Immingham Green Energy Terminal

TR030008

Volume 6

6.4 Environmental Statement Appendices

Appendix 18.B: Drainage Strategy

Planning Act 2008

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

September 2023

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

Immingham Green Energy Terminal

Development Consent Order 2023

6.4 Environmental Statement Appendices

Appendix 18.B: Drainage Strategy

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Revision 1	21 September 2023	DCO Application

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1 Introduction

1.1 Background

1.1.1 This document is an appendix to an Environmental Statement ("ES") which has been prepared by AECOM Ltd ("AECOM") on behalf of Associated British Ports ("ABP") ("The Applicant"). This document supports an application for development consent ("the Application") for the construction, operation and maintenance of a multi-user liquid bulk Terminal, which would be located on the eastern side of the Port of Immingham ("the Port"), as well as associated development (collectively termed "the Project"). A part of the associated development is the construction and operation of a green hydrogen production facility for the production of green hydrogen from imported green ammonia on site by Air Products BR Ltd ("Air Products"). This document describes the surface and foul water drainage strategies associated with the landside development forming part of the Project. It details the applicable design standards, policies, and key design criteria that have been applied in developing a technically viable and compliant concept drainage strategy. Approval of and compliance with one or more final drainage plans, in accordance with this strategy, is secured by a requirement of the **draft Development Consent Order** ("DCO") **[TR030008/APP/2.1]**.

1.1.2 The Project would comprise the alteration of a harbour facilities for the construction, operation and maintenance of a multi-user green energy terminal to facilitate the import and export of bulk liquids associated with the energy sector, together with associated development. The terminal consists of a jetty and associated loading/unloading infrastructure, landside infrastructure and pipelines connecting to a number of storage and processing areas inland. The Site is located in North East Lincolnshire on the south bank of the Humber Estuary to the east of the Port as shown in **Plate 1**. **Chapter 2: The Project [TR030008/APP/6.2]** of the ES provides further detailed information.

1.1.3 For this drainage strategy, the Site is split into three main areas, named; 'East Site – Hydrogen Production Facility', 'East Site – Ammonia Storage Area' and 'West Site'. These lie on individual plots of land, separated by public roads. These areas represent the permanent operational parts of the Project that would be actively drained by the proposed systems. These areas, together with the jetty and jetty access road, are described further in the next section.

1.2 The Site

1.2.1 The Project (see **Section 2**) will be constructed on land that is currently largely undeveloped and could therefore increase surface water runoff through an increase in impermeable area. The current condition of the East Site – Hydrogen Production Facility is artificially raised and has been developed previously. The East Site – Ammonia Storage Area appears to have been used for stockpiling and may have been levelled but is not currently paved. The West Site is greenfield.

1.2.2 The Project includes a jetty that extends into the Humber estuary and contains a pipe rack and vehicle access. The access is expected to carry up to five vehicle movements a day and its use is therefore not considered a pollution risk. The jetty is located over the river and therefore no drainage attenuation is required. For this reason the jetty is not considered any further in this drainage strategy.

1.2.3 Connecting the jetty to the operational sites is an access road and utility corridor. This road and corridor will be located above a stretch of drainage ditch, which will be culverted beneath. Analysis of the surrounding topography suggests the stretch of ditch does not receive flow from the adjacent land. Whilst the detailed design of the culvert is yet to be prepared, it is intended that the culvert will provide a similar flow area to the ditch as a minimum. The walkway section of the road will be positioned above the culverted ditch and will be grated to allow surface water runoff to continue to reach the ditch as it does currently. The adjacent road and utility corridor will drain to the ditch directly or via a filter drain or filter strip. This represents a small increase in the area draining directly to the ditch. While flows to the ditch may be slightly increased during storm events, this will be more than balanced by the reduction in upstream flow brought by the works for the East Site – Hydrogen Production Facility (see below). The design also provides effective access for maintenance. For these reasons no further input to the drainage strategy is considered necessary for the jetty access road and utility corridor.

1.2.4 The East Site – Hydrogen Production Facility (see **Plate 1** and **Plate 2**) is bound to the north by industrial land (owned by Associated Petroleum Terminal ("APT") Immingham), to the east by an existing drainage channel, which separates the Site from an area of woodland known as Long Strip which is subject to a tree preservation order, to the west by Queens Road and an unnamed road and to the south by Laporte Road. This part of the Site is currently accessed from an unnamed private road to the west.

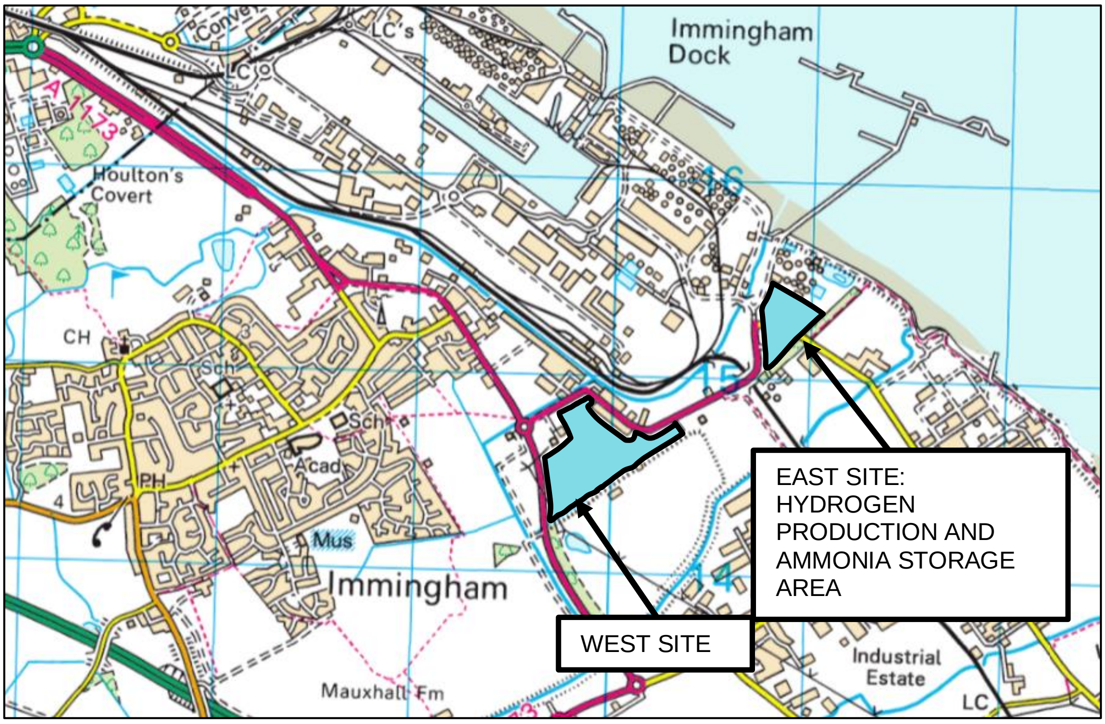
1.2.5 The East Site – Ammonia Storage Area (see **Plate 1** and **Plate 2**) is bound by Laporte Road to the north (and the East Site – Hydrogen Production Facility beyond), an existing drainage channel to the east and south, and Queens Road to the east. The site is currently accessed from Queens Road to the west.

1.2.6 The West Site (see **Plate 1** and Plate 3) is bound to the north by Kings Road and a power station, to the east by Queens Road, to the south by an existing drainage channel and to the west by the A1173. It is currently accessed from Kings Road to the north.

1.2.7 The East Site – Hydrogen Production Facility and East Site – Ammonia Storage Area (together the East Site) are located approximately 1.7km to the east of the suburbs of the town of Immingham, and approximately 0.25km west of the Humber Estuary, at its closest points. The West Site is located approximately 460m to the east of Immingham's closest suburbs.

1.2.8 The eastern sites are centred on Ordnance Survey ("OS") National Grid Reference ("NGR") SD 53.620058, -0.174425. The West Site is centred on OS NGR SD 53.614078, -0.189049. See **Plate 1** below.

Plate 1: Location of the Site, East of Immingham



2 The Project

2.1.1 The Site is currently undeveloped and, as explained above, can be accessed from Kings Road, Queens Road and an unnamed private road.

2.1.2 The Project is planned to be constructed in a number of phases with the East Site – Ammonia Storage Area and part of the West Site being included in Phase 1. The other main site elements will be constructed in later phases to complete the Project. This drainage strategy presents a proposed design which will meet the requirements for the management of surface water drainage after all phases have been constructed. The design may also be used to manage surface water during the construction phases if the construction work is planned appropriately.

2.1.3 The East Site - Hydrogen Production Facility area consists of three hydrogen production units to produce hydrogen, separated by asphalt paving. The East Site - Ammonia Storage area contains an ammonia tank and a boil off gas unit. The West Site contains hydrogen production units, hydrogen liquefier units, a liquid H_2 bullet storage area and a trailer loading and venting area.

2.1.4 The relevant works are set out in Schedule 1 of the **draft DCO [TR030008/APP/2.1]** and will take place within the areas allocated for those works shown on the Work Plans **[TR030008/APP/4.2]**. See **Plate 2, Plate 3;** and **Plate 4,** for the illustrative plans of how the Project could come forward within defined Project parameters, however, the detailed design is yet to be finalised. For further detail refer to **ES Chapter 2: The Project [TR030008/APP/6.2].**

2.1.5 The total area of the East Site – Hydrogen Production Facility, East Site – Ammonia Storage Area and West Site is 27.4ha. As explained above, this does not include the jetty and access road as these do not have a drainage system associated with them. The West Site has a footprint of 19.9ha, the East Site - Hydrogen Production Facility has a footprint of 4.8ha and the East Site - Ammonia Storage Site has a footprint of 2.7ha. An unnamed land drain currently exists along the south-west boundaries of the East Site – Hydrogen Production Facility and the East Site – Ammonia Storage Area. To the east of these two parts of the Site, the land drain connects to North Beck Drain. At the West Site, an unnamed land drain runs parallel to the southern boundary, connecting to a pumped system that also feeds North Beck Drain.

Plate 2: East Site – Hydrogen Production Facility

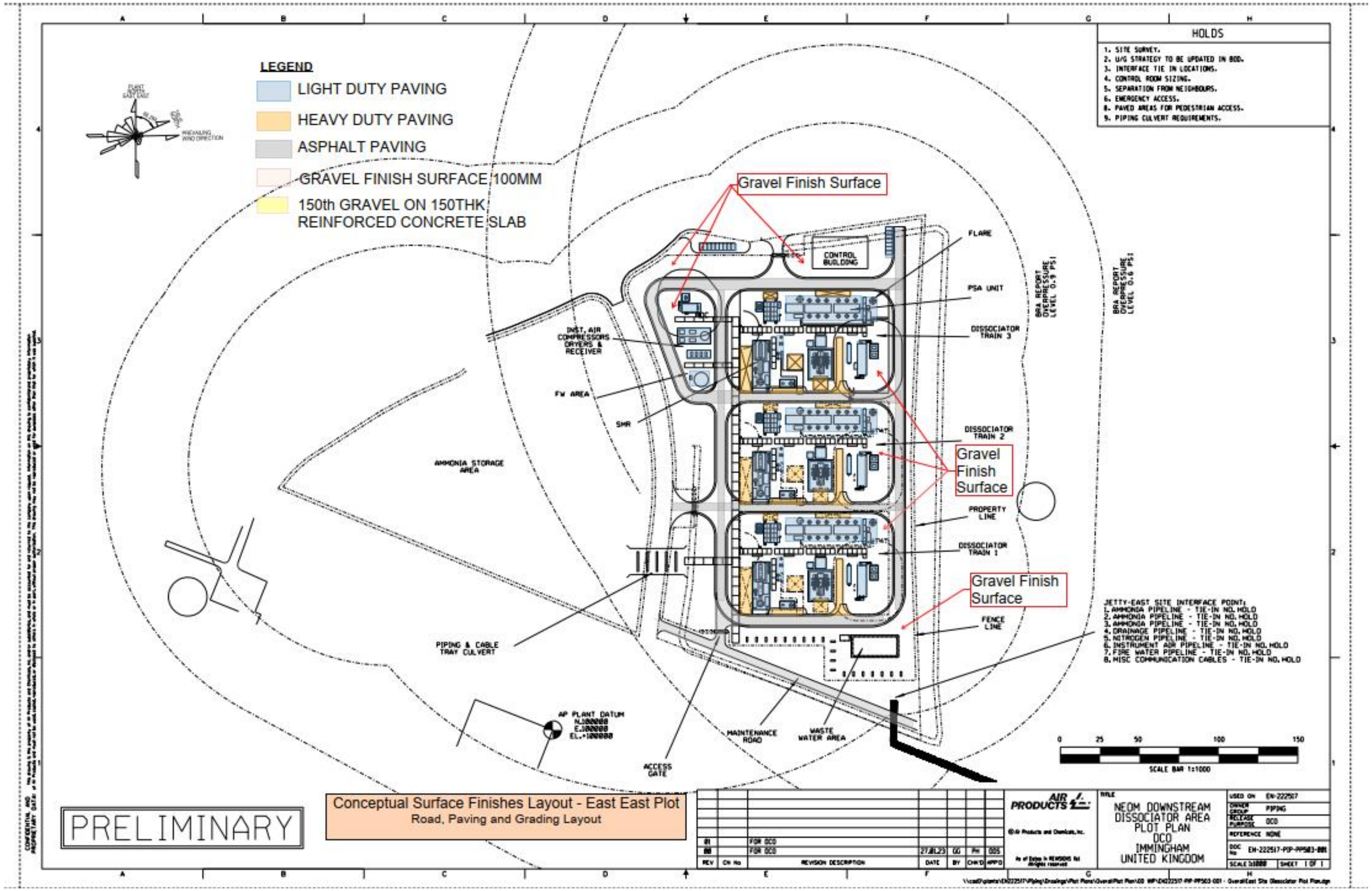


Plate 3: East Site – Ammonia Storage Area

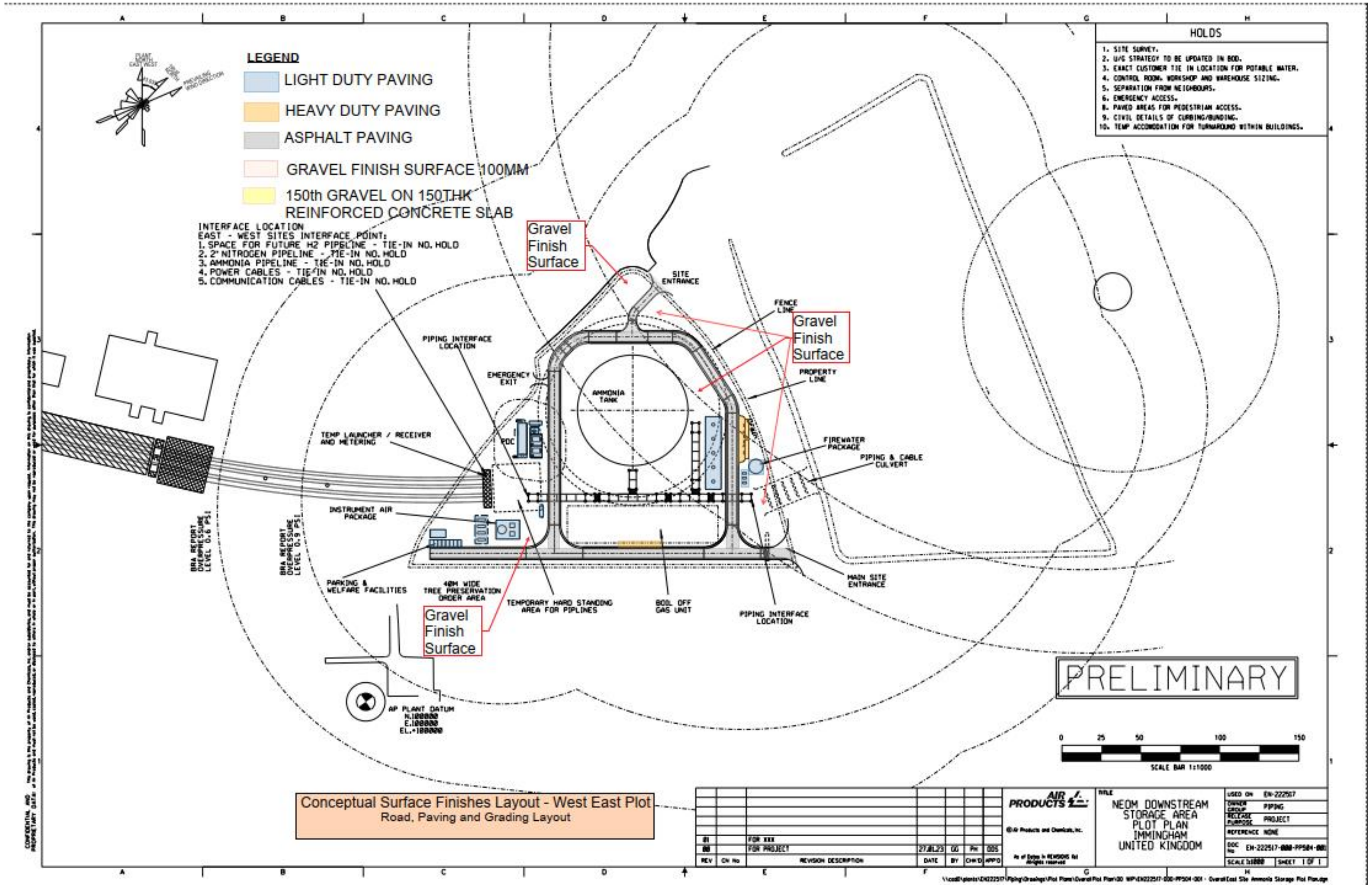
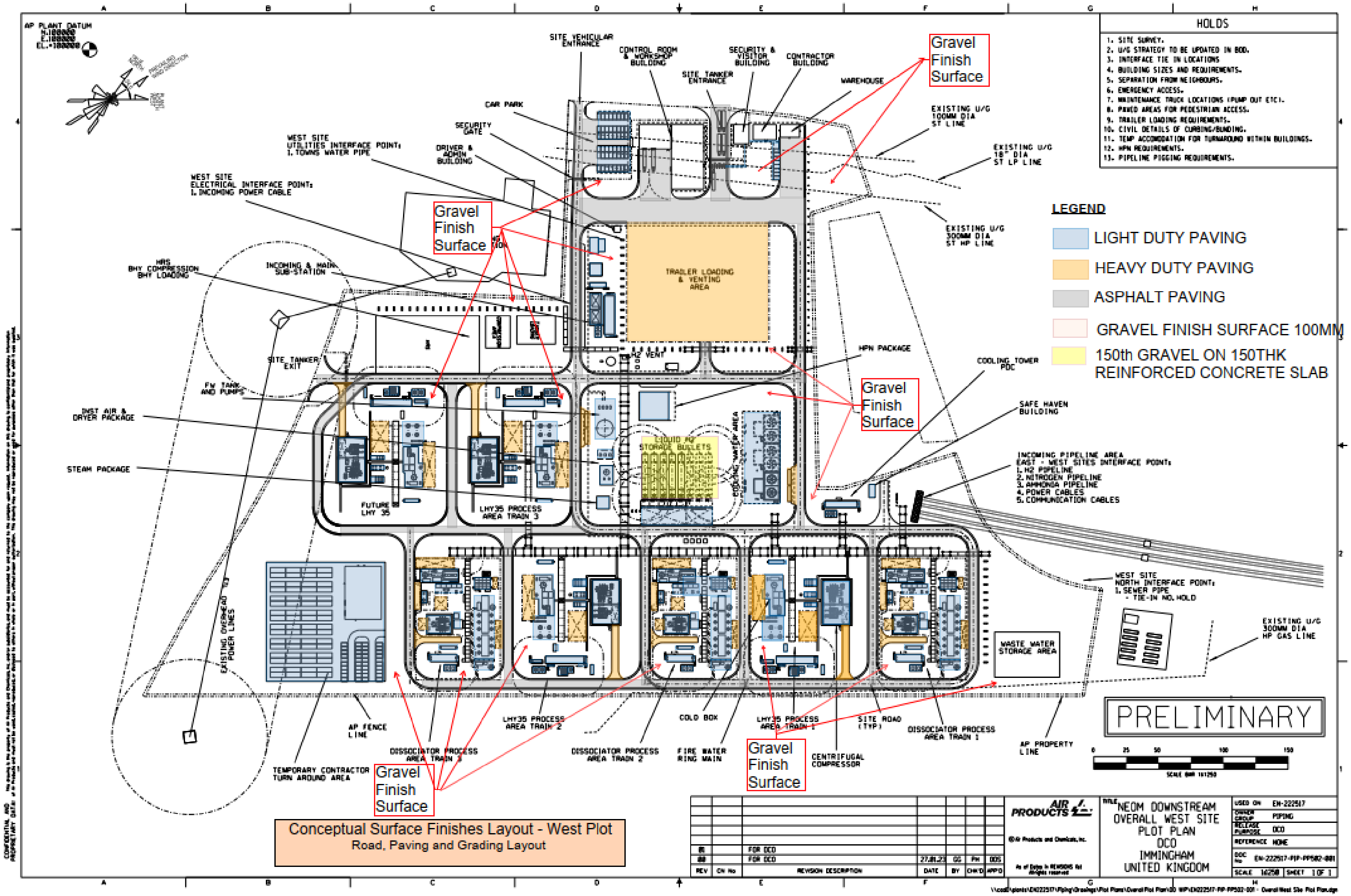


Plate 4:West Site



3 Policy and Legislation

3.1 National Planning Policy Framework

3.1.1 National Planning Policy Framework ("NPPF") (Ref 1-1) and its supporting Planning Practice Guidance ("PPG") requires that the Project should not increase flood risk both on the Site and in the area surrounding it, meaning that surface water runoff should not exceed the peak volumes already generated on the Site and that betterment should be provided, where possible. The NPPF does not contain specific policies for nationally significant infrastructure projects ("NSIPs"). The framework states that communities should be made resilient to the impacts of climate change.

3.2 National Policy Statement for Ports ("NPSfP")

3.2.1 The NPSfP is a framework to address proposals for port development in the UK and associated development (rail and road). It describes the UK Government's policy on new port infrastructure in the context of future demand, needs and the current economy. The NPSfP is the relevant National Policy Statement for the Project.

3.2.2 Paragraph 5.2.9 of the NPSfP states that where an application for development consent order has drainage implications, approval for the drainage system will form part of the development consent. The development should not increase flood risk elsewhere and priority should be given to the use of sustainable drainage systems ("SuDS").

3.2.3 The document also notes the requirement to engage with the decision maker and a range of other relevant bodies. For the Project the North-East Lindsay Internal Drainage Board ("IDB") is a key body in the determination of planning applications. The IDB have responsibility for the operation and maintenance of a number of drainage features across Immingham. Their primary role is to manage water levels and reduce the risk from flooding within their district. They are a consultee in planning decisions within the IDB area.

3.3 North and North-East Lincolnshire Strategic Flood Risk Assessment

3.3.1 Paragraph 9.7 in Appendix D of the North and North-East Lincolnshire Strategic Flood Risk Assessment[i] ("SFRA") document states that, surface water runoff from new development sites must be managed sustainably such that flood risk is not increased on site or elsewhere and that major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate.

3.3.2 The assessment states throughout that climate change should be considered in line with current guidance. The current guidance is from the Environment Agency and is called "Flood risk assessments: climate change allowances" which was updated 27 May 2022. (Ref 1-87Ref 1-8)

3.3.3 Section 8 of the SFRA stipulates the expectations of the council for designers and developers regarding the use of SuDS. It summarises various types of SuDS and appropriate considerations when incorporating them into a drainage strategy.

3.3.4 The National Planning Practice Guidance and paragraph [2.4] in Section 2 of the North and North-East Lincolnshire SFRA both require the use of the sequential approach where the discharge of surface water into the ground (infiltration) should be the preferred disposal method unless it can be demonstrated why this is not possible.

3.4 North-East Lincolnshire Council Local Plan

3.4.1 North-East Lincolnshire Council ("NELC") (Ref 1-2) is the Lead Local Flood Authority ("LLFA"). Their Local Plan[ii] includes a Flood Risk Policy which states sustainable drainage (SuDS) should be incorporated into all development proposals unless their use has been deemed inappropriate.

3.5 Other Relevant Policy, Standards and Guidance

Non-Statutory Technical Standards for Sustainable Drainage Systems (2015)

3.5.1 The Non-Statutory Technical Standards for Sustainable Drainage Systems produced by Department for Environment, Food & Rural Affairs ("DEFRA") (Ref 1-3) represent the current guidance for the design, maintenance and operation of SuDS. The standards set out that peak runoff rates from development sites should be as close as is reasonably practicable to the greenfield rate but should never exceed the pre-development runoff rate.

3.5.2 The standards also set out that drainage systems should be designed so that flooding does not occur on any part of a site for a 1 in 30-year rainfall event, and that no flooding of a building (including basement) would occur during a 1 in 100-year rainfall event.

3.5.3 It is also noted within the standards that pumping should only be used when it is not reasonably practicable to discharge by gravity.

Building Standards Regulations 2000 Part H

3.5.4 The Building Standards Regulations 2000 Part H (Ref 1-4) requires that surface water runoff be preferentially discharged first to soakaway, then to surface watercourse and finally to sewer.

4 Desk Study

4.1 Topography

4.1.1 Review of OS mapping and contours from an aerial survey indicates that all three Site areas are relatively flat.

4.1.2 At the East Site – Hydrogen Production Facility, the ground elevations range from 3.0m – 4.0m Above Ordnance Datum (“AOD”). At the East Site – Ammonia Storage Area, ground elevations range from 3.0m-4.5mAOD. Both sites gradually slope downwards to the south-east, towards the unnamed drainage ditch running to the north-east.

4.1.3 For the West Site, the ground elevations range from the highest point of 3.0mAOD at the north-east corner, to 2.0mAOD at the lowest point in the south-west corner. The ground levels slope towards the southern boundary, where the drainage ditch lies.

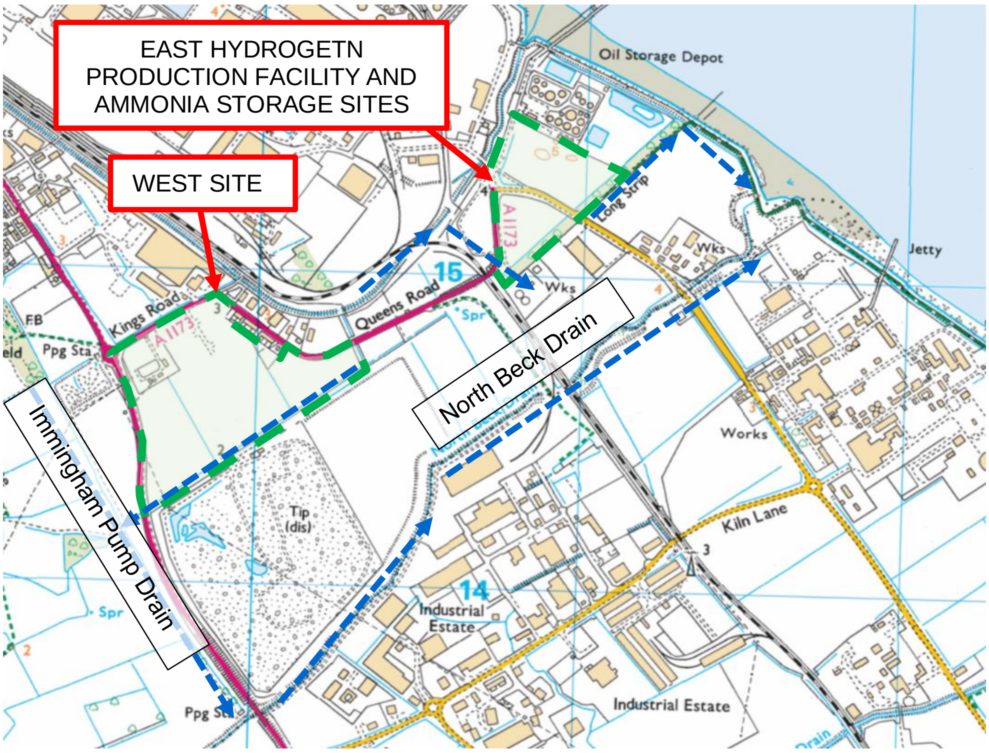
4.2 Existing Site Surface Water Conditions

4.2.1 There are no watercourses running directly across the East Site, but there are some ditch drains running alongside the boundaries of the two parts. The wider area surrounding the Project has a complex network of ditch drains feeding into the North Beck Drain. This, combined with the close proximity and similar water levels of the River Humber, suggests that infiltration is not possible at these Sites. As a result, this means they must discharge to the ditch network.

4.2.2 In discussions with the IDB it was agreed that the East Site - Hydrogen Production Facility and East Site - Ammonia Storage Area can be considered formerly developed brownfield land. The IDB confirmed that the surface water discharge into the surrounding IDB managed drainage system from any redevelopment will be expected to be reduced to 70% of the ‘real’ existing discharge. The East Site – Ammonia Storage Area appears to not have any impermeable surface but was likely a stockpile area and may have been compacted or paved previously. The East Site – Hydrogen Production Facility Site is artificially raised and contains a drainage system. It was agreed with the IDB that discharge should be estimated from this part of the Site and used in the calculation of a 70% reduction.

4.2.3 The West Site is crossed by local watercourses forming part of the wider managed low land drainage network. These discharge to the existing drainage ditch along the southern boundary. As the West Site is currently undeveloped land, the IDB confirmed that flows leaving the Site should be restricted to greenfield rates, in alignment with the North Lincolnshire SUDS and Flood Risk Guidance Document. See **Plate 5** below for the existing drainage ditches and flow paths for the West and East Sites.

Plate 5: Existing Drainage Ditch Systems around the Site



4.3 Existing Flood Risk

4.3.1 The **Flood Risk Assessment** (**Appendix 18.A [TR030008/APP/6.4]**) describes the flood risk for the Site. To summarise, the flood risk to the Project from surface water is considered to be low, and the flood risk from groundwater is considered to be medium due to the potential for high groundwater levels. The proposals here are concerned with changes to the surface water behaviour and this suggests there are no existing issues in terms of surface water drainage that require management.

4.4 Ground Conditions

4.4.1 An Interim Geotechnical Advice Note (AECOM, 07/02/2023) has been produced, based on a preliminary assessment of ground conditions across the Site. It is based on draft borehole and trial pit logs available up to 23 December 2022.

4.4.2 Borehole logs show the bedrock geology beneath the Site is Chalk. The superficial deposits beneath the majority of the Site are Clay and Silt (Tidal Flat Deposits). This further supports the assumption that infiltration is not possible at the Site.

4.4.3 The North Lincolnshire and NELC Flood Risk Assessment 2022 notes that there is a risk of artesian spring flows in a wide area that includes the Site. No direct evidence has been found for this and the colloquial understanding of the area suggests it is not an issue. If spring flows are present, it would require the use of dewatering during construction and may result in a baseflow moving through the SuDS ponds during normal operation. The impact of this baseflow would need to be quantified and mitigated during the detailed design stage, potentially resulting in a higher allowable discharge rate at all locations. This would be developed in coordination with the NELC and the IDB and would be part of the drainage plan that is approved before construction.

5 Surface Water Management Strategy

The following strategy for surface water considers each of the relevant three parts of the Project in turn and outlines the likely impact on surface water flows across the Site.

5.1 Proposed Surface Water Run-Off Rates Limits

5.1.1 The drained area of the Project covers 27.4ha across the three sites, with a cumulative total of 11.8ha of hardstanding areas, which are assumed to be impermeable. At each site, the hardstanding areas will be served by a drainage system and attenuated to the agreed discharge rate. Through discussion with the North-East Lindsey IDB, acceptable surface water runoff rates have been agreed for each of the three Sites and are identified below.

5.1.2 As explained above, for the East Site - Hydrogen Production Facility and East Site - Ammonia Storage Area, the surface runoff post-development should be limited to 70% of the ‘real’ existing discharge rate. They both have been partly developed in the past, with hardstanding areas present. For the West Site, surface water runoff has been agreed to be limited to the Q_{bar} greenfield rate, as it is considered an undeveloped site with no hardstanding areas.

5.2 Catchment Areas Outside of the Proposed Site

5.2.1 A review of LiDAR data enabled identification of the wider catchment that drains to the three sites. There is no wider catchment area draining into the area comprised in the East Site - Hydrogen Production Facility and East Site - Ammonia Storage Area. There are two areas which drain into small ditches crossing the West Site. Detailed design has not been carried out for these locations, but it is expected that a similar sized channel will be created to move any surface flow around the raised areas of the West Site. By doing this, the current drainage of these areas is maintained. At detailed design stage, the ground levels will be finalised and the required channel sizes calculated. This will form part of the final drainage plan that will be submitted for approval.

5.2.2 Drawing 60673509-ACM-XX-XX-0004 in **Annex A** shows the general flow directions of the surrounding land and also identifies the required drainage ditch realignments in the West Site.

5.3 Greenfield Runoff Rates

IH24 Greenfield Runoff Rates

5.3.1 The greenfield runoff rates for the three sites have been calculated using Flood Estimation Handbook (“FEH”) data for catchment 520659 414825, and the IH124 Method (Ref 1-5). The catchment identified for this point is located in the centre of all the Sites. Based on Equation 8 in The Revitalised Flood Hydrograph Model: ReFH2.2 Technical Guidance (Ref 1-6) [iii], the peak greenfield runoff rates have been calculated as shown in **Table 1** below. From discussion with the IDB, the Q_{bar} value for greenfield rate has been used, which is equal to the mean annual greenfield peak flow. Q_{bar} has been calculated for all three sites, to give a comparison figure for the calculated 'real' discharge runoff rates that will be used for the two parts of the East Site.

Table 1: Greenfield Peak Runoff Rate for the East and West Sites

Site	Area (ha)	Q_{bar} (l/s)
East: Hydrogen Production Facility and Ammonia Storage	7.5	18.3
West	19.9	49.0

5.3.2 As discussed above, the surface water discharge rate limit for the West Site is agreed to be the greenfield peak runoff rate which is 49 l/s.

'Real' Greenfield Runoff Rates

5.3.3 For the East Site, surface water runoff should be limited to 70% of the 'real' discharge rates present, based on an assessment of the existing drainage ditch which runs along the south-east boundary.

5.3.4 Photos from a site walkover show a twin concrete pipe culvert discharging surface water from the East Site - Hydrogen Production Facility Site into the drainage ditch. As a topographic survey has not been undertaken, LiDAR data was used to estimate the inlet channel depth and drainage ditch depth. From photos, the diameter of each culvert pipe was estimated to be 300mm and the channel gradient was estimated to be 1 in 100. From an open channel calculation, for one pipe assumed to be running at full bore, the discharge was determined to be 28 l/s.

5.3.5 No information was available for the East Site – Ammonia Storage Area to calculate the 'real' discharge. From discussions with the IDB (refer to **Annex B**), it was decided that 70% of 28 l/s should be taken as the combined discharge limit for the East Site, giving a combined discharge rate limit of 19.6l/s. Relative to the area of each Site, this gave a discharge rate of 12.6 l/s and 7.0 l/s for the Hydrogen Production Facility Site and Ammonia Storage Site respectively. It can be seen that this is only marginally above the greenfield rate for the two areas.

Summary

5.3.6 **Table 2** below summarises the agreed surface water discharge rate limits for all three Sites.

Table 2: Determined Surface Water Greenfield Discharge Rates

Site	Area (ha)	Limiting Discharge Rate (l/s)
East: Hydrogen Production Facility	4.8	12.6
East: Ammonia Storage Area	2.7	7.0
West	19.9	49.0

5.3.7 As the total area of impermeable surfaces will increase across all three sites, it will be necessary to mitigate increased runoff to the above determined greenfield rate.

5.4 Attenuation Storage

5.4.1 In order to prevent increases in flood risk downstream, in accordance with NPPF, NELC and IDB requirements, surface water discharge from each of the sites should be restricted to the determined runoff rate. Surface water attenuation will be required, to ensure the agreed runoff rates (**Table 2**) are not exceeded.

5.4.2 For all three sites, the proposed drainage system is designed to store a 100-year design storm plus a 40% climate change ("CC") allowance with no surface water flooding. This corresponds to the "Upper End" climate change allowance for both the 2050s and 2070s. As shown in **Table 3** the agreed runoff rates for the East Site – Hydrogen Production Facility; East Site – Ammonia Storage Area; and West Site are 12.6 l/s, 7.0 l/s and 49.0 l/s, respectively. The proposed storage volume prevents flow leaving the sites for storms up to the design storm and therefore prevents the site from having a negative impact on the surrounding land.

Quick Storage Estimate

5.4.3 An initial estimate of the required storage volume for each site was undertaken using InfoDrainage. The typical approach to estimating storage volumes is based on the impermeable areas of each site, assuming infiltration takes places across all other areas. This would normally give suitable values to mitigate for the additional runoff caused by the impermeable areas of the site.

5.4.4 For the three relevant sites, there is low permeability and the low, flat land means there are restricted flow routes to the wider drainage network. During larger storm events in current conditions, parts of the sites are expected to lie under water, due to the inability of the sites to drain. This means that a flood risk would remain and any infrastructure located in this area would be impacted. To compensate for this, a further estimate of required storage volume was undertaken for each site assuming all parts of the sites act as if they are impermeable, so that a larger attenuation storage is required.

5.4.5 **Table 3** provides the results of this storage estimate, undertaken using InfoDrainage. The analysis used FEH data from catchment 520659 414825 and the agreed runoff rates as shown in **Table 3**. A storage estimate has only been undertaken for the 1 in 100-year+40% CC event, due to the need at this site to store all water below ground and prevent impact to the surrounding land (refer to Paragraph 5.4.7.

Table 3: Storage Volumes at Agreed Runoff Rate

Rainfall Event Frequency		**To Achieve Agreed Runoff**					
	Site	Hydrogen Production Facility		Ammonia Storage		West	
	Flow (l/s)	12.6		7.0		49	
	Area (ha)	*4.8*		*2.7*		*19.9*	
		Min Storage (m³)	*Max Storage (m³)*	*Min Storage (m³)*	*Max Storage (m³)*	*Min Storage (m³)*	*Max Storage (m³)*
1 in 100 year (1% AEP) + 40% CC		3,857	4,565	2,082	2,470	14,358	18,319

CC= Climate Change

5.4.6 To meet the agreed runoff rates during a 1 in 100 year +40% CC event, an estimated storage volume of up to 4,565m^3, 2,470m^3 and 18,319 m^3 is required for the East Site – Hydrogen Production Facility, East Site – Ammonia Storage Area and West Site respectively.

Site Ground Raising

5.4.7 The volumes stated above represent significant storage volumes. All three sites lie at low ground levels, relative to the drainage ditches they are proposed to drain into. As a result, ground raising is necessary at all three Sites, to allow for a drainage system with underground storage which is able to drain freely under gravity into the required ditch. The raising of the land, in conjunction with the area of infrastructure involved in the Project, make it difficult to store any volume on the surface, as is also allowed by the relevant policy. Therefore, the drainage strategy proposes the majority of attenuation storage below ground. Where space allows, surface storage has been provided adjacent to the proposed infrastructure and consists of a basin with banks raised to the same level as the adjacent raised ground. A drainage model has been created, described in **Section 5.7**.

5.5 Sustainable Drainage Systems

5.5.1 There are several potential SuDS options that could be utilised to both manage and attenuate runoff. However, consideration of the site characteristics must be given to ensure that the drainage system is compatible. The NPPF and the Environment Agency encourage the use of such systems where practicable, to ensure a reduction in flood risk to the Site and elsewhere, and to provide water quality benefits.

5.5.2 **Table 4** below sets out the SuDs opportunities and constraints as appropriate to the Site.

Table 4: Sustainable Drainage Systems

Technique	Description	Suitability to Site
Rainwater Harvesting	Rainwater from roofs and hard surfaces can be stored and used for non-potable purposes. This can provide some source control of surface water runoff as well as reducing demands on water supply.	Not suitable No connection to systems that can use recycled water.
Below Ground Attenuation	Below ground storage tanks will attenuate surface water and convey flows to the combined sewer. A flow control to allow for a steady outfall of surface water in line with the greenfield runoff rate.	Not suitable While this may be possible with raised ground conditions, large tanks would pose a risk to the large vehicles and future construction and maintenance vehicles that are likely to require access to the Site.
Swale	Landscaped channel depressions that are normally dry except during and following rainfall events. Designed to attenuate and provide treatment due to being vegetated.	Not Suitable The sites are compact and swales may limit access and pose a safety risk to operations staff.
Attenuation Basin	Ponds and wetland feature with a permanent pool of water that provide attenuation and treatment of surface water runoff.	Suitable Where space is available, surface storage outside of the main operating site areas would be suitable.
Permeable/ Porous Paving	Permeable paving as part of a closed system allows rainwater to infiltrate through the surface to an underlying storage facility which then outfalls to sewer or watercourse. This system allows use of pervious paving in areas where infiltration is not feasible.	Suitable The proposed gravelled areas of the Site operate in a similar way to permeable paving and have been used as storage areas incorporated into the working areas of the Site.

5.5.3 The proposed systems use a combination of permeable gravel beds and surface level attenuation basins to provide attenuation storage and suitable water quality management. The permeable gravel beds allow efficient capture of surface water runoff, maximising benefits within the space constraints across the Site. It should also be noted that the ditch network that carries flow from the three site will act as a swale and provide further treatment. For the East Site – Ammonia Storage Area, the ditch connection only takes flow from that site and therefore is considered to provide quality improvement for that site.

5.6 Water Quality

5.6.1 CIRIA C753 The SuDS Manual (Ref 1-7) lays out a simple index method to account for water quality in the design of SuDS. It indicates the minimum treatment indices appropriate for contributing pollution hazards for different land use classifications. To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant) that equals or exceeds the pollution hazard index.

5.6.2 To undertake the simple index approach, suitable pollution hazard indices must be allocated for the proposed land use. SuDS measures with a total pollution mitigation index equalling or exceeding the pollution hazard index should be selected.

5.6.3 Surface water runoff from the Project is most closely matched to “commercial yard and delivery areas” as identified in the SuDS Manual. This represents the general areas of the Site with higher risk sources of contamination bunded and drained to a suitable treatment system. The Site is classified as having a medium pollution hazard according to CIRIA C753 The SuDS Manual. The pollution hazard indices are detailed in **Table 5**.

Table 5: Pollution Hazard Indices

	Pollution Hazard Indices			
Location	**Pollution hazard level**	**Suspended solids**	**Metals**	**Hydrocarbons**
Commercial yard and delivery areas	Medium	0.7	0.6	0.7

Source: CIRIA C753 The SuDS Manual (Excerpt from Table 26.2)

5.6.4 To provide the correct level of treatment, an assessment needs to be made of the mitigation provided by each SuDS feature. This is shown in **Table 6**. The table also includes the indices for a swale which represents the wider ditch network that carries flow from the Sites. The treatment impacts of the swales are not relied upon for two of the sites, but for the East Site – Ammonia Storage Area it is used. The East Site – Ammonia Storage Area is expected to have fewer vehicle movements and is considered less likely to produce the same contaminant levels as the other Sites. Therefore, the inclusion of the swale is considered a suitable additional treatment component.

Table 6: SuDS Mitigation Indices

	Pollution Mitigation Indices		
Types of SuDS component	**Suspended solids**	**Metals**	**Hydrocarbons**
Permeable Pavement	0.7	0.6	0.6
Attenuation Basin	0.7	0.7	0.5
Swale	0.5	0.6	0.6

Source: CIRIA C753 The SuDS Manual (Excerpt from Table 26.3)

5.6.5 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index.

5.6.6 Where more than one mitigation feature is to be used, CIRIA C753 The SuDS Manual states that the total mitigation index will be calculated as follows:

$$Total\ SuDS\ mitigation\ index = mitigation\ index_1 + (0.5 \times mitigation\ index_2) + (0.5 \times mitigation\ index_3)$$

5.6.7 As a minimum, all runoff will be drained through the permeable pavement, meaning that the total mitigation indices can be calculated as shown in **Table 7.**

Table 7: Total SuDS Mitigation Indices

	Pollution Mitigation Indices		
SuDS Components	Suspended solids	Metals	Suspended solids
Permeable Pavement + Attenuation Basin	1.05	0.95	0.85
Permeable Pavement + Swale	0.95	0.9	0.9

5.6.8 While not included in the above assessment, it is intended for oil water separators to also be incorporated into the system. These are to provide additional water quality treatment and to provide additional protection against unforeseen incidents, such as a vehicle breakdown. As stated earlier, the high risk areas are bunded separately and discharge managed appropriately.

5.6.9 The jetty access road will have limited vehicle movements, estimated to be 2-3 per day during normal operation possibly increasing to five during an unloading operation. It will therefore have similar or lower pollution indices to those described above. Due to the road's location directly above the ditch, it is not possible to provide treatment to the flow before it reaches the ditch. However, the ditch will act as a swale and will provide a level of treatment, especially given that the ditch is approximately 330m long before it joins North Beck Drain at its discharge to the River Humber. While this approach does not meet the strict quantitative requirements resulting from the above analysis, it provides reasonable treatment for a short reach of very lightly trafficked road. It is therefore considered sufficient given the limitations of the site.

5.7 Drainage Model

5.7.1 A hydraulic pipe drainage model has been created using the InfoDrainage software for each of the three relevant sites. Available aerial survey contour data has been used as a surface for the reference ground level in each InfoDrainage model. The areas of permeable gravel paving which are available for storage have been estimated from illustrative site plans provided by Air Products.

5.7.2 For all three sites, the proposed drainage system predominantly consists of permeable gravel paving which will be used to collect flow from the hard standing areas. It allows surface water to infiltrate gradually. It has been assumed that this permeable gravel paving will have a porosity of 30%, providing some underground storage. Other alternative underground attenuation methods could be used in the final desigin, depending on site constraints, ground conditions and ease of construction. Pipes connect the gravel areas, allowing flow to move through the system. The layout of each drainage system is shown in the drawings included in **Annex A**.

5.7.3 Flow control structures will limit the storm water discharge into the drainage ditches for each site, in the form of a HydroBrake®. Where multiple HydroBrake® controls are required for a site, the sum of the individual HydroBrake® discharge rates will equal the agreed discharge rate limit.

5.7.4 The model results show that each site is able to store the 1 in 100-year + 40% climate change design event below ground. Larger storms would cause the system to back up and ponding would occur on the surface. This ponding would be held on the hardstanding and eventually would flow over land to the wider ditch network.

5.8 Assumptions for the System Design

a. Permeable paving, gravel storage and attenuation basin will be sufficient pollution mitigation measures for the proposed use.

b. The 1 in 100-year event must be held within the system but may back up into the gravel storage areas.

c. The agreed discharge rate can be accepted by the surrounding ditch network at all times.

d. The attenuation basins have 1:3 side slopes.

East Sites – Hydrogen Production Facility and Ammonia Storage Area

5.8.1 The drainage system designs for the East Site – Hydrogen Production Facility and the East Site – Ammonia Storage Area are limited by flat topography and the approximate depth estimation of the outfall drainage ditch is based on LiDAR data. As the drainage ditch is assumed to always hold some water, the drainage systems have been designed with an outflow level above the assumed regular water level, to avoid the system backing up under normal conditions. Average tidal levels were used to determine the regular water level in the ditch.

5.8.2 Due to the limited depth between the existing ground levels and the outfall level to the drainage ditch, the drainage solutions require the ground level to be raised at both sites. The East Site – Hydrogen Production Facility and the East Site – Ammonia Storage Area are proposed to be raised by 0.3m and the 0.5m, respectively, giving finished ground levels of 3.8mAOD and 3.5mAOD.

5.8.3 Both sites contain attenuation basins that store water before discharge. The basins will be bunded up to these raised ground levels, matching the levels of the surrounding Site areas. Detailed design will establish an exceedance route from the storage basin to the wider ditch network.

5.8.4 The drainage systems have constrained gradients, even with the noted ground raising. The systems are therefore slow moving and the risk of sedimentation would be overcome with regular inspection and maintenance to clear material from the pipe system.

West Site

5.8.5 The West Site drainage system design is also limited due to the shallow depth between the existing ground levels and estimated ditch depth. The drainage ditch is assumed to be dry under normal conditions, allowing the system to have an outflow level slightly above the ditch channel base.

5.8.6 To achieve a freely draining gravity system, the drainage system has been designed with a 1.0m raised ground level, giving a final level of 2.5mAOD. This also allows for suitable gravel bed depths to be constructed, to store the required volume of flood water.

5.8.7 The West Site is proposed to be developed in two parts, with the first part constructed in Phase 1 of the works and the second part at a later date. Each part has a drainage system which carries flood water to a attenuation basin, in the south-eastern corner for Phase 1 and the south-western corner for the remaining works. These ponds will be bunded up to the raised ground level at the same level as the rest of the site, of 2.5mAOD. Detailed design will establish an exceedance route from the storage basin to the wider ditch network.

5.8.8 The drainage system has constrained gradients, even with the noted ground raising. The system is therefore slow moving and the risk of sedimentation would be overcome with regular inspection and maintenance to clear material from the pipe system.

6 Conclusion

6.1.1 A drainage strategy for the parts of the Project within the East Site and West Site, with a hardstanding area of 11.8ha (the total area of the East Site and West Site being 27.4ha) has been prepared to manage surface water runoff from those sites. The strategy meets the requirements of the NPSfP, NPPF and the NELC LLFA Policy for the Management of Surface Water.

6.1.2 Surface water runoff rates have been agreed with the IDB to be limited to a Q_{bar} greenfield runoff rate of 49 l/s for the West Site, and 70% of the 'real' brownfield runoff rate for the East Site – Hydrogen Production Facility and East Site – Ammonia Storage Area, at 12.6 l/s and 7.0 l/s respectively resulting in storage volumes of 4,565m^3, 2,470m^3 and 18,319m^3 respectively.

6.1.3 These volumes can only be accommodated by the planned raising of ground levels across all three sites. The required levels are 3.8mAOD, 3.5mAOD and 2.5mAOD for the East Site – Hydrogen Production Facility, East Site – Ammonia Storage Area and West Sites, respectively. At these levels, due to the designed gradients, storm water will be stored throughout the system. The low gradients bring a risk of sedimentation as flows will be slow moving at the peak of the storm. The detailed design of the system and the final drainage plan will include a maintenance strategy to maintain the operation of the system.

6.1.4 Outflow from the drainage system from each site is controlled to the agreed discharge rate by several Hydrobrake® units. From here, the outflow enters the ditch network surrounding the Sites and eventually discharges to the Humber Estuary.

6.1.5 This drainage strategy will be followed by a drainage plan that will be developed as part of the detail design. The drainage plan will be submitted for final approval by NELC in consultation with the IDB.

7 References

Ref 1-1 North Lincolnshire Council, North-East Lincolnshire Council (2021) Strategic Flood Risk Assessment Rev 2 November 2021.

Ref 1-2 North East Lincolnshire Council (2018) Local Plan. Available Online.

Ref 1-3 Non-Statutory Technical Standards for Sustainable Drainage Systems produced by Department for Environment, Food & Rural Affairs (DEFRA)

Ref 1-4 The Building Standards Regulations 2000 Part H.

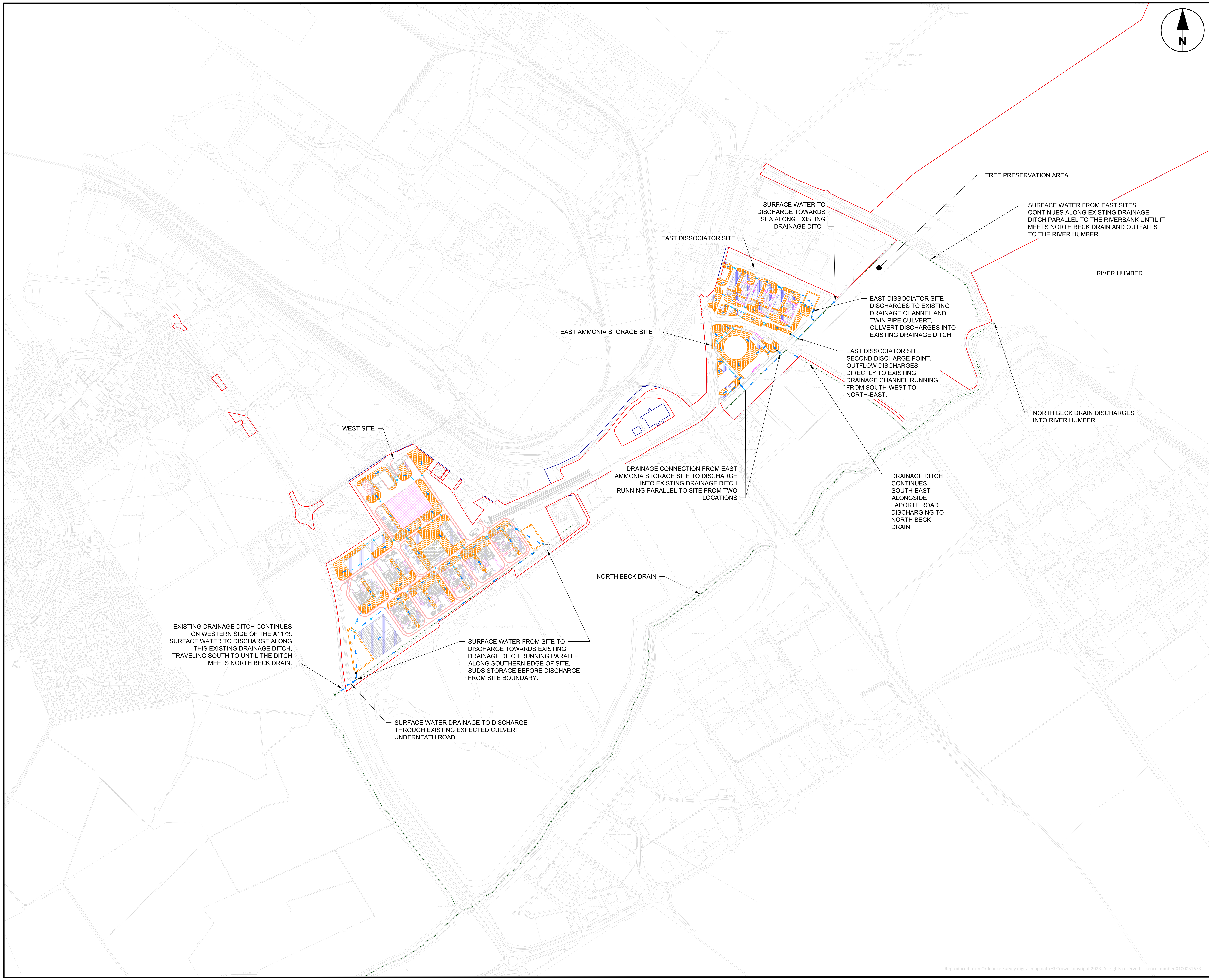
Ref 1-5 Flood Estimation Handbook (FEH) data for catchment 520659 414825, and the IH124 Method.

Ref 1-6 Wallingford HydroSolutions Ltd, (2016); The Revitalised Flood Hydrograph Model: ReFH2.2 Technical Guidance.

Ref 1-7 CIRIA (2015), The SuDS Manual, C753, Version 6 including 2016, 2018, 2019.

Ref 1-8 Environment Agency (2022). Flood risk assessments: climate change allowances.

Annex A - Drainage Strategy Drawings



AECOM

PROJECT

IMMINGHAM GREEN ENERGY TERMINAL

CLIENT

AIR PRODUCTS

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www.aecom.com

NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. FOR DRAINAGE STRATEGY LAYOUT FOR WEST SITE SEE DRAWING 60673509-ACM-XX-XX-0002.
3. FOR DRAINAGE STRATEGY LAYOUT FOR EAST SITES SEE DRAWING 60673509-ACM-XX-XX-0003.

KEY PLAN

- HYDROBRAKE® FLOW CONTROL STRUCTURE
- LIGHT DUTY PAVING
- HEAVY DUTY PAVING
- 150mm GRAVEL ON 150mm THICK REINFORCED CONCRETE SLAB
- STORM WATER PIPE
- (IL) OUTFLOW LOCATION (WITH INVERT LEVEL)
- EXISTING DRAINAGE DITCH
- AREAS OF DEEPENED GRAVEL TO CREATE PERMEABLE PAVING STORAGE (ALTERNATE SYSTEMS ALSO POSSIBLE)
- SURFACE WATER DRAINAGE PATH

ISSUE/REVISION

P03	20/09/2023	PLANNING BOUNDARY UPD.
P02	26/07/2023	EXISTING FLOW PATHS AMND.
P01	11/05/2023	FOR INFORMATION
I/R	DATE	DESCRIPTION

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FOR INFORMATION ONLY

PROJECT NUMBER

60673509

SHEET TITLE

IMMINGHAM GREEN ENERGY TERMINAL
SITE OVERVIEW

SHEET NUMBER

60673509-ACM-XX-XX-0001

ISO A1 594mm x 841mm
Drawn:
Approved: NM
Checked: AM
Designer:
Project Management Initials:
Revision:
Last Plotted: 2023-09-19
Last saved by: THOMAS.O.ADAMS(2023-09-19)
Filename:

ISO A1 594mm x 841mm

Drawn:

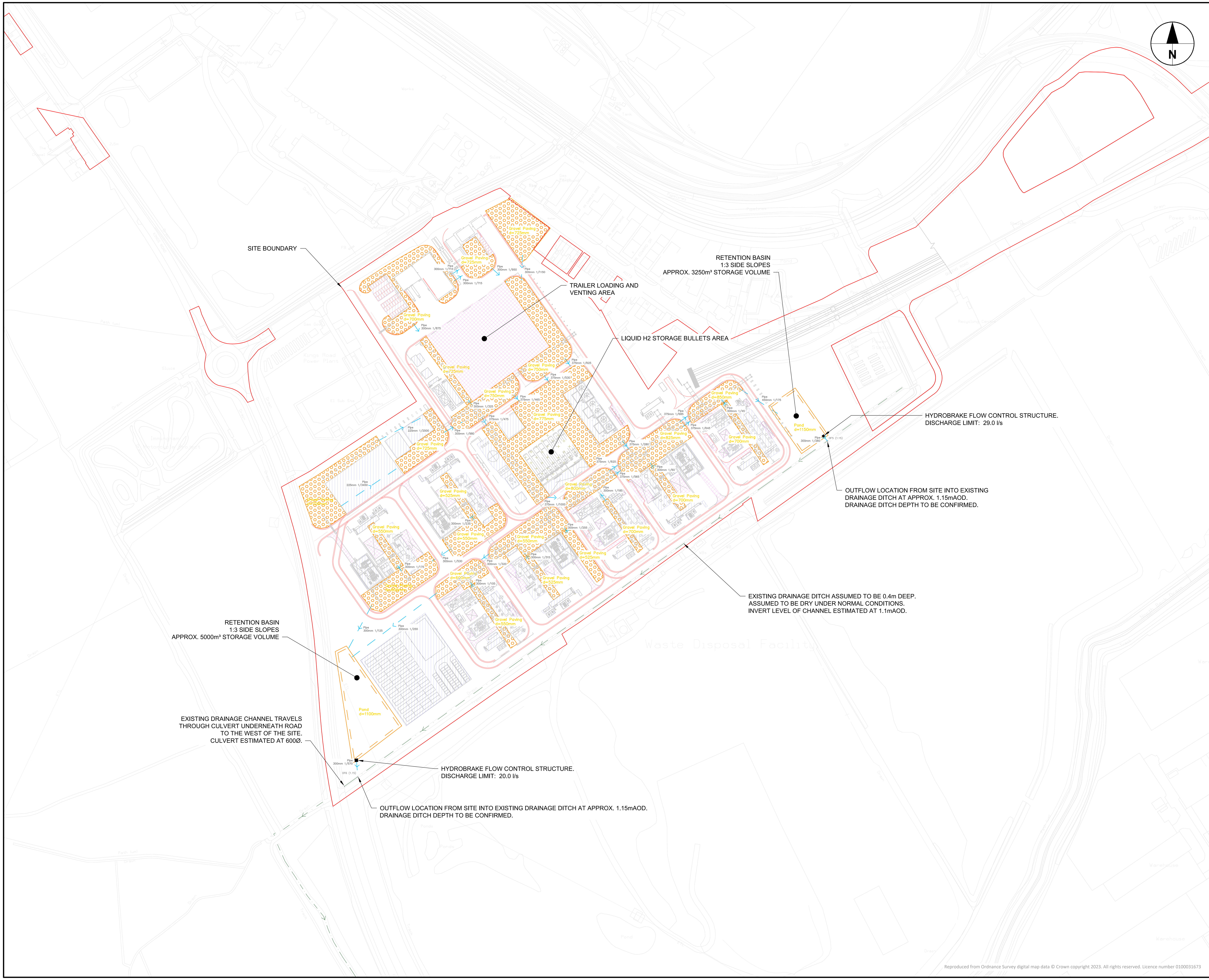
Approved:

Checked: NM

Designer: AM

Project Management Initials:

Revision:



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NOTES

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2. LAYOUT PREFERENCE OF INITIAL MODELLING. PIPE SIZES AND DEPTHS, PERMEABLE PAVING SIZING AND POND SIZING TO BE ESTABLISHED DURING DETAILED DESIGN.
3. LOCATIONS AT HIGH RISK OF CONTAMINATION ARE BUNDED AND ASSUMED TO BE MANAGED SEPARATELY TO DRAINAGE SYSTEM WITH COLLECTED FLOWS REMOVED TO TREATMENT.
4. DOWNSTREAM DRAINAGE DITCH ASSUMED TO HAVE AN INVERT LEVEL AT LEAST 400mm BELOW EXISTING GROUND LEVEL.

KEY PLAN

- HYDROBRAKE® FLOW CONTROL STRUCTURE
- LIGHT DUTY PAVING
- HEAVY DUTY PAVING
- 150mm GRAVEL ON 150mm THICK REINFORCED CONCRETE SLAB
- STORM WATER PIPE
- (IL) OUTFLOW LOCATION (WITH INVERT LEVEL)
- EXISTING DRAINAGE DITCH
- AREAS OF DEEPENED GRAVEL TO CREATE PERMEABLE PAVING STORAGE (ALTERNATE SYSTEMS ALSO POSSIBLE)

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P03	20/09/2023	PLANNING BOUNDARY UPD.
P02	26/07/2023	EXISTING FLOW PATHS AMND.
P01	10/05/2023	FOR INFORMATION ONLY

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FOR INFORMATION ONLY

PROJECT NUMBER

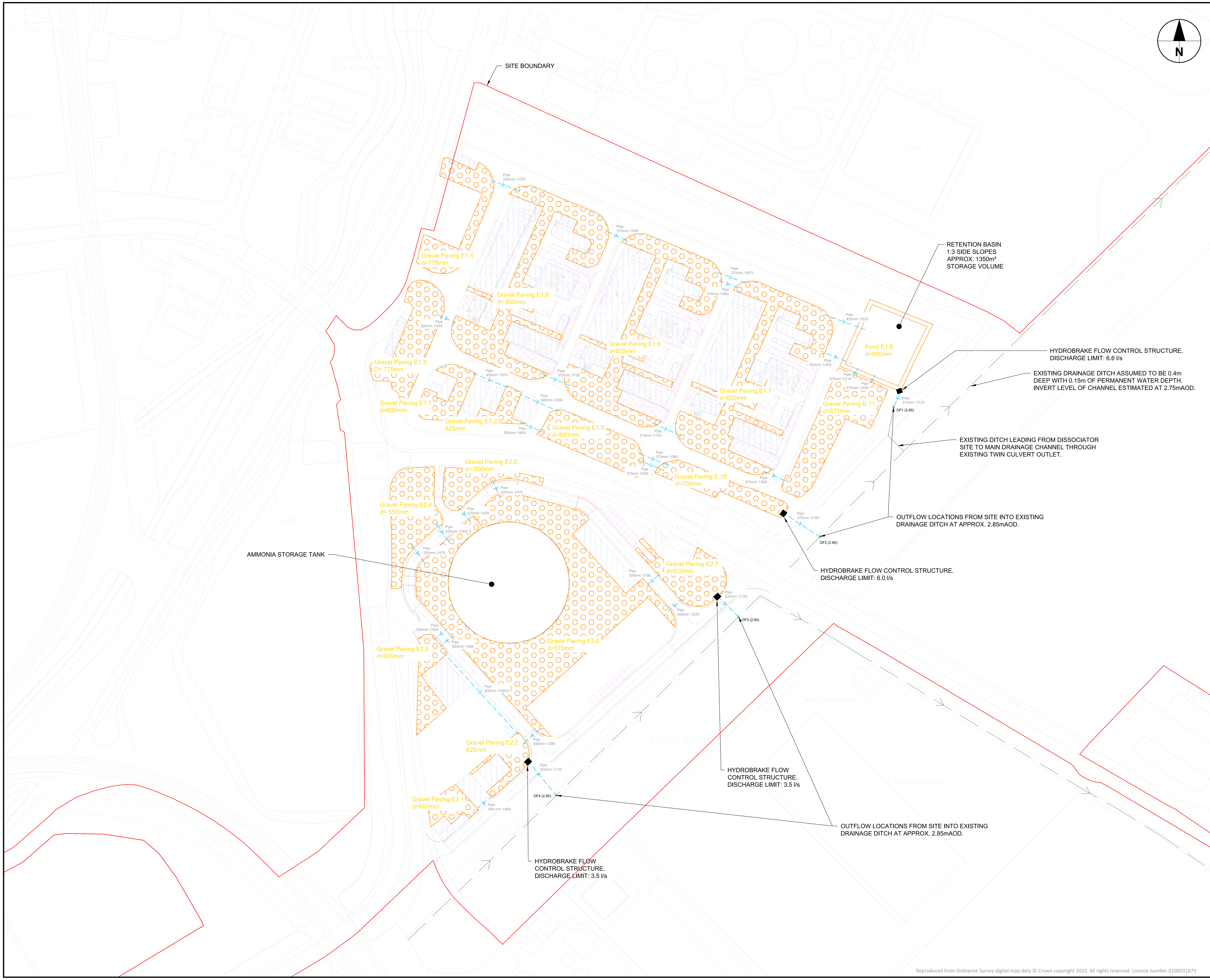
60673509

SHEET TITLE

IMMINGHAM GREEN ENERGY TERMINAL
WEST SITE
DRAINAGE PLAN

SHEET NUMBER

60673509-ACM-XX-XX-0002



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Designer: AM

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3. LOCATIONS AT HIGH RISK OF CONTAMINATION ARE BUNDED AND ASSUMED TO BE MANAGED SEPARATELY TO DRAINAGE SYSTEM WITH COLLECTED FLOWS REMOVED TO TREATMENT.
4. DOWNSTREAM DRAINAGE DITCH ASSUMED TO HAVE AN INVERT LEVEL AT LEAST 400mm BELOW EXISTING GROUND LEVEL.

KEY PLAN

HYDROBRAKE® FLOW CONTROL STRUCTURE
LIGHT DUTY PAVING
HEAVY DUTY PAVING
STORM WATER PIPE
(IL) OUTFLOW LOCATION (WITH INVERT LEVEL)
EXISTING DRAINAGE DITCH
AREAS OF DEEPENED GRAVEL TO CREATE PERMEABLE PAVING STORAGE (ALTERNATE SYSTEMS ALSO POSSIBLE)

ISSUE/REVISION

P03	20/09/2023	PLANNING BOUNDARY UPD.
P02	26/07/2023	EXISTING FLOW PATHS AMND.
P01	11/05/2023	FOR INFORMATION ONLY
I/R	DATE	DESCRIPTION

0 25 50 m
1:1000

FOR INFORMATION ONLY

PROJECT NUMBER

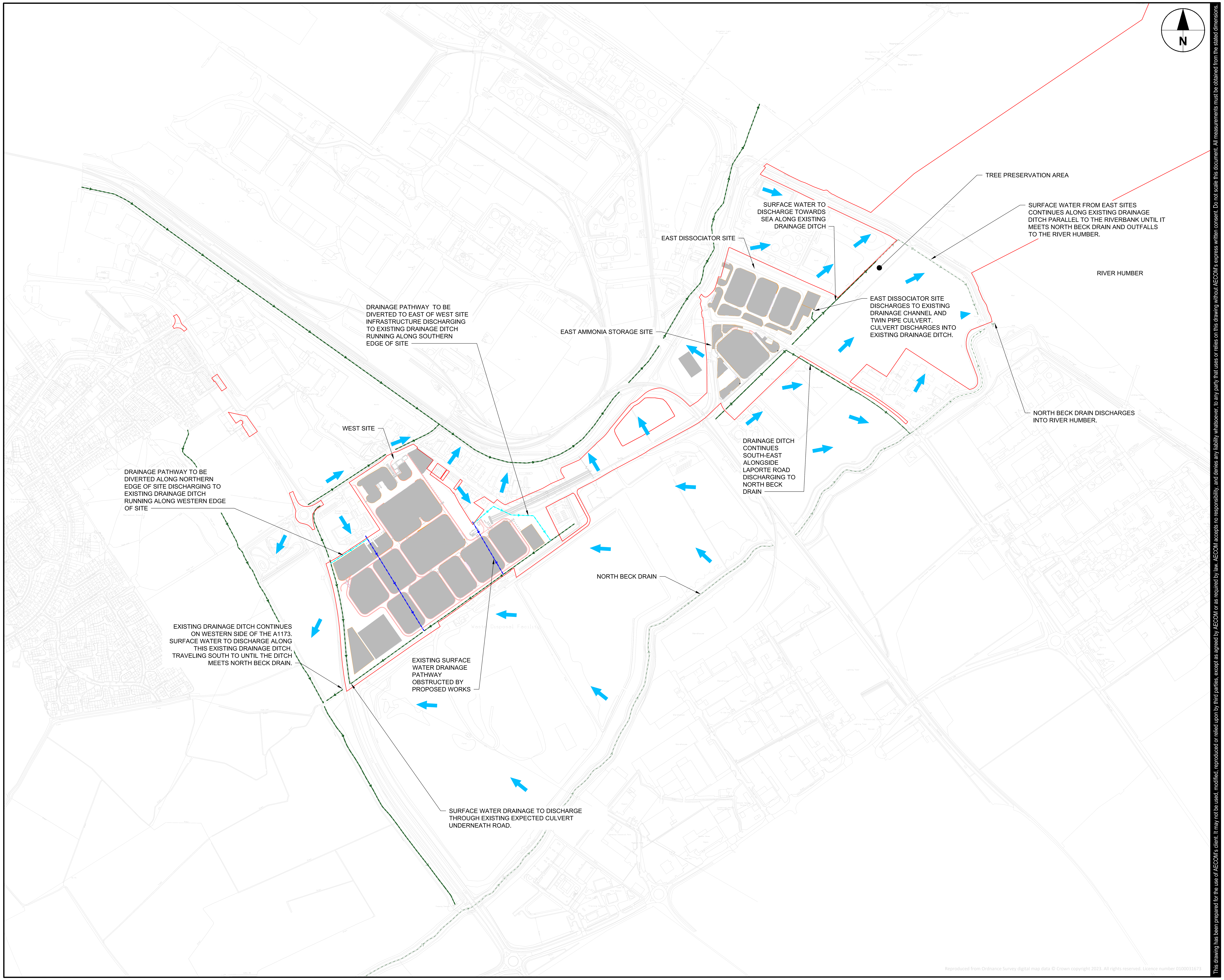
60673509

SHEET TITLE

IMMINGHAM GREEN ENERGY TERMINAL (IGET)
DISSOCIATOR SITE AND AMMONIA STORAGE SITE
DRAINAGE PLAN

SHEET NUMBER

60673509-ACM-XX-XX-0003



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Drawn:

Approved: NM

Checked: TA

Designer:

Project Management Initials:

Revision:

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3. FOR DRAINAGE STRATEGY LAYOUT FOR WEST SITE SEE DRAWING 60673509-ACM-XX-XX-0002.
4. FOR DRAINAGE STRATEGY LAYOUT FOR EAST SITES SEE DRAWING 60673509-ACM-XX-XX-0003.

KEY PLAN

- OUTFLOW LOCATION
- EXISTING DRAINAGE DITCH TO BE RETAINED
- EXISTING DRAINAGE DITCH OBSTRUCTED BY PROPOSED WORKS
- PROPSED DRAINAGE PATHWAY DIVERSION
- EXTERNAL CATCHMENT FLOW DIRECTIONS
- OTHER PROPOSED WORKS

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P02	20/09/2023	PLANNING BOUNDARY UPD.
P01	26/07/2023	FOR INFORMATION

0 125 250 m
1:5000

FOR INFORMATION ONLY

PROJECT NUMBER

60673509

SHEET TITLE

IMMINGHAM GREEN ENERGY TERMINAL SITE OVERVIEW DIVERSION OF OBSTRUCTED EXISTING DRAINAGE PATHWAYS

SHEET NUMBER

60673509-ACM-XX-XX-0004

Annex B - Communication with the IDB

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Leeds LS11 9AR
United Kingdom

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aecom.com

Project name:
IGET

Project ref:
60673509

From:
[redacted]

Date:
22 March 2023

To:
[redacted]
AECOM

CC:

Memo

Subject: Meeting with IDB 21/03/2023

This is a summary of the points discussed and outcomes of a meeting of members of the North East Lindsey Drainage Board (NELDB) on 21 March 2023

Attendees:

[redacted]
AECOM

[redacted]
NELDB
NELDB

Discussions:

- Real Current Discharge from the East of the Site
  - This started with a discussion of how flow uses an existing ditch to flow north east before running parallel with the Humber and joining North Beck Drain.
  - It was established that there was no monitoring of the flow in this area. DS suggested that it was high rainfall events that caused the ditch network to back up, caused by a 300 mm dia. pipe at the outlet.
  - GH stated that it was possible to allow a discharge rate of 70% of the real current discharge.
  - NM described the attempts to establish an estimate of real discharge as follows:
    - The ditch channel is approximately 1.2 m wide with approximately 0.25 m of capacity above a typical standing water level. With minimal channel slope, this would give a discharge of 32 l/s.
    - The twin culverts discharging from the eastern of the two plots in the eastern half of the site were assumed to have a 300 mm diameter. Using culvert calculations it was estimated that the flow through each of these was 28 l/s.
    - The greenfield runoff rate for both of the plots in the area combined was found to be 18.3 l/s.
  - It was agreed that the eastern half of the plot should use the discharge from a single culvert as an estimate of the real discharge and 70% of this value is 19.6 l/s, so a slight increase over the greenfield rate.

- Discharge Rate from the West of the Site
  - The western side of the site is currently undeveloped and therefore the greenfield rate would apply here. This gives a discharge rate of 49 l/s.
- Introducing a Culvert in the Eastern Part of the Site
  - GH stated that the IDB were generally against the culverting of any watercourse due to the separation from the wider drainage system during times of flood and the general reduction in available storage volume that often results from the use of a culvert.
  - NM ran through AECOM's understanding of the contributing catchments for the ditch which is limited to only the development sites in question.
  - GH was willing to consider proposals that could demonstrate no loss in the volume available for flood water.
  - NM agreed to return with suitable proposals, accepting that the current design did not achieve this requirement.