AMBER PLANNING
Flood Risk & Hydrology

Flood Consequences Assessment
August 2024
Version 1

Wood Processing & Recycling Facility
Berth 31, No. 2 Dock
Port of Barry
Wimbourne Road
Vale of Glamorgan
South Wales
CF62 5QS

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NON TECHNICAL SUMMARY

Site Area	c.4.25ha
Existing / Historic Use	Brownfield / Scrap Yard / Sorting Facility
Proposed Use	Wood Processing & Recycling Facility with access & associated infrastructure.
Flood Zone	Flood Zone B: *Areas known to have flooded in the past.*
Groundwater Flooding	**Low.** Desk based review indicates main groundwater to be located at depth. Underlying clay geology and overlying concrete pad would limit the upward migration of groundwater with potential impacts to both on-site surface water management and groundwater quality indicated to be low. The presence of unimpeded flowpaths for extruded groundwater into the Docks further reduces this risk.
Infrastructure Failure	**Raised Waterways:** Low. The property is remote from raised waterways, the failure of which could lead to flooding. **Flood Defences:** Low. The property is not located in an area benefitting from the presence of flood defences. **Reservoirs:** Low. The property is remote from reservoirs.
Overland Flow - Flooding	Low
Sewer Flooding	Low
Change to Site Surface Finishings (Y/N)	Yes. Whilst no uplift in the runoff coefficient is anticipated to arise from the proposals, full surface water management is proposed in line with best practice for new development – contaminated areas only.
Infiltration Potential?	No. BGS data indicates the presence of impermeable soils with limited potential for the use of infiltration for surface water disposal.
Attenuation Storage Proposed	Clean Runoff: No attenuation proposed. Direct discharge to tidal receiving waters following upstream water quality treatment. Outfalls are confirmed to be located above the MHWS tidal level with no tide locking anticipated. Contaminated Runoff: 1,465m^3. Retained within concrete pad by 2 no. sealed concrete upstands. Runoff will be pumped into a 1,110m^3 storage tank from where it will be utilised within on site processes, with residual water tankered off site for treatment as trade waste at the local sewage treatment works.
Potential Receptor for Surface Water Discharges	Clean Runoff: SuDS based drainage will promote infiltration at source, with excess runoff discharged to Dock Number 2 via existing outfall(s) present on the south eastern boundary following upstream water quality treatment.
Climate Change Allowance	**Tidal:** Welsh Government Guidance: 299.5mm to 2055. **Fluvial:** 20% Central Estimate to 2060. **Pluvial:** 20% Upper Estimate to 2069.

1.0 INTRODUCTION

1.1 Background

1.1.1 Amber Planning Ltd. has been appointed to prepare a Technical Advisory Note 15 (TAN 15) compliant Flood Consequences Assessment in support of an application for the change of use of an existing industrial site to provide a Wood Processing & Recycling Facility, with access and associated infrastructure within a c.4.25ha plot of land at Berth 31, No. 2 Dock, Port of Barry, Wimborne Road, Vale of Glamorgan, South Wales, CF62 5QS. The Port of Barry falls within the administrative remit of the Vale of Glamorgan Council.

1.1.2 Reference to Natural Resource Wales (NRW) Development Advice Maps[1] indicates the application area to be situated within Flood Zone B: *Areas known to have flooded in the past*, Figure 001a. Review of the Flood Map for Planning indicates the property to be partially affected by tidal flooding, Figure 001b, but to be unaffected by surface water flooding.

1.1.3 A Flood Consequences Assessment is therefore required to inform determination at planning. This should consider the potential impacts to / from the facility from / to all forms of flooding and the drainage measures required to ensure no detrimental impacts on flooding to downstream areas arises from development proposals.

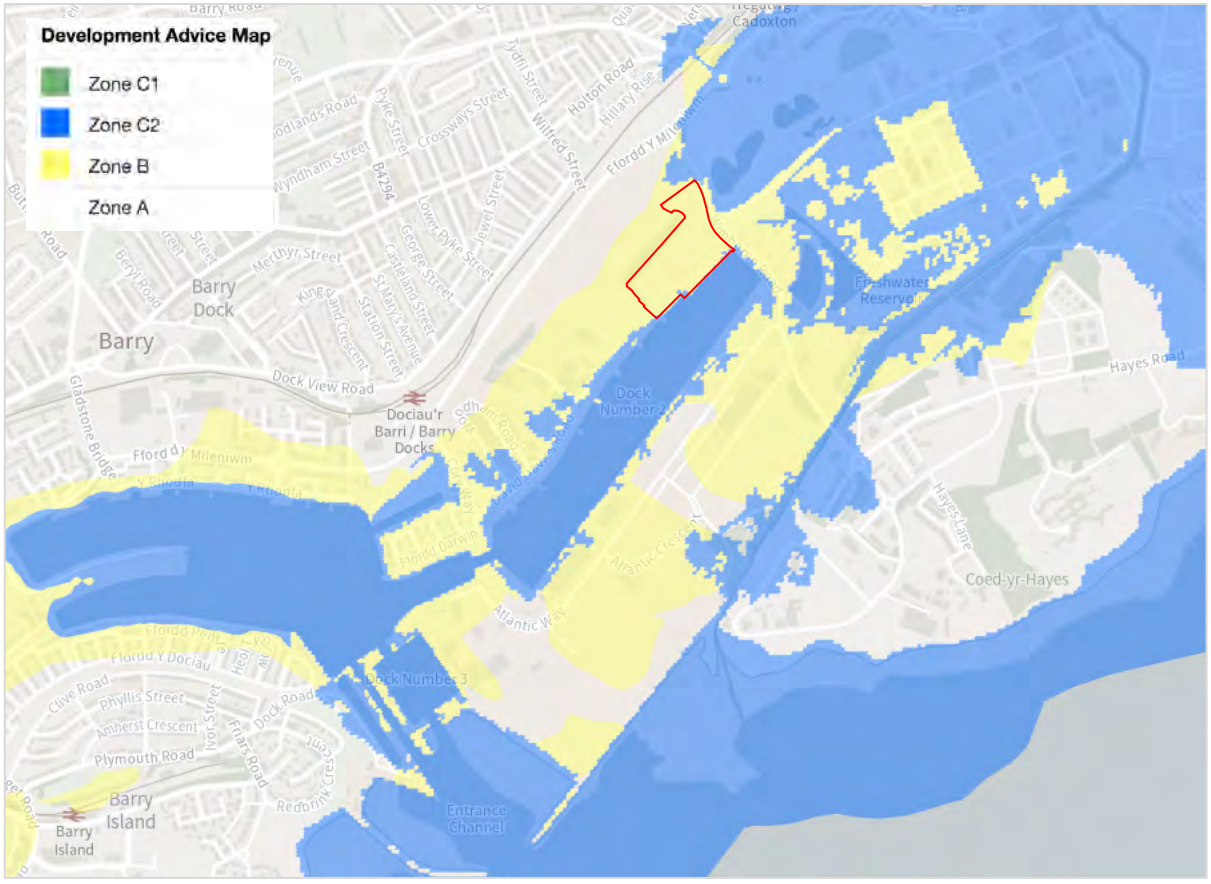

Figure 001a: Natural Resources Wales – Development Advice Map

[1] https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default&layerTheme=2 / https://naturalresources.wales/flooding/flood-map-for-planning-development-advice-map/?lang=en

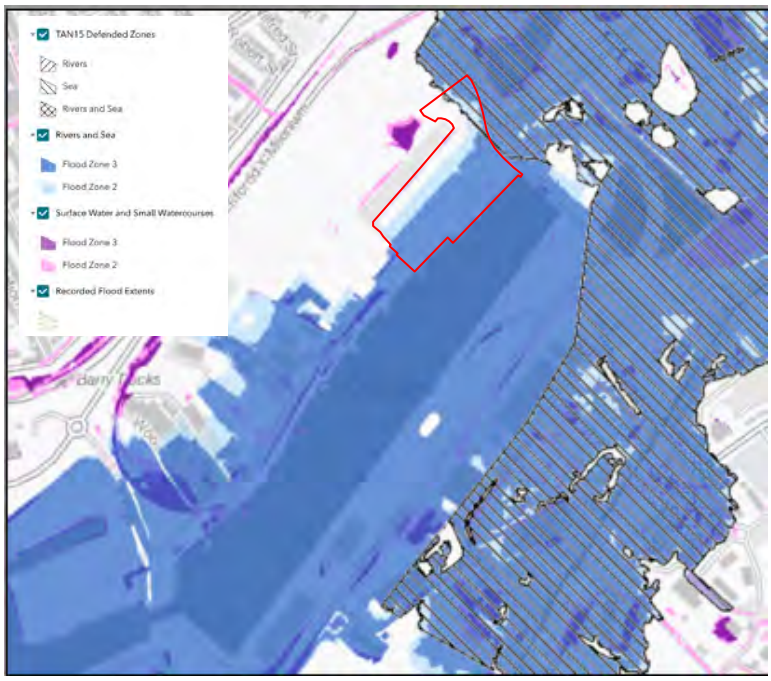

Figure 001b: Natural Resources Wales Flood Map for Planning

1.1.4 This Flood Consequences Assessment has been prepared in accordance with Technical Advice Note 15 (TAN 15). The requirements of Natural Resources Wales and the Vale of Glamorgan Council have also been accounted for within this study.

1.2 Objectives

1.2.1 The objectives of this Flood Consequences Assessment are to:

- Review national and local planning policy documents and identify any issues they raise, and which need to be addressed in relation to flooding and hydrology;
- Review readily available information on flooding using data provided by the NRW and, where available, from local Planning Policy and Technical Studies;
- Evaluate the background hydrology;
- Assess the risks from all sources of flooding, including fluvial;
- Consider the impacts of the development on predeveloped rates and volumes of surface water runoff;
- Investigate opportunities for the integration of Sustainable Drainage Systems (SuDS);
- Consider the impacts of climate change on surface water runoff;
- Provide recommendations for the design and delivery of surface water management. This includes the design of a drainage scheme which incorporates mitigation and / or management measures to prevent detrimental impacts to surface water flooding or hydrology at the site or within downstream receptors and which accounts for the requirements of the Natural Resources Wales and the Local Planning Authority / Lead Local Flood Authority.
- Consider the Management and Maintenance requirements for the drainage network;
- Prepare preliminary drainage plans indicating the location and dimensions of the proposed surface water drainage networks and attenuation facilities; and
- Prepare a TAN15 compliant Flood Consequences Assessment report summarising the findings of the assessment.

1.2.2 Local development framework documents, including strategic policy and technical studies, have been reviewed as part of this study.

1.3 Confidentiality

1.3.1 Amber Planning has prepared this report solely for the use of The Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Amber Planning; a charge may be levied against such approval.

2.0 SOURCES OF INFORMATION

2.1 General

2.1.1 In preparing this assessment background information has been sought from the following sources:

- Welsh Government (2024). Planning Policy Wales – Edition 12;
- Planning Policy Wales (2004 – revised 2021). Technical Advice Note 15: *Development and Flood Risk*;
- UK Government Guidance (May 2022). Flood Risk Assessments: Climate Change Allowances[2];
- CIRIA (2015). C753: The SUDS Manual;
- National SuDS Working Group (2004). Interim Code of Practice for Sustainable Drainage Systems;
- Natural Resources Wales. Development Advice Maps[3];
- Natural Resources Wales (Living Document). Flood Map for Planning[4];
- Vale of Glamorgan Council (2010). Shoreline Management Plan;
- Vale of Glamorgan Council (2017). Local Development Plan 2011-2026;
- Vale of Glamorgan Council Interactive Proposals Map;
- Vale of Glamorgan Council Planning Policy Page[5];
- Vale of Glamorgan Council (2009). Preliminary Flood Risk Assessment;
- Vale of Glamorgan Council (2013). Local Flood Risk Management Strategy;
- Vale of Glamorgan Council Flood and Coastal Erosion Risk Management (FCERM);
- Vale of Glamorgan Council (1996-2011). Barry Development Guidelines[6];
- Natural Resources Wales Website[7];
- British Geological Survey online mapping[8];
- Centre for Ecology and Hydrology Flood Estimation Handbook (FEH) Web Service, hydrometric data[9];
- Topographical Survey; and
- OS Mapping data[10].

2.2 Planning Context - National Planning Policy

Technical Advice Note 15: *Development and Flood Risk*

2.2.1 Technical Advice Note 15: *Development and Flood Risk* provides guidance on the consideration of flood risk, drainage and water quality within development design. This document has been referred to in the preparation of this Flood Consequences Assessment.

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2 https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#table-2

3 https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default&layerTheme=2

4 https://flood-map-for-planning.naturalresources.wales

5 https://www.valeofglamorgan.gov.uk/en/living/planning_and_building_control/Planning/planning_policy/Planning-Policy.aspx

6 https://www.valeofglamorgan.gov.uk/Documents/Living/Planning/Policy/Barry_Development_Guidelines_SPG.pdf

7 https://naturalresources.wales/?lang=en

8 https://www.bgs.ac.uk/geological-data/map-viewers/

9 https://fehweb.ceh.ac.uk/GB/map

10 www.promap.co.uk

2.3 Planning Context – Vale of Glamorgan Local Development Plan 2011-2026

2.3.1 The Vale of Glamorgan Local Development Plan (LDP) 2011-2026 was adopted in June 2017 and provides the local planning policy framework for the Vale of Glamorgan. The Plan sets out the vision, objectives, strategy and policies for managing development in the Vale of Glamorgan. It contains a number of planning policies and makes provision for land use for purposes including waste. It also seeks to identify the infrastructure that will be required to meet the anticipated growth in the Vale of Glamorgan to 2026.

2.3.2 Barry comprises the administrative centre for Glamorgan and is highlighted for regeneration, with this including consideration of increased employment opportunities.

2.3.3 The Vale of Glamorgan Council has also produced an Interactive Proposals Map, as part of the Adopted LDP, the property is understood to be allocated for existing employment use, Figure 002.

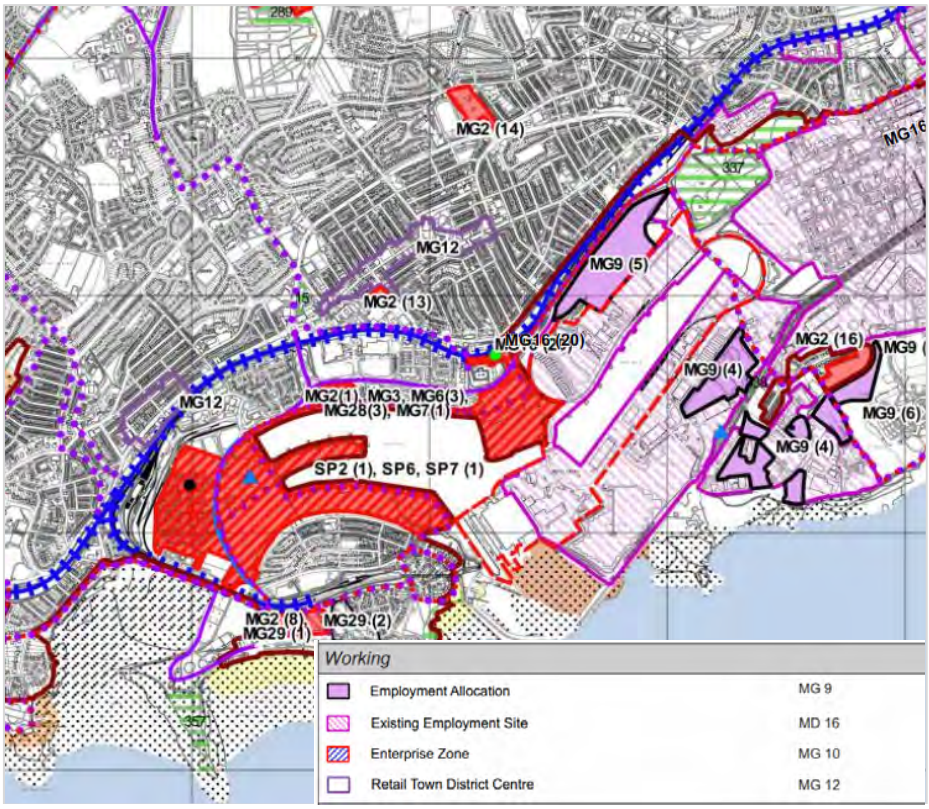


Figure 002: Excerpt from Local Plan Proposals Map

2.3.4 The Vale of Glamorgan Council's LDP policies relevant to the consideration of Flood Risk and Drainage are as follows:

- Policy MD1: Location of New Development
- Policy MD2: Design of New Development
- Policy MD7: Environmental Protection
- Policy SP8: Sustainable Waste Management

2.3.5 Supplementary Planning Guidance is also available, including Barry Development Guidelines.

Vale of Glamorgan – Replacement Local Development Plan

2.3.6 Local Development Plans (LDPs) need to be reviewed a least every four years to make sure they are up to date. The current LDP was reviewed in 2021, with the recommendation that a Replacement Local Development Plan (RLDP) be prepared for the period 2021 to 2036. A period of consultation on the Preferred Strategy of the RLDP ran from December 2023 to February 2024. A Deposit Draft is anticipated Feb. 2025, with Submission / Examination late 2025 / early 2026 and adoption late 2026.

3.0 BACKGROUND AND DATA REVIEW

3.1 Site Setting

Property Address	Berth 31, No 2 Dock, Port of Barry, Wimborne Road, Vale of Glamorgan, South Wales, CF62 5QS.
National Grid Reference	313010, 168145
Area	c.4.25ha

Table 001: Site Setting

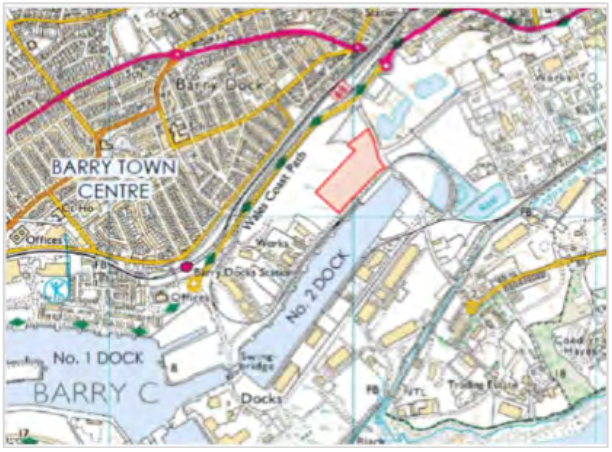


Figure 003: Site Location Plan

3.2 Current Layout

Figure 004: Existing Site Layout – Aerial Photograph

3.2.1 The application area comprises a c.4.25ha plot of brownfield land situated in the north eastern section of No. 2 Dock, Port of Barry, Figure 004. Access is via Wimborne Road to the north, which links to the A4055, Cardiff Road via Ffordd Y Mileniwm (Millennium Way).

3.2.2 The property was originally developed for use by the South Wales coal industry operations with coal stored and loaded onto ships for export. More recently, part of the plot has been used as a wood processing facility. The property is understood to benefit from a consent for an external Incinerator Bottom Ash (IBA) Processing facility which dates from 2015 but which has never been implemented.

3.3 Surrounding Area

Direction	Description
North	Further industrial land, Ffordd Y Mileniwm road, main train line, Wimborne Road, Cadoxton Wetlands SINC and the town of Barry beyond.
East	Open land with ponds, industrial works beyond transected by the Cadoxton River.
South	Dock, industrial works, Cadoxton River, Trading Estate and Break Water with Bristol Channel beyond.
West	Open land, Ffordd Y Mileniwm road, train line with town of Barry beyond.

Table 002: Site Surrounds

3.4 Proposed Layout

Figure 005: Proposed Layout

3.4.1 The application relates to the change of use of existing industrial land for development of a proposed Wood Processing & Recycling Facility with access and associated infrastructure, including the following elements:

- Wood Storage
- Processing Area
- Lorry Parking

3.4.2 The following elements are already present within the property:

- Water Tank (1,110m^3)
- Office / store / welfare
- Weighbridge x 3 - existing
- Substation - existing

3.4.3 The facility will have capacity for the processing of up to 250,000 tonnes of wood per year. Approximately 50% of the wood products created will be exported by boat.

3.4.4 The proposals involve no material change to the ground profile or surface finishes. Figure 005 provides a summary of the proposed layout, with full details contained within Drawing LMM/072/02: *Site Layout*, located to the rear of this report. The proposals are non-residential in nature, with an anticipated lifetime of <30 years.

3.5 Topography

3.5.1 Site specific topographical survey has been provided which indicates surface elevations of between 7.75m AOD and 9.20m AOD increasing in a north westerly direction, refer to Drawing LMM/072/02: *Site Layout* which includes topographical survey a full copy of which is located to the rear of this report. The presence of elevated land, a stone retaining wall and railway line on the south eastern margins of the property, indicates there to be no flowpath to site for tidal water levels <7.90m AOD.

3.5.2 Surface elevations at the access onto Ffordd Y Mileniwm / Millennium Way are located between 8.45m AOD and 11.16m AOD also increasing in a north westerly direction.

3.6 Hydrogeology

3.6.1 Regional geological mapping indicates the bedrock geology to comprise the Mercia Mudstone Group – Mudstone, overlain by superficial deposits of Tidal Flat Deposits - Clay.

3.6.2 Borehole data is available in this locale, a summary of which is provided in Figure 006, with full copies presented at Appendix I: *Data*.

3.6.3 Boreholes ST16NW159 and ST16NW201 are located within the property towards the north eastern end of the quayside. The former dates from May 1976 and records clays to 7.30m bgl, over a layer of sand to 9.30m bgl and a thin layer of peat. Clay / marl is then recorded to depth, (24.60m bgl). Water strikes are recorded at 6.20m bgl, with a standing water level of 5.10m bgl; and again at 13.20m bgl with a final standing level of 6.80m bgl. The latter borehole data dates from July 1958 and records marls and clays to depth, with some gravel present. No groundwater data is recorded.

3.6.4 Borehole ST16NW200 is located on the south eastern boundary adjacent to the dock. It's data is recorded within ST16NW201, with both dating from July 1958. Gravel with fragments of marl and limestone is noted over hard red marl to depth. No groundwater data is recorded.

Figure 006: British Geological Survey Borehole Location Map

3.6.5 Based on the above data, main groundwater is anticipated to be located at depth with extrusion at the surface unlikely. Whilst perched groundwater may be encountered at the interface between the sand deposits and overlying/ underlying clays, this is likely to be of limited lateral extent with potential impacts on the facility and its drainage networks also likely to be limited. The presence of a concrete pad coupled with unimpeded flowpaths for the conveyance of extruded groundwater into local watercourses and the Docks further reduces this risk. The risk from groundwater flooding is therefore considered to be **Low** with no further assessment proposed.

3.7 Tidal Flooding

General Tidal Levels

3.7.1 National Tidal and Sea Level Facility (NTSLF)[11] Tide Tables have been reviewed to ascertain the general tidal levels for the nearest tidal nodes, the results of which are summarised in Table 003.

Location	MHWS*	MLWS*	Range (m)	MHWN*	MLWN*	Range
Mumbles (m AOD)	3.85	-4.61	8.46	1.59	-2.44	4.03
Barry	**6.06**	**-5.09**	**11.15**	**3.03**	**-2.55**	**5.58**
Newport	6.45	-5.18	11.63	3.28	-2.57	5.85

Table 003: Tide Data – Bristol Channel *All levels in m AOD

3.7.2 General tidal levels were available only for Mumbles or Newport. The value for Barry has therefore been interpolated based on the respective distances of each of the subject nodes from the centre of the nearest amphidromic point (in this instance on Salisbury). Newport is estimated as being located c.100km from the centre of the amphidromic point, with Barry 110km and Mumbles 165km. A -15% correction has therefore been applied to the tidal levels for Newport to achieve tidal levels at Barry.

3.7.3 The tidal data has been corrected to account for Chart Datum, with all levels converted to m AOD also using data downloaded from the NTSLF[12] (for Newport - interpolated). The same -15% adjustment has been applied to the Datum Correction figure for Barry.

3.7.4 A standard rule of twelfths approximation has been applied to the calculated tidal ranges to derive basic tidal curves, which are summarised in Figures 007a and 007b.

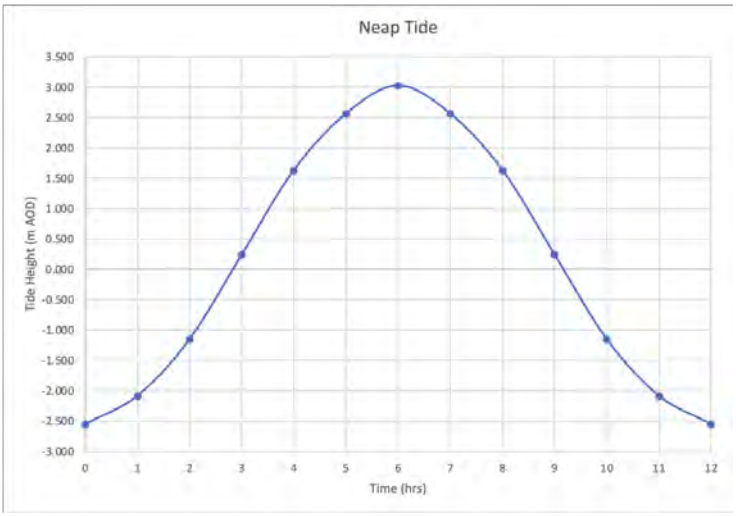


Figure 007a: Neap Tidal Curve – Port of Barry

[11] https://ntslf.org/tides/hilo
[12] https://ntslf.org/tides/datum

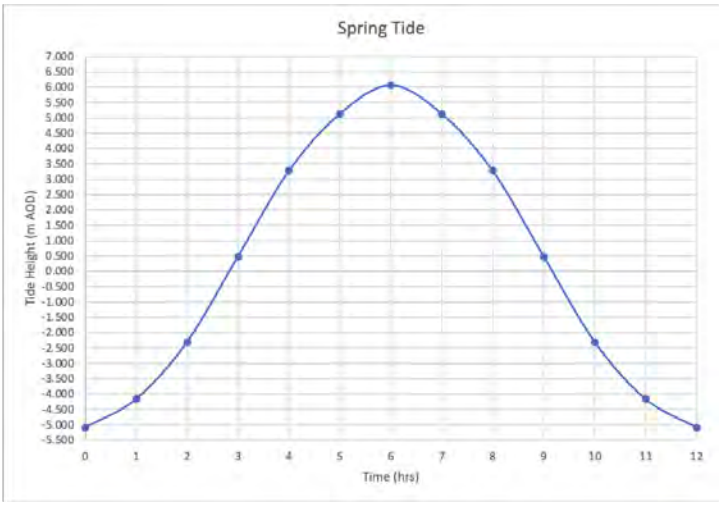


Figure 007b : Spring Tidal Curve – Port of Barry

Tidal Flooding

3.7.5 The application area is indicated by NRW Flood Mapping (Figure 008) to be partially at risk from tidal flooding, with a **Low** to **High** associated flood hazard indicated and with further assessment required. The NRW tidal Flood Map for Planning flood outlines are understood to account for the effects of climate change.

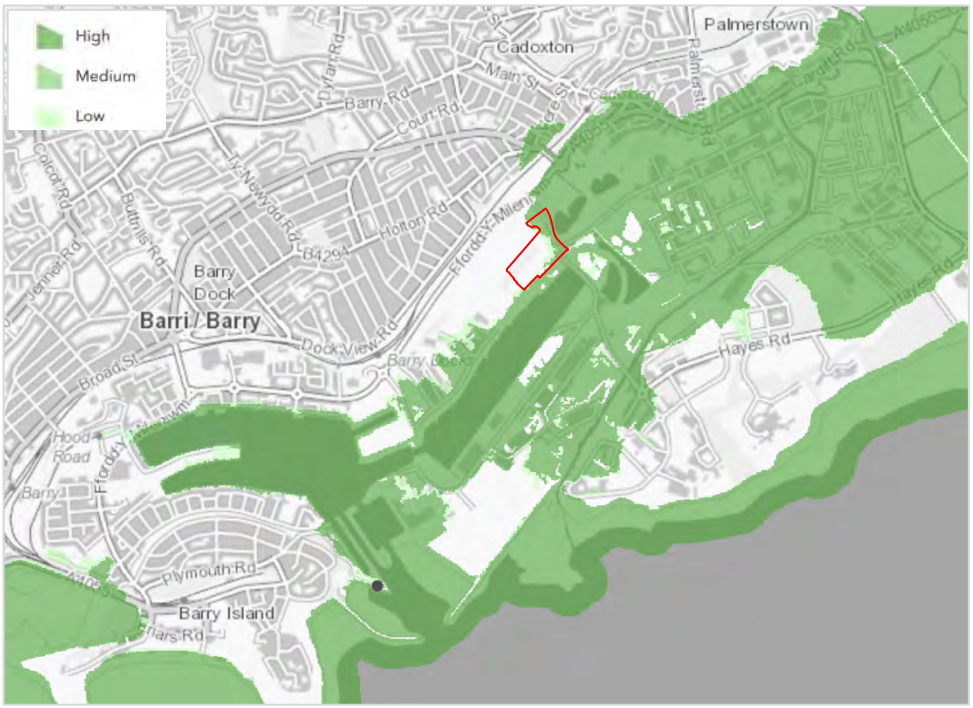


Figure 008: Flood Risk from the Sea – Including Climate Change

Tidal Flood Data

3.7.6 Tidal Flood Levels have been requested for the area which is awaited at the time of writing. In the absence of flood data, topographical analysis has been undertaken which indicates the following flood levels:

- 200 Year Tidal: 8.41m AOD
- 1000 Year Tidal: 8.50m AOD

3.7.7 This data understood to incorporate updated climate change allowance.

3.8 Flood Defences

3.8.1 Land immediately north east of the plot and south east of Number 2 Dock is indicated to benefit from TAN 15 Defended Zones for the sea which are understood to provide a 200 year standard of protection. The Property itself is not indicated to benefit from these flood defences.

3.8.2 The Barry Docks area is located within Shoreline Management Plan Policy Unit 20 Lavernock Point to St. Anne's Head. The policy intention in this locale is to enable the continued functioning of the Docks by maintaining and upgrading existing structures.

3.9 Fluvial Flooding and Hydrology

Fluvial Flooding

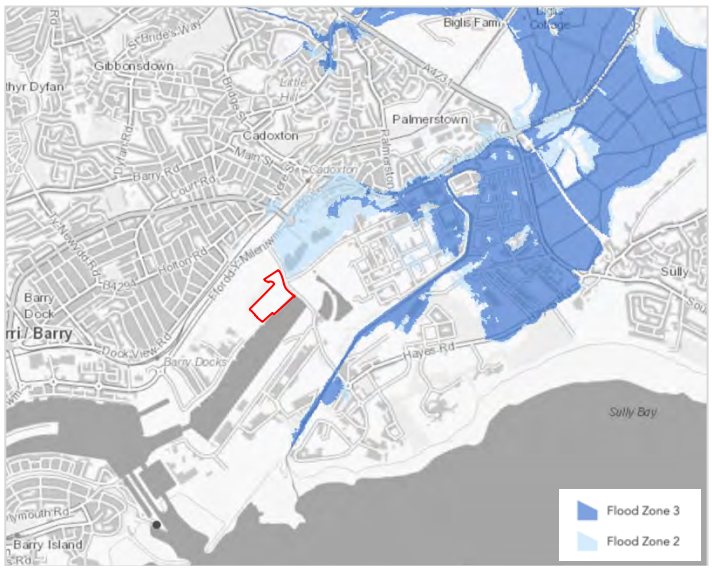


Figure 009: Flood Risk From Rivers

3.9.1 The application area is situated at the north eastern end of Number 2 Dock within the Port of Barry. An area of marsh land, ponds and wetlands is present to the north west, north and north east which is understood to form the Cadoxton Wetlands Site of Importance for Nature Conservation (SINC). This comprises an area of restored wetland noteworthy for its tall herbs, scattered scrub and grassland habitat, together with two small lakes and a reedbed.

3.9.2 The Cadoxton River is the nearest Main River. It rises from the confluence of the Wrinstone Brook and Bullcroft Brook on the northern outskirts of Powys Village, near the Hamlet of Michaelstone-le-Pit. From here, it flows in a south westerly direction through Dinas Powys towards Barry. On reaching Barry, the watercourse flows south west within an artificial channel towards the docklands, passing 470m to the south east of the property before flowing into the Bristol Channel via a sluice at Bendricks, c.800m south west and on the opposite side of No. 2 Dock.

3.9.3 Review of Natural Resources Wales Flood Map for Planning (Figure 009) indicates the property to be unaffected by fluvial flooding for return period events up to and including 1000 years now and in the future, with no further assessment required.

Hydrology

3.9.4 Catchment descriptor information has been downloaded from the CEH Flood Estimation Handbook Web Service for this sub-catchment, which is summarised in Table 004. This indicates a small, *heavily urbanised* catchment, with elevated topographical relief, moderately permeable geology and medium average annual rainfall.

3.9.5 Flows within local watercourses are likely to be predominated by subterranean / baseflow (BFIHOST) with more minor contributions via overland flow (SPRHOST) and with a moderately low catchment response to incident rainfall anticipated. The catchment response to rainfall may be locally elevated by the presence of impermeable overlying soils or urban surfaces.

3.9.6 The low FARL value indicates a degree of flood attenuation within the upper catchment. This is generally afforded by the presence of reservoirs and lakes; however given the absence of reservoirs within the upper catchment, this may be attributed to the presence of the Cadoxton Wetlands upstream of the property. These wetlands may also contribute to the elevated Catchment Wetness Index value.

Catchment Descriptor	Value
Area	38.65km^2
River Baseflow Index (BFIHOST-19)	0.450
Standard Percentage Runoff (SPRHOST)	35.180%
Drainage Path Length (DPLBAR)	7.090km
Drainage Path Slope (DPSBAR)	60.600m/km
Flood Attenuation by Rivers and Lakes (FARL)	0.953
Proportion of time soils are wet (PROPWET)	0.470
Standard Annual Average Rainfall (SAAR)	1,030mm
Urban Extent (URBEXT: 2000)	0.1471

Table 004: FEH Catchment Descriptor Information

3.10 Historic Flooding

3.10.1 Desk based investigation including review of Flood Map for Planning indicates the property to be located within an area known to have experienced flooding historically. The following event is noteworthy:

- 20th July 2007, Barry. Intense rainfall. Flooding of roads and properties. Colbrook Watercourse and open stream adjacent to the A4231 Barry Docks Link Road.

3.10.2 Caution should be exercised when reviewing historic flood records. This information is largely anecdotal and does not always include record of either the antecedent conditions giving rise to flooding (e.g. flood source), or reference to a flood return period. Furthermore, a lack of recorded incidents is no guarantee that an area has never flooded.

3.11 Flood Zone Classification

3.11.1 NRW Development Advice Maps indicate the application area to be located within Flood Zone B: *Areas known to have previously flooded.*

3.12 Flood Risk Vulnerability

3.12.1 The application area comprises a change of use of existing industrial land to provide a Wood Processing facility. TAN 15, Figure 2, defines this development as '*General industrial, employment, commercial and retail development'* and classifies this use as '*Less Vulnerable*.'

3.12.2 *Less Vulnerable* development is considered appropriate within Flood Zone B.

3.13 Climate Change

Tidal Allowance

3.13.1 Welsh Government Guidance on Climate Change Allowances for Flood Consequences Assessments[13] is available which includes consideration of impacts on tidal flood levels which is summarised in Table 005.

Period	2009-2025	2026-2055	2056-2085	2086-2116	Cumulative Total
Annual Change (mm/yr)	3.5 (59.5)	8.0 (240.0)	11.5 (345.0)	14.5 (449.5)	1094.0

Table 005: Welsh Government Climate Change Allowances - Tidal (2008)

Fluvial Allowance

3.13.2 Welsh Government Guidance on Climate Change Allowances to Peak Fluvial Flood Levels requires application of climate change factors of up to 20% (Central Estimate) to 2060 based on a development lifetime <36 years, Table 006.

	To 2030	2031-2060	2061-2090
Severn Basin (Central Estimate)	10%	20%	25%

Table 006: Welsh Government Climate Change Allowances - Fluvial

Rainfall Allowance

3.13.3 Welsh Government Guidance on Climate Change Allowances to Peak Rainfall Intensity[14],requires application of climate change factors of up to 20% (Upper Estimate) to 2069 based on a development lifetime <36 years, Figure 010.

Table 2 - Change to extreme rainfall intensity (compared to a 1961-90 baseline)

Applies across all of Wales	Total potential change anticipated for 2020s (2015-2039)	Total potential change anticipated for 2050s (2040-2069)	Total potential change anticipated for 2080s (2070-2115)
Upper estimate	10%	20%	40%
Central estimate	5%	10%	20%

Figure 010: Welsh Government Climate Change Allowances – Rainfall Intensity

[13] https://www.gov.wales/climate-change-allowances-and-flood-consequence-assessments-cl-03-16
[14] https://www.gov.wales/sites/default/files/publications/2021-09/climate-change-allowances-and-flood-consequence-assessments_0.pdf

3.14 Infrastructure Failure

3.14.1 Flooding from artificial sources occurs when man made infrastructure, e.g. flood defences, raised channels or surface water storage features (i.e. reservoirs), becomes overwhelmed leading to breach or failure of the dam, banks or control structures. The probability of failure is low owing to regular inspection and maintenance regimes. However, in the event of a breach occurring the consequences can be significant.

Flood Defences

3.14.2 The application area is indicated not to benefit from flood defences the failure of which could lead to flooding, with no further assessment required.

Raised Waterways

3.14.3 The property is remote from raised waterways the breach or failure of which could lead to flooding.

Reservoirs

3.14.4 Review of the Natural Resources Wales Flood and Coastal Erosion Maps indicates the area to be unaffected by reservoir flooding, with no further assessment required.

3.15 Surface Water Flooding

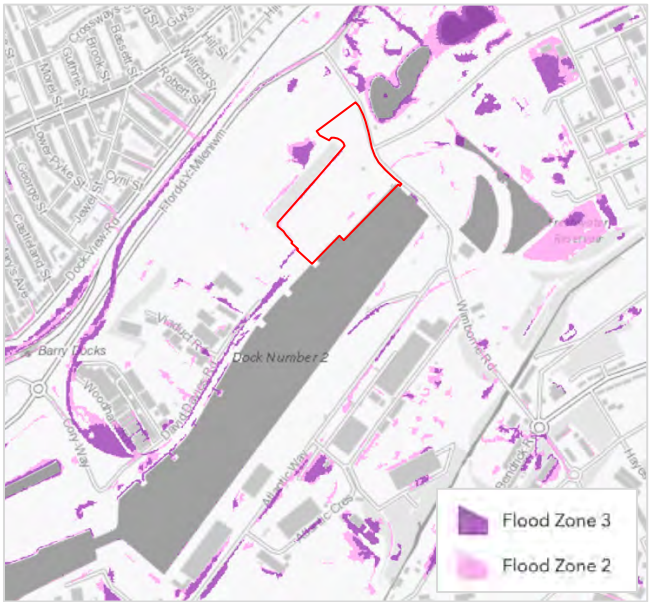


Figure 011: NRW Detailed Flood Map: Surface Water and Small Watercourses

3.15.1 Detailed Natural Resources Wales pluvial mapping downloaded from the Natural Resources Wales website, assesses two main scenarios, Medium Risk (0.1%-1% probability of flooding annually from surface water and small watercourses) and High Risk (>1%). The findings of this assessment are summarised in Figure 011.

3.15.2 This data indicates the application area to be unaffected by pluvial flooding or flooding from small watercourses, with a ***Very Low*** associated risk. The input of a level development platform and formal surface water management would further reduce this risk with no impact to the facility or its drainage networks anticipated to arise from pluvial flooding and with no further assessment proposed.

3.16 Sewers

3.16.1 The property is considered to be remote from public sewers, with the nearest likely to be present beneath Ffordd Y Mileniwm (Millennium Way) to the north. The potential flood extents are likely to be similar to that outlined for surface water, with a **Negligible** associated flood risk and with no further assessment required.

4.0 FLOOD CONSEQUENCES ASSESSMENT

4.1 Flood Risk Screening Opinion

4.1.1 In accordance with Technical Advice Note 15, it is necessary to consider all forms of flood risk. A flood risk scoping exercise has therefore been completed for the site, the results of which are outlined in Table 007.

Nature of Flood Risk	Flood Risk to Site?
Groundwater	Low. Underlying Clay/ Mudstone geology, with main groundwater indicated to be located at depth. Perched groundwater, where present, is unlikely to be laterally extensive. The presence of unimpeded flowpaths for extruded groundwater into the dock and away from the development further reduces this flood risk.
Tidal	Yes. The application area is located immediately adjacent to Barry Docks and is indicated to be partially affected by the High Risk tidal flood zone. A set of lock gates is present between Barry Docks and the Bristol Channel.
Fluvial	No. The plot is unaffected by fluvial flooding.
Infrastructure Failure (Reservoirs, Canals and Other Artificial Sources)	Flood Defence Breach / Failure: Not at risk. Raised Waterways: Not at risk. Reservoir Failure: Not at risk.
Overland Flow (surface water from off-site sources)	No. Natural Resources Wales flood mapping indicates a **Very Low** risk from SW flooding for the majority of the site, with no further assessment required. Residual risks would be further reduced by the input of a level development platform and formal SW management systems.
Sewers	No. The flood risk from sewerage infrastructure is considered to be **Very Low** with no further assessment required.
Surface Water Drainage (on-site)	Yes. Whilst no material amendment to the site layout or surface finishings are proposed, full surface water management is proposed in line with best practice for new development.

Table 007: Flood Risk Screening Opinion

4.1.2 Flood screening indicates principal flood hazard to arise from tidal sources associated with the adjacent Bristol Channel, which has been duly assessed.

4.1.3 Residual risks associated with extreme tidal flooding also require further consideration and have been duly assessed, with the results summarised below.

4.2 Tidal Flooding – 200 Year + CC

4.2.1 Tidal flood data is available for the Barry area which indicates maximum flood levels of 8.41m AOD for a future 200 year tidal flood accounting for climate change. Maximum water depths of 0.66m are estimated within the southern section of the concrete pad, where minimum ground levels are located at 7.75m AOD. Flood water is anticipated to enter the property freely via the adjacent quayside the elevation of which is set at 7.90m AOD.

4.2.2 The tidal flood level has been superimposed onto a Spring (MHWS) tidal curve. The results are summarised in figure 012 with inundation of the property indicated for a period of 86mins – 96mins around high water accounting for the ground level at the overtopping point and minimum site surface elevations, respectively.

4.2.3 Once flood water begins entering the property, it will gradually flood the southern portion of the concrete pad reaching 0.66m depth within 43-48 mins. The flood mechanism will be similar to an incoming tide on a beach. Flow velocities would be low

owing to the mechanism of flooding (overtopping) but inflow will be persistent across c.48mins before water levels begin to subside.

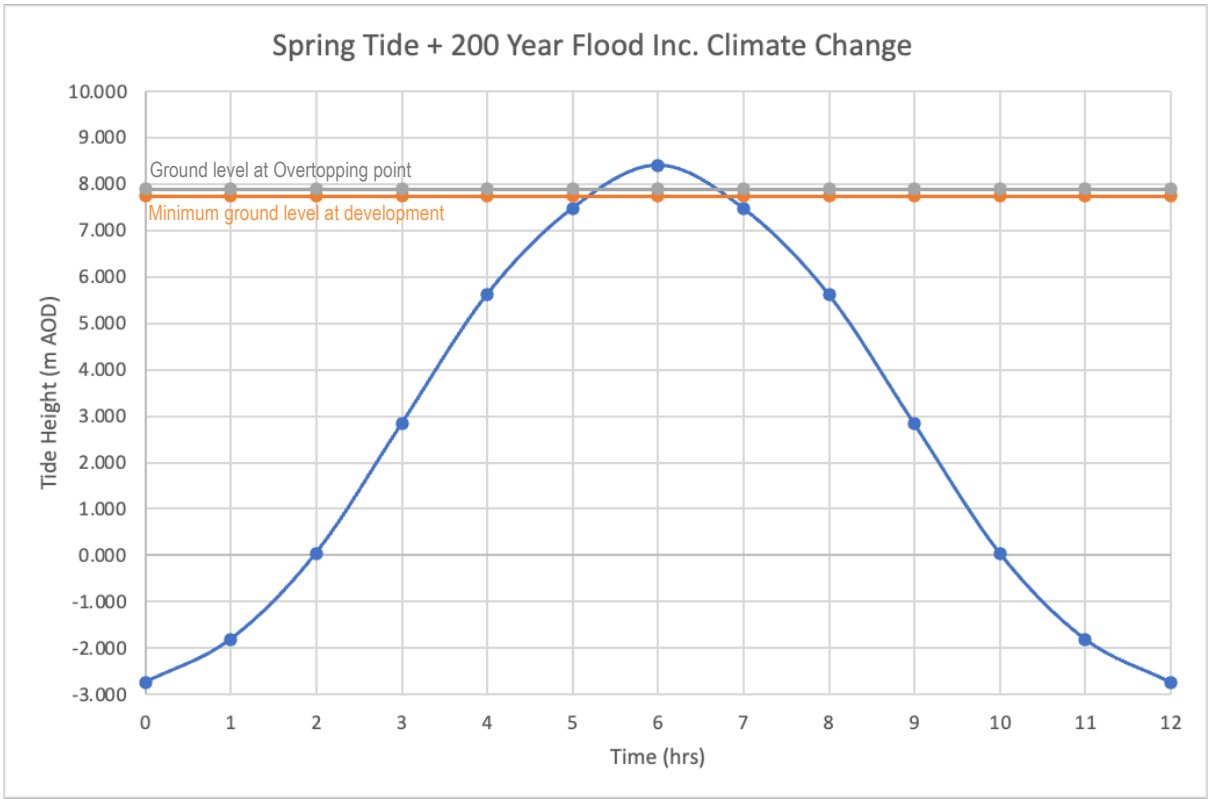


Figure 012: 200 Year Tidal Flood Curve – Spring Tide Including Climate Change

Table 4 – Hazard to People Classification using Hazard Rating *(HR= d x (v + 0.5) + DF)* for (Source Table 13.1 of FD2320/TR2 - Extended version)

HR	Depth of flooding - d (m)												
	DF = 0.5				DF = 1								
Velocity v (m/s)	0.05	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.0	0.03 + 0.5 = 0.53	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.13 + 0.5 = 0.63	0.15 + 1.0 = 1.15	0.20 + 1.0 = 1.20	0.25 + 1.0 = 1.25	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.75 + 1.0 = 1.75	1.00 + 1.0 = 2.00	1.25 + 1.0 = 2.25
0.1	0.03 + 0.5 = 0.53	0.06 + 0.5 = 0.56	0.12 + 0.5 = 0.62	0.15 + 0.5 = 0.65	0.18 + 1.0 = 1.18	0.24 + 1.0 = 1.24	0.30 + 1.0 = 1.30	0.36 + 1.0 = 1.36	0.48 + 1.0 = 1.48	0.60 + 1.0 = 1.60	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50
0.3	0.04 + 0.5 = 0.54	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.19 + 0.5 = 0.69	0.23 + 1.0 = 1.23	0.30 + 1.0 = 1.30	0.38 + 1.0 = 1.38	0.45 + 1.0 = 1.45	0.60 + 1.0 = 1.60	0.75 + 1.0 = 1.75	1.13 + 1.0 = 2.13	1.50 + 1.0 = 2.50	1.88 + 1.0 = 2.88
0.5	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.25 + 0.5 = 0.75	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.60 + 1.0 = 1.60	0.80 + 1.0 = 1.80	1.00 + 1.0 = 2.00	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	2.50 + 1.0 = 3.50
1.0	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.38 + 0.5 = 0.88	0.45 + 1.0 = 1.45	0.60 + 1.0 = 1.60	0.75 + 1.0 = 1.75	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50	2.25 + 1.0 = 3.25	3.00 + 1.0 = 4.00	3.75 + 1.0 = 4.75
1.5	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.50 + 0.5 = 1.00	0.60 + 1.0 = 1.60	0.80 + 1.0 = 1.80	1.00 + 1.0 = 2.00	1.20 + 1.0 = 2.20	1.60 + 1.0 = 2.60	2.00 + 1.0 = 3.00	3.00 + 1.0 = 4.00	4.00 + 1.0 = 5.00	5.00 + 1.0 = 6.00
2.0	0.13 + 0.5 = 0.63	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	0.63 + 0.5 = 1.13	0.75 + 1.0 = 1.75	1.00 + 1.0 = 2.00	1.25 + 1.0 = 2.25	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	3.50	4.75	6.00	7.25
2.5	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.60 + 0.5 = 1.10	0.75 + 0.5 = 1.25	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50	1.80 + 1.0 = 2.80	3.40	4.00	5.50	7.00	8.50
3.0	0.18 + 0.5 = 0.68	0.35 + 0.5 = 0.85	0.70 + 0.5 = 1.20	0.88 + 0.5 = 1.38	1.05 + 1.0 = 2.05	1.40 + 1.0 = 2.40	1.75 + 1.0 = 2.75	5.10	5.80	4.50	6.25	8.00	9.75
3.5	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.80 + 0.5 = 1.30	1.00 + 0.5 = 1.50	1.20 + 1.0 = 2.20	1.60 + 1.0 = 2.60	3.00	3.40	4.20	5.00	7.00	9.00	11.00
4.0	0.23 + 0.5 = 0.73	0.45 + 0.5 = 0.95	0.90 + 0.5 = 1.40	1.13 + 0.5 = 1.63	1.35 + 1.0 = 2.35	1.80 + 1.0 = 2.80	3.25	3.70	4.60	5.50	7.75	10.00	12.25
4.5	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	1.00 + 0.5 = 1.50	1.25 + 0.5 = 1.75	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	3.50	4.00	5.00	6.00	8.50	11.00	13.50
5.0	0.28 + 0.5 = 0.78	0.60 + 0.5 = 1.10	1.10 + 0.5 = 1.60	1.38 + 0.5 = 1.88	1.65 + 1.0 = 2.65	2.20	3.75	4.30	5.40	6.50	9.25	12.00	14.75

Flood Hazard Rating (HR)	Colour Code	Hazard to People Classification
Less than 0.75		Very low hazard - Caution
0.75 to 1.25		Danger for some – includes children, the elderly and the infirm
1.25 to 2.0		Danger for most – includes the general public
More than 2.0		Danger for all – includes the emergency services

Figure 013: Excerpt from Table 4 of the Supplementary Note on Flood Hazard Ratings

4.2.4 Table 4 of Defra's Supplementary Note on Flood Hazard[15] (Figure 013) considers the combination of flow velocity and flood depth in defining flood hazard. This has been used in assessing the flood hazard to the Wood Processing facility, taking account of the nature of proposed use (*non-residential*).

4.2.5 This indicates a flood hazard of '***Danger for Most***' for flows up to 1.0m/s^{-1} for future design return period tidal flood events based on a maximum on on-site water depth of 0.66m. No flooding is indicated to occur within the northern section of the property or at the site access onto Ffordd Y Mileniwm (Millennium Way) where ground levels are >8.41m AOD.

4.2.6 The following factors serve to increase the lead time for flood warning and to further reduce the flood hazard:

- The tidal nature of flooding with elevated water levels likely subject to a degree of predictability and with maximum water levels anticipated to be restricted to the peak around the high tide, with flood water receding quickly in the period between high waters;
- Mechanism of flooding, with water entering the property via the quayside with unimpeded flowpaths for the recession of floodwater once tidal water levels subside;
- Flood mitigation incorporated within the development design;
- Flood management measures proposed to alert personnel to the risks posed by flooding and the actions to be taken should flooding occur;
- Development lifetime <30 years, with the impacts of climate change unlikely to be fully realised within this time;
- Nature of operation (industrial) with no public access;
- The facility would be subject to shut down and evacuation procedures, to ensure that no personnel would be placed at risk in the event of flooding;
- Presence of safe refuge within the northern section of the property which is indicated to be unaffected by flooding;
- Availability of safe access / egress which is achievable via Ffordd Y Mileniwm (Millennium Way) to the north; and
- The property benefits from flood warning which would alert site users to the potential for elevated water levels in the Bristol Channel area, which may lead to flooding.

4.2.7 It is considered that with the outlined mitigation and management measures in place, the residual risks posed to the installation by tidal flooding can be reduced to an acceptable level.

4.3 Residual Flood Risk

Flood Zone 2 - 1000 Year Flood Outline: Tidal

4.3.1 Tidal flood data is available for the Barry area which indicates maximum flood levels of 8.50m AOD during a 1000 year tidal flood accounting for climate change. Maximum water depths of 0.75m are estimated within the southern section of the concrete pad, where minimum ground levels are located at 7.75m AOD. Flood water is anticipated to enter the property freely via the adjacent quayside the elevation of which is set at 7.90m AOD.

4.3.2 The tidal flood level has been superimposed onto a Spring (MHWS) tidal curve. The results are summarised in figure 014 with inundation of the property indicated for a period of c.<89mins – 103mins around high water accounting for the ground level at the overtopping point and minimum site surface elevations, respectively.

4.3.3 Table 4 of Defra's Supplementary Note on Flood Hazard (Figure 013) indicates a flood hazard of '***Danger to Most***' for flows up to 0.5m/s^{-1} for future extreme return period tidal flood events based on a maximum on on-site water depth of 0.75m. No flooding is indicated to occur within the northern section of the property or at the site access onto Hermitage Way where ground levels are >8.50m AOD.

4.3.4 The probability of extreme flooding occurring is considered to be low, which further reduces the flood hazard.

[15] Defra & the Environment Agency (2008). Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose: *Clarification of the Table 13.1 of FD2320/TR1 and Figure 3.2 of FD2321/TR1.*

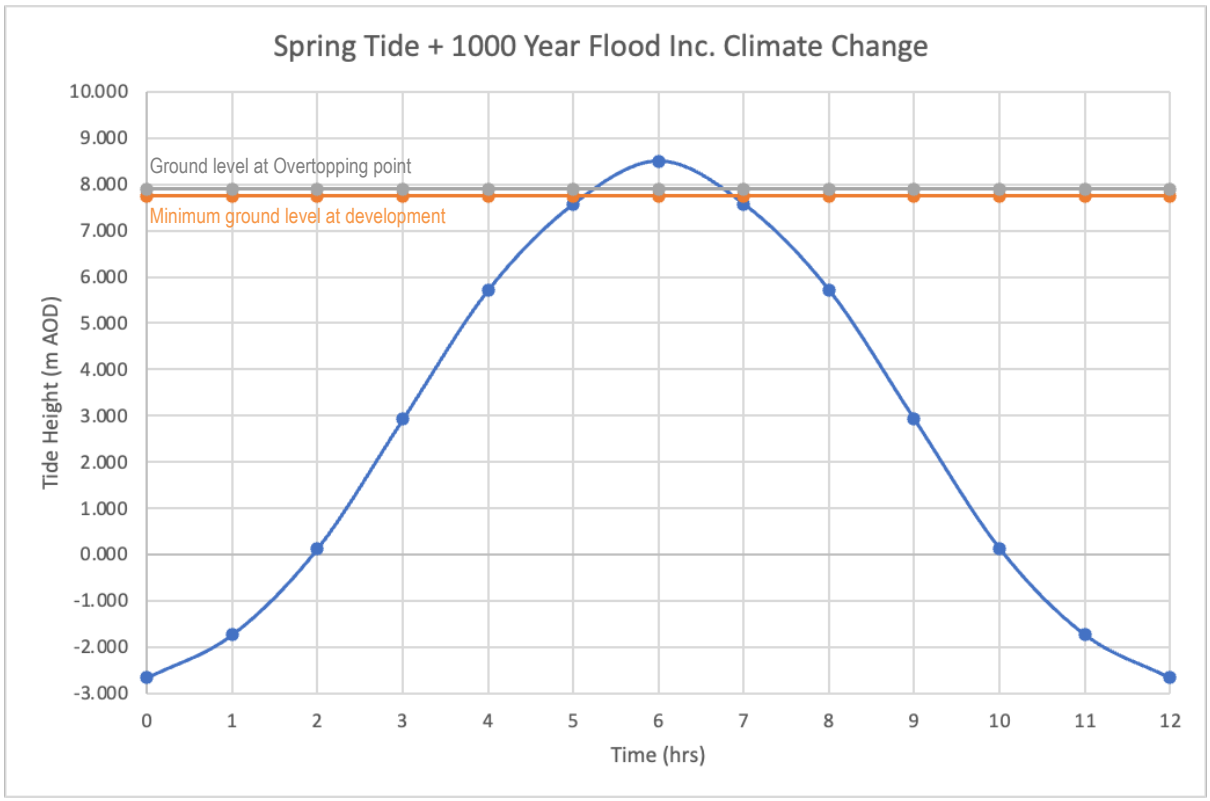


Figure 014: 1000 Year Tidal Flood Curve – Spring Tide Including Climate Change

4.4 Flood Mitigation and Management

4.4.1 The property is indicated to be unaffected by fluvial flooding for return period events up to and including 1000 years but to be inundated by tidal flooding for design return period events accounting for climate change allowance. On this basis, it is recommended that the following flood resilience measures be incorporated within the development design to minimise risks to personnel and reduce disruption to site processes where flooding occurs:

- Raising of all on-site controls, critical infrastructure and entry points for services (gas / electricity / water) by 300mm above the maximum 200 year + climate change tidal flood level (e.g. to 8.71m AOD) to minimise any disruption caused by flooding;
- Location of all wood processing and storage in areas of the site which are situated at 8.71m AOD or above. Where this is not possible, a concrete upstand should be input around those areas of wood storage and processing which are potentially affected by tidal flooding for design return period events e.g. surface elevations <8.41m AOD. This should be sealed to the concrete pad using a penetrative sealant and the blocks of the upstand should also sealed together to prevent the ingress of floodwater. The crest of the upstand should be located at 9.01m AOD, placing it 600mm above the current tidal flood level; and
- Incorporation of flood resistant and resilient construction techniques within the design of those parts of the facility (particularly any elements which have not been raised) which are potentially affected by flooding (e.g. at ground levels <8.41m AOD), to minimise water ingress in this event. This should apply up to 600mm above the tidal flood level (e.g. to 9.01m AOD). The design of these measures should be suited to salt water environments.

4.4.2 The proposed flood mitigation measures would not impact fluvial flows or floodplain storage since the site is unaffected by fluvial flooding. Furthermore, Tidal flooding is governed by level and is not subject to impacts on floodplain storage volume. It is therefore considered that the proposed flood mitigation measures would not detrimentally impact the flood risk to third party property.

4.4.3 The following flood management measures are proposed to further ameliorate those residual risks which cannot be borne out by design:

- Preparation of a Flood Management Plan outlining the procedures to be followed in the event of flooding;
- Signing up to the NRW flood warning system to alert personnel to the potential for flooding and allow safe evacuation and execution of the Flood Management Plan; and
- In the event of flood warning and / or flooding, the facility will be subject to shut down / evacuation.

4.4.4 It is considered that with the outlined flood mitigation and management measures in place, the risks posed to personnel and the Plant by flooding, can be reduced to an acceptable level, with particular regard to the requirements surrounding the specified maximum rate of rise of floodwaters for industrial development, e.g. 0.3m/hr as noted within Appendix 1 of TAN-15, section A1.15.

Safe Refuge and Access

4.4.5 Safe access is indicated to be achievable from the property. Where flooding is anticipated but has not yet occurred, personnel should evacuate north onto via Ffordd Y Mileniwm (Millennium Way), then head west towards the roundabout with Gladstone Bridge, crossing Gladstone Bridge and heading north via Buttrills Road and linking into the A4050 via Barry Road. These roads are elevated; are unaffected by flooding throughout all return period events now and in the future; and link into the main arterial road network serving the area.

4.4.6 Safe refuge exists within the northern half of the property where ground levels are located >8.41m AOD and where c.75% of the plot is indicated to be unaffected by flooding. Maximum ground levels of 9.20m AOD are present in this part of the site, with >790mm freeboard above the maximum design return period tidal flood level and 700mm above the extreme tidal flood level. Where flooding has already occurred personnel should execute the Flood Management Plan, evacuate to the northern parts of the plant and await further instruction from Natural Resources Wales and the emergency services.

4.4.7 The risks posed to site users will be minimised through the nature of use (industrial) and the predictability of tidal flooding.

4.5 Summary of Flood Risk

4.5.1 In accordance with the requirements of Welsh Government guidance, TAN15 and local planning policy documents, all potential flood risks posed to / by the development have been assessed.

4.5.2 The facility is indicated to be unaffected by fluvial flooding for both design and extreme return period events accounting for climate change allowance.

4.5.3 The property is however indicated to be affected by tidal flooding for design return period events including allowance for climate change.

4.5.4 Flood mitigation measures are specified to reduce identified risks to an acceptable level accounting for both the development lifetime and flood risk vulnerability.

4.5.5 Flood management is also proposed to alert site users to the risks posed by flooding and the actions to be taken should this occur. This includes consideration of flood warning and designation of points of safe refuge. Safe access / egress is achievable throughout all periods of flooding (design and extreme events), now and in the future.

4.5.6 The proposed flood management measures, which include shut down and evacuation, further reduce the flood hazard to site users.

4.5.7 The application area is linked to an existing and established business use, with this considered to be a '*Less Vulnerable'* land use by TAN 15.

4.5.8 Furthermore, the property is located within an area designated for employment and industrial uses within the current Local Plan. on this basis proposals are considered to fulfil points i-iv of TAN 15 Section 6: *Justifying the Location of Development.* Although generally speaking this test only applies where development is situated within Flood Zone C.

4.5.9 It is duly presented that with the outlined flood mitigation and management measures in place, the identified flood risks to the site and its users can be reduced to an acceptably **Low** level ensuring the safety of site users throughout all periods of flooding,

and accounting for both the proposed nature of use (*Less Vulnerable*) and development lifetime and with no detrimental impact on flood risk at the property or to third party land anticipated to arise from the proposals. On this basis it is considered that the aims of TAN 15 Section 7: *Assessing Flooding Consequences* are also met. Although generally speaking this test only applies where development is situated within Flood Zone C.

4.5.10 The proposals are duly presented as appropriate within the context of the Local Planning Policy documents and TAN 15 Sections 6 and 7.

4.5.11 Potential impacts to flood risk arising from surface water generated within the development are addressed in Section 5.0.

5.0 SURFACE WATER

5.1 Introduction

5.1.1 Proposals include the development of a Wood Processing & Recycling Facility with associated infrastructure within a c.4.25ha plot of land at Berth 31, No. 2 Dock, Port of Barry, Wimborne Road, Vale of Glamorgan, South Wales, CF62 5QS.

5.1.2 The property comprises Brownfield land, the surface finishes of which are currently entirely impervious or highly compacted. The plot is understood to be served by an existing surface water management network, including above ground concrete drainage channels, piped drainage and existing surface water outfalls into the adjacent No. 2 Dock. No on-site attenuation or discharge control measures are indicated to be present.

5.1.3 Welsh Planning Policy and its Technical Advice Note 15 (TAN 15) require that existing runoff rates be maintained, taking account of climate change and that, wherever possible, a degree of betterment is provided. Whilst no overall increase in impervious area will arise from development proposals, climate change impacts may lead to detrimental impacts on the rate and volume of runoff generated over time which, without mitigation, would have a consequent detrimental impact on downstream flooding.

5.1.4 Full surface water management is therefore proposed, which incorporates flood attenuation measures (contaminated areas) sized to accommodate flows from impervious surfaces for return period pluvial flood events up to and including 100 years, accounting for climate change and with zero discharge, to prevent contamination of downstream receiving waters.

5.1.5 As the property will discharge to tidal receiving waters, no surface water attenuation measures are proposed for clean areas. However, water quality treatment is proposed to mitigate potential detrimental impacts to downstream receptors, including groundwater, local watercourses and coastal waters. Sustainable Drainage Systems (SuDS) must be incorporated within the design, wherever practicable.

5.2 Land Use

	Existing		Proposed	
Land Use	**Area (ha)**	**Runoff Coefficient**	**Area (ha)**	**Runoff Coefficient**
Soft Landscaping	0.089	0.40	0.00	0.40
Gravel Chippings	0	0.70	0.00	0.70
Impermeable (roads / hardstanding / built) / Highly Compacted Surface	4.161	0.90	1.130	0.90
Potentially Contaminated Areas	0	0.00	3.120	0.00
Total	**4.250**	**0. 90**	**4.250**	**0.77**

Table 008: Summary of Land Use

5.3 SuDS Options for Surface Water Disposal

5.3.1 Desk based investigation indicates the presence of underlying Mercia Mudstone overlain by Tidal Flat - Clay deposits, with limited potential for the use of infiltration as a means of surface water disposal.

5.3.2 The property is situated immediately adjacent to Number 2 Dock into which a connection could be established for the disposal of site generated runoff (Clean water only). This is the preferred method of surface water discharge. This will be supplemented by SuDS measures (where practicable) to maximise infiltration at source and limit off site discharges for minor rainfall events.

5.3.3 This conforms with the discharge hierarchy outlined within Section 3.2.3 of the SuDS Manual, as follows:

SuDS Discharge Hierarchy:

- Infiltration
- Discharge to surface waters
- Discharge to surface water sewer
- Discharge to combined sewer (Last Resort).

5.4 Existing Drainage

5.4.1 Table 009 summarises the existing drainage elements present within the site. These were recorded by a site survey undertaken in April 2024. The presence of outfalls on the south eastern quayside indicates discharge from the property into No. 2 Dock via the outfalls.

Drainage Element	Cover Level (m AOD)	Invert Level (m AOD)	Comments
Concrete channel 1	8.18 - 8.24	7.85 – 7.93	Central SW section of site N. of railway line & S. of water tank. Runs for 75m to NE edge of weighbridge. No discernible gradient either way – highest IL is in centre of channel.
Concrete channel 2	8.23 – 8.25	7.97 - 8.01	Short channel situated in centre of site. Runs from NE end of weighbridge NE for c.15m.
Concrete channel 3	8.21 – 8.25	7.89 – 7.99	Short (45m) channel continues c.23m NE of channel 2. Ends at NE end of concrete block wall. Unclear where drains to but an inspection cover is present at the NE end. No discernible gradient either way – highest IL in central section of channel.
Concrete channel 4		US IL 7.84 DS IL 7.54	Commences NE of channel 5 heads NE to south of & parallel to channels 2 & 3. Ends on SE edge of sub-station. Gradient generally reduces to NE although an elevated invert (7.96m AOD) is present in the central section of the channel run.
Channel 5. Central square shaped concrete channel.	8.23	7.98 - 8.00	Appears to connect channels 1, 2 & 4. Situated to south of SW weighbridge.
Manholes			Two sets of 5 manholes are situated SE of the substation & S. of the SW weighbridge, respectively. A further set of 3 manholes is situated SE of the water tank. Possible presence of Petrol Interceptors / water quality treatment measures. A number of manholes are present in the SW of the site adj. to the water tank & S. of the SW weighbridge, with a further manhole located on the NW corner of the property.
Gulleys			Along entire length of Wimbourne road & adj. to pumped chamber.
Outfall 1		Obvert: 6.67 IL: 6.17	500mm dia. located on SW edge of slipway at NE end of quayside.
Outfall 2		Obvert: 7.25 IL: 6.05	1200mm dia. located on SW edge of slipway at NE end of quayside.
Outfall 3		Obvert: 6.56 IL: 6.06	500mm dia. located on SW edge of slipway at NE end of quayside.
Pump chamber			A gulley and pump chamber are situated on the northern side of the railway line in the SE section of the property.
Water Storage Tank	NA	Obvert: 11.75 IL: 8.55	1,110m^3 located on south western boundary. Understood to accept runoff (pumped) from contaminated areas for treatment / re-use.

Table 009: Summary of Existing Drainage Infrastructure

5.5 Surface Water Discharge Rates

Contaminated Runoff

5.5.1 Owing to the potentially contaminating nature of the Wood Processing & Recycling Plant, all runoff generated by this facility will pass to a sealed system. Stored runoff will be recycled for use within on-site processes with residues tankered off-site for processing at the nearest Sewage Treatment Works. This will prevent potential detrimental impacts to downstream receptors, including groundwater, local watercourses and coastal receiving waters.

5.5.2 Runoff will be retained by the upstands present on the south eastern margins of the two separate (northern and southern) wood storage and processing areas.

Clean Runoff

5.5.3 Given the location of the property adjacent to the No. 2 Dock which outflows into the tidal Bristol Channel, it is considered that an unlimited discharge would be applicable for clean surface water discharges.

Tide Locking

5.5.4 Investigation has been undertaken to establish the Mean High Water Springs tidal level, with this located at 6.06m AOD. The invert levels on all 3 outfalls are located at, or above, 6.05m AOD with the obvert levels on the pipes set above this and with tide locking considered unlikely. It is however recommended that the discharge point incorporate a flap valve at the outfall to prevent ingress where elevated water levels occur within the adjacent Dock.

5.6 Attenuation Measures – Contaminated Runoff

5.6.1 The WinDes Micro Drainage software package has been used to assess the surface water attenuation requirements for the Wood Processing and storage areas for a 100 year 60 minute duration storm. This accounts for the upstream impervious area, winter and summer storm profiles, climate change, and zero rates of discharge, respectively, with all runoff conveyed to a sealed system for off-site processing. Full copies of these calculations are contained within Appendix II: Workings, with a summary provided in Table 010.

Results

Return Period Rainfall Event (Yrs.)	Storage Requirement (m^3) +20%CC
$Q_{BAR\ Urban}$	475
30	1,030
100	1,465

Table 010: Surface Water Attenuation Requirements – Contaminated Runoff

5.7 Drainage Layout

Clean Runoff

5.7.1 Clean runoff will be intercepted by the existing / new open concrete gullies and will discharge unattenuated to No. 2 Dock via existing outfalls present on the south eastern boundary, following upstream water quality treatment.

Contaminated Runoff

5.7.2 A maximum rainwater storage requirement of 1,465m^3 has been estimated. The concrete pad serving the Wood Storage and Processing Plant is contoured to direct water towards the south western boundary and away from the clean drainage networks, which drain to the south east.

5.7.3 The pad is bisected by a working railway line with 33% of the pad present to the south of the railway and the remaining 67% present to the north. The surface water storage requirements have therefore been split across the two separate areas to prevent flooding of the railway line. The following design considerations have been assumed for each:

Southern Storage Area

- Depth: 7.97m AOD (0.12m above min. ground level)
- Length: 240m
- Width: 34.5m
- Area: 8,280m^2
- Max. Water Depth: 0.12m (accounting for surface gradient)
- Volume: 490m^3
- Freeboard: >300mm (to top of concrete upstand: 9.01m AOD)
- Invert Level: 7.85m AOD (base of pad)
- Level of retaining wall: 8.27m AOD / 0.42m – to include returns either end tying into higher ground (8.27m AOD) to retain runoff. In reality the retaining wall level will be set by flood defence requirements (e.g. to 9.01m AOD).

Northern Storage Area

- Depth: 8.42m AOD (0.27m above min. ground level)
- Length: 240m
- Width: 30.0m
- Area: 7,200m^2
- Volume: 975m^3
- Max. Water Depth: 0.27m (accounting for surface gradient)
- Freeboard: >300mm (to top of concrete upstand: 8.72m AOD)
- Invert Level: 8.15m AOD (base of pad)
- Level of retaining wall: 8.72m AOD / 0.57m – to include returns either end of wall tying into higher ground (8.72m AOD) to retain runoff.

5.7.4 The two areas of the concrete pad will be bordered on their south eastern margins by an impermeable upstand. The retreated wall serving the Northern Storage Area will be located on the northern edge of the railway line and will retain runoff from the northern half of the facility, preventing flooding of the railway line from surface runoff.

5.7.5 The upstand serving the northernmost pad will be constructed as demountable to enable vehicular access between both areas of the working site. During day to day operations gaps will be left in this upstand with demountable barriers put in place during periods of sustained rainfall / flooding.

5.7.6 The containment wall serving the southernmost pad will be fixed to the pad using a penetrative sealant which is designed to retain runoff to ensure that potentially contaminated water is directed into the sealed drainage network and prevented from entering the Dock.

5.7.7 The above upstands will form the basis for the sealed storage areas and are calculated to comprise a suitable size to accommodate runoff for return period rainfall events up to and including the 100 year 60 minute duration storm, accounting for climate change.

5.7.8 A cross sectional profile of the concrete pad and retaining wall (Southern Area) is provided at Figure 015.

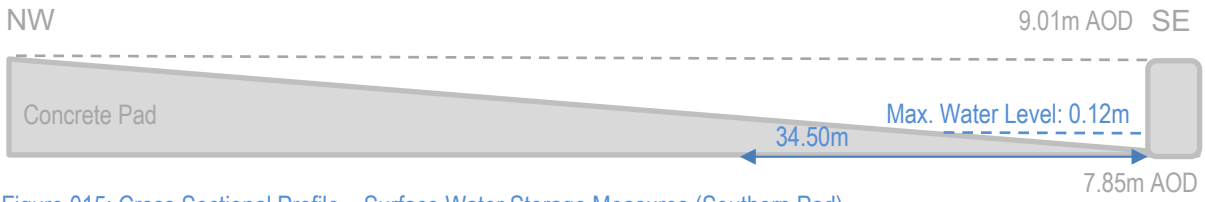


Figure 015: Cross Sectional Profile – Surface Water Storage Measures (Southern Pad)

5.7.9 Stored runoff will be intercepted by a combination of overland flowpaths and open concrete drainage gullies (existing) and directed to a sealed storage area / sump present in the south western corner from where it will be pumped into the large storage tank present on the south western boundary which has capacity for up to 1,110m^3 storage.

5.7.10 Under general rainfall conditions stored water will be used for wash down / dust suppression or filtered and re-used within on site processes. Residual runoff will be transported to the local sewerage treatment works for processing as trade waste.

5.8 Network Capacity

Clean Runoff

5.8.1 Site generated runoff will drain to the surface water outfall via a combination of surface contouring and open concrete drainage gullies (existing and / or proposed), sized to convey runoff for rainfall events of up to 100 years, including climate change and without surcharge.

5.8.2 Surface contouring will be used to direct runoff into the gullies, with exceedance pathways incorporated within the design to convey runoff to the outfall via overland flow should pipe blockage / surcharge occur.

5.8.3 Intercept drainage will be placed at the facility perimeter to direct runoff back into the on-site surface water management systems and tidal outfall(s) preventing the uncontrolled discharge of runoff to adjacent properties.

5.8.4 It is recommended that the main surface water outfall be fitted with a non-return valve to prevent backflow where elevated water levels occur downstream.

Contaminated Runoff

5.8.5 The sealed storage facilities are designed to be dry under normal conditions becoming operational only following intense or sustained rainfall / storm activity. Capacity is present to accommodate rainfall events up to and including the 60 minute 100 year storm, accounting for climate change and without surcharge.

5.8.6 Water will drain to the sealed storage areas via open concrete yard gulleys (existing), with piped networks avoided owing to the potential for blockage of below ground drainage systems within recycling facilities. These are / will be sized to convey runoff for storm events up to and including 100 years, accounting for climate change, without surcharge, and with capacity present for short duration rainfall (high intensity) rainfall events, e.g. the 15 minute storm.

5.8.7 Exceedance pathways are incorporated within the design to direct floodwater water into the storage facility via overland flowpaths using contouring and kerbing / concrete upstands to prevent off-site flooding.

5.8.8 In the event of blockage or surcharge, the storage areas are designed to overflow onto the concrete pad, with runoff retained using surface contouring and sealed upstands until such time as the blockage is removed or downstream water levels subside.

5.8.9 Safety factors are incorporated within the surface water storage calculations to allow for successive rainfall, fluctuations in flow and flood levels, climate change sensitivity and losses in efficiency associated with sedimentation.

5.9 Water Quality

5.9.1 The following water quality treatment measures will be interspersed throughout the clean areas of the development and will service the different built elements as follows:

- Roof drainage to pass to the outfall via standard pipework with no further treatment aside from silt traps located at the upstream end of all pipe runs to remove silts and sediments upstream of the discharge point;
- Potentially contaminated runoff from the clean areas of the Plant, roads and hardstanding will discharge to the outfall via the following water quality treatment, designed in accordance with the requirements of the SuDS Manual section 4 (Table 4.3) and Section 26 (Tables 26.2 and 26.3):
    - **Porous Surfaces:** Runoff would be intercepted at source and passed through the sub-base which will drain to filter drains / permeable pipes located at the perimeter of the permeable surfaces for onward release to downstream receiving waters. The porous surface will slow runoff and encourage sediment deposition upstream of the outfall. Hydrocarbons will be removed through adsorption, adhesion and microbial processes within the paviours and underlying sub-base; and
    - **Oil Separator (where required):** Situated upstream of the surface water outfall(s) and sized to accommodate the upstream impervious catchment area. Removal of silts, suspended solids and hydrocarbons from runoff.

5.9.2 The inclusion of the above measures will encourage the settlement and retention of sediments, preventing blockage of the inlet(s) / outfall(s) and the discharge of sediment laden water to local receiving waters and associated scour, and will ensure that only clean water is discharged.

5.9.3 Principal areas of the property which are at elevated risk of fire will discharge runoff into the sealed drainage network. This would limit the potential for off-site discharges / pollution incidents in the event of fire.

5.10 Management and Maintenance Responsibility

5.10.1 **South West Wood Ltd;** or its successor, will be responsible for ensuring the ongoing management and maintenance of the surface water management systems serving the facility, either directly or via an appointed contractor. The responsibility for management and maintenance will pass to the lessee, where the facility is operated by a third party, and to the purchaser where the site is subject to sale.

Inspection and Maintenance Schedule

5.10.2 It is proposed that a programme of inspection and maintenance be executed for the surface water management systems by the facilities manager, or appointed drainage contractor. This should be undertaken in accordance with the schedule outlined below and following significant rainfall events and / or storm activity.

5.10.3 A photographic record of inspections should be undertaken to pick up long term changes that may not be apparent within a single inspection. Inspections should comply with all relevant Health and Safety legislation.

5.10.4 This maintenance schedule applies for the lifetime of the development.

Notes

5.10.5 Where silt removal is proposed, this should be undertaken in an environmentally sensitive manner.

5.10.6 All waste arisings should be collected by an approved contractor and should be subject to appropriate treatment and disposal.

5.10.7 The facilities manager should be contacted where pollution or blockage are identified.

Element	Frequency	Notes
Gulleys / Gulley Pots / Drainage grates	Quarterly / following storm activity	▪ Remove grill and check for debris / blockage. ▪ Remove accumulated debris to prevent blockage of pipework. ▪ Rod / jet where required. Silt traps to be cleansed before **and** after rodding.
Manholes / Inspection Covers / pipework	Quarterly / following storm activity	▪ Visual inspection – remove cover, shine torch into manhole. ▪ Check every orifice for blockage / siltation. ▪ Pour water into each to verify through flow. ▪ Remove debris /silt and rod / jet where required.
Silt Traps	Quarterly / following storm activity	▪ Visual inspection, removal of accumulated silt. ▪ Where rodding of manholes is proposed silt traps should be cleansed before and after to prevent silt bypassing the traps.
Filter Drains / Porous Surfaces	Quarterly / following storm activity	▪ Visual inspection for accumulated silt / vegetation (at surface). ▪ Check for surface clogging / ponding. Remove vegetation / silt. ▪ Remove siltation / blockage from the stone sub-base and/or underlying pipework / drainage blanket (where present).
Sealed Attenuation (Contaminated)	Monthly	▪ Visual inspection for accumulated silt. Where significant siltation is seen, remedial works should be undertaken. ▪ Visual inspection / removal of accumulated debris / blockage.
Inlets / Outfalls	Monthly / following storm activity	▪ Visual inspection for accumulated debris or blockage, at both upstream and downstream faces. ▪ Check every orifice / inlet / outlet / structure for blockage or siltation, pour water into each to verify through flow. ▪ Remove any debris and rod where required.
Vegetation	Quarterly (ensure cutting / strimming is undertaken at least twice during peak growing seasons, e.g. Mar. / Sept.)	▪ Regular grass cutting and maintenance of shrubs / trees will be key in reducing the presence of debris which could block the drainage network or cause eutrophication of water bodies. ▪ Grass should be cut quarterly, with focus on the growing season (Mar. – Oct.) and leaves / debris cleared from landscaped areas. ▪ During the winter shrubs and trees should be pruned to reduce accumulated vegetation within the property / detention facilities. ▪ All mowings / cuttings to be removed from vicinity of SW storage areas to prevent eutrophication.
Pumps / Oil Separator(s)	In accordance with the manufacturers' specifications.	NA

Table 011: Drainage Inspection and Maintenance Schedule

6.0 CONCLUSIONS

6.0.1 Amber Planning Ltd. has been appointed to prepare a Technical Advice Notice 15 (TAN 15) compliant Flood Consequences Assessment in support of an application for a proposed Wood Recycling & Processing Facility with access and associated infrastructure within a c.4.25ha plot at Berth 31, No. 2 Dock, Port of Barry, Wimborne Road, Vale of Glamorgan, CF62 5QS. The Port of Barry area falls within the administrative remit of Vale of Glamorgan Council.

6.0.2 This Flood Consequences Assessment report has been completed in accordance with the guidance set out within TAN 15 for '*Less Vulnerable'* development within Flood Zone B. The requirements of Local Planning Policy and Technical Studies have also been accounted for within this assessment.

6.0.3 A scoping exercise has been completed which considers all potential flood risks, each of which have been fully assessed as part of this study, accounting for flood risk vulnerability, anticipated lifetime and climate change predictions. The principal flood risk to the property is indicated to arise from tidal flooding, which has been duly assessed and concluded to be acceptably **Low** accounting for the flood mitigation and management measures specified for the facility.

6.0.4 Residual risks associated with extreme flooding have also been assessed with flood management measures proposed to further reduce those risks which cannot be borne out through design to an acceptable level, now and in the future, accounting for both development lifetime and flood risk vulnerability.

6.0.5 It is duly demonstrated that the risks posed to the facility by tidal flooding can be reduced to an acceptably **Low** level, ensuring the safety of site users throughout all periods of flooding, accounting for the proposed nature of use (*Less Vulnerable*) and development lifetime, with no detrimental impact to flood risk at the property or to third party land. On this basis, it is considered that the aims of TAN 15 Sections 6: *Justifying the Location of Development* & 7: *Assessing Flooding Consequences*, are met.

6.0.6 The surface water storage requirements for the facility have been assessed using the WinDes Micro Drainage software package for return period rainfall events up to and including 100 years, taking account of land use data and climate change consideration.

6.0.7 Clean runoff will discharge unattenuated to tidal receiving waters following upstream water quality treatment. Contaminated runoff will drain directly to sealed, isolated, systems from where it will be re-used within on site processes, with residues tankered off-site for separate processing at a suitable wastewater treatment facility. A total surface water storage of 1,465m^3 has been calculated for the 100 year (60-minute) storm event, accounting for zero rates of discharge, land use data and climate change consideration.

6.0.8 All drainage networks have been designed / audited to ensure the existing and proposed drainage measures present within the facility account for industry best practice with regards system capacity, with safety factors accounted for within the surface water storage calculations to allow for successive rainfall events, fluctuations in flow, flood level, climate change sensitivity and losses in efficiency associated with siltation.

6.0.9 It is duly presented that the provision of a formal surface water management system, which incorporates on-site (sealed) attenuation and water quality treatment, will ensure that potential detrimental impacts to flood risk and water quality are suitably mitigated throughout the anticipated development lifetime, in accordance with TAN 15. The requirements of Local Planning Policy and Technical studies have also been accounted for within this assessment.

6.0.10 Water re-use measures are proposed to reduce over reliance on potable supply for non-potable uses and to minimise off-site surface water discharges during minor rainfall events.

6.0.11 **South West Wood Ltd**; or successor, will be responsible for the ongoing management and maintenance of the surface water management system(s), throughout the development lifetime, either directly or via an appointed contractor. The responsibility for management and maintenance will pass to the lessee, where the site is operated by a third party, and to the purchaser where the site is subject to sale.

6.0.12 The mitigation solutions noted within this report are subject to agreement with Natural Resources Wales and the Vale of Glamorgan Council in their respective capacities within the Lead Local Flood Authority, and as part of the application process.

6.0.13 It is duly presented that the proposed facility is appropriate within the context of Welsh Government Planning Policy, TAN 15 and Local Planning Policy.

7.0 CLOSURE

7.0.1 This report has been prepared by Amber Planning Ltd. with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with The Client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

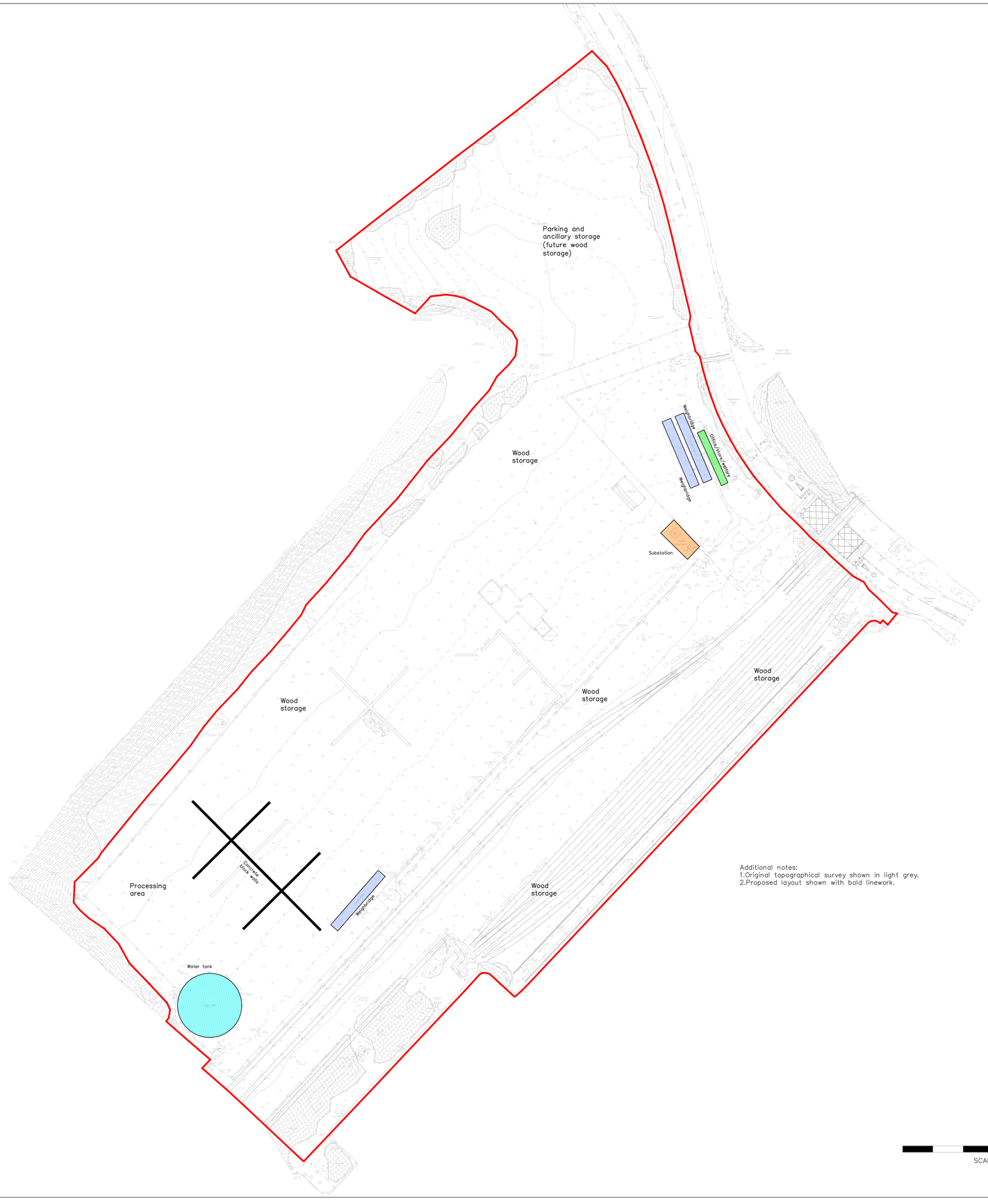
7.0.2 Reliance has been placed on factual and anecdotal data obtained from the sources identified. Amber Planning Ltd. cannot be held responsible for the scope of work, or any omissions, misrepresentation, errors or inaccuracies within the supplied information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part in the event of delay between the writing of the report and its consideration by The Client, with particular regard to submission of a planning application.

7.0.3 This report is for the exclusive use of The Client; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Amber Planning.

7.0.4 Amber Planning disclaims any responsibility to The Client and others in respect of any matters outside the agreed scope of the work.

Notes:
1.This drawing should only be used for its original intended purpose.
2.Critical dimensions, levels, clearances etc. should be checked on site before construction work commences.
3.Dimensions in metres unless otherwise stated.

Application boundary



Additional notes:
1.Original topographical survey shown in light grey.
2.Proposed layout shown with bold linework.

SCALE BAR = 70M

Revision	Comment	Date
A	Block walls amended	02 May 2024

South West Wood Products Ltd

Unit A4 Pacific Road, Compass Business Park, Cardiff CF24 5HL

Project
BARRY DOCK
WOOD DEPOT

Drawing Title
SITE LAYOUT

Drawn Date
28/04/24

Surveyed Date

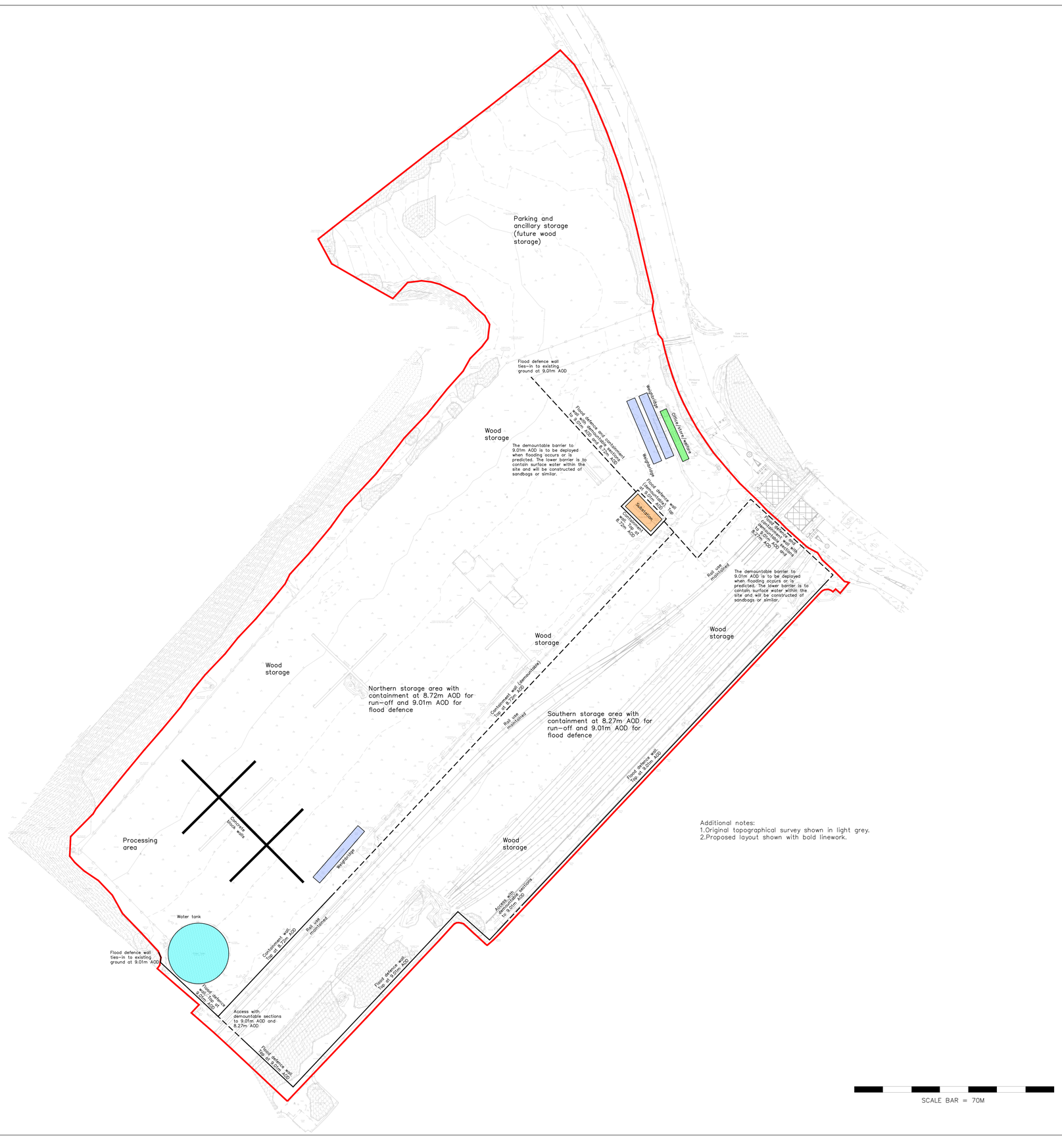
Scale
1:500 (AT A0)

Drawing Number
LMM/072/02

REVA FOR COMMENT
02 MAY 2024

Notes:
1.This drawing should only be used for its original intended purpose.
2.Critical dimensions, levels, clearances etc. should be checked on site before construction work commences.
3.Dimensions in metres unless otherwise stated.

Application boundary



Revision	Comment	Date
B	Flood defence wall added	18 Aug 2024
A	Block walls amended	02 May 2024

South West Wood Products Ltd

Unit A4 Pacific Road, Compass Business Park, Cardiff CF24 5HL

Project
BARRY DOCK
WOOD DEPOT

Drawing Title
SITE LAYOUT

Drawn Date: 28/04/24
Surveyed Date:

Scale: 1:500 (AT A0)

Drawing Number: LMM/072/02
Rev: B

Δ 16NW ST17SE/159

Welsh Soil Engineering Limited 1309.682

Borehole No. 4

BOREHOLE LOG

Contract No. 2735/F.3365
Location Barry Docks
Client British Transport Docks Board
Method of Boring Percussion
Diameter of Borehole 250mm/200mm

Sheet 1 of 2
Chainage
Ground Level 8.03m AOD
Date 17/5/76

Description of Strata	Legend	Depth Below G.L.(m)	Thickness of Strata(m)	Type of Sample	c KN/sq.m	ø deg	m.c. %	γ Kg/cu.m	N
MADEGROUND:- Bricks and clay		0.30	0.30	0.50	31	0	31.0	1870	
Soft/firm light brown silty CLAY with occasional stones				1.80	28	0	33.3	1830	
				3.30	38	0	32.0	1930	
				5.00	17	0	44.0	1740	
Soft grey very silty sandy CLAY with bands of loose sand		5.50	5.20	6.20	16	0	31.5	1955	
Loose grey medium grained SAND		7.30	1.80	8.00					7
PEAT		9.30	2.00						
Grey silty highly organic CLAY		9.50	0.20	9.80	10	0	92	1500	(-2.27)
Stiff red brown shaly CLAY with bands of marl (weathered marl)		10.30	0.80	11.00	41	16	15.8	2025	
				12.50	81	14	14.1	2105	
Highly weathered red/brown MARL with bands of clay (zone 3)		13.50	3.20	14.00					65
				15.50					118
				17.00					110
Moderatley weathered red/brown silty MARL (zone 2)		18.30	4.80	18.70					141for 270mm

Key
- ▯ Undisturbed Sample
- O Disturbed Sample
- Δ Water Sample
- I Penetration Test
- Ø Angle of Friction
- m.c. Moisture Content
- γ Bulk Density
- N S.P.T. Value
- c Apparent Cohesion

Remarks (Observations of Ground Water etc.)

ST16NW/159
1309.6821

Borehole No. 4

Holst Soil Engineering Limited

BOREHOLE LOG

Contract No. ....2735/F.3365.....
Location .....Barry Dock.....
Client.....British Transport Docks Board.....
Method of Boring.....Percussion.....
Diameter of Borehole ...250mm/200mm.....

Sheet 2 ...of ...2.....
Chainage.....
Ground Level .....
Date.....

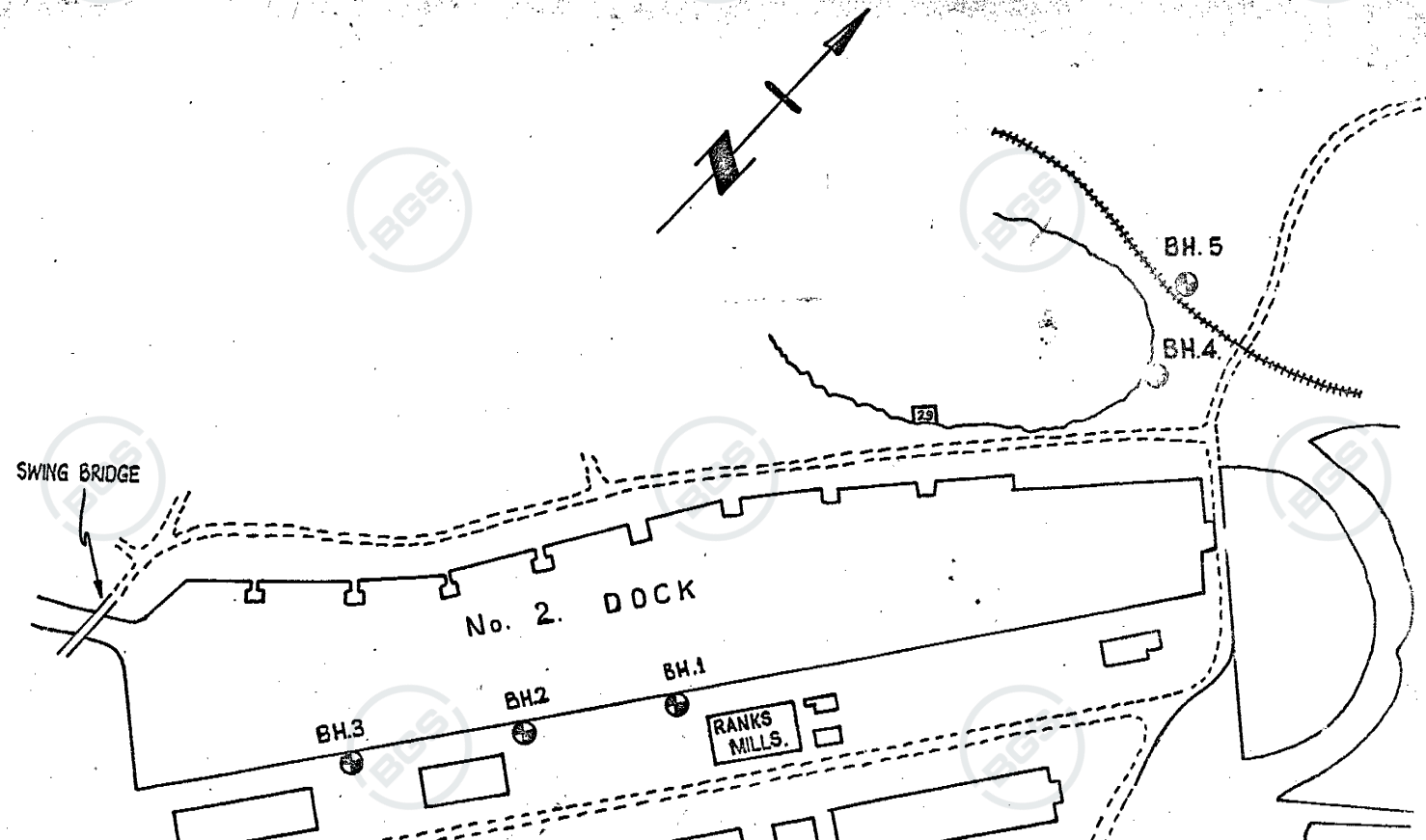
Description of Strata	Legend	Depth Below G.L.(m)	Thickness of Strata(m)	Type of Sample	c KN/sq.m	ø deg	m.c. %	γ Kg/cu.m	N
Moderate/slightly weathered red brown silty MARL (zone 2)				20.00 I					96 for 250mm
				21.50 I					114for 200mm
				23.00 I					97 for 75mm
		24.60	6.30	24.60 I					106for 75mm

Key

- ▯ Undisturbed Sample
- O Disturbed Sample
- △ Water Sample
- I Penetration Test
- Ø Angle of Friction
- m.c. Moisture Content
- γ Bulk Density
- N S.P.T. Value

Remarks (Observations of Ground Water etc.)

Water struck at 6.20m
Standing level 5.10m Sealed at 10.00m
Water again struck at 13.20m
Final standing level 6.80m



S.I. BARRY DOCKS.
Borehole locations.
(N.T.S.)

ST16NW/156 - 159

ST16NW/200, 201

By Soil Mechanics Ltd.

ST16NW/200 and 201

Geol.Dept.Cardiff.

Ref. Nos 10, 11
2½-inch sheets ST/16

RECORD OF BORE OR PIT.

Bore Nos 1 & 2.
At.Barry Docks:North end-Dock No. 2.

For. Land & Marine Contractors.

Borers. Soil Mechanics Ltd. Date. July,1958.
Purpose. Site Exploration.
Surface level above O.D.
Standing water level below top.
Yield.

GEOLOGICAL NOTES.	ORIGINAL DESCRIPTION.	Thickness. Ft.	Thickness. In.	Depth. Ft.	Depth. In.
ST16NW/200	1301 6803				
	1. S.L. 24'				
	Gravel with fragments of marl & marl & limestone boulders.	51	6	51	6
	Hard Red Marl.	24	-	75	6
ST16NW/201	1310 6819.				
	2. S. L. 24'				
	Marl,clay & gravel.	39	-	39	-
	Hard,red marl.	21	-	60	-

Summary of Results for 2 year Return Period (+20%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	0.025	0.025	254.9	O K
30 min Summer	0.032	0.032	328.8	O K
60 min Summer	0.042	0.042	424.0	O K
120 min Summer	0.054	0.054	546.8	O K
180 min Summer	0.062	0.062	634.5	O K
240 min Summer	0.069	0.069	705.2	O K
360 min Summer	0.080	0.080	818.3	O K
480 min Summer	0.089	0.089	909.4	O K
600 min Summer	0.097	0.097	987.0	O K
720 min Summer	0.103	0.103	1055.3	O K
960 min Summer	0.113	0.113	1155.1	O K
1440 min Summer	0.129	0.129	1311.9	O K
2160 min Summer	0.146	0.146	1490.0	O K
2880 min Summer	0.160	0.160	1630.9	O K
4320 min Summer	0.178	0.178	1810.7	O K
5760 min Summer	0.191	0.191	1950.2	O K
7200 min Summer	0.203	0.203	2065.7	O K
8640 min Summer	0.212	0.212	2165.2	O K
10080 min Summer	0.221	0.221	2253.1	O K
15 min Winter	0.028	0.028	285.5	O K
30 min Winter	0.036	0.036	368.2	O K
60 min Winter	0.047	0.047	474.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	43.576	35
30 min Summer	28.099	50
60 min Summer	18.119	80
120 min Summer	11.683	140
180 min Summer	9.039	200
240 min Summer	7.534	260
360 min Summer	5.828	380
480 min Summer	4.858	500
600 min Summer	4.218	620
720 min Summer	3.758	740
960 min Summer	3.085	980
1440 min Summer	2.336	1460
2160 min Summer	1.769	2180
2880 min Summer	1.452	2900
4320 min Summer	1.075	4340
5760 min Summer	0.868	5784
7200 min Summer	0.736	7224
8640 min Summer	0.643	8664
10080 min Summer	0.573	10104
15 min Winter	43.576	35
30 min Winter	28.099	50
60 min Winter	18.119	80

Summary of Results for 2 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m^3)	Status
120 min Winter	0.060	0.060	612.4	O K
180 min Winter	0.070	0.070	710.6	O K
240 min Winter	0.077	0.077	789.8	O K
360 min Winter	0.090	0.090	916.5	O K
480 min Winter	0.100	0.100	1018.5	O K
600 min Winter	0.108	0.108	1105.5	O K
720 min Winter	0.116	0.116	1181.9	O K
960 min Winter	0.127	0.127	1293.7	O K
1440 min Winter	0.144	0.144	1469.3	O K
2160 min Winter	0.164	0.164	1668.8	O K
2880 min Winter	0.179	0.179	1826.6	O K
4320 min Winter	0.199	0.199	2028.0	O K
5760 min Winter	0.214	0.214	2184.2	O K
7200 min Winter	0.227	0.227	2313.6	O K
8640 min Winter	0.238	0.238	2425.0	O K
10080 min Winter	0.247	0.247	2523.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
120 min Winter	11.683	140
180 min Winter	9.039	200
240 min Winter	7.534	260
360 min Winter	5.828	380
480 min Winter	4.858	500
600 min Winter	4.218	620
720 min Winter	3.758	740
960 min Winter	3.085	980
1440 min Winter	2.336	1460
2160 min Winter	1.769	2180
2880 min Winter	1.452	2900
4320 min Winter	1.075	4340
5760 min Winter	0.868	5784
7200 min Winter	0.736	7224
8640 min Winter	0.643	8664
10080 min Winter	0.573	10104

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.276	Cv (Winter)	0.840
Return Period (years)	2	E (1km)	0.288	Shortest Storm (mins)	15
Site Location		F (1km)	2.515	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.385	Winter Storms	Yes		
D2 (1km)	0.332	Cv (Summer)	0.750		

Time / Area Diagram

Total Area (ha) 3.120

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.624	4-8	0.624	8-12	0.624	12-16	0.624	16-20	0.624

Model Details

Storage is Online Cover Level (m) 0.725

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	10200.0	0.425	10200.0

Summary of Results for 30 year Return Period (+20%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m^3)	Status
15 min Summer	0.060	0.060	609.7	O K
30 min Summer	0.073	0.073	749.1	O K
60 min Summer	0.090	0.090	920.3	O K
120 min Summer	0.111	0.111	1130.7	O K
180 min Summer	0.125	0.125	1275.4	O K
240 min Summer	0.136	0.136	1389.2	O K
360 min Summer	0.154	0.154	1567.0	O K
480 min Summer	0.167	0.167	1706.7	O K
600 min Summer	0.179	0.179	1823.7	O K
720 min Summer	0.189	0.189	1925.2	O K
960 min Summer	0.202	0.202	2065.2	O K
1440 min Summer	0.224	0.224	2279.9	O K
2160 min Summer	0.247	0.247	2517.1	O K
2880 min Summer	0.265	0.265	2700.1	O K
4320 min Summer	0.286	0.286	2914.0	O K
5760 min Summer	0.302	0.302	3075.9	O K
7200 min Summer	0.314	0.314	3207.7	O K
8640 min Summer	0.325	0.325	3319.6	O K
10080 min Summer	0.335	0.335	3417.2	O K
15 min Winter	0.067	0.067	682.9	O K
30 min Winter	0.082	0.082	839.0	O K
60 min Winter	0.101	0.101	1030.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	104.225	35
30 min Summer	64.025	50
60 min Summer	39.330	80
120 min Summer	24.161	140
180 min Summer	18.168	200
240 min Summer	14.842	260
360 min Summer	11.161	380
480 min Summer	9.117	500
600 min Summer	7.794	620
720 min Summer	6.856	740
960 min Summer	5.516	980
1440 min Summer	4.060	1460
2160 min Summer	2.988	2180
2880 min Summer	2.404	2900
4320 min Summer	1.730	4340
5760 min Summer	1.369	5784
7200 min Summer	1.142	7224
8640 min Summer	0.985	8664
10080 min Summer	0.869	10104
15 min Winter	104.225	35
30 min Winter	64.025	50
60 min Winter	39.330	80

Summary of Results for 30 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m^3)	Status
120 min Winter	0.124	0.124	1266.4	O K
180 min Winter	0.140	0.140	1428.5	O K
240 min Winter	0.153	0.153	1555.9	O K
360 min Winter	0.172	0.172	1755.0	O K
480 min Winter	0.187	0.187	1911.6	O K
600 min Winter	0.200	0.200	2042.5	O K
720 min Winter	0.211	0.211	2156.2	O K
960 min Winter	0.227	0.227	2313.0	O K
1440 min Winter	0.250	0.250	2553.5	O K
2160 min Winter	0.276	0.276	2819.1	O K
2880 min Winter	0.296	0.296	3024.1	O K
4320 min Winter	0.320	0.320	3263.6	O K
5760 min Winter	0.338	0.338	3445.0	O K
7200 min Winter	0.352	0.352	3592.6	O K
8640 min Winter	0.365	0.365	3717.9	O K
10080 min Winter	0.375	0.375	3827.2	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
120 min Winter	24.161	140
180 min Winter	18.168	200
240 min Winter	14.842	260
360 min Winter	11.161	380
480 min Winter	9.117	500
600 min Winter	7.794	620
720 min Winter	6.856	740
960 min Winter	5.516	980
1440 min Winter	4.060	1460
2160 min Winter	2.988	2180
2880 min Winter	2.404	2900
4320 min Winter	1.730	4340
5760 min Winter	1.369	5784
7200 min Winter	1.142	7224
8640 min Winter	0.985	8664
10080 min Winter	0.869	10104

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.276	Cv (Winter)	0.840
Return Period (years)	30	E (1km)	0.288	Shortest Storm (mins)	15
Site Location		F (1km)	2.515	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.385	Winter Storms	Yes		
D2 (1km)	0.332	Cv (Summer)	0.750		

Time / Area Diagram

Total Area (ha) 3.120

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.624	4-8	0.624	8-12	0.624	12-16	0.624	16-20	0.624

Model Details

Storage is Online Cover Level (m) 0.725

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	10200.0	0.425	10200.0

Summary of Results for 100 year Return Period (+20%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m^3)	Status
15 min Summer	0.089	0.089	904.1	O K
30 min Summer	0.107	0.107	1086.7	O K
60 min Summer	0.128	0.128	1306.2	O K
120 min Summer	0.154	0.154	1570.0	O K
180 min Summer	0.171	0.171	1748.4	O K
240 min Summer	0.185	0.185	1887.1	O K
360 min Summer	0.206	0.206	2101.5	O K
480 min Summer	0.222	0.222	2268.3	O K
600 min Summer	0.236	0.236	2406.7	O K
720 min Summer	0.248	0.248	2526.0	O K
960 min Summer	0.263	0.263	2685.1	O K
1440 min Summer	0.287	0.287	2926.6	O K
2160 min Summer	0.313	0.313	3189.8	O K
2880 min Summer	0.332	0.332	3390.8	O K
4320 min Summer	0.354	0.354	3612.8	O K
5760 min Summer	0.370	0.370	3779.1	O K
7200 min Summer	0.384	0.384	3913.3	O K
8640 min Summer	0.395	0.395	4026.5	O K
10080 min Summer	0.404	0.404	4124.7	O K
15 min Winter	0.099	0.099	1012.6	O K
30 min Winter	0.119	0.119	1217.2	O K
60 min Winter	0.143	0.143	1463.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	154.554	35
30 min Summer	92.884	50
60 min Summer	55.822	80
120 min Summer	33.548	140
180 min Summer	24.906	200
240 min Summer	20.162	260
360 min Summer	14.968	380
480 min Summer	12.117	500
600 min Summer	10.285	620
720 min Summer	8.996	740
960 min Summer	7.172	980
1440 min Summer	5.211	1460
2160 min Summer	3.787	2180
2880 min Summer	3.019	2900
4320 min Summer	2.144	4340
5760 min Summer	1.682	5784
7200 min Summer	1.394	7224
8640 min Summer	1.195	8664
10080 min Summer	1.049	10104
15 min Winter	154.554	35
30 min Winter	92.884	50
60 min Winter	55.822	80

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m^3)	Status
120 min Winter	0.172	0.172	1758.4	O K
180 min Winter	0.192	0.192	1958.2	O K
240 min Winter	0.207	0.207	2113.6	O K
360 min Winter	0.231	0.231	2353.7	O K
480 min Winter	0.249	0.249	2540.5	O K
600 min Winter	0.264	0.264	2695.5	O K
720 min Winter	0.277	0.277	2829.1	O K
960 min Winter	0.295	0.295	3007.4	O K
1440 min Winter	0.321	0.321	3277.8	O K
2160 min Winter	0.350	0.350	3572.6	O K
2880 min Winter	0.372	0.372	3797.7	O K
4320 min Winter	0.397	0.397	4046.4	O K
5760 min Winter	0.415	0.415	4232.6	O K
7200 min Winter	0.430	0.430	4382.9	Flood Risk
8640 min Winter	0.442	0.442	4509.7	Flood Risk
10080 min Winter	0.453	0.453	4619.7	Flood Risk

Storm Event	Rain (mm/hr)	Time-Peak (mins)
120 min Winter	33.548	140
180 min Winter	24.906	200
240 min Winter	20.162	260
360 min Winter	14.968	380
480 min Winter	12.117	500
600 min Winter	10.285	620
720 min Winter	8.996	740
960 min Winter	7.172	980
1440 min Winter	5.211	1460
2160 min Winter	3.787	2180
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Model Details

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Tank or Pond Structure

Invert Level (m) 0.000

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0.000	10200.0	0.425	10200.0