APPENDIX 9: FLOOD RISK AND DRAINAGE

APPENDIX 9.1: FRA

Flood Risk Assessment and Surface Water Management Strategy

Kinkerdale Road, Teesport, TS6 6UE

Green Lithium Refining Limited

30 March 2023

215005-00740

Advisian
Worley Group

advisian.com

Disclaimer

Company details

Advisian
08659784

Level 1, 27 Great West Road
Brentford
Middlesex
TW8 9BW
United Kingdom

PROJECT 215005-00740- Flood Risk Assessment and Surface Water Management Strategy- Kinkerdale Road, Teesport, TS6 6UE

Rev	Description	Author	Review	Advisian approval	Revision date	Client approval	Approval date
A	DRAFT	A. Caldwell	H. Mehta	J. Assem	3/2/2023		Approval date
0	Issued for Use	A. Caldwell	H. Mehta	pp. J. Assem	30/03/2023		

Table of contents

Appendices

Table list

Figure list

Executive summary

Advisian has been retained by Green Lithium Refining Ltd (Green Lithium), to prepare a Flood Risk Assessment (FRA) and Surface Water Management Strategy for the landholding located at Kinkerdale Road, Teesport, TS6 6UE (NGR NZ 55635, 23330).

The proposed scheme comprises the construction and development of a low carbon lithium refinery and associated dockside reception, handling, storage and manufacturing activities for the production of high purity lithium hydroxide monohydrate and associated by-products.

The development is located within Flood Zone 1 and therefore has low probability of flooding from rivers and the sea. The Sequential Test and the Exception Test are not required.

The FRA demonstrates that the site is not at significant risk of flooding from fluvial, tidal, pluvial, sewer, artificial or breach sources of flooding.

There is a moderate risk of groundwater flooding associated with the development due to the potential for encountering shallow groundwater at deep foundations and sub-surface structures. Groundwater levels will be determined prior to the works, and design will take into consideration of shallow groundwater.

The use of the site is classified as “less vulnerable” which is permitted in Flood Zones 1, 2 and 3a.

The FRA demonstrates that the development is consistent with the requirements of the NPPF and that the site will not be at any additional risk of flooding or increase the flood risk to others with the mitigation measures included.

The site usage is considered to be less vulnerable and the development is deemed to be suitable. Consequently, flood risk should not be a limiting factor to the granting of Planning Consent for this development.

Surface runoff generated on site will be discharged to the River Tees via on site drainage and the existing off-site surface water drainage system that forms part of the wider PD Teesport development.

After consideration of sustainable drainage (SuDS) options, the use of rainwater harvesting, pervious paving, filter drains, gravel cover and attenuation storage tanks are recommended. These will capture, attenuate and improve the quality of surface runoff. SuDS will enable site runoff to be discharged at greenfield runoff rates (QBar), calculated as 99 l/s.

Isolated areas of the site will have elevated fire risk due to higher risk activities. At this stage, provision will be made within the site-wide drainage system to retain any water used in the event of fire on site for disposal at an appropriate facility.

1 Introduction

1.1 Context

Advisian has been retained by Green Lithium Refining Ltd (Green Lithium), to prepare a Flood Risk Assessment (FRA) and Surface Water Management Strategy for the landholding located at Kinkerdale Road, Teesport, TS6 6UE (NGR NZ 55635, 23330), hereafter referred to as the "site" (Figure 1-1).

This FRA and Surface Water Management Strategy has been written with reference to the requirements of the National Planning Policy Framework (NPPF).

The site is currently used as a logistics terminal, car depot and storage and has extant permissions relating to Port Logistics and Storage uses. The site is currently owned and operated by PD Teesport as shipping container storage with a corporate office on site.

1.2 Proposed Works

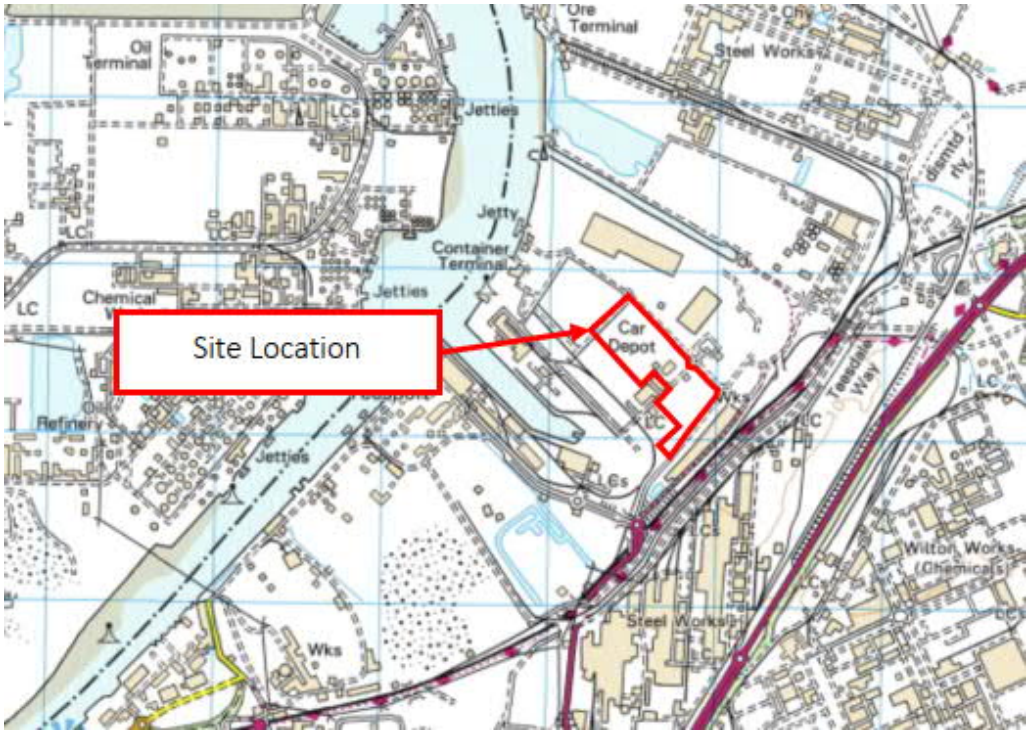
The site currently comprises approximately 15.2 ha (65%) of concrete hard standing housing office buildings, and approximately 8.3 ha (35%) of currently undeveloped former industrial land. Site levels will remain similar to current levels.

The proposed scheme comprises the construction and development of a low carbon lithium refinery and associated dockside reception, handling, storage and manufacturing activities for the production of high purity lithium hydroxide monohydrate and associated by-products.

The proposed Lithium Refinery has been designed with a zero liquid discharge (ZLD) process, therefore removing the need for effluent treatment and offsite disposal of liquid wastes. Water emissions from the proposed Green Lithium development are therefore confined solely to the discharge of surface water runoff from the buildings and associated hard standing and small volume domestic sewage releases to foul sewer. All discharges from the site will be routed via the internal site drainage system.

All surface water discharges from the site will connect to the existing off-site surface water drainage system that forms part of the wider PD Teesport development and discharge into the Tees Estuary. The piped network discharges via two identified outfalls to the north of the site.

Figure 1-1 Site Location



2 Policy

2.1 National Planning Policy Framework

The revised NPPF was published in July 2021; paragraphs 159 to 169 inclusive establish the planning policy relating to sustainable flood risk management (MHCLG, 2021).

The main focus of the policy is to direct development towards areas of lowest practicable flood risk and to ensure that all development is safe, without increasing flood risk elsewhere. The main considerations are:

- Applying the Sequential Test;
- If necessary, applying the Exception Test;
- Safeguarding land from development that is required for current and future flood management;
- Using opportunities offered by new development to reduce the causes and impacts of flooding;
- Where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations.

The NPPF states that an FRA is required for "all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: Sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use".

The application of the NPPF Exemption Test should be informed by a strategic or site-specific flood risk assessment. For the NPPF Exception Test to be passed it should be demonstrated that:

i. "the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
ii. 'the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."

The first point of the Exception Test is for the Local Planning Authority (LPA) to consider the supporting information provided as part of the planning submission. It considers the proposals as a whole. The second point should be demonstrated by a suitably detailed FRA.

The Planning Practice Guidance (PPG) to the NPPF (MHCLG, 2022), last updated in August 2022 provides the methodology required to undertake the Sequential and Exception Test.

2.2 Local Planning Policy

Redcar & Cleveland Borough Council (RCBC) is the local planning authority (LPS) and Lead Local Flood Authority for the site. Redcar & Cleveland Council Local Plan adopted on May 2018 forms part of the planning framework for the borough (RCBC, 2018). Policy SD 7– Flood and Water Management outlines the approach taken by the Borough of Redcar & Cleveland.

The Redcar & Cleveland Borough Council produced an update to their Level 1 strategic flood risk assessment (Level 1 SFRA) covering the site in 2016 (JBA, 2016). The document provides a high level assessment of flood risk across the area and informs local development planning.

A Level 2 SFRA, which looks in detail at any potential site allocations located in areas where there is a degree of flood risk, was published in 2010 (JBA, 2010). The wider Tees Estuary area is shown to be at risk of tidal flooding, however the site is elevated over 5m Above Ordinance Datum (AOD) and falls outside the 1 in 100 year and 1 in 200 year flood zone.

This FRA has been written in alignment with the local planning policies.

3 Context and Setting

3.1 Site Description

Table 3-1 Site Location and Description

Item	Description
Site Location	Kinkerdale Road, Teesport, TS6 6UE NGR: NZ 55635 23330
General Site Description	The site is approximately 23.5 hectares (ha) within the wider 315 ha Teesport industrial, shipping and logistics estate in South Tees. The area is relatively flat, and approximately 6 m AOD. The site is currently owned and operated by PD Teesport as shipping container storage with a corporate office on site. The site and surrounding areas are earmarked for remediation and regeneration in line with the wider Tees Estuary industrial zone and Freeport, including a dedicated 1 km quay for immediate access to the Tees Estuary and North Sea The site comprises approximately 15.2 ha of concrete hard standing housing the office buildings, and approximately 8.3 ha of currently undeveloped former industrial land. There are a number of minor surface water drains, electrical lines and other utilities located on the developed portion of the site. There are various drainage features in nearby proximity to site which connect to the downstream River Tees.
Site boundaries / adjacent land use	The site is bound to the northeast and southeast by the local road network, northwest by additional hard standing used for vehicle storage, and southwest by additional hard standing as part of the PD Teesport site. In the middle of the western boundary, the site diverts around Eustace House, a government office building currently used by HMRC.

3.2 Topography

The area is relatively flat, approximately 6 m Above Ordnance Datum (AOD), with a range of approximately 8.5 m AOD to 4.5 m AOD within the site boundary (GOV.uk, 2022c). Figure 3-1 shows topography at the site and in the surrounding area.

Figure 3-1 Topography (GOV.uk, 2022c)

3.3 Hydrology

The Statutory Main River Map (Environment Agency, 2022) indicates there are no main rivers running through the site. A main river, the River Tees, is located approximately 800m to the north of the site. The Tees Dock is located 500m west of the site and the Dabholm Gut is located 500m northeast of the site (Ordnance Survey, 2022). There are various drainage features in close proximity to site which connect to the downstream River Tees.

There a number of minor surface water drains present on the site as visible on the service plans presented in Appendix A.

The RCBC Level 2 SFRA (JBA, 2010) does not indicate any critical drainage problems at the site.

3.4 Geology

The British Geological Survey (BGS) GeoIndex website (2022) indicates that Made Ground is at surface across the entire site. Made Ground is associated with the site's current land use and historical industrial land uses. The northern portion of the site was previously a refinery tank farm and southern portion of the site used a railway siding and storage.

Natural superficial deposits at the site comprise of Tidal Flat Sand and Silt (Figure 3-2). Bedrock geology underlying the superficial deposits is indicated to comprise primarily of the Mercia Mudstone Group Mudstone, with nearby deposits of Penarth Group Mudstone and Redcar Mudstone Formation Mudstone (Figure 3-3) (BGS, 2022).

Figure 3-2 Superficial Geology

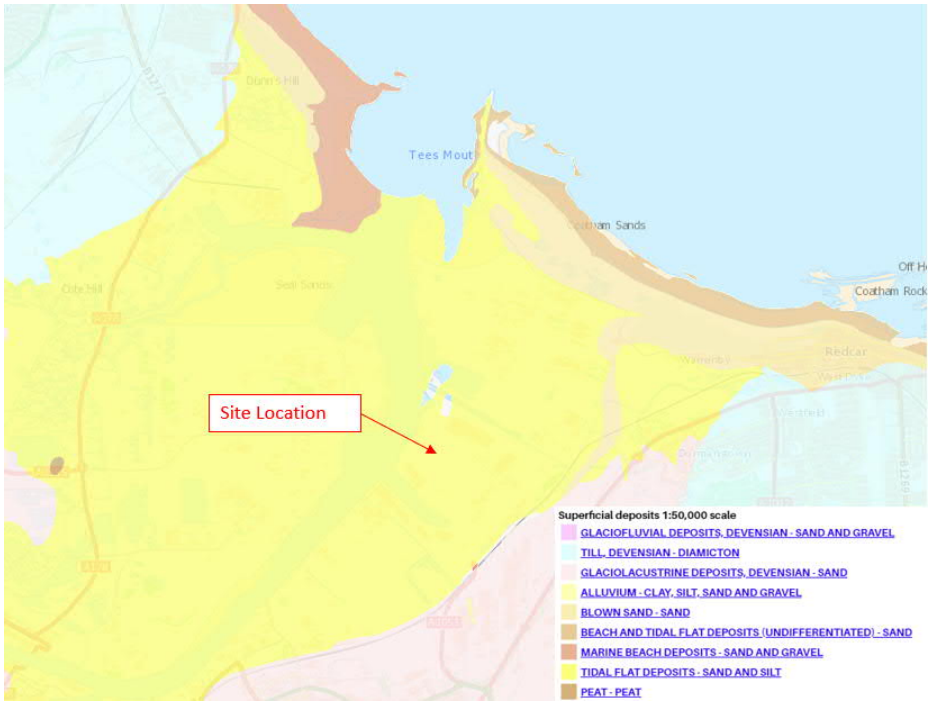
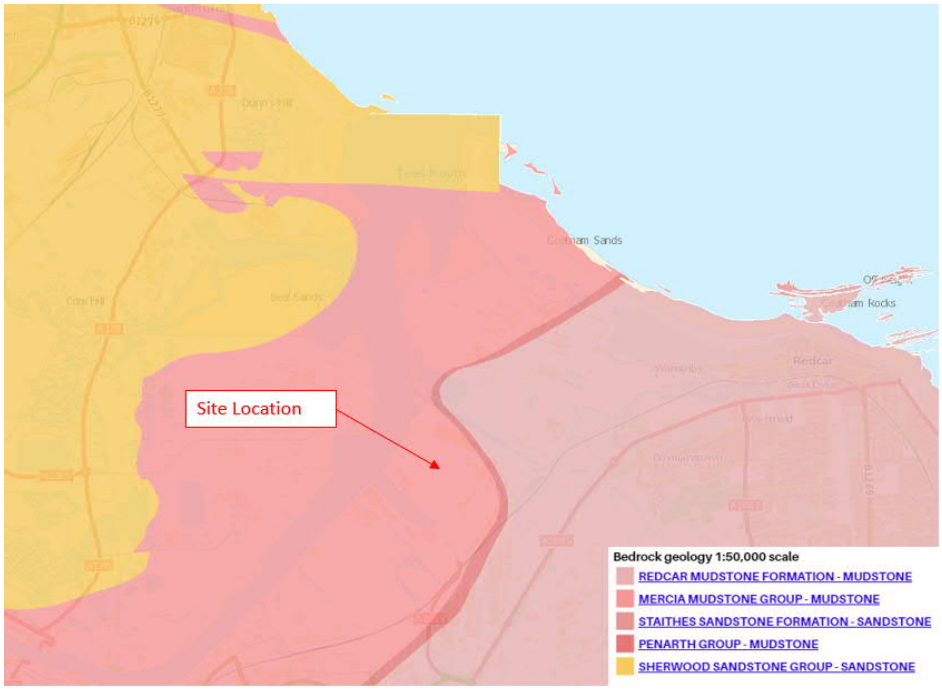


Figure 3-3 Bedrock Geology



3.5 Hydrogeology

The Tidal Flat Sand and Silt superficial deposits that underlie the site are designated as a Secondary (undifferentiated) Aquifer. Secondary undifferentiated are aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value (GOV.uk, 2022).

The Mercia Mudstone Group bedrock is classified by the EA as a Secondary B aquifer. “Secondary B aquifers are mainly lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin cracks (called fissures) and openings or eroded layers” (GOV.uk, 2022).

Soilscapes (England) (Cranfield University, 2013) mapping indicates that the site is underlain by loamy and clayey soils of coastal flats with naturally high groundwater. Shallow groundwater is likely to be in hydraulic continuity with the nearby River Tees, several metres below site level.

3.6 Utilities

The site comprises of shipping container storage with a corporate office on site. The services present on site include gas, electric, water & sewer, telecoms and infrastructure (Murphy, 2022).

Across the impermeable areas of the site, surface runoff discharges off-site via a piped network, to the northeast and southwest. It then discharges through outfalls to the Tees Estuary to the north via the off-site piped network. Interceptors are located off-site, between the site and the outfall.

Service plans can be found in Appendix A.

4 Sources of Flooding and Pathway Assessment

In accordance with the requirements of the NPPF, the flood risks from each of the following sources have been considered in this FRA:

- fluvial sources (river flooding);
- tidal sources (flooding from the sea);
- groundwater sources;
- pluvial sources (flooding resulting from overland flows);
- artificial sources, canals, reservoirs etc.;
- sewer sources; and
- breach sources.

The site is located in Flood Zone 1 (low probability of flooding) therefore detailed flood modelling was not considered be required.

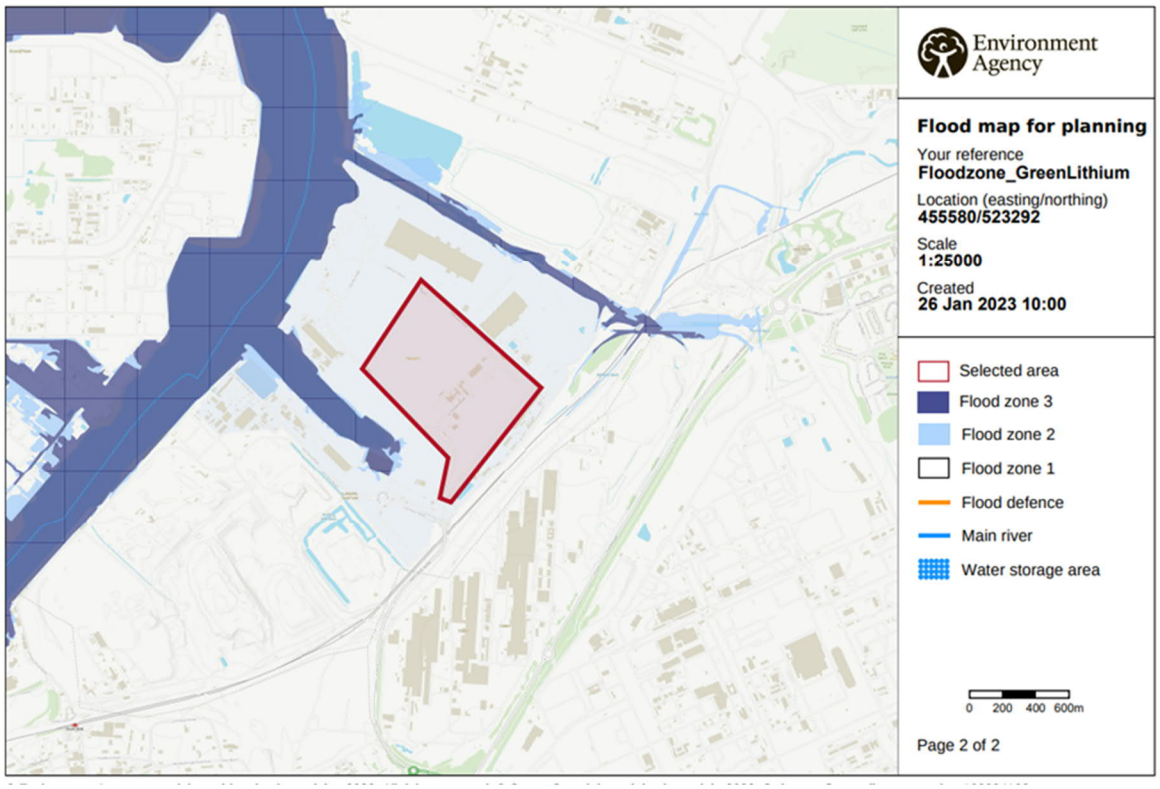
4.1 National Flood Zone Definitions

The Environment Agency flood zones are defined as follows for England:

- Flood Zone 3a - fluvial flooding 1% AEP or greater and/or tidal flooding 0.5% AEP or greater (dark blue shading on Environment Agency flood maps)
- Flood Zone 3b – functional flood plain (generally fluvial/tidal flooding 5% AEP or greater - dark blue shading on Environment Agency flood maps)
- Flood Zone 2 – fluvial and tidal flooding between 1% AEP and 0.1% AEP (light blue shading on Environment Agency flood maps)
- Flood Zone 1 – fluvial and tidal flood risk less than 0.1% AEP, unlikely to be affected by a flood (no shading on Environment Agency flood maps).

The Environment Agency's Flood Map for Planning showed the site to be located within Flood Zone 1 (Figure 4-1).

Figure 4-1 Environment Agency Flood Zone Map – Planning (Environment Agency, 2022a)



4.2 Historical Records of Flooding

Redcar & Cleveland Borough Council (RCBC) have limited records regarding historical flood incidents (JBA, 2016). The Environment Agency's historic flood map (Environment Agency, 2022b) indicates there are no historical incidents of flooding at the proposed site.

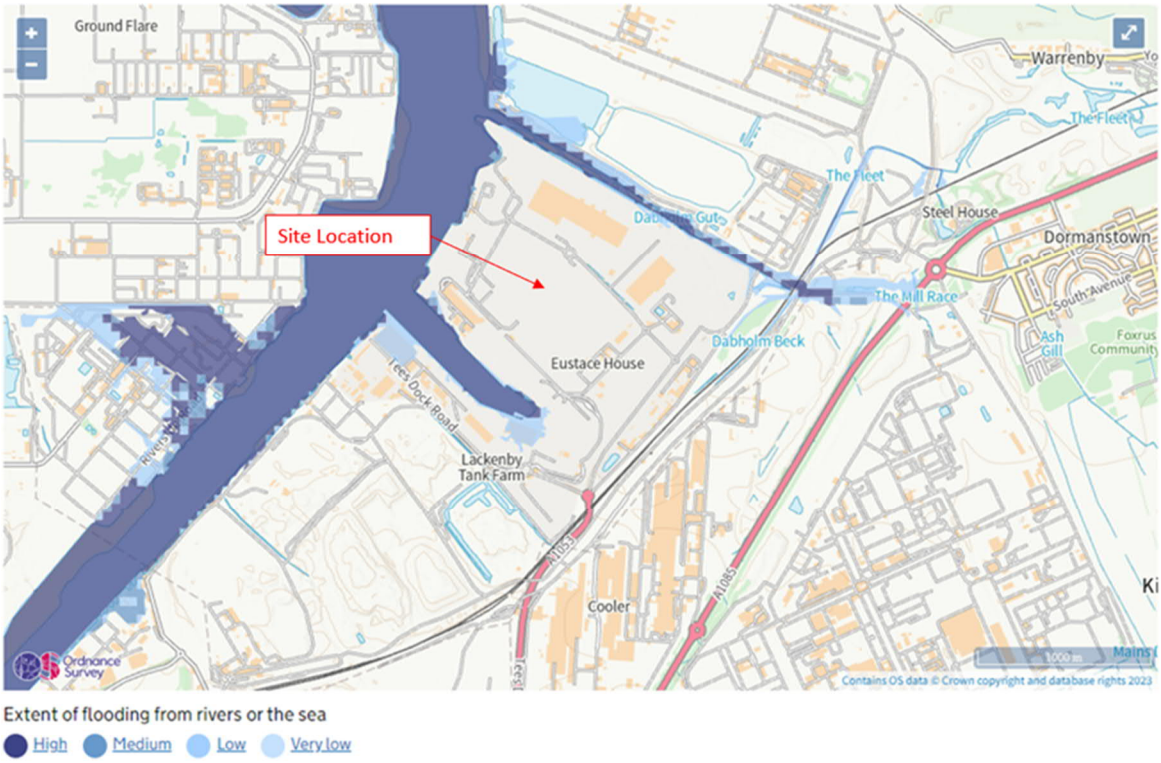
4.3 Fluvial

The Environment Agency's flood map for planning (Environment Agency, 2022a), shown in Figure 4-1, indicates that the site is located in Flood Zone 1 and, therefore, has a low probability of flooding from rivers and the sea.

The Environment Agency's long term flood risk map for flooding from rivers and the sea indicates that the site is at very low risk (Figure 4-2).

Proposed works are not considered to alter the risk of fluvial flooding.

Figure 4-2 Long Term Flood Risk – Rivers and the sea (GOV.uk, 2022a)



4.4 Tidal

The wider Tees Estuary area is shown to be at risk of tidal flooding, however the site is slightly raised and falls outside of flood zones 1 and 2 (see Figure 4-2).

The RCBC Level 2 SFRA (JBA, 2010) shows southernmost point of the site falls within the '1 in 200 year + climate change' extent (Figure 4-3) with predicted depths up to 1 m (Figure 4-4). However, the flood extent covers a small portion of the site and the overall flood risk is considered low. The development is not considered to increase the risk of tidal flooding.

Figure 4-3 Flood Extents if the Extreme Tide Levels Were Projected Over the Topography (Undefended) (JBA, 2010)

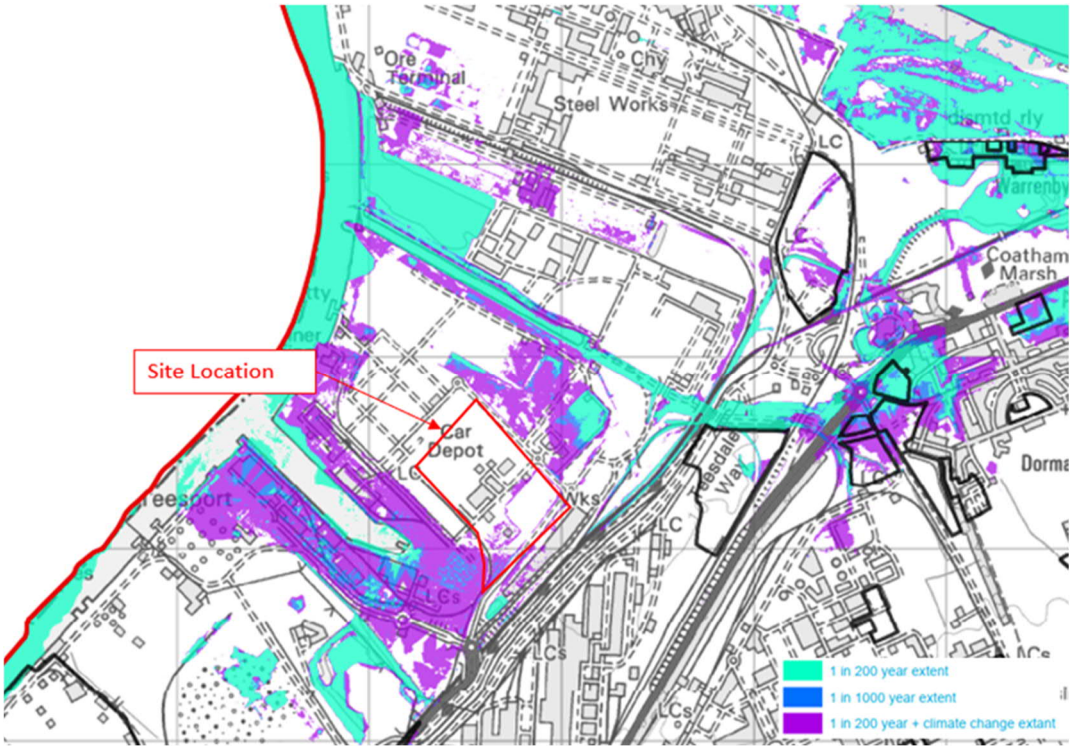
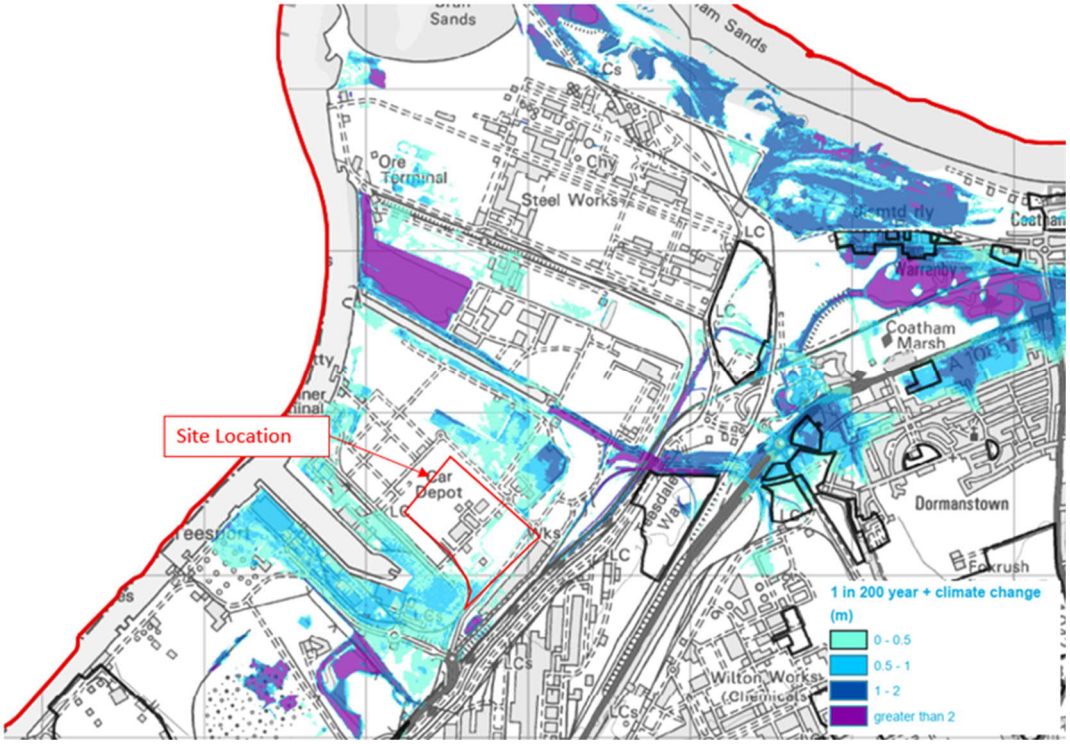


Figure 4-4 Flood Depth if the 1 in 200 year plus climate change Tidal Flooding Level (Undefended) (JBA, 2010)



4.5 Groundwater

The site is underlain by Made Ground and superficial deposits of Tidal Flat Sand and Silt (Secondary Undifferentiated aquifer). Bedrock geology comprises Mercia Mudstone Group Mudstone (Secondary B aquifer). Groundwater is anticipated to be several metres below the site, in hydraulic continuity with the River Tees.

Based on the typical infiltration coefficients in Table 4-1, it is expected that the potential for water movement is variable, with low potential in the silt and clays. Due to extensive hard standing cover as part of the land's current land use, infiltration potential across the site is currently low.

There is considered to be a low risk of groundwater flooding currently on site.

Given the nature of the proposed works, there is the potential for deep foundations and underground working to intercept groundwater, therefore the risk of groundwater flooding is considered moderate. Groundwater levels shall be determined prior to the works. All below ground elements should be designed to take into account shallow groundwater and mitigate potential risks posed.

Table 4-1 Typical Infiltration Coefficients

Soil Type	Infiltration Coefficient (mm/hr)
Gravel	10 – 1000
Sand	0.1 – 100
Loamy Sand	0.01 – 1
Sandy Loam	0.05 – 0.5
Loam	0.001 – 0.1
Silt Loam	0.0005 – 0.005
Chalk	0.001 – 100
Cut-off point for most infiltration drainage systems	0.001
Sandy Clay Loam	0.001 – 0.01
Silty Clay Loam	0.00005 – 0.005
Clay	< 0.0001
Till	0.00001 – 0.01
Rock	0.00001 – 1

4.6 Pluvial

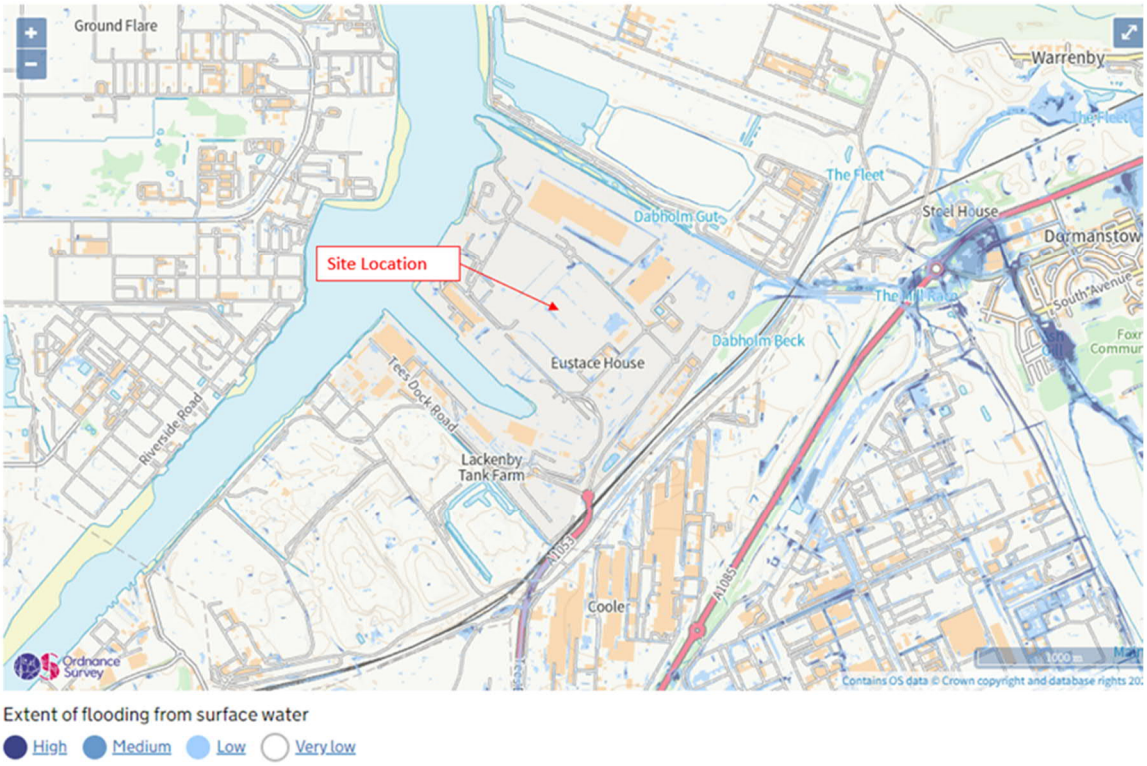
The Environment Agency's long term flood risk map for pluvial flooding indicates that the site is generally at low risk from pluvial flooding (Figure 4-5).

There are a few small areas which fall within low to medium risk of flooding, mainly located in surface water drains on site. Low risk indicates a chance of flooding of between 0.1% and 1% each year and medium risk indicates flooding of between 1% and 3.3% each year.

Under the NPPF, surface water discharges from the site should be minimised in order to maintain the low risk of pluvial flooding in the surrounding area. Proposed works are not considered to increase the risk of pluvial flooding on site or to the surrounding area.

The overall risk of pluvial flooding is low.

Figure 4-5 Long Term Flood Risk – Pluvial Flooding (GOV.uk, 2022a)



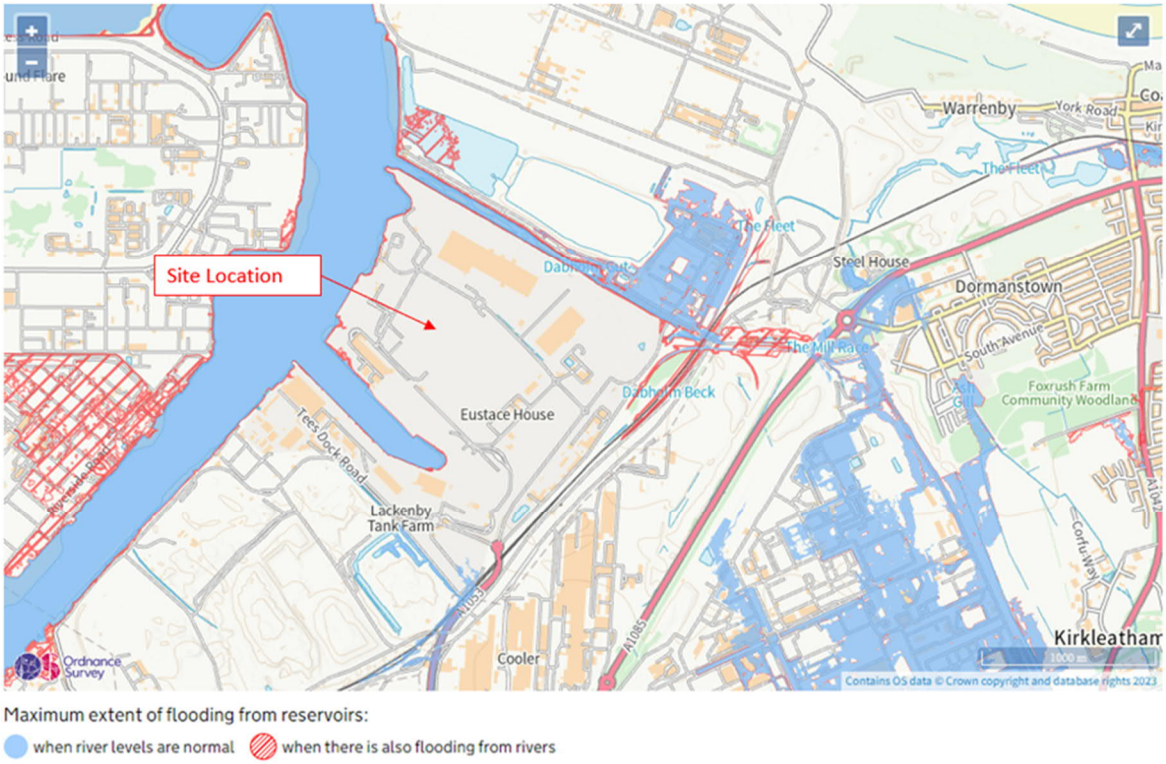
4.7 Artificial Sources

The Environment Agency flood map indicates the site is not at risk of flooding from reservoirs (Figure 4-6).

The flood map shows there is flooding from reservoirs approximately 600 m to the east of the site in drains near the Dabholm Gut and unlikely to impact the site.

The site is not considered to be vulnerable to flooding as a result of artificial sources.

Figure 4-6 Environment Agency - Flood Risk from Artificial Sources



4.8 Sewer

Sewer flooding is generally attributable to a failure (collapse) or blockage within the sewer system. The sewerage undertaker has a responsibility to maintain the operation of the sewerage system and, therefore, under normal operational conditions, sewer flooding should not occur. Therefore, it is considered to be at low risk of flooding from sewer sources.

4.9 Breach

A desktop review of aerial imagery and Ordnance Survey mapping has identified no potential sources of breach flooding.

The site is not considered to be vulnerable to flooding as a result of breach.

4.10 Flood Risk Assessment

The site is considered to be at low risk of fluvial, tidal, groundwater, pluvial, artificial, sewer and breach sources of flooding (see Table 4-2).

Table 4-2 Assessed Flood Risk Matrix

Source	Likelihood [L]	Vulnerability [V]	Risk [L x V]	Source
Fluvial	Low	Low	Low	No specific mitigation required.
Tidal	Low	Low	Low	No specific mitigation required.
Groundwater	Moderate	Low	Moderate	Determination of groundwater levels at the site. Deep foundations and sub-surface structures to be designed to mitigate impacts of shallow groundwater.
Pluvial	Low	Low	Low	No specific mitigation required.
Artificial	Low	Low	Low	No specific mitigation required.
Sewer	Low	Low	Low	No specific mitigation required.
Breach	Low	None	None	No specific mitigation required.

5 Sequential Test and Exception Test

5.1 Sequential Test

The NPPF aims to ensure that flood risk is considered at all stages in the planning process, steering development towards areas with low probability of flooding through the use of a sequential approach that avoids inappropriate development in areas at risk of flooding. Local Planning Authorities are expected to allocate land for development based on a 'Sequential Test'. This means avoiding, so far as possible, development in current and future medium and high flood risk areas considering all sources of flooding including areas at risk of surface water flooding. Only if no suitable areas are available in areas at low risk of flooding is development within areas with medium flood risk acceptable and, as a last option, within areas at high risk of flooding.

The site is located within an area of low flood risk (Flood Zone 1), therefore, the Sequential Test is not required.

5.2 Exception Test

The Planning Practice Guidance to the NPPF (MHCLG, 2022) identifies several categories of land use vulnerability classifications and the compatibility of these development types within each flood zone (Table 6-2).

Table 5-1 Flood Risk Vulnerability and Flood Zone 'incompatibility' (GOV.uk, 2022b)

Flood Risk Vulnerability Classification		Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test required	✓	✓	✓
	Zone 3a	Exception Test required	✕	Exception Test required	✓	✓
	Zone 3b	Exception Test required	✕	✕	✕	✓

Key: ✓ Development is appropriate

✕ Development should not be permitted

Based on NPPF categorisations, the site is classified as development for minerals working and processing (MHCLG, 2021) which is considered to be a "less vulnerable" land use. As the site is located within an area of low flood risk (Flood Zone 1) the application of the Exception Test is not required.

6 Surface Water management

The NPPF states that major developments should incorporate sustainable drainage systems (SuDS) unless there is clear evidence that this would be inappropriate. The systems used should:

- take account of advice from the lead local flood authority;
- have appropriate proposed minimum operational standards;
- have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
- where possible, provide multifunctional benefits.

6.1 Allowable Drainage Discharge Rates

It is assumed that the allowable discharge rate from the site during operation should not exceed the Greenfield Mean Annual Runoff Rate (QBar).

The greenfield runoff rate for the site has been calculated using the Greenfield Estimation Tool on the UK SuDS Guidance and Tools website (HR Wallingford, 2023), following the Institute of Hydrology 124 methodology. For the calculations, the entire site (23.5 ha) is assumed to contribute to surface runoff.

The results are provided in Table 6-2 and the calculations are included in Appendix B.

Table 6-1 Estimated Greenfield Runoff Rates for the Site

Event	Flow Rate (l/s)
QBar (mean annual)	94
100% AEP	81
3.3% AEP	165
1% AEP	196

Under the requirements of the NPPF, surface runoff from the site cannot increase following development as it could increase the flood risk posed downstream of the site. Attenuation and/or storage is required on site to limit the surface runoff from the site to the greenfield runoff rate.

6.2 Surface Water Storage Volume

The Surface water storage volume estimation tool (HR Wallingford, 2023) provides estimates of the required volumes of storage needed on a site along with recommendations on the limits of discharge that should be applied.

There are four storage volumes to determine. These are:

- Interception storage may not require explicit provision of storage but is the volume of runoff which must be prevented from leaving the site up to the first 5 mm of a rainfall event.
- Attenuation storage aims to limit the rate of runoff into the receiving water to similar rates of discharge to that which took place before the site was developed (greenfield runoff rate). This can

be provided at one or several different locations using a variety of SuDS or other storage techniques.

- Long Term storage is similar to attenuation storage but aims to specifically address the additional volume of runoff caused by the development. This is either infiltrated into the ground or, if this is not possible due to soil conditions, attenuated and discharged at very low rates of flow to the receiving watercourse so as to minimise the risk of exacerbating river flooding.
- Treatment storage aims to ensure the water quality of the stormwater is sufficiently improved to minimise its impact on the flora and fauna in the receiving water. This is normally provided as the dry period volume of one or more ponds. This value has not been considered in the calculation.

6.2.1 Design Criteria

The design criteria considered in the calculation were:

- The lifetime of the project is estimated to be 25 years (2050s epoch), however, in terms of climate change an additional peak rainfall intensity allowance has been added to take a conservative approach. On this basis, the climate change allowance factor considered has been 30%. This value corresponds to the central allowance of the 2070s epoch (Environment Agency, 2022c).
- The urban creep allowance factor reflects the future predicted increase of paved surfaces over the future life of the development. The site has been assumed to be 100% impermeable, therefore there is no scope for any increase in impermeable area and this factor has not been included.
- The areas considered in the calculation of surface water storage volume have been determined on the basis of the plant boundary and planning application boundary.

6.2.2 Results

Based on the design criteria, Table 6-2 lists the main inputs introduced I the tool and the storage volumes. The detailed calculations are presented in Appendix B.

Table 6-2 Surface Water Storage Requirements

Parameter	Proposed Development Area
Total Site Area (ha)	23.5
Impermeable Area (ha)	23.5
Attenuation Storage 1/100 years (m^3)	14,400
Long Term Storage 1/100 years (m^3)	4,700
Total Storage 1/100 years (m^3)	19,100

On this basis, the proposed storage required is 19,100 m^3.

6.3 Fire Water

Isolated areas of the site will have elevated fire risk due to higher risk activities. At this stage, provision will be made within the site-wide drainage system to retain any water used in the event of fire on site

for disposal at an appropriate facility. The storage volume of 19,100 m^3 is considered sufficient to meet fire water requirements.

At a more advanced design stage, areas at elevated fire risk will be identified and the potential for providing more targeted fire water storage will be considered.

6.4 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems or SuDS are a variety of surface water management techniques which reduce the velocity of surface water and partially treat it prior to discharge to a watercourse or sewer.

After consideration of the SuDS Manual approach (CIRIA, 2015), the use of rainwater harvesting, pervious paving, filter drains and gravel cover is recommended to attenuate surface runoff.

Incorporation of rainwater harvesting is recommended across suitable site buildings, with the potential for collected water to be used on-site to meet domestic and process needs. Rainwater harvesting will reduce the volume of runoff generated and will contribute to reduced attenuation storage.

Pervious paving is recommended across car park areas, enabling rainwater to infiltration into the sub-base and discharge in a controlled manner to the site drainage system. Pervious paving will reduce peak runoff through the provision of attenuation storage and offer filtration, adsorption, biodegradation and sedimentation within the sub-surface.

Filter drains are recommended along site roads. Filter drains are shallow, lined, stone/gravel filled trenches, which create temporary subsurface storage for attenuation, conveyance and filtration of surface runoff. They also offer a degree of filtration, adsorption, biodegradation and sedimentation. A perforated pipe near the base of the filter drain conveys the water into the wider site drainage system.

Across other areas of hard standing, where achievable the use of gravel cover is recommended. Pore spaces within the gravel matrix provide attenuation storage, reducing peak runoff rates. In additional the gravel provides a degree of pre-treatment as discussed with the filter drains.

Additional control of surface runoff will be achieved using on-site storage, such as a lined pond or tank. A conservative storage volume of 19,100 m^3 is required in line with the calculations in Section 6.2 and does not take into account additional SuDS recommendations.

At this stage, SuDS options which such as soakaways and permeable paving were not considered due to potential low infiltration capacity, high groundwater levels and contamination at the site.

The drainage system and attenuation storage will be designed to ensure flows off-site are limited to the QBar rate of 94 l/s.

All surface water discharges from the site will connect to the existing off-site surface water drainage system that forms part of the wider PD Teesport development and discharge into the Tees Estuary.

7 Conclusions

7.1 Flood Risk Assessment

The development is located within Flood Zone 1 and therefore has low probability of flooding from rivers and the sea. The Sequential Test and the Exception Test are not required.

The FRA demonstrates that the site is not at significant risk of flooding from fluvial, tidal, pluvial, sewer, artificial or breach sources of flooding.

There is a moderate risk of groundwater flooding associated with the development due to the potential for encountering shallow groundwater at deep foundations and sub-surface structures. Groundwater levels will be determined prior to the works, and design will take into consideration of shallow groundwater.

The use of the site is classified as “less vulnerable” which is permitted in Flood Zones 1, 2 and 3a.

The FRA demonstrates that the development is consistent with the requirements of the NPPF and that the site will not be at any additional risk of flooding or increase the flood risk to others with the mitigation measures included.

The site usage is considered to be less vulnerable and the development is deemed to be suitable. Consequently, flood risk should not be a limiting factor to the granting of Planning Consent for this development.

7.2 Surface Water Management

Surface runoff generated on site will be discharged to the River Tees via on site drainage and the existing off-site surface water drainage system that forms part of the wider PD Teesport development.

After consideration of sustainable drainage (SuDS) options, the use of rainwater harvesting, pervious paving, filter drains, gravel cover and attenuation storage tanks are recommended. These will capture, attenuate and improve the quality of surface runoff. SuDS will enable site runoff to be discharged at greenfield runoff rates (QBar), calculated as 94 l/s.

Isolated areas of the site will have elevated fire risk due to higher risk activities. At this stage, provision will be made within the site-wide drainage system to retain any water used in the event of fire on site for disposal at an appropriate facility.

8 Recommendations

It is recommended that the Local Planning Authority considers the proposed works to have no impact on flood risk and that the Site to be considered at low overall flood risk.

9 References

BGS	2022	Geology of Britain viewer http://mapapps2.bgs.ac.uk/geoindex/home.html
Cranfield University	2013	Soilscapes (England) Mapping http://www.landis.org.uk/soilscapes/
Environment Agency	2022	Statutory Main Rivers Map https://environment.maps.arcgis.com/apps/webappviewer/index-.html?id=17cd53dfc524433980cc333726a56386
Environment Agency	2022a	Flood Map for Planning https://flood-map-for-planning.service.gov.uk/
Environment Agency	2022b	Historic Flood Map https://www.data.gov.uk/dataset/76292bec-7d8b-43e8-9c98-02734fd89c81/historic-flood-map
Environment Agency	2022c	Flood risk assessments: climate change allowances https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
Google Earth	2022	Google Earth https://www.google.co.uk/earth/
Gov.uk	2022	Protect groundwater and prevent groundwater pollution https://www.gov.uk/government/publications/protect-groundwater-and-prevent-groundwater-pollution/protect-groundwater-and-prevent-groundwater-pollution
Gov.uk	2022a	Long Term Flood Risk – Pluvial Flooding https://check-long-term-flood-risk.service.gov.uk/map
Gov.uk	2022b	Flood risk and coastal change https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification
Gov.uk	2022c	National LIDAR Programme https://data.gov.uk/dataset/f0db0249-f17b-4036-9e65-309148c97ce4/national-lidar-programme
HMSO	2010	Flood and Water Management Act 2010 https://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf
HR Wallingford	2023	Surface water storage for sites Tool https://www.uksuds.com/tools/greenfield-runoff-rate-estimation
JBA	2016	Redcar & Cleveland Borough Council Level 1 Strategic Flood Risk Assessment Update, Final Report, May 2016

		https://www.redcar-cleveland.gov.uk/sites/default/files/2022-04/RCBC%20Level%201%20SFRA%20Update%202016.pdf
JBA	2010	Redcar and Cleveland Borough Council Level 2 Strategic Flood Risk Assessment, Final Report, August 2010
Ministry of Housing, Communities and Local Government (MHCLG)	2021	National Policy Planning Framework https://www.gov.uk/government/publications/national-planning-policy-framework--2
Ministry of Housing, Communities and Local Government (MHCLG)	2022	Planning Practice Guidance: Flood risk and coastal change https://www.gov.uk/guidance/flood-risk-and-coastal-change
Murphy	2022	Utility Desktop Search, Green Lithium Refinery - Surveys
North Yorkshire County Council (NYCC)	2022	North Yorkshire Local Flood Risk Strategy 2022 – 2027 https://www.northyorks.gov.uk/flood-and-water-management
Ordnance Survey (OS)	2022	Ordnance Survey Explore OS Mapping https://explore.osmaps.com
Redcar & Cleveland Borough Council (RCBC)	2018	Redcar & Cleveland Local Plan Adopted May 2018
Sol Environment	2022	Pre-Application and EIA Scoping Request Lithium Hydroxide Refining Facility. Green Lithium Refining Limited, PD Ports, Kirkdale Road, South Teesside, TS6 6TX

IMPORTANT: Do not delete this section break

APPENDIX 9.A: Service Plan

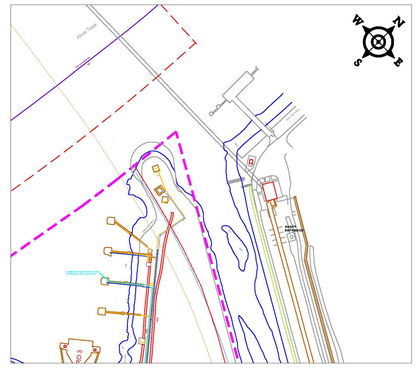
PD PORTS

PROJECT ENGINEERING DEPARTMENT
VULCAN STREET
MIDDLESBROUGH
TS2 1LX

TEL 01642 877000

TEESPORT SERVICES

REVISED: 12 JUL 2021 SCALE @ A0: 1:2,500



NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. MAP COORDINATE REFERENCE SYSTEM FOR THIS DRAWING IS BRITISH NATIONAL GRID (BNG). THE BNG SPATIAL REFERENCE SYSTEM USES OSGB36 GEODETIC DATUM AND A SINGLE TRANSVERSE MERCATOR PROJECTION. POSITIONS ON THIS PROJECTION ARE DESCRIBED USING EASTING AND NORTHING COORDINATES IN UNITS OF METRES.
3. ALL LEVELS IN METERS RELATIVE TO ORDNANCE DATUM NEWLYN (ODN) UNLESS OTHERWISE STATED.
4. MAP PROJECTION SCALE FACTOR IS 0.9996 ETSD

LEGEND

- ESTATE BOUNDARY
- BUILDING
- RAIL TRACK
- CRANE RAIL
- TIDAL WATER RANGE
- STRUCTURES
- LIGHTING MAST

- SW — SW — SURFACE WATER DRAIN
- SW SW — SURFACE WATER DRAIN ABANDONED
- FOUL — FOUL — FOUL WATER
- F F — FOUL WATER ABANDONED
- RW — RW — RAW WATER
- WATER — WATER — POTABLE WATER
- W W — POTABLE WATER ABANDONED
- 400 LV — 400 LV — ELECTRICITY 400LV
- LV LV — ELECTRICITY LV ABANDONED
- 11kV — 11kV — ELECTRICITY 11kV (HV)
- 66kV — 66kV — ELECTRICITY 66kV (HV)
- 275kV — 275kV — ELECTRICITY 275kV (HV)
- DUCT OUTLINE
- D x1 — D x1 — 1x DUCT IN A ROUTE
- D x2 — D x2 — 2x DUCTS IN A ROUTE
- D x3 — D x3 — 3x DUCTS IN A ROUTE
- D x4 — D x4 — 4x DUCTS IN A ROUTE
- D x5 — D x5 — 5x DUCTS IN A ROUTE
- D x6 — D x6 — 6x DUCTS IN A ROUTE
- BT — BT — BT COMMS
- BT BT — BT COMMS ABANDONED
- NAT. GAS — NAT. GAS — NATURAL GAS SUPPLY
- B. OXY — B. OXY — BOC OXYGEN PIPELINE
- B. NIT — B. NIT — BOC NITROGEN PIPELINE
- FIRE — FIRE — FIRE MAIN DRY

- NON RETURN VALVE — NON RETURN VALVE
- DIRECTIONAL FLOW
- ISOLATION VALVE — ISOLATION VALVE
- PENSTOCK
- SHOWER
- HYDRANT
- WATER METER
- WATER METER
- MH — MANHOLE CHAMBER COVER
- GULLY — GULLY DRAIN
- LP — STREET LIGHT AND BASE
- STREET LIGHT
- DP — DRAW PIT COVER
- DP BT — DRAW PIT BT COVER
- BT — BT BOX
- BT CABINET — BT SURFACE CABINET
- DB — DISTRIBUTION BOARD

ALL MODIFICATIONS AND CHANGES RELATED TO INFORMATION SHOWN ON THIS DRAWING MUST BE REPORTED TO PROJECT ENGINEERING DEPARTMENT.