NPPF: Flood Risk Assessment

Hownsgill Energy Facility

Project Genesis Ltd

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Executive Summary

This report is an FRA in accordance with the NPPF and NPPG ID: 7 guidance, for a proposed Combined Heat and Power Facility development, located on land west of Knitsley Lane, in Hownsgill Industrial Estate Consett, Durham.

The report details the flood risk and how this could be managed and mitigated to allow the Site to be developed in support of the full planning application; and includes an assessment of the surface water drainage requirements of the Site.

The FRA has demonstrated the following:

- The 1.67ha Site land use comprises open land, which falls in a south-east direction.
- The Site is underlain by low permeable (clayey) soils and geology. Made Ground is also likely to be present.
- The risk of flooding was assessed as follows:
  - The risk of surface water flooding is assessed as negligible for the Site but medium for the access/egress.
  - The risk of flooding from all other sources is assessed as negligible.
- The risk of surface water flooding affects the access/egress but would still be accessible by emergency services. Flood risk along the access/egress route could be mitigated to a low and acceptable level through the implementation of a basic Flood Evacuation and Management Plan. Residual flood risk would be mitigated through the following approach:
  - Adoption of a surface water management strategy.
  - Set finished floor levels above external levels.
- The proposed development is classified as essential infrastructure. Such uses are considered acceptable in terms of flood risk when located in Flood Zone 1 (low risk). Subject to the implementation of the mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required.

The FRA also considered the potential impact of the development on surface water runoff rates, due to an increase in impermeable area post-development. These rates were calculated, and it is demonstrated that surface water can be managed such that flood risk to and from the Site following development will not increase. This will be achieved through restricted discharge rates and appropriately sized attenuation (cellular storage) with an outfall to the adjacent private surface water sewer.

Foul flows will discharge to the adjacent private foul sewer.

The FRA demonstrates that the proposed development would be operated with minimal risk from flooding and would not increase flood risk elsewhere. The development should therefore not be precluded on the grounds of flood risk or surface water and foul drainage.

1.0 Introduction

1.1 Background

1.1.1 Enzygo Ltd was commissioned by Project Genesis Ltd to carry out a site-specific flood risk assessment (FRA) including a surface water drainage strategy in support of a full planning application for a proposed Combined Heat and Power Facility ('Energy Facility') on land west of Knitsley Lane, in Hownsgill Industrial Estate Consett, Durham (the 'Site').

1.1.2 The proposal is for an Energy Facility, which will include associated plant and facilities (water tank, gas fired back up boilers, furnace, chimney, bag house, damper, multicyclone, transformer, dry coolers, security hut, weigh bridge), hardstanding areas (including parking and delivery lorry drop off areas), with and access from Knitsley Lane to the east. A copy of the proposed layout is included in Appendix 1.

1.1.3 A site-specific FRA assesses the current and future flood risk to and from a development site. It demonstrates how flood risk will be managed now and over the development's lifetime, taking climate change, drainage, and the vulnerability of its intended users into account.

1.1.4 The objectives of a site-specific FRA are to:

- Assess whether a proposed development is likely to be affected by current or future flooding from a range of sources,
- Assess whether the development will increase flood risk elsewhere,
- Decide on measures to deal with these effects and risks and assess their appropriateness,
- Provide enough evidence for the local planning authority to apply (if necessary) the Sequential Test, and
- Decide whether the development will be safe and will pass the Exception Test if applicable.

1.1.5 In England, planning applications for development need an FRA[1] for most developments including:

- In Flood Zones 2 and 3 including minor development and change of use,
- Sites of 1ha or larger in Flood Zone 1,
- Sites of less than 1ha in Flood Zone 1, including change of use to a more vulnerable class (for example from commercial to residential), and where they could be affected by sources of flooding other than rivers and the sea,
- Land in Flood Zone 1 in a Critical Drainage Area (CDA) as notified by the Environment Agency,
- Land in Flood Zone 1 identified in a strategic flood risk assessment as being at increased flood risk in future.

1.1.6 An FRA is required for this development, as initial site screening using Environment Agency online indicative flood mapping shows that although the Site is in Flood Zone 1 (low risk) and is at low risk of surface water flooding, the Site is greater than 1ha.

[1] https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications 2014 (as updated February 2017)

1.1.7 The purpose of this FRA is to assess the risk of flooding to the proposed development and where possible provide sufficient mitigation to demonstrate that future users of the development would remain safe throughout its lifetime, that the development would not increase flood risk on Site and elsewhere and, where practicable, would reduce flood risk overall.

1.2 Scope

1.2.1 Government policy on development and flood risk is set out in the National Planning Policy Framework (NPPF)[2] and is supported by National Planning Practice Guidance: Flood Risk and Coastal Change [NPPG ID7][3].

1.2.2 NPPF paragraphs 148-169 set out the need for an appropriate assessment of flood risk at all levels of the planning process and require the application of a sequential risk-based approach to assess the suitability of land for development in flood risk areas.

1.2.3 The FRA should also make allowances for climate change[4] to minimise vulnerability and provide resilience to flooding and coastal change in the future. The allowances are predictions of anticipated change in

- Peak river flow by river basin district,
- Peak rainfall intensity,
- Sea level rise; and
- Offshore wind speed and extreme wave height.

1.2.4 They are based on climate change projections and different scenarios of carbon dioxide emissions to the atmosphere. There are different allowances for different periods of time over the next century.

1.2.5 Site-specific FRAs are categorised according to level. Simple Level 1 Screening studies give a general indication of the potential flood risk to a site and identify whether more detailed Level 2 assessment is required or not. A Level 2 assessment is a qualitative appraisal to develop understanding of flood risk to a site and the effects of the site on flooding elsewhere including recommended mitigation measures. Level 3 assessments are more detailed quantitative studies, for example modelling to establish flood levels at a site in the absence of Environment Agency or other data or providing detailed drainage designs.

1.2.6 This report is a Level 2 qualitative FRA and includes a Level 3 detailed surface water and foul drainage assessment for the proposed development.

1.3 Aims

1.3.1 This FRA aims to provide enough flood risk information to satisfy the requirements of the NPPF, PPG ID7 and regional/local government plans and policies. It describes the potential for the Site to be impacted by flooding, the impacts of the proposed development on flooding elsewhere near the Site, and the proposed measures that could be incorporated into the development to mitigate the identified risks.

[2] Department for Communities and Local Government (2018) Revised National Planning Policy Framework (as updated February 2019).
[3] Department for Communities and Local Government (2014) Planning Practice Guidance ID7-030-20140306; Flood Risk & Coastal Change.
[4] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

1.4 Planning Context

National Policy

1.4.1 The FRA was prepared in accordance with the NPPF and NPPG ID7.

Regional/Local Policy

1.4.2 The FRA considered the drainage guidance presented in the following guidance documents:

- Durham County Council Sustainable Drainage Systems (SuDS) Adoption Guide 2016[5].
- Durham County Council Strategic Flood Risk Assessment (SFRA) and associated flood mapping[6].
- Durham County Council Local Flood Risk management Strategy[7].

1.5 Report Structure

- Section 2 summarises the sources of information that were consulted.
- Section 3 describes the existing Site.
- Section 4 outlines the flood risk to the existing site and proposed development.
- Section 5 details the proposed mitigation measures against identified flooding sources.
- Section 6 assesses the potential impacts of the proposed development on surface water drainage and proposes mitigation for those effects; and
- Section 7 presents a summary and conclusion.

[5] https://www.durham.gov.uk/article/7363/Sustainable-drainage-systems
[6] https://www.durham.gov.uk/article/1953/Strategic-Flood-Risk-Assessment
[7] https://www.durham.gov.uk/media/20637/Local-Flood-Risk-Management-Strategy/pdf/LocalFloodRiskManagementStrategy.pdf?m=636735625812300000

2.0 Sources of Information

2.1 Sources of Information

- Ordnance Survey (OS) 1:25,000 online mapping.
- Detailed topographic survey (Appendix 2).
- Environment Agency online mapping (Flood Map for Planning[8], Long Term Flood Risk Assessment for Locations in England[9], Catchment Data Explorer[10] and Main River Map[11]).
- River Basin District (RBD) Maps[12] together with guidance on climate change allowances[13].
- National River Flow Archive[14].
- Catchment Flood Management Plans (CFMP) / Preliminary Flood Risk Assessment (PFRA) / Surface Water Management Plan (SWMP) Thames River Basin Management Plan 2015 (RBMP).
- British Hydrological Society Chronology of British Hydrological Events[15].
- National Soils Resources Institute (NSRI): Soilscapes online mapping[16].
- British Geological Survey [BGS] online mapping: 3D Geology of Britain Viewer[17].
- Landmark's Promap: Flood Data package: Additional flood mapping.
- Geosmart 1 in 100-year groundwater flood risk map.
- Northumbrian Water sewer asset plans (Appendix 3).
- DEFRA's Magic Map[18] for identifying Designated Sites and Groundwater SPZ.

[8] https://flood-map-for-planning.service.gov.uk/
[9] https://flood-warning-information.service.gov.uk/long-term-flood-risk/
[10] http://environment.data.gov.uk/catchment-planning/
[11] https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386
[12] https://www.gov.uk/government/publications/flood-risk-assessments-river-basin-district-maps
[13] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
[14] http://nrfa.ceh.ac.uk
[15] http://www.cbhe.hydrology.org.uk/search.php
[16] http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html
[17] http://mapapps.bgs.ac.uk/geologyofbritain/home.html
[18] http://www.natureonthemap.naturalengland.org.uk/

2.2 Regulators

Environment Agency

2.2.1 The Environment Agency is a statutory consultee on flood risk and planning and is directly responsible for the prevention, mitigation, and remediation of flood damage for main rivers and coastal areas; and it has a strategic overview for all forms of flooding.

2.2.2 Environment Agency Standing Advice[19] and the NPPF/PPG ID: 7 and online flood mapping was consulted and reviewed.

Lead Local Food Authority (LLFA)

2.2.3 Durham County Council is the Lead Local Flood Authority (LLFA), responsible for local flood risk management in its area and for maintaining a register of flood risk assets. It also has lead responsibility for managing the risk of flooding from surface water, groundwater, and ordinary watercourses. Online flood risk and drainage documentation was reviewed.

Water Utility

2.2.4 Northumbrian Water is responsible for sewerage in the region.

2.2.5 All sewerage undertakers maintain the 'DG5 register' of properties and external areas (such as gardens, highways, open spaces) which have suffered flooding from public foul/combined sewers. It does not include flooding caused by blockages.

[19] https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

3.0 Site Location and Description

3.1 Location

3.1.1 The Site is located on land west of Knitsley Lane, in Hownsgill Industrial Estate, Consett, DH8 7EQ.

3.1.2 The Site is centred on National Grid Reference (NGR) 410469, 549814.

3.1.3 The Site location is shown in Drawing 001 and in more detail in Drawing 002, which shows the approximate red line boundary enclosing an area of 1.67ha.

3.2 Current Land Use

3.2.1 The Site comprises open land (Figure 3.1) following its previous use as a quarry and for steel works. The site has remained vacant for 33 years.

3.2.2 Vehicle access is currently from Knitsley Lane, which served the wider industrial estate.

Figure 3.1: Aerial Photograph of the Site

Image © 2020 Digital Globe.

3.3 Topographic Information

3.3.1 A copy of the detailed topographic survey is included as (Appendix 2). The Site is relatively level, falling in a south-east direction from 246.27 metres Above Ordnance Datum (m AOD) in the northern corner, to 244.36m AOD at the Site entrance. The fall of 1.91m over 157m gives a gradient of 1:82.

3.4 Soils Mapping

3.4.1 The Soilscapes online soils map viewer shows that the Site is underlain by slowly permeable, seasonally wet, loamy and clayey soils.

3.5 Geology

3.5.1 The Geology of Britain online map viewer shows the superficial deposits beneath the southern extent is Till, Devensian - Diamicton. There are no superficial deposits beneath the northern extent. The underlying bedrock geology is Pennine Lower Coal Measures Formation - Mudstone, siltstone and sandstone.

3.5.2 The Geology of Britain online map viewer shows there are numerous boreholes records located in the Site boundary and immediate vicinity. The borehole records confirm the mapped geology. Furthermore, that Made Ground is present.

3.6 Hydrogeology

3.6.1 The infiltration potential of the bedrock is likely to be low based on the low-permeability clay-dominant geology.

3.6.2 Defra Magic Map online mapping shows the Site is not located in a groundwater Source Protection Zone (SPZ). These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. Where infiltration-based SuDS are proposed to manage surface water from a development, then direct discharge into groundwater would not be permissible. Therefore, the elevation of the groundwater table with respect to the base of the soakaway is critical, and there must be an unsaturated zone in the aquifer unit.

3.6.3 The Site is located above a Secondary A (bedrock) and Secondary undifferentiated (superficial drift) Aquifer. Indirect inputs of clean surface water to groundwater are permissible, for example where the base of the soakaway is above the water table and there is an unsaturated zone in the aquifer unit.

3.7 Catchment Hydrology

3.7.1 OS mapping (Drawing 002) and the Environment Agency online main river map show there are no watercourses located in the immediate vicinity of the Site.

3.7.2 The Site is in the Smallhope Burn from Source to Browney, Stocke Catchment, which is in the Browney Operational Catchment, the Wear Management Catchment, and Northumbria River Basin District.

3.8 Sewerage Assets

3.8.1 Northumbrian Water asset plans (Appendix 3) show there is a Ø375mm S102 surface water sewer and Ø150mm S102 foul sewer, beneath Knitsley Lane to the east of the Site. Northumbrian Water do not hold information on manhole and invert levels.

3.9 Designated Sites

3.9.1 The DEFRA Magic Map (England and Wales) shows there are no designated sites in or close to the Site including downstream from a flood risk and drainage perspective.

4.0 Flood Risk Assessment

4.1 Potential Sources of Flooding

4.1.1 A summary of the potential sources of flooding and the potential risk posed by each source at the Site is presented in Table 4.1. Each source of flooding and level of risk is then assessed in further detail.

Table 4.1: Potential Risk Posed by Flooding Sources

Flooding Source	Potential Flood Risk at Application Site (Yes/No)	Potential Source	Data Sources
Fluvial	No	None identified	Environment Agency online Flood Map for Planning.
Tidal	No	None identified	Environment Agency online Flood Map for Planning.
Groundwater	Yes	Underlying Aquifer	BGS mapping (Drawing 003) and Geosmart Groundwater (Drawing 005).
Surface Water	Yes	Poor permeability and Site topography	JBA Surface Water Flooding (Drawing 004) and Environment Agency Complex mapping (Drawings 007.1 to 007.4).
Sewer	Yes	Private sewers	Northumbrian Water asset plans.
Infrastructure Failure	No	Reservoir failure	Environment Agency online flood mapping.

4.2 Fluvial Flooding

Environment Agency Flood Zone Mapping

4.2.1 The Environment Agency Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, since these can be breached, overtopped and may not be in existence for the lifetime of a development.

4.2.2 The Environment Agency flood map (Drawing 002) shows the Site is located in Flood Zone 1, which is land outside the 1 in 1000-year (0.1% AEP) and 1 in 1000-year (0.1% AEP) probability of fluvial flooding, at 'low' risk.

Flood Defences

4.2.3 Environment Agency flood mapping shows the Site does not benefit from flood defences.

Flood Warning Service

4.2.4 The Site is not located in an area which receives flood warnings.

Summary Flood Risk

4.2.5 The risk of fluvial flooding is assessed as negligible.

4.3 Tidal Flooding

4.3.1 The Site is not located close to tidally affected flooding sources and so the flood risk from this source is assessed as negligible.

4.4 Groundwater Flooding

4.4.1 Groundwater flooding occurs when subsurface water emerges either at surface or in made ground or in subsurface structures such as basements and services ducts. It occurs as diffuse seepage, emergence from new point source springs or an increase in flow from existing springs. It results from aquifer recharge from infiltrating rainfall, from sinking streams entering aquifers from adjacent non-aquifers, or from high river levels or tides driving water through near surface deposits. It tends to occur with a delay following rainfall and can last for several weeks or months. Groundwater flooding or shallow water tables also prevent or reduce infiltration and so can worsen surface water flooding.

BGS Groundwater Flooding Susceptibility Map

4.4.2 The BGS Groundwater Flooding Susceptibility Map (Drawing 003) shows the western and northern extent of the Site is in the mapped extent where there is limited potential for groundwater flooding to occur, the middle extent has potential for flooding of property situated below ground level, and the easternmost extent has potential for groundwater flooding to occur at the surface.

4.4.3 Groundwater flooding is likely to be associated with the underlying Secondary A (bedrock) and Secondary undifferentiated (superficial drift) Aquifer. The Site is underlain by clayey soils with low infiltration potential; therefore, it is unlikely that groundwater would rise to the surface.

4.4.4 The BGS mapping is coarse and should be superseded by the Geosmart groundwater flood risk map.

Geosmart Groundwater Flood Risk Map

4.4.5 The groundwater flood risk map (Drawing 006) shows the Site is at negligible risk of groundwater flooding and falls within Risk Class 2 - Moderate risk (Table 4.2).

4.4.6 Mapped classes combine understanding of likelihood, model and data uncertainty, and possible severity. Likelihood is ranked according to whether we expect groundwater flooding at a site due to extreme elevated groundwater levels with an annual probability of occurrence greater than 1%, considering model and data uncertainty. Severity relates to expectations of the amount of property damage or other harm that groundwater flooding at that location might cause (Table 4.2).

Table 4.2: Groundwater Flood Risk Classification

Risk Class	Probability of Groundwater Flooding	Effect
4: Negligible	Annual probability less than 1%.	Negligible unless unusually sensitive use.
3: Low	Annual probability greater than 1%.	Remote possibility of damage to property or harm to sensitive receptors. Flooding likely to be limited to seepages and waterlogged ground, damage to basements

Risk Class	Probability of Groundwater Flooding	Effect
		and subsurface infrastructure, and should pose no significant risk to life. Surface water flooding may be worsened.
2: Moderate	Annual probability greater than 1%.	Significant possibility of damage to property or harm to other sensitive receptors at or near this location. Flooding is likely to be in the form of shallow pools or streams. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.
1: High	Annual probability greater than 1%.	Groundwater flooding will occur which could lead to damage to property or harm to other sensitive receptors at or near this location. Flooding may result in damage to property, road, or rail closures and, in exceptional cases, may pose a risk to life. Surface water flooding and failure of drainage systems may be worsened when groundwater levels are high.

Summary Flood Risk

4.4.7 The risk of groundwater flooding is assessed as negligible.

4.5 Surface Water Flooding

4.5.1 Surface water flooding occurs following rainfall on ground where infiltration rates are less than the rainfall precipitation rate. This can occur when either:

- Soils or ground materials are naturally of low permeability or have been compacted (infiltration excess runoff).
- Soils or ground materials are saturated from previous rainfall either directly or from upslope (saturation excess runoff and return flow) or from high groundwater levels.

JBA Surface Water Flood Map

4.5.2 The JBA Surface Water Flood Map (Drawing 004) shows the Site is located outside the mapped extent of surface water flooding. There is however a large area of surface water ponding associated with the 1 in 75-year, 200-year and 1000-year events to the east of the Site, which affects the access/egress along Knitsley Lane to the north-east.

4.5.3 The JBA Surface Water Flood mapping is superseded by the more detailed Environment Agency Complex Surface Water Flood mapping.

Environment Agency Complex Surface Water Flood Mapping

4.5.4 The Environment Agency Complex Surface Water Flood Mapping (Drawings 007.1 to 007.4) shows the Site is located outside the mapped extent of surface water flooding.

4.5.5 There is a surface water flow pathway orientated south-west along Knitsley Lane to the north-east. The flow pathway is associated with the 1 in 30-year, 100-year and 1 in 1000-year events. Flood depths are mostly up to 0.60m during the extreme 1 in 1000-year event. The flood velocity is mostly up to 1.0m/s and the flood hazard is up to 'Significant' (1.25-2.00).

The DEFRA Hazard to People Classification table (Table 2 of the Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose) classifies the hazard rating as 'Danger for most – includes the general public'. The Site would still be accessible by emergency services.

Flood Risk

4.5.6 The risk of surface water flooding is assessed as negligible for the Site but medium for the access/egress.

4.5.7 Mitigation measures against surface water flooding are discussed in Section 5.

4.6 Sewer Flooding

4.6.1 Sewer flooding occurs when urban drainage networks become overwhelmed after heavy or prolonged rainfall due to restrictions or blockage in the sewer network or if the volume of water draining into the system exceeds the sewer design capacity.

4.6.2 New sewers are built to the guidelines within Sewers for Adoption[20] and have a design standard to the 1 in 30-year flood event. Older sewers were not designed to any standard. Modern sewer systems will only surcharge during rainstorm events with a return period greater than 1 in 30-years (e.g. 1 in 100-years).

4.6.3 Northumbrian Water asset plans (Appendix 3) show there is a Ø375mm S102 and Ø150mm S102, beneath Knitsley Lane to the east of the Site.

4.6.4 There are no recorded sewer flooding incidents located within the Site. Any surcharged flow would shed overland as shallow flows, south-east away from the Site.

Flood Risk

4.6.5 The risk of flooding from sewers is assessed as negligible.

4.7 Flooding from Infrastructure Failure

Reservoir

4.7.1 The Environment Agency online flood mapping shows the Site is located outside the extent of flooding sourced from reservoirs. The risk of flooding from reservoirs is assessed as negligible.

[20] WRC (2012) Sewers for Adoption 7th Edition.

5.0 Flood Risk Mitigation Measures

5.1 Introduction

5.1.1 The following sources of flooding were identified:

- Surface water flooding (flow pathway along access/egress).

5.2 Mitigation Measures

Surface Water Flooding

5.2.1 The risk of surface water flooding affects the access/egress along Knitsley Lane to the north-east, as opposed to the Site. The Defra hazard rating classifies the hazard rating as 'Danger for most – includes the general public'. The Site would still be accessible by emergency services.

5.2.2 Flood risk along the access/egress route could be mitigated through the following approach:

- Implementation of a basic Flood Evacuation and Management Plan (FEMP), which could include visual monitoring of any flooding along the access/egress route during storm events and monitoring MET Office weather warnings. When the FEMP is activated, the Site could remain operation, albeit no new persons should be allowed to enter the Site, and no existing persons should be leaving the Site (if not already evacuated).

5.2.3 Residual flood risk would be mitigated through the following approach:

- Adoption of a surface water management strategy (see Section 6) to manage runoff from the Site, thereby not contributing the existing flooding issues.
- Set finished floor levels a minimum of +150mm above external levels.

5.3 Summary of Flood Risk

5.3.1 Table 5.1 summarises the probability and level of risk, both with and without mitigation measures.

Table 5.1: Probability and Consequences of All Sources of Flooding

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation
Fluvial	None identified	Negligible	Negligible	Negligible
Tidal	None identified	Negligible	Negligible	Negligible
Groundwater	Underlying Aquifer	Negligible	Negligible	Negligible
Surface Water	Poor permeability and Site topography	Negligible for the Site but Medium for the flow pathway along the access/egress	Negligible for the Site but Medium for the flow pathway along the access/egress	Low

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation
Sewer	Private sewers	Negligible	Negligible	Negligible
Infrastructure Failure	Reservoir failure	Negligible	Negligible	Negligible

Key: Green - Negligible, Yellow - Low, Orange - Medium and Red - High; based on consequence and impact with mitigation from each flooding source.

5.4 Flood Guidance and Sequential Test

5.4.1 The proposal is for a Combined Heat and Power Facility. Table 2 of PPG ID: 7 (not included in this report) classifies the proposed use as 'essential infrastructure'.

5.4.2 The Environment Agency Flood Zones and acceptable development types are listed in Table 5.2. All development types (including essential infrastructure uses) are acceptable in Flood Zone 1 (low risk). Subject to the above mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required as indicated in Table 5.3.

Table 5.2: Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	All development types generally acceptable.
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year.	Most development type are generally acceptable.
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	Some development types not acceptable.
Zone 3b	'Functional Floodplain'	Land where water must flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).	Some development types not acceptable.

***Note:** The Flood Zones are the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The identified risk of fluvial flooding is highlighted green.*

Table 5.3: Vulnerability and Flood Zone 'Compatibility' as Identified in Table 3 of PPG ID: 7

Flood Risk Vulnerability classification (see Table 1 of PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: *Yes: Development is appropriate, No: Development should not be permitted.*
The identified risk of fluvial flooding is highlighted green.

6.0 Site Drainage

6.1 Surface Water Drainage

6.1.1 Consideration of flood issues is not confined to the floodplain. This is recognised in the NPPF and associated guidance where all proposed development of 1ha or more in flood zone 1 and so outside the floodplain nevertheless requires an FRA. The alteration of natural surface water flow patterns through development can lead to problems elsewhere in a catchment, particularly flooding downstream,; and the replacement of permeable vegetated areas by low-permeability roofs, roads and other paved surfaces will increase the speed, volume and peak flow of surface water runoff. So, the NPPF and associated guidance require an FRA for all proposed development of 1ha or more outside the floodplain in flood zone 1.

6.1.2 A surface water management strategy for the development is proposed to manage and reduce the flood risk posed by surface water runoff from the Site. The developer will be required to ensure that any scheme for surface water management should build in enough capacity for the entire Site.

6.1.3 The surface water drainage arrangements for any development Site should be such that the volume and peak flow rates of surface water leaving a developed Site are no greater than the rates prior to the proposed development, unless specific off-Site arrangements are made and result in the same net effect.

6.1.4 An assessment of the surface water runoff rates was undertaken to determine the surface water options and attenuation requirements for the Site.

6.2 Existing Drainage System

3.9.2 The 1.67ha Site land use comprises open land.

6.2.1 The Site is underlain by low permeable (clayey) soils and geology. It is likely that drainage is predominantly via overland flow, following the topography of the Site (south-east), with a small amount of infiltration to bedrock.

6.3 Developable and Impermeable Areas

6.3.1 The proposal is for a Combined Heat and Power Facility development.

6.3.2 An allowance of 100% impermeable area was applied to the Site. The existing and proposed impermeable areas are shown in Table 6.1.

6.3.3 The proposed development will increase the impermeable surfaces and so increase the amount of runoff.

Table 6.1: Impermeable Area

Area	Existing Buildings and Hardstanding	Proposed Buildings and Hardstanding	Difference
Area (ha)	0.00	1.67	+1.67
Percentage of Total Site Area (%)	0.00	100	+100

6.4 Greenfield Runoff Rates

6.4.1 An assessment of greenfield runoff rates was undertaken to determine the attenuation requirements for the proposed development.

6.4.2 The runoff rates were calculated using Causeway design software, with FEH method inputs (descriptors obtained from the FEH webservice[21]). This is a recommended methodology for Sites up to 50ha in area and the approach is in line with the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS[22], and Environment Agency Report SC030219 – Rainfall runoff management for developments.

6.4.3 The following parameters were used in the runoff calculations:

- Site Area: 1.67ha
- Average Annual Rainfall (SAAR): 766mm/year
- Region No.: 3
- BFIHOST19: 0.333

6.4.4 BFIHOST was updated to BFIHOST19 (November 2019) since a number of issues were identified with BFIHOST, which including a tendency to underestimate BFI in clay-dominated catchments.

6.4.5 BFIHOST19 is the baseflow index developed using the Hydrology of Soil Types (HOST) classification and is the baseflow proportion of the flow on average. It is estimated based on the daily mean flow data. Baseflow comprises water entering the watercourse through shallow subsurface flow and groundwater flow (mechanisms other than direct surface runoff); hence permeable soils and geology tend to yield a higher baseflow.

6.4.6 BFIHOST19 value assigned by the FEH webservice is considered to replicate on-site conditions.

6.4.7 Table 6.2 shows the calculated greenfield runoff rates. Runoff calculations are included in Appendix 4.

Table 6.2: Greenfield Runoff Rates

Annual Probability (Return Period, years)	Greenfield Runoff (l/s)
QBAR	7.7
100% (1)	6.6
3.33% (30)	13.5
1% (100)	16.1
1% Plus Climate Change	22.5

Note: *40% added to the data to account for long-term climate change as stated in 'Flood Risk Assessment: Climate Change Allowance'. The 1 in 1-year, 30-year and 100-year annual probability events are of importance to the Water Companies and the Environment Agency when looking at sewage discharge and flood risk.*

[21] Centre for Ecology and Hydrology, Flood Estimation Handbook Web Service [https://fehweb.ceh.ac.uk/].
[22] Office of the Deputy Prime Minister, National SuDS Working Group (July 2004) Interim Code of Practice for Sustainable Drainage Systems [https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf].

6.5 Sustainable Drainage Options (SuDS)

Feasibility of SuDS

6.5.1 Online mapping and borehole records indicate the Site is underlain by low preamble (clayey) soils and geology. Furthermore, Made Ground is also present. The use of infiltration-based SuDS is not considered feasible.

Choice of SuDS Options

6.5.2 Sustainable water management measures should be used to control the surface water runoff from the proposed development Site, thereby managing the flood risk to the Site and surrounding areas from surface water runoff. These measures will also improve the quality of water discharged from the Site.

6.5.3 Current guidance promotes sustainable water management using SuDS. Options applicable to this Site are identified in Table 6.3.

Table 6.3: SuDS Options

Green roofs	Infiltration basins
Water butts	Detention basins
Permeable paving	Oversized pipes
Rainwater harvesting	Brown roofs
Filter strips	Swales
Wetland Areas	Cellular Storage

Note: *SuDS appropriate to the development are highlighted green.*

6.5.4 A hierarchy of SuDS techniques is identified[23]:

1. **Prevention** – the use of good Site design and housekeeping measures on individual Sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).
3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole Site).
4. **Regional Control** – management of runoff from several Sites, typically in a detention pond or wetland.

6.5.5 Using SuDS as opposed to conventional drainage systems provides several benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;

[23] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed Sites;
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- Reducing potable water demand through rainwater harvesting;
- Improving amenity through the provision of public open spaces and wildlife habitat; and
- Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

SuDS Maintenance

6.5.6 A copy of the maintenance and management plan (Reference. CRM.0138.001.HY.R.002.A) is included in Appendix 5.

6.6 Surface Water Management Strategy

Hierarchy of Discharge

6.6.1 In accordance with requirement H3 of the Building Regulations 2000[24] rainwater runoff must discharge to one of the following, listed in order of priority:

1. **An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable:** The use of infiltration-based SuDS is not feasible due to low infiltration potential and presence of Made Ground.
2. **A watercourse; or where that is not reasonably practicable:** There are no watercourses located in the immediate vicinity of the Site.
3. **A sewer:** There is a private surface water and foul sewer located beneath Knitsley Lane to the east of the Site.

6.6.2 The potential route to discharge from the existing Site will be by outfall to the adjacent private surface water sewer.

Drainage Design

6.6.3 Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

6.6.4 Landscaped areas should be incorporated into the layout where possible, and the associated gardens of each unit will allow a proportion of the rainfall to infiltrate into the soil substrate.

6.6.5 A drainage layout is included in Drawing 101.

Attenuation Requirements

6.6.6 Attenuation storage is required to reduce the post-application surface water runoff from the Site to calculated greenfield runoff rates, up to and including the 1 in 100-year (+40%CC) rainfall event, assuming no infiltration losses.

[24] Office of the Deputy Prime Minister, The Building Regulations 2000.

6.6.7 The following input parameters were assumed in the calculations:

- Site Area: 1.67ha;
- Cv (proportion of rainfall forming surface water runoff): 75% summer, 84% winter;
- Infiltration losses: 0.00m/hour;
- With outfall: 7.7l/s (QBAR).

6.6.8 The attenuation volume for the 1 in 100-year event (plus climate change) is 912m^3.

6.6.9 Attenuation calculations are included in Appendix 4.

6.7 Exceedance Routes

6.7.1 The onsite attenuation will be designed with a capacity up to a 1 in 100-year (plus 40% climate change) event, based on the QBAR discharge rate (subject to agreement with the asset owner). This provides a betterment (reduction) in runoff when compared to existing undeveloped conditions, where runoff is uncontrolled across all return periods.

6.7.2 A storm event in excess of this design standard would be extreme and would cause the cellular storage to overtop (with no sudden deluge) and would then shed overland following the topography (south-east) away from the Site, as per existing conditions (Drawing 101).

6.7.3 Finished floor levels will be set above external levels, which will mitigate the residual risk of overtopping.

6.8 Foul Drainage

6.8.1 The Site is not currently served by a foul drainage network.

6.8.2 It is proposed that foul flow is discharged to the public foul sewer beneath Knitsley Lane. The topography of the site would allow for a gravity fed connection (subject to confirmation of sewer invert levels and agreement with the asset owner). A drainage layout is included in Drawing 101.

7.0 Summary and Conclusion

7.1 Introduction

7.1.1 A site-specific Flood Risk Assessment (FRA) has been undertaken for a proposed Combined Heat and Power Facility development, located on a 1.67ha Site on land west of Knitsley Lane, in Hownsgill Industrial Estate Consett, Durham.

7.2 Flood Risk

7.2.1 The risk of surface water flooding is assessed as negligible for the Site but medium for the access/egress.

7.2.2 The risk of flooding from all other sources is assessed as negligible.

7.3 Mitigation Measures

7.3.1 The risk of surface water flooding affects the access/egress but would still be accessible by emergency services. Flood risk along the access/egress route could be mitigated to a low and acceptable level through the implementation of a basic Flood Evacuation and Management Plan.

7.3.2 Residual flood risk would be mitigated through the following approach:

- Adoption of a surface water management strategy.
- Set finished floor levels above external levels.

7.4 Flood Guidance

7.4.1 The proposed use is classified as essential infrastructure. Essential infrastructure uses are considered acceptable in terms of flood risk in Flood Zone 2. Subject to the implementation of the above mitigation measures, the Sequential Test would be passed, and the Exception Test would not be required.

7.5 Site Drainage

Surface Water

7.5.1 The proposed development will increase the area of impermeable surfaces and therefore increase the amount of runoff without mitigation.

7.5.2 Surface water runoff from the Site will be restricted rate, which offers a betterment to existing conditions with uncontrolled runoff across all return periods.

7.5.3 Surface water runoff from the proposed development would be attenuated on-site up to and including the 1 in 100-year event, plus 40% climate change.

7.5.4 A SuDS drainage scheme is proposed to manage excess runoff from the development using cellular storage, with a connection to the adjacent private surface water sewer.

Foul Water

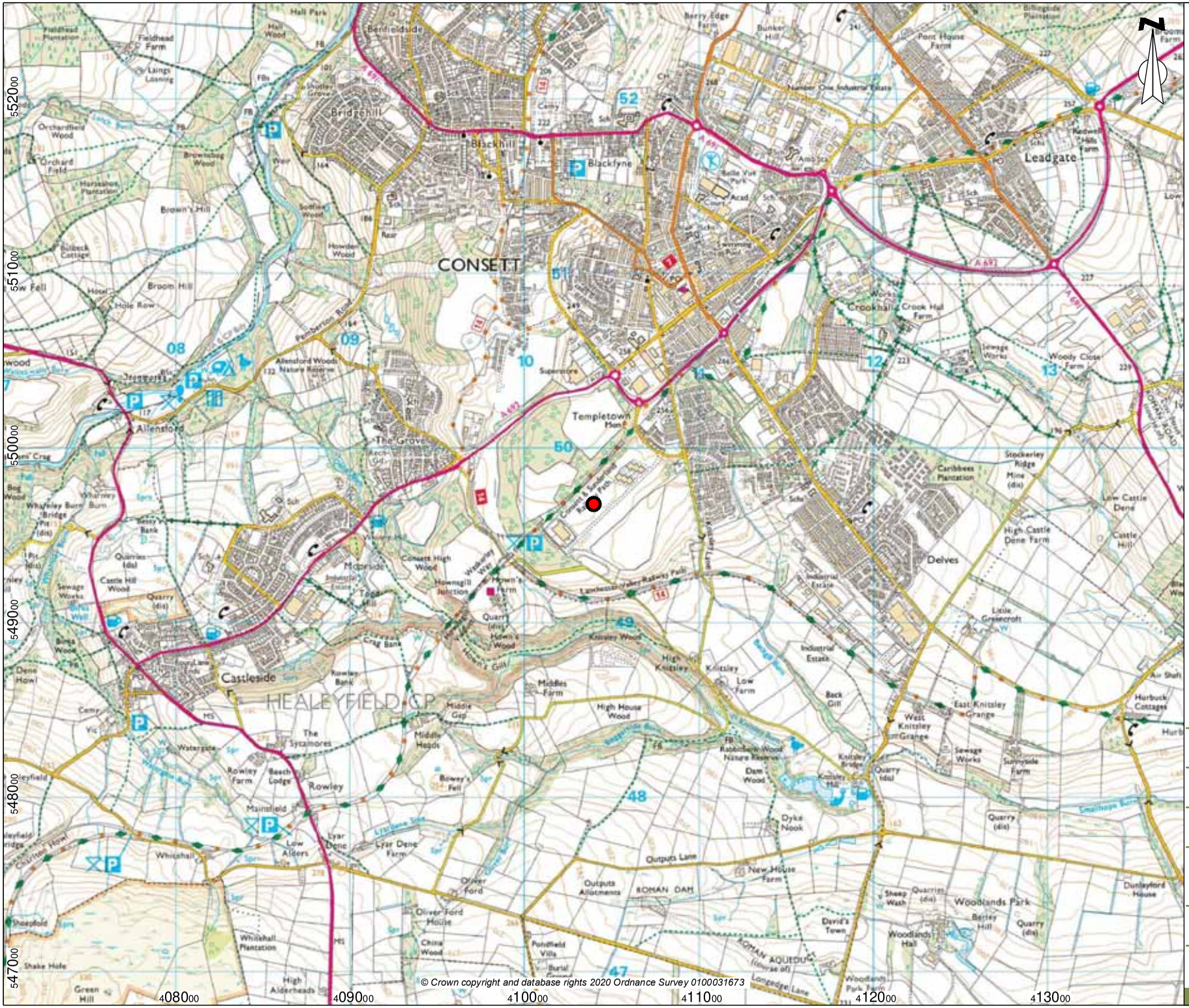
7.5.5 It is proposed that foul flows will discharge to the adjacent private foul sewer.

7.6 Conclusion

7.6.1 This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of national and local policy and guidance.

7.6.2 The development should therefore not be precluded on the grounds of flood risk or surface water and foul drainage.

DRAWINGS



enzygo
environmental consultants
Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT:
Project Genesis Ltd

SCALE: 1:20,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

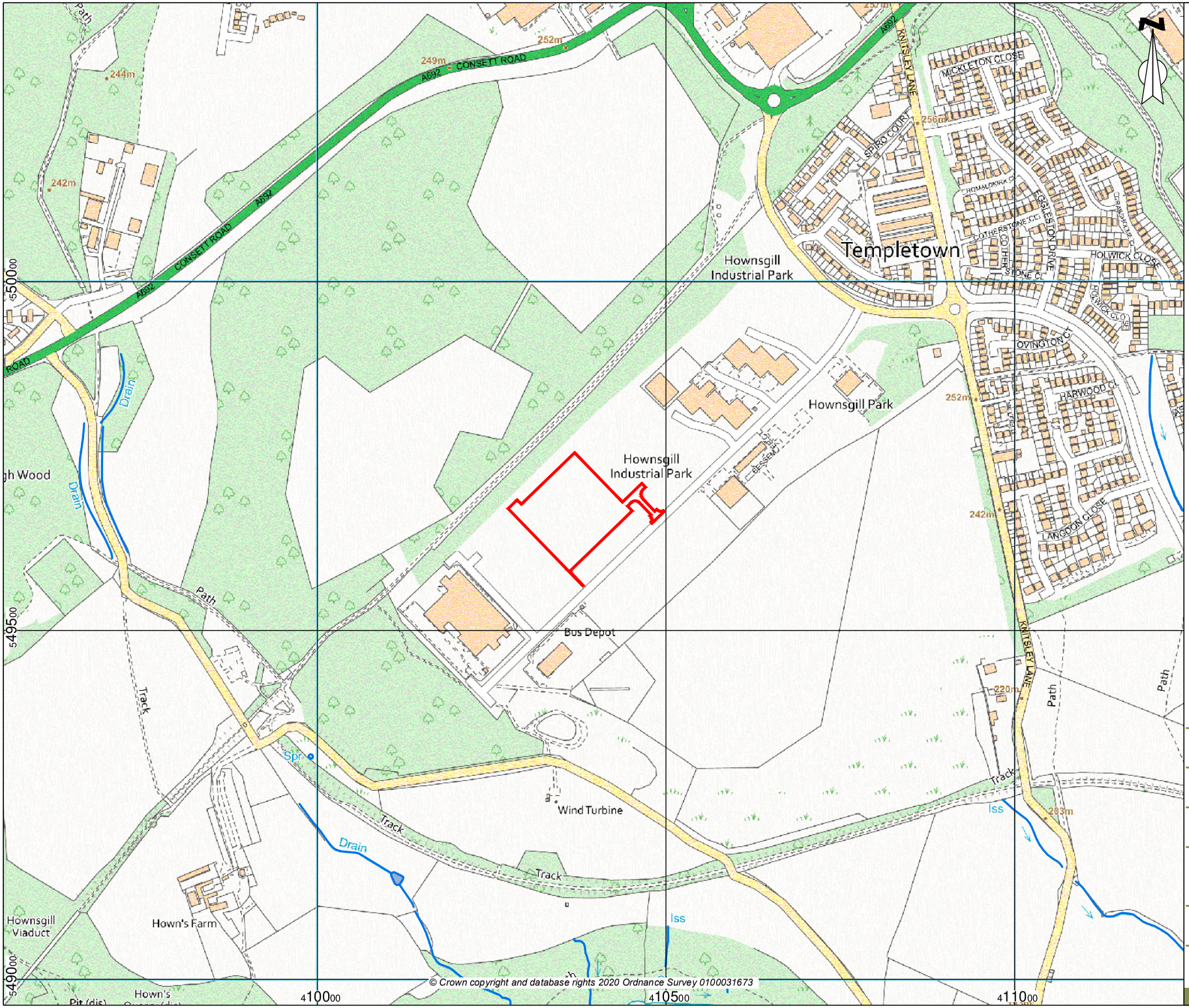
CHECKED: DA

DATE: Oct 2020

PROJECT:
Knitsley Lane,
Hownsgill Industrial Estate

TITLE:
Site Location Plan

DRAWING NO:
CRM.0138.001.HY.D.001



Key

- Site Boundary
- Surface Water Features

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Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

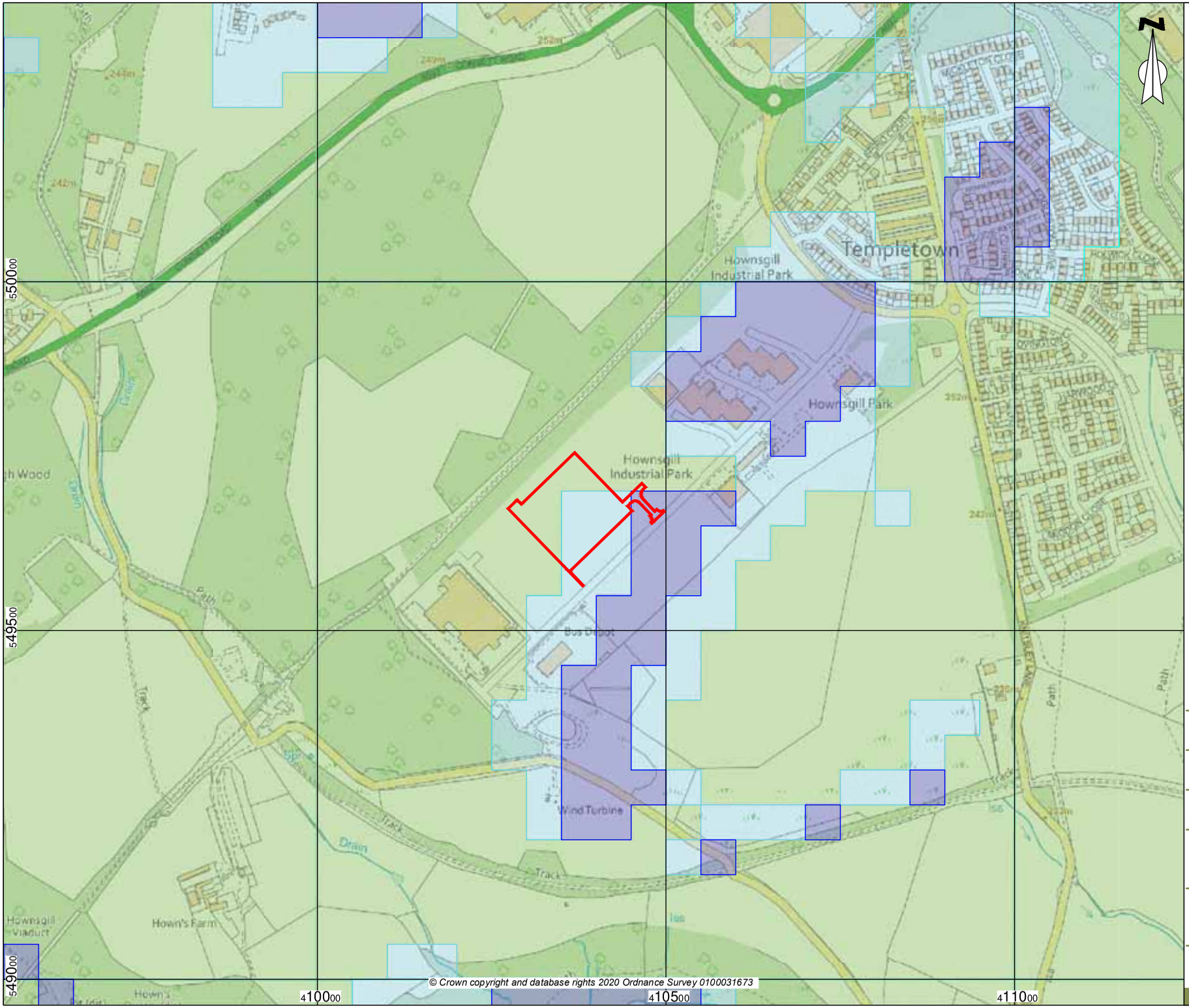
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Surface Water Features

DRAWING NO: CRM.0138.001.HY.D.002



Key

- Site Boundary
- Potential for Groundwater Flooding to Occur at Surface
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Limited Potential for Groundwater Flooding to Occur

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CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

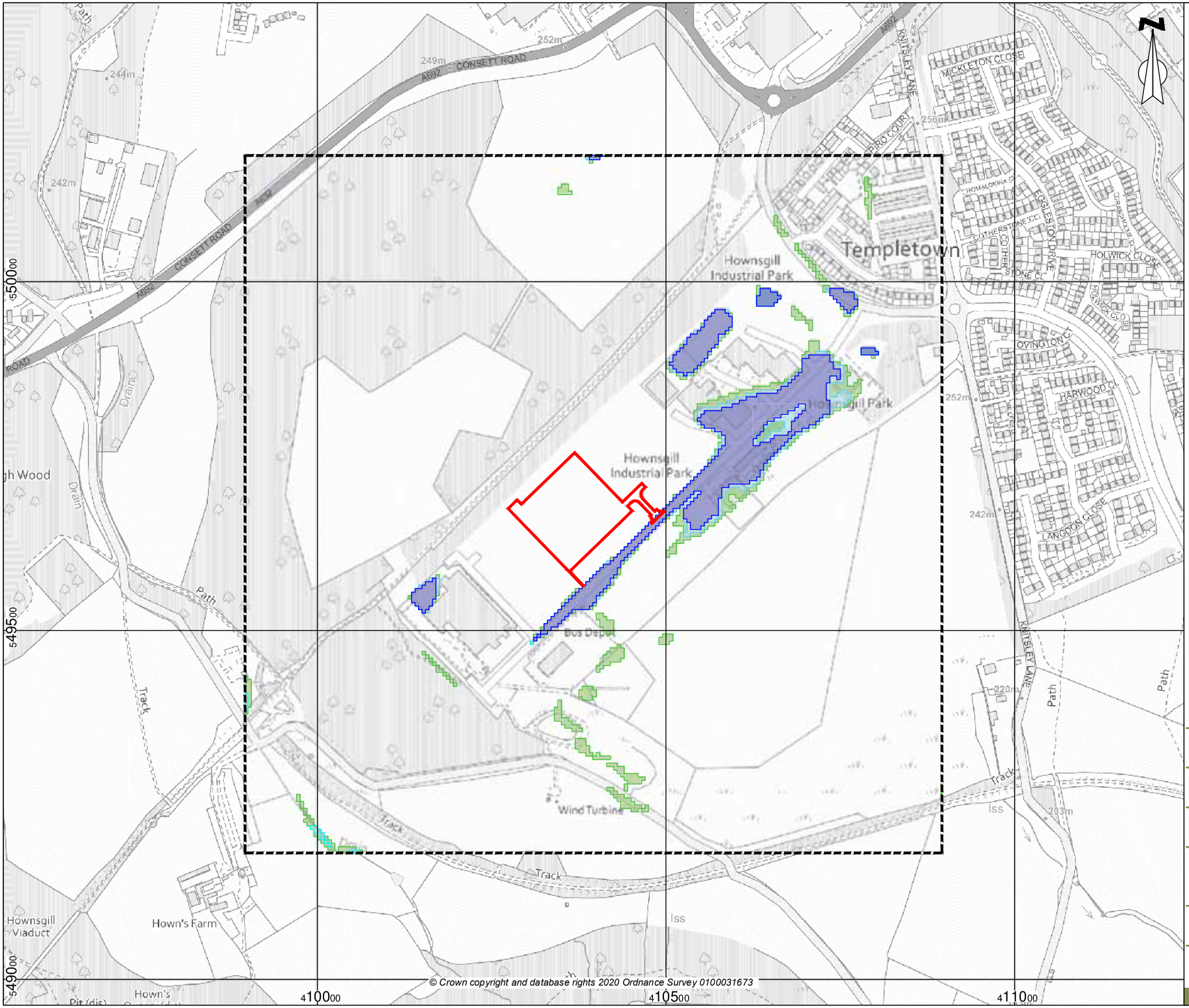
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: BGS Groundwater Flooding Susceptibility

DRAWING NO: CRM.0138.001.HY.D.003



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CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

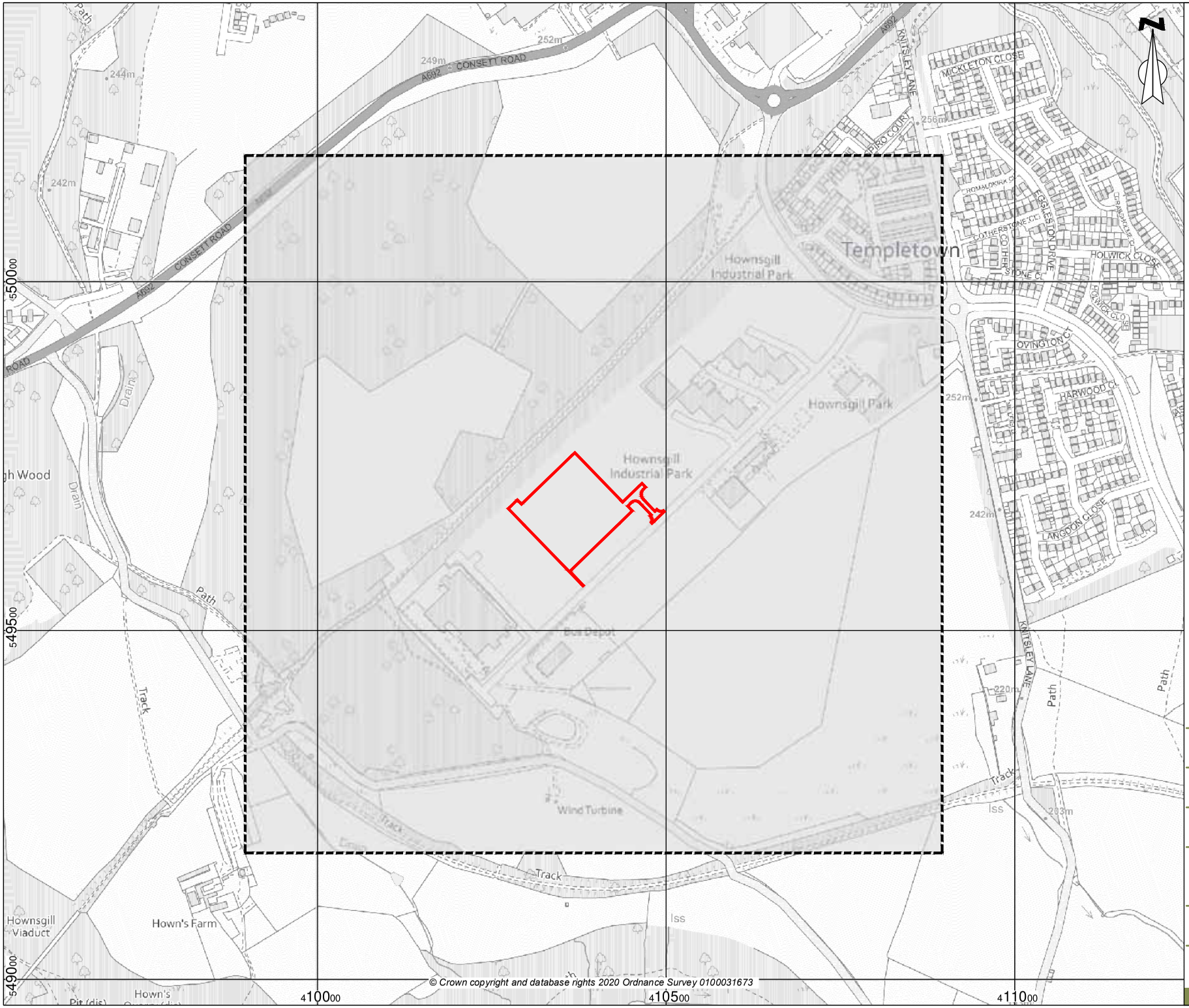
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: JBA Surface Water Flooding

DRAWING NO: CRM.0138.001.HY.D.004



Key

- Site Boundary
- Search Extent
- Class 1 - High Risk
- Class 2 - Moderate Risk
- Class 3 - Low Risk
- Class 4 - Negligible Risk

Notes:

GEOSMART GROUNDWATER FLOOD RISK MAP GW5
Version 2.2© - www.geosmartinfo.co.uk

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CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

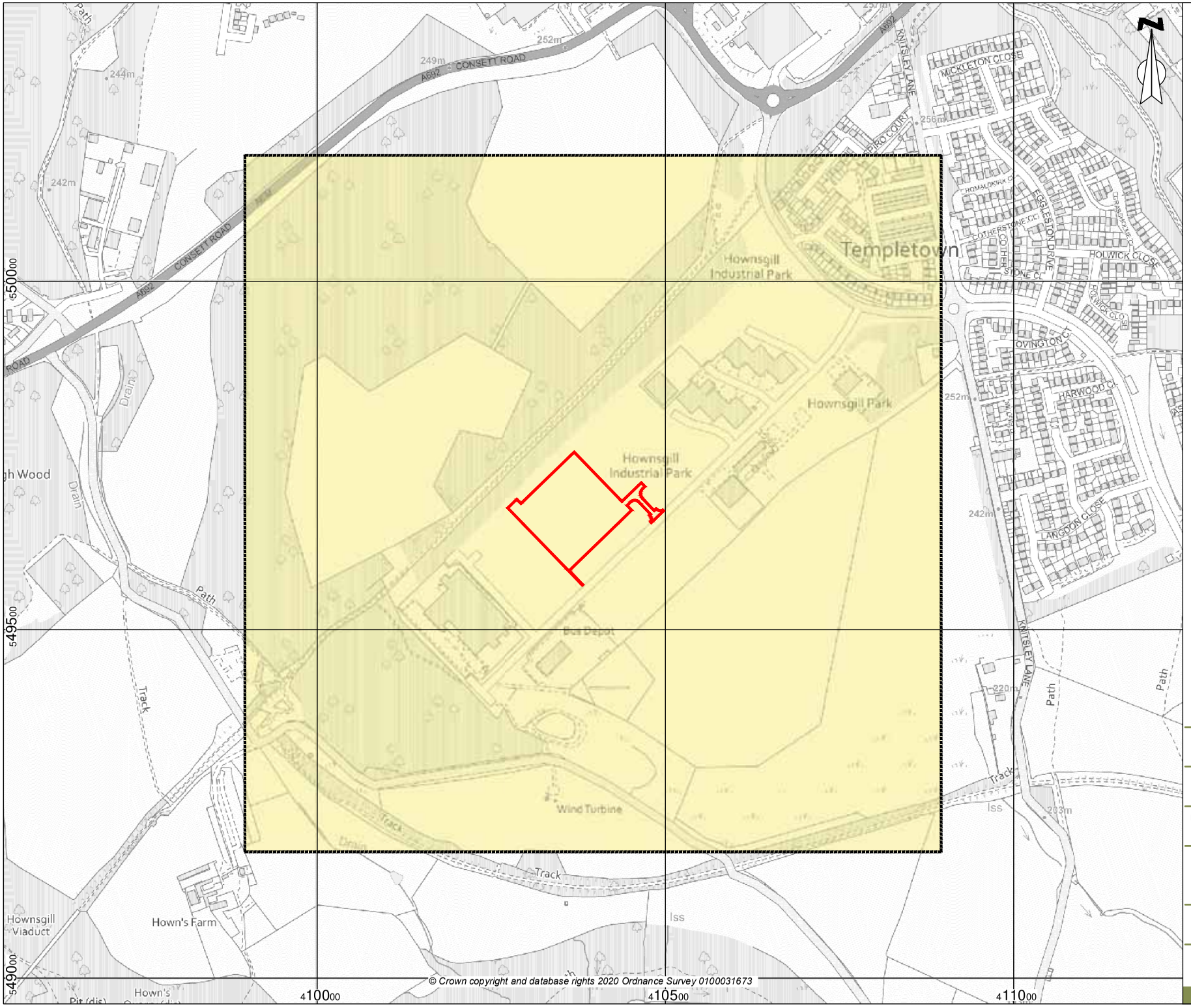
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Groundwater Flood Risk Map

DRAWING NO: CRM.0138.001.HY.D.005



Key

- Site Boundary
- Search Extent
- High Potential
- Moderate Potential
- Low Potential

Notes:

GEOSMART SUDS INFILTRATION POTENTIAL MAP SD50
Version 1.0© - www.geosmartinfo.co.uk

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CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

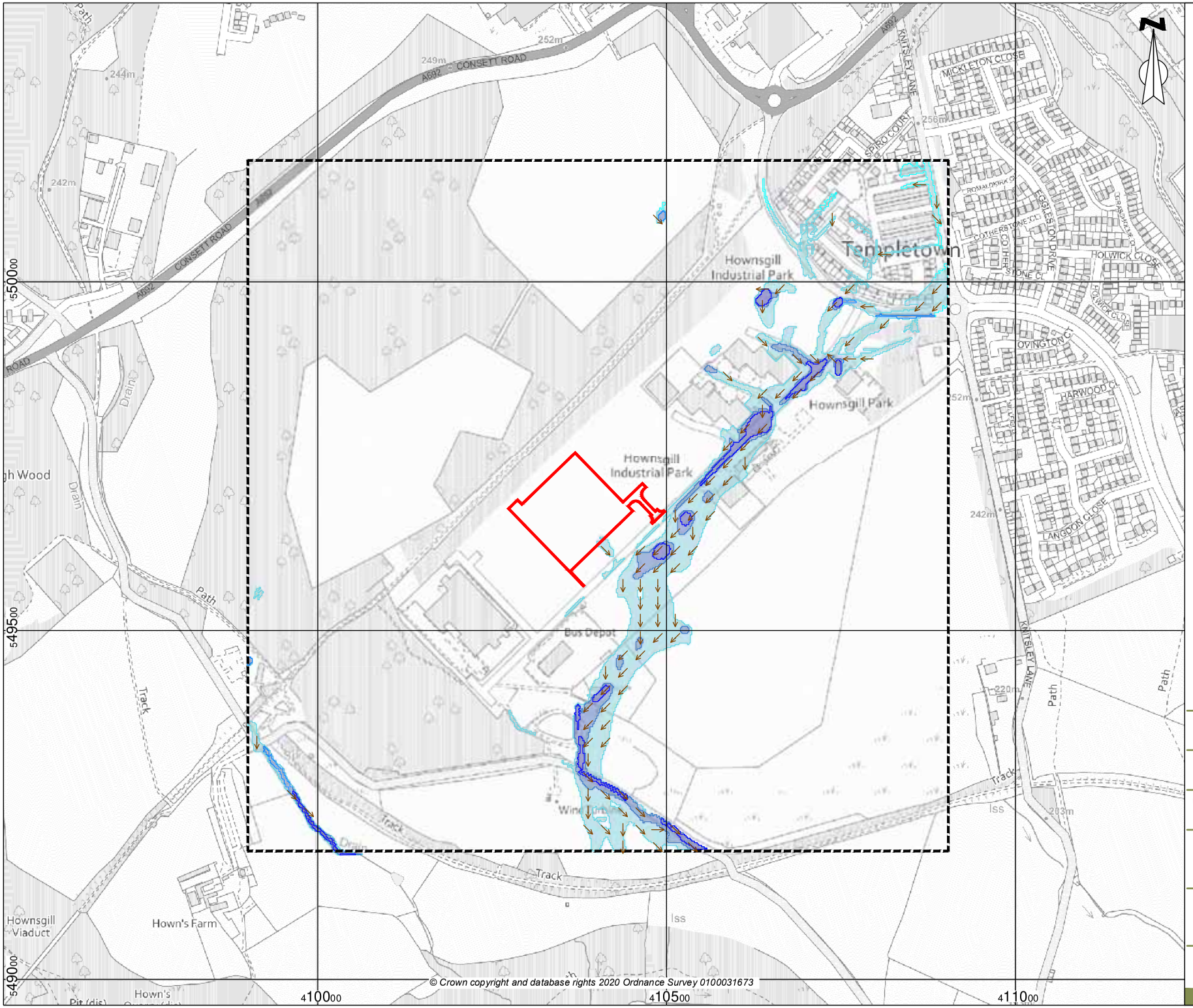
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: SuDS Infiltration Potential Map

DRAWING NO: CRM.0138.001.HY.D.006



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CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

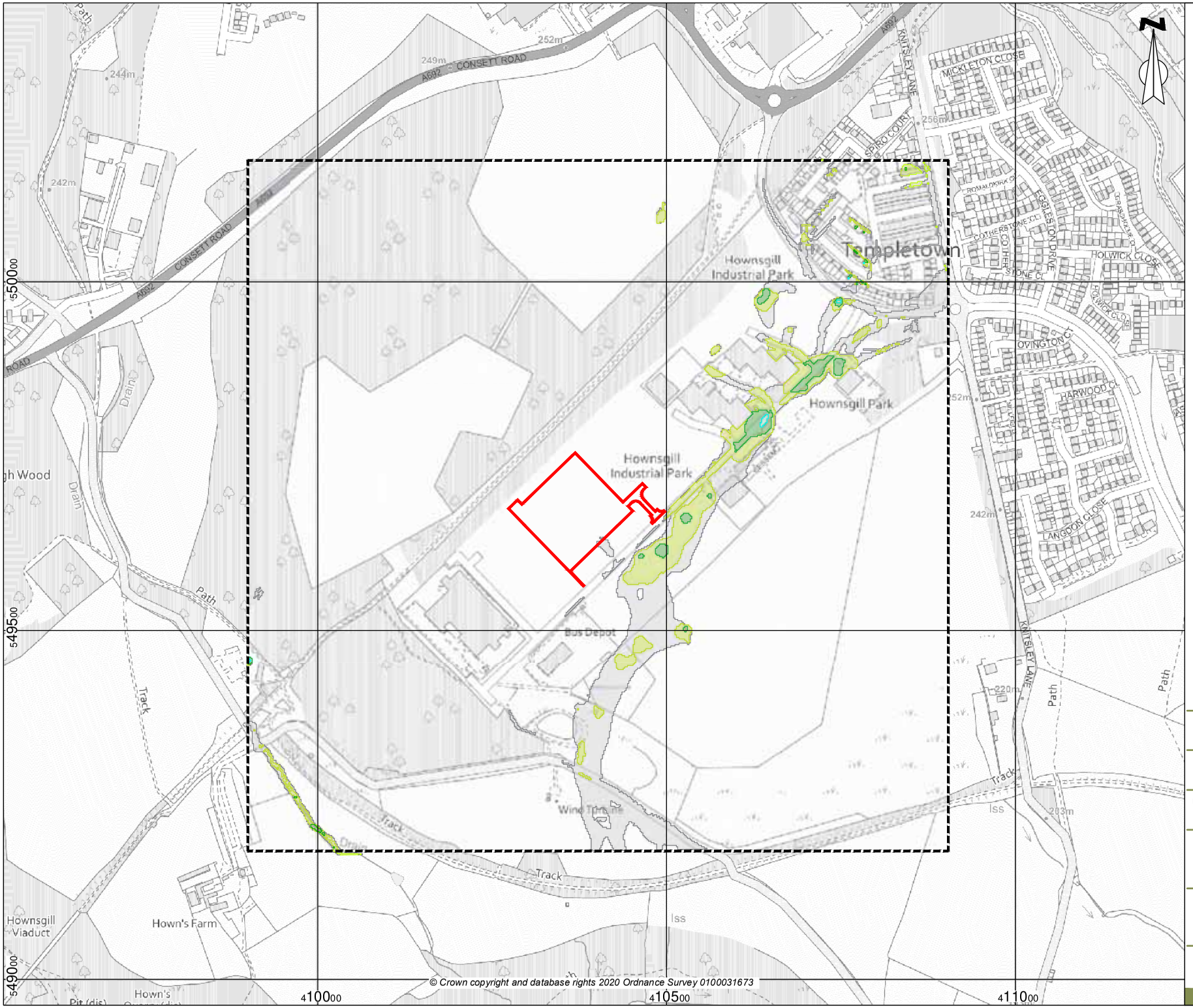
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Environment Agency Surface Water Flow Paths

DRAWING NO: CRM.0138.001.HY.D.007.1



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CLIENT:
Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

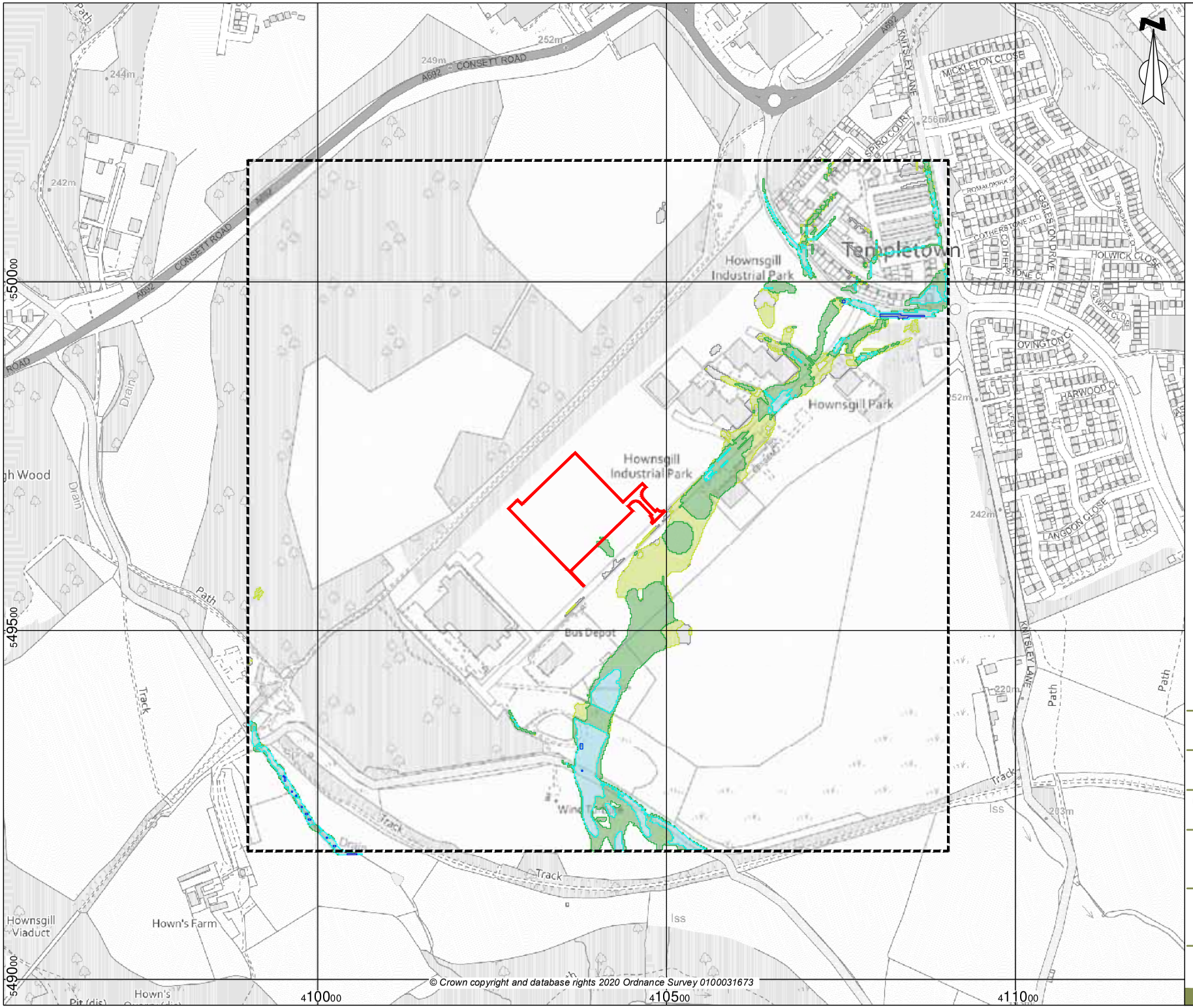
CHECKED: DA

DATE: Oct 2020

PROJECT:
Knitsley Lane,
Hownsgill Industrial Estate

TITLE:
Environment Agency 1 in 1000 Year Surface Water Depth

DRAWING NO:
CRM.0138.001.HY.D.007.2



Key

- Site Boundary
- Search Extent
- Velocity 2.00 or greater (m/s)
- Velocity 1.00 - 2.00 (m/s)
- Velocity 0.50 - 1.00 (m/s)
- Velocity 0.25 - 0.50 (m/s)
- Velocity 0.00 - 0.25 (m/s)

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CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

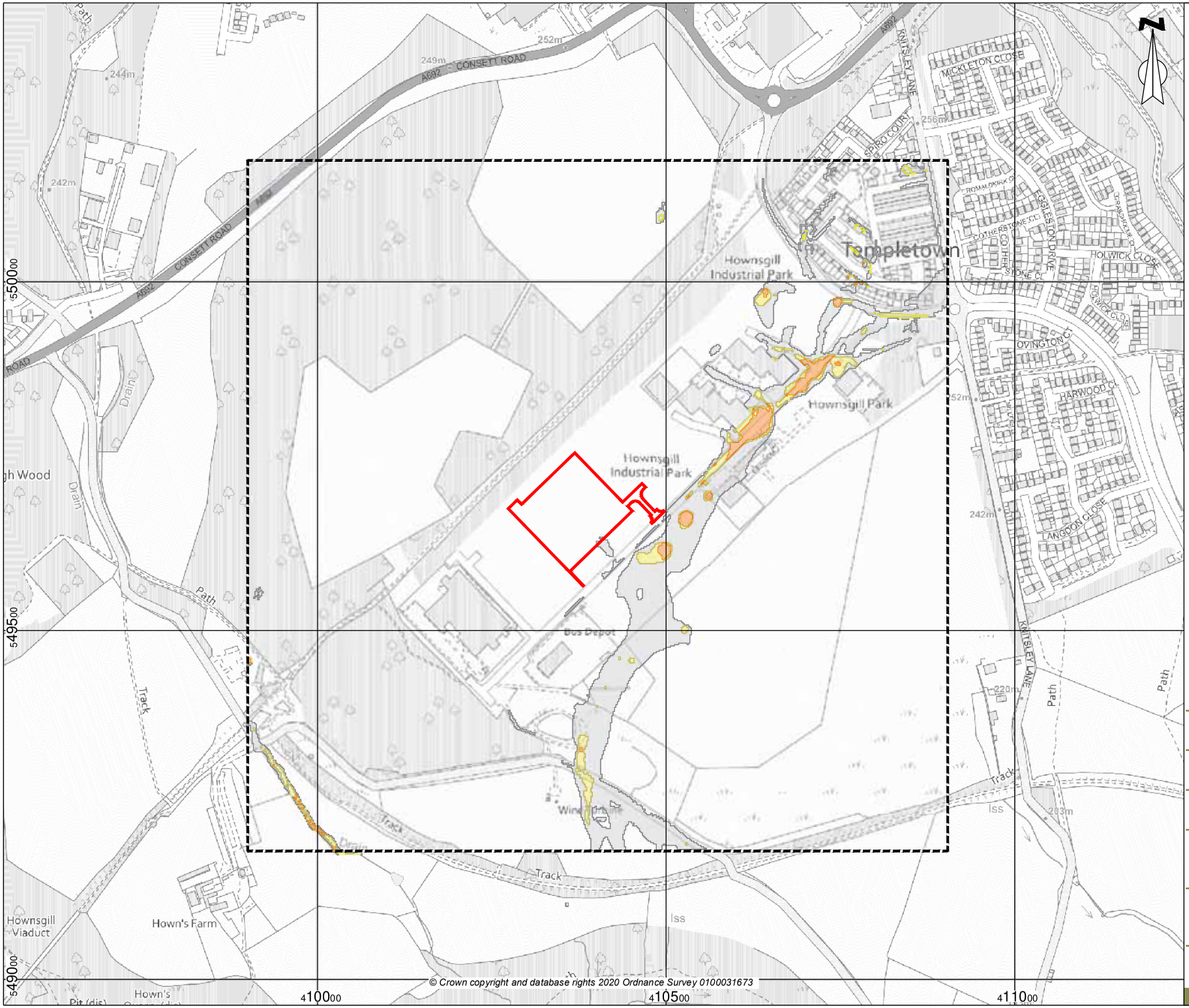
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Environment Agency 1 in 1000 Year Surface Water Velocity

DRAWING NO: CRM.0138.001.HY.D.007.3



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CLIENT: Project Genesis Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Environment Agency Surface Water 1000 Year Hazard Rating

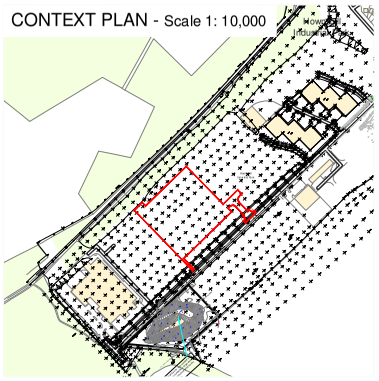
DRAWING NO: CRM.0138.001.HY.D.007.4

Hownsgill
Industrial Park

Key

Site Boundary

CONTEXT PLAN - Scale 1: 10,000



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Scale 1:1,000@A3

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CLIENT: Project Genesis Ltd

SCALE: 1:1,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

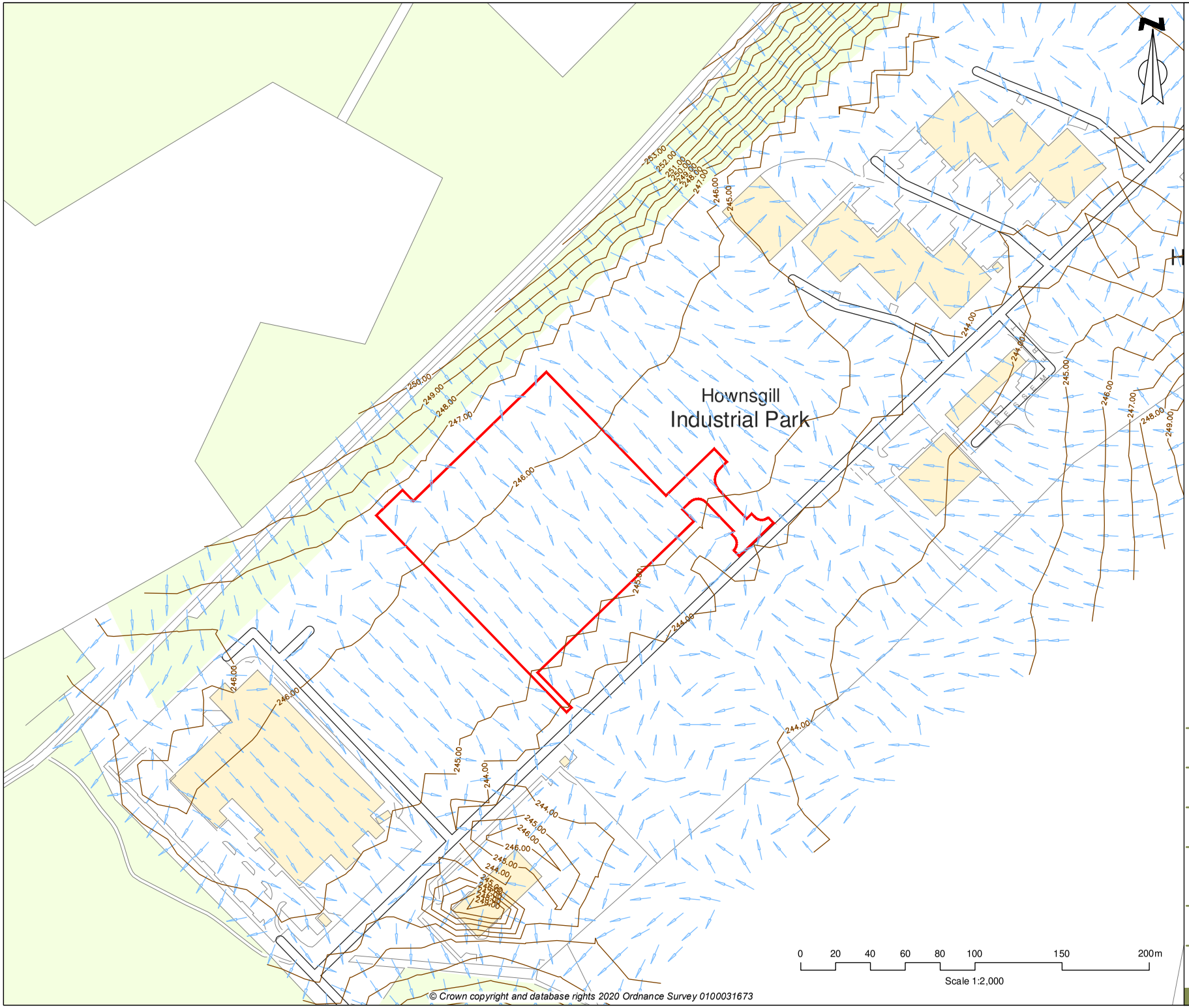
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Topographical Survey

DRAWING NO: CRM.0138.001.HY.D.008



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CLIENT: Project Genesis Ltd

SCALE: 1:2,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

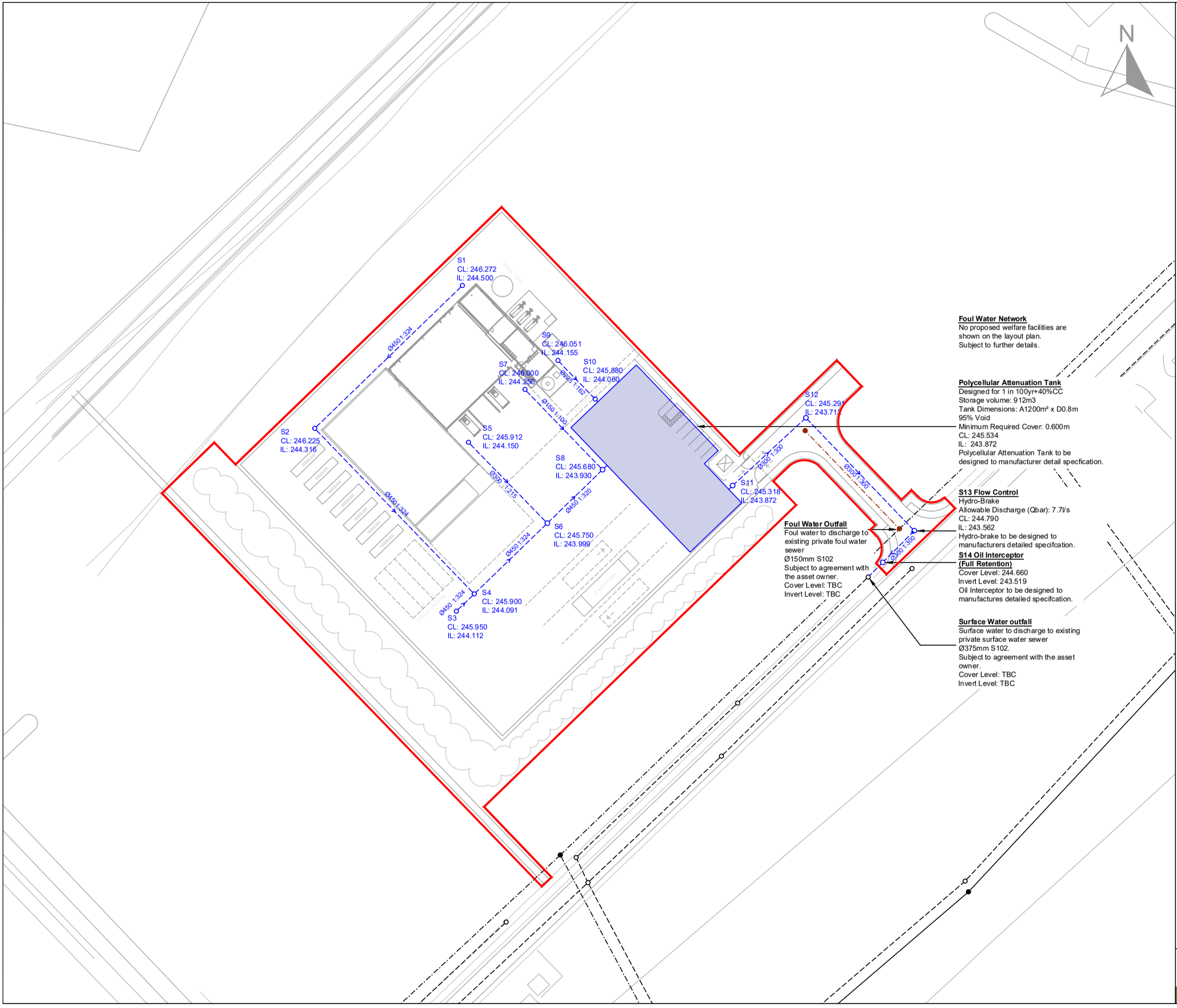
CHECKED: DA

DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Exceedance Routes

DRAWING NO: CRM.0138.001.HY.D.009



NOTES

1. Do not scale from this drawing
2. All dimensions are in meters unless stated otherwise
3. This drawing is to be read in conjunction with all relevant drawings and documents associated with this project.
4. All surveyed information including levels and layout is provided by others
5. All existing and proposed dimensions, levels and locations to be checked and verified by the main contractor on site prior to the commencement of the works and any anomalies reported to the engineer.
6. All works, workmanship and materials on private drainage to be in accordance with the civil engineering specification for water industry 7th edition published by the water research council.

Key

- Site Boundary
- Surface Water Sewer
- Surface Water Manhole (S1)
- Foul Water Sewer
- Foul Water Manhole (F1)
- Ø150 S102 — Existing Foul Water Sewer
- Ø375 S102 — Existing Surface Water Sewer
- Ø375 — Existing Combined Water Sewer
- Polycellular Attenuation Tank

REV:	DATE:	DETAIL:	DES:	CHK:	APP:
P02	21/10/20	Site layout updated	CH	WW	DA
P01	14/09/20	First Issue	CH	WW	DA

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Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT: Project Genesis Ltd

PROJECT: Hownsgill Energy Facility

DRAWING TITLE: Detailed Surface Water Drainage Strategy

DRAWN:	DESIGNED:	CHECKED:	APPROVED:
CH	CH	WW	DA

DATE: 09/09/2020

SCALE @ A3: 1:1000

PROJECT NO.: CRM.0138.001

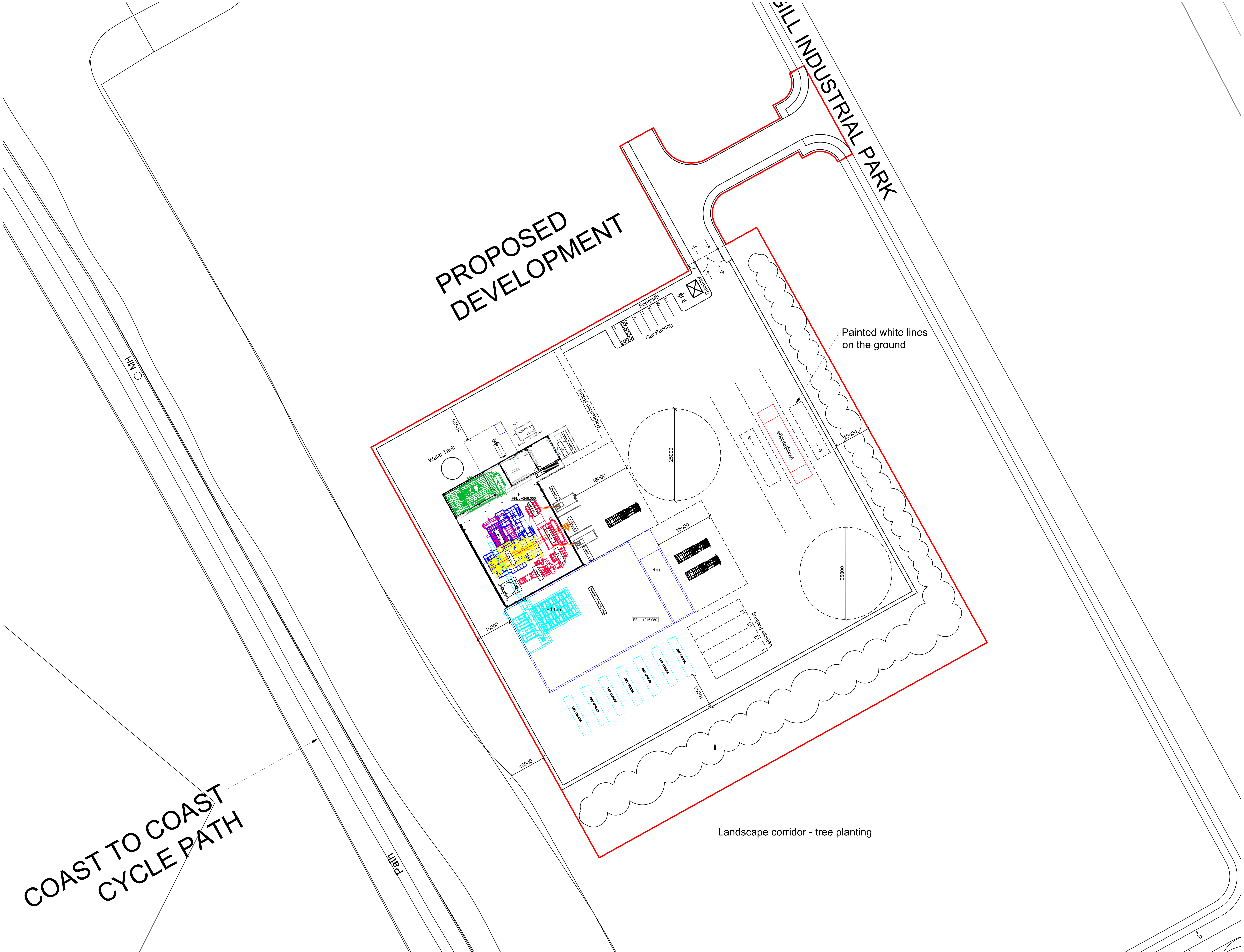
DRAWING NO.: 101

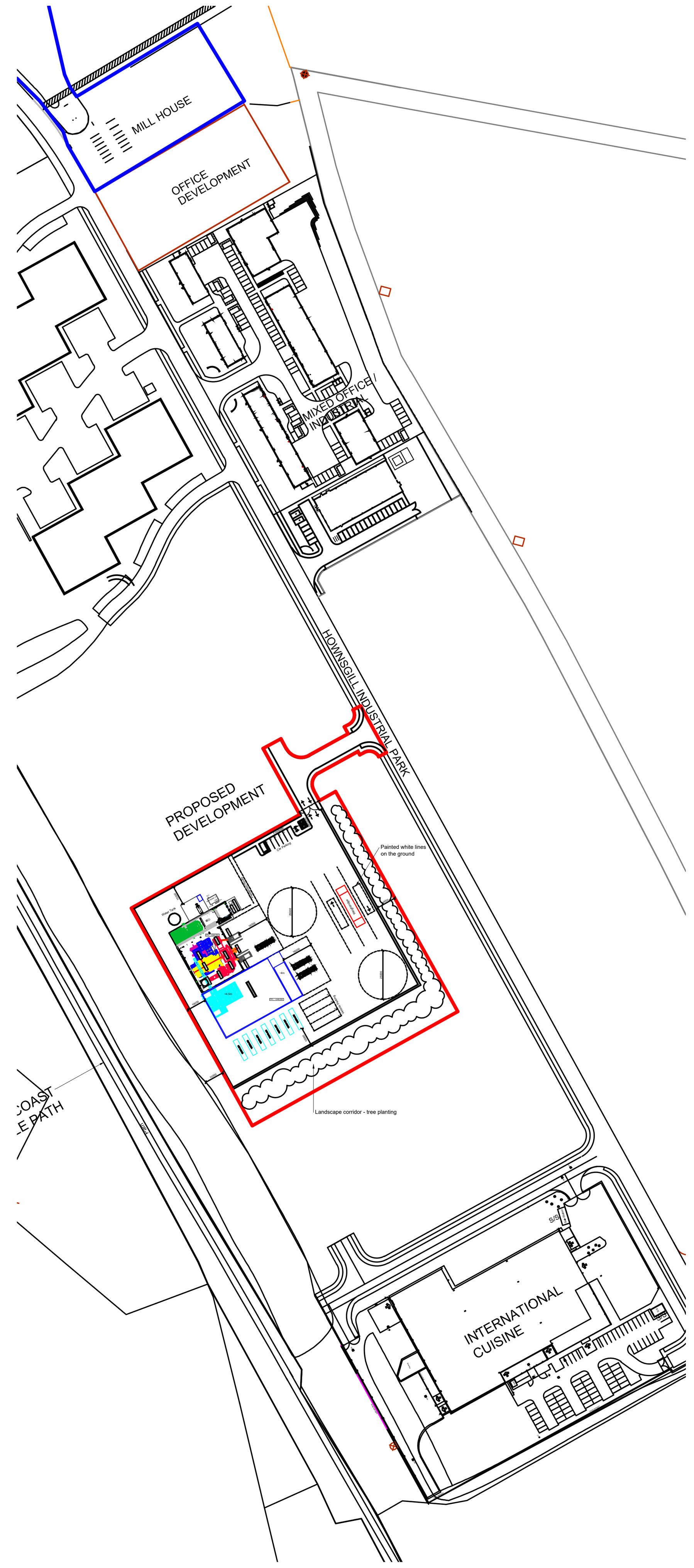
DRAWING STATUS: Preliminary

ISSUE: P02

APPENDICES

Appendix 1 – Proposed Layout





Key Location Plan
1:2500

NOTE:

Site area
4.04 acres
1.64 hectares

- DRAWING NOT TO BE SCALED.
- REPORT ERRORS & OMISSIONS TO ARCHITECT.
- CHECK ALL DIMENSIONS ON SITE.
- DRAWING TO BE READ IN CONJUNCTION WITH HEALTH AND SAFETY PLAN AND ALL RELEVANT RISK ASSESSMENTS.

Residual Risks
In addition to the hazard/risks normally associated with the types of work detailed on this drawing take note of the above. It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.
Safety Health and Environmental Information Box

Rev	Revision	Date	Drwn	Chkd
-	First Issue	03.11.20	FC	DD

Rev	Revision	Date	Drwn	Chkd

Project: EFW Facility, Consett
Client: Project Genesis Ltd
Layout Title: Proposed Site Plan

N

0 5 10 15 20 25
Scale in m. 1:500

Drawing Number

project	originator	zone	level	type	role	number	rev
***	SBA	00	GF	DR	A	AL(0) 012	-

SBA/AKA Project No.: 2200033
Scales @ A1: 1:500
Status: PLANNING

t: Newcastle (head office): 0191 265 7080 / 0191 213 0133
e: info@sadlerbrown.co.uk / mail@akarchitects.net,
w: www.architects-group.com

SBA AKA ARCHITECTS GROUP

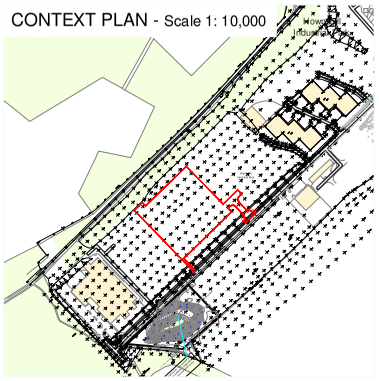
Appendix 2 – Topographic Survey

Hownsgill
Industrial Park

Key

Site Boundary

CONTEXT PLAN - Scale 1: 10,000



0 20 40 60 80 100m

Scale 1:1,000@A3

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Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT: Project Genesis Ltd

SCALE: 1:1,000@A3

PROJECT REF: CRM.0138.001

DRAWN: MG

CHECKED: DA

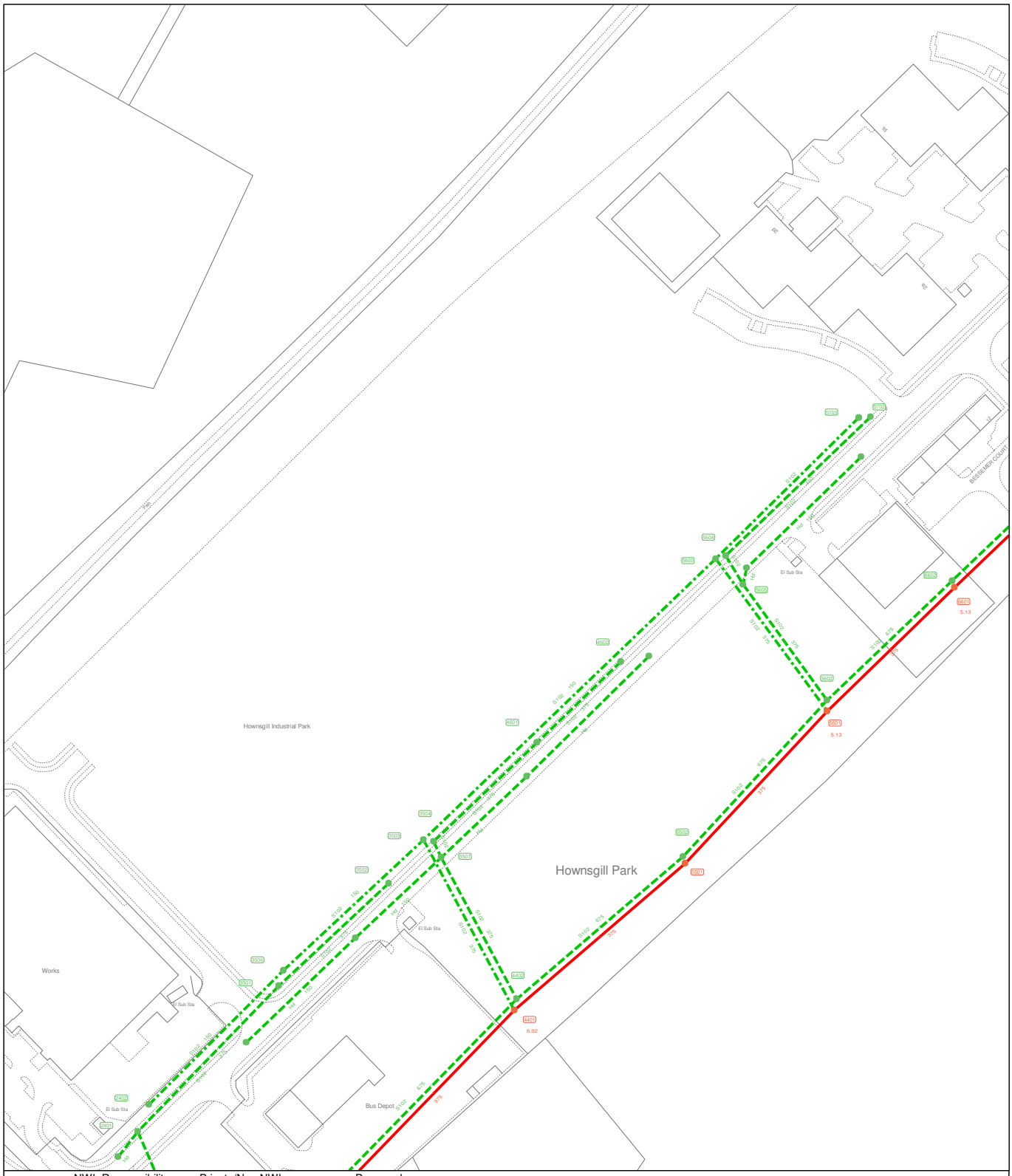
DATE: Oct 2020

PROJECT: Knitsley Lane, Hownsgill Industrial Estate

TITLE: Topographical Survey

DRAWING NO: CRM.0138.001.HY.D.008

Appendix 3 – Northumbrian Water Asset Plans



NWL Responsibility

- Combined
- Foul
- Surface
- Treated Eff
- Untreated Eff
- Overflow

Private/Non NWL

- Combined
- Foul
- Surface
- Treated Eff
- Trade Eff
- Watercourse

Proposed

- Combined
- Foul
- Surface

Annotations

- Direction of flow
- Backdrop
- Abandoned
- Rising Main

Symbols

- Chambers
- Inlet/Outlet
- Treatment Works
- Pumping Station
- Capped End
- Balancing Pond
- Termination Node
- Rodding Eye
- Unknown End
- Attribute Change
- Air Valve
- Property Connection
- Lamp Hole
- Hatchbox
- Dual Usage Chamber

NORTHUMBRIAN WATER living water

User : DAWSJ1

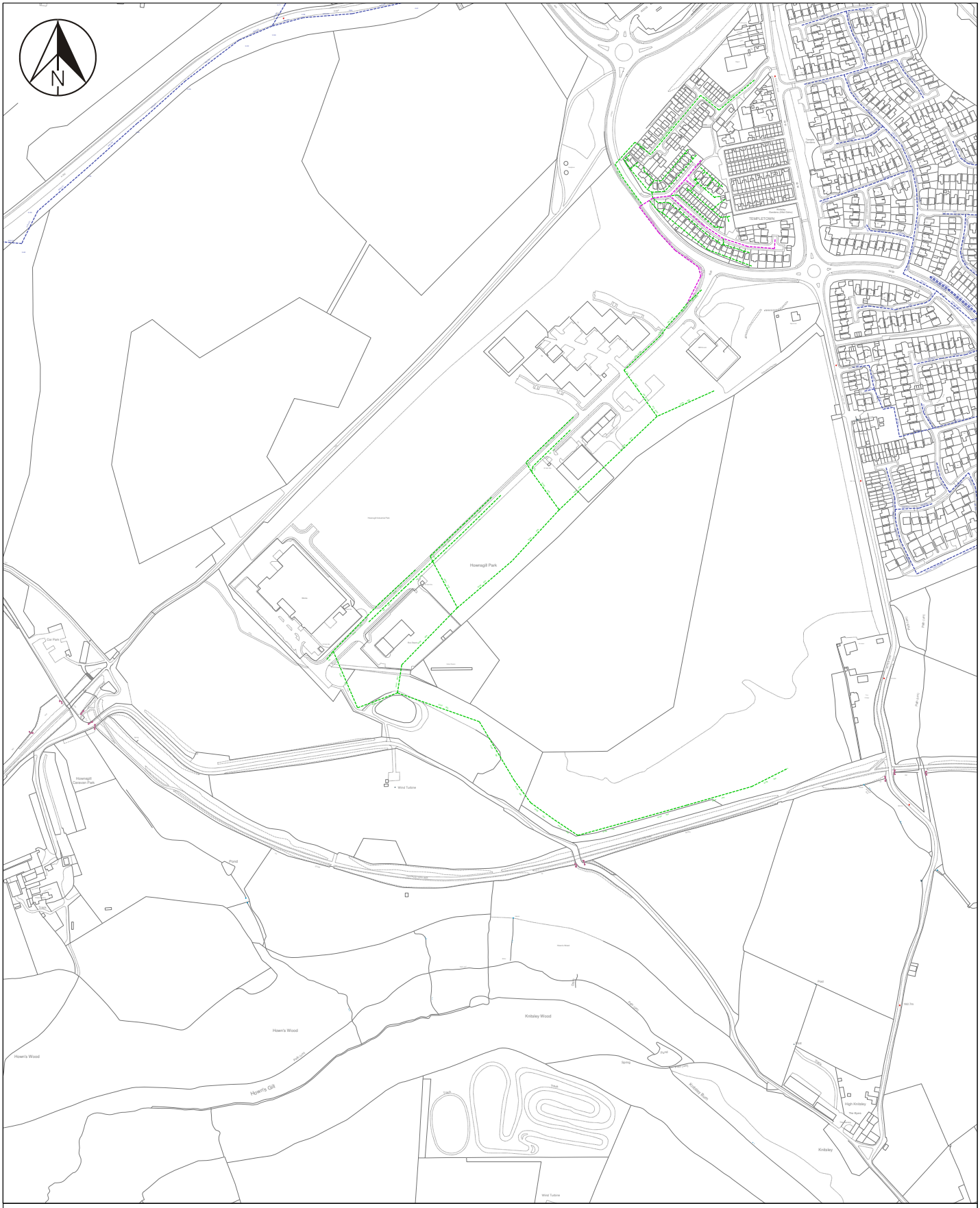
Date : 03/08/2020

Title : 0000

Centre Point : 410423,549684

Map Sheet : NZ1049NW

25 m



NWL Responsibility	Private/Non NWL	Proposed
Combined	Combined	Combined
Foul	Foul	Foul
Surface	Surface	Surface
Treated Eff	Treated Eff	
Untreated Eff	Trade Eff	
Overflow	Watercourse	

Annotations

- Direction of flow
- Backdrop
- Abandoned
- Rising Main

Symbols

- Chambers
- Inlet/Outlet
- Treatment Works
- Pumping Station
- Capped End
- Balancing Pond
- Termination Node
- Rodding Eye
- Unknown End
- Attribute Change
- Air Valve
- Property Connection
- Lamp Hole
- Hatchbox
- Dual Usage Chamber

User : DAWSJ1
Title :

Date : 28/08/2020 09:29:42
Centre Point : 410472,549506

Map Sheet : NZ1049NW
Paper / Scale : A1@1:2500

25 m

Appendix 4 – Drainage Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Inverts
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.172	5.00	246.272	1200	410357.724	549734.532	1.772
2	0.179	5.00	246.225	1200	410314.889	549693.090	1.909
3	0.136	5.00	245.950	1200	410356.000	549641.000	1.838
4	0.143	5.00	245.900	1200	410360.821	549645.662	1.809
5	0.111	5.00	245.912	1200	410359.500	549689.500	1.762
6	0.116	5.00	245.750	1350	410382.136	549666.274	1.751
7	0.058	5.00	246.000	1200	410375.719	549704.695	1.750
8			245.680	1350	410398.027	549681.641	1.750
9	0.133	5.00	246.051	1200	410385.200	549713.000	1.896
10			245.880	1200	410395.887	549701.925	1.820
Attenuation Tank	0.128	5.00	245.534	1350	410416.737	549680.203	1.662
11			245.318	1350	410434.891	549676.614	1.508
12	0.045	5.00	245.291	1350	410456.445	549696.545	1.579
13	0.060	5.00	244.790	1350	410487.601	549664.122	1.228
14_OUT			244.590	1350	410474.325	549650.812	1.091

Simulation Settings

Rainfall Methodology	FEH-13	Drain Down Time (mins)	240	100 year (l/s)	16.1
Summer CV	0.750	Additional Storage (m³/ha)	20.0	Check Discharge Volume	✓
Winter CV	0.840	Check Discharge Rate(s)	✓	100 year 360 minute (m³)	
Analysis Speed	Normal	1 year (l/s)	6.6		
Skip Steady State	✓	30 year (l/s)	13.5		

Storm Durations

15	60	180	360	600	960	2160	4320
30	120	240	480	720	1440	2880	5760

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	QBar/QMed conversion factor	1.064
Greenfield Method	FEH	Growth Factor 1 year	0.86
Positively Drained Area (ha)	1.281	Growth Factor 30 years	1.75
SAAR (mm)	766	Growth Factor 100 years	2.08
Host	21	Betterment (%)	0
BFIHost	0.333	QMed	7.3
Region	3	QBar	7.7

Pre-development Discharge Rate

Q 1 year (l/s)	6.6	Q 100 year (l/s)	16.1
Q 30 year (l/s)	13.5		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	1.281	Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	243.562	Product Number	CTL-SHE-0128-7700-1110-7700
Design Depth (m)	1.110	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	7.7	Min Node Diameter (mm)	1200

Node Attenuation Tank Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	243.872
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	0.800	1200.0	0.0	0.801	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	244.596	0.096	19.1	0.2940	0.0000	OK
15 minute winter	2	11	244.451	0.135	38.0	0.4061	0.0000	OK
15 minute winter	3	12	244.424	0.312	15.1	0.8151	0.0000	OK
15 minute winter	4	12	244.424	0.333	62.2	0.9035	0.0000	OK
15 minute winter	5	12	244.414	0.264	12.3	0.6304	0.0000	OK
15 minute winter	6	12	244.419	0.420	94.0	1.1573	0.0000	OK
15 minute winter	7	12	244.435	0.185	6.4	0.3326	0.0000	SURCHARGED
15 minute winter	8	12	244.410	0.480	113.4	0.6864	0.0000	SURCHARGED
15 minute winter	9	10	244.293	0.138	14.8	0.3486	0.0000	OK
15 minute winter	10	10	244.271	0.210	15.6	0.2381	0.0000	OK
600 minute winter	Attenuation Tank	435	244.014	0.142	20.3	162.2419	0.0000	OK
600 minute winter	11	435	244.013	0.203	8.4	0.2900	0.0000	OK
600 minute winter	12	435	244.012	0.300	9.0	0.5996	0.0000	OK
600 minute winter	13	435	244.010	0.447	8.6	1.0780	0.0000	SURCHARGED
15 minute summer	14_OUT	1	243.499	0.000	7.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	18.4	0.586	0.103	1.9238	
15 minute winter	2	1.001	4	36.3	0.707	0.203	5.1572	
15 minute winter	3	2.000	4	12.4	0.316	0.069	0.8154	
15 minute winter	4	1.002	6	74.1	0.683	0.414	4.1479	
15 minute winter	5	3.000	6	13.8	0.351	0.182	2.2058	
15 minute winter	6	1.003	8	106.9	0.895	0.595	3.4528	
15 minute winter	7	4.000	8	6.5	0.522	0.365	0.5648	
15 minute winter	8	1.004	Attenuation Tank	122.4	2.081	0.685	1.5024	
15 minute winter	9	5.000	10	15.6	0.693	0.383	0.4931	
15 minute winter	10	5.001	Attenuation Tank	20.8	1.558	0.509	0.5875	
600 minute winter	Attenuation Tank	1.005	11	8.4	0.621	0.131	0.7721	
600 minute winter	11	1.006	12	8.3	0.570	0.130	1.7761	
600 minute winter	12	1.007	13	7.6	0.313	0.120	3.1652	
600 minute winter	13	Hydro-Brake®	14_OUT	7.7				267.4

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	11	246.211	1.711	85.5	5.2571	0.0000	FLOOD RISK
15 minute winter	2	11	246.157	1.841	179.3	5.5327	0.0000	FLOOD RISK
15 minute winter	3	10	245.923	1.811	71.1	4.7287	0.0000	FLOOD RISK
15 minute winter	4	10	245.900	1.809	323.1	4.9060	5.4086	FLOOD
15 minute winter	5	10	245.763	1.613	58.0	3.8569	0.0000	FLOOD RISK
15 minute winter	6	10	245.670	1.671	390.5	4.6051	0.0000	FLOOD RISK
15 minute winter	7	11	245.955	1.705	30.4	3.0587	0.0000	FLOOD RISK
15 minute winter	8	10	245.267	1.337	426.7	1.9137	0.0000	SURCHARGED
15 minute winter	9	11	245.113	0.958	69.5	2.4277	0.0000	SURCHARGED
15 minute winter	10	11	244.775	0.715	66.8	0.8091	0.0000	SURCHARGED
2160 minute winter	Attenuation Tank	1680	244.646	0.774	28.1	884.3613	0.0000	SURCHARGED
2160 minute winter	11	1680	244.645	0.835	7.7	1.1945	0.0000	SURCHARGED
2160 minute winter	12	1680	244.643	0.931	8.1	1.8635	0.0000	SURCHARGED
2160 minute winter	13	1680	244.641	1.079	8.0	2.5993	0.0000	FLOOD RISK
15 minute summer	14_OUT	1	243.499	0.000	7.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	77.0	0.727	0.431	9.4434	
15 minute winter	2	1.001	4	188.0	1.186	1.052	10.4611	
15 minute winter	3	2.000	4	66.8	0.437	0.374	1.0625	
15 minute winter	4	1.002	6	291.8	1.842	1.633	4.6980	
15 minute winter	5	3.000	6	59.3	0.842	0.785	2.2838	
15 minute winter	6	1.003	8	399.0	2.518	2.220	3.5026	
15 minute winter	7	4.000	8	27.7	1.576	1.564	0.5648	
15 minute winter	8	1.004	Attenuation Tank	435.3	3.829	2.436	2.0406	
15 minute winter	9	5.000	10	66.8	1.679	1.639	0.6121	
15 minute winter	10	5.001	Attenuation Tank	67.9	2.176	1.657	1.0993	
2160 minute winter	Attenuation Tank	1.005	11	7.7	0.606	0.120	1.3031	
2160 minute winter	11	1.006	12	7.7	0.571	0.120	2.0673	
2160 minute winter	12	1.007	13	7.5	0.310	0.117	3.1665	
2160 minute winter	13	Hydro-Brake®	14_OUT	7.6				898.3

Appendix 5 – Maintenance and Management Plan

Hownsgill Energy Facility – Maintenance & Management Plan

Project:	CRM.0138.002.HY.R.002.A
For:	Project Genesis Ltd
Status:	Issued
Date:	October 2020
Author:	Daniel Alstead BSc (Hons) MSc MCIWEM C.WEM - Associate Director
Approver:	Matt Travis BSc (Hons), MSc, MCIWEM, C.WEM, CEnv, CSci - Director

1. Introduction

Enzygo Ltd was commissioned by Project Genesis Ltd to prepare a Flood Risk Assessment (FRA) (Reference: CRM.0138.002.HY.R.001.A [October 2020]), inclusive of a drainage strategy, in support of a full planning application for a proposed Combined Heat and Power Facility development, located on land west of Knitsley Lane, in Hownsgill Industrial Estate Consett, Durham (the 'Site').

2. Purpose

The purpose of the maintenance and management plan is to ensure the ongoing monitoring and maintenance to ensure the effectiveness of the drainage strategy for the lifetime of development.

3. Drainage Design Principles

A copy of the drainage strategy drawing (including layout) is included in Appendix 1, and a summary is included below:

Surface Water

- Surface water runoff would be directed to the drainage system through drainage gullies with sumps located around the perimeter of the buildings and through contouring of the hardstanding areas.
- Surface water will be directed to an onsite attenuation (cellular storage), positioned to achieve a gravity fed connection to the private surface water sewer beneath Knitsley Lane (subject to confirmation of sewer invert levels and agreement with the asset owner).
- Attenuation storage is required to reduce the post-application surface water runoff from the Site to the surface water sewer at the QBAR rate, for all storm events up to and including the 1 in 100-year (plus 40% climate change) event.

Foul Water

- The proposal is to discharge foul flows to the adjacent private foul sewer (subject to confirmation of sewer invert levels and agreement with the asset owner).

4. Drainage Layout

The drainage strategy drawing (Appendix 1) includes information on:

- Surface water and foul drainage runs, including pipe sizes, invert, and cover levels.
- The position of the onsite cellular storage, including cover level, invert level, total volume, and tank dimensions.
- Flow control and separator structures.
- Outfall arrangements.
- Exceedance routes.

5. Operation Phase

Principles of the Maintenance and Management Plan

Key areas of maintenance have been identified from the drainage layout. The following identifies how the drainage layout has considered access, the anticipated maintenance activities and who might be responsible for the maintenance.

Maintenance of the SuDS features would be in line with the SuDS Manual (CIRIA C753, 2015). The maintenance would be undertaken by a private maintenance company. It is standard for SuDS features within a new development to be maintained by a private maintenance company unless the Council adopt it. If the maintenance company goes into administration, the Site will be contracted to a new maintenance company. The owner of the facility will pay a surcharge to the maintenance company. This will ensure maintenance throughout the lifetime of the development.

The schedule should be a living document as it may change, where inspections advise changes to the scheme maintenance requirements.

The SuDS attenuation features should be designed in line with design guidance by the LLFA if they are to be adopted.

Proprietary Systems

i. Flow Control Structures

Flow control structures (Hydrobrake) will be positioned downstream from the tank in a chamber which would allow access for inspection and maintenance. The Hydro-brake vortex flow control provides water quantity management for surface, foul or combined water across a wide range of flows and for a variety of applications. It has no moving parts and no power requirements and provides reliable, low maintenance, engineered flood management as part of green infrastructure developments.

Typical maintenance would include:

- Periodic de-silting of the Hydrobrake sump.
- Checking the emergency drain down mechanism is functioning.

- The sump should be emptied/checked at least as follows (but with an annual inspection and additional cleansing if required): The timetable of the maintenance would be on completion of drainage works, Year 1, Year 3, then every 5 years. This would allow for first year flush when sediment from construction would be greatest, then less frequently as the Site matures.

The flow control structure will be the responsibility of the private management company unless adopted. This is dependent on whether the Statutory Authority (Durham County Council) is willing to adopt.

ii. Highway Infrastructure

Highways infrastructure is readily accessible with traffic management in place.

Typical maintenance will include:

- Periodic desilting of catchpits, gully sumps and channel drains to ensure operation as per the design and prevent blockage. These should be emptied at least as follows (but with an annual inspection and additional cleansing if required): On completion of drainage works, Year 1, Year 3, then every 5 years. This would allow for first year flush when sediment from construction would be greatest, then less frequently as the Site matures.
- Gratings on any gullies and channel drains to be kept clear of debris.
- Periodic jetting or rodding of pipework as required to clear blockages.

A Section 104 agreement could be put in place to ensure that pipes within the adopted highway will be under the ownership of Northumbrian Water.

Gullies (and their sumps) in adopted roads will be the responsibility of the Highway Authority.

iii. Headwalls (Inlets and Outlets)

The outlet to the tank will be set above tank bed levels so that it remains operational between periods of maintenance.

The outlet from the tank will be set at the tank bed level to allow the tank to drain until dry between rainfall events.

iv. Retention Separator

Retention separators will be positioned upstream from the attenuation features (tank). Separators will provide water quality benefits, before discharging surface water to the adjacent private surface water sewer.

Typical maintenance activities and frequency are summarised in Table 1.1.

Table 1.1: Full Retention Separator Maintenance Activities

Maintenance Frequency	Required Action	Maintenance Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly, if required take immediate remedial action.	Inspect every six months.
	Clean out any oil and silt from interceptor.	Audio Visual Alarm when 90% of the recommended maximum oil storage volume is reached.
Remedial Work	Repair physical damage if necessary.	As required.

v. Below Ground Drainage Pipes

Pipes between the attenuation tank and Hydrobrake chamber and from the chamber to outfalls will be the responsibility of a private management company, unless adopted.

Typical maintenance activities and frequency are summarised in Table 1.2.

Table 1.2: Below Ground Drainage Pipes

Maintenance Frequency	Required Action	Maintenance Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris from the catchment surface where it can cause risks to performance.	Monthly.
	Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually/as required.
Remedial Work	Repair physical damage if necessary.	As required.
Monitoring	Inspect all inlets, outlets, and wets to ensure that they are in good condition and operating as designed.	Annually.
	Survey inside of pipe runs for sediment build up and remove if necessary.	Every 5 years/as required.

SuDS Features

i. Cellular Storage

The cellular storage will be the responsibility of a private management company, unless adopted. The SuDS attenuation features were designed in line with design guidance by the LLFA.

Typical maintenance activities and frequency are summarised in Table 1.3.

Table 1.3: Attenuation Tank Storage Maintenance Activities

Maintenance Frequency	Required Action	Maintenance Frequency
Regular Maintenance	Inspect and remove debris from inlet structure.	Monthly or as required.
	Remove sediment from pre-treatment structure where present.	Monthly or as required.
	Check inlets, outlets, control structure and overflows.	Annually or as required.
Occasional Maintenance	Jetting and suction where silt has settled in the structure.	On completion of drainage works, Year 1, Year 3, then every 5 years. This would allow for first year flush when sediment from construction would be greatest, then less frequently as the Site matures.
Remedial Work	Full replacement of the structure if permanently silted or structural failure.	As required.

6. Construction Phase

Mitigation measures are designed in to reduce the potential for impacts on hydrology, flood risk and water quality:

A summary of the mitigation measures during the construction phase, timetable for implementation and validation of the final drainage design is provided below.

- Good environmental practice based on legal responsibilities and guidance in accordance with the general overarching guidance on good environmental management in PPG1 (Environment Agency, 2013) and more specific guidance including:
  - CIRIA C650 (2005) Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors.
  - CIRIA C648 (2006) Control of Water Pollution from Linear Construction Projects.
  - PPG21: Pollution Prevention Guidelines. Incident Response Planning.
- Minimise where practicable the production of silt and contaminated water by minimising:
  - Dewatering and pumping of excavations and subsequent disposal of water.
  - Runoff from exposed ground and stockpiles.
  - Plant and wheel washing.
  - Site roads.
  - Fuel and other spillages.
  - Waste storage and disposal.
- Surface Water Management (SuDS) Scheme. The development will result in the construction of low permeability surfacing, increasing the rate of surface water run-off. The surface water drainage scheme ensures the runoff rates to the surrounding water environment are maintained at pre-development greenfield rates incorporating the effects of climate change.

The maintenance and management of the SuDS during the construction phase is essential in managing runoff on and from the Site.

A separate Construction Environmental Management Plan (CEMP) will be required to control environmental issues during the construction process. The CEMP forms part of the Project Management Plan, which integrates the core arrangements for health and safety, quality and environmental management for the construction phase. This integrated approach ensures that environmental aspects are considered at all stages of the design and construction process.

The construction phase will be undertaken in accordance with good practice guidelines on hydrology, flood risk and water quality for consultants and contractors, including:

- CIRIA Environmental Good Practice on Site (C502) (1999).
- CIRIA Control of Water Pollution from Construction Sites (C532) (2001).
- Environment Agency Pollution Prevention Guidelines.

Timetable for Implementation

The SuDS attenuation and conveyance features will be constructed before development begins, so that they are ready to accept runoff from impermeable areas (i.e. roofs, highways and other hardstanding areas) as these are constructed.

Validation

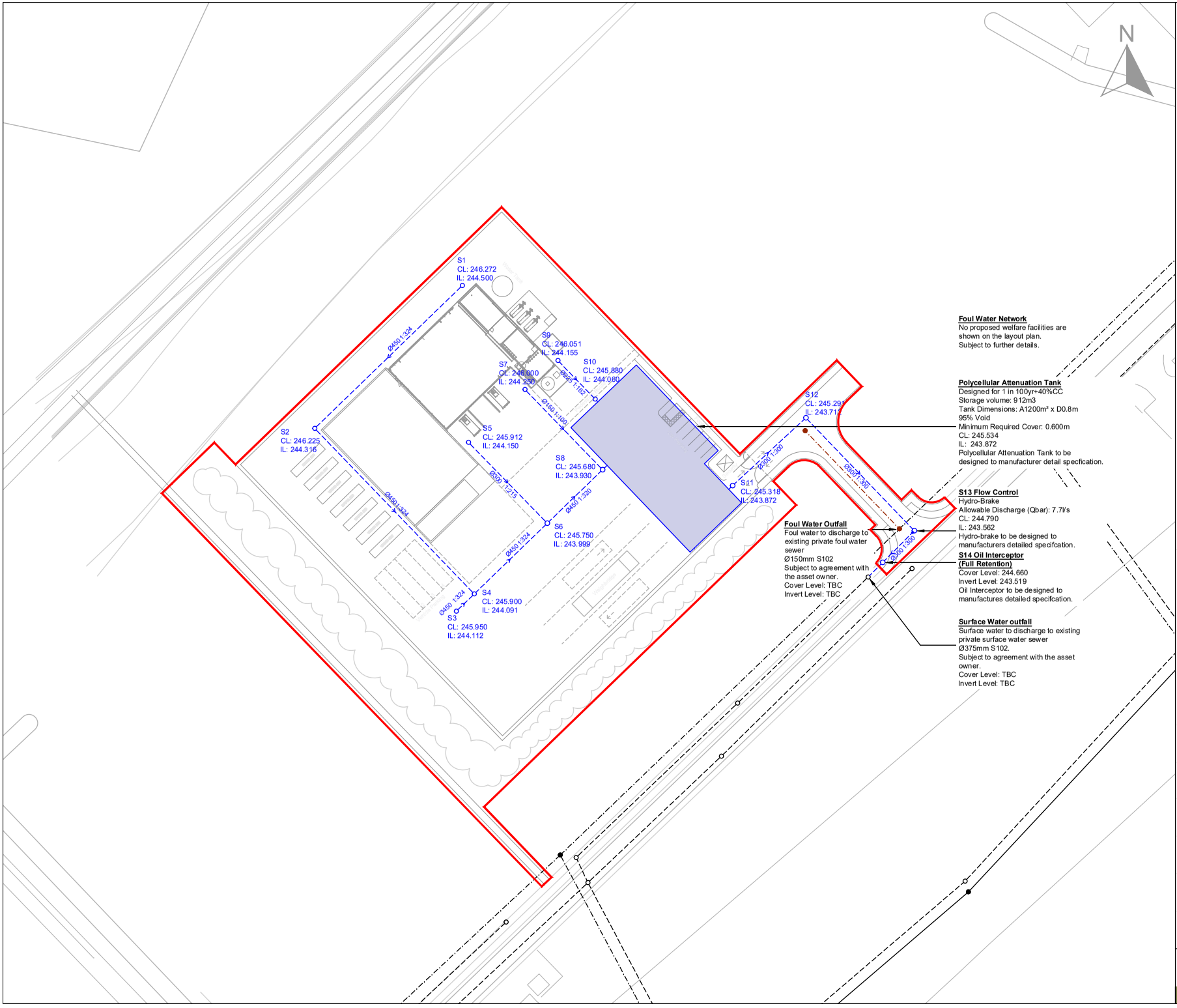
Proprietary systems will be jetted, and SuDS features de-silted, before being surveyed and inspected prior to final sign-off. This will ensure the drainage system is constructed in line with the detailed drainage design or subsequent (agreed) amendments.

7. Summary and Conclusions

This report provides an indicative drainage strategy, meeting the requirements of Durham County Council online drainage documentation.

The maintenance plan will ensure the ongoing monitoring and maintenance to ensure the effectiveness of the drainage strategy for the lifetime of development.

Appendix 1 – Detailed Drainage Strategy



NOTES

1. Do not scale from this drawing
2. All dimensions are in meters unless stated otherwise
3. This drawing is to be read in conjunction with all relevant drawings and documents associated with this project.
4. All surveyed information including levels and layout is provided by others
5. All existing and proposed dimensions, levels and locations to be checked and verified by the main contractor on site prior to the commencement of the works and any anomalies reported to the engineer.
6. All works, workmanship and materials on private drainage to be in accordance with the civil engineering specification for water industry 7th edition published by the water research council.

Key

- Site Boundary
- Surface Water Sewer
- Surface Water Manhole (S1)
- Foul Water Sewer
- Foul Water Manhole (F1)
- Ø150 S102 — Existing Foul Water Sewer
- Ø375 S102 — Existing Surface Water Sewer
- Ø375 — Existing Combined Water Sewer
- Polycellular Attenuation Tank

REV:	DATE:	DETAIL:	DES:	CHK:	APP:
P02	21/10/20	Site layout updated	CH	WW	DA
P01	14/09/20	First Issue	CH	WW	DA

enzygo environmental consultants
Samuel House, 5 Fox Valley Way, Stocksbridge, Sheffield, S36 2AA

CLIENT: Project Genesis Ltd

PROJECT: Hownsgill Energy Facility

DRAWING TITLE: Detailed Surface Water Drainage Strategy

DRAWN:	DESIGNED:	CHECKED:	APPROVED:
CH	CH	WW	DA

DATE: 09/09/2020

SCALE @ A3: 1:1000

PROJECT NO.: CRM.0138.001

DRAWING NO.: 101

DRAWING STATUS: Preliminary

ISSUE: P02

Enzygo specialise in a wide range of technical services:

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