

# PEMBROKE DOCK INFRASTRUCTURE

## Flood Consequence Assessment

On Behalf of

**Milford Haven Port Authority (MHPA)**

JER1262  
Pembroke Dock  
V0.9  
12 April 2019

## REPORT

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## REPORT

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# EXECUTIVE SUMMARY

- S1 RPS has undertaken a Flood Consequence Assessment (FCA) in accordance with the requirements of Planning Policy Wales (PPW) and Technical Advice Note 15 (TAN 15) for the proposed development at Pembroke Port, known as Pembroke Dock Infrastructure (PDI).
- S2 The TAN 15 Development Advice Maps (DAMs) confirm that the proposed development site is located in Zone A, defined as an area that is considered to be at little or no risk of fluvial or coastal/tidal flooding.
- S3 The NRW Flood Zone Map indicates that the majority of the proposed development is located within an area designated as low risk of flooding (Flood Zone 1) with less than 1 in 1,000 annual probability of river and/or sea flooding. The main source of flooding is associated with the tidally dominated Milford Haven Waterway. Fluvial flooding is not considered a risk to the site.
- S4 NRW extreme tidal model outputs indicate that tidal flooding for a 1 in 100-year event would reach 4.69 mAOD, the site topography identifies a range of 6.0 mAOD to 8.1 mAOD indicating that the site would not be at risk of tidal flooding. The site would also be protected against a 1 in 200 year tidal flood event plus climate change as tides in this event would only reach 5.82 mAOD.
- S5 The majority of the site is at 'very low' (less than 0.1%) risk of surface water flooding with localised areas within the site being defined as low to high risk of surface water flooding.
- S6 The site susceptibility to groundwater flooding has been assessed as low.
- S7 The site is not at risk of flooding from reservoir infrastructure failure.
- S8 NRW and Welsh Government records indicate that the site has not been subject to historical flooding.
- S9 The proposed development type is defined as 'less vulnerable' in TAN 15 and is appropriate for the present Flood Zone and the Flood Zone including climate change.
- S10 There will be a 1 ha increase in impermeable surfacing as a consequence of the development at the site, any additional 'clean' runoff will be directed to the current drainage system and discharged directly to the estuary, therefore, no additional surface water attenuation features are required.

## REPORT

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# 1 SCOPE OF WORK

## 1.1 Background

1.1.1 At the request of Milford Haven Port Authority (MHPA), RPS has prepared a site-specific Flood Consequence Assessment (FCA) for the proposed development at Pembroke Port, known as Pembroke Dock Infrastructure (PDI). The FCA has been undertaken in accordance with Planning Policy Wales Edition 10 (PPW) and Technical Advice Notice 15 (TAN 15).

1.1.2 The key objectives of the FCA are:

- To assess the flood risk to the proposed development and to demonstrate the feasibility of appropriately designing the development such that any residual flood risk to the development and users would be acceptable; and
- To assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate the feasibility of appropriately designing the development such that the development would not increase flood risk elsewhere.

## 1.2 Project Scope

1.2.1 The FCA has been produced in accordance with the requirements of PPW and TAN 15 and provides an outline of the potential flood risk and hydrological constraints to the site.

## 1.3 Report Structure

1.3.1 This FCA has the following structure:

- Section 2 identifies the sources of information that have been consulted in preparation of the report;
- Section 3 provides an overview of the existing site environment and of the proposed development;
- Section 4 provides a hydrological review of the site and sets out the flood risk assessment of the proposed development;
- Section 5 describes the sites vulnerability status in line with PPW and TAN 15;
- Section 6 describes the run off characteristics and drainage of the site and the principles of the Outline Drainage Strategy;
- Section 7 describes the flood risk management measures that should be applied to the site, where required; and
- Section 8 provides a summary and conclusion to the FCA.

## 1.4 Limitations

1.4.1 The report is based on publicly available hydrological and flood risk data extracted from the NRW website ([www.naturalresources.wales/](http://www.naturalresources.wales/)) (Accessed November 2018).

## 2 SOURCES OF INFORMATION

### 2.1 Introduction

2.1.1 Table 2-1 below lists the information sources consulted during preparation of this FCA.

**Table 2-1: Information Sources consulted during Preparation of the FCA.**

| Source                                             | Data                                                   | Information consulted/ provided                                                                                      |
|----------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Ordnance Survey                                    | Online OS Mapping 1: 50 000 Sheet 158: Tenby &Pembroke | Area information, rivers and other watercourses, general site environs, built environment and catchment Information. |
| British Geological Survey                          | BGS (online) Geology of Britain Viewer                 | Site and area geology.                                                                                               |
| Welsh Government and NRW                           | NRW data holdings and the Lle Geo-Portal               | Current flood risk, local flood defences, flood levels, supplementary geology and groundwater information.           |
| Pembrokeshire Local Planning Authority (LPA) 2013) | Pembrokeshire Local Development Plan (February 2013)   | Flood Zoning and Local Development Plan.                                                                             |
| Pembrokeshire County Council                       |                                                        |                                                                                                                      |
| Water Utility Company                              | Private Water Utility                                  | Water and sewerage assets linking to Welsh Water.                                                                    |
| Welsh Government                                   | Planning Policy Wales (PPW).<br>TAN 14<br>TAN 15       | Flood zoning for the site as used by NRW.                                                                            |

2.1.2 The reports consulted during the preparation of the FCA are listed below (Table 2-2):

**Table 2-2: Reports consulted during Preparation of the FCA**

| Source                       | Data                                                      | Information consulted/ provided                                                                                            |
|------------------------------|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Pembrokeshire County Council | Pembrokeshire Local Development Plan (February 2013)      | Current Zone/risk to the site including historical flooding locations. Any relevant flood modelling complete for the site. |
| (NRW)                        | NRW Western Wales Flood Risk Management Plan (April 2013) | Flood risk management policies.                                                                                            |

## 2.2 Legislation and Guidance

### National Planning Policy

2.2.1 Section 6.6 of Planning Policy Wales (PPW) Edition 10 relates to 6 'Water and Flood Risk' and outlines the Welsh Government's objectives in terms of addressing flood risk.

- 2.2.2 PPW states that all development on land within the flood plain of a watercourse, or drained via a culvert, or on low lying land adjacent to tidal water is at some risk of flooding and whilst flood risk can be reduced using mitigation measures it can never be completely eliminated.
- 2.2.3 Paragraph 6.6.22 states climate change is likely to increase the risk of flooding as a result of sea-level rises, increased storminess and more intense rainfall. Flooding as a hazard involves the consideration of the potential consequences of flooding, as well as the likelihood of an event occurring. Planning authorities should adopt a precautionary approach of positive avoidance of development in areas of flooding from the sea or from rivers. Surface water flooding will affect choice of location and the layout and design of schemes and these factors should be considered at an early stage in formulating development proposals.

### Technical Advice Note 14: Coastal Planning (1998)

- 2.2.4 Technical Advice Note 14 (TAN 14) paragraph 6 states that local planning authorities need to be aware of coastal issues. For planning purposes along open stretches of coast, the geographical extent of influence of physical processes affecting the coastline can be defined with some certainty by sediment cells or sub cells. In estuaries, the upstream extent of the tidal reach is an important boundary.
- 2.2.5 Paragraph 7 states that physical processes and ground conditions at the coast may be essential for creating and maintaining conservation and recreation sites and features. Interference with these processes may have consequences for the overall balance of the physical system. Whilst it is mandatory for the developer to demonstrate that the proposed site can be developed satisfactorily, having regard to those matters, local planning authorities still need to consider these potential effect when making planning decisions.

### Technical Advice Note 15: Development and Flood Risk (July 2004)

- 2.2.6 TAN15 provides technical guidance which supplements the policy set out in Planning Policy Wales in relation to development and flooding. It advises on development and flood risk as this relates to sustainability principles, and provides a framework within which risks arising from both river and coastal flooding, and from additional run-off from development in any location, can be assessed.

### Pembroke County Council Local Development Plan (February 2013)

- 2.2.7 The Pembroke County Council (PCC) Local Development Plan (LDP), adopted February 2013, identifies policies related to hydrology which are set out below:
- Policy GN.1-General Development Policy*
- 2.2.8 *Development will be permitted where the following criteria are met:*
- *It would not have a significant adverse impact on water quality.*
- Policy GN.2 -Sustainable Design*
- 2.2.9 *Development will be permitted where the relevant criteria are met:*
- *It incorporates a resource efficient and climate responsive design through location, orientation, density, layout, land use, materials, water conservation and the use of sustainable drainage systems and waste management solutions.*

## Legislative Background

- 2.2.10 Following the implementation of the Flood and Water Management Act 2010 local flood risk has become the responsibility of the local planning authority. The Act places new duties on Councils, by designating them as Lead Local Flood Authorities (LLFAs) for the coordination of local flood risk management in their respective administrative areas.
- 2.2.11 From 7<sup>th</sup> January 2019 the responsibility for drainage and surface water management design approval resides with the local planning authority.
- 2.2.12 The local planning authority has responsibility for the approval of proposed drainage systems in new developments and redevelopments. Approval must be given before any developer can commence construction. In order to be approved, the proposed drainage system would have to meet national standards for sustainable drainage.
- 2.2.13 The local planning authority is also responsible for adopting and maintaining SuDS which they have approved. Highways authorities will be responsible for maintaining SuDS in public roads.
- 2.2.14 The Statutory Standards for Sustainable Drainage Systems (2018) and the SuDS Manual C753 set out the criteria by which the form of drainage appropriate to any particular site or development can be determined, as well as requirements for the design, construction, operation and maintenance of SuDS.
- 2.2.15 Additional guidance for the use of SuDS is provided via CIRIA and BRE in the following:
- C523 Sustainable Drainage Systems- Best Practice;
  - C156 Infiltration Drainage – Manual of Good Practice;
  - BRE365 Soakaway Design.

## 2.3 Climate Change

- 2.3.1 PPW sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. PPW and TAN 15 explain when and how FCAs should be used. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.
- 2.3.2 In December 2016 the Welsh Government and NRW updated advice on climate change allowances. The new advice requires that FCAs and Strategic FCAs take into account, where appropriate, increases in rainfall intensity, peak river flows and sea level rise. Table 2-3 presents both the central and upper end estimates for climate change associated with rainfall intensity to understand the range of impact.

**Table 2-3: Change to Extreme Rainfall Intensity compared to a 1961-90 Baseline**

| West Wales     | Total potential change anticipated for '2020s' (39) | Total potential change anticipated for '2050s' (2040- 2069) | Total potential change anticipated for the '2080s' (2070-2115) |
|----------------|-----------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------------|
| Upper Estimate | 25%                                                 | 40%                                                         | 75%                                                            |

Central Estimate      15%                                      25%                                      30%

### Sea Level Allowances

2.3.3 The guidance provides a single regional allowance for each epoch or timeframe for sea level rise, summarised in Table 2-4.

**Table 2-4: Sea Level Allowances (2008 baseline)**

| Wales             |        | 2009<br>2025    | to2026 to 2055 | 2056 to 2085 | 2086 to 2116      | Cumulative rise to 2116 (m) |
|-------------------|--------|-----------------|----------------|--------------|-------------------|-----------------------------|
| Annual<br>(mm/yr) | Change | 3.5<br>(59.5mm) | 8.0 (240mm)    | 11.5 (345mm) | 14.5<br>(449.5mm) | 1.094 m                     |

2.3.4 The climate change guidance notes that the allowances provided have been derived from regional scale research. There may be cases where local evidence supports the use of other local climate change allowances. With specific reference to changes to extreme rainfall, LIT 5707 notes that UKCP09 provides useful information on change to rainfall across the UK.

2.3.5 RPS has added 40% to all attenuation/runoff calculations for the proposed development to account for climate change.

## 3 SITE SETTING

### 3.1 Site Location

- 3.1.1 The site is located in the town of Pembroke Dock in Pembrokeshire, south west Wales. The county town of Pembroke lies approximately 4 km to the southeast. The site is located at the approximate grid reference SM 96006 03670.
- 3.1.2 The site is approximately 11.10 hectares in size and is roughly L-shaped (Drawing 1).

### 3.2 Existing Development

- 3.2.1 The site was previously a naval dockyard and is currently operated as a port by MHPA and also accommodates a number of commercial and industrial businesses including garages, and end-of-life vehicles services and mechanical engineers.

### 3.3 Proposed Development

- 3.3.1 The proposed development (Drawing 2) includes the following:
- Transport corridors
  - Open-air lay down areas
  - Increased dockside space
  - Buildings for a variety of engineering purposes
  - Infilling of the Graving Dock
  - Capital dredging
  - Infilling of the Timber Pond
  - Widening and extension of a slipway
  - Demolition of buildings unfit for purpose.
- 3.3.2 As a consequence of the development there will be an approximate 1 ha increase in impermeable surfacing at the site.

### 3.4 Topographical Survey

- 3.4.1 A topographical survey (Appendix A) shows that the site and surrounds are relatively flat, with the site sloping marginally towards the west, from 8.1 mAOD along the eastern extent of the site to the lowest point of 6.0 mAOD along the western boundary.

## 4 FLOOD RISK ASSESSMENT

### 4.1 Hydrological Overview

- 4.1.1 The closest watercourse to the site is Milford Haven Waterway which is immediately to the north.

### 4.2 Flood Risk

- 4.2.1 The NRW Flood Map (Figure 1 and Appendix B) indicates that the majority of the site lies within an area defined as being at 'very low' flood risk (Flood Zone 1), having a less than 1 in 1,000 (0.1%) risk of flooding in each year. A small proportion of the site is at 'low' flood risk defined as having between 1 in 1000 (0.1%) and 1 in 100 (1%) of flooding.
- 4.2.2 The Welsh Government Development Advice Map (DAM) that accompanies TAN 15 defines the site as being in Zone A (at little or no risk of flooding) – see Appendix C.
- 4.2.3 The NRW Western Wales Flood Risk Management Plan (2015) confirms that the flood risk at the site is tidally dominant.





**Figure 1: NRW Flood Map - (Accessed October 2018)**

## Fluvial Flooding

- 4.2.4 The NRW Western Wales Flood Risk Management Plan (2015) has determined that fluvial flooding is not considered a risk at this site and therefore, will not be considered further.

## Tidal Flooding

- 4.2.5 The NRW Western Wales Flood Risk Management Plan (2015) indicates that the flood risk is tidally dominant from high tides, strong winds and large Atlantic waves. Extreme tide levels within the site boundary were extracted from the Lle Website (<http://lle.gov.wales/home?lang=en>) (Accessed November 2018).

**Table 4-1: NRW Extreme Tide Levels**

| Return Period (years)                       | Extreme Tide Level (mAOD) |
|---------------------------------------------|---------------------------|
| 100                                         | 4.69                      |
| 200                                         | 4.78                      |
| 200 plus Climate Change (1.094m up to 2116) | 5.87                      |
| 1,000                                       | 4.98                      |

4.2.6 The most recent climate change allowances (NRW, December 2016) outlined in Section 2.3 of this report indicate that an additional 1.094 m ground level should be incorporated to account for future climate change up to 2116. To ensure that climate change is not 'double counted' the 1.094 m allowance for the site has been added to the modelled 1 in 200-year tidal flood level (4.78 mAOD) generating a flood level of 5.87 mAOD. Compared against the lowest approximate site level of 6.0 mAOD flooding is not anticipated to reach site based on the 1 in 200-year flood event plus climate change.

4.2.7 The levels therefore confirm that the site is not at risk of flooding from tidal sources.

## 4.3 Flood Defences

4.3.1 NRW flood risk mapping confirms that there are no flood defences in close proximity to the site.

## 4.4 Surface Water Flooding

4.4.1 NRW surface water flood mapping (Figure 2 below) confirms that the majority of the site is located on land defined as being at 'very low' (less than 1 in 1,000 (0.1%)) risk of surface water flooding. However, a number of localised areas of the site sit on land defined as 'low' (between 1 in 1,000 (0.1%) and 1 in 100 (1%)), 'medium' (between 1 in 100 (1%) and 1 in 30 (3.3%)) and 'high' (greater than 1 in 30 (3.3%)) chance of surface water flooding.



**Figure 2: NRW Surface Water Flood Map – Accessed October 2018**

4.4.2 Overall, the site is assessed as having a low susceptibility to surface water flooding.

## 4.5 Reservoir Failure Assessment

4.5.1 NRW mapping also indicates that the site is not at risk of reservoir flooding.

## 4.6 Flooding from Rising/High Groundwater

4.6.1 The site is surfaced by a low permeable hardstanding material, underlain by Made Ground that overlays superficial deposits. BGS online mapping (Accessed October 2018) indicates that the superficial deposits consists of Tidal Flat Deposits comprised of consolidated soft silty clay, with layers of peat, sand and a basal gravel. The superficial deposits are underlain by bedrock of the Pembroke Limestone and Black Rock subgroup and Gully Oolite formation, Limestone.

4.6.2 BGS geindex onshore online mapping (Accessed November 2018) defines the area being located on a moderately productive aquifer. It is a “massive karstic limestone aquifer with rapid response to rainfall. Yields highly variable from dry to 40 L/s”.

- 4.6.3 Based on the underlying cohesive geology the potential for groundwater flooding is considered to be low.

## 4.7 Source Protection Zones

- 4.7.1 Magic mapping confirms that the site is not within a Source Protection Zone (SPZ).

## 4.8 Sewer/Water Main Failure Assessment

- 4.8.1 A culvert survey undertaken by Arcadis in January 2019 identifies a number of outfalls from the site into Milford Haven Waterway. The main outfall is located on the western boundary of the site and links the Waterway to the Timber Pond via a stone chamber with flows through the culvert and the water level within the Pond being managed by a manually operated penstock. A secondary culvert then links the Timber Pond with the Graving Dock facilitating the management of water levels within the Graving Dock. Surface water runoff from low permeable areas of the site are conveyed by virtue of gravity and a drainage network to a number of outfalls which discharge into both the Timber Pond and Graving Dock. The Timber Pond and Graving Dock will be infilled as part of the proposed development. A drainage plan is presented in Appendix E.
- 4.8.2 The Envirocheck Report (2018) identified six active discharge consents within a 500m buffer of the site. These relate to trade drainage, public sewage and sewage discharge into Milford Haven Waterway. The consents are held by MHPA and Dwr Cymru Cyfyngedig. The most common causes of flooding from sewers are; inadequate flow capacity, blockages, pumping station failures, burst water mains, water inflow from rivers or the sea, tide locking, siltation, fats/greases, and sewer collapse. Should any of these events occur there is a risk of flooding by surcharge where the flood is in excess of the sewer capacity (usually 1 in 30 year event or greater).
- 4.8.3 Records provided by the site owner note that following a heavy rainfall event in 2011 a Welsh Water sewer broke into a redundant culvert running across the southern extent of the proposed development site. Water broke through the culvert in the vicinity of the pickling pond. Welsh Water later plugged the leak near Market Square, to the southeast of the site. Subsequently, maintenance works have been undertaken on the culvert. The details of which have not been supplied. No further flood events have been recorded.
- 4.8.4 Considering the above the overall risk of flooding via artificial drainage system to the site has been assessed to be low.

## 4.9 Infrastructure Failure Assessment

- 4.9.1 No records of flooding due to infrastructure failure have been found.

## 4.10 Historical Flood Events

- 4.10.1 The NRW Western Wales Flood Risk Management Plan (2015) indicates that in 2014 a combination of high tides, strong wibes and large waves resulting in the worst tidal flooding in 15 years, however the site was not affected.
- 4.10.2 The site was subject to flooding due to a failure in the culvert within the southern area of the site.

## 5 FLOOD RISK VULNERABILITY CLASSIFICATION

### 5.1 Vulnerability Classification

- 5.1.1 In accordance with TAN 15, the proposed development is classified as a 'Less Vulnerable' development in flood risk terms.
- 5.1.2 The majority of the site is located within an area identified as Zone A. Paragraph 9 of TAN 15 (Table 5-1 of this report) indicates that Less Vulnerable uses are acceptable for locations in Zones A and B. Such development is also acceptable in Zones C1 and C2, but subject to a justification test, including acceptability of consequences.

**Table 5-1: Flood Risk Vulnerability and Zone 'Compatibility'**

| Flood Risk Vulnerability<br>classification (see Chapter 9 of TAN 15) | Emergency Services     | Highly Vulnerable           | Less Vulnerable             | Other                         |
|----------------------------------------------------------------------|------------------------|-----------------------------|-----------------------------|-------------------------------|
| Zone A                                                               | Yes                    | Yes                         | Yes                         | Yes                           |
| Zone B                                                               | Yes                    | Yes                         | Yes                         | Yes                           |
| Zone C1                                                              | Justification required | Justification test required | Justification test required | Acceptability of consequences |
| Zone C2                                                              | No                     | No                          | Justification test required | Acceptability of consequences |

*Key: **Yes:** Development is appropriate, **No:** Development should not be permitted.*

### 5.2 Justification Test

- 5.2.1 The aim of the justification test, as stated in TAN 15, is to direct new developments away from Zones C1 and C2 and towards more appropriate land located within Zones A and B.
- 5.2.2 As the site is located in Zone A, as confirmed by the DAM that accompanies TAN 15, a justification test is not required.

## 6 DRAINAGE

### 6.1 Surface Water and Drainage Strategy

- 6.1.1 The sustainable management of surface water is an essential element of reducing future flood risk to the site and its surroundings.
- 6.1.2 As the proposed development is located on already low permeable hardstanding land there will be negligible change in permeability of site surfacing as a result of the proposed development. However, part of the development in the south west of the site is currently a Timber Pond into which a proportion of the site's surface water runoff discharges via the existing drainage network and then discharges via an outfall into the Milford Haven Waterway. It is proposed that the Timber Pond will be infilled as part of the development. As such, an appropriate surface water management strategy will be required to re-route the existing site drainage network through or around the infilled Timber Pond possibly to a new outfall to the Milford Haven Waterway.

### 6.2 Sustainable Drainage Options

- 6.2.1 PPW, TAN 15, CIRIA C753 SUDS Manual (2015) and Pembroke County Council (PCC) all promote sustainable water management through the use of SuDS. A hierarchy of techniques is identified:
1. Prevention – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
  2. Source Control – control of runoff at or very near its source (such as the use of rainwater harvesting).
  3. Site Control – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
  4. Regional Control – management of runoff from several sites, typically in a detention pond or wetland.
- 6.2.2 The implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:
- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
  - Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
  - Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
  - Reducing potable water demand through rainwater harvesting;
  - Improving amenity through the provision of public open spaces and wildlife habitat; and
  - Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.



## 6.3 Runoff Calculations

6.3.1 An assessment of the current runoff rates was undertaken to determine the surface water attenuation requirements for the site in line with the SuDS Manual (2015), which indicates that for previously developed sites the flow rate discharged from the site must not exceed that prior to the proposed development for the:

- 1 in 1 year event;
- 1 in 30 year event; and
- 1 in 100 year event.

6.3.2 The rates of runoff were determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS. The Defra recommended methodology for sites up to 50 hectares in area is the Institute of Hydrology Report 124 method (IoH 124). The runoff rates were calculated using the MicroDrainage software suite. The calculations are included as Appendix D.

### Current Runoff Rate

6.3.3 The following parameters were incorporated into the current brownfield site runoff calculations:

- Catchment Area: 11.10 ha (assume 0% permeable (landscaping) and 100% low permeable surfacing (hardstanding/buildings);
- Average Annual Rainfall (Met Office): 1,100 mm/year;
- Soil: 0.300;
- Region No: 9.

**Table 6-1: Current Runoff Characteristics**

| Annual<br>(Return Period, years) | ProbabilityCurrent<br>(l/s) | Runoff |
|----------------------------------|-----------------------------|--------|
| 1 in 1                           | 78.10                       |        |
| QBAR                             | 88.80                       |        |
| 1 in 30                          | 132.20                      |        |
| 1 in 100                         | 143.70                      |        |
| 1 in 100 + 40% Climate Change    | 201.18                      |        |

*Note: 40% added to rainfall data to account for long-term climate change*

6.3.4 As confirmed in Section 6.1, it is anticipated that the proposed development will increase low permeable surfacing by approximately 1 ha. Any additional 'clean' runoff will be directed to the current drainage system and discharged directly to the estuary. It is therefore determined that no additional surface water attenuation will be required.

6.3.5 Run-off will be directed to new outfalls passing through interceptors and/or separators, as appropriate, prior to 'clean' water discharging into Milford Haven Waterway. Based on the elevation of the site in comparison to the high tide levels of approximate 7.2 m above chart datum

equivalent to 3.49 mAOD (Milford chart datum 7.2 m -3.71 m) the probability of tidal locking of the outfall (6.0 mAOD) is low.

- 6.3.6 Detailed design of drainage infrastructure is to be secured via an appropriately worded condition and supplied prior to construction for regulator approval.
- 6.3.7 The existing culvert connection between the Timber Pond and Graving Dock is to be sealed with inflows diverted accordingly. A detailed review of the infilling works of the Timber Pond and Graving Dock is provided in Appendix 2.2 (Pembroke Dock Marine Infrastructure Gate 4 –Graving Dock and Timber Pond Infill Report (Arcadis 2019)).



## 7 FLOOD MANAGEMENT

### 7.1 Mitigation Options

- 7.1.1 Welsh Government DAM and NRW Flood Zone mapping confirms that the site is within Zone A and Flood Zone 1 respectively. Extreme tide level outputs indicate the site is at very low risk of flooding from tidal sources.
- 7.1.2 Taking into account the less vulnerable development proposed and the location of the site (Zone A/Zone 1), the proposed development has been identified as not requiring any mitigation options.

## 8 SUMMARY AND CONCLUSIONS

### 8.1 Summary

- 8.1.1 A site-specific FCA in accordance with PPW and TAN 15 has been undertaken for the proposed development.

### 8.2 Flood Risk

- 8.2.1 The Welsh Government DAM that accompanies TAN 15 confirms that the majority of the site is located within an area designated as Zone A, classified at low risk of flooding with less than 1 in 1,000 annual probability of river flooding.
- 8.2.2 Extreme tide level outputs confirm that tidal flooding for a 1 in 200 year event plus climate change would reach approximately 5.87 mAOD.
- 8.2.3 The site is at 'very low' (less than 0.1%) risk of surface water flooding.
- 8.2.4 The site susceptibility to groundwater flooding has been assessed as low.
- 8.2.5 The site is not at risk of flooding from reservoir infrastructure failure.
- 8.2.6 The NRW Western Wales Flood Risk Management Plan confirmed that in 2014 the worst tidal flood event in 15 years occurred, however, the site was not affected by the flooding.
- 8.2.7 The proposed development type is defined as "Less Vulnerable" in TAN 15 and is therefore appropriate within Zone A (even including consideration of climate change).
- 8.2.8 There will be an approximate 1 ha increase in impermeable surfacing as a consequence of the development at the site, any additional 'clean' runoff will be directed to the current drainage system and discharged directly to the estuary,, therefore no additional surface water attenuation is required.

### 8.3 Conclusion

- 8.3.1 This FCA and supporting documentation illustrates that the application area is at low risk of flooding from tidal sources and meets the requirements of PPW and TAN 15.

## REFERENCES

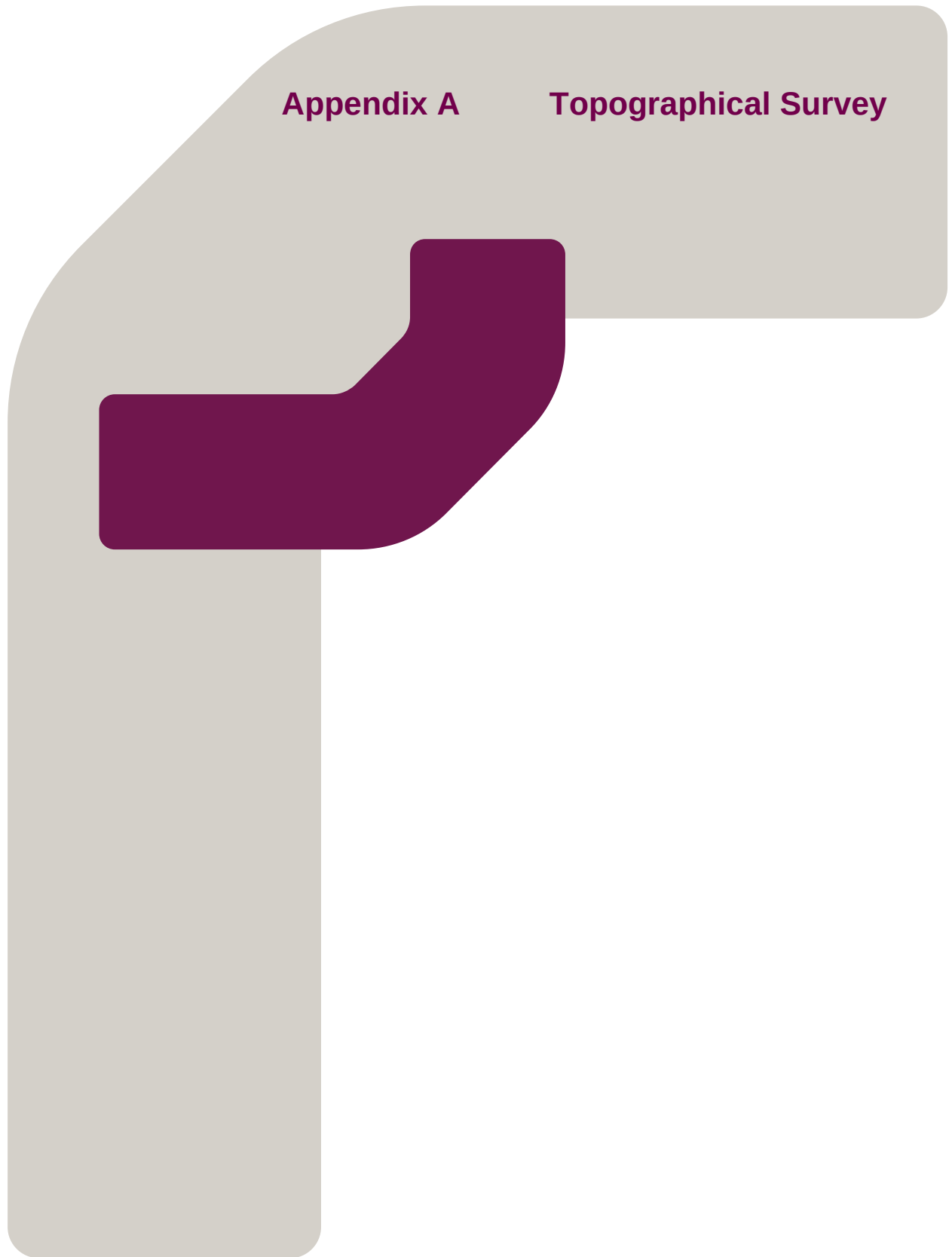
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REPORT

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**Appendix A**

**Topographical Survey**



REPORT

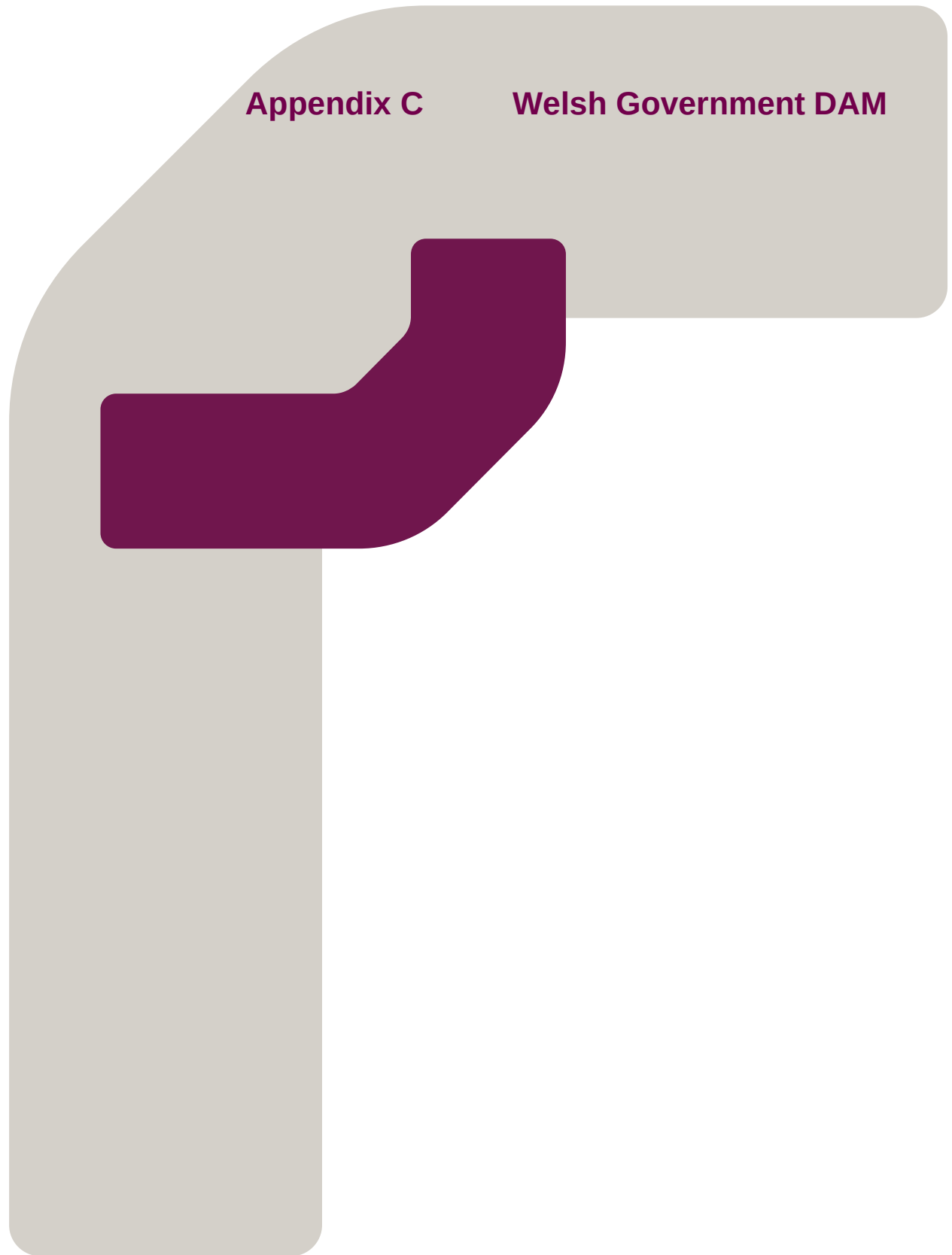
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**Appendix B**

**NRW Flood Map**

## Appendix C

## Welsh Government DAM



## Appendix D

## MicroDrainage Calculations

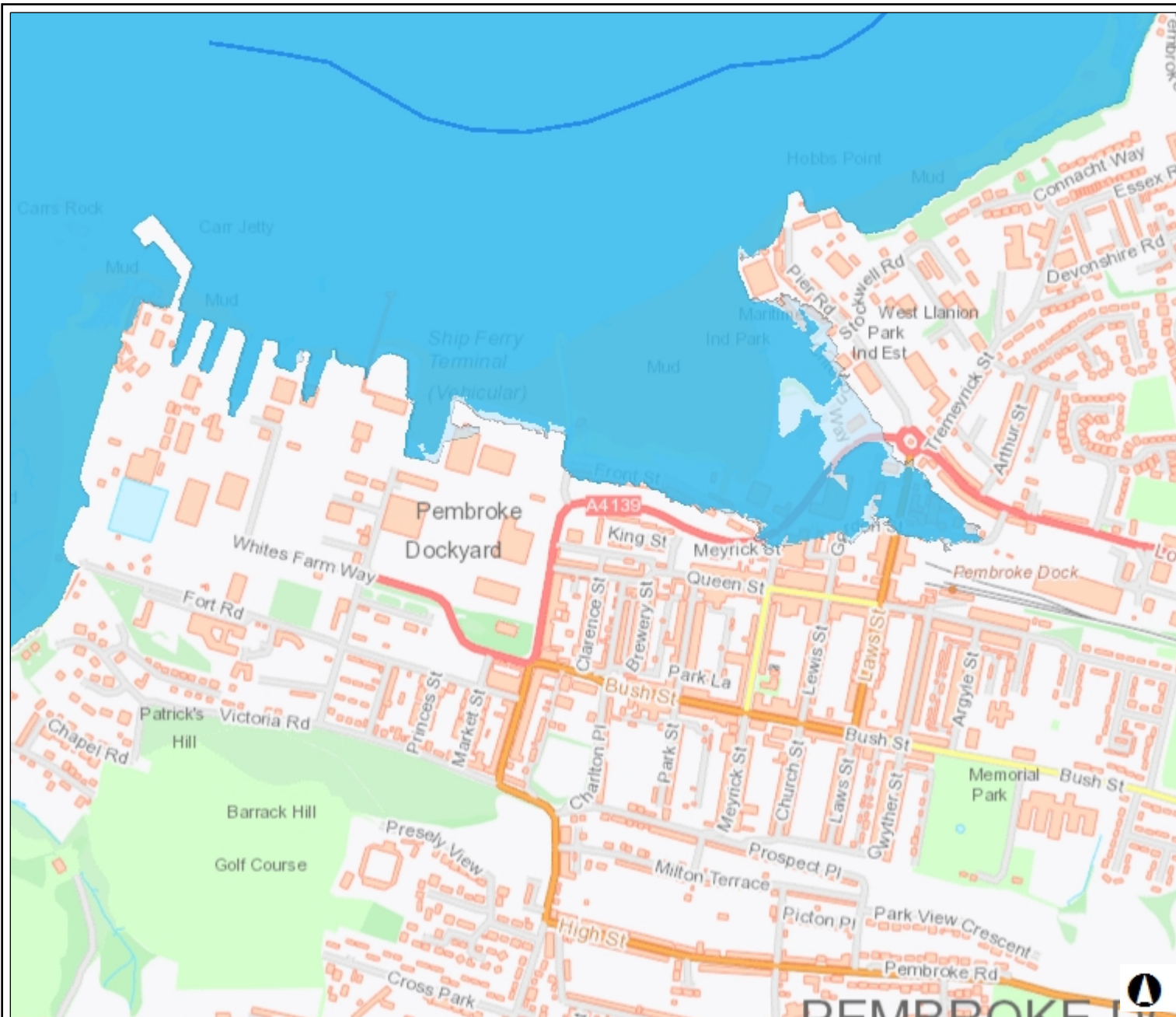
## Appendix E

## Drainage Survey Plan









## Map Title

**Map Perygl Llifogydd / Flood Risk Map**

## Allwedd / Map Key

- Main Rivers
- Flood Defences
-  Areas Benefiting from Flood Defences
-  Flood Storage Areas
- Floodmap Flood Zone 3
- Floodmap Flood Zone 2

**Graddfa / Scale** 1: 10,000

**Dyddiad / Date**  
24/12/2019



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Map Title

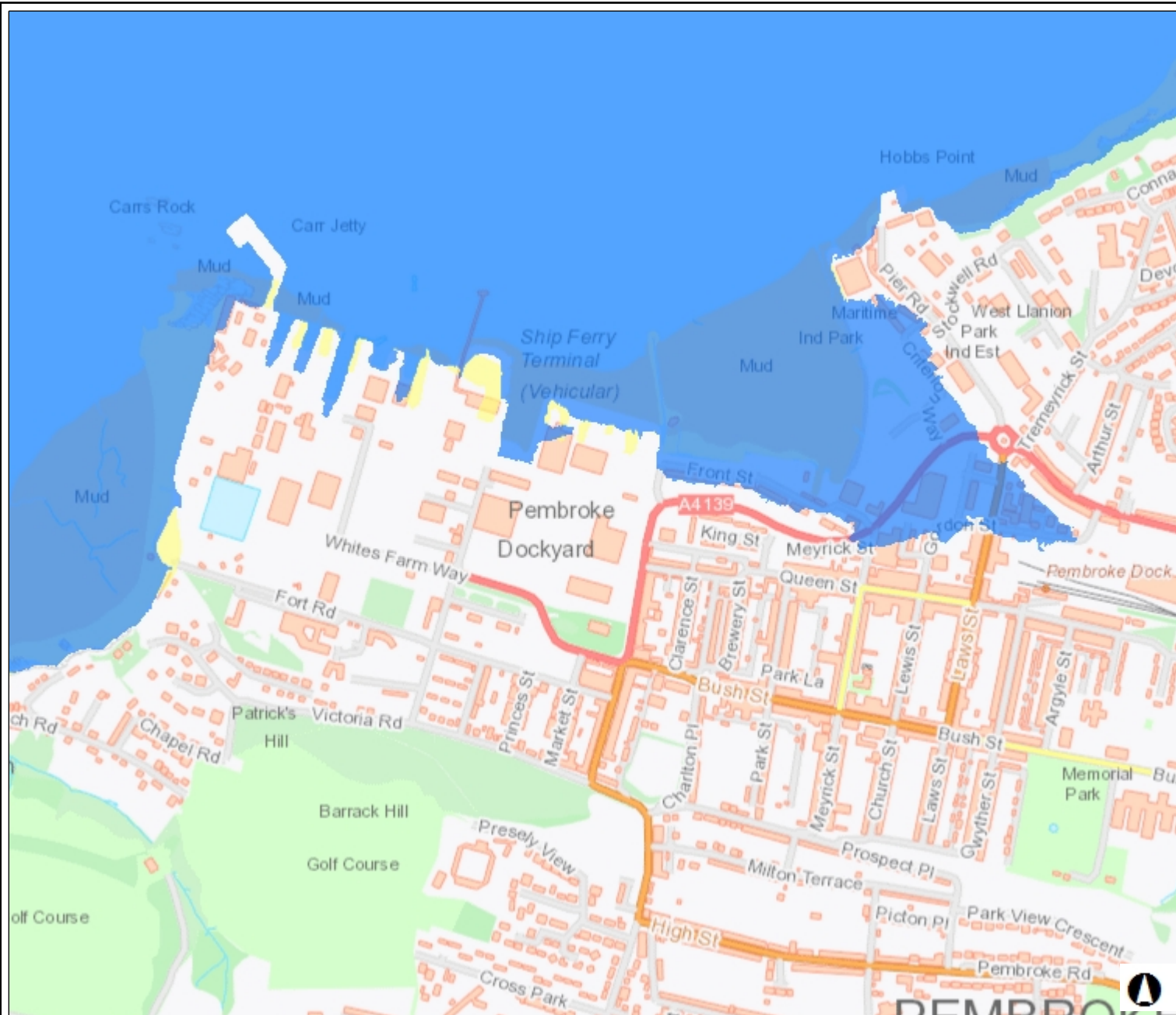
Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

- Zone C1
- Zone C2
- Zone B
- Zone A

Graddfa / Scale 1: 10,000

Dyddiad / Date  
24/12/2019



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| Date 23/11/2018 14:26<br>File                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Designed by jonathan.morley<br>Checked by |                                                                                     |
| Micro Drainage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                           | Source Control 2017.1.2                                                             |
| <p style="text-align: center;"><u>ICP SUDS Mean Annual Flood</u></p> <p style="text-align: center;">Input</p> <p>Return Period (years)      2                      Soil      0.300</p> <p>Area (ha) 10.720                      Urban      0.750</p> <p>SAAR (mm)      1100 Region Number Region 9</p> <p style="text-align: center;"><b>Results      l/s</b></p> <p>QBAR Rural      33.2</p> <p>QBAR Urban      88.8</p> <p>Q2 years      91.2</p> <p>Q1 year      78.1</p> <p>Q30 years      132.2</p> <p>Q100 years      143.7</p> |                                           |                                                                                     |
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| Micro Drainage                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             | Source Control 2017.1.2                                                             |
| <p align="center"><u>ICP SUDS Mean Annual Flood</u></p> <p align="center">Input</p> <p>Return Period (years)      2    SAAR (mm)    1100      Urban      0.750</p> <p>Area (ha) 11.100      Soil 0.300    Region Number    Region 9</p> <p align="center"><b>Results    1/s</b></p> <p>QBAR Rural    34.3</p> <p>QBAR Urban    92.0</p> <p>Q2 years      94.5</p> <p>Q1 year       80.9</p> <p>Q30 years     136.8</p> <p>Q100 years    148.7</p> |                             |                                                                                     |
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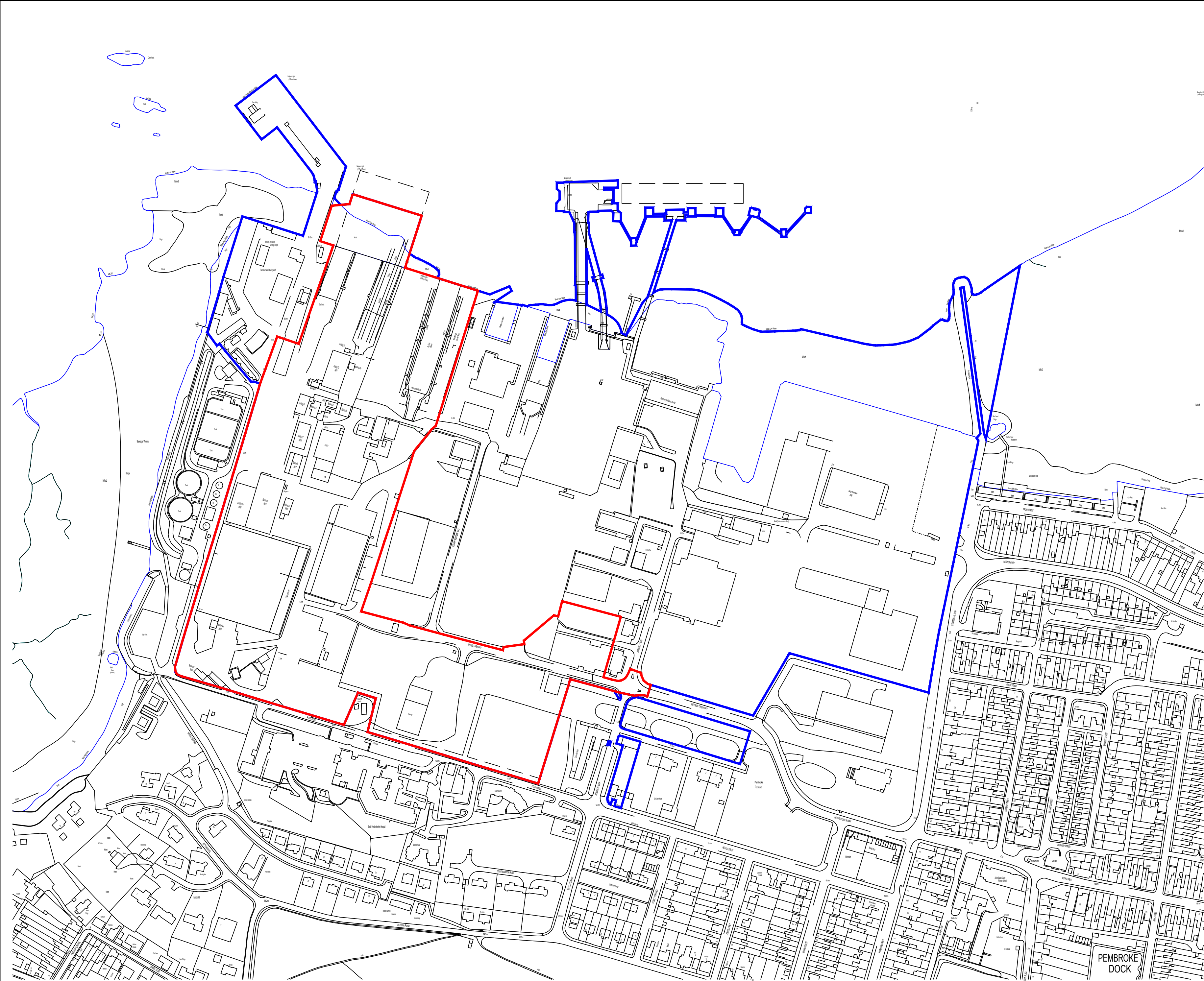












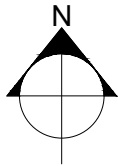
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Application Red Line

Other Ownership Areas



|     |                       |    |    |          |
|-----|-----------------------|----|----|----------|
| C   | Revised Red Line Plan | GG | DW | 17/07/19 |
| B   | Red Line Amendment    | GG | DW | 12/07/19 |
| Rev | Description           | By | CB | Date     |



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Client **Milford Haven Port Authority**

Project **Pembroke Dock Infrastrutture**

Title **Site Location Plan**

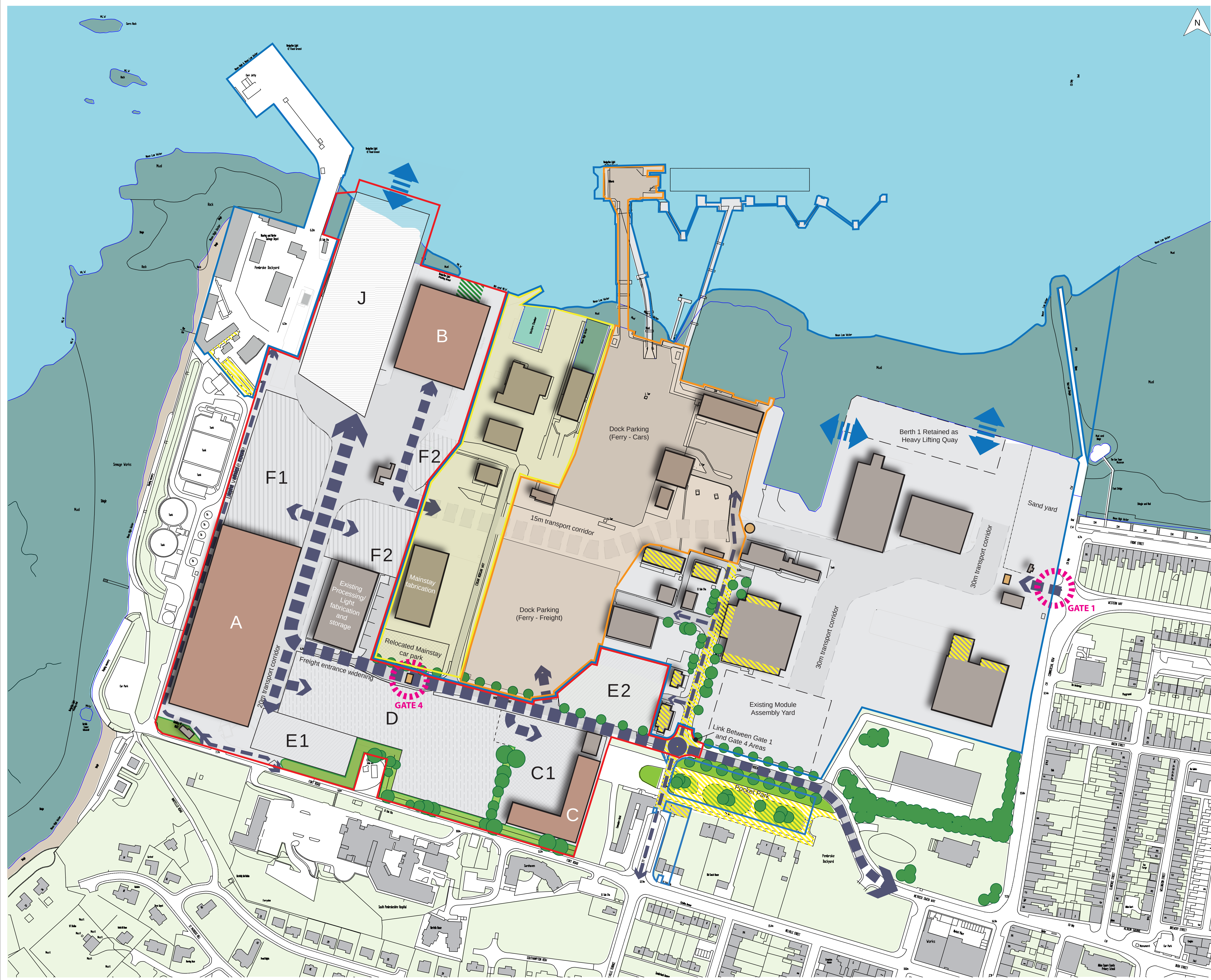
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| DRAFT  | GG       | DW            |

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- Application boundary  
11.10 ha (27.42 acres)
- Land Leased to Mainstay
- Proposed buildings
- Proposed transport corridor
- Mean Low Water
- Proposed Multi-use laydown/assembly yard Areas
- Security gate/check point
- Temporarily Manned Security Point
- Key movement routes
- 6m ecology corridor (including 1m maintenance footpath)
- Key Access Points
- Heritage Mitigation areas and enhancement (subject to separate LBC applications)
- Ferry Terminal Area
- Existing buildings to be retained
- Ship Access
- Mud/Mean High Water
- Landscaping
- Proposed Revetment

**Proposed High Quality Fabrication Facility**  
A – Fabrication building for sub-assemblies and marine engineering related activities (11,900sqm) – (170m X 70m and 40m to ridge)  
F1 – External/open multi-use laydown and final assembly area (8,058sqm)  
F2 – Existing external processing/open multi-use laydown and assembly area (4,836sqm)

**Proposed High Bay Ship Repair and Fabrication Facility**  
B – High bay ship repair and fabrication building (4,900sqm) – (75m X 65m and 40m to ridge)

**Proposed Slipway and Transition Area**  
J – Slipway and large open transition area (11,838sqm) – required to transfer completed components to the slipway and to allow large vessels to be moved to/from the high bay ship repair and fabrication building (Building B)

**Proposed Light Assembly and Maintenance Facility**  
C – Light assembly and maintenance building (2,500sqm) – (129m X 20m and 10m to ridge)  
C1 – Light assembly and maintenance external storage and parking area (5,000sqm)

**Proposed Batching Plant**  
D – Open batching plant and storage area (12,937sqm)

**Proposed Employee Car Park**  
E1 – Employee car park (3,040sqm)  
E2 – Employee car park (4,853sqm)

The building sizes are indicative parameters only and will be adjusted to suit exact requirements.  
The transport corridors will allow smaller completed modules or vessels to be transported to/from the existing heavy lift quay or partially completed sub-assemblies to be transported to/from the existing module assembly yard.  
The light vehicle route is to allow access from Fort Road to the area occupied by Switzer.

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Client Milford Haven Port Authority

Project Pembroke Dock Marine

Title Indicative Proposed Masterplan

Status Draft  
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PM/Checked by DW

Job Ref JPW1115  
Scale @ A1 1:1500  
Date Created April 2018

Drawing Number JPW1115-04  
Rev N