FWS Geological & Geo-Environmental Consultants

SIRIUS MINERALS PLC - DISCHARGE OF PLANNING CONDITIONS FOR PLANNING APPLICATION NYM/2014/0676/MEIA, THE YORK POTASH PROJECT

CONDITION	NYMNPA 46
REPORT	CONSTRUCTION AND OPERATION PHASE GROUND AND SURFACE WATER MONITORING SCHEME
SITE	PHASE 2 SITE PREPARATORY WORKS AT DOVES NEST FARM MINE SITE, NORTH YORKSHIRE

1433DevOR29Rev2/January 2017

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PROJECT NUMBER	1433Dev	
PROJECT TITLE	York Potash Project	
CLIENT	Sirius Minerals Plc 7-10 Manor Court Manor Garth SCARBOROUGH YO11 3TU	
REPORT TITLE	Construction and Operation Phase Ground and Surface Water Monitoring Scheme for Phase 2 Site Preparatory Works At Doves Nest Mine Site, North Yorkshire	
REPORT REFERENCE	1433DevOR29	
REVISION	**Date**	**Checked**
Rev00	20/12/2016	RIL
Rev01	09/01/2017	RIL
Rev02	13/01/2017	RIL

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CONSTRUCTION AND OPERATION PHASE GROUNDWATER AND SURFACE WATER MONITORING SCHEME FOR PHASE 2 SITE PREPARATORY WORKS AT DOVES NEST FARM MINE SITE, NORTH YORKSHIRE

1 INTRODUCTION

1.1 General Background

This document has been prepared on behalf of Sirius Minerals Plc (Sirius Minerals) and provides the Construction and Operation Phase Groundwater and Surface Water Monitoring Scheme for the Phase 2 Works at Doves Nest Farm Mine Site (Phase 2 Works). This is required to discharge Condition 46 of the North York Moors National Park (NYMNP) planning permission NYM/2014/0676/MEIA.

This document details the hydrological, hydrogeological and ecological monitoring to be undertaken during the Phase 2 Works at Doves Nest Farm Mine Site, as defined in Section 1.2 below.

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

1.2 Phase 2 Works

The Phase 2 Works comprise:-

- Construction of an acoustic fence / environmental barrier and installation of fencing, gates and security, as shown on Arup Drawing YP-P10-DNF-CX-004;
- General site clearance including tree clearance for the Welfare Road and scrub clearance, as shown on Arup Drawing YP-P10-DNF-CX-009;
- Excavation and construction of the two tiered working platform with a western upper level at around 204m Above Ordnance Datum (AOD) and an eastern lower level at around 200m AOD, as shown on Arup Drawing YP-P10-DNF-CX-004;
- Excavation and construction of the site roads, as shown on Arup Drawing YP-P10-DNF-CX-004;
- Construction of temporary and permanent soil mounds including the environmental screening bund (Bund A) along the western boundary, as shown on Arup Drawing YP-P10-DNF-CX-010;
- Construction of surface water drainage, a silt removal facility and an attenuation pond with outfalls to an existing drain, as shown on Arup Drawing YP-P10-DNF-CD-001;
- Construction of a site compound to the east of the Welfare Access Road.

1.3 Compliance with Conditions

The table below 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:-

NYMNP 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 SITE DETAILS

2.1 Existing Development

The Dove's Nest Farm Mine Site covers an area of approximately 67 ha and is predominantly agricultural fields, with farm buildings located in the eastern area.

The site slopes gently to the east away from the B1416 road along the western boundary of the site. Along this western boundary the topography rises from around 208 m AOD in the north to 214 m AOD in the south, and falls to around 200 m AOD on the eastern boundary. West and south of the minesite are areas of moorland that are designated as part of the North York Moors Special Area of Conservation (SAC) at Ugglebarnby Moor and Sneaton Low Moor, respectively, as shown on Drawing 1433DevOD215 Rev1. In this report they will be referred to as Ugglebarnby Moor SAC and Sneaton Low Moor SAC for clear distinction. Ugglebarnby Moor is at an elevation of around 210 m AOD along its eastern margin, falling to around 180 to 190 m AOD along its western margin. Sneaton Low Moor is at an elevation of 231 to 212 m AOD. North and east of the site, the topography falls away more steeply and comprises woodland and/or agricultural land.

2.2 Hydrogeological Receptors

2.2.1 Aquifers

The shallow aquifer units beneath the development are shown on Drawing 1433DevOD237 Rev1 and detailed below:-

Aquifer	Designation	Description
Superficial Deposits	Non-aquifer	Present across the majority of the site, comprising low permeable firm to stiff clays, with discontinuous granular layers that sustain only limited and discontinuous horizontal and vertical flow through isolated sand lenses.
Moor Grit	Secondary A Aquifer	Present across the southern, central and western parts of Doves Nest Farm Mine Site, extending to the west beneath Ugglebarnby Moor. It comprises interbedded mudstone, sandstone and siltstone of between 6 to 10m thick. The groundwater is locally used for a single dwelling drinking water supply via a spring discharge (Moorside Farm Spring MF2), feeds the hydrogeologically supported spring flush and provides a limited contribution of baseflow to a Sneaton Thorpe Beck.
Scarborough Formation	Secondary A Aquifer	Present beneath the majority of the minesite and extends to the west beneath Ugglebarnby Moor. It comprises three horizontal to sub-horizontal bedded weathered mudstone and siltstone units of between 6.5 to 13m thick and some vertical hydraulic continuity with overlying Moor Grit. The groundwater in this aquifer locally supports non-continuous and continuous spring flows used locally for single dwelling drinking water supplies (Soulsgrave Farm Spring SF1), and may provide baseflow to a number of surface water bodies including Knaggy House Farm ponds and Sneaton Thorpe Beck.
Cloughton Formation	Secondary A Aquifer	Present beneath the entire mine site and adjacent SAC. It comprises a series of interbedded sandstones and mudstones with occasional siltstones of between 23.5 to 52 m thick. This groundwater is locally used for borehole drinking water supplies as it is capable of generating a high yield, and provides baseflow to surface water bodies, such as Little Beck.

2.2.2 Abstractions

The following groundwater abstractions shallow aquifer units beneath the development are shown on Drawing 1433DevOD231 Rev1 detailed below:-

Abstractions	NGR coordinates	Geometry and physical properties	Source of groundwater
Moorside Farm Spring (MF2)	489063 504803	Moorside Farm Spring discharges from an elevation of 210m AOD and feeds a domestic water storage tank with an overflow from the tank at an elevation of 202.6 m AOD. A proportion of the flow from the spring provides flow sustaining hydrogeologically supported flora in the Spring Flush area within the Ugglebarnby Moor. As the domestic water supply and hydrogeologically supported flora are dependent on this spring flow it has a very limited potential to accommodate chemical change. The spring, however, does not provide continuous flow throughout the year, with very low or no flow observed during the summer months.	Superficials and the Moor Grit aquifer during winter Only low groundwater flows from the Moor Grit during spring and summer.
Soulsgrave Farm Spring (SF1 and SF1)	490198 504380	The storage chamber (SF1) used to collect spring water for Soulsgrave Farm is at an elevation of 198.0 m AOD. SF1 is a spring discharge in an area marked by distinctive rush-dominated vegetation at an elevation of 196.8 m AOD. This groundwater spring is used for drinking water purposes to this individual property and has, therefore, a very limited potential to accommodate chemical change. It does not provide continuous flow throughout the year, with no flow observed during the summer months.	Scarborough Formation

2.2.3 Springs

Spring discharges and groundwater seepages in the area of the Phase 2 Works at Doves Nest are shown on Drawing 1433DevOD231 Rev1 and summarised below:-

Base Flow Springs	NGR coordinates	Geometry and physical properties	Source of spring
Doves Nest Farm Springs (DNS1)	489510 505160	Located in the central eastern area of the minesite and discharges from a piped overflow at an elevation of 200 m AOD, from a buried tank into a drainage channel that ultimately outflows to Sneaton Thorpe Beck. Provides a limited and non-continuous discharge to this surface watercourse.	Moor Grit
Ugglebarnby Moor Spring (SP01)	488944 504557	This spring is located in the southern part of Ugglebarnby Moor SAC. It comprises a discharge to surface through moorland peat into a narrow channel that discharges into Little Beck. The ground level at SP01 is 207.3 m AOD. This groundwater spring is located 600 m to the east of Little Beck and provides a limited and non-continuous indirect discharge to this surface watercourse.	Combination of superficial deposits and Moor Grit
Springs North of Dove's Nest Farm Mine Site (SP04)	489290 505995	SP04 is located to the north of the Dove's Nest Farm Mine Site. The ground level at SP04 is 195.6 m AOD. This groundwater spring located 550 m south of Buskey Beck provides a limited, potentially indirect discharge to this surface watercourse.	Moor Grit
Springs North of Dove's Nest Farm Mine Site (KHF)	489530 505999	The Knaggy House Farm (KHF) spring is located approximately 30 m east of SP04 The ground level at KHF spring is 185.0 m AOD. This groundwater spring located 50 m west of the surface water ponds at Knaggy House Farm (KHF) provide a limited, potentially indirect discharge to this surface watercourse.	Scarborough Formation

2.3 Surface Water Receptors

2.3.1 Surface Water Courses

Surface water course in and around the Phase 2 Works area is summarised overleaf:-

Surface water course	Geometry and physical properties	Water sources
Sneaton Thorpe Beck	The Sneaton Thorpe Beck is located to the east of Dove's Nest Farm and its headwaters are located in Haxby Plantation in the southeast of the site. The Dove's Nest Farm Mine Site lies within the catchment area of the Sneaton Thorpe Beck The headwaters of the Sneaton Thorpe Beck are located within the Moor Grit and Scarborough Formation whilst the main channel of the beck is within the Cloughton Formation.	Numerous drains, issues, collects and un-named streams discharge into Sneaton Thorpe Beck.

2.3.2 Abstractions

There are no active surface water abstractions or discharges identified within 1 km of the site.

2.4 Ecological Receptors

2.4.1 Spring Flush

There are two principal areas of sensitive ecological receptors in close proximity to the site; Ugglebarnby Moor and Sneaton Low Moor, both of which are part of the North York Moors and are designated as Special Areas of Conservation (SACs), Special Protection Areas (SPA) and Sites of Special Scientific Interest (SSSI). Within these areas, the only ecological receptor that has been determined as containing flora that is hydrogeologically supported (Ref. 2) is the Spring Flush area within the Southern Dry Heath area of Ugglebarnby Moor (Drawing 1433DevOD231 Rev1).

Ecological Receptor	Geometry and physical properties	Water sources
Ugglebarnby Moor Southern Spring Flush	The Spring Flush area in the southern part of Ugglebarnby Moor lies to the southwest of the minesite, where ground levels slope from around 210 m AOD in the east down to around 197 m AOD in the west. Beneath the superficial deposits along the line of the Spring Flush are the Moor Grit, Scarborough Formation and Cloughton Formation.	Surface runoff and shallow groundwater (superficial deposits and Moor Grit)

3 MONITORING

3.1 General

In the following sections, the requirements for undertaking ground water, surface water and ecological monitoring are presented in terms of the monitoring locations, frequency of monitoring, determinands to be analysed for, Trigger Values and reporting procedures.

The monitoring requirements have been determined specifically to enable monitoring of Phase 2 Works as outlined in the Groundwater Management Scheme (Ref. 3) and the Surface Water Drainage Scheme (Ref. 4). The following sections present details of the scope, data

requirements, frequency and Trigger Values (where appropriate) to be adopted for monitoring the following elements:-

- Meteorology (Section 3.2),
- Groundwater levels (Section 3.3) and quality (Section 3.4),
- Springs (Section 3.5),
- Surface Water (Section 3.6),
- Ecology (Section 3.7).

The meteorological monitoring is to be undertaken to enable comparison and informed assessment of impacts on groundwater, surface water and ecological conditions. This data is not evaluated in its own right and no Trigger Values have been set for this purpose.

Ground and surface water quality Trigger Values, comprising "Control" and "Compliance" values, have been set, in accordance with Environment Agency guidance (Ref. 5), to enable evaluation of whether the works have an adverse chemical impact on water resources, as detailed below:-

- The Control Trigger Values are an early warning system designed to draw attention to the development of adverse trends in the monitoring data that may suggest the mitigation measures incorporated into the Phase 2 Works are not working as anticipated. These values have been derived from the baseline data, and, where the baseline data is less than the detection limit, the Control Trigger value has been set at the detection limit.

- The Compliance Trigger Values are defined as the levels at which significant adverse environmental effects have occurred, i.e. if compliance value for a specific receptor has been breached there is a chemical impact occurring. These values have been derived from current Statutory Instruments for water quality, where available. Where the detection limit is greater than the Statutory Instrument value, the Compliance Trigger value has been set at the detection limit.

Groundwater level Trigger Values, comprising "Control" and "Compliance" values, have been set as summarised below to enable evaluation of whether the Phase 2 Works have an adverse impact on spring discharges from Moorside Farm Spring, which supports the spring drinking water abstraction and surface flows to the hydrogeologically supported flora in the Spring Flush area:-

- The Control Trigger Values are an early warning system designed to draw attention to the development of adverse trends in the monitoring data that may be contrary to the groundwater level conditions anticipated from groundwater modelling of the Phase 2 Works (Ref 2). These values have been derived by consideration of the monthly baseline data and the results of the ESI modelling (Ref 2).

- The Compliance Trigger Values are defined as the levels at which significant adverse environmental effects have occurred at Moorside Farm Spring, i.e. if the compliance value at this receptor has been breached there is an adverse physical impact occurring. These values have been derived from evaluation of the historical monthly values determined from the baseline data.

Spring flow rate Trigger Values, comprising "Control" and "Compliance" values, have been set as summarised below to enable evaluation of whether the works have an adverse impact on spring discharges:-

- The Control Trigger values are an early warning system designed to draw attention to the development of adverse trends in the monitoring data that may be contrary to the spring flow conditions anticipated from groundwater modelling of the Phase 2 Works (Ref 2). These values have been derived by consideration of the mean monthly baseline data for the spring receptor.

- The Compliance Trigger values are defined as the levels at which significant adverse environmental effects have occurred at a spring receptor, i.e. if the compliance value at this receptor has been breached there is an adverse physical impact occurring. These values have been derived by consideration of the minimum monthly baseline data for the spring receptor.

For the geomorphological monitoring of Sneaton Thorpe Beck, it is proposed that a qualitative assessment of erosion and siltation conditions will be undertaken by comparison against pre-commencement geomorphological conditions at a number of locations in the stream banks and bed downstream of the consented discharges to this water course. As such, no control and compliance Trigger Values will be established for this purpose.

Ecological habitat trigger criteria have been set, as summarised below, to enable evaluation of whether the works have an adverse impact on the flora within the Spring Flush area. The Habitat Trigger values are an early warning system designed to draw attention to the development of adverse trends in the monitoring data that may be contrary to the vegetation baseline surveys (Ref 2):-

- Change in National Vegetation Classification (NVC) class;
- Change in percentage cover (loss of 5%) of the key indicator species;
- Colonisation by new species;

3.2 Meteorology

3.2.1 Objectives

The objectives of the meteorological monitoring are to provide rainfall and evapotranspiration information to confirm water balance inputs and outputs and to enable correlation with groundwater level, spring flow, surface water geomorphological and ecological data.

3.2.2 Monitoring Location

Meteorological monitoring will be undertaken of the following parameters (Section 3.2.4) from the automated permanent weather station to be located at the Dove's Nest Farm Mine Site.

3.2.3 Monitoring Frequency

The monitoring frequency will be set for 30 minute intervals for all parameters and the data recorded to a data logger to be downloaded on a weekly basis.

3.2.4 Meteorological Data

Meteorological monitoring will consist of:-

- Rainfall (mm),
- Evapotranspiration (mm),
- Temperature (°C),
- Wind Speed (km/hr) and Direction,
- Barometric Pressure (m/bar).

3.2.5 Assessment & Compliance Values

None.

3.3 Groundwater Level Monitoring

3.3.1 Objectives

The purpose of the groundwater level monitoring strategy is to detect physical impacts on groundwater quality within the Secondary A Aquifers caused by the Phase 2 Works, so that appropriate remedial measures can be adopted should potentially detrimental impacts arise.

From the results of the Revised Hydrogeological Risk Assessment (Ref. 2), the objectives of the groundwater level monitoring is to determine whether the Phase 2 Works have an adverse impact on groundwater flow paths and levels in the Moor Grit and Scarborough Formation Secondary A aquifers as a result of constructing Bund A, the tiered Shaft Platform, the site roads and attenuation ponds. The principal target receptors for this impact are the hydrogeologically supported flora within the Spring Flush and Moorside Farm spring water supply (MF2).

3.3.2 Monitoring Locations

From the design layout of the Phase 2 Works, monitoring of construction stage boreholes with response zones within the Moor Grit and Scarborough aquifers will be undertaken as summarised below, for which the monitoring well positions are shown on Drawing 1433DevOD242 Appendix 1:-

Groundwater levels will be monitored in the Moor Grit and Scarborough aquifers using the series of monitoring wells detailed overleaf that are orientated in a line approximately north to south between the Shaft Platform development and the Spring Flush and Moorside Farm target receptors, as shown on Drawing 1433DevOD242 Appendix 1.

Groundwater levels will also be measured within the superficial deposits using the series of monitoring wells detailed overleaf within the Spring Flush area, as shown on Drawing 1433DevOD242 Appendix 1, to identify potential variations in the soil moisture conditions in comparison with the baseline conditions.

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

3.3.3 Monitoring Frequency

From evaluation of the Moor Grit sandstone permeability data and the distance between the tiered Shaft Platform and Moorside Farm Spring/Spring Flush area, it is determined that physical draw down impacts on groundwater levels supporting the spring area, caused by natural groundwater drawdown at the platform, would take over a month to cause a noticeable change to spring flow conditions. On this basis, it is determined that whilst groundwater level data will be collected by the divers on an hourly basis, implementing a weekly collation of that data will be an adequate review period to enable detection of significant changes in groundwater levels and correlation with spring flow rates at Moorside Farm Spring.

During the Phase 2 Works groundwater level monitoring will be undertaken at the following intervals.

Monitoring phase	Duration	Frequency
Pre-Commencement	3 Months	The data loggers will be set at an hourly interval of reading and the data will be downloaded and reviewed on a weekly basis.
Phase 2 Works	Duration of works	
Post Phase 2 Works	1 Month	

It is acknowledged that Phase 3 Works are currently scheduled to follow directly after the Phase 2 Works are completed, with a minimum period of cessation of works. Consequently, the Phase 2 monitoring will continue into Phase 3, and an assessment of any Trigger Levels exceedances will look at all active and past Phases of work, and the potential for cumulative impacts, to determine the cause and appropriate remedial actions.

3.3.4 Groundwater Level Data

To meet the monitoring objectives, groundwater levels will be monitored using diver data loggers, calibrated against an onsite barometer, installed within the monitoring wells to provide continuous groundwater level data for comparison with the Control and Compliance Values Trigger values.

3.3.5 Assessment Trigger Values

Groundwater level "Trigger Values" have been set, as detailed below, for all monitoring well locations detailed in Section 3.3.2, by consideration of the baseline groundwater level data and the ESI modelled impact of the Phase 2 Works on groundwater levels at these locations (Ref 2).

The Control Trigger Value for water levels metres Above Ordnance Datum (m AOD) in the superficial deposits, the Moor Grit strata and the Scarborough Formation has been set for each monitoring location at a value equivalent to:-

Control Trigger Value	=	mean baseline value for that monitoring location	-	1 x the Standard Deviation of baseline data for that monitoring location	-	the modelled impact for that modelled location

The Compliance Trigger Value has been set for the monitoring well, installed within the Moor Grit aquifer (GW133A; previouslyHG11A) immediately up hydraulic gradient of Moorside Farm Spring, at a value equivalent to the minimum monthly baseline value recorded, as presented below.

Superficial Deposits

Monitoring Well	GW132	GW132B	GW132C	GW132D	GW132E
	HG112	HG112B	HG112C	HG112D	HG112E
Modelled Impact	N/A	N/A	N/A	N/A	N/A
Groundwater Control Value (m AOD)					
January	196.27	197.64	201.35	201.48	201.59
February	196.42	197.63	201.29	201.48	201.54
March	196.36	197.61	201.28	201.38	201.60
April	196.24	197.59	201.28	201.29	201.53
May	196.17	197.58	201.20	201.31	201.34
June	195.85	197.38	201.01	201.13	201.24
July	195.47	197.01	200.81	200.95	200.91
August	195.39	197.06	200.84	200.92	200.90
September	195.31	196.90	200.80	200.89	200.76
October	195.50	197.16	201.01	201.10	201.20
November	195.87	197.60	201.29	201.35	201.49
December	196.23	197.51	201.32	201.44	201.56

Moor Grit

Monitoring Well	GW122A (SAC1)	GW124 (SAC3)	GW125 (SAC4)	GW129 (SAC5)	GW118	GW130 (SAC6)	GW131 (SAC7)	GW116 (SAC8)	GW133A	
	HG105A	--	--	--	HG122	--	--	--	HG111A	
Modelled Impact (m)	-0.33	-0.5	-0.25	-0.15	-0.14	-0.04	-0.01	-0.01	-0.01	
(m OD)	**Groundwater Control Value**									**Compliance Value**
January	204.86	203.16	205.67	206.00	204.73	208.50	205.53	212.22	211.44	211.35
February	204.55	203.63	205.46	205.22	205.23	208.03	206.24	212.10	211.77	211.65
March	205.20	203.58	205.52	205.12	205.05	207.94	206.28	211.91	211.24	210.60
April	203.99	203.68	205.57	205.32	204.62	208.08	206.45	212.10	210.16	209.94
May	203.97	--	--	--	204.67	--	--	--	210.16	210.11
June	203.52	--	--	--	204.40	--	--	--	209.27	208.40
July	202.05	--	--	--	204.20	--	--	--	209.54	209.40
August	201.63	--	--	--	203.99	--	--	--	209.28	209.24
September	201.35	200.17	197.73	203.72	203.76	206.00	204.25	208.99	209.15	209.15
October	201.60	199.91	203.17	203.25	203.43	205.35	203.99	208.91	209.27	209.20
November	203.54	199.89	203.52	203.27	203.37	206.05	204.09	209.37	209.91	209.73
December	205.61	201.83	204.56	203.92	203.99	206.38	205.26	210.82	211.40	211.38

Scarborough Formation

Monitoring Well	GW126A	GW117	HG5
	HG108A	--	--
Modelled Impact	-0.08	-0.12	N/A
Groundwater Control Value (m)			
January	197.95	202.17	188.12
February	198.46	201.76	188.87
March	198.31	201.92	188.03
April	198.48	202.24	187.92
May	198.41	--	188.22
June	198.07	--	187.87
July	197.66	--	187.66
August	197.53	--	187.81
September	197.46	200.89	187.43
October	197.37	199.12	187.41
November	197.41	198.87	187.37
December	197.40	199.26	187.59

3.4 Groundwater Quality Monitoring

3.4.1 Objectives

The purpose of the groundwater quality monitoring strategy is to detect chemical impacts on groundwater quality within the Secondary A Aquifers caused by the Phase 2 Works, so that appropriate remedial measures can be adopted should potentially detrimental impacts arise.

From the results of the Revised Hydrogeological Risk Assessment (Ref. 2), the objectives of the groundwater quality monitoring is to determine whether the Phase 2 Works have an adverse chemical impact on groundwater quality in the Moor Grit, Scarborough or Cloughton aquifers from hydrocarbon and salt pollution by construction surface water runoff in the vicinity of the

tiered Shaft Platform and compound areas that could infiltrate into the Moor Grit and Scarborough aquifers.

3.4.2 Monitoring Locations

As determined from the Hydrogeological Risk Assessment (Ref 2), due to the northeasterly hydraulic gradient across the Phase 2 Works, should groundwater pollution arise from the Phase 2 Works and in particular the plant compound, this could only cause a chemical impact on groundwater receptors down hydraulic gradient of the works comprising the Secondary A Moor Grit and Scarborough aquifers. Such chemical impacts would, however, not occur to the more sensitive receptors up hydraulic gradient of the works, including Moorside Farm Spring, Soulsgrave Farm Spring or the Spring Flush vegetation habitat.

In accordance with current guidance (Ref. 5), groundwater quality sampling will be undertaken at a location up hydraulic gradient of the receiving aquifer and at two locations down hydraulic gradient within that aquifer of the potentially polluting activities associated with the Phase 2 works. As such, groundwater quality will be monitored in the Moor Grit, Scarborough and Cloughton aquifers using a series of boreholes both up and down gradient of the development areas, as listed below, at the positions shown on Drawing 1433DevOD242, Appendix 1. 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.

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
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.

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 GW141	-- HG124	489236.66, 505102.82 489412.00, 504958.60	Monitor changes in the groundwater quality within the Scarborough 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.

3.4.3 Monitoring Frequency

On the basis that the all construction activities with be managed in accordance with the Construction Environmental Management Plan (CEMP), the likelihood of pollution arising from these works is considered low and a monthly frequency for groundwater quality monitoring is therefore considered appropriate for these works and sampling for ground water quality analysis will be undertaken at the following intervals.

Monitoring phase	Duration	Frequency
Pre-Commencement	3 Months	Monthly
Phase 2 Works	Duration of works	Monthly
Post Phase 2 Works	1 Month	Monthly

Monitoring of groundwater quality shall continue for a minimum period of 1 month following completion of the Phase 2 Works and until it has been demonstrated that no significant variance from the Control Trigger Values has occurred and no exceedance above the Compliance Limits detailed below has been detected.

It is acknowledged that Phase 3 Works are currently scheduled to follow directly after the Phase 2 Works are completed, with a minimum period of cessation of works. Consequently, the Phase 2 monitoring will continue into Phase 3, and an assessment of any Trigger Levels exceedances will look at all active and past Phases of work, and the potential for cumulative impacts, to determine the cause and appropriate remedial actions.

3.4.4 Groundwater Quality Data

To meet with the groundwater monitoring objectives, the minimum baseline suite of analysis will include both onsite water analysis and laboratory testing, as detailed below. The suite of determinands will include the specific Contaminants of Concern (CoC) identified by the Hydrogeological Risk Assessment (Ref 2) associated with the Phase 2 Works.

Presented below are details of the onsite monitoring and of the sampling and laboratory testing that will be undertaken to obtain the groundwater quality data for the Phase 2 Works. All chemical analysis will be undertaken by an MCERTS accredited laboratory.

Onsite Water Analysis

On site monitoring, using appropriately calibrated field equipment, will be undertaken for the following determinands:-

- Temperature,
- pH,
- Electrical Conductivity; and,
- Total Dissolved Solids.

Sampling

Prior to sampling of the up and down gradient boreholes, each well will be developed by pumping and either purged to three well volumes or the establishment of stable pH and conductivity readings (typically three consecutive field measurements of +/- 0.1 pH units and +/- 250 µS/cm) to ensure the groundwaters sampled are representative of the surrounding groundwater quality in accordance with current guidance (Ref. 5).

Unfiltered samples will be collected in two 1-litre coloured glass jars, and one 100 ml vial and as required by the laboratory, to complete the specified testing suites.

Laboratory Analysis

The chemical analysis will be undertaken for the following suite of determinands:-

- pH,
- Conductivity,
- Chloride,
- BTEX (Benzene, Toluene, Ethylbenzene and Xylene),
- Speciated Polycyclic Aromatic Hydrocarbons (including Anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and Naphthalene),
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) (Aliphatic/Aromatic split).

The detection limits for the above determinands will either be a tenth of the trigger value or the Minimum Reporting Value (MRV), as appropriate.

3.4.5 Assessment Trigger Values

Groundwater quality Control Values have been set for all monitoring well locations (as detailed in Section 3.4.2, above) for the determinands to be analysed by consideration of the baseline groundwater level range and typical variation. The Control Trigger value has been set at a value equivalent to the mean baseline value plus 2 x the Standard Deviation for that dataset. The Compliance Value has been set at the equivalent Drinking Water Standard (DWS), Environmental Quality Standard (EQS) or the baseline value determined where the current baseline value exceeds the EQS value. Where the analytical detection limit (MRV) has been adopted as the Compliance Value, then no Control Value is included, as presented overleaf.

Moor Grit

Contaminant of Concern	Detection Limit	Groundwater Quality Control Value	Groundwater Quality Compliance Value	Source of Compliance Value
pH (Laboratory)		5.6 – 6.9	5.1 – 7.5	Max Baseline Range
Conductivity (Laboratory)	1 µS/cm	2,676 µS/cm	3,910 µS/cm	Max Baseline Value
Chloride	5 mg/l	1,167 mg/l	1,200 mg/l	Max Baseline Value
Benzene	1 µg/l	--	1 µg/l	DWS/Detection Limit
Toluene	1 µg/l	--	1 µg/l	Detection Limit
Ethylbenzene	1 µg/l	--	1 µg/l	Detection Limit
Xylene	1 µg/l	--	1 µg/l	Detection Limit
Anthracene	0.01 µg/l	0.01 µg/l	0.1 µg/l	Detection Limit
Benzo(a)pyrene	0.01 µg/l	--	0.01 µg/l	DWS/Detection Limit
Benzo(b)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Benzo(g,h,i)perylene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Benzo(k)fluoranthene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Fluoranthene	0.01 µg/l	0.03 µg/l	1 µg/l	EQS
Indeno(1,2,3-cd)pyrene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Naphthalene	0.01 µg/l	0.01 µg/l	2.4 µg/l	EQS
TPH Aliphatic C5-C6	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C6-C8	0.1 µg/l	12.9 µg/l	33 µg/l	Max Baseline Value
TPH Aliphatic C8-C10	0.1 µg/l	11 µg/l	28 µg/l	Max Baseline Value
TPH Aliphatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C12-C16	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C16-C21	1 µg/l	1.6 µg/l	3.2 µg/l	Max Baseline Value
TPH Aliphatic C21-C35	1 µg/l	5 µg/l	12 µg/l	Max Baseline Value
TPH Aromatic C5-C7	0.1 µg/l	4.7 µg/l	12 µg/l	Max Baseline Value
TPH Aromatic C7-C8	0.1 µg/l	0.4 µg/l	0.9 µg/l	Max Baseline Value
TPH Aromatic C8-C10	0.1 µg/l	0.2 µg/l	0.4 µg/l	Max Baseline Value
TPH Aromatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C12-C16	1 µg/l	7 µg/l	17 µg/l	Max Baseline Value
TPH Aromatic C16-C21	1 µg/l	3 µg/l	6.9 µg/l	Max Baseline Value
TPH Aromatic C21-C35	1 µg/l	--	1 µg/l	Detection Limit
Total TPH	10 µg/l	33.9 µg/l	74 µg/l	Max Baseline Value

Scarborough Formation

Contaminant of Concern	Detection Limit	Groundwater Quality Control Value	Groundwater Quality Compliance Value	Source of Compliance Value
pH		5.9 – 7.1	5.2 – 8.0	Max Baseline Range
Conductivity	1 µS/cm	1,816 µS/cm	2,500 µS/cm	EQS
Chloride	5 mg/l	463 mg/l	630 mg/l	Max Baseline Value
Benzene	1 µg/l	--	1 µg/l	DWS/Detection Limit
Toluene	1 µg/l	--	1 µg	Detection Limit
Ethylbenzene	1 µg/l	--	1 µg/l	Detection Limit
Xylene	1 µg/l	--	1 µg/l	Detection Limit
Anthracene	0.01 µg/l	0.05 µg/l	0.15 µg/l	Max Baseline Value
Benzo(a)pyrene	0.01 µg/l	--	0.01 µg/l	DWS
Benzo(b)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Benzo(g,h,i)perylene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Benzo(k)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Fluoranthene	0.01 µg/l	0.01 µg/l	1 µg/l	EQS
Indeno(1,2,3-cd)pyrene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Naphthalene	0.01 µg/l	0.01 µg/l	2.4 µg/l	EQS
TPH Aliphatic C5-C6	0.1 µg/l	--	0.1 µg/l	Detection Limit

TPH Aliphatic C6-C8	0.1 µg/l	1 µg/l	2.3 µg/l	Max Baseline Value
TPH Aliphatic C8-C10	0.1 µg/l	5 µg/l	16 µg/l	Max Baseline Value
TPH Aliphatic C10-C12	1 µg/l	\	1 µg/l	Detection Limit
TPH Aliphatic C12-C16	1 µg/l	1.4 µg/l	3.6 µg/l	Max Baseline Value
TPH Aliphatic C16-C21	1 µg/l	2 µg/l	5.5 µg/l	Max Baseline Value
TPH Aliphatic C21-C35	1 µg/l	11.4 µg/l	36 µg/l	Max Baseline Value
TPH Aromatic C5-C7	0.1 µg/l	0.9 µg/l	2.6 µg/l	Max Baseline Value
TPH Aromatic C7-C8	0.1 µg/l	0.3 µg/l	0.9 µg/l	Max Baseline Value
TPH Aromatic C8-C10	0.1 µg/l	1.1 µg/l	3.1 µg/l	Max Baseline Value
TPH Aromatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C12-C16	1 µg/l	5.5 µg/l	15 µg/l	Max Baseline Value
TPH Aromatic C16-C21	1 µg/l	5.7 µg/l	16 µg/l	Max Baseline Value
TPH Aromatic C21-C35	1 µg/l	--	1.0 µg/l	Detection Limit
Total TPH	10 µg/l	19.6 µg/l	36µg/l	Max Baseline Value

Note – Values thought to represent a hydrocarbon plume detected November/December 2015 have been excluded from the Baseline data.

Cloughton Formation

Contaminant of Concern	Detection Limit	Groundwater Quality Control Value	Groundwater Quality Compliance Value	Source of Compliance Value
pH		6.1 – 7.4	4.9 – 8.4	Max Baseline Range
Conductivity	1 µS/cm	722 µS/cm	2,500 µS/cm	EQS
Chloride	5 mg/l	93 mg/l	250 mg/l	EQS
Benzene	1 µg/l	--	1 µg/l	DWS/Detection Limit
Toluene	1 µg/l	0.98 µg/l	2.3 µg/l	Max Baseline Value
Ethylbenzene	1 µg/l	--	1 µg/l	Detection Limit
Xylene	1 µg/l	--	1 µg/l	Detection Limit
Anthracene	0.01 µg/l	0.05 µg/l	0.16 µg/l	Max Baseline Value
Benzo(a)pyrene	0.01 µg/l	--	0.01 µg/l	DWS
Benzo(b)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Benzo(g,h,i)perylene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Benzo(k)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Fluoranthene	0.01 µg/l	0.11 µg/l	1 µg/l	EQS
Indeno(1,2,3-cd)pyrene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Naphthalene	0.01 µg/l	0.01 µg/l	2.4 µg/l	EQS
TPH Aliphatic C5-C6	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C6-C8	0.1 µg/l	0.7 µg/l	2.6 µg/l	Max Baseline Value
TPH Aliphatic C8-C10	0.1 µg/l	10 µg/l	39 µg/l	Max Baseline Value
TPH Aliphatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C12-C16	1 µg/l	2.3 µg/l	7.4 µg/l	Max Baseline Value
TPH Aliphatic C16-C21	1 µg/l	2.2 µg/l	7.1 µg/l	Max Baseline Value
TPH Aliphatic C21-C35	1 µg/l	--	1.0 µg/l	Detection Limit
TPH Aromatic C5-C7	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C7-C8	0.1 µg/l	0.7 µg/l	2.3 µg/l	Max Baseline Value
TPH Aromatic C8-C10	0.1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C12-C16	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C16-C21	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C21-C35	1 µg/l	7.5 µg/l	27 µg/l	Max Baseline Value
Total TPH	10 µg/l	17.3 µg/l	44 µg/l	Max Baseline Value

3.5 Springs

3.5.1 Objectives

The purpose of the spring water monitoring strategy is to detect chemical and physical impact on Soulsgrave Farm Spring and to Moorside Farm Spring caused by the Phase 2 Works, so that appropriate remedial measures can be adopted should potentially detrimental impacts arise.

From the results of the Hydrogeological Risk Assessment (Ref. 2), the principal impact on spring receptors that could arise from the Phase 2 Works, is the alteration of groundwater flow paths and levels in the shallow aquifers sustaining spring flows to Moorside Farm (MF2) and Soulsgrave Farm (SF1).

Due to the north-easterly hydraulic gradient in the vicinity of the Phase 2 Works, chemical impacts would, however, not occur up hydraulic gradient of the works. Therefore pollution of surface water runoff by hydrocarbon spillage/leakage in the vicinity of the shaft platform and compound areas that infiltrates into the shallow aquifers is inferred to result in a negligible impact on water quality at the spring receptors at Moorside Farm (MF2) and Soulsgrave Farm (SF1).

As such, the objectives of the spring monitoring are to enable evaluation of the impacts on both the flow rates and water quality at these receptors. As these two springs provide a domestic water supply and as Moorside Farm Spring also supports the vegetation within the Spring Flush habitat they are classified as having a high sensitivity to both physical and chemical impacts. Consequently, a weekly monitoring frequency is proposed to enable rapid evaluation and implementation of remedial actions, should contravention of the Control values arise.

3.5.2 Monitoring Locations

From the design layout of the Phase 2 Works, monitoring of the spring receptors at Moorside Farm (MF2) and Soulsgrave Farm (SF1) will be undertaken at the locations listed below and shown in Drawing 1433DevOD231 Rev1 (Appendix 1). Due to the diffuse nature of the Moorside Farm spring (MF2) discharge, it is not possible to monitor either the flow or water quality at this location and, therefore, the first collection chamber at MF1 is to be used as a surrogate representation of the spring.

Name	NGR Coordinates	Purpose
Moorside Farm Spring (MF1)	489063 504803	Monitor potential changes in the spring flow rate and water quality providing a discharge collected for domestic water and supporting the spring flush target receptor.
Soulsgrave Farm (SF1)	490198 504380	Monitor potential changes in the spring flow rate to domestic water supply.

3.5.3 Monitoring Frequency

Spring flow rate and water quality monitoring will be undertaken at the following intervals.

Monitoring phase	Duration	Flow Rate Frequency	Water Quality Frequency
Pre-Commencement	3 Months	Weekly	Monthly
Phase 2 Works	Duration of works	Weekly	Weekly
Post Phase 2 Works	1 Month	Weekly	Weekly

Monitoring of spring flow rates and water quality shall continue for a minimum period of 1 month following completion of the Phase 2 Works and until it has been demonstrated that no significant variance from the Control Trigger Values has occurred and no exceedance above the Compliance Limits detailed below has been detected.

It is acknowledged that Phase 3 Works are currently scheduled to follow directly after the Phase 2 Works are completed, with a minimum period of cessation of works. Consequently, the Phase 2 monitoring will continue into Phase 3, and an assessment of any Trigger Levels exceedances will look at all active and past Phases of work, and the potential for cumulative impacts, to determine the cause and appropriate remedial actions.

3.5.4 Spring Flow Rate Data

To meet the monitoring objectives, spring flow rates will be monitored by manual measurement for comparison with the Control and Compliance Values derived from the baseline data.

3.5.5 Assessment Trigger Values

Spring flow rate Control and Compliance Values have been set for the two spring monitoring locations, as detailed below, by consideration of the baseline flow rate range and typical variation. Due to the relatively narrow natural variation/range of flow rates recorded, the Control Trigger value has been set at a value equivalent to the mean baseline flow rate value for that dataset and the Compliance Value as the minimum baseline flow rate value recorded, as presented below. It should be noted that baseline monitoring of flow from these springs has demonstrated intermittent flows in response to seasonal conditions. As such, where baseline monitoring has demonstrated sustained "No flow" conditions can occur during a month, no Compliance Value is deemed appropriate.

Monitoring Location	Baseline Flow Rate Statistics (l/s)				Flow Rate Control Value (l/s)	Flow Rate Compliance Value (l/s)
	Mean	Minimum	Maximum	Standard Deviation		
Moorside Farm (MF1)						
January	0.05	0.03	0.08	0.02	0.05	0.03
February	0.07	0.05	0.14	0.03	0.07	0.05
March	0.07	0.03	0.19	0.04	0.07	0.03
April	0.05	0.02	0.08	0.01	0.05	0.02
May	0.10	0.04	0.25	0.09	0.10	0.04
June	0.04	0.03	0.06	0.01	0.04	0.03
July	0.03	0.00	0.07	0.02	0.03	*
August	0.03	0.02	0.04	0.01	0.03	0.02
September	0.02	0.00	0.05	0.01	0.02	*
October	0.02	0.00	0.04	0.02	0.02	*
November	0.03	0.00	0.07	0.02	0.03	*
December	0.06	0.03	0.08	0.02	0.06	0.03
Soulsgrave Farm (SF1)						
January	0.34	0.22	0.70	0.16	0.34	0.22
February	0.32	0.09	0.59	0.16	0.32	0.09
March	0.25	0.05	0.70	0.18	0.25	0.05
April	0.12	0.02	0.33	0.10	0.12	0.02
May	0.16	0.03	0.61	0.22	0.16	0.03
June	0.17	0.01	0.55	0.20	0.17	0.01
July	0.04	0.00	0.13	0.05	0.04	*
August	0.05	0.00	0.20	0.07	0.05	*

September	0.01	0.00	0.08	0.03	0.01	*
October	0.01	0.00	0.06	0.02	0.01	*
November	0.27	0.00	0.53	0.22	0.27	*
December	0.35	0.11	1.01	0.34	0.35	0.11

Note - * No Compliance Value is appropriate as no flow conditions have been recorded

3.5.6 Spring Water Quality Data

To meet with the spring water quality monitoring objectives, the minimum baseline suite of analysis will include; onsite analysis and sampling for laboratory testing, as detailed below. The suite of determinands will include the specific Contaminants of Concern (CoC) associated with the Phase 2 Works, as detailed in Section 3.5.1.

Onsite Monitoring

On site monitoring using calibrated field equipment will be undertaken for the following determinands:-

- Temperature,
- pH,
- Electrical Conductivity; and,
- Total Dissolved Solids.

Sampling

Unfiltered samples will be collected in two 1-litre coloured glass jars, and one 100 ml vial, or as required by the laboratory to complete the specified testing suites.

Laboratory Analysis

All chemical analysis will be undertaken by an MCERTS accredited laboratory and will include the following:-

- pH,
- Conductivity,
- Chloride,
- BTEX (Benzene, Toluene, Ethylbenzene and Xylene),
- Speciated Polycyclic Aromatic Hydrocarbons (including Anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and Naphthalene),
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) (Aliphatic/Aromatic split).

3.5.7 Assessment Trigger Values

Spring specific water quality Control Values have been set for the two springs by consideration of their respective baseline water quality and typical variation. The Control Trigger value has been set at a value equivalent to the mean baseline value plus 1 or 2 x the Standard Deviation for that dataset, dependent on the magnitude of variation of the data. The Compliance Value has been set at the equivalent Environmental Quality Standard (EQS) or the minimum baseline value

determined where baseline data exceeds the EQS value. Where the analytical detection limit has been adopted as the Compliance Value, then no Control Value is included, as presented below.

Moorside Farm (MF1)

Contaminant of Concern	Detection Limit	Spring Quality Control Value	Spring Quality Compliance Value	Source of Compliance Value
pH (Laboratory)		5.6 – 6.4	4.8 – 7.4	Max Baseline Range
Conductivity (Laboratory)	1 µS/cm	226 µS/cm	2,500 µS/cm	EQS
Chloride	5 mg/l	60 mg/l	250 mg/l	EQS
Benzene	1 µg/l	--	1 µg/l	DWS/Detection Limit
Toluene	1 µg/l	--	1 µg/l	Detection Limit
Ethylbenzene	1 µg/l	1.8 µg/l	2.6 µg/l	Max Baseline Value
Xylene	1 µg/l	1.4 µg/l	2 µg/l	Max Baseline Value
Anthracene	0.01 µg/l	0.01 µg/l	0.1 µg/l	EQS
Benzo(a)pyrene	0.01 µg/l	0.01 µg/l	0.01 µg/l	DWS
Benzo(b)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Benzo(g,h,i)perylene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Benzo(k)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Fluoranthene	0.01 µg/l	0.01 µg/l	1 µg/l	EQS
Indeno(1,2,3-cd)pyrene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Naphthalene	0.01 µg/l	0.01 µg/l	2.4 µg/l	EQS
TPH Aliphatic C5-C6	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C6-C8	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C8-C10	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C12-C16	1 µg/l	3.1 µg/l	4.9 µg/l	Max Baseline Value
TPH Aliphatic C16-C21	1 µg/l	2.7 µg/l	4.3 µg/l	Max Baseline Value
TPH Aliphatic C21-C35	1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C5-C7	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C7-C8	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C8-C10	0.1 µg/l	2.6 µg/l	4.5 µg/l	Max Baseline Value
TPH Aromatic C10-C12	1 µg/l	1.3 µg/l	1.8 µg/l	Max Baseline Value
TPH Aromatic C12-C16	1 µg/l	1.4 µg/l	2.1 µg/l	Max Baseline Value
TPH Aromatic C16-C21	1 µg/l	1.4 µg/l	2.1 µg/l	Max Baseline Value
TPH Aromatic C21-C35	1 µg/l	--	1 µg/l	Detection Limit
Total TPH	10 µg/l	--	10 µg/l	Detection Limit

Soulsgrave Farm (SF1)

Contaminant of Concern	Detection Limit	Spring Quality Control Value	Spring Quality Compliance Value	Source of Compliance Value
pH		5.5 – 6.6	5.5 – 7.4	Max Baseline Range
Conductivity	1 µS/cm	576 µS/cm	2,500 µS/cm	EQS
Chloride	5 mg/l	169 mg/l	250 mg/l	EQS
Benzene	1 µg/l	--	1 µg/l	DWS/Detection Limit
Toluene	1 µg/l	--	1 µg/l	Detection Limit
Ethylbenzene	1 µg/l	--	1 µg/l	Detection Limit
Xylene	1 µg/l	--	1 µg/l	Detection Limit
Anthracene	0.01 µg/l	0.00 µg/l	0.05 µg/l	EQS
Benzo(a)pyrene	0.01 µg/l	0.01 µg/l	0.01 µg/l	DWS

Benzo(b)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Benzo(g,h,i)perylene	0.01 µg/l	--	0.02 µg/l	Detection Limit
Benzo(k)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Fluoranthene	0.01 µg/l	0.04 µg/l	1 µg/l	EQS
Indeno(1,2,3-cd)pyrene	0.01 µg/l	--	0.01 µg/l	Detection Limit
Naphthalene	0.01 µg/l	0.01 µg/l	2.4 µg/l	EQS
TPH Aliphatic C5-C6	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C6-C8	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C8-C10	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C12-C16	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C16-C21	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C21-C35	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C5-C7	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C7-C8	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C8-C10	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C12-C16	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C16-C21	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C21-C35	1 µg/l	--	1 µg/l	Detection Limit
Total TPH	10 µg/l	--	10 µg/l	Detection Limit

3.6 Surface Water

3.6.1 Objectives

The purpose of the surface water monitoring strategy is to detect chemical and physical impact on surface waters within Sneaton Thorpe Beck caused by the Phase 2 Works, so that appropriate remedial measures can be adopted should potentially detrimental impacts arise.

From the results of the Revised Hydrogeological Risk Assessment (Ref. 2) and the Surface Water Drainage Scheme (Ref. 4), potential impacts on Sneaton Thorpe Beck that could arise from the Phase 2 Works, and therefore require evaluation by the surface water monitoring strategy include:-

- Chemical pollution in the form of hydrocarbon (fuel, hydraulic oil, lubricant oil) spillage or leakage from construction plant and silt/particulate suspended solids entering surface water drainage via runoff and discharging into controlled waters.
- Physical impacts of the surface water outfall system on Sneaton Thorpe Beck by causing siltation, scour or erosion of the stream bed.

3.6.2 Monitoring Locations

To meet the above objectives, the surface water monitoring locations have been designed to provide:-

a) early monitoring of surface water drainage within the onsite construction activities, and

b) monitoring of surface water outfalls at downstream compliance points prior to discharge to Sneaton Thorpe Beck.

From the design layout of the Phase 2 Works, monitoring of the construction stage discharges up and down stream of the surface water drainage outfall points will be undertaken as summarised below and shown in Drawing 1433DevOD241 (Appendix 1):-

- Surface drainage discharge points from key outfalls from the construction works denoted OF1 to OF6, to monitor the water quality from the works area prior to discharge to Sneaton Thorpe Beck;

- Downstream Sneaton Thorpe Beck (STB01 to STB04) to monitor the water quality and impacts on stream geomorphology of surface drainage discharges downstream of the Phase 2 works and exiting the development site.

3.6.3 Monitoring Frequency

Sampling for surface water quality analysis will be undertaken at the following intervals.

Monitoring phase	Duration	Frequency
Pre-Commencement	3 Months	Monthly
Phase 2 Works	Duration of works	Weekly
Post Phase 2 Works	1 Month	Weekly

Monitoring of surface water quality shall continue for a minimum period of 1 month following completion of the Phase 2 Works and until it has been demonstrated that no significant variance from the Control Trigger Values has occurred and no exceedance above the Compliance Limits detailed below has been detected.

It is acknowledged that Phase 3 Works are currently scheduled to follow directly after the Phase 2 Works are completed, with a minimum period of cessation of works. Consequently, the Phase 2 monitoring will continue into Phase 3, and an assessment of any Trigger Levels exceedances will look at all active and past Phases of work, and the potential for cumulative impacts, to determine the cause and appropriate remedial actions.

3.6.4 Surface Water Data

To meet with the surface water monitoring objectives, the minimum baseline suite of analysis will include onsite analysis, sampling and laboratory testing, together with geomorphological inspection will be carried out as detailed below.

The suite of determinands to be analysed for to evaluate construction related pollution will include the specific Contaminants of Concern (CoC) associated with the Phase 2 Works, as detailed in Section 3.6.1. In addition, NYMNPA have advised within Condition 46 that they also require the surface water quality analysis to include pH, sediment (suspended solids), Biological Oxygen Demand (BOD) and ammonia (Section 1.3).

Sampling

During the sampling visits, surface water sampling of the downstream monitoring points (STB1 to STB4) will be collected first, to minimise disturbed sediment impacting on the results. These samples are to be taken from sections of fast flowing water, where possible. The specific monitoring locations of the outfall piped discharge points (OF1 to OF6) will be confirmed during the first monitoring visit after each water feature has been constructed..

Unfiltered samples will be collected in two litre coloured glass jars, and one 100 ml vial, or as required by the laboratory to complete the specified testing suites.

Onsite Monitoring

Visual inspection will be undertaken of the construction works surface water drainage systems to observe for evidence of high suspended solids, discolouration or hydrocarbon pollution.

On site monitoring using calibrated equipment will be undertaken for the following determinands:-

- Temperature,
- pH,
- Electrical Conductivity,
- Total Dissolved Solids,
- Turbidity.

Laboratory Analysis

All chemical analysis will be undertaken by an MCERTS accredited laboratory.

From the expected potentially polluting activities associated with Phase 2 Works the CoC that are to be analysed for will include:-

- pH,
- Conductivity,
- Suspended Solids,
- Biological Oxygen Demand,
- Free ammonia (NH_3),
- Chloride
- Benzene,
- Toluene,
- Ethylbenzene,
- Xylene,
- Anthracene,
- Benzo(a)pyrene,
- Benzo(b)fluoranthene,
- Benzo(g,h,i)perylene,
- Benzo(k)fluroanthene,
- Indeno(1,2,3-cd)pyrene,
- Naphthalene,
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) (Aliphatic/Aromatic split).

Geomorphological Data

A geomorphological stream reconnaissance survey will be undertaken at two downstream locations (STB 01 and 02) on Sneaton Thorpe Beck on a long a section of the stream bank of between 10m to 30m long. The survey will be undertaken in accordance with current guidance

(Ref. 8), utilising a reconnaissance record sheet adapted from current guidance (Ref. 9). The data that will be obtained from this inspection will include:-

- A photographic record of the stream section,
- A description of the channel,
- A description of the stream bed sediment,
- A description of the left and right bank characteristics,
- A description of the left and right bank face vegetation,
- A description of visual evidence of left and right bank erosion,
- A description of visual evidence of left and right bank geotechnical failure,
- A description of visual evidence of left and right bank toe sediment accumulation.
- Visual evidence of construction related debris within or adjacent to the stream.
- A visual description of evidence of pollution/discolouration.

3.6.5 Assessment Trigger Values

Surface Water Quality Control and Compliance Trigger Values

Surface Water Quality Control Values have been set for all of the determinands to be analysed for by consideration of the baseline surface water quality testing undertaken to date at STB01 to STB04. The Control Trigger value has been set at a value equivalent to the mean baseline value plus 2 x the Standard Deviation for that dataset. The Compliance Value has been set at the appropriate Environmental Quality Standard (EQS) or the minimum baseline value where this exceeds the EQS value. Where the analytical detection limit (MRV) has been adopted as the Compliance Value, then no Control Value is included, as presented below.

A Control Trigger Value will be derived for turbidity based on the initial three months monitoring data using the same methodology.

Contaminant of Concern	Detection Limit	Surface Water Quality Control Value	Surface Water Quality Compliance Value	Source of Compliance Value
pH		6.9 – 7.6	6.4 – 7.8	Max Baseline Range
Conductivity	1 µS/cm	980 µS/cm	2,500 µS/cm	EQS
Chloride	5 mg/l	40.8 mg/l	250 mg/l	EQS
Turbidity	TBC	TBC	TBC	Max Baseline Value
Suspended Solids	5 mg/l	6 mg/l	25 mg/l	EQS
Biological Oxygen Demand (BOD)	1 mg/l	3.8 mg/l	6 mg/l	Max Baseline Value
Free Ammonia (NH_3)	0.02 mg/l	0.18 mg/l	0.29 mg/l	Max Baseline Value
Benzene	1 µg/l	--	1 µg/l	Detection Limit
Toluene	1 µg/l	--	1 µg/l	Detection Limit
Ethylbenzene,	1 µg/l	--	1 µg/l	Detection Limit
Xylene	1 µg/l	--	1 µg/l	Detection Limit
Anthracene	0.01 µg/l	0.01 µg/l	0.1 µg/l	EQS
Benzo(a)pyrene	0.01 µg/l	0.02 µg/l	0.01 µg/l	DWS/Detection Limit
Benzo(b)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Benzo(g,h,i)perylene	0.01 µg/l	0.04 µg/l	0.05 µg/l	EQS
Benzo(k)fluoranthene	0.01 µg/l	0.01 µg/l	0.03 µg/l	EQS
Fluoranthene	0.01 µg/l	0.09 µg/l	1 µg/l	EQS

Indeno(1,2,3-cd)pyrene	0.01 µg/l	0.03 µg/l	0.04 µg/l	Max Baseline Value
Naphthalene	0.01 µg/l	0.4 µg/l	2.4 µg/l	EQS
TPH Aliphatic C5-C6	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aliphatic C6-C8	0.1 µg/l	1.93 µg/l	2.9 µg/l	Max Baseline Value
TPH Aliphatic C8-C10	0.1 µg/l	0.41 µg/l	0.6 µg/l	Max Baseline Value
TPH Aliphatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C12-C16	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C16-C21	1 µg/l	--	1 µg/l	Detection Limit
TPH Aliphatic C21-C35	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C5-C7	0.1 µg/l	--	0.1 µg/l	Detection Limit
TPH Aromatic C7-C8	0.1 µg/l	1.47 µg/l	2.2 µg/l	Max Baseline Value
TPH Aromatic C8-C10	0.1 µg/l	1.60 µg/l	2.4 µg/l	Max Baseline Value
TPH Aromatic C10-C12	1 µg/l	--	1 µg/l	Detection Limit
TPH Aromatic C12-C16	1 µg/l	1.55 µg/l	12 µg/l	Max Baseline Value
TPH Aromatic C16-C21	1 µg/l	0.97 µg/l	5.7 µg/l	Max Baseline Value
TPH Aromatic C21-C35	1 µg/l	--	1 µg/l	Detection Limit
Total TPH	10 µg/l	14 µg/l	18 µg/l	Max Baseline Value

Surface Water Geomorphology Control and Compliance Trigger Values

The stream reconnaissance survey to monitor the visual evidence of physical impacts of the Phase 2 Works on the geomorphology of Sneaton Thorpe Beck is a qualitative assessment and no specific Trigger Values are appropriate. As such, this visual assessment will provide a qualitative evaluation of observed changes in relation to the baseline conditions observed, during the baseline monitoring period.

3.7 Ecological Monitoring

3.7.1 Objectives

The objective of the ecological monitoring is to determine whether the Phase 2 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.

3.7.2 Scope of Monitoring

The key indicator species to be monitored in the Spring Flush are:-

- purple moor grass;
- deer grass;
- cross leaved heath;
- sharp flowered rush; and
- bog mosses.

The monitoring is not to be limited to these species and the presence of all species, and changes in their populations will be assessed.

Monitoring Locations

The survey area will be the Spring Flush area shown in Drawing 1433DevOD245. A series of ten fixed monitoring locations for quadrat sampling will be identified on site during the first baseline sampling visit and a wooden stake left to demarcate the location for future monitoring. The grid coordinates for these locations will be identified by the use of GPS and a photographic record will be used to enable identification for all future sampling. The areas for sampling will be selected based on those areas where habitats show more diversity although some areas of lesser diversity will also be selected.

3.7.3 Monitoring Frequency

The window for National Vegetation Classification (NVC) surveys is April to September with the optimal time for monitoring being July to September when the plants are in bloom. All NVC monitoring will be undertaken in accordance with the NVC methodology set out in the NVC guidance (Ref. 11). The preconstruction baseline monitoring will be undertaken immediately prior to the start of the construction works in April 2017 with a further survey being undertaken in August or September 2017 upon completion of the Phase 2 Works. Surveys will be undertaken in Spring and the end of Summer during subsequent Phases of work.

3.7.4 Assessment Trigger Values

The ecological habitat Trigger Values will be set on the following basis:-

Change in NVC class	The quadrats will allow the detailed definition of NVC class(es) for each habitat type and location. A change in NVC class will indicate a change in assemblage sufficient to cause a change in vegetation thereby impacting the interest of the site.
Change in percentage cover (loss of 5%) of the key indicator species	The quadrats will allow determination of the percentage cover. Should the coverage of the key indicator species drop by 5% or more, this will trigger a review of the significance of the change in the context of the wider habitat conditions.
Colonisation by new species	An evaluation will be undertaken to determine evidence of colonisation by new species. Where colonisation by a new species has been identified a review will be carried out of the significance and consequence of the change;

4 REMOVAL AND REPLACEMENT OF EXISTING MONITORING POINTS

The following monitoring wells, as shown on Drawing 1433DevOD243, will be decommissioned as part of the Phase 2 Works:-

- Environmental Bund – GW123
- Shaft Platform area – HG116, HG127 to HG135, SS1 to 3 and GCBH05
- Access Road – GCBH01 and GW135
- Silt Removal Facility – MB3.

Borehole decommissioning will be undertaken in accordance with current guidance (Ref. 7) and will adopt one of the three decommissioning options detailed overleaf:-

OPTION 1	In boreholes where there is 1m or less of plain pipework	Grout up standpipe from the base to 1.5m below ground level. Remove headworks and plain pipe from 0-1m bgl. Remove the gravel pack and slotted pipework from 1.0-1.5m and replace with a bentonite/grout plug. Replace upper section 0-1.0m bgl with appropriate topsoil/arisings mix.
OPTION 2	In boreholes where there is greater than 1 m of plain pipework	Grout up standpipe from the base to 1m below ground level. Remove headworks and plain pipe from 0-1m bgl and replace with appropriate topsoil mix.
OPTION 3	In boreholes located on land that may be ploughed:-	Where boreholes are located on land that may be ploughed then guidance recommends that installations are removed to a minimum of 2.0 m bgl. Grout up standpipe from base to 2 m bgl. Remove headworks and plain pipe from 0-2m bgl . Remove the gravel pack and slotted pipework from 2.0-2.5m and replace with a bentonite/grout plug. Replace upper section 0-2.0m bgl with appropriate topsoil/arisings mix.

On completion of the decommissioning, a report of the works undertaken will be prepared.

5 MONITORING REPORTING

5.1 Scope

Reporting will assess the monitoring results against the Control and Compliance values to highlight exceedances and to record if remedial action is required as outlined in the Remedial Action Plan (compiled to discharge Condition 46 of planning permission NYM/2014/0676/MEIA).

In compliance with Condition 46 of planning permission NYM/2014/0676/MEIA, should any monitoring result exceed those Control and Compliance Values set out within this document, the Local Planning Authority, the Environment Agency and Natural England will be informed as soon as practicable, and the approved Remedial Action shall be implemented in accordance with the Remedial Action Plan.

Summary reports will review the weekly/monthly monitoring reports, and review the adopted Control values, and where necessary, suggest amendments.

5.2 Frequency

Monitoring reports will be prepared on a monthly basis during the pre-commencement period, on a weekly basis during the Phase 2 Works, and for one month thereafter. Where exceedances are recorded above the agreed Control and Compliance Values, the monitoring report will be issued to the LPA, the EA and Natural England.

A summary report will be issued at the end of the pre-commencement period and monthly summary reports will be issued during the Phase 2 Works and on completion of the works. A final report will be issued to the LPA, the EA and Natural England one month after the completion of the Phase 2 Works.

5.3 Format

The format for the weekly/ monthly reports will include:-

- Summary of weekly construction activities,
- Record of monitoring positions decommissioned,
- Summary of meteorological data,
- Comparison of monitoring data to control and compliance Trigger Values,
- Conclusions,
- Recommendations for remedial actions.

The format of the summary reports will include:-

- Summary of monthly activities,
- Summary of meteorological data,
- Comparison of monitoring data to control and compliance Trigger Values,
- Analysis of baseline data and review of control values,
- Review of any remedial actions taken,
- Conclusions,
- Recommendations for remedial actions.

M LAKEY
PRINCIPAL CONSULTANT

R IZATT-LOWRY
DIRECTOR

6 REFERENCES

1 FWS Consultants Ltd, 2016. Hydrogeological Baseline Report for the Dove's Nest Minesite, North Yorkshire 2012 to 2016 (1975OR01)

2 FWS Consultants Ltd, December 2016. Revised Hydrogeological Risk Assessment for the Doves Nest Farm Mine Site Phase 2 Works, North Yorkshire. Doc. Ref. No. 1433DevOR27Rev1.

3 FWS Consultants Ltd, May 2016. Groundwater Management Scheme for Site Preparatory Works – Doves Nest Farm Mine Site. Doc. Ref. No. 1433DevOR31.

4 Arup, December 2016. Surface Water Drainage Scheme. Ref. 234376-00.

5 Environment Agency, 2010. Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Values

6 Arup, December 2016. Draft Technical Note - Surface Water Management Plan for Phase 2 Dove's Nest Farm. Ref. TN-P10-DNF-CD-001.

7 Environment Agency, 2012. Good practice for decommissioning redundant boreholes and wells.

8 Environment Agency 2007. Geomorphological Monitoring Guidelines for River Restoration.

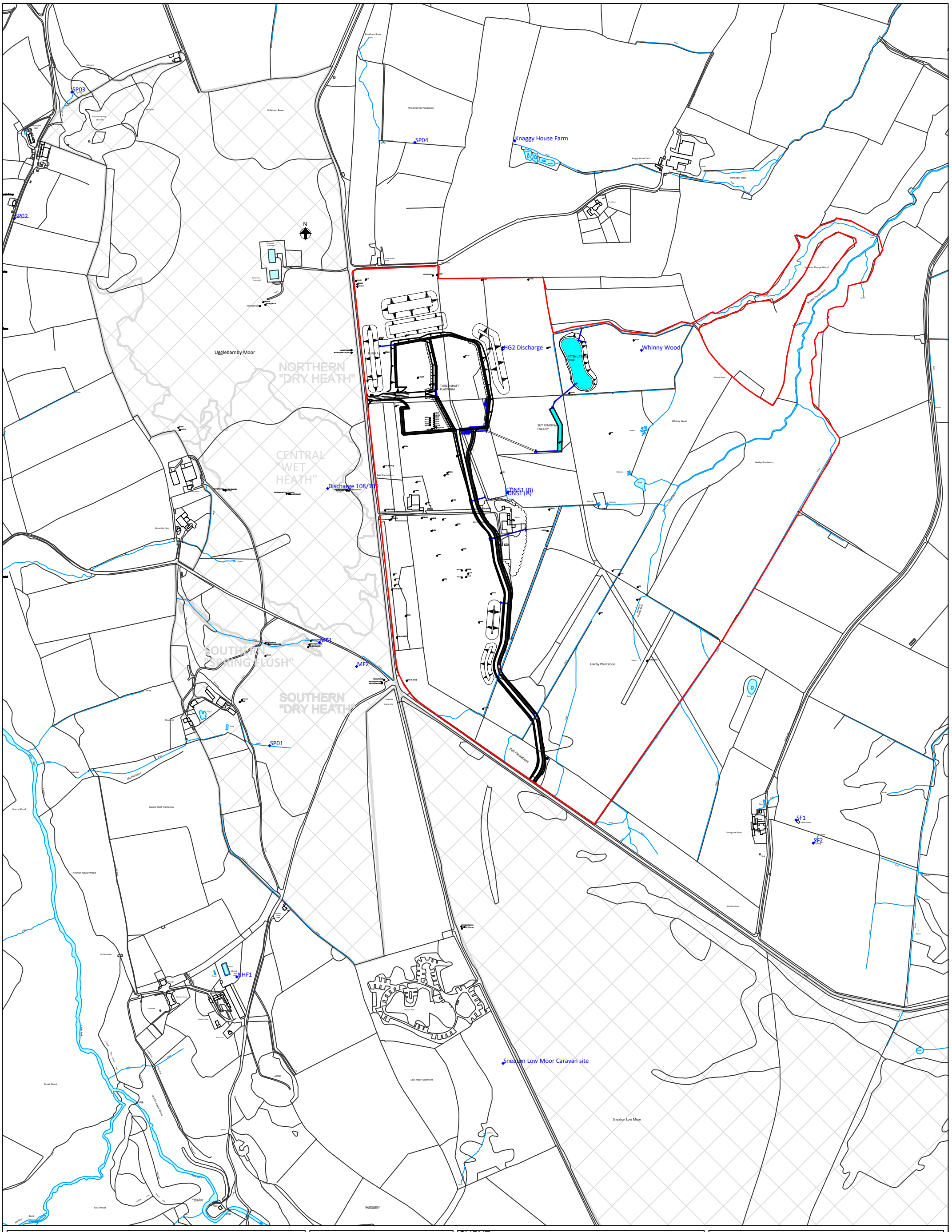
9 Thorne, 1998. Stream Reconnaissance Guidebook – Geomorphological Investigation and Analysis of River Channels

10 FWS Consultants Ltd, December 2016. Remedial Action Plan for the Doves Nest Farm Mine Site Phase 2 Works, North Yorkshire. Doc. Ref. No. 1433DevOR230.

11 Rodwell, J.S., 2006. National Vegetation Classification:Users' handbook

APPENDIX 1

DRAWINGS



NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

BOREHOLES GCBH01

HYDROGEOLOGICAL RECEPTORS MF2

DRAWING TITLE

HYDROGEOLOGICAL RECEPTORS

PROJECT TITLE

YORK POTASH PROJECT

CLIENT
SIRIUS MINERALS PLC

STATUS
FINAL

PROJECT NUMBER
1433Dev

DRAWN BY
CB

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DRG. No.
1433DevOD231Rev.1

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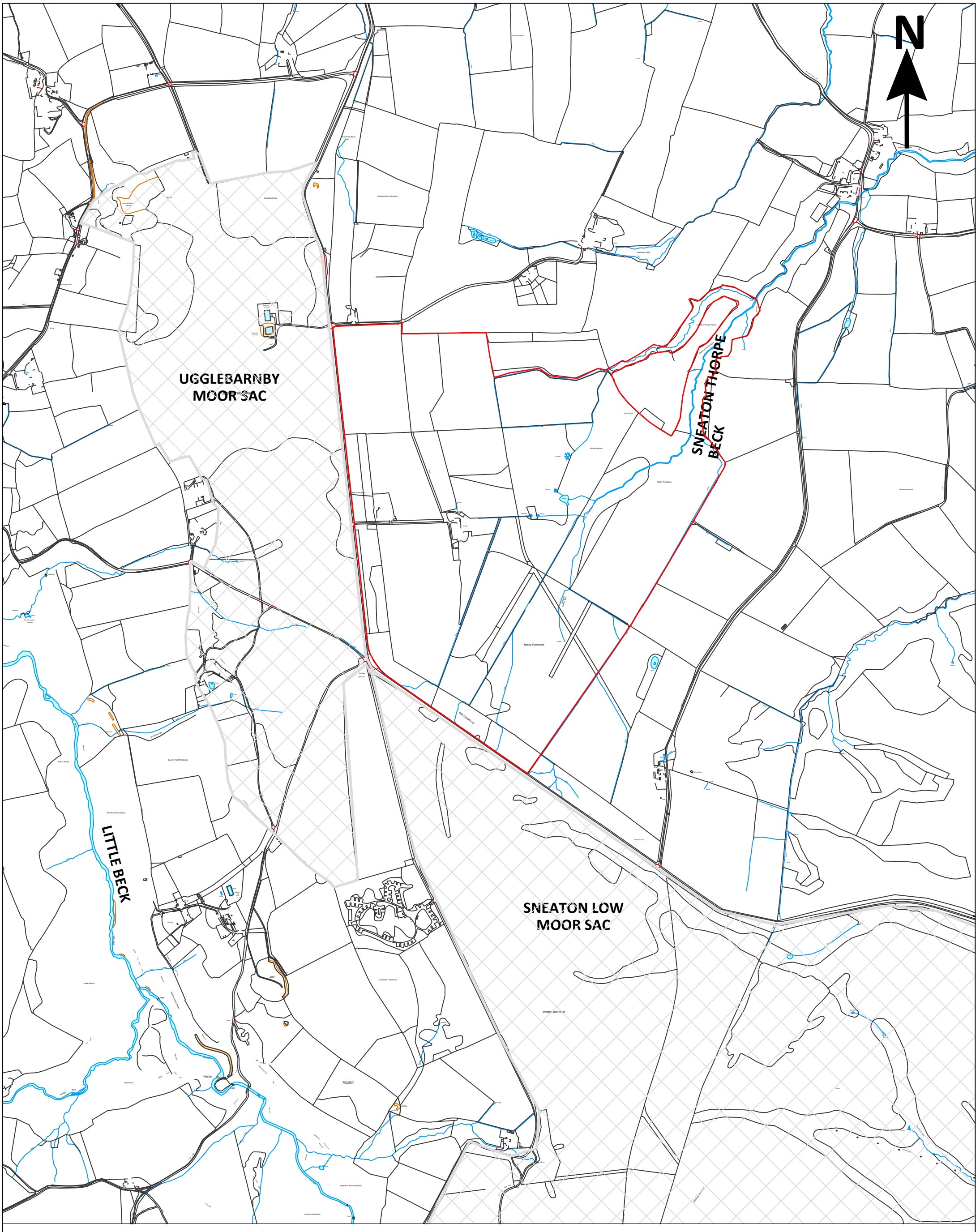

NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

DRAWING TITLE
DOVES NEST LOCATION PLAN

PROJECT TITLE
YORK POTASH PROJECT

CLIENT
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BUND A

GW123 (SAC2)

TIERED SHAFT PLATFORM

HG116

GCBH5

HG135
HG135A
HG131
HG127
HG132
HG128
HG133
HG129
HG134
HG130
HG137
HG135B
S Shaft BH
HG136
HG135C

ATTENUATION POND

SILT REMOVAL FACILITY

MB3

Track

Belt Plantations

Sinks

Spring

Spreads

GCBH1

Spring

Doves Nest Farm

GW124

B 1416

NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

BOREHOLES GCBH01

DRAWING TITLE

BOREHOLES TO BE DECOMMISSIONED DURING PHASE 2 WORKS

PROJECT TITLE

YORK POTASH PROJECT

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PROJECT NUMBER
1433Dev

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DATE
December 2016

SCALE
1:2,000@A3/1:500@A1

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Ugglebarnby Moor

NORTHERN "DRY HEATH"

CENTRAL "WET HEATH"

SOUTHERN "SPRING FLUSH"

SOUTHERN "DRY HEATH"

Reservoir (covered)

Reservoir (covered)

Track

Ash Ken

Honeysuckle Farm

Cattle Grid

Parkdown

GW103

GW105

GW106

GW101

GW101A

BUND A

HG105A/GW122A (SAC1)

HG2

TIERED SHAFT PLATFORM

GW124 (SAC3)

ATTENUATION POND

GW108

Drain

SILT REMOVAL FACILITY

Collects

Track

GW125 (SAC4)

Belt Plantations

HG4

HG108A/GW126A

Sinks

Spring

Pond

Spreads

Collects

GW129 (SAC2)

GW127

HG122/GW128

GW109

Spring

Dovecote Farm

HG120

Drain

Collects

HG5

HG124

GW130 (SAC6)

Sneaton Thorpe Beck

GW131 (SAC7)

Drain

Drain

Issues

Haxby Plantation

Drain

Drain

HG112/GW132

HG112C/GW132C

HG112B/GW132B

HG112D/GW132D

HG112E/GW132E

Drain

Drain

Track

Path (um)

Pond

Pond

Drain

HG111A/GW133A

GW116 (SAC8)

Red Gate

Cattle Grid

Belt Plantations

Drain

NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

BOREHOLES GCBH01

DRAWING TITLE

PHASE 2 WORKS BOREHOLE MONITORING LOCATIONS

PROJECT TITLE

YORK POTASH PROJECT

CLIENT
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STATUS	PROJECT NUMBER
FINAL	1433Dev
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Windmill Hill Plantation
Knaggy House Farm
Harding's Slack
Parkdown
Honeysuckle Farm
Cattle Grid
Sneaton Thorpe Wood
Sneaton Thorpe Beck
BUND A
TIERED SHAFT PLATFORM
ATTENUATION POND
SILT REMOVAL FACILITY
Whinny Wood
Haxby Plantation
Belt Plantations
Soulsgrave Farm
Red Gate Cattle Grid
Pond
Wind Pump
Spring
Sinks
Issues
Collects
Spreads
Drain
Water
Ford
STB1
STB2
STB3
STB4
OF1
OF2
OF4
OF5
OF6

NOTES / KEY

SITE OWNERSHIP BOUNDARY

NYM SAC

SURFACE WATER

BOREHOLES GCBH01

SURFACE WATER MONITORING LOCATIONS OF1

DRAWING TITLE

SURFACE WATER MONITORING LOCATIONS

PROJECT TITLE

YORK POTASH PROJECT

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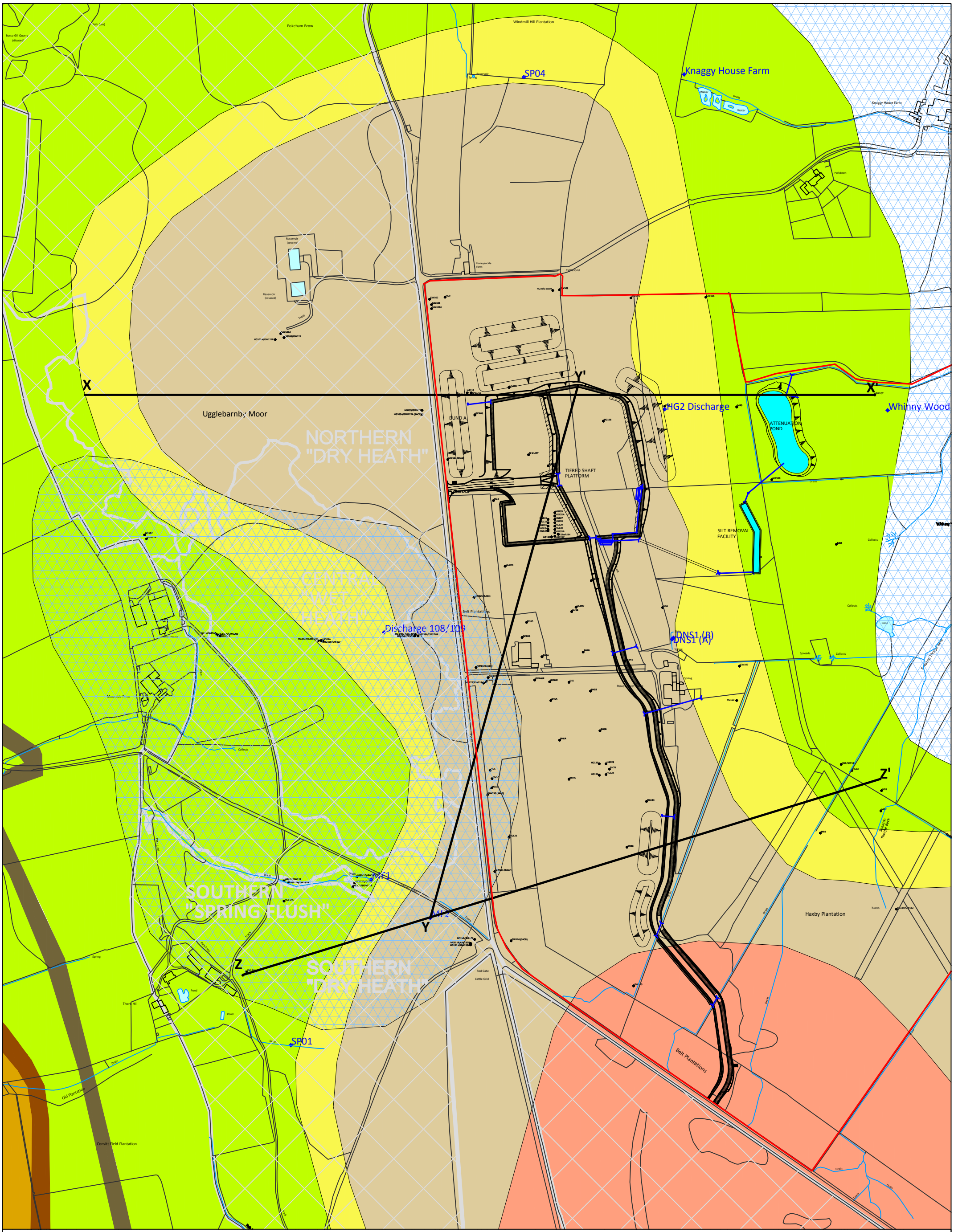

NOTES / KEY

SITE OWNERSHIP BOUNDARY
NYM SAC
SURFACE WATER
BOREHOLES GCBH01
HYDROGEOLOGICAL RECPTORS MF2
LINE OF CROSS SECTION
CROSS SECTION X-X' DRAWING 1433DevOD220
CROSS SECTION Y-Y' DRAWING 1433DevOD217
CROSS SECTION Z-Z' DRAWING 1433DevOD236

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
YORK POTASH PROJECT

CLIENT
SIRIUS MINERALS PLC

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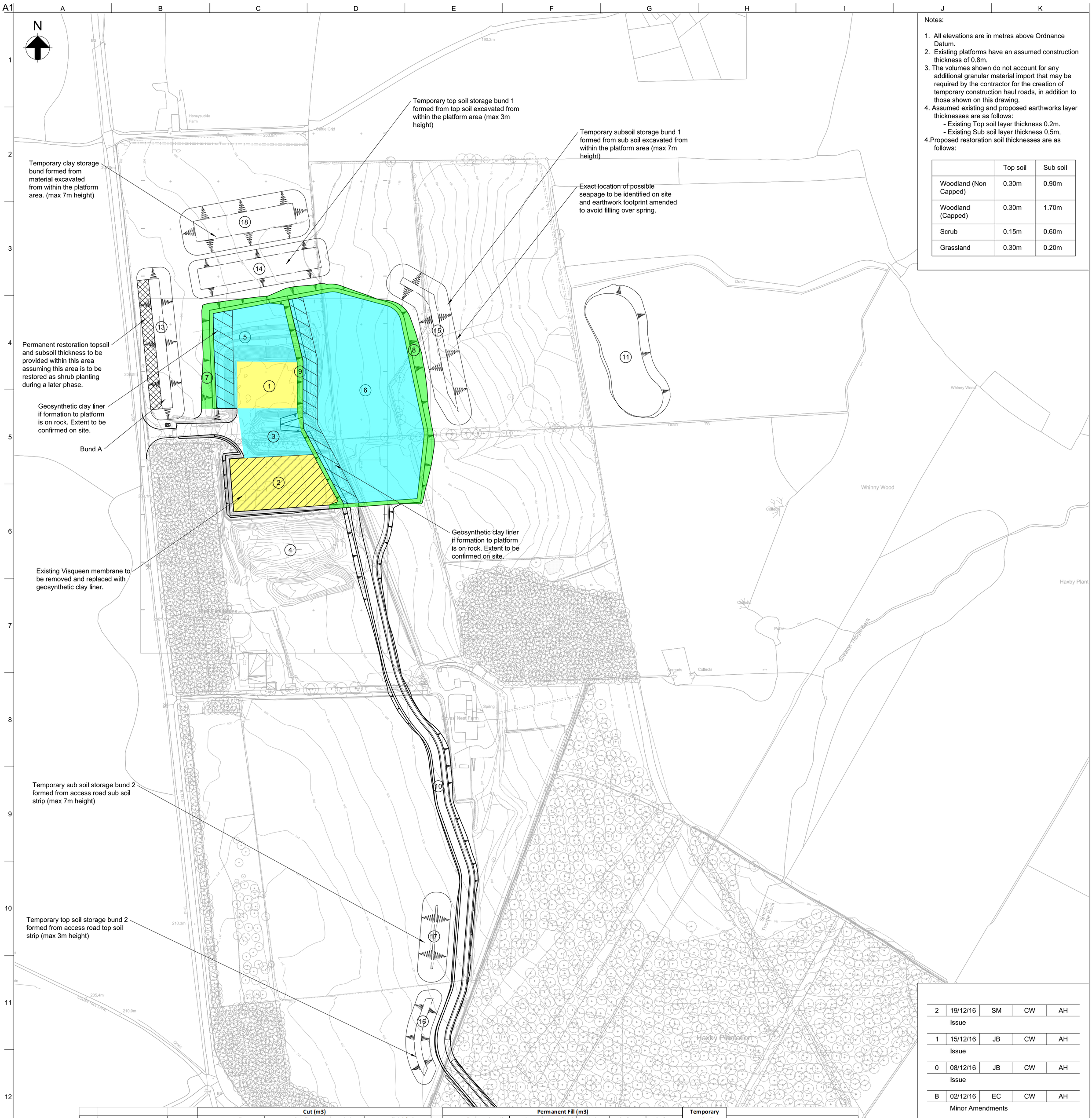
APPENDIX 2

DESIGN DRAWING



Notes:

1. All elevations are in metres above Ordnance Datum.
2. Existing platforms have an assumed construction thickness of 0.8m.
3. The volumes shown do not account for any additional granular material import that may be required by the contractor for the creation of temporary construction haul roads, in addition to those shown on this drawing.
4. Assumed existing and proposed earthworks layer thicknesses are as follows:
   - Existing Top soil layer thickness 0.2m.
   - Existing Sub soil layer thickness 0.5m.
4. Proposed restoration soil thicknesses are as follows:

	Top soil	Sub soil
Woodland (Non Capped)	0.30m	0.90m
Woodland (Capped)	0.30m	1.70m
Scrub	0.15m	0.60m
Grassland	0.30m	0.20m

Area		Area m2	Cut (m3) Top Soil To Tip	Top Soil Reuse / Stockpile	Subsoil To Tip	Subsoil Reuse / Stockpile	Existing Platform Material	Superficial / Clay To Tip	Superficial / Clay Reuse / Clay	Permanent Fill (m3) Top Soil	Sub Soil	Tip	Superficial / Clay	Existing Platform	Platform Construction Class 1A (Import)	Platform Construction (Import)	Temporary Stockpiles	Comments
1	North Platform	3,055	611		1,528		917	4,780								1,315		0.3m depth of existing platform to be removed and new construction provided on top. It is assumed that top, sub and sperficial soil cut volumes from this area are currently stored in the landscaped bunds surrounding the northern platform.
2	South Platform	5,360					1,340									2,080		0.25m depth of existing platform to be removed and new construction provided on top. Assumes all material previously stripped from this area is stockpiled in Area 4.
3	Middle Extension	3,285		657		1,643			3,160							1,970		
4	Existing spoil bund	16,545																No impact on this area during phase 4.
5	North Extension	5,600		1,120		2,800			9,730							3,360		
6	East (Lower) Extension	23,420		4,684		11,710		6,330	9,610					2,257	6,770	14,052		
7	Slope	2,625		525		1,313			2,190	788					100			
8	Slope	4,835		967		2,418			990	1,451			4,720					
9	Slope	1,290		258		645			1,160	387					110			
10	Access Road	7,290		1,458		3,645			6,330	1,550			2,080			6,197		Assume 30% of area top soiled
11	Pond	7,626		1,525					2,323	2,290			3,963					
13	Bund A	5,518		1,104		2,759				310	1,245	14,543						Assumed Scrub planting for basis of restoration soils thickness.
14	Temp Top Soil Bund 1	5,790		1,158													8,779	
15	Temp Sub Soil Bund 1	6,391		1,278													21,177	
16	Temp Top Soil Bund 2	2,421		484													3,631	
17	Temp Sub Soil Bund 2	2,672		534													9,510	
18	Clay Stockpile	7,160		1,432													24,730	
Total		110,883	611	17,185	1,528	26,932	2,257	11,110	35,493	6,775	1,245	14,543	10,763	2,257	6,980	28,974	67,827	
				95,114								35,583			35,954		67,827	

Cut	Top Soil	0.2
	Sub Soil	0.5
FILL	Platform Construction	0.6
	Road Construction	0.85

		Cut	Bulking	Cut (Total)	Fill	Stockpile
Top Soil		17,185	1.05	18,044	6,775	10,410
Sub Soil		26,932	1.10	29,625	1,245	25,687
Superficial / Clay		35,493	1.10	39,042	10,763	24,730
Existing Platform		2,257	1.00	2,257	2,257	-1
Tip	Top Soil	611	1.05	642	14,543	0
	Sub Soil	1,528	1.10	1,680		
	Other	11,110	1.10	12,221		
Total		95,114		103,510	35,583	60,825

Issue	Date	By	Chkd	Appd
2	19/12/16	SM	CW	AH
	Issue			
1	15/12/16	JB	CW	AH
	Issue			
0	08/12/16	JB	CW	AH
	Issue			
B	02/12/16	EC	CW	AH
	Minor Amendments			
A	01/12/16	EC	CW	AH
	Issue			

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Client
Sirius Minerals Plc

Job Title
York Potash

Dove's Nest Farm
Construction Phase 2
Earthworks Strategy

Scale at A1 1:2000

Discipline Highways

Job No 234376

Drawing Status Issue

Drawing No YP-P10-DNF-CX-010

Issue 2

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Do not scale

A1

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Temporary bund with silt fence swales and check dams.

Secondary silt fences to capture overflow from temporary swales.

Swale with check dams around landscaped bund.

Tributary of Sneaton Thorpe Beck where additional temporary silt control measures are able to be installed.

Landscape bund.

Silt fence.

Overflow from swale.

Temporary bund with silt fence swales and check dams.

Temporary outfall to tributary of Sneaton Thorpe Beck.

Perimeter ditch around platforms.

Surface water attenuation pond. Refer to drawing YP-P10-DNF-CD-020.

For continuation see inset plan

Oil separators.

Silt removal facility. Refer to drawing YP-P10-DNF-CD-025.

Phase 2 platforms.

Temporary ditch with check dams.

Oil separators.

Tributary of Sneaton Thorpe Beck where additional temporary silt control measures are able to be installed.

Temporary outfall to existing ditch to maintain existing drainage paths.

Ditch to intercept run-off and direct it to watercourse.

Temporary outfall to existing ditch to maintain existing drainage paths.

Ditch with check dams to drain access road.

Access road.

Ditch to intercept run-off and direct it to watercourse.

Existing stream to be culverted under access road to maintain existing drainage paths.

Tributary of Sneaton Thorpe Beck where additional temporary silt control measures are able to be installed.

Ditch to intercept run-off and direct it to watercourse.

Existing stream to be culverted under access road, to maintain exisiting drainage paths.

Sneaton Thorpe Wood

Sneaton Thorpe Beck

Drain

Issues

Inset Plan

Notes:

1. The surface water drainage has been coordinated with Earthworks contours dated November 2016.
2. This drawing shows the proposed surface water drainage network for Site Preparation Phase 2.
3. For surface water drainage features refer to drawings YP-P10-DNF-CD-020 to 025.
4. The perimeter ditches around the platforms are to be lined with an impermeable liner.

Key:

- Land Ownership Boundary
- Proposed General Arrangement layout
- Surface water drainage attenuation pond
- Existing watercourses / ditch
- Manhole and carrier pipe
- Swale
- Check dam
- Silt fence
- Ditch
- Inlet/ outlet headwall

Issue	Date	By	Chkd	Appd
1	19/12/16	SM	NF	AH
	Issue			
0	15/12/16	JB	NF	AH
	Issue			
C	07/12/16	JB	NF	AH
	Discharge Planning			
B	02/12/16	EC	NF	AH
	Discharge Planning			
A	01/12/16	SM	NF	AH
	Discharge Planning			

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Client
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Job Title
York Potash

Surface Water Drainage
General Arrangement

Scale at A1
1:2000

Discipline
Drainage

Job No
234376

Drawing Status
Issue

Drawing No
YP-P10-DNF-CD-001

Issue
1

Do not scale

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A1

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Safety bunds to be constructed.

Environmental screening bund, to be constructed with topsoil, subsoil and superficial soils from existing temporary mounds.

Security cabin to be provided.

For section details refer to drawing YP-P10-DNF-CX-005.

Proposed acoustic fence / environmental barrier.

Land ownership boundary

Attenuation pond with volume of 5,000m³.

Slit separation facility is to be provided to treat the surface water runoff before outfalling into the attenuation pond.

Proposed location for site preparation contractors temporary site compound located within and around the existing farm buildings.

Security cabin to be provided at the site access.

HV

AH

B 1416

Honeysuckle Farm

Cattle Grid

Belt Plantations

Doves' Nest Farm

Haxby Plantation

Stratton Thorpe Beck

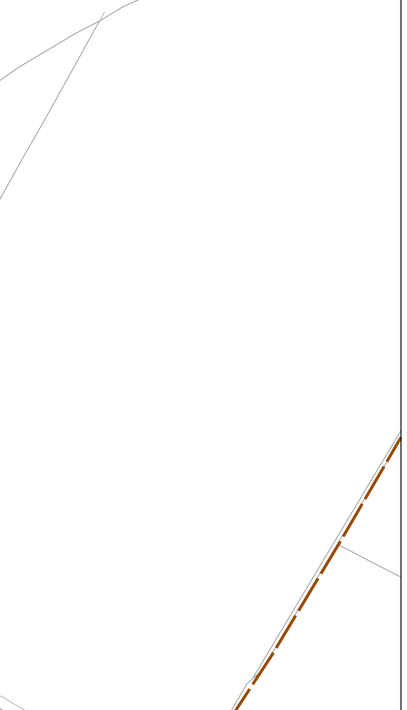
Key:

- Land ownership boundary
- Construction Phase Security Fence
- Temporary Heras Fence
- Topographical survey
- Proposed layout
- 3m high Environmental / acoustic barrier
- Safety Bund
- Proposed drainage ditch

Key to utilities:

- HV — Existing Northern Powergrid electrical apparatus

Wind Rose:



Issue	Date	By	Chkd	Appd
2	19/12/16	SM	CW	AH
	Issue			
1	15/12/16	JB	CW	AH
	Issue			
0	08/12/16	JB	CW	AH
	Issue			
C	02/12/16	JB	CW	AH
	Draft			
B	25/11/16	JB	CW	AG
	Draft			
A	11/11/16	JB	CW	AH
	Draft			

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Client
Sirius Minerals Plc

Job Title
York Potash

Dove's Nest Farm
Construction Phase 2
Masterplan

Scale at A1 1:2000

Discipline Highways

Job No **234376**

Drawing Status **Issue**

Drawing No **YP-P10-DNF-CX-004**

Issue **2**

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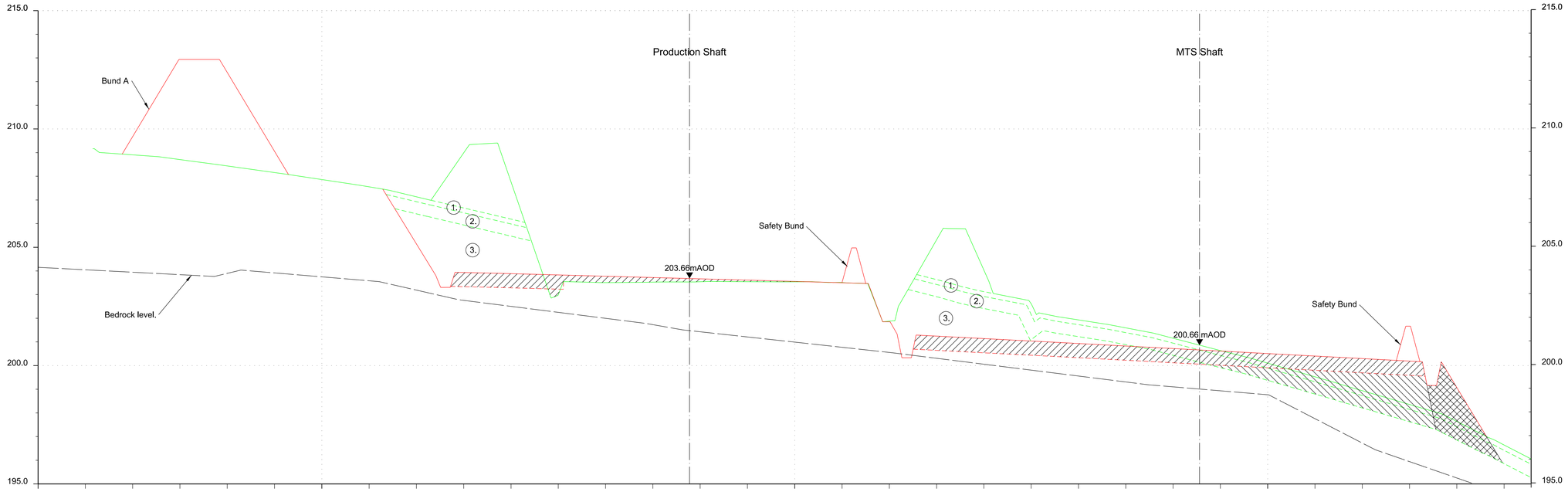
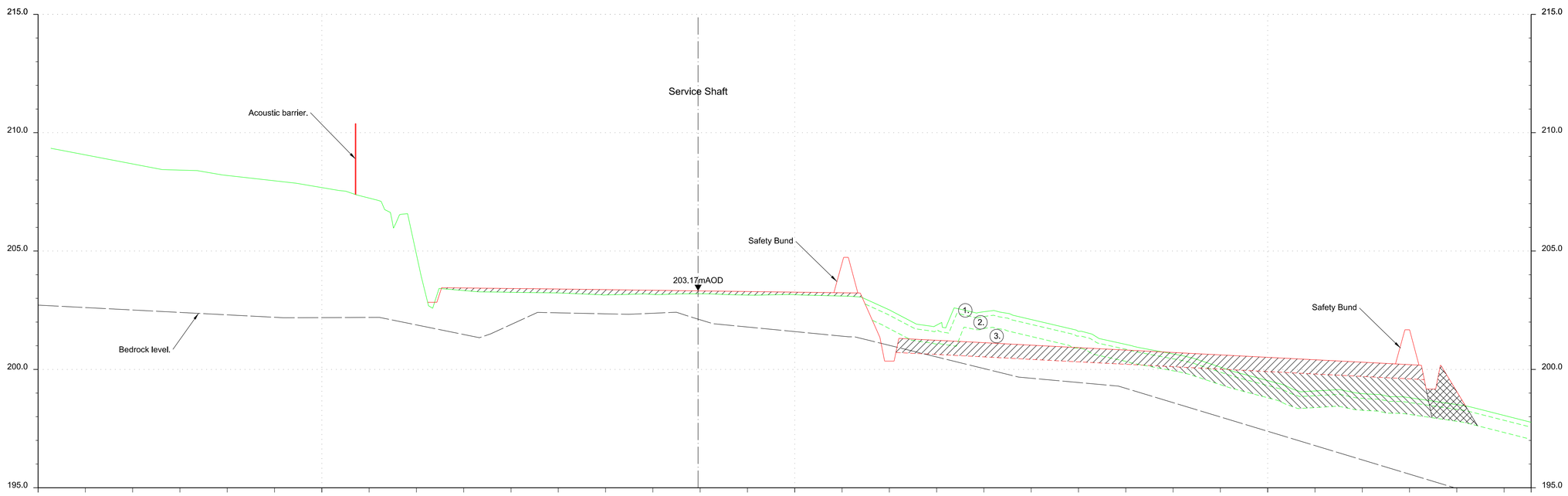


Section A-A

Scale H 1:500 V 1:100



Section B-B

Scale H 1:500 V 1:100

Notes:

1. All levels are in meters unless stated otherwise.
2. For section location refer to drawing YP-P10-DNF-CX-004.

Key:

- Existing platform/ ground profile
- Proposed platform profile
- Approximate level of rockhead
- Assumed base of new platform construction

Key to assumed platform pavement construction depths and details:

1. Top Soil Cut
2. Sub-Soils Cut
3. Superficial Soils Cut
- Platform Construction (Import)
- Class 1A Fill (Import)
- Superficial Soils / Clay

Issue	Date	By	Chkd	Appd
0	08/12/16	JB	CW	AH
	Issue			
B	02/12/16	EC	CW	AH
	Sections Updated			
A	11/11/16	JB	CW	AH
	Draft			

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Client
Sirius Minerals Plc

Job Title
York Potash
Site Preparation
Redesign

Dove's Nest Farm
Construction Phase 2
Sections

Scale at A1 1:500

Discipline Highways

Job No **234376**

Drawing Status **Issue**

Drawing No **YP-P10-DNF-CX-005**

Issue **0**

A1

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Notes:

1. Drawing shows vegetation clearance requirements for the Phase 2 works only. Additional vegetation clearance is required for the Phase 1 Highway Works which is not shown on this drawing.

Key:

Tree and Hedgerow Clearance

Scrub Clearance

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Issue	Date	By	Chkd	Appd
1	19/12/16	SM	CW	AH
	Issue			
0	08/12/16	JB	CW	AH
	Issue			
B	02/12/16	SM	CW	AH
	Clearance Extents Amended			
A	30/11/16	JB	CW	AH
	Draft			

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Client
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Job Title
York Potash

Dove's Nest Farm
Construction Phase 2
Vegetation Clearance

Scale at A1 1:2000

Discipline Highways

Job No	Drawing Status
234376	Issue

Drawing No	Issue
YP-P10-DNF-CX-009	1

Do not scale