RETFORD CIRCULAR ECONOMY PROJECT

TECHNICAL APPENDIX 9.3 DRAINAGE MANAGEMENT PLAN

FEBRUARY 2023

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1 INTRODUCTION

1.1 Background

This Drainage Management Plan (DMP) has been produced in support of a planning application for the Retford Circular Economy Project, comprising the extraction of PFA contained in former disposal lagoons, progressive restoration, processing and export.

The Drainage Plan has been prepared by Arcus Consultancy Services Ltd ('Arcus'), on behalf of Lound Hive Limited (the Applicant), part of Hive Aggregates and the Hive Energy Group.

The proposed Site Layout Plan, including the boundary of the 'Site' and the outline dewatering and drainage management strategy detailed in this report, is presented in Figure 1, Appendix A.

1.2 Site Context

The Site boundary is located approximately 400m south of Lound, 380m south-east of Sutton-Cum-Lound and 670 north west of Retford.

The main section of the Site is comprised of former PFA disposal lagoons (Area A) that have been re-instated for agricultural use (low quality grazing land). The area to the south of the former lagoons includes the Bellmoor Industrial Estate where the proposed 'Main Processing Site' (Area C) would be located.

Area A is raised with vegetated bunds or embankments around its perimeter and largely comprises grassland for grazing, of relatively poor quality. The area has historically been subject to a significant amount of sand and gravel extraction and is therefore not alien to extractive industries, with the proposed Main Processing Site having been used until recently for the processing and export of won resources and remaining in industrial use to this day.

The area is split between 'Low-Rise' to the east (7.5 – 11 m AOD) and 'High-Rise' to the centre and west (17 – 19 m AOD). The Site is also well screened owing to a combination of topography and existing vegetation, including tree planting and hedgerows along its perimeter and woodland blocks and hedgerows in the surrounding area.

1.3 The Proposed Development Infrastructure

As presented in Figure 1, Appendix A, the Proposed Development includes:

- Main Processing Site;
- Processing Areas 1-3;
- Haul Road;
- Excavation Areas;
- Settlement Ponds; and
- Soakaway Ponds.

2 PROPOSED GROUNDWATER DRAINAGE DESIGN

Operations at the Site are likely to generate significant quantities of water through active dewatering of groundwater in addition to surface water flows, through runoff and direct rainfall.

Initially inflow volumes would be relatively low due to the low permeability of the PFA, however once the excavation reaches the base of the PFA / top of the underlying sandstones the volumes would potentially be significantly higher due to groundwater upwelling from the quarry floor. Dewatering, where necessary, would be achieved by excavating base ditches at the bottom of the wet extraction face, to collect groundwater. This would then travel into a sump or similar, where the top water would be removed

allowing the remaining silt laden water to settle within the main dig. A schematic cross section of the excavation is presented in Figure 2, Appendix A.

In accordance with the drainage disposal hierarchy outlined in the CIRIA SuDS Manual[1] it is proposed that the discharge of dewatering from active areas of the Site would be via pumping to settlement and soakaway ponds, to be constructed in LR P1 and LR P 2 along the southern boundary of the Site by excavating through the PFA and into the underlying sandstone. Initial settlement ponds and ditches would be maintained within the dig, with gravity flow from the open face. Flow controls would be implemented to improve silt retention within the dig (check dams etc).

A preliminary assessment of the viability of this disposal option has been carried out using infiltration rates derived from slug tests carried out in three PFA wells and two groundwater boreholes within the sandstone. The testing data and main parameters derived from the data that have been used to assess potential infiltration rates and dewatering impacts are provided in Tables 1 and 2 below.

Table 1: Summary of Slug Test Results

Test No	**Hydraulic Conductivity m/day**				
	PFA21/03	**PFA21/11**	**PFA21/23**	**GW1**	**GW2**
Test 1 (falling)	1.25E-3	7.88E-3	2.55E-3	3.77	2.47
Test 1 (rising)	3.08E-3	4.10E-3	4.84E-3	6.43	3.49
Test 2 (falling)				2.88	2.75
Test 2 (rising)				6.75	3.94
Test 3 (falling)				2.15	3.04
Test 3 (rising)				6.86	3.13
Min				**2.15**	**2.47**
Mean				**4.8**	**3.13**
Max				**6.86**	**3.94**

Table 2: Hydraulic Parameters Used in Recharge and Dewatering Calculations

Parameter		**Value Used**		**Source**
Sandstone hydraulic conductivity (m/day)		2.47 – 3.94		Based on slug test data for GW2 located in the vicinity of the soakaway
PFA Hydraulic Conductivity (m/day)		0.005		Based on slug test results in PFA
Radius of Influence (m)	Drawdown (m)	PFA	Sandstone	Calculated based on Sichardt using K values in Table 1.
	1	0.72	17.75	
	2	1.44	35.5	
	3	2.17	53.24	
	4	2.89	70.99	
	5	3.61	88.74	

[1] The SuDS Manual (C753), CIRIA, December 2015

Parameter		Value Used		Source
	6	4.33	106.49	

A likely infiltration rate into the sandstone of 135m^3/day has been calculated using the Thiem Equation for steady state confined conditions[2].

To help with water management it is proposed that the primary soakaway would comprise of at least 3 separate ponds (to allow for sediment settlement and removal from one whilst maintaining discharge from others). 5 soakaways are shown on Figure 1, Appendix A. The primary settling ponds would be positioned adjacent to the soakaway ponds with overflow to the soakaway ponds by gravity.

Preliminary sizing of the soakaways has considered the potential rainfall-runoff volumes from the active area including direct rainfall to the bench below groundwater level and potentially runoff from higher benches. Where necessary bunds would be constructed around the perimeter of the active area in order to segregate overland flows (clean water) from surrounding grassland areas from the water in the active excavation. Currently surface water infiltrates and runs off, and the surface water scheme would seek to maintain this passive drainage approach where practicable.

Additional slug testing will be carried out in the sandstone boreholes on Site to validate the hydraulic conductivity values assumed in the assessment of infiltration rates from the proposed groundwater soakaway. Consideration will also be given to the potential volumes of leachate and runoff from areas of hardstanding at the Processing Areas (1-3) where material is stockpiled temporarily prior to screening and onward transport to the Main Processing Site. It is envisaged that this water would be intercepted by a system of sealed cut-off drains and collected in a sump where the top water would be pumped to the primary settlement lagoons. During HR Phase 1, it is envisaged that an initial settlement pond and soakaway may be established within the main dig area prior to construction of the primary settlement and soakaway ponds to allow discharge of settled leachate to groundwater by infiltration. However, the more likely scenario is that the Applicant would avoid any groundwater abstraction until the main settlement and soakaway ponds are constructed.

3 PROPOSED SURFACE WATER DRAINAGE DESIGN

3.1.1 Main Processing Site

The outline dewatering and drainage management strategy for the Main Processing Site is presented in Figure 2.

The Main Processing Site would be constructed on the same footprint as the existing Bellmoor Industrial Estate and, subject to a detailed condition survey, would utilise the same drainage system that outfalls to an unnamed watercourse, which is a tributary of the River Idle.

A review of Severn Trent asset drawings for the road system in the immediate vicinity of the Site did not identify any existing surface water or foul sewers and it is therefore proposed to improve the existing outfalls and use these to discharge clean "non-contact" water to the tributary of the River Idle. All water that has come into contact with PFA (for example, leachate draining from material stockpile areas or any water from drying) would be intercepted by a cut-off drainage system and directed to a settlement pond and then discharge point at the Main Processing Site and/or to the settlement and soakaway ponds within the extraction area (Area A).

[2] Assessing the impacts of dewatering on water resources, Environment Agency, Science Project Sc040020, Tier 1 analytical tools, Version 1.6.

If required, additional below ground storage and interceptors would be retrofitted into the existing drainage system local to ancillary buildings, processing plant and car parking areas to ensure that there is no adverse impact on the quality and quantity of drainage entering the receiving watercourse.

3.1.2 Processing Areas

Development of the main settlement ponds and soakaways is anticipated to be completed in year 3 (in LR P1 and LR P2). Prior to this, it is proposed that excavation of the PFA would be above the water table and surface water runoff would be pumped to the Main Processing Area to be discharged through the drainage system here. The more detailed assessment of the condition and capacity of the existing system, to be undertaken as part of the design for the main dig dewatering system, would confirm whether this is practicable. If not, alternative arrangements, such as the construction of a temporary settlement lagoon within the main dig (Area A), would be made in order to discharge the water.

On completion of the main settlement ponds and soakaways, and for the entire operation of Processing Areas 2 and 3, direct rainfall and runoff from temporary stockpiles would be intercepted by the leachate management system described in the groundwater drainage system described in Section 2.

It is anticipated that the runoff volumes generated from these areas would be insignificant in comparison to dewatering volumes and can be pumped directly to the settlement and soakaway ponds. A more detailed assessment of the runoff volume in a 1 in 100 year storm plus allowance for climate change would be undertaken as the design of the dewatering system is refined to confirm this, and if necessary additional attenuation would be provided within a stormwater system.

3.1.3 Extraction Areas (within Area A)

Direct rainfall and run-off from active areas would be managed through the dewatering system described in the groundwater drainage system described in Section 2.

3.1.4 Haul Road

It is anticipated that the haul roads would be constructed using a mixture of compacted material including sandstone won from excavation within the working area and imported clean material that is deemed suitable for road construction. This material would be placed in layers and compacted. The surface of the haul road would be unsealed and therefore is considered to be semi-permeable. It is therefore likely that there would be a proportion of surface runoff in an extreme storm event that would exceed the greenfield runoff rate. This excess volume would be stored in an unlined ditch system running parallel to the haul road. Runoff from the road surface in an extreme storm event would flow over the edge of the road and into the ditch system. If upon further, more detailed analysis of the haul road drainage there is deemed to be a requirement to control potential sediment runoff, then there is scope to incorporate semi-permeable check dams to encourage ponding and settlement within the ditch system.

A number of mitigation measures would be put in place to avoid cross contamination of surface runoff by traffic using the haul road:

- Wheel wash on the Main Processing Site and mobile jetwash. This would ensure debris from the Main Processing Site is not deposited on the haulage road by traffic; and
- Dust management to ensure that PFA dust is not be blown onto the haulage road.

3.1.5 Restoration Strategy

It is proposed to provide a new and permanent network of unlined field ditches as the Site is progressively restored. The ditch network will have a gentle flow from north to south across the Site, and to the northeast, where water will join the wider hydrological network. Ditches are a Nottinghamshire Priority Habitat. Within the restoration strategy they will aid drainage of the restored landform and act as field boundaries in wet grassland. Additionally they will provide a mechanism for water level management, such as seasonal flooding of wet grassland. These ditches are shown on the Restoration Landscape Masterplan (Figure 7.12), Volume 2.

4 CONCLUSION

This DMP provides the proposed overview of surface water and groundwater management at the Site. Pre-application discussions with the Environment Agency with regards to the abstraction permit that is required for de-watering are ongoing and further dialogue is planned, following which a more detailed drainage plan will be produced, which will include the outcomes of further site-specific slug testing/infiltration testing. It is notable that the Applicant is also applying for discharge consent (as necessary) and an environmental permit from the Environment Agency.

The further detail referred to in this DMP would be secured by planning conditions and/or the aforementioned permits/consents to be issued by the Environment Agency.

APPENDIX A – FIGURES

N

385500mN

385000mN

384000mN

68500mE

69000mE

69500mE

70000mE

70500mE

SOIL / OVERBURDEN STORE

PROCESSING AREA 2

HR P1

HR P2

HR P3

HR P4

HR P5

HR P6

LR P1

LR P2

LR P3

LR P4

LR P5

HR P1 & Processing Area 1

Optional dewatering of active areas and leachate draining from stockpiled material to initial settling lagoon and soakaway ponds constructed within main dig (Area A).

Main Processing Site (see figure 4092_DR_P_0005)

PFA EXTRACTTED-FILTER AND SETTLEMENT PONDS CONSTRUCTED

0 250 500 750m

SCALE 1:8000

KEY

- SITE BOUNDARY
- PHASE BOUNDARY
- EXISTING GROUND
- PROPOSED EXCAVATION PHASE
- SOIL / OVERBURDEN STORAGE AREA
- FILTER PONDS (INDICATIVE)
- SOAKAWAY (INDICATIVE)
- PROCESSING AREA
- ADVANCE PLANTING
- RETAINED WOODLAND
- FIELD CONVEYOR & HAUL ROAD
- REINSTATED DRAINAGE DITCH & ACCESS ROAD
- BASE DITCH AT BOTTOM OF WET FACE TO COLLECT GW
- SUMP
- PUMPING MAIN ROUTED ALONG HAUL ROAD CORRIDOR
- INITIAL SETTLING AND SOAKAWAY PONDS IN HR P1 DIG AREA
- UNLINED FIELD DITCH COLLECTING OVER THE EDGE RUNOFF FROM HAUL ROAD

Project Title: RETFORD CIRCULAR ECONOMY PROJECT

Client: LOUND HIVE LTD

Drawing Title: OUTLINE DEWATERING AND DRAINAGE MANAGEMENT STRATEGY

Purpose of issue: PRELIMINARY

Designed	Drawn	Checked	Approved
-	SR	RC	TA

Arcus Internal Project No.: 4092

Scale @ A3: 1:8000

Date: 03.02.23

Drawing Number: 4092_DR_P_0004

Rev: -

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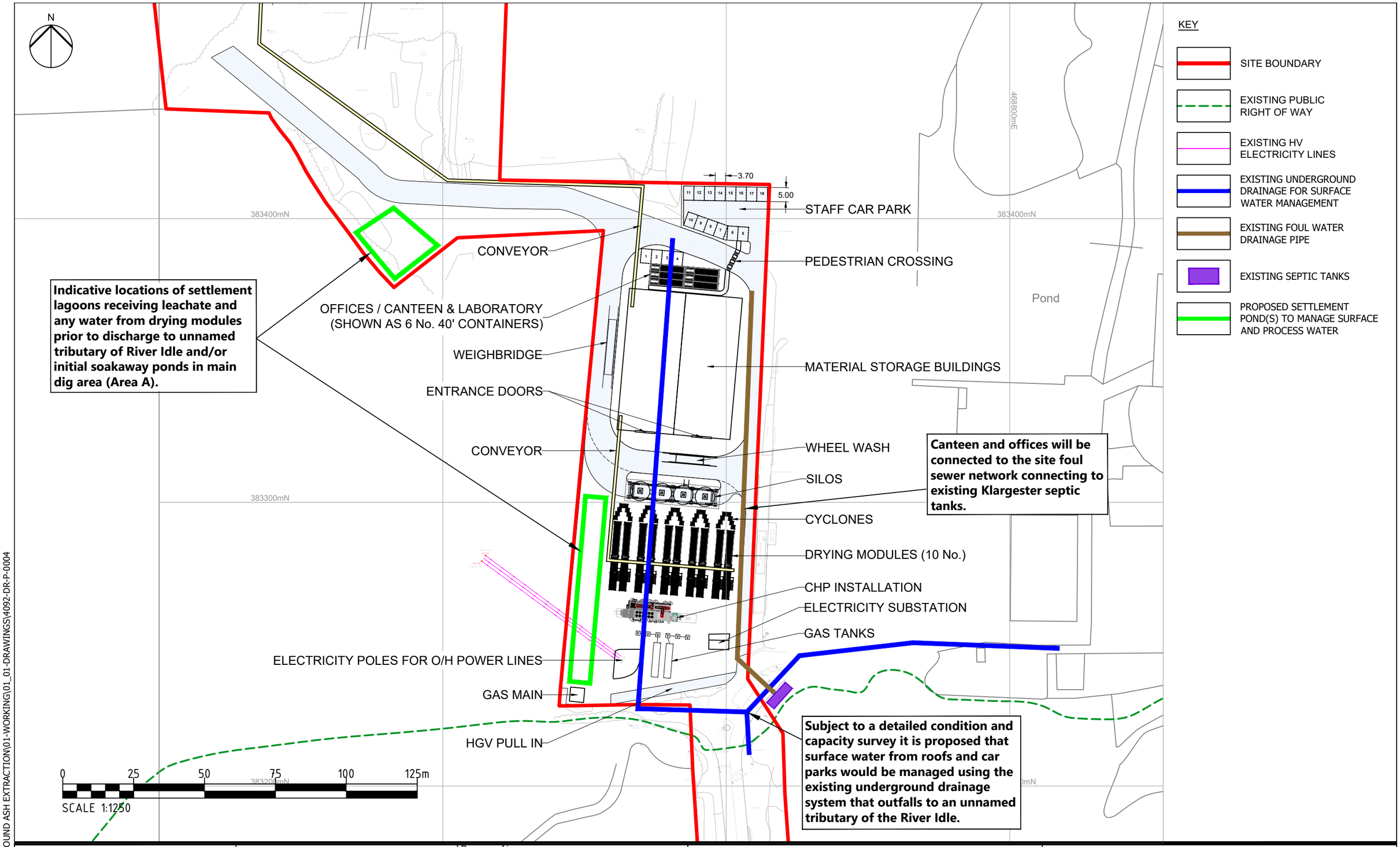

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		Arcus Internal Project No.: 4092	Date: 06.02.23
		Scale @ A3: 1:1250	

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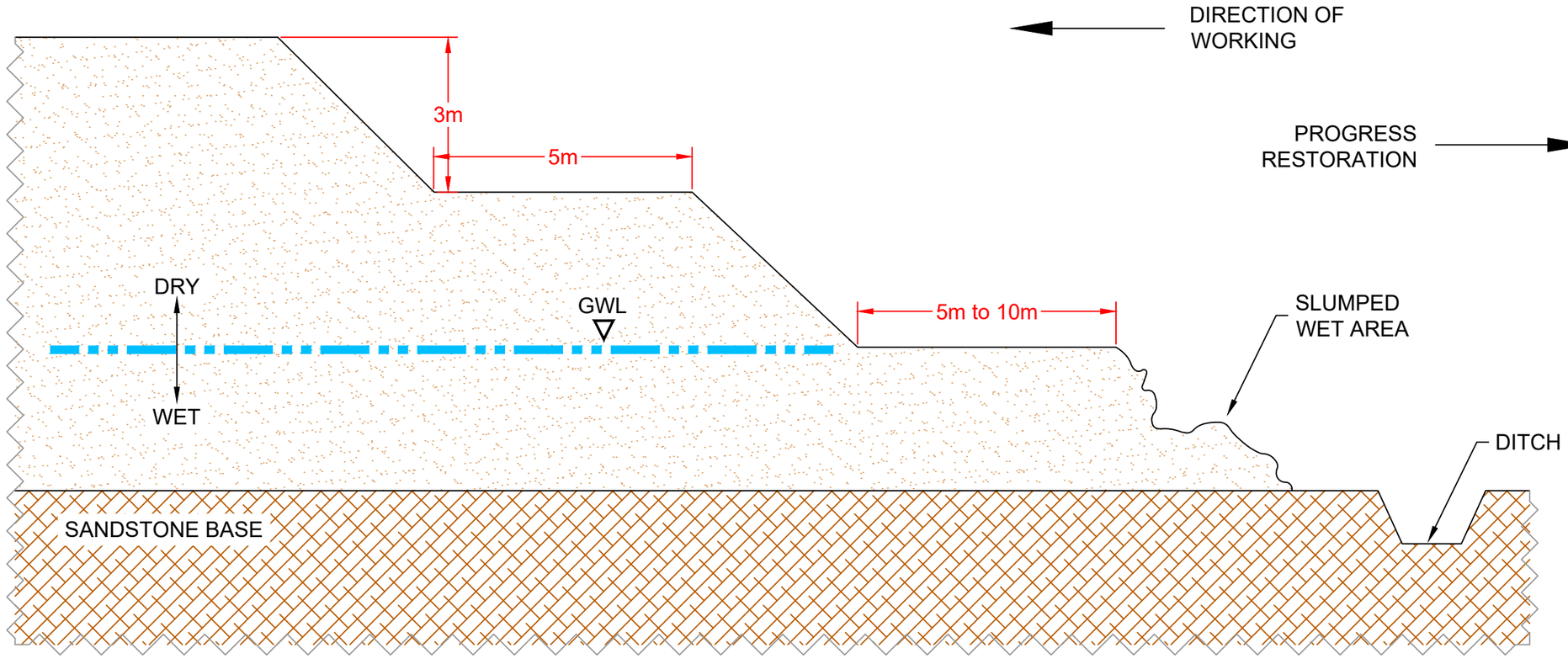
SCHEMATIC CROSS-SECTION

NOT TO SCALE



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		Arcus Internal Project No.: 4092	Date: 03.02.23
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Drawing Number	Rev
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