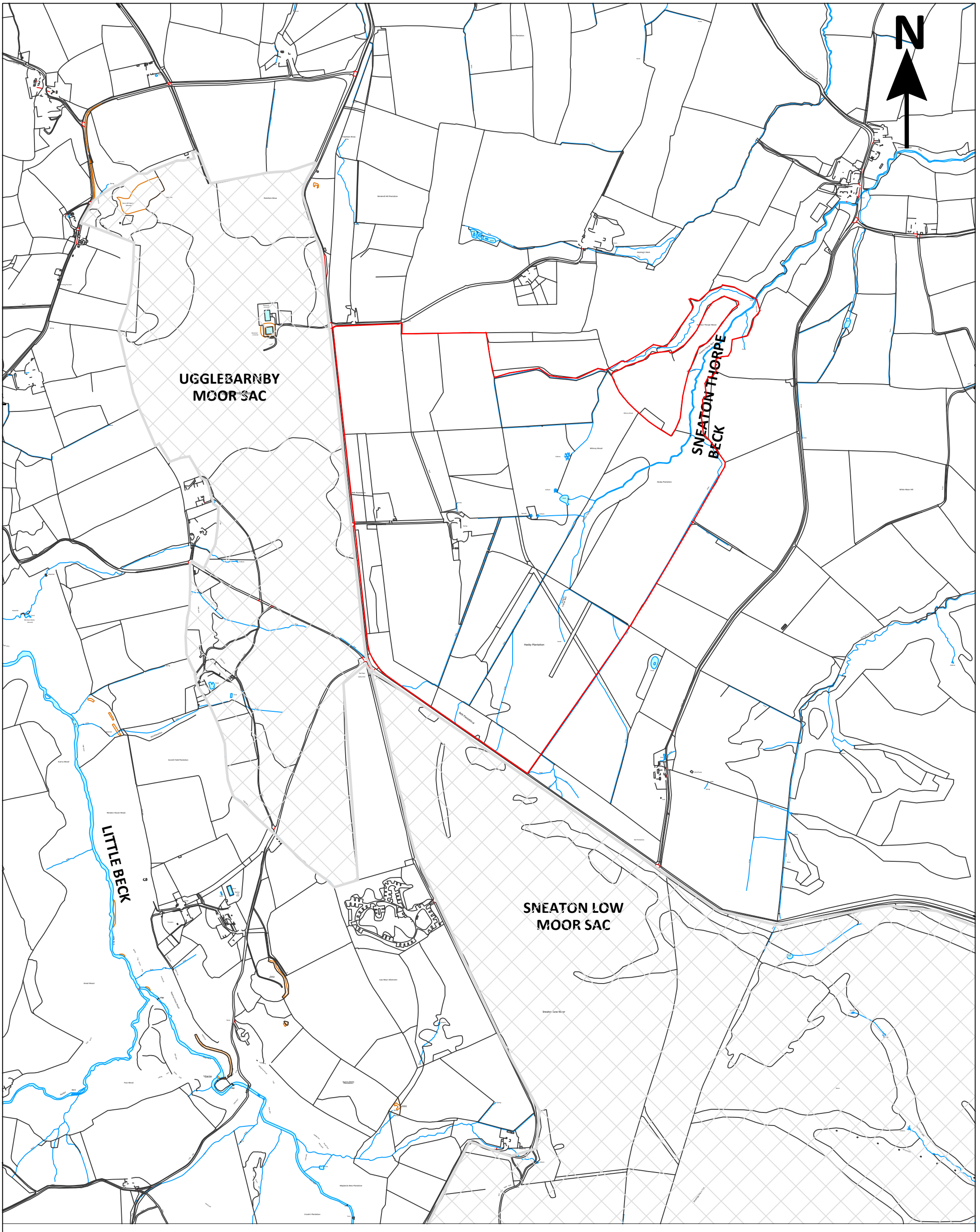
Procedure	Responsibility	Control Trigger Value Breach	Compliance Trigger Value Breach
		Spring water quality	**Spring water quality**
Inspection	Environmental Engineer	A review will be undertaken of the construction activities within the catchment area to the shaft platform or site compound, as appropriate up to and during the period of breach, and of the meteorological conditions during the period of the breach. A visual inspection of the ongoing construction works will be carried out including inspection of oil separators for hydrocarbon breaches, and of fuel, lubricant, hydraulics and salt storage facilities. The visual inspection will include observations on evidence of cloudy discharges and a record of the turbidity value recorded in the surface water and spring discharges.	A review will be undertaken of the construction activities within the catchment area to the shaft platform or site compound, as appropriate up to and during the period of breach, and of the meteorological conditions during the period of the breach. A visual inspection of the ongoing construction works will be carried out including inspection of oil separators for hydrocarbon breaches, and of fuel, lubricant, hydraulics and salt storage facilities. The visual inspection will include observations on evidence of cloudy discharges and a record of the turbidity value recorded in the surface water and spring discharges.
Consultation with Project Manager and Planning Remedial Actions	Environmental Engineer/ Project Manager	Evaluate findings of monitoring to determine the cause of the change in conditions and design the appropriate course of remedial action, if required.	Evaluate findings of monitoring to determine the cause of the change in conditions and design the appropriate course of remedial action if required.
Implementing Remedial Actions	Project Manager/ Environmental Manager/ Environmental Engineer	Changes to working practices including management of fuel, lubricant, hydraulics and salt storage facilities Maintenance clearance of filter drains to the shaft platform areas, maintenance of oil separator, and maintenance of construction vehicles. Changes to working practices (CEMP) such as implementation of additional surface water management measures, such as additional filter drains, or oil separators.	Changes to working practices including management of fuel, lubricant, hydraulics and salt storage facilities Maintenance clearance of filter drains to the shaft platform areas, maintenance of oil separator, and maintenance of construction vehicles. Changes to working practices (CEMP) such as implementation of additional surface water management measures, such as additional filter drains, or oil separators. Temporary provision of tankered drinking water to Moorside Farm and to Soulsgrave Farm, as necessary. Where groundwater pollution associated with the Phase 3 Works is determined to be the cause of a long term change to spring quality, remediation of the groundwater pollution will be considered. Such measures may include; repeat monitoring within 24 hours and laboratory analysis on an accelerated turn around, to confirm if the breach in water quality conditions is sustained. Subject to the receipt of which, provision will be made within 24 hours for a temporary tankered water supply to Moorside Farm and Soulsgrave Farms supplemented, where necessary, with pollution clean-up proposals.
Reporting	Environmental Engineer	Report to include details of breach, inspection, and remedial actions	
Timescale		1 week to identify the cause and design and implement any remedial actions required. Remedial action of cloudy discharge or turbidity readings exceeding background quality within 48 hrs.	If the repeat follow up monitoring confirms that a Compliance Trigger Value breach is being caused by the Phase 3 works, a tankered interim water supply is to be provided within 24 hours, if necessary. Within a period of 1 month, implementation of any pollution clean-up remedial actions required shall be initiated

APPENDIX 1.5 - PROCEDURE FOR ADDRESSING TRIGGER VALUE BREACH FOR SURFACE WATER QUALITY AND GEOMORPHOLOGY

Procedure	Responsibility	Control Trigger Value Breach	Compliance Trigger Value Breach
		Surface Water Quality and Stream Geomorphology	**Surface Water Quality and Stream Geomorphology**
Inspection	Environmental Engineer	A review will be undertaken of the construction activities within the catchment area to the shaft platform or site compound, as appropriate, up to and during the period of breach and of the meteorological conditions during the period of the breach. The visual inspection of the ongoing construction works will include inspection of oil separators for hydrocarbon breaches, inspection of surface drainage and of pond outfalls for evidence of cloudy discharges and to provide a record of the turbidity value recorded, geomorphological inspection for evidence of erosion, geotechnical failure, sediment accumulation, vegetation change, pollution and discolouration and construction litter.	A review will be undertaken of the construction activities within the catchment area to the shaft platform or site compound, as appropriate, up to and during the period of breach and of the meteorological conditions during the period of the breach. The visual inspection of the ongoing construction works will include inspection of oil separators for hydrocarbon breaches, inspection of surface drainage and of pond outfalls for evidence of cloudy discharges and to provide a record of the turbidity value recorded, geomorphological inspection for evidence of erosion, geotechnical failure, sediment accumulation, vegetation change, pollution and discolouration and construction litter.
Consultation with Project Manager and Planning Remedial Actions	Environmental Engineer/ Project Manager	Evaluate findings of monitoring to determine the cause of the physical or chemical change in surface water conditions and design the appropriate course of remedial action, if required.	Evaluate findings of monitoring to determine the cause of the change in surface water conditions and design the appropriate course of remedial action if required.
Implementing Remedial Actions	Project Manager/ Environmental Manager/ Environmental Engineer	Changes to working practices including implementation of silt fences and hay/heather bales. Maintenance clearance of filter drains to the shaft platform areas, maintenance of oil separator, and maintenance of construction vehicles. Changes to working practices (CEMP). Implementation of additional surface water management measures, such as additional filter drains, or oil separators.	Implementation of additional emergency surface water management measures including hay/heather bales, silt busters and silt fences, absorbent spill pads and boons, environmentally friendly coagulant, or additional oil separators, temporarily closing the penstock in the attenuation pond. Maintenance clearance of filter drains to site road, ponds including dredging or reprofiling, oil separators and of construction vehicles. Changes to working practices (CEMP) Implementation of additional surface water management measures, such as additional filter drains, clay stanks and the use of hydrobrakes to slow water flow and discharge rates down and to allow more settlement of suspended solids prior to discharge to Sneaton Thorpe Beck.
Reporting	Environmental Engineer	Report to include details of breach, inspection, and remedial actions	
Timescale		1 week to identify the cause, design and implement remedial actions required. Remedial action of cloudy discharge or elevated turbidity readings exceeding background quality are to be implemented within 48 hrs.	48 hours to identify the cause and 1 week to design and implement the remedial actions required.

APPENDIX 2

DRAWINGS



NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

DRAWING TITLE
WOODSMITH MINE
LOCATION PLAN

PROJECT TITLE
THE NORTH YORKSHIRE POLYHALITE PROJECT

CLIENT
SIRIUS MINERALS PLC

STATUS
FINAL

PROJECT NUMBER
1433

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DATE
March 2017

SCALE
1:10,000 @ A3

DRG. No.
1433DevOD215Rev2

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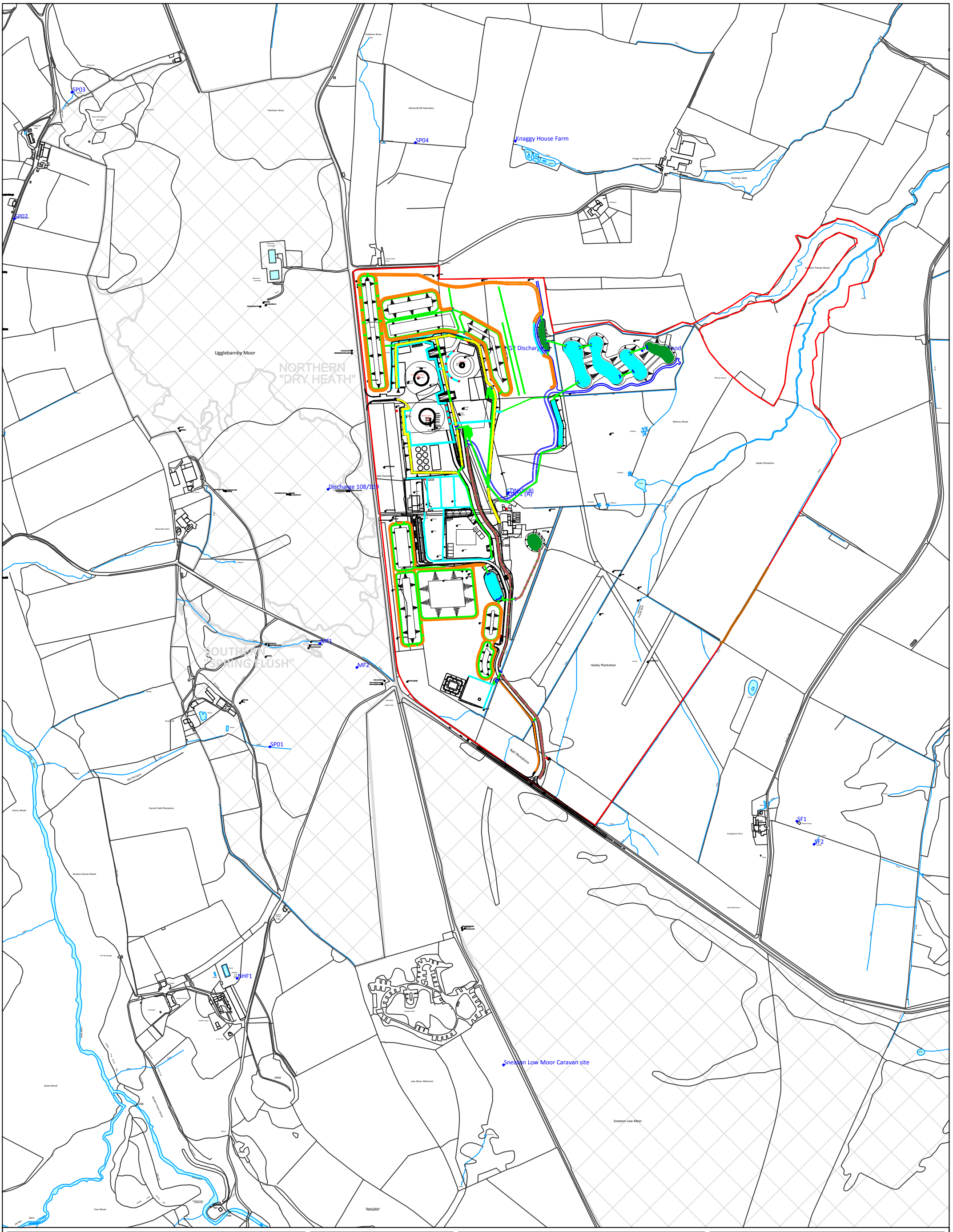

NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

BOREHOLES GCBH01

HYDROGEOLOGICAL RECEPTORS MF2

DRAWING TITLE

HYDROGEOLOGICAL RECEPTORS - PHASE 4

PROJECT TITLE

NORTH YORKSHIRE POLYHALITE PROJECT

CLIENT
SIRIUS MINERALS PLC

STATUS
FINAL

PROJECT NUMBER
1433Dev

DRAWN BY
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DATE
May 2017

SCALE
1:8,000@A3/1:4,000@A1

DRG. No.
1433DevOD281

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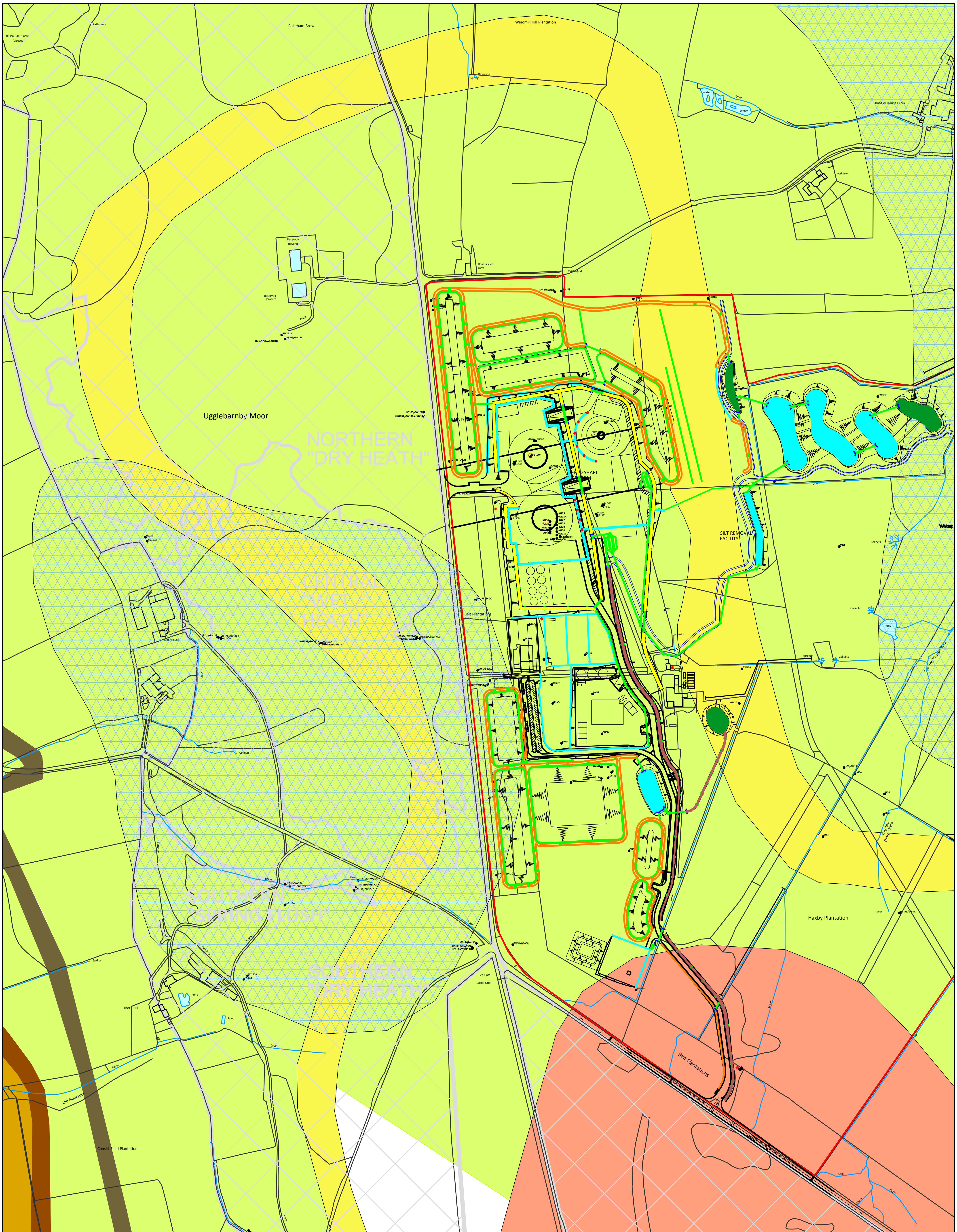

NOTES / KEY

SITE OWNERSHIP BOUNDARY
NYM SAC
SURFACE WATER
BOREHOLES GCBH01
HYDROGEOLOGICAL RECPTORS MF2
LINE OF CROSS SECTION
CROSS SECTION A-A' and B-B' DRAWING 1433DevOD244
CROSS SECTION A-A' DIAPHRAGM WALL DRAWING1433DevOD268
CROSS SECTION C-C' DRAWING 1433DevOD266
CROSS SECTION D-D' DRAWING 1433DevOD267

GEOLOGY
GLACIAL TILL
LONG NAB
MOOR GRIT
SCARBOROUGH FORMATION
CLOUGHTON & SALTWICK FORMATION
ELLER BECK FORMATION
DOGGER FORMATION
WHITBY MUDSTONE

DRAWING TITLE
GEOLOGICAL MAP AND LINE OF CROSS SECTIONS

PROJECT TITLE
NORTH YORKSHIRE POLYHALITE PROJECT

CLIENT SIRIUS MINERALS PLC	
STATUS FINAL	PROJECT NUMBER 1433Dev
DRAWN BY CB	DATE May 2017
SCALE 1:5,000@A3/1:2,500@A1	DRG. No. 1433DevOD280

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Ugglebarnby Moor

NORTHERN "DRY HEATH"

SOUTHERN "SPRING FLUSH"

Haxby Plantation

Belt Plantations

Soulsgrave Farm

Whitney Wood

Honeysuckle Farm

Cattle Grid

Red Gate Cattle Grid

Reservoir (covered)

Reservoir (covered)

Track

Drain

Collects

Pond

Spreads

Sinks

Issues

Wind Pump

Spring

Tank

Smeaton Thorpe Beck

HG2 Discharge

Discharge 108/109

DNS1 (B)

DNS1 (A)

SF1

SF2

SP01

MF1

MF2

GW123 (SAC2)

GW124 (SAC3)

GW125 (SAC4)

GW129 (SAC5)

GW130 (SAC6)

GW116 (SAC8)

GCBH1 GCBH2 GCBH3 GCBH4 GCBH5 GCBH6 GCBH7 GCBH8 GCBH9 GCBH10 GCBH11 GCBH12 GCBH13 GCBH14 GCBH15 GCBH16 GCBH17 GCBH18 GCBH19

BH1A BH1B BH2A BH2B BH3A BH3B BH4A BH4B BH5A BH5B BH6A BH6B BH7A BH7B BH8A BH8B BH9A BH9B BH10A BH10B BH11A BH11B BH12A BH12B BH13A BH13B BH14A BH14B

GW101 GW102 GW103 GW104 GW105 GW106 GW107 GW108 GW109

HG1 HG2 HG3 HG4 HG5 HG6 HG7 HG8 HG9 HG10 HG11 HG12 HG13 HG14 HG15 HG16 HG17 HG18 HG19 HG20 HG21 HG22 HG23 HG24 HG25 HG26 HG27 HG28 HG29 HG30 HG31 HG32 HG33 HG34 HG35 HG35A HG35B HG35C HG36 HG37 HG38 HG39 HG40 HG41 HG42 HG43 HG44 HG45 HG46 HG47 HG48 HG49 HG50 HG51 HG52 HG53 HG54 HG55 HG56 HG57 HG58 HG59 HG60 HG61 HG62 HG63 HG64 HG65 HG66 HG67 HG68 HG69 HG70 HG71 HG72 HG73 HG74 HG75 HG76 HG77 HG78 HG79 HG80 HG81 HG82 HG83 HG84 HG85 HG86 HG87 HG88 HG89 HG90 HG91 HG92 HG93 HG94 HG95 HG96 HG97 HG98 HG99 HG100 HG101 HG102 HG103 HG104 HG105 HG106 HG107 HG108 HG109 HG110 HG111 HG112 HG113 HG114 HG115 HG116 HG117 HG118 HG119 HG120 HG121 HG122 HG123 HG124 HG125 HG126 HG127 HG128 HG129 HG130 HG131 HG132 HG133 HG134 HG135 HG136 HG137 HG138 HG139 HG140 HG141 HG142 HG143 HG144 HG145 HG146 HG147 HG148 HG149 HG150 HG151 HG152 HG153 HG154 HG155 HG156 HG157 HG158 HG159 HG160 HG161 HG162 HG163 HG164 HG165 HG166 HG167 HG168 HG169 HG170 HG171 HG172 HG173 HG174 HG175 HG176 HG177 HG178 HG179 HG180 HG181 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NOTES / KEY

- SITE OWNERSHIP BOUNDARY
- NYM SAC
- SURFACE WATER
- BOREHOLES - GROUNDWATER LEVEL MONITORING GCBH01
- BOREHOLES - GROUNDWATER QUALITY MONITORING GCBH01
- BOREHOLES - GROUNDWATER LEVEL AND QUALITY MONITORING GCBH01
- HYDROGEOLOGICAL RECEPTORS MF2

DRAWING TITLE
PHASE 4 - GROUNDWATER AND SPRING MONITORING LOCATIONS

PROJECT TITLE
NORTH YORKSHIRE POLYHALITE PROJECT

CLIENT
SIRIUS MINERALS PLC

STATUS	PROJECT NUMBER
FINAL	1433Dev
DRAWN BY	**DATE**
CB	May 2017
SCALE	**DRG. No.**
1:4,000@A3	1433DevOD283

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WEEKLY GEOMORPHOLOGICAL SURVEY POINTS

STB2/Peg7
STB2/Peg6
STB2/Peg5
STB2
STB2/Peg1
STB2/Peg2
STB2/Peg3
STB2/Peg4
Ford
Sneaton Thorpe Wood
Sneaton Thorpe Beck
Issues
STB4A
Whinny Wood
Haxby Plantation
STB1/Peg4
STB1/Peg3
STB1/Peg2
STB1/Peg1
STB1
Sneaton Thorpe Beck
Ditch
Mortar Hall Farm
Sneaton Thorpe
Whinny Wood Farm
Catwick House farm
Sneaton Thorpe Beck
Sneaton Thorpe Wood
Whinny Wood
Haxby Plantation
Belt Plantations
White Moor Hill
Soulgrave Farm
ATTENUATION POND
SILT REMOVAL FACILITY
SHAFT
STB4
STB1
OF5

FULL GEOMORPHOLOGICAL SURVEY REACH

NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

BOREHOLES GCBH01

SURFACE WATER MONITORING LOCATIONS OF1

GEOMORPHOLOGY SURVEY

DRAWING TITLE
PHASE 4 SURFACE WATER QUALITY MONITORING POINTS AND PRE & POST GEOMORPHOLOGICAL SURVEY REACH

INSET - WEEKLY GEOMORPHOLOGICAL SURVEY REACH

PROJECT TITLE
NORTH YORKSHIRE POLYHALITE PROJECT

CLIENT
SIRIUS MINERALS PLC

STATUS	PROJECT NUMBER
FINAL	1433Dev
DRAWN BY	DATE
CB	May 2017
SCALE 1:8,000@A3 Inset 1:5,000@A3	DRG. No. 1433DevOD282

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