



Flood Risk Assessment

Revision 3

Liverpool Waters
Plot CO2
West Waterloo Dock

26th October 2019

Ref: 4/6679

Prepared For:
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Report Reference: 4/6679
Version 3
Date originated: 23rd November 2018

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1.0 INTRODUCTION

1.1 General

- 1.1.1 This report has been prepared on instructions received from Romal Capital Group Ltd and relates to the proposed development works at West Waterloo Dock as part of Liverpool Waters Project. The development is currently referred to as Plot CO2.
- 1.1.2 The development comprises of the formation of a new dock wall with the area behind infilled to provide the platform to erect four new apartment blocks (A-D) of 10 storeys. A total of 538 apartments (one – three bedrooms) will be provided across the development along with associated commercial space, car parking, landscaping, servicing and access.
- 1.1.3 This report sets out the results of a Flood Risk Assessment (FRA) required by the Local Planning Authority in support of the planning application for this development. The assessment has been carried out in accordance with the general principals set out in National Planning Policy Framework (February 2019) and Technical Guidance to the National Planning Policy Framework (October 2018).
- 1.1.4 This report is prepared solely for the benefit of the Client. This report may not be assigned without prior written permission from Clancy Consulting.

1.2 Background Information

- 1.2.1 In 2001 the Department for Transport Local Government Regions (DTLR) published Planning Policy Guidance Note 25 (PPG25), which explains how flood risk should be taken into consideration during the planning and development process.
- 1.2.2 PPG25 was replaced by Planning Policy Statement 25: Development and Flood Risk published in March 2010. This Policy Statement was introduced to place more emphasis on the increased flood risk from climate change.
- 1.2.3 PPS25 specified a sequential test which local planning authorities should apply to all future proposed development sites. An exception test may also be applied to provide a method of managing flood risk while still allowing necessary development to occur.
- 1.2.4 In February 2019, the Government released the updated National Planning Policy Framework (NPPF).
- 1.2.5 NPPF supersedes PPS25 although the principles set out in the new publication remain similar in terms of the flood risk aspect.
- 1.2.6 The NPPF has now been supplemented with a Planning Practice Guide which is available online.
- 1.2.7 The following zones define the levels of flood risk:

[Zone 1: Low Probability](#)

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any one year. (<0.1%)

Zone 2: Medium Probability

This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Zone 3a: High Probability

This zone comprises land assessed as having between 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b: Functional Flood Plain

This zone comprises land where water has to flow or be stored in times of flood. Strategic Flood Risk Assessments should identify this zone.

- 1.2.8 As part of its general obligations under the Water Resources Act 1991, The Environment Agency has carried out surveys of its existing defences against flooding and has published a series of nationwide 'Indicative Floodplain Maps' based upon information from historic flood events and basic hydraulic modelling.
- 1.2.9 In general terms, these maps give a good indication of the areas likely to be affected by flooding. More recently the Environment Agency have published the 'Flood Map' on their website which is based on improved hydraulic modelling and detailed local data. The map indicates Zones 2 and 3 with Flood Zone 1 being all the land falling outside the Zones 2 and 3.
- 1.2.10 The EA Flood Map for the area of the proposed development indicates that the development is predominantly in Flood Zone 1. There is approximately less than 4% of the development which could be said to be within Flood Zone 3 and within the Flood Risk Assessment, further justification as to why this site should be considered Flood Zone 1 will be presented.
- 1.2.11 During this assessment, Merseyside Environmental Advisory Service (MEAS) have been contacted and as per their correspondence dated 4th October 2018. Item 35 indicates a Flood Risk Assessment is required as part of the Environmental Impact Assessment.
- 1.2.12 This report sits as part of the planning application and Flood Risk and Drainage have been considered as part of the EIA process in Chapter 12 of the Environment Statement which supports the application.

Likelihood of flooding in this area

This location is in an area with a low probability of flooding

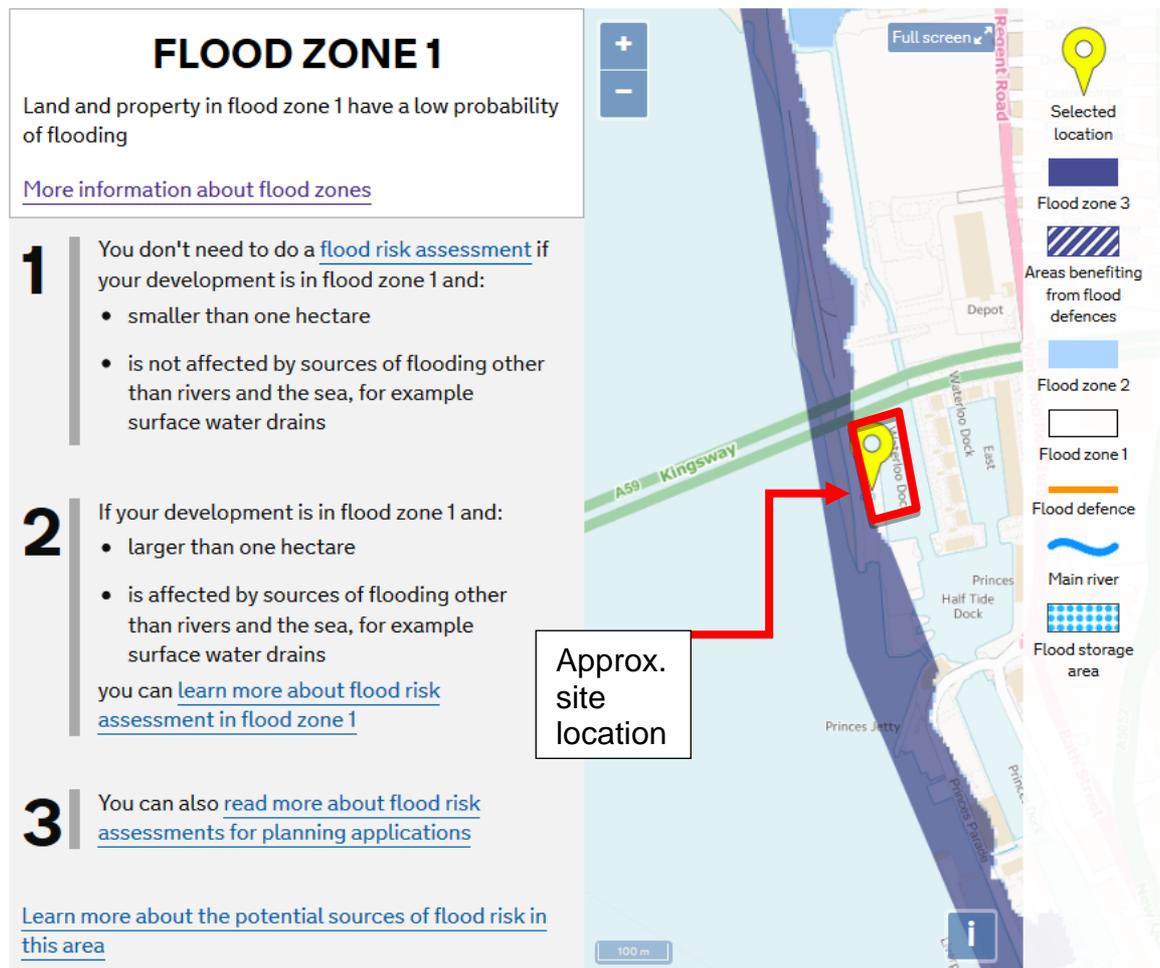


Figure 1 - Flood Risk Mapping for Rivers and Seas (<https://flood-map-for-planning.service.gov.uk>)

2.0 STRUCTURE OF THE REPORT

- 2.1 The report has been structured to follow the general principals set out in the Web based Practice Guidance.
- 2.2 The methodology for this FRA has comprised of a desktop study.
- 2.3 Sources of information have included, but not limited to the following;
- Environment Agency/ UK Government flood maps for rivers and sea flooding.
 - Flood Risk Assessment by Detailed flood levels and mapping direct from the Environment Agency.
 - UK Government Flood Warning Information Service maps for surface water flooding and reservoir flooding.
 - Lead Local Flood Authority – Liverpool City Council – Surface Water Policy
 - Flood Risk Resilience Strategy (Condition 21): Neighbourhood C by Curtins (June 2018) – referred to as Curtins Condition 21 Report within this document.
 - United Utilities Public Sewer Records
 - Ground Investigation Report by CC Geotechnical (October 2018).
 - Non-statutory technical standards for sustainable drainage systems.
 - Merseyside Environmental Advisory Service Discretionary Advice
 - Natural England Discretionary Advice
 - Canal & River Trust

3.0 SITE CATCHMENT CHARACTERISTICS

3.1 History and Current Use

3.1.1 The development is located as detailed as below.

OS X (Eastings)	333455
OS Y (Northings)	391242
Nearest Post Code	L3 0BT
Lat (WGS84)	N53:24:50 (53.413770)
Long (WGS84)	W3:00:09 (-3.002624)
LR	SJ334912
mX	-334250
mY	7025569

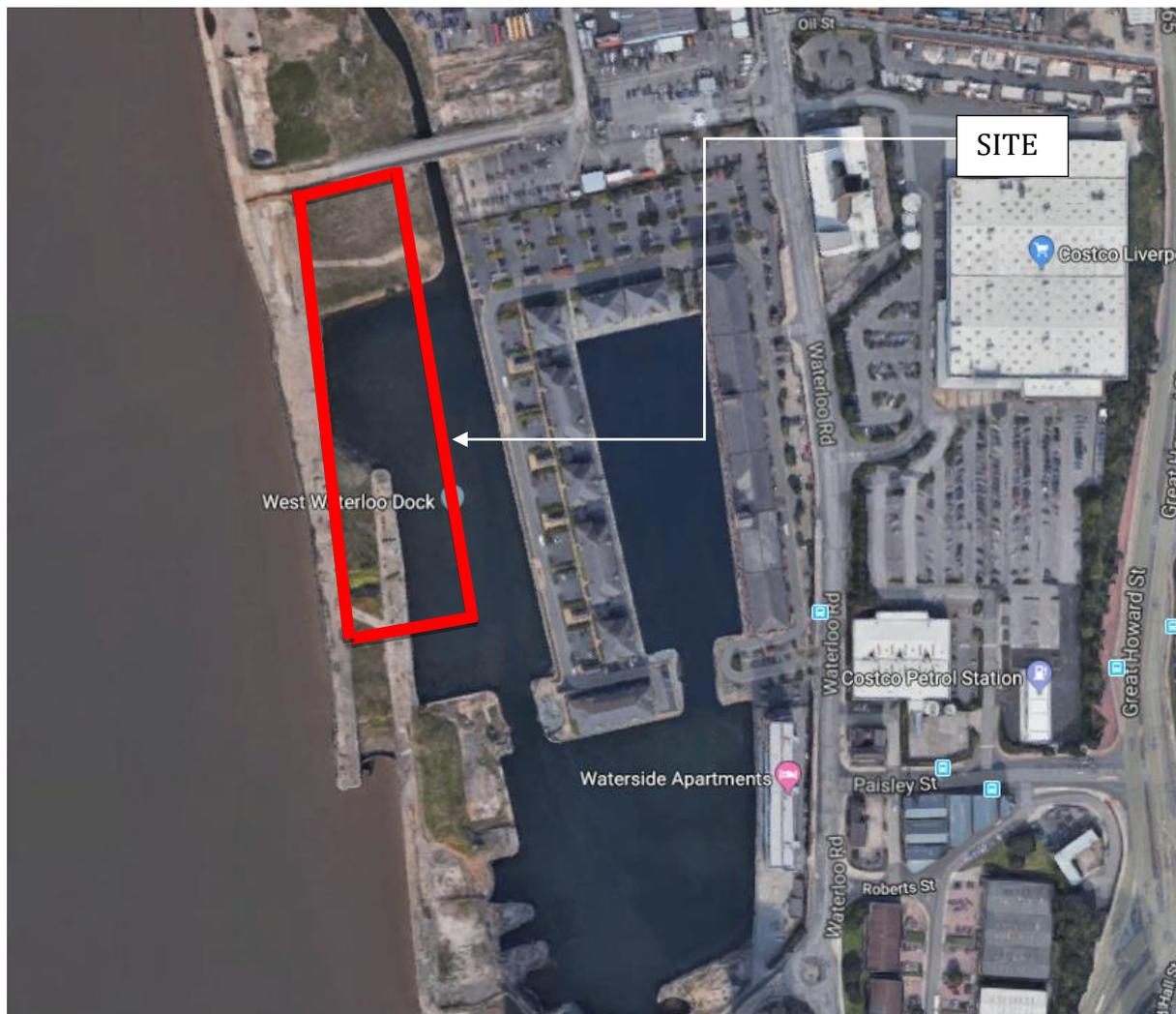


Figure 2 – Location Plan (Google Maps)

- 3.1.2 The development is located North of Liverpool City Centre within West Waterloo Dock on the waterfront. The development is bordered by the Liverpool Canal Link to the West, Princes Half Tide Dock to the South, The River Mersey (and river wall) to the East and undeveloped land to the North.
- 3.1.3 The area proposed for development was historically West Waterloo Docks and warehouses. Over time, the warehouses have been demolished and the dock itself has been partially infilled along with Waterloo Lock system, whilst other areas remain as the dock.
- 3.1.4 The development falls within the wider Liverpool Waters masterplan – covering the re-development of up to 60 hectares of former dock land along Liverpool Waterfront providing mixed use developments and an extension from Liverpool City Centre northwards.
- 3.1.5 Outline planning was granted by Liverpool City Council in June 2013 (Application no. 100/2424) for a mixed-use development across 60 hectares of derelict dockland.
- 3.1.6 The overall area proposed for development is approximately 1.12 hectares
- 3.1.7 Site ground levels along the dock sides are generally flat at a level of approximately 8.000m AOD. The canal level is generally kept at approximately 4.770m AOD.

3.2.1 Development Proposals

- 1.2.13 The development comprises of the formation of a new dock wall with the area behind infilled to provide the platform to erect four new apartment blocks (A-D) of 10 to . A total of 538 apartments (one – three bedrooms) will be provided across the development along with associated commercial space, car parking, landscaping, servicing and access.
- 3.2.2 The ground floors of Blocks B and D are set at 8.400m AOD and the ground floors of Blocks A and C are set at 8.050m AOD. Across all the blocks, these contain commercial units, reception areas, plant rooms and storage for bicycles.
- 3.2.3 At Blocks C and D, the ground floor also contains residential dwellings facing onto the River Mersey.
- 3.2.4 A canal side walkway/ boardwalk will be provided at canal level with Blocks A and B projecting over into the canal to create a colonnade.
- 3.2.5 The lowest accessible level is set at 6.600m AOD (canalside/ colonnade) to provide a transition and access point between the blocks and the canal side.
- 3.2.6 A plan showing the proposed site layout is included within Appendix A.

4.0 FLOOD POTENTIAL

4.1 Development Proposal

4.1.1 As the site is proposed for mixed use development, Table 2 of the NPPF flood risk vulnerability classification indicates;

- Residential areas are classified as '*More Vulnerable*' developments.
- Retail and Commercial areas are classified as '*Less Vulnerable*' developments.

4.1.2 As Table 3 of the NPPF, Flood risk vulnerability and flood zone 'compatibility' indicates the site is predominantly in Flood Zone 1, with an estimation of less than 4% of the site being considered to be in Flood Zone 3.

4.1.3 Therefore, all forms of development are acceptable, and no exception tests are required to be undertaken.

4.2 Potential for Flooding

4.2.1 There are seven potential sources of flooding at the site which will be addressed in more detail in this report, i.e.

- (i) Flooding from The River Mersey - Fluvial.
- (ii) Flooding from The River Mersey - Tidal.
- (iii) Flooding from Surface Water run-off
- (iv) Flooding from the surcharging of drains or sewers on or around the development.
- (v) Flooding due to high groundwater levels.
- (vi) Flooding from Reservoirs.
- (vii) Flooding from canals
- (viii) Wave Action

4.3 Existing Historical Flooding Information

4.3.1 No historical flood records have been identified within or in the vicinity of the development.

4.4 Existing Structures Likely to Affect Local Hydraulics

4.4.1 There are no obstructions on the River Mersey within the immediate vicinity likely to result in flooding. The width and depth of the River Mersey reduce around Warrington where obstructions such as bridges can become a problem, but this is some 20km away.

4.4.2 The level of the canal is retained at 4.770m AOD and has a series of isolation structures primarily used to regulate water levels and contain any contamination should spills occur, along with a lock flight which is not believed to vary the water level significantly.

4.5 Flood Risk Probabilities

(i) *Flooding from the River Mersey (Fluvial)*

4.5.1 Flooding to the development from Rivers or the Sea is indicated in Figure 3. It can be seen that the development is at very low risk from fluvial flooding, although it is immediately adjacent to an area which is at high risk from fluvial flooding.

4.5.1.1 Although the Environment Agency note that there are no designated flood defences along the River Mersey adjacent to the development, there is a riverside dock wall.

The risk of fluvial flooding at this development is very low.

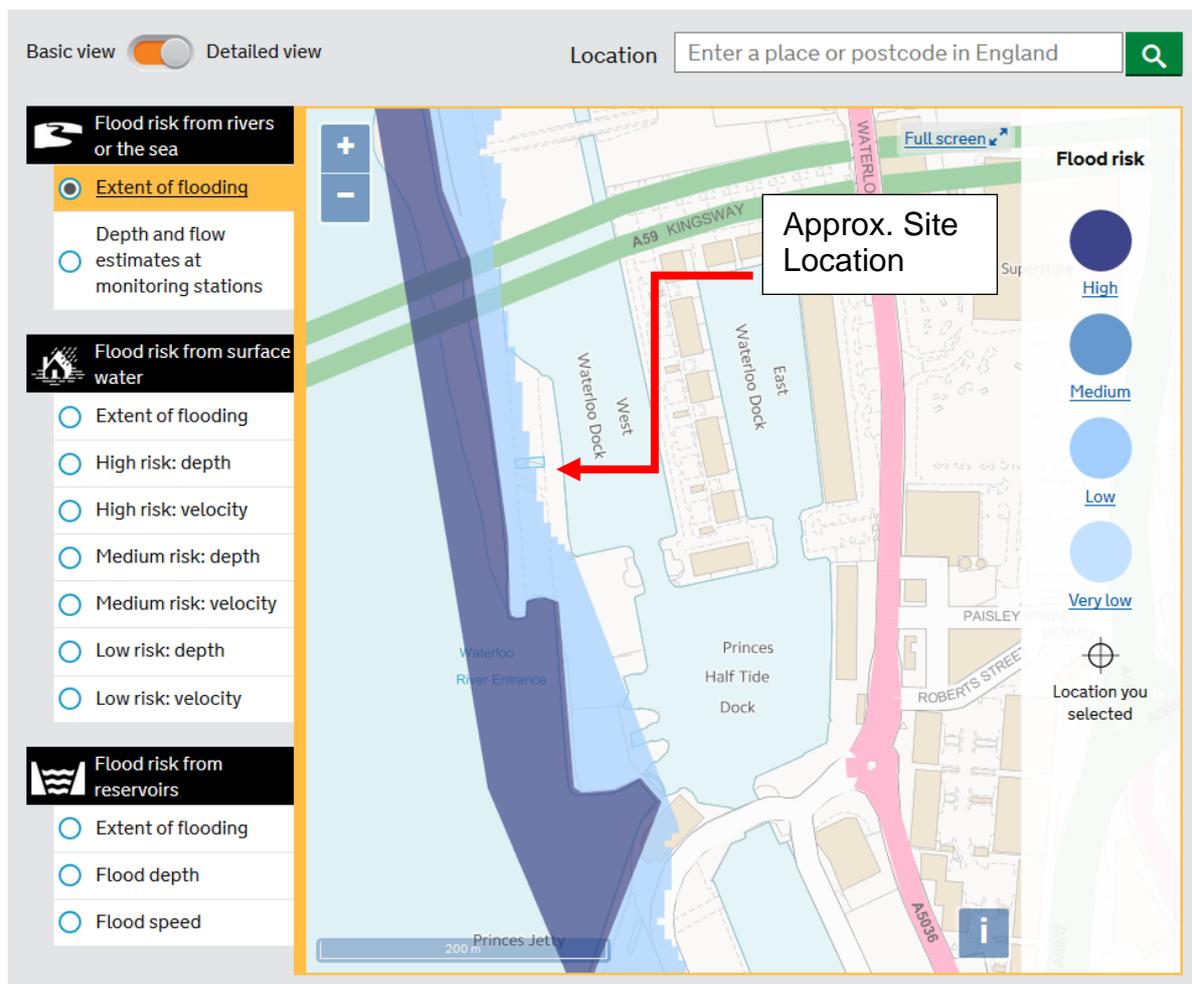


Figure 3 – Extent of Flood Risk from Rivers or the Sea (Environment Agency)

(ii) *Flooding from the River Mersey (Tidal)*

4.5.2 Liverpool Waters 2016 Extreme Sea Level Study indicates that for the 1 in 200-year extreme sea level up to the year 2115 has been estimated to be 6.830 m AOD. The

existing site is generally above this and the new development will predominantly be above this also.

4.5.3 All levels of the four Blocks are set higher than this level (minimum 8.050m AOD)

4.5.4 The modelled levels (2016) provided are as below;

Model node	Max Water level		
	1 in 10	1 in 100	1 in 200
Ea013_90001	5.69	6.03	6.13
	1 in 1000	1 in 200 + CC 2065	1 in 200 + CC 2115
	6.33	6.42	6.83

4.5.5 Although the Environment Agency note that there are no designated flood defences along the River Mersey adjacent to the development, there is a riverside dock wall. The lowest level surveyed on top of the wall adjacent to the site is 6.930m AOD which is just above the 1 in 200 + 2115 event.

4.5.6 Due to the topography of the development, any potential wave overtopping is likely to run straight across the site and into the dock which is considerably lower than the rest of the development.

The risk of tidal flooding at this development is generally low for habitable areas of the development but the commercial, plant and storage areas of the developments due to the lower ground level canal side access are at medium risk.

(iii) *Flooding from Surface Water run-off*

4.5.7 During periods of heavy rainfall, the capacity of sewers and drainage systems can be exceeded, surcharging of manholes and gullies can occur and surface water 'over-land' flood flows can occur.

4.5.8 The Environment Agency flood maps for surface water have been consulted and an extract for this area is included below (Figure 4). The mapping indicates that there is generally a medium risk of surface flooding within the dock with a small area of high risk identified adjacent to the infilled lock.

4.5.9 The actual area of existing land which forms part of the development is at low risk and should remain at low risk as the proposed levels are higher than existing.

The risk of flooding from Surface Water Run-off at this development is low.

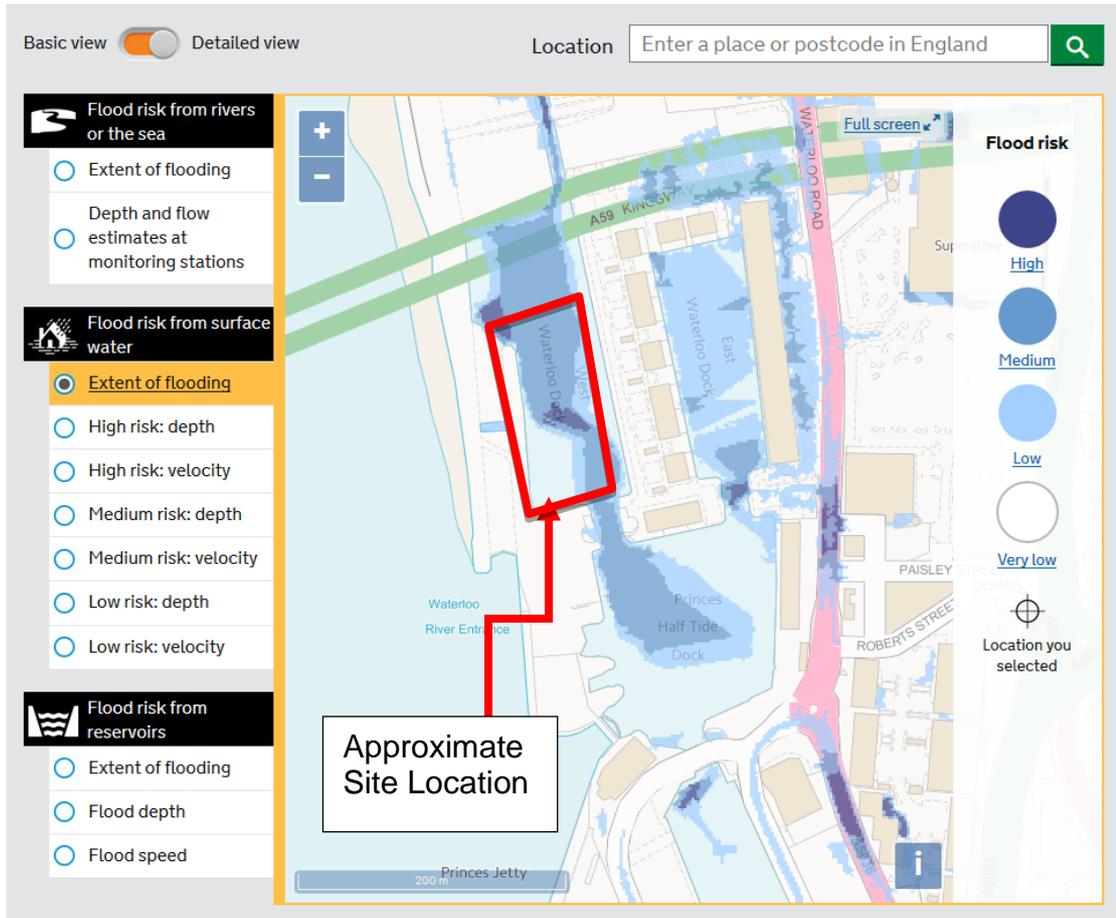


Figure 4 – Surface Water Flood Map (Environment Agency)

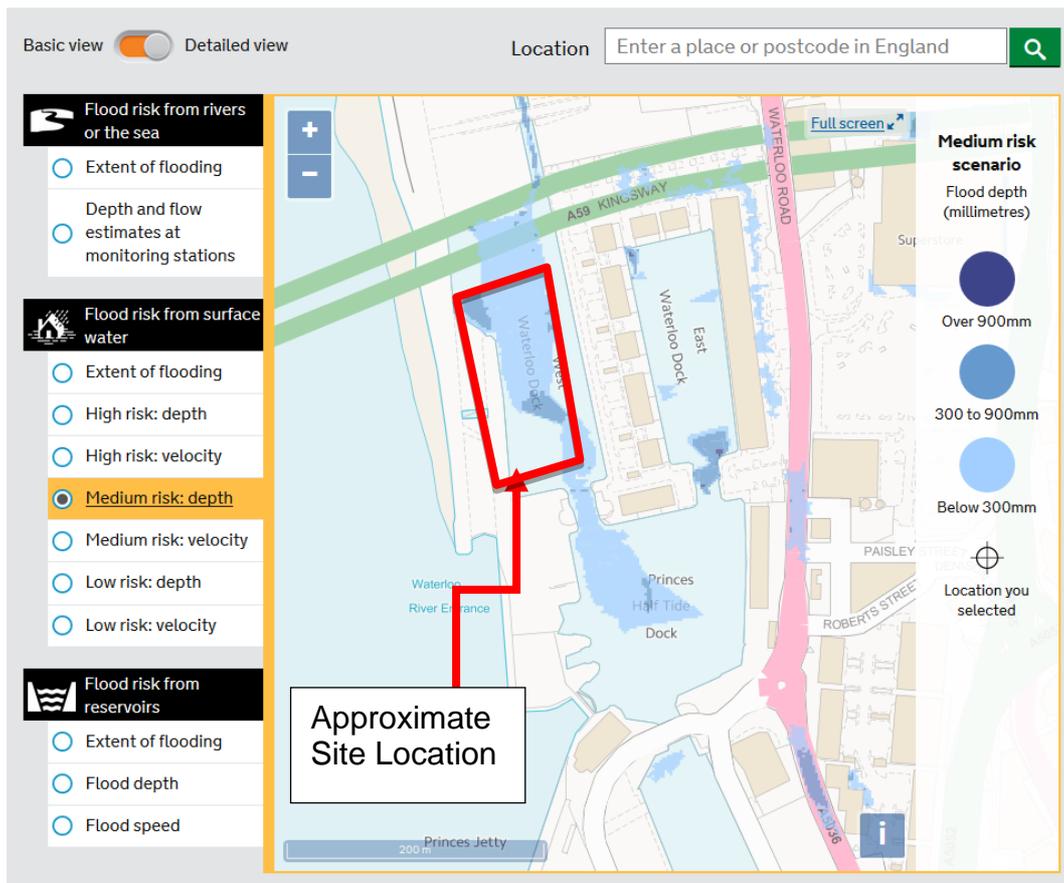


Figure 5 – Surface Water Flood Map Depths (Environment Agency)

(iv) Flooding from the surcharging of drains or sewers on or around the site.

- 4.5.10 The approximate depths of surface water flooding have been estimated by the Environment Agency to be generally below 300mm within the dock, with those peak areas increasing to between 300 – 900mm.
- 4.5.11 There are currently no drainage systems situated along the existing dock access road which runs adjacent to the development.
- 4.5.12 However, the adjacent site is to be developed for the Isle of Man Ferry Terminal and a new road – referred to as the Northern Link Road - is proposed to run along the perimeter of the site.
- 4.5.13 The Flood Risk Assessment for the Northern Link Road indicates the storm sewerage for the site has been designed in accordance with DMRB Volume 4 (HD 33/16 and HA 102/00) for a 1 in 100 year storm event with checks against 1 a in 30 year storm event. The drainage system has also been assessed for the consequences of exceedance for return periods in excess of 1 in 100 years to ensure any surcharge levels do not exceed the levels of chamber covers.
- 4.5.14 The South to North link road which runs parallel to the West boundary of the development has a lowest proposed level of 6.849m AOD – lifting, on average, the existing ground level by approximately 300mm and similar to this development.

- 4.5.15 The Flood Risk Assessment for the Northern Link Road states that the lowest level remains higher than the minimum ground level of 6.70m AOD as set out within Liverpool Waters Environmental Statement.
- 4.5.16 Review of the Northern Link Road levels against proposed site ground floor levels show the development has been set to remain above the road level – further reducing the risk of flooding from the Northern Link Road.
- 4.5.17 The Flood Risk Assessment for the Northern Link Road indicates that stormwater run-off will be adequately managed by inclusion of road gullies and designated carrier networks, with discharge into the canal and locks – as existing drainage is believed to do.
- 4.5.18 No calculations or mitigations measures have been presented within the Flood Risk Assessment for review of the proposals and flood risk management.
- 4.5.19 The proposed development will be designed to ensure the flood risk does not increase on site and elsewhere.
- 4.5.20 There is potential to increase flood risk due to the increased impermeable areas and changes in proposed levels.
- 4.5.21 The Curtins Condition 21 report requires that the proposed surface water drainage network shall be designed to not surcharge any pipes for the critical 1 in 2 year storm event.
- 4.5.22 The Curtins Condition 21 report also states that the attenuation requirements for the critical 1 in 30 year and 1 in 100 year (plus climate change) storm events can be satisfied by allowing the water level of the dock to rise temporarily during these storm events.
- 4.5.23 Further consideration of the drainage systems is included in Chapter 5.0.

The risk of surface water flooding at this site is low.

(v) *Groundwater Flooding*

- 4.5.24 The Site Investigation Report for the development undertaken by CC Geotechnical indicates that the site is underlain by loose Made Ground deposits comprising silty sands, gravel and what could be described as construction waste materials over the natural sandstone strata at depths ranging between 8m to 21m below ground level (-0.600m to -13.000m AOD).
- 4.5.25 Groundwater encountered in each of the boreholes was recorded to around 4.900m AOD – consistent with the dock level.
- 4.5.26 Based upon the above desk study evidence, the ground water level is below the proposed levels of the development and so, the proposed development is at a very low risk of flooding from Groundwater. Precautions may be required for the construction of foundations, but this would be part of the standard procedures for a construction project of this scale.

The risk of groundwater flooding at this site is low.

(vi) *Flooding from Reservoirs*

4.5.27 Artificial sources of flooding are potentially from man-made structures and infrastructure. The Environment Agency have modelled the potential effect of flooding from failures in retaining structures containing reservoirs and this is shown in Figure 5.

4.5.28 It should be noted that reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs are inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensure that reservoirs are inspected regularly, and essential safety work is carried out.

The risk of flooding from reservoirs at this site is low.

(vii) *Flooding from Canals*

4.5.29 The Liverpool Canal Link runs along the Eastern boundary of the development and the risk of flooding from the canal is considered low as the canal is interlinked between a series of docks with isolation structures in place to minimise water level change between adjacent docks.

The risk of flooding from reservoirs at this site is low.

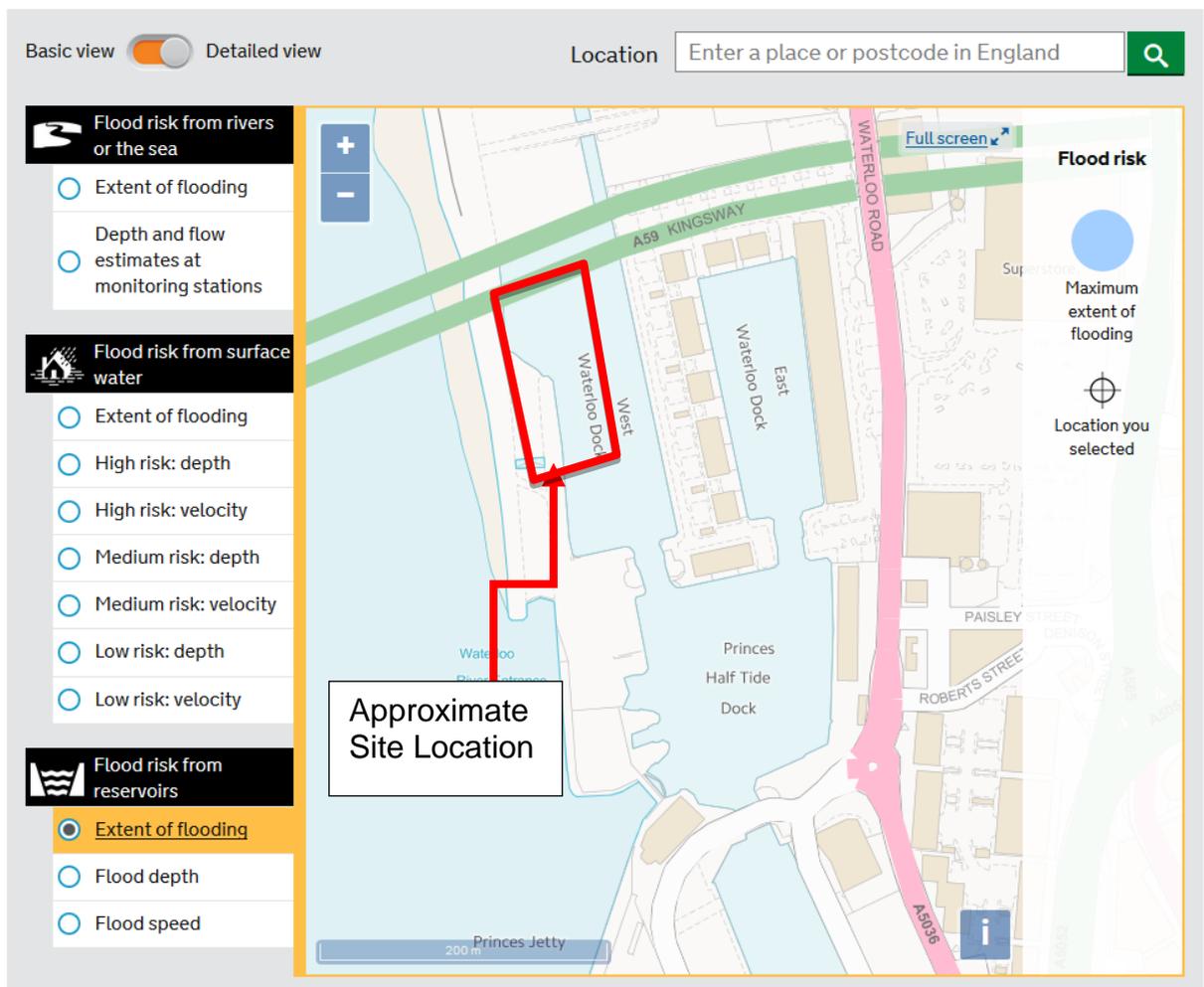


Figure 6 – Flood Risk from Reservoirs (Environment Agency)

(viii) *Wave Action*

4.5.30 The Met Office have calculated a range of theoretical wave heights for the new Northern Link Road which separates this development with the River Mersey. These estimates are understood to be highly conservative and are noted below;

- Hs (significant wave) = 1.7m
- H(mean) = 1.088m
- H1/10 (10% highest waves) = 2.159m
- H1/100 (1% highest waves) = 2.839m
- H (most probable) = 1.0m
- Hmax = 3.4m

Figure 7 – Meteorological Office Predicted Wave Heights

4.5.31 The maximum wave level depicted in Figures 11 and 12 (taken from Curtins Condition Report 21) is shown as 5.160m AOD. Considering a maximum wave height of 3.4m, this increases the peak wave height to 8.560m AOD.

4.5.32 Review of the proposed ground floor levels of the development indicate the ground floor ranges in level from 8.050m AOD up to 8.400m AOD – both below the peak wave height.

4.5.33 However, there are mitigating factors which reduce the risk of flooding due to wave action.

4.5.34 The river wall has a lowest level recorded on the topographic survey of 6.930m AOD. This will dissipate some of the energy of the waves when they crash against the river wall.

4.5.35 The development is in excess of 20m away from the river – and therefore the source of the source of the waves. The means the remaining energy from the waves after it crashes over the wall has to travel this 20m distance to come into contact with the development.

The risk of flooding from reservoirs at this site is low.

4.6 Impact of Development on Fluvial Morphology

4.6.1 The development will not alter any flow regimes which will have an adverse effect on the fluvial morphology of the area.

5.0 DRAINAGE

5.1 Existing Drainage

- 5.1.1 Asset drawings provided by United Utilities have shown no existing sewer infrastructure on or in the vicinity of the development.
- 5.1.2 It is likely that the vast majority – if not all - of the existing surface water drains freely into the dock.
- 5.1.3 However, the future development of the area will see a new road constructed to service the Isle of Man Ferry Terminal and Plot C02".
- 5.1.4 Figures 7 and 8 show the proposed drainage below this road which borders the development. A Surface Water sewer is proposed ranging in diameter from 150mm up to 300mm but this appears to be solely for the road drainage as there are numerous gullies connected to it with no provisions for a connection for the development.
- 5.1.5 There is also a Foul Water sewer proposed below the road with a number of branches along the length coming onto the development for connection of the foul water system.
- 5.1.6 Following further consultation, it has been established although these branches are shown to come onto site, no foul water drainage has been accounted for this development a new pumping station and rising main will be installed to connect to the wider foul sewer system. Details are contained on the drawing included in Appendix F).

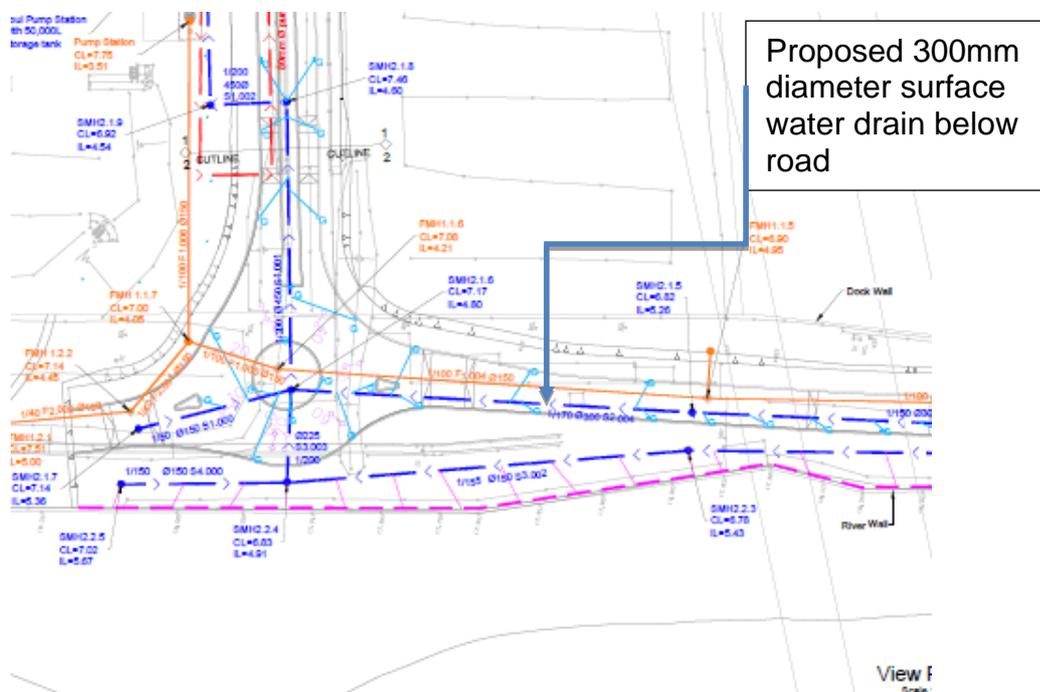


Figure 8 – Road Drainage Extract One (Amey Consulting Drawing C000205341-H-D-NLR-500)

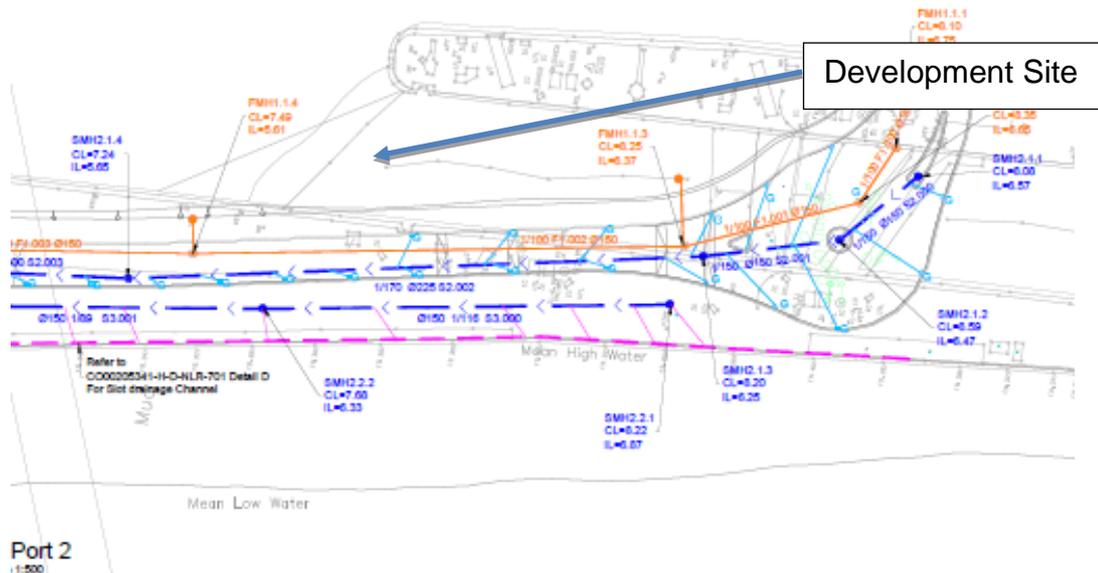


Figure 9 – Road Drainage Extract Two (Amey Consulting Drawing CO00205341-H-D-NLR-500)

- 5.1.7 The impermeable areas on the existing site are the dockside wharf, with the rest either being dock (open, partial infill or full infill).
- 5.1.8 The total impermeable area of the existing site is 800m². Based on a 1 in 2 year 15 minute storm the existing run-off from the site is approximately 8 litres/second.
- 5.2 Proposed Sustainable Drainage Systems (SuDS.)**
 - 5.2.1 Any new drainage for the development should be designed in accordance with the non-statutory technical guidance for the design of sustainable drainage systems.
- 5.3 Surface Water Disposal Hierarchy**
 - 5.3.1 The disposal of surface water should be considered in the following order of priority;
 1. Infiltration into the subsoil via soakaways or permeable paving.
 2. Discharge to a water course or the sea.
 3. Discharge to a surface water sewer.
 4. Discharge to a combined sewer.
 - 5.3.2 If it is not possible to discharge to a soakaway, then surface water should be controlled with the use of Sustainable Drainage Systems (SuDS) and considered using the SuDS Hierarchy.

	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
↑ Most Sustainable ↓ Least Sustainable	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviers	✓	✓	
	Tanked systems - over-sized pipes/tanks - storms cells	✓		

Figure 10 – SUDS Hierarchy

5.4 Disposal Strategy for Plot CO2, Liverpool Waters

5.4.1 Infiltration

All soakaways must be situated at least 5m away from the building footprint as per building regulations which may limit the location of such soakaways.

In addition, although there are areas on this development subject to dock infill and this is likely to be by imported aggregates, the permeability at the base of the fill is likely to be minimal with its previous history as a water retaining dock.

5.4.2 Water Course

The nearest water course is the River Mersey located approximately 20m to the west of the site. While this would be a potential discharge point for the surface water, it is unlikely that this would be acceptable to Environment Agency and would also mean crossing third party land to do so.

A feasible option is to discharge directly into West Waterloo Dock. From initial discussions with both The Canal and Rivers Trust and Peel Land and Property Group Management Limited (Dock Operators), there have been no objections to this proposal. The only consideration Peel have advised is with regard to achieving a flow velocity into the dock of 0.5m/s. However, this is outside the limit advised for best practice construction and within Sewers for Adoption in order to achieve self-cleansing within the surface water drainage network.

To achieve this, the energy generated within the flow of water along the surface water network must be disrupted to dissipate the energy and subsequently its velocity. This can be achieved in a number of ways such as including orifice plates or flow controls with the effective volume of water behind this stored in storage in order to remain within the design requirements. This will require conversations with all relevant parties to achieve an amicable solution.

The outfall of the drainage into the dock should be located at a level above the maximum canal level to ensure surface water can discharge from the development but not too high to minimise any potential for turbulence in the water.

5.4.3 **Surface Water Sewer**

The nearest surface water drainage system will be below the new access road to the Isle of Man Ferry Terminal. The proposed drawings show no branches onto this development and it appears it may have been designed for the road drainage only. This drainage run does ultimately discharge into West Waterloo Dock.

5.4.4 **Combined Sewer**

No combined sewer exists as part of the new road development – foul and surface water drainage systems are kept separate.

6.0 FLOOD MITIGATION MEASURES

6.1 Fluvial/ Tidal Flood Mitigation

6.1.1 The Curtins Condition 21 Report has specified that residential threshold levels should be set at a minimum 7.850m AOD to provide a 600mm above the 1 in 200 year extreme sea level up to the year 2115. This has been estimated at 7.250m AOD.

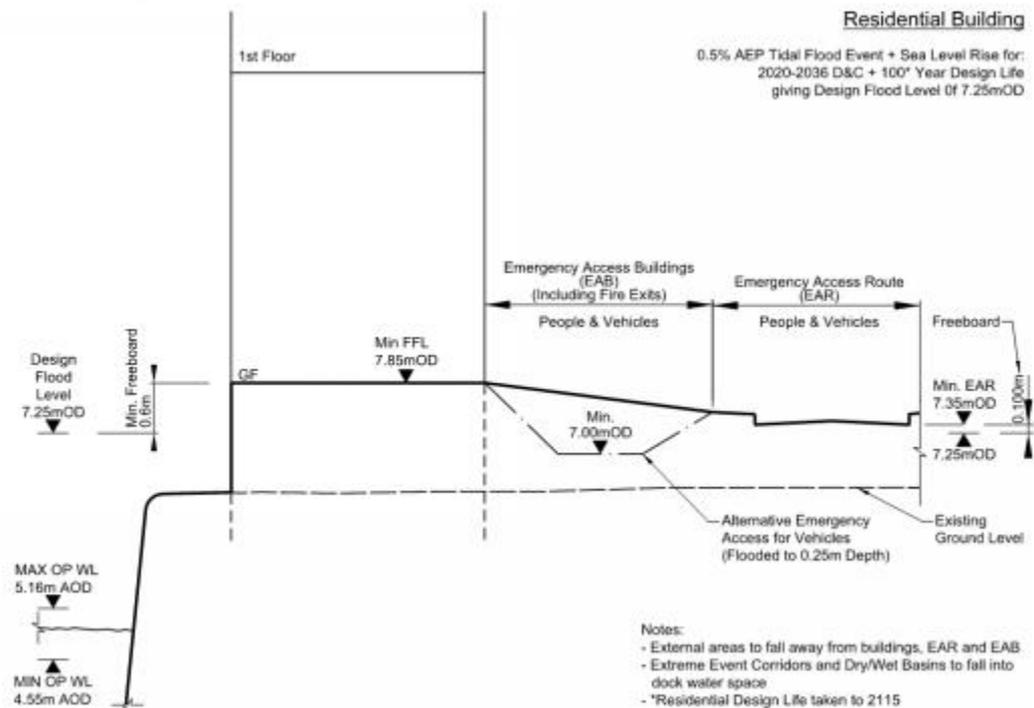


Figure 11 – Curtins Condition 21 Report Residential Building Floor Levels

6.1.2 The Curtins Condition 21 Report has specified that commercial threshold levels should be set at a minimum 7.850m AOD to provide a 600mm freeboard above the 1 in 200 year extreme sea level up to the year 2115. This has been estimated at 7.250m AOD.

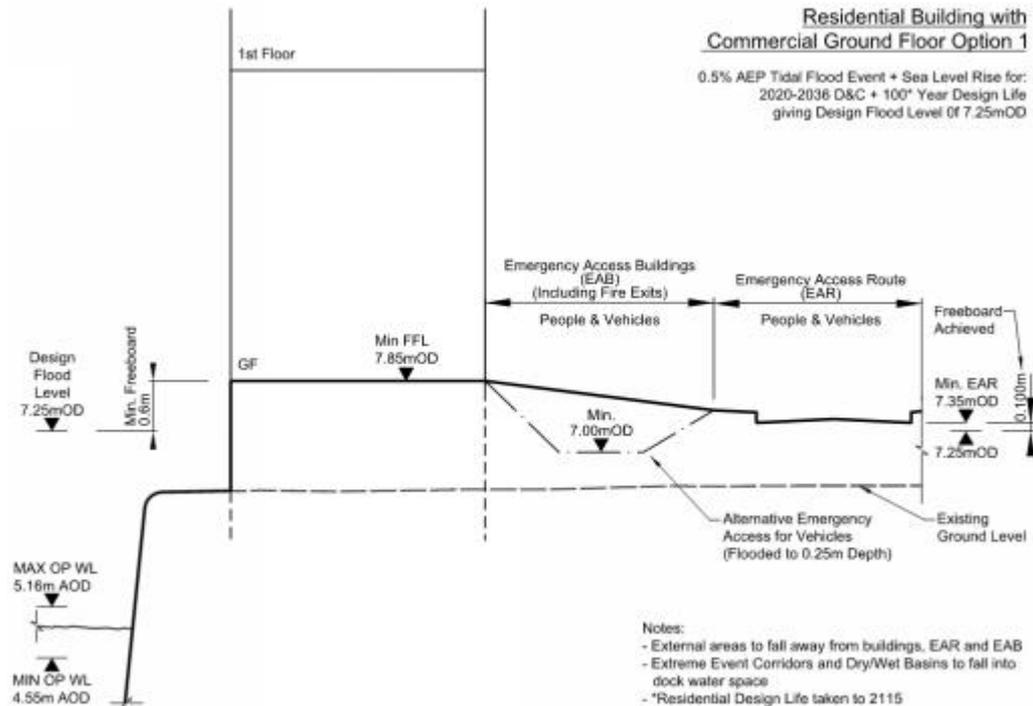


Figure 12 – Curtins Condition 21 Report Residential Building with Commercial Floor Levels

- 6.1.3 The Curtins Condition 21 Report specifies that levels of the emergency access route (EAR) should be set at a minimum 7.35m AOD.
 - 6.1.4 The proposed ground floor levels of the buildings range from 8.050m AOD at the North end of the development up to 8.400m AOD at the South end of the development.
 - 6.1.5 The external areas have a minimum level of 7.735m AOD near the buildings falling to 6.600m AOD along the canal side walkway/ boardwalk.
 - 6.1.6 The risk from tidal flooding following mitigation can be considered generally low for the habitable areas of the development as the ground floor levels are set above or at the minimum required levels.
- 6.2 Wave Action Mitigation**
- 6.2.1 The 600mm freeboard allowance noted in Section 6.1 is traditionally considered as a suitable allowance to counter the effects of extreme wave action.
 - 6.2.2 There are mitigating factors which need to be considered alongside the assumed peak wave height and the implications this has on the development.
 - 6.2.3 The river wall has a lowest level recorded on the topographic survey of 6.930m AOD. This will dissipate some of the energy of the waves when they crash against the river wall.
 - 6.2.4 The development is in excess of 20m away from the river – and therefore the source of the source of the waves. This means the remaining energy from the waves after it crashes over the wall has to travel this 20m distance to come into contact with the development.

6.3 Groundwater Flood Mitigation

- 6.3.1 Groundwater flooding tends to last over a number of weeks or months rather than hours or days. Groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, it can cause significant risk to property.
- 6.3.2 The development is considered to be at a low risk of groundwater flooding, ground water levels have been recorded comparable to the canal water level.
- 6.3.3 Finished floor levels are set above ground water levels.
- 6.3.4 External ground levels across the development fall away from the proposed buildings and ensure that the creation of low points are avoided (other than those used intentionally for drainage features) in order that in the unlikely event of groundwater flooding, the flood water is safely routed away from the buildings.
- 6.3.5 Providing the above mitigation measures are imposed, the risk from groundwater flooding would therefore be considered to be low post development.

6.4 Surface Water Flooding to the Site Mitigation

- 6.4.1 It is recommended that proposed external ground levels across the development should fall away from the proposed buildings in a manner which does not create low points where water may pond unintentionally. This will ensure the any surface water will not flow towards the proposed buildings.
- 6.4.2 Upon implementation of the proposed drainage network, it is proposed to accommodate the necessary flows generated from the site and therefore limit future surface flood risk from the development.
- 6.4.3 Providing the above measures are implemented on the development, flooding risk from surface water is therefore considered low post development.

6.5 Surface Water Flood from the Site Mitigation

- 6.5.1 All new development drainage will be designed in accordance with the FRA, Lead Local Flood Authority requirements and best practice.
- 6.5.2 The Curtins Condition 21 Report requirements are that proposed surface water drainage network shall be designed to not surcharge any access chambers/ manholes for the critical 1 in 2 year storm event.
- 6.5.3 The Curtins Condition 21 Report has also stated that the attenuation requirements for the critical 1 in 30 year and the 1 in 100 year (plus climate change allowance) storm event can be satisfied by allowing the water level in the dock waters to temporarily rise during these storm events.
- 6.5.4 Based on the nature of the development, a lifespan in excess of 60 years is anticipated. Therefore, the potential climate change allowance for 2070-2115 ranges between 20% for the central allowance and 40% for the upper end allowance. As such, an average allowance of 30% for climate change on peak rainfall intensity will be included for within calculations.

- 6.5.5 The Curtins Condition 21 Report also indicates that the 40% allowance should be considered to understand the implications.
- 6.5.6 In following the hierarchy of drainage solutions, consideration has been given firstly to the discharge of surface water runoff by sustainable method of infiltration, through to discharge into a sewer. These options are discussed in Sections 5.3 and 5.4.
- 6.5.7 To minimise localised flooding within the development, the drainage design should ensure that gullies, drainage channels and drains are all suitably sized to accommodate peak storm flows. Additionally, all inlet features should include suitably sized sumps to catch silts and should be subject to documented maintenance and cleansing regime.
- 6.5.8 The invert level of the outfall into the dock should also be set at a level above the maximum level of the dock to ensure that the invert is never fully submerged and preventing discharge from the site. The canal level is generally kept to 4.770m AOD and therefore the invert of the outfall should be set above this level.

6.6 Flood Mitigation Generally

- 6.6.1 Flood water exceedance routes should be identified, both on and off site.
- 6.6.2 For any sustainable drainage systems employed in the development, an appropriate management and maintenance plan for the sustainable drainage system for the lifetime of the development should be submitted and should include;
- Any arrangements for adoption by an appropriate public body or statutory undertake, management and maintenance by a Resident's Management Company.
 - Arrangements concerning appropriate funding mechanisms for its ongoing maintenance of all elements of the sustainable drainage systems (i.e. inspections, regular maintenance).
 - Means of access for maintenance and easements where applicable.
- 6.6.3 The site is in an Environment Agency Floodline Warnings Direct which is a free service that provides warnings by phone, text or email. Property owners and commercial unit managers can register to receive notifications. This will enable people to prepare for flooding and evacuate the building if necessary.
- 6.6.4 The development should be designed in accordance with guidance given in BS 85500:2015 - Flood resistant and resilient construction. Guide to improving the flood performance of buildings. This document can be used to help improve the resistance and resilience of buildings against flooding with the use of suitable materials and construction techniques.
- 6.6.5 For example, materials that are to be used up to first floor could be resilient to water.
- 6.6.6 The proposed ground floor level has been set between 8.050m AOD and 8.400m AOD and are both above the 600mm freeboard figure above the determined sea levels.

- 6.6.7 External levels will be locally 'ramped' upwards adjacent to the entrance doors from the surrounding external levels.
- 6.6.8 The introduction of thresholds drains are proposed to each of the entrance doors to the buildings residential and commercial doors.
- 6.6.9 To mitigate damage to the substation and internal plant rooms accessed from street level, an internally raised plinth can be introduced to raise equipment above the average external levels providing additional protection from residual flood risks.
- 6.6.10 Additionally, services entries to the plant rooms would be at high level.
- 6.6.11 Assuming that the proposed drainage system is designed to provide adequate capacity, and that the private and adopted sewers will be maintained by their adopted authority, it can be assumed risk of flood from blockage or overloading is minimal.
- 6.6.12 The final design of the drainage networks shall be in accordance with the legislation set by the Environment Agency, Liverpool City Council and United Utilities.

7.0 CONCLUSIONS AND RECOMMENDATIONS

- 7.1 This report gives details of the Flood Risk Assessment, which has been carried out in relation to the proposed redevelopment of Plot CO2 at Liverpool Waters for Residential use.
- 7.2 The development is predominantly within Flood Zone 1 as defined by the Environment Agency, with an area of less than 4% just within Flood Zone 3. The risk of flooding from rivers, seas and surface water is generally low subject to suitable design and maintenance of the proposed drainage systems.
- 7.3 The proposed development has been designed to take flood risk into account where possible.
- 7.4 All more vulnerable residential properties are located above the required minimum levels for residential use as defined in Curtins Condition 21 Report.
- 7.5 Less vulnerable uses, such as commercial and storage are also located above the required minimum levels for residential use as defined in Curtins Condition 21 Report.
- 7.6 The Emergency Access Route level of a minimum 7.350m AOD level is not infringed with this development.
- 7.7 This Flood Risk Assessment has demonstrated that the development is generally at low risk from all forms of flooding applicable to this development and would not increase the risk of flooding elsewhere.
- 7.8 A flood management plan is recommended for the proposed development and general advice is given in Section 8.0. This can be developed at the detailed design stage and following completion with the buildings managers and residents.
- 7.9 The development provides the opportunity to reduce flood risk overall with the use of sustainable drainage systems to attenuate surface water run-off from the site.
- 7.10 The Drainage Strategy for the development is a separate document which can be read alongside this Flood Risk Assessment.

8.0 FLOOD MANAGEMENT PLAN ADVICE

- 8.1 The Health and Safety File which will be required under the Construction, Design and Management Regulations, will contain a section on flood management. This document will have all operation and maintenance manuals for any drainage systems.
- 8.2 The Development managers will need to be made aware of flood warning procedures. A flood management plan should be developed. This chapter provides guidance on the contents for the management plan. Reference can also be made with the EA advice at <http://apps.environment-agency.gov.uk/flood/151256.aspx>
- 8.3 The property is within an area covered by the Environment Agency's Flood Line Warnings Direct. This is a free service and provides flood warnings by telephone, mobile, email, text and fax. The managers can sign up on-line <https://www.gov.uk/sign-up-for-flood-warnings>
- 8.4 Flood advice will be provided at different levels:-

FLOOD WATCH

Flooding of low-lying land and roads is expected.

What to do:

- Monitor local news and weather forecasts.
- Be aware of water levels near you.
- Be prepared to act on your flood plan.
- Charge mobile phones.

FLOOD WARNING

Act Now! Flooding is expected.

What to do:

- Move students, staff, valuables and important documents to safety.
- Turn off gas, electricity and water supplies if safe to do so.
- Be prepared to evacuate.
- Act on your flood plan.

SEVERE FLOOD WARNING

Act Now! Severe flooding is expected with extreme danger to life and property.

What to do:

- Collect things you need for evacuation.
- Turn off gas, electricity and water supplies if safe to do so.
- Stay in a high place with a means of escape.
- Avoid electricity sources.
- Avoid walking or driving through flood water.
- If in danger, call 999 immediately.
- Listen to emergency services.
- Act on your flood plan.

ALL CLEAR

No further flooding is expected. Water levels will start to go down.

What to do:

- Keep listening to weather reports.
- Only return to evacuated buildings if you are told it is safe.
- Beware sharp objects and pollution in flood water.
- If your property or belongings are damaged, contact your insurance company. Ask their advice before starting to clean up.

- 8.5 All managers / residents should be made aware of the health risk associated with contaminated flood water. Water should not be waded through or touched if at all possible.
- 8.6 Prepare a flood kit of essential items.
First aid kit and supplies
Details of all important contact numbers
Water proof clothing for use by key staff
- 8.7 Ensure that there are clear instructions on how to turn off electric, water mains and gas supplies if appropriate.
- 8.8 A plan is also required for the return to the site after a flood.

A safety inspection should be carried out by park managers to ensure that there is no dangerous debris or displaced manhole covers etc.

Structures should be inspected to ensure that there is no structural damage.

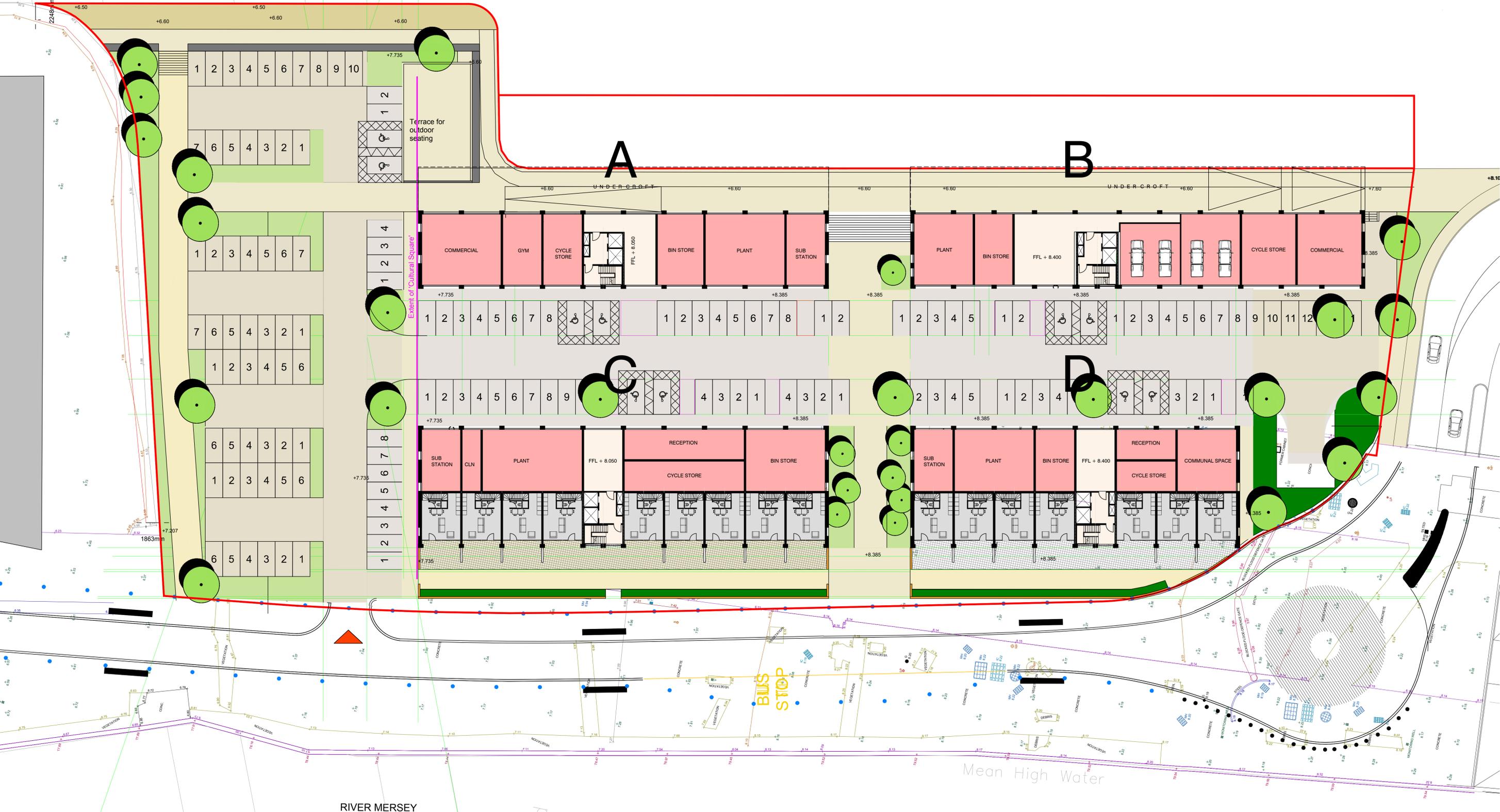
Power should only reinstated by professional electricians.

Flood water clean-up operations should only be undertaken with suitable personal protective equipment to avoid contact with sewerage and contamination.

APPENDIX A

Development Proposal

Cont. edge of batter



- cores/ reception/ circulation
- one bed - 38sqm
- two bed - 57sqm
- three bed - 97sqm
- penthouse - varies
- duplex - 79sqm
- ancillary

C02 SITE GROUND FLOOR PLAN

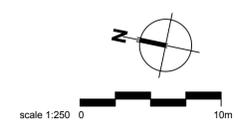
NOTES
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Scale: 00.00.00
rev: 0006
drawing status: **DRAFT**

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OLLIER SMURTHWAITE ARCHITECTS

Client	ROMAL CAPITAL	Scale	1:500@A3	Drawn	VM	Checked	VM	Date	20.08.19
Job title	LOTS C02 CENTRAL DOCKS, LIVERPOOL	Drawn	VM	Checked	VM	Date	20.08.19		
Drawing title	PROPOSED GROUND FLOOR PLAN	job number	A476	Drawing number	A476_P_101				



APPENDIX B

Environment Agency Data

Likelihood of flooding in this area

This location is in an area with a low probability of flooding

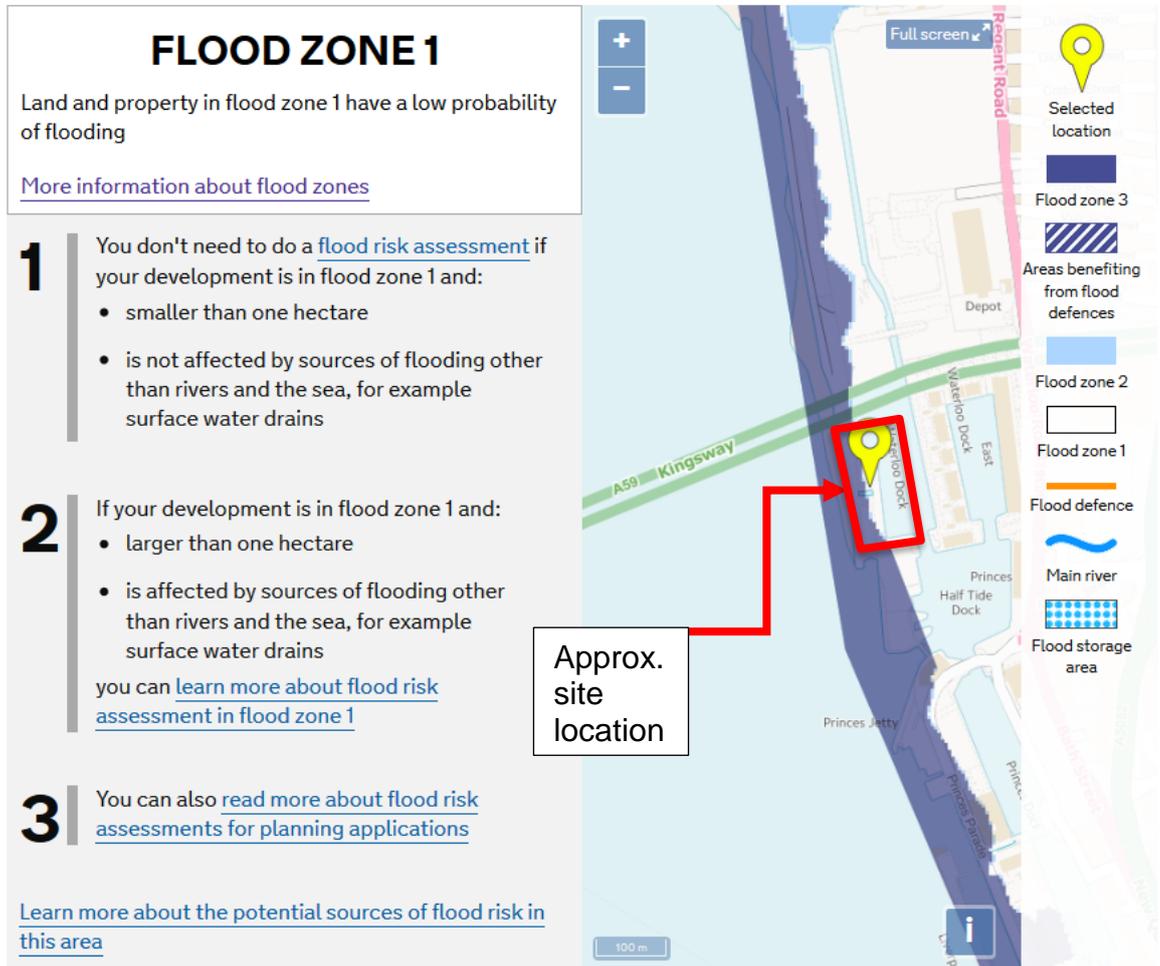


Figure 1 - Flood Risk Mapping for Rivers and Seas (<https://flood-map-for-planning.service.gov.uk>)

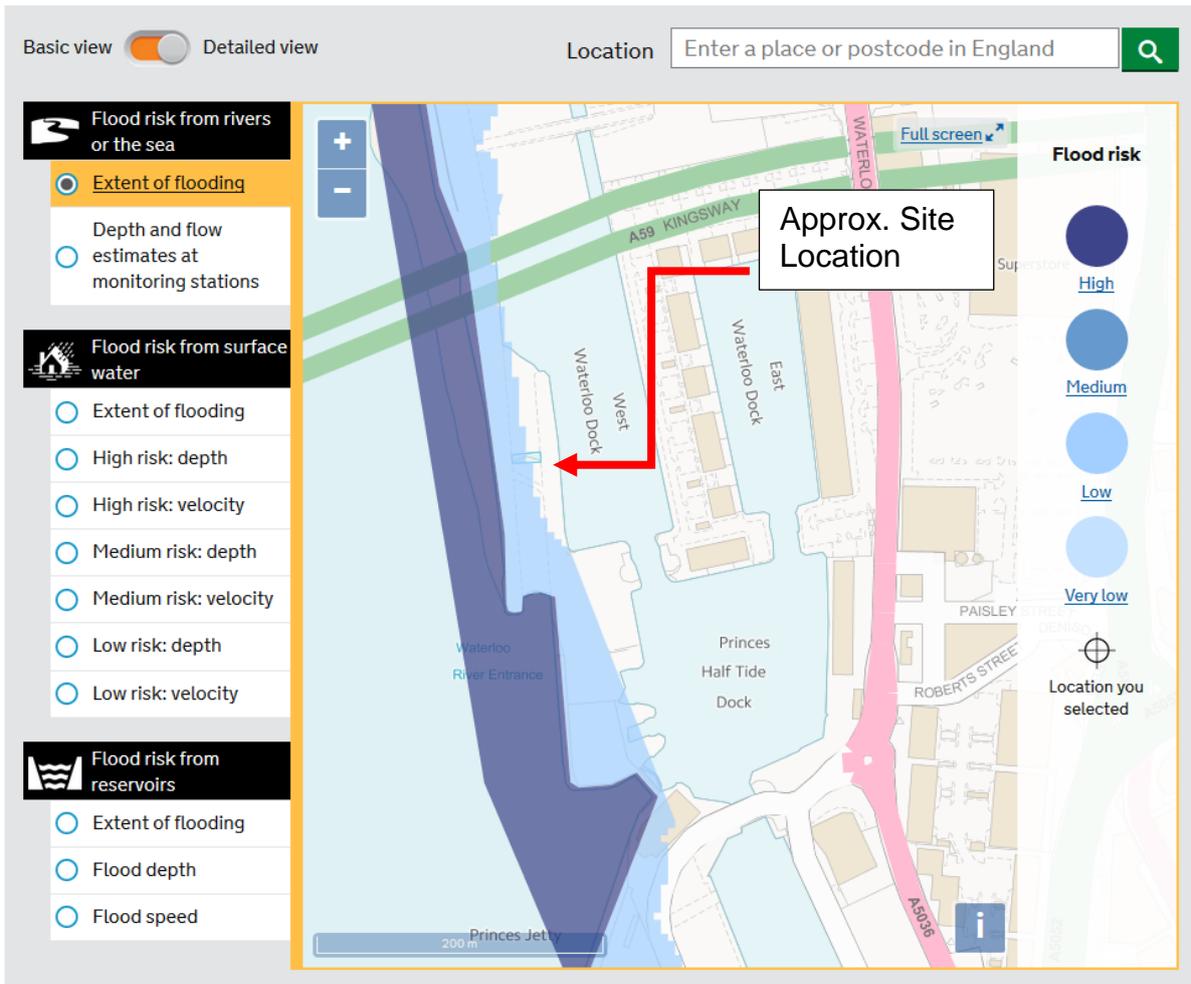


Figure 2 – Extent of Flood Risk from Rivers or the Sea (Environment Agency)

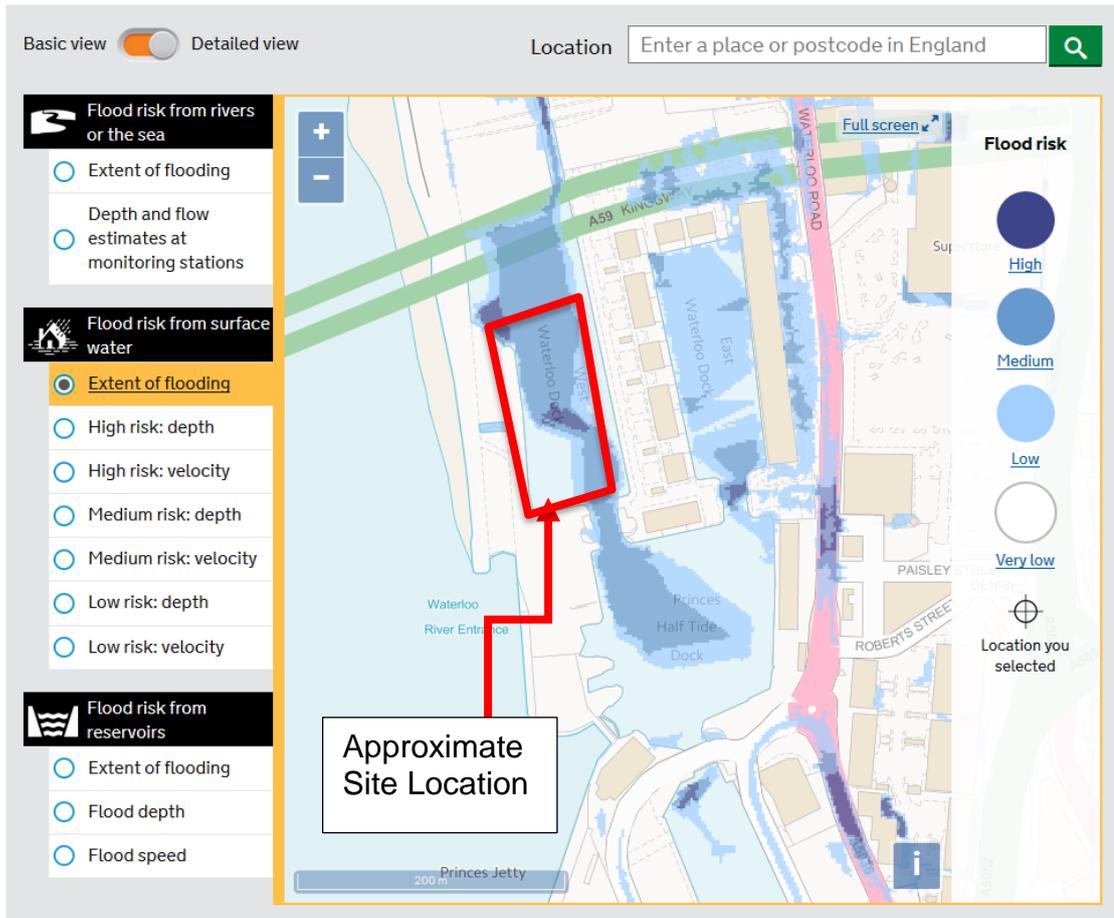


Figure 3 – Surface Water Flood Map (Environment Agency)

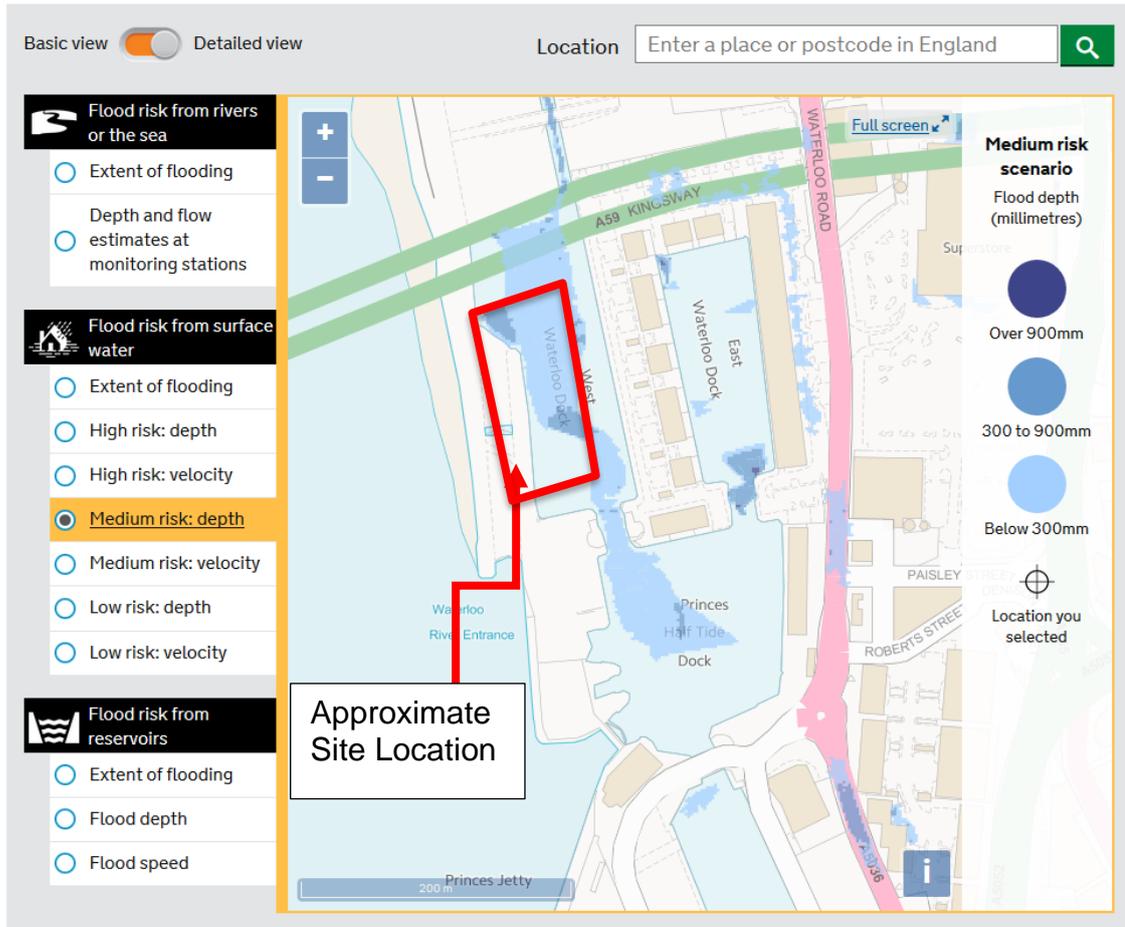


Figure 4 – Surface Water Flood Map Depths (Environment Agency)

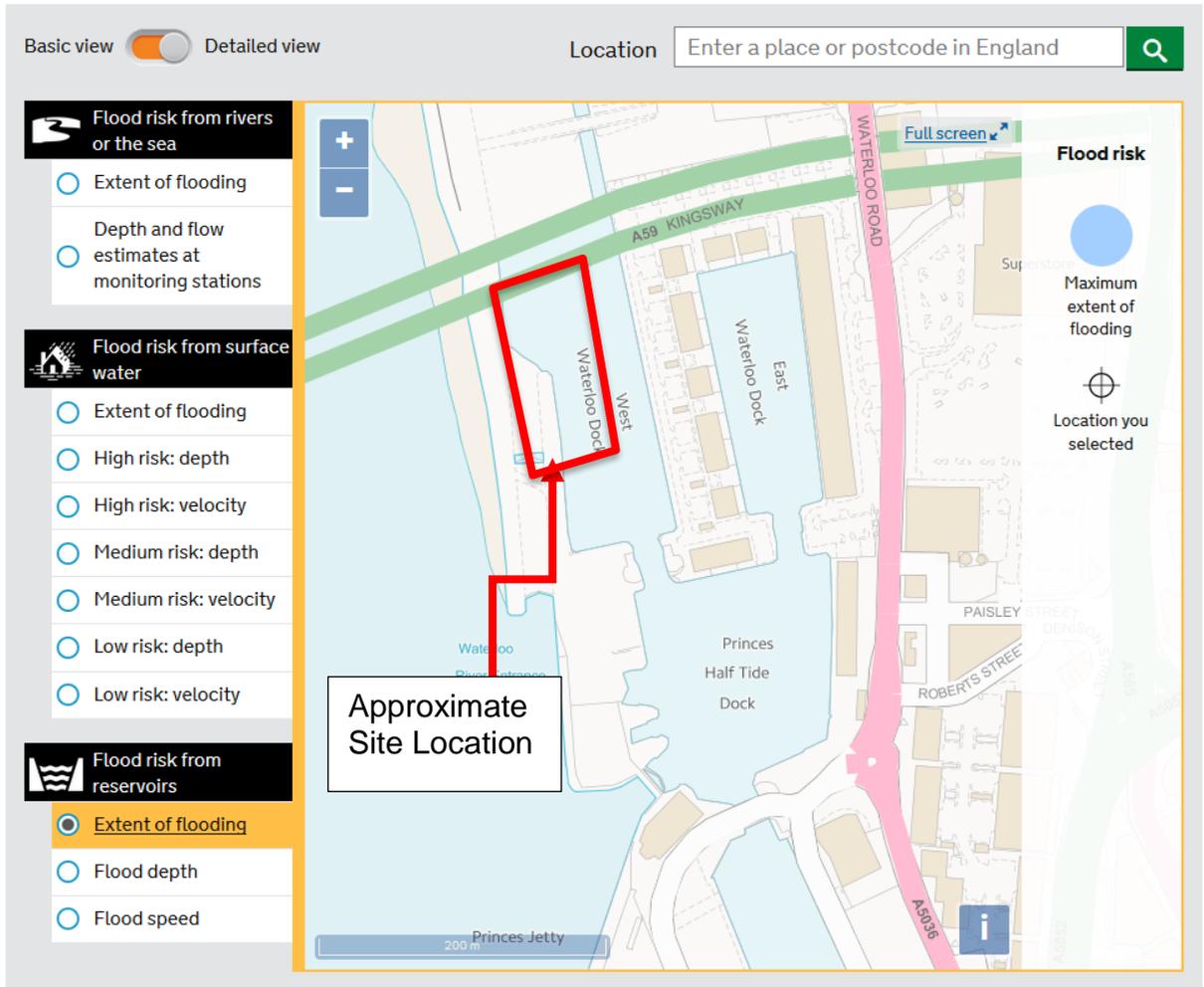


Figure 5 – Flood Risk from Reservoirs (Environment Agency)

APPENDIX C

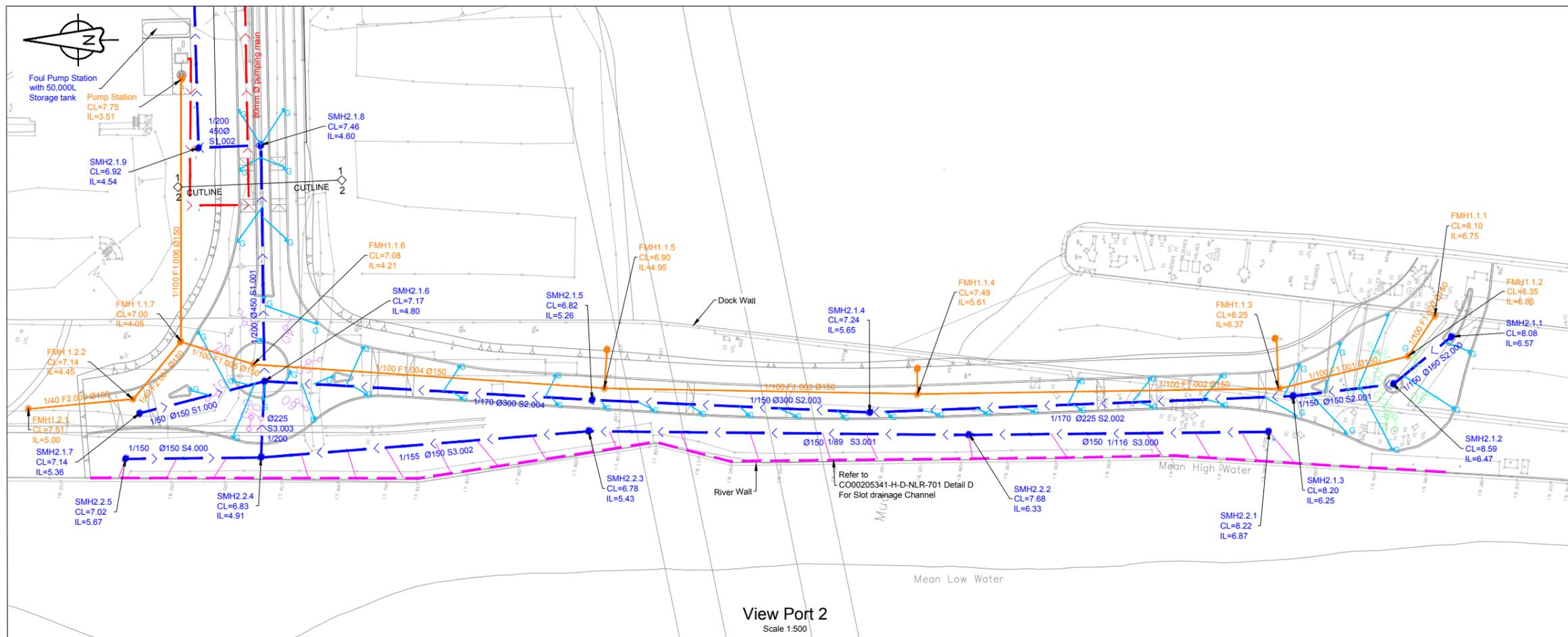
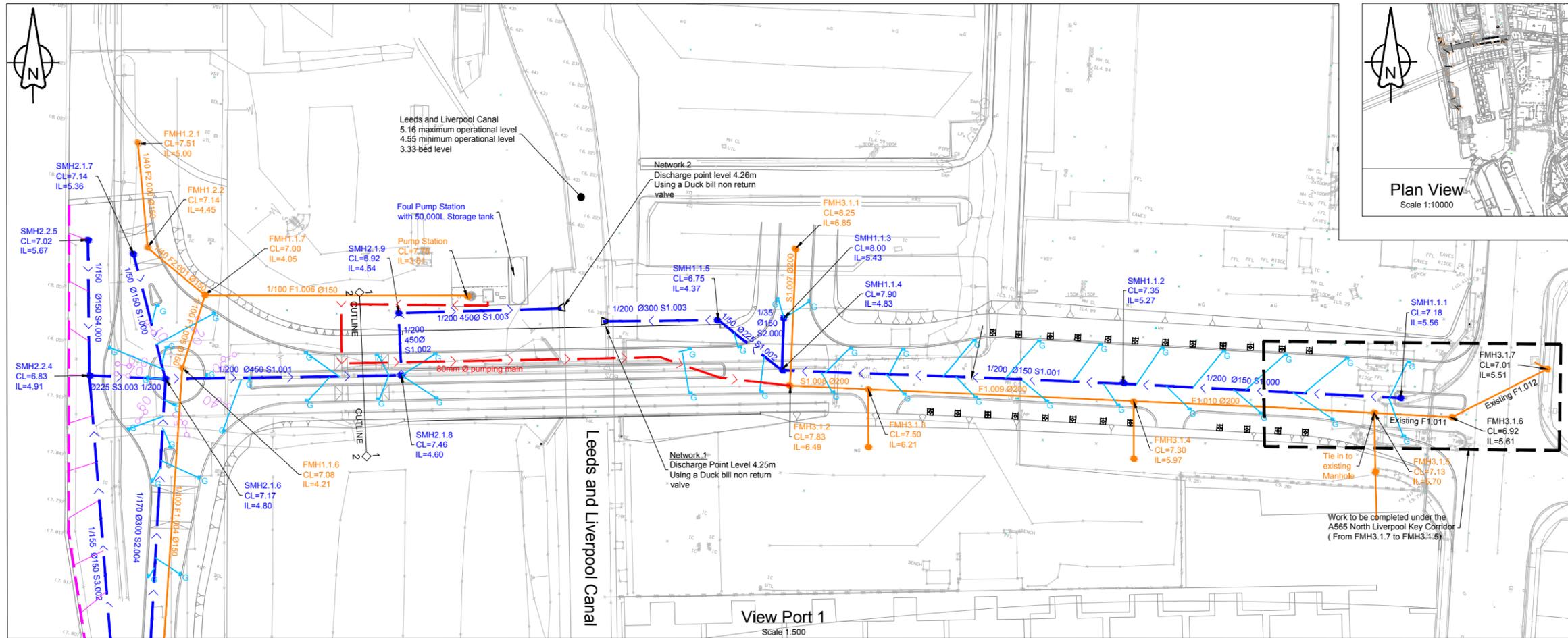
Topographical Survey By Powers and Tiltman

APPENDIX D

United Utilities Public Sewer Records

APPENDIX E

Proposed Link Road by Amey Consulting



RESIDUAL DESIGN HAZARDS
(The following information has been collected from Preconstruction Information and the Arney CDM Hazard Management Process.)

- Asbestos
- Working Near Water
- Unexpected void shafts in existing ground
- Working on unstable ground
- Working at heights

- NOTES**
- All levels are in metres above Ordnance Datum.
 - All Dimensions are in metres unless stated otherwise.
 - The Specification clauses referred to in this drawing, unless stated otherwise are from the Manual of Contract Documents for Highway Works (MCHW) - Volume 1 Specification for Highway Works.
 - Any discrepancies to be brought to the attention of Arney.
 - This drawing is to be read in conjunction with;
 - CO00205341-H-D-NLR-501-503 Proposed Drainage Long-Sections
 - CO00205341-H-D-NLR-700-701 Proposed Construction Details
 - FMH 3.15, 3.16 and 3.17 constructed under A565 Liverpool (NLKC). Refer to drawing CO0020216-PH3-DR-506 included in site information.
 - For gully and manhole detail please refer to LCC standard drainage detail SD-D-05 Type G1 gully and SD-D-16 Type 1 Manhole respectively.
 - Outfall pipes should be turned in the direction of flow
 - Precast concrete headwall to be constructed for road drainage outfalls shall be to spec. cl. 1710 and to comply with BS EN206-1:2000.
 - Adequate protection measures should be constructed at each outfall to prevent bank erosion or scouring of the channel bed.
 - Carrier drain to be solid wall pipe with Type S bedding.

KEY

- Pumping Main:
- Foul Drainage:
- Storm Drainage:
- Gully & Connection:
- Slot Drainage Channel:
- Channel Drainage Connection:
- SMH = Storm Manhole:
- FMH = Foul Drainage Manhole:

TENDER

Rev	Revision details	Drwn	Chkd	Appd	Date



Client

Project Name
Liverpool City Centre Connectivity Phase 2

Drawing Title
Northern Link Proposed Storm and Foul Drainage

Original Drawing Size : A1 Scale : As Shown
Dimensions : m

Drawing Status
PUBLISHED

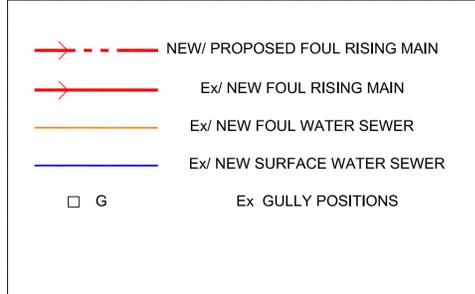
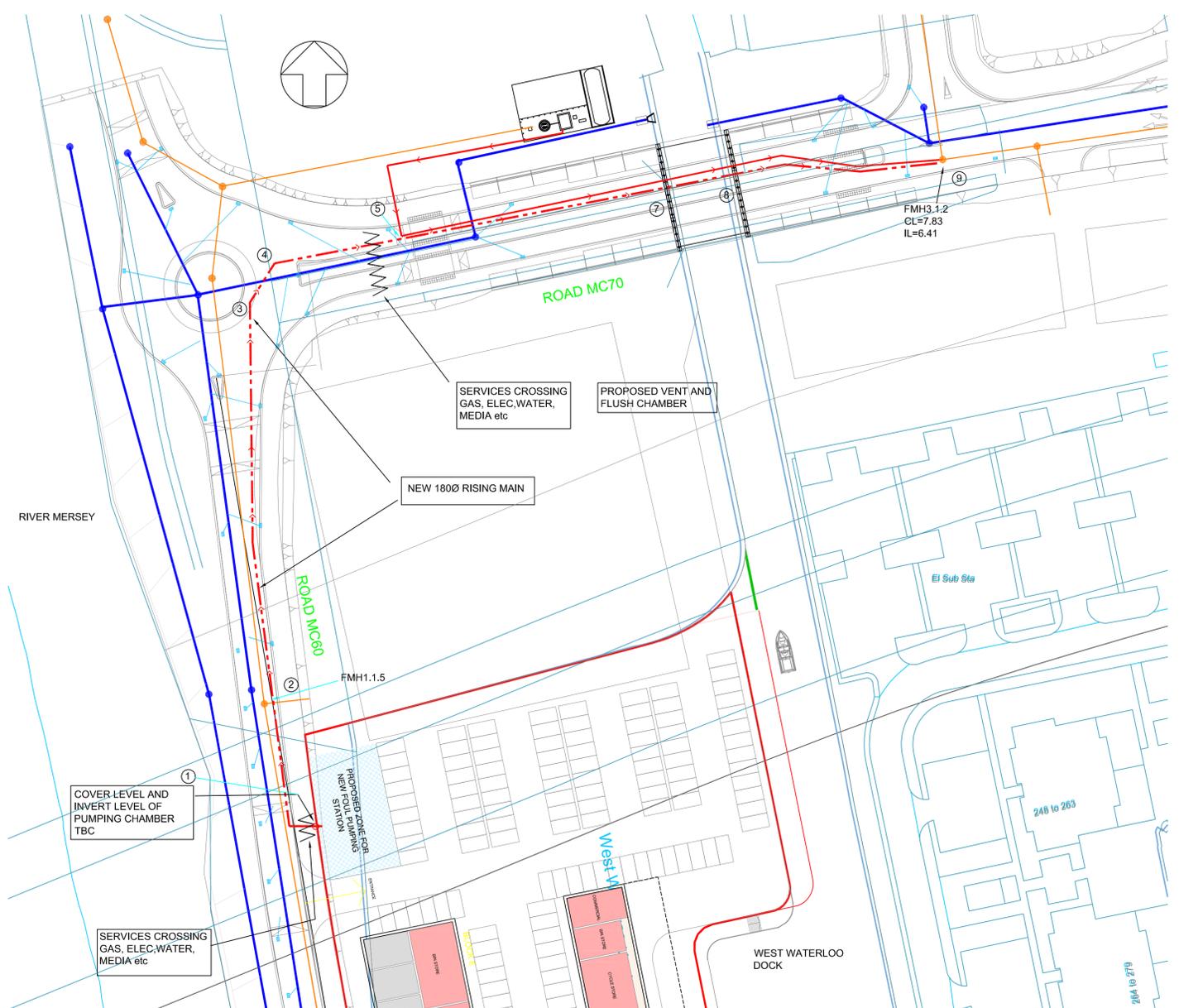
Suitability
D2

Drawing No
CO00205341-H-D-NLR-500

Rev
-

APPENDIX F

Clancy Consulting Rising Main General Arrangement Drawing



GENERAL NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT CLANCY CONSULTING, ARCHITECTURAL, AMEY CONSULTING AND OTHER ENGINEERS DRAWINGS AND SPECIFICATIONS.

DO NOT SCALE THIS DRAWING.

EXISTING DRAINAGE AND LEVELS SHOWN ON THIS DRAWING TO BE CONFIRMED BY THE CONTRACTOR ON SITE PRIOR TO COMMENCEMENT OF THE DRAINAGE WORKS. THE ENGINEER IS TO BE NOTIFIED OF ANY DISCREPANCIES.

COVER LEVELS TO BE CHECKED AGAINST ARCHITECTS PROPOSED EXTERNAL WORKS LEVEL / DETAIL DRAWINGS

EXISTING MANHOLES, LEVELS & PIPE SIZES TO BE CHECKED ON SITE

ALL OUTGOING AND INCOMING PIPES AT MANHOLE JUNCTIONS TO BE CONNECTED SOFFIT TO SOFFIT UNLESS SPECIFIED OTHERWISE.

PRELIMINARY COVER LEVEL AND INVERT LEVEL INTO THE PUMPING STATION ON CO2 SITE IS SUBJECT TO CONFIRMATION BY THE LANDSCAPE ARCHITECT

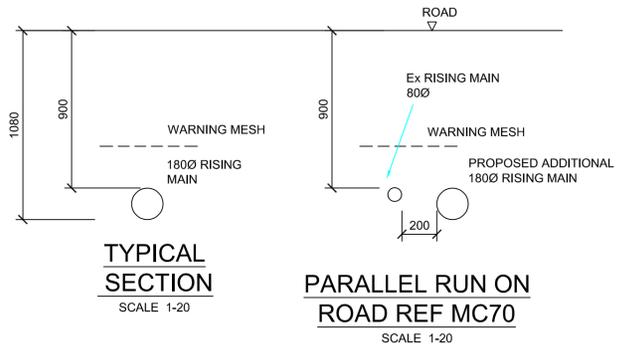
PROPOSED NEW RISING MAIN - LOCATED ADJACENT TO EX/ NEW 80Ø RISING MAIN PIPE TO HAVE A min 200mm GAP TO PREVENT UNDERMINING PIPE.

180mm RISING MAIN FROM CO2 SITE SET 900mm BELOW ROAD LEVEL AND 2m OFF THE KERB LINE AS PER AMEY CONSULTING EMAIL DATED 23 AUG 2019.

THE NEW 180mm RISING MAIN FROM CO2 SITE IS TO FOLLOW THE LINE OF THE OTHER 80mm RISING MAIN AT THE POINT IT RUNS PARALLEL ACROSS THE BRIDGE AND CONNECTION INTO THE EXISTING COMBINED SEWER. DATED 23 AUG 2019.

POSITION, DEPTH, QUANTITY OF WASH OUT CHAMBERS AND AIR VALVES SUBJECT TO CONFIRMATION BY PUMP PROVIDERS

THE DRAWING IS CONCEPT AND SUBJECT TO CHANGE FOLLOWING COMMENTS. DO NOT CONSTRUCT FROM THIS DRAWING.



LONGITUDINAL ROAD SECTION
(USING AMEY CONSULTING DRG C000205341-H-D-NLR-714 CO3 MC60 LONG SECTION AS REFERENCE)
SCALE 1-500

Station	140	150	160	170	180	190	200	210	220	231.77
PIPE FROM SITE PUMPING STATION PASSES BELOW SERVICES BELOW PAVEMENT										
AMEY DRG 503/ 504 FMH 1.1.5 CL 6.90										
AMEY DRG 503/ 504 FMH 1.1.5 CL 6.90										
DATUM (m) 0 000										
PIPE DIA (mm)	180			333	143	250	-	-	-	
SLOPE (1 in X)	-	-	-							
DEPTH (m)	1.37	1.25	1.13	1.08	1.08	1.08	1.11	1.11	1.08	1.08
ROAD LEVEL (m)	7.13	7.01	6.89	6.84	6.87	6.94	7.01	7.01	6.98	6.98
INVERT LEVEL (m)	5.76	5.76	5.76	5.76	5.79	5.86	5.90	5.90	5.90	5.90

LONGITUDINAL ROAD SECTION
(USING AMEY CONSULTING DRG C000205341-H-D-NLR-715 CO2 MC70 LONG SECTION AS REFERENCE)
SCALE 1-500

Station	30	40	50	60	70	80	90	100	110	120	130			
DOGLEG TO ROAD ISLAND														
DOGLEG TO ROAD ISLAND	6.27	14.27	20	30	40	50	60	70	80	90	100			
STANDARD UTILITY SERVICES CROSS ROAD (GAS WATER, etc)														
AMEY DRG 503 Ex 80Ø RISING MAIN CL 7.76 IL 6.88														
AMEY DRG 503 BRIDGE CL 8.25 IL 7.94 80Ø EX RISING MAIN (80Ømm DEPTH)														
AMEY DRG 503/ 504 FMH 3.1.2 CL 7.85 IL 6.41 225Ø OUTLET														
DATUM (m) 0 000														
PIPE DIA (mm)	180													
SLOPE (1 in X)	-	-	-	34.5	27	30.3	31.3	23.3		31.2	30.3	20.8		
DEPTH (m)	1.08	1.29	1.38	1.08	1.08	1.08	1.08	1.08	0.59	1.08	1.08	1.08	1.31	
ROAD LEVEL (m)	6.98	7.73	7.19	7.28	7.46	7.73	8.06	8.48	8.81	8.92	8.81	8.49	8.16	7.91
INVERT LEVEL (m)	5.90	5.90	5.90	5.90	6.28	6.65	6.98	7.30	7.73	8.33	7.73	7.41	7.08	6.600

Rev	Date	Description	By	Check	App.
01	03/09/19	ISSUED FOR INFORMATION	RJM	MD	BRH

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Client	ROMAL CAPITAL GROUP LTD
Project	PLOT CO2 LIVERPOOL WATERS
Office	LIVERPOOL
Discipline	CIVIL
Title	PROPOSED RISING MAIN

Scale @ A1	1:500	Status	INFORMATION
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Job Number	Originator	Building/Zone	Level
4/6679	CCL	CO2	DRN
Type	Discipline	Drawing No.	Revision
GA	C	100	01

Birmingham 0121 300 3700 | Glasgow 0141 333 1700 | Liverpool 0151 227 5500 | London 020 3077 0970 | Manchester 0161 616 0000 | Newcastle 0191 221 0700 | Norwich 01603 300196 | Plymouth 01752 472000 | Reading 0118 914 1788