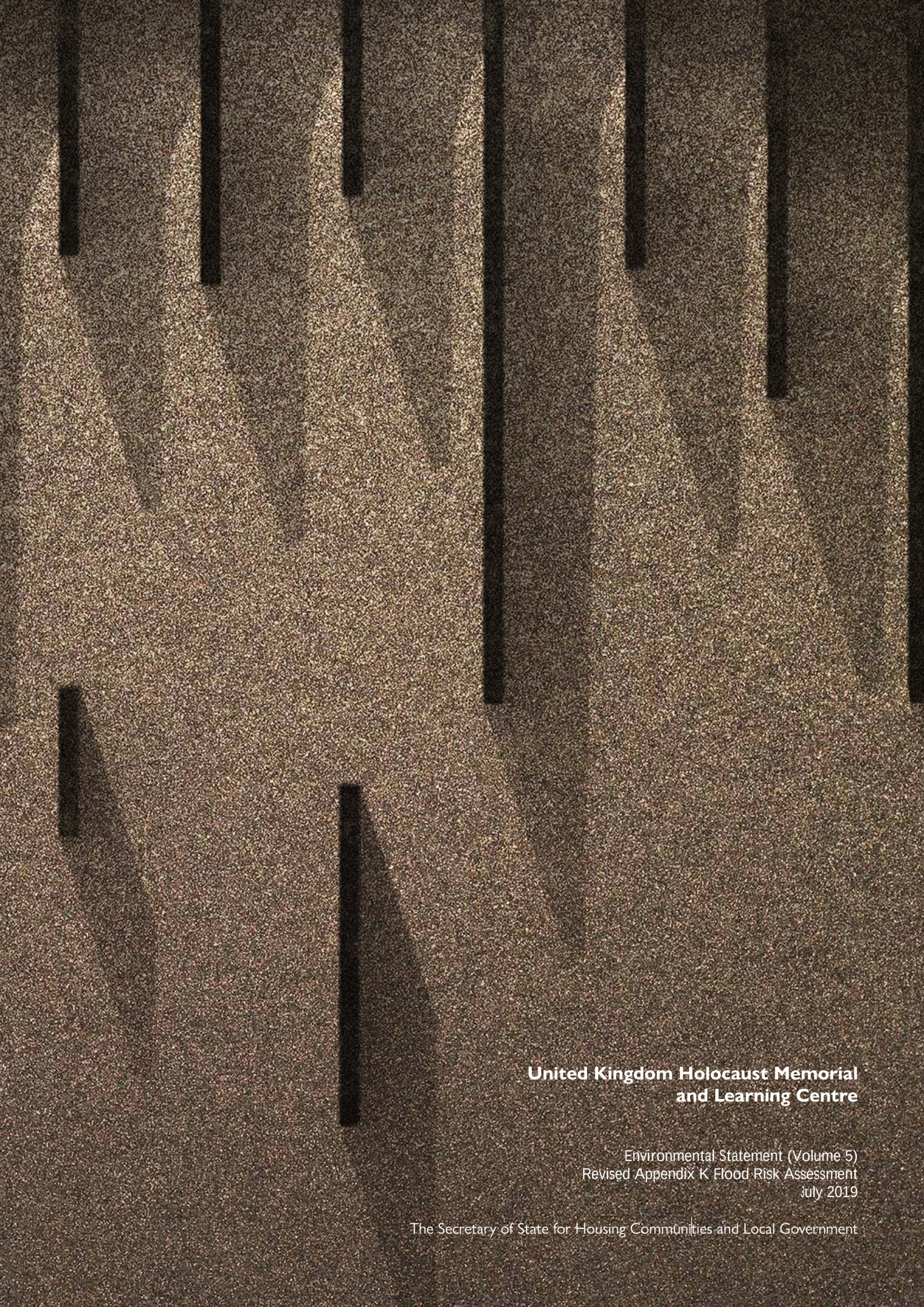

United Kingdom Holocaust Memorial and Learning Centre

Environmental Statement (Volume 5)
Revised Appendix K Flood Risk Assessment
July 2019

The Secretary of State for Housing Communities and Local Government

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Glossary of terms

Term	Description
ABD	Areas Benefitting from Defences
AEP	Annual Exceedance Probability
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
Flood Zone 1	Area with a low probability of flooding from either rivers or the sea (< 1 in 1,000 annual chance of flooding).
Flood Zone 2	Area with a medium probability of flooding from either rivers (1 in 100 – 1 in 1,000 annual chance of flooding) or the sea (1 in 200 – 1 in 1000 annual chance of flooding).
Flood Zone 3	Area with a high probability of flooding from either rivers (> 1 in 100 annual chance of flooding) or the sea (> 1 in 200 annual chance of flooding).
FRA	Flood Risk Assessment
Ha	Hectare
IDB	Internal Drainage Board
LiDAR	Light Detection and Ranging
mAOD	metres Above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water Management Plan
SoP	Standard of Protection
SuDS	Sustainable Drainage Systems
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water

Executive Summary

Site Name and Address	United Kingdom Holocaust Memorial and Learning Centre Victoria Tower Gardens, London

Grid Ref	TQ 30255 79119	Size	2.34ha

Current Use	Grade II listed garden Adjacent to Westminster World Heritage Site.	Proposed use	Stand Alone Memorial Including landscaping and above ground work, along with a below ground learning centre.

Flood Zone	3
Vulnerability class	Less Vulnerable
Is it compatible?	Yes

Application of the Sequential test.	*The Site allocated for the new Memorial and Learning Centre was selected on the recommendation of the UK Holocaust Memorial Foundation (UKHMF) as the Victoria Tower Gardens, adjacent to the Palace of Westminster, London. Following an extensive site search, Victoria Tower Gardens was recommended as a location primarily because of its proximity to Parliament. The Government recognised that the Memorial and Learning Centre should stand as a reminder of the role of Parliaments in legitimising the rise of Nazism in Germany and also explore the dilemmas and challenges faced by Britain's own Parliament before, during and in the aftermath of the Holocaust. The view of Parliament from the Memorial will serve as a reminder that decisions have consequences.* *After a carefully considered search for a suitable location, the cross-party UKHMF recommended Victoria Tower Gardens as the Site for the Holocaust Memorial and Learning Centre; owned by the Government and managed by Royal Parks, it has a central location engaging directly with Parliament, standing as a reminder of the role of democracy, at home and abroad, in both legitimising and challenging hatred, intolerance and prejudice.*

Exception test?	Choose an item.	*The proposed development requires completion of the Exception Test*

Overview Statement

Atkins Limited was commissioned to complete a Level 3 Flood Risk Assessment (FRA) to support the planning application and development at the chosen UK Holocaust Memorial Site in Victoria Tower Gardens, London. This document describes the proposed works, the flood risks at the site and the potential implications of this development in terms of flood risk. This document also identifies relevant planning policies (both national and local) and concludes with recommendations for the work to ensure that planning policy requirements are met.

1. Introduction

1.1. Background

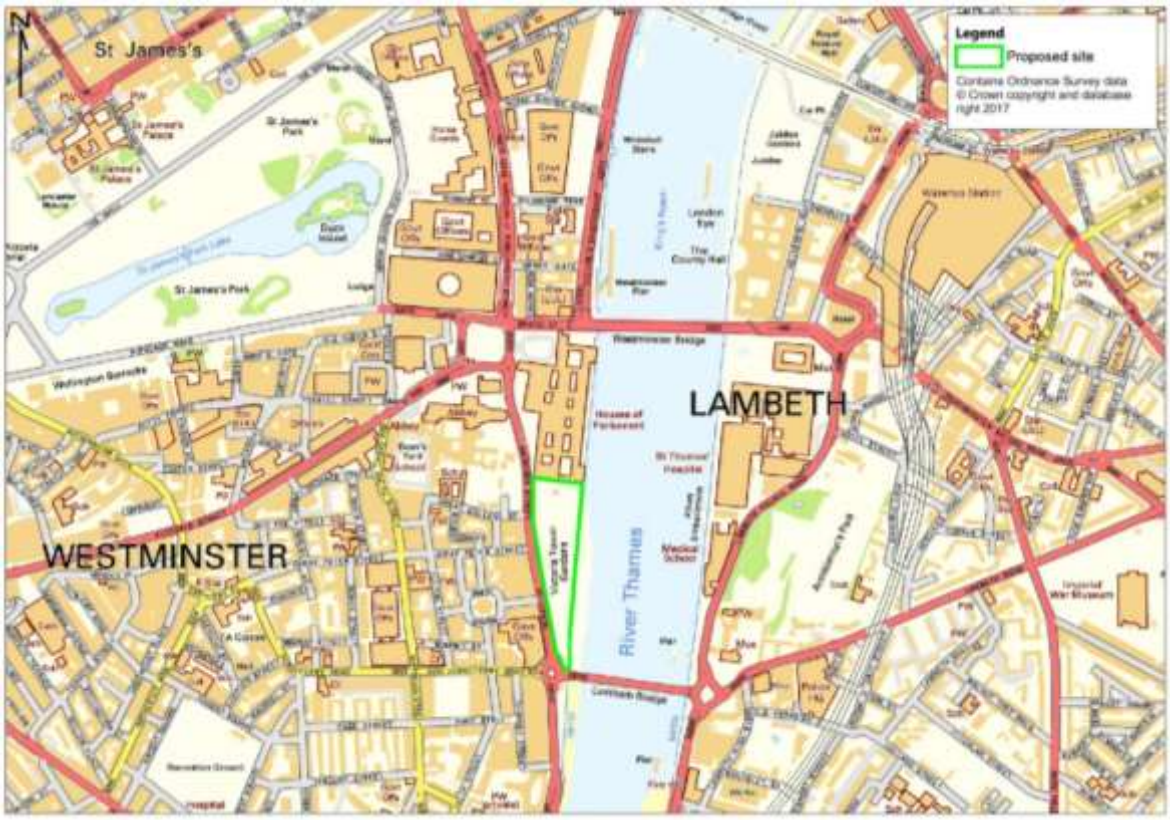
This flood risk assessment (FRA) report supports the application for planning permission for the UK Holocaust Memorial in Victoria Tower Gardens, London and should be read in conjunction with the suite of documents that accompany the application for planning permission. This FRA will be used to support the planning application being submitted to The City of Westminster and Greater London Authority. This report provides a quantitative assessment of the risks arising to the Site as a result of both its location and development proposals.

1.2. Site location

The Scheme location is in Victoria Tower Gardens, London, which is situated on the left bank of the River Thames immediately to the south of the Palace of Westminster, as illustrated in **Figure 1-1 Site Location**. Managed by The Royal Parks, Victoria Tower Gardens is a designated Grade II listed garden adjacent to the Westminster World Heritage Site.

The Site is bounded to the east by the River Thames (360 m frontage), designated a 'main river'. St James' Park Lake and The Serpentine (Hyde Park) are the only other waterbodies within the vicinity of the Site, situated approximately 600 m and 2.5 km north-west of Victoria Tower Gardens respectively. Five hidden rivers run through Westminster City, one of which, 'Long Ditch' is located underneath the northern end of the Site. These hidden rivers have been subsumed into the sewerage network (Westminster City Council, 2010).

Figure 1-1 Site Location



1.3. The Scheme

The proposed works are as follows: a stand-alone memorial, including landscaping and above ground work, along with a below ground learning centre (**Figure 1-2 Scheme taken from the UK Holocaust Public Exhibition Boards**). The position of the proposed memorial is to be centrally positioned in the gardens between the Burghers of Calais sculpture (north) and the Buxton Monument (south-east). Further scheme details can be found in Appendix A.

Figure 1-2 Scheme taken from the UK Holocaust Public Exhibition Boards

1.4. Previous Studies

The following flood risk studies have been completed relevant to this development site:

- United Kingdom Holocaust Memorial Level 1 Flood Risk Assessment (Atkins, 2017).

1.5. Assessing flood risks

A FRA should consider all types of flooding to satisfy the following three key objectives:

- to assess flood risk to the Scheme and to demonstrate that any residual risks to the development and its users would be acceptable;
- to assess the potential impact of the Scheme on flood risk elsewhere and to demonstrate that the development would not increase flood risk elsewhere; and,
- to satisfy the requirements of the National Planning Policy Framework (NPPF).

Flood risk should be considered alongside other spatial planning issues such as transport, housing, economic growth, natural resources, regeneration, biodiversity, the historic environment and the management of other hazards.

CIRIA C6241, from 2004, provides guidance on the implementation and good practice in assessing flood risks through the development process. The aim of C624 was to promote developments that are sustainable with regard to flood risk. The document recommends that a FRA should be undertaken in phases so that the type of development corresponds with the detail required.

[1] Lancaster, J.W., Preene, M. & Marshall, C.T. (2004) Development & Flood Risk – Guidance for the Construction Industry. CIRIA publication C624.

There are three levels of assessment:

- Level 1 FRA (Screening Study): To identify if there are any flooding issues related to a development site which may warrant further consideration. The screening study will ascertain whether a Level 2 or Level 3 FRA is required;
- Level 2 FRA (Scoping Study): Undertaken if a Level 1 study indicates that the site may lie within an area which is prone to flooding or that the site may increase flood risk due to increased runoff; and to confirm the possible sources of flooding which may affect the site. The Scoping Study will identify any residual risks that cannot easily be controlled and, if necessary will recommend that a Level 3 FRA is undertaken;
- Level 3 FRA (Detailed Study): Undertaken if the Level 2 study concludes that quantitative analysis is required to assess flood risk issues related to the development site. This may include detailed hydraulic modelling of rivers or drainage systems.

1.6. Scope and data

This report forms a Level 3 FRA. Hence this report provides a quantitative assessment of the risks arising to the Site as a result of both its location and development proposals, which seeks to address the following questions:

- Is the site likely to be at risk of flooding from: a watercourse, the sea, an estuary, groundwater, overland flow, an artificial drainage system, infrastructure failure?
- Is the proposed development likely to obstruct the maintenance access requirements or affect the integrity of an existing flood defence?
- Is the Scheme likely to increase flood risk elsewhere due to increased runoff rates and volumes from the site?
- Given the above and the nature of the development, is continued promotion of a possible development at the site appropriate?

This Level 3 FRA is a detailed study which determines whether there are any flood risk issues related to the development that may warrant further assessment and what the impacts would be. At this stage of assessment consultation with the Environment Agency has been undertaken to ascertain their requirements and data available to inform this assessment. The EA state there is a requirement for a minimum 16m setback from the flood defence wall. “If a minimum of 16m setback is not possible we would expect the applicant to submit evidence to demonstrate that any flood walls/defences are in good enough condition to protect the Scheme for its lifetime. This should be submitted in the form of a survey and should include and assessment of any remedial works or flood defence replacement options”.

A riverwall visual condition survey was conduct by WSP UK Limited in 2018 (Appendix G). The visible sections of the river wall are generally considered to be good condition (rating 2), with localised defects of a fair condition (rating 3) which require maintenance within the next 2 years. Based on the visual inspection the report recommends maintenance measures alongside future monitoring and inspection works. This scheme does not impact upon the existing wall, the ability for it to be raised in the future nor does it impede access and therefore it is recommended that maintenance is undertaken in line with its current regime. However, the EA has stated that they have no plans for maintenance of the riverwall at this location at present..

A ground movement assessment was carried out by WSP UK Limited in May 2019 (Appendix H) to assess any additional surcharge loading on the existing wall as a result of the proposed buildings and to demonstrate that the basement and the café will not destabilise the existing or future raised wall. The report concluded that “the resulting increase in wall height results in a very limited (<1.0 kPa) increase in soil bearing pressure and as such no further assessment is required” (WSP UK Limited, 2019). The Vertical movement and horizontal strain are also considered to be low and it “is not anticipated to cause any deterioration in the condition of the wall” (WSP UK Limited, 2019).

The riverwall will be monitored during the development works to confirm the above predictions in line with the ground movement assessment and monitoring strategy (WSP UK Limited, 2019).

The development shown in Appendix A, on the whole meets the requirement for a minimum 16 m setback from the flood defence. However, the current existing toilet block and the new above ground café area may need foundations within the 16 m setback. It has been confirmed that no pilings will be required for this structure and that the café will sit on a raft circa 300 to 350 mm thick

(WSP UK Limited, 2018). There is a raised seating area adjacent to the riverwall, however this is demountable and can be removed if access or works to the wall need to be undertaken. Drawings of the seating are shown in Appendix A. The proposed site plan in Appendix I show the vehicle access from the road for future wall maintenance and wall raising works to take place. The existing accesses to the current site will not be altered by the proposed development.

The report has been completed in line with the National Planning Policy Framework (NPPF) and makes use of readily available information from the following sources:

- Environment Agency Spatial Data Catalogue (Environment Agency, 2016a)
- Site information and development proposal plans provided by the design team;
- Geology information from the Geology of Britain online viewer (British Geological Survey, 2017);
- Publicly available information on the Environment Agency website (Environment Agency, 2017);
- Product 4 (Detailed Flood Risk) for Beckton DLR: Reference: HNL102743JH (Environment Agency, 2018);
- Information and data available from The City of Westminster and the Greater London Authority (full reference list available at the end of this document);
- TE2100 Plan: Managing Flood Risk through London and the Thames Estuary (Environment Agency, 2012)
- UK Holocaust Memorial and Learning Centre Outline Drainage Strategy Report (WSP UK Limited, 2018);
- UK Holocaust Memorial Public Exhibition Boards (UK Holocaust Memorial Foundation, 2018);
- Riverwall Visual Condition Survey: UK National Holocaust Memorial and Learning Centre (WSP UK Limited, 2018);
- Holocaust Mermorial, Westminster, Ground Movement Assessment and Monitoring Strategy (WSP UK Limited, 2019)
- UK Holocaust Memorial Foundation, United Kingdom Holocaust Memorial and Learning Centre Ground Movement Assessment -Thames Riverwall (WSP UK Limited, 2019)

2. Assessment of flood risk

The NPPF states that all types of flooding should be considered in the development framework. The extent to which these should be considered will vary and depends on whether they are considered as significant at the spatial planning scale, and in setting constraints on development in certain areas. This section of the report assesses the risk of flooding to the Scheme and identifies those sources of flooding that require further consideration.

2.1. Data quality score

The quality and confidence in the data used to assess flood risk for a given site is a key consideration in a FRA. Where data is not considered to be robust, or where significant uncertainty exists, further analysis and study may be required. The approach to scoring data quality is displayed in the table below.

Table 2-1 Data quality score approach (Table 3.6 in the Multi-Coloured Manual, 2013)

Data Quality Score	Description	Explanation
1	Best of breed	No better available; unlikely to be improved soon.
2	Data with known deficiencies	To be replaced as soon as third parties re-issue.
3	Gross assumptions	Not invented but deduced by the project team from experience or related literature/data sources.

4	Heroic assumptions	No data sources available or yet found; data based on educated guesses.

2.2. Existing site topography

The key features of the Site topography as outlined in drainage strategy (WSP UK Limited, 2018) are as follows, and are shown in the figure below:

- The minimum ground level on the Scheme Site is 4.23 mAOD;
- The maximum ground level on the Scheme Site is 5.04 mAOD; and
- The maximum difference in ground levels on the Scheme Site is 0.81 m.

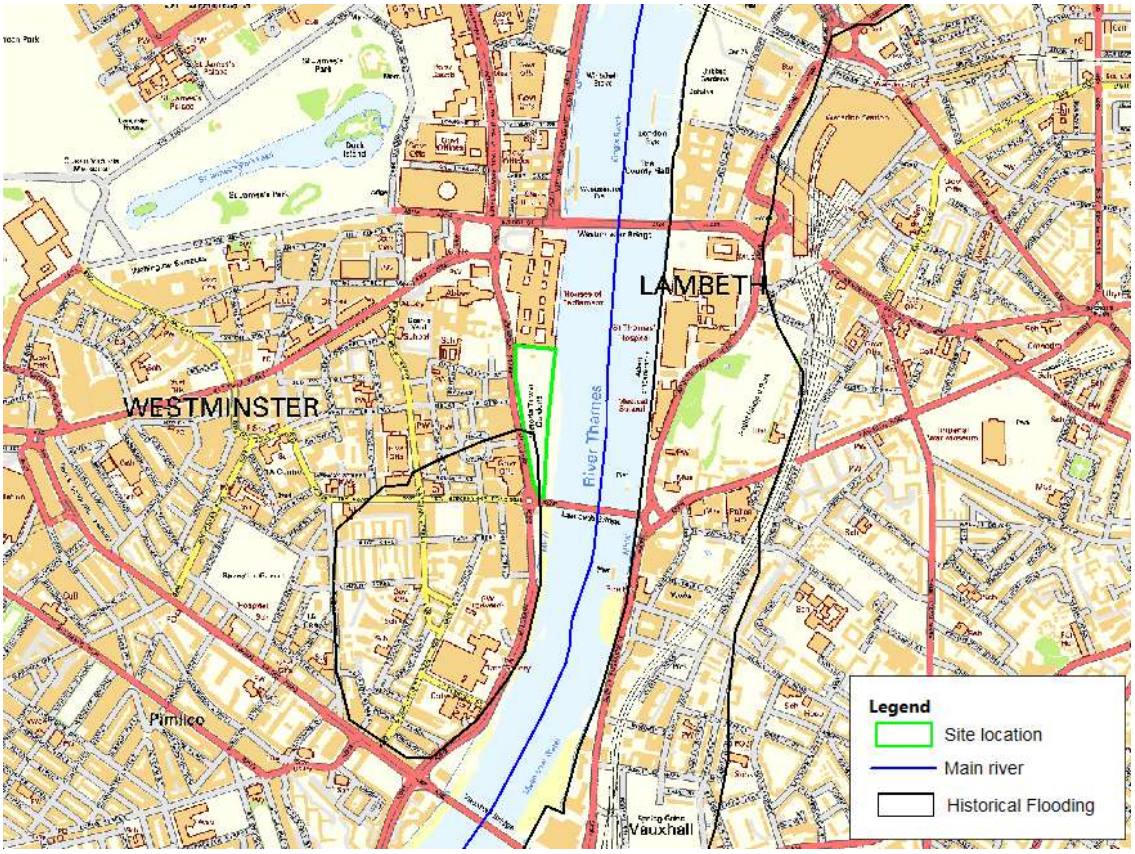
2.3. History of flooding

Past evidence of flooding at or near the Site helps to reinforce flood risk information provided by the Risk Management Authorities (RMAs). For example, the fact that a site has been reported to have flooded twice in the last 50 years, even if the actual flood levels and flows are unknown, is useful and can be used as a broad 'sensibility' check on any modelling results.

The Environment Agency hold a GIS dataset containing historic flood risk information, this dataset has been interrogated to establish if the Scheme Site has been identified as flooding in the past.

Figure 2-1 shows the historic flood risk for the UK Holocaust Memorial Site. Only the southern section of the Site is partially within the historic flood risk area. However, confidence in this data can be considered low due to the hand drawing of the records and the true extent of the data being limited.

Figure 2-1 Environment Agency's Historical Flood Risk Outline



The Site is partially inside the Environment Agency's historic flood risk outline

Data quality assessment

The assessment has indicated that the data quality score for this flood risk source is 3. The confidence in this data source is therefore relatively low and unlikely to be improved due to lack of historical data.

2.4. Flooding from rivers

Flooding from rivers (fluvial flooding) occurs following exceedance of the flow capacity of river channels, leading to overtopping of the river banks and inundation of the surrounding land.

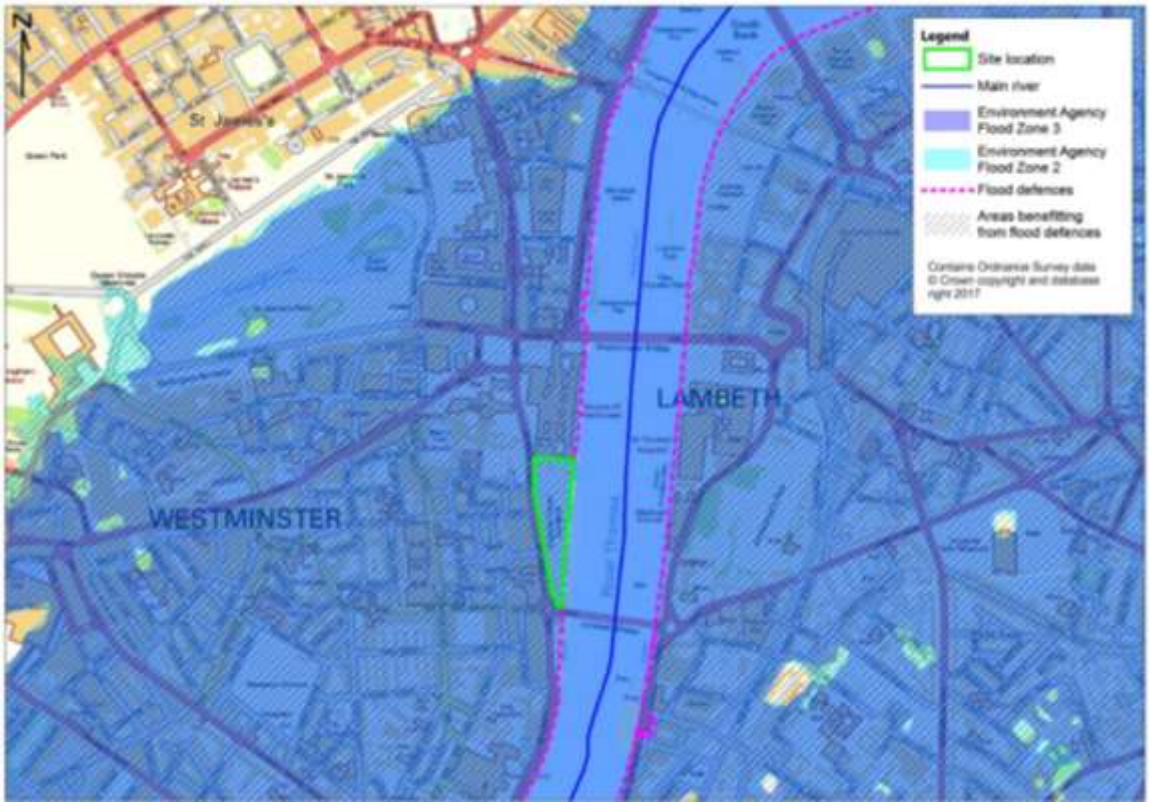
The Environment Agency Flood Map for Planning identifies the probability of river and sea flooding, ignoring the presence of defences. Flood Zone 1 has the lowest probability of flooding from the rivers or sea, whereas Flood Zone 3b has the highest probability of flooding.

The Site is identified (Environment Agency, 2017) as being located in Flood Zone 3, with a ≥ 1 in 100 (1%) annual probability of fluvial flooding or ≥ 1 in 200 (0.5%) annual probability of tidal flooding (see

Figure 2-2). It is usual, for planning purposes, to subdivide Flood Zone 3 into 3a and 3b of areas below and above a 1 in 20 (5%) annual probability of flooding, respectively. However, given the presence of extensive flood defences on the River Thames that provide protection in excess of a 1 in 1000 (0.1%) annual probability event, the Site is simply referred to as being in Flood Zone 3, as is consistent with the SFRA.

Although this flood risk is related to flooding from the River Thames, the river in this location is tidal and hence the flood risk is considered to have a tidal source and not a fluvial one. Risk of fluvial flooding is much lower (Westminster City Council, 2010) and is adequately managed by the flood defences described in the “Tidal Flooding” section below. Therefore, the risk of flooding from a fluvial source is not considered significant and does not need further assessment.

Figure 2-2 Environment Agency Flood Zones



Environment Agency Flood Zone 3: locations which have a 1 in 200 (0.5%) or greater annual probability of tidal flooding. Environment Agency Flood Zone 2: locations which have between a 1 in 200 (0.5%) and 1 in 1,000 (0.1%) annual probability of tidal flooding.

The Scheme is within 600m of a Main River or Ordinary watercourse.

The Scheme is within 600m of flood defences.

The Scheme is in Environment Agency Flood Zone 3 and an area benefiting from flood defences

Data quality assessment

The assessment has indicated that the data quality score for this flood risk source is 1. The confidence in this data source is therefore high and unlikely to be improved soon and no further analysis is required to refine this data.

2.5. Flooding from the sea

Inundation by high tides, storm surges and waves along coastal regions is described as coastal flooding. The propagation of high tides and storm surges up estuarine channels can lead to overtopping of the river banks and inundation of the surrounding land. This is referred to as tidal flooding.

The Site is identified (Environment Agency, 2017) as being located in Flood Zone 3, with a high probability (≥ 1 in 200 (0.5%) annual event) of tidal flooding. However, the Environment Agency Flood Zones are allocated assuming no presence of flood defences. The River Thames has extensive defences (including the Thames Barrier, flood defence walls, embankments, and gates) and the actual level of protection against flooding is extremely high.

The Strategic Flood Risk Assessment (SFRA) (Westminster City Council, 2010) discusses the residual risk of tidal flooding, highlighting that the Embankment wall is the most significant defence for the borough and the risk of overtopping is extremely low. Therefore, residual risk is only considered to relate to a breach of the Embankment wall.

The Environment Agency commissioned a study (Halcrow Group Limited, 2008) to model the impact of flooding if such a breach was to occur with mapped model results reported in the SFRA.

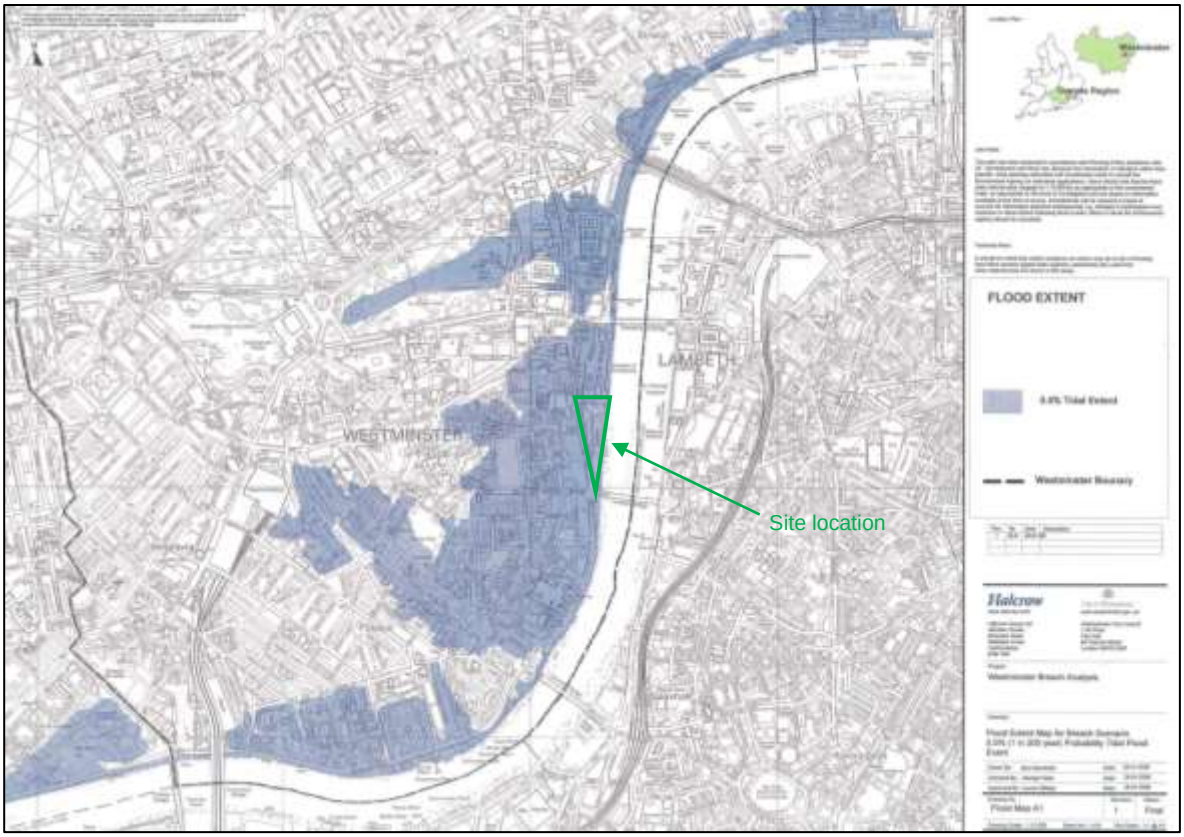
Figure 2-3 shows that the Site is located within the area modelled to flood in a 1 in 200 (0.5%) annual probability event with defence breach. Furthermore,

Figure 2-4 shows that the Site is also within the rapid inundation zone predicted to flood within 30 minutes of defence breach. Flood risk product 4 (Appendix B) has been obtained from the Environment Agency and confirms this analysis.

The Environment Agency provided updated breach maps on 31st October 2018 (Appendix B) which is considered to be up to date and accurate breach information, confirms that the Site is at risk in a breach scenario. The current 2014 flood hazard map for the 1 in 1000 (0.1%) annual probability event shows the majority of the Site flooding up to a depth of <0.25 m with the eastern side of the Site flooding to a depth of <1 m (

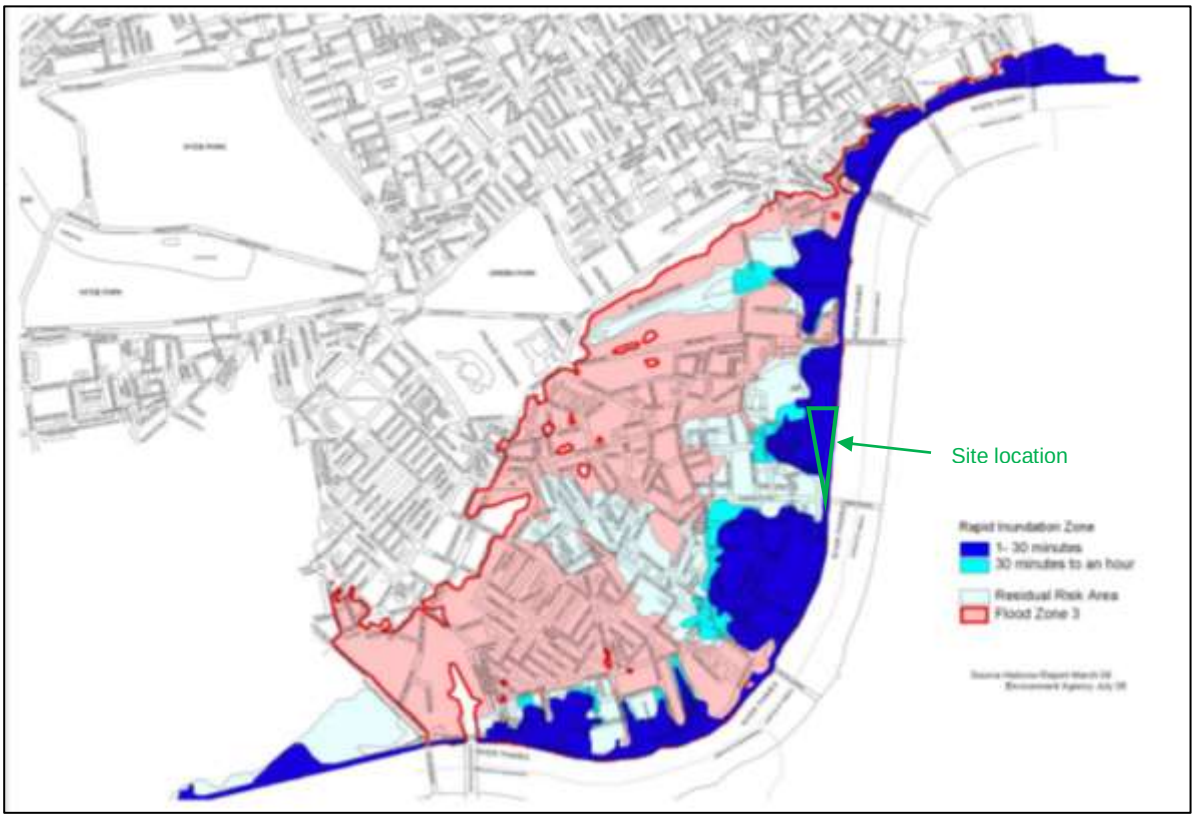
Figure 2-5). The flood hazard level for the 2100, 1 in 1000 (0.1%) annual probability event ranges from “Low” up to the “Danger for Most” category. The development is unlikely to have an impact on the hazard category.

Figure 2-3 1 in 200 (0.5%) annual probability tidal flood extent map with defence breach



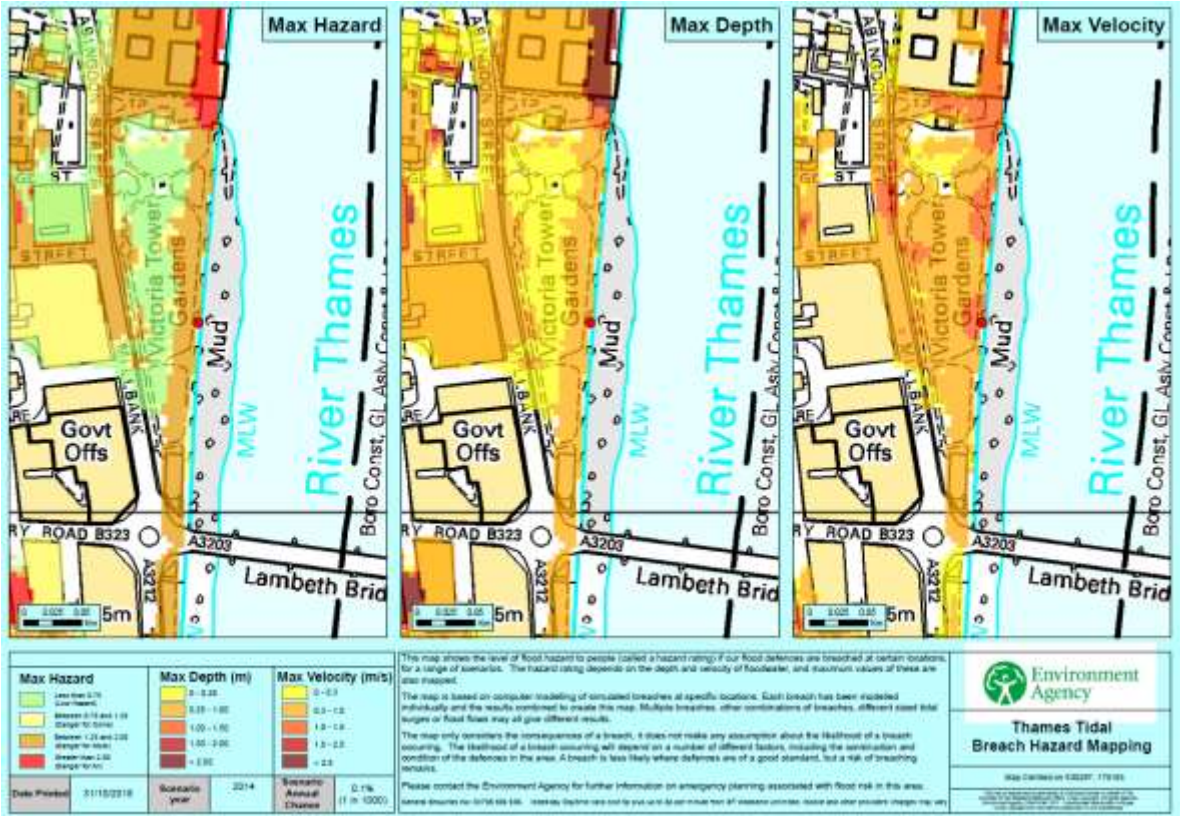
Extract of Flood Extent map from Halcrow Report Appendix A (Halcrow Group Limited, 2008)

Figure 2-4 Rapid inundation zone during a 1 in 200 (0.5%) annual probability breach event



Extract from Map 7 in the SFRA (Westminster City Council, 2010)

Figure 2-5 Thames Tidal Breach Hazard Mapping (1 in 1000. 0.1%, 2014 Scenario)



The Scheme lies between Lambeth Bridge and Westminster Bridge, adjacent to the section of critical defence. To reduce the likelihood of breach and associated flood risk, Halcrow made the following recommendations:

- In addition to regular structural surveys carried out along the whole Westminster tidal defence, more emphasis should be paid to the structural condition of tidal defences along the four critical reaches.
- Priority funding should be given to the maintenance of the tidal defences along the critical reaches.
- Proposed new development or changes in land use within the tidal flood extent should pass the Exception Test reported as part of a detailed FRA that considers all flood mechanisms.
- Proposed developments within areas at risk of tidal breach flooding should consider various flood resilient measures.
- A robust evacuation plan should be implemented for all proposed development within the tidal flood extent, especially if the land use is within the rapid inundation zone (> 30 minutes).

The Environment Agency's pre-application response (Appendix C) also suggests that realistic flood mitigation measures and the required level of refuge are determined based on estimated flood depths at the Site in the event of a breach. Should there be a breach in the riverwall flood defence, rapid inundation of the Holocaust Memorial Learning Centre basement areas would occur and a detailed evacuation procedure is recommended to ensure early evacuation of the basement area prior to any breach. This should be informed by the Environment Agency Flood Warning System. It is anticipated that an evacuation route would be possible via the higher land south of the site and heading west on Horseferry Road, which has not been modelled to flood in a breach event.

The current Statutory Flood Defence Crest Level in this reach of the River Thames is 5.41 mAOD with an actual current defence crest level of 5.81 m AOD (WSP UK Limited, 2018). According to the TE2100 plan the Statutory Flood Defence Crest Level will increase to 5.85 m AODN by 2065 and 6.35 mAODN by 2100. The TE2100 plan outlines that sea level rise is a factor that will impact the flood defences. However, the Environment Agency states that they are confident the TE2100 plan can cope with the changing climate and sea level rise and can improve the existing defence

system to manage flood risk on the Thames. The timing of defence raising will depend on the rate of sea level rise.

Technical drawings of the flood defence structures have been requested and received from the Environment Agency. These are provided in Appendix D and should be used during design and when determining the construction methodology to ensure that construction does not adversely impact the stability of the Embankment wall or reduce access for future maintenance and / or defence raising.

The Site is located within a potential tidal breach flooding area of the Thames estuary and at a level of 4.23 mAOD and is therefore at risk of flooding from the sea ((WSP UK Limited, 2018).

The Scheme is within a Flood Zone associated with tidal flooding

Data quality assessment

The assessment has indicated that the data quality score for this flood risk source is 1. The confidence in this data source is therefore high and unlikely to be improved soon and no further analysis is required to refine this data.

2.6. Flooding from groundwater

Emergence of groundwater at the surface (and subsequent overland flows) or into subsurface voids as a result of abnormally high groundwater levels is referred to as groundwater flooding. This can have a direct impact on buildings and buried services, as well as an indirect impact by increasing infiltration of groundwater into sewers and soakaways (reducing their capacity to convey surface water runoff).

Groundwater flood risk has been assessed using the BGS susceptibility of groundwater flooding map. In general, Westminster sits above a regional chalk aquifer covered with gravels and clay (Westminster City Council, 2010). Chalk shows some of the largest seasonal variations in groundwater levels and is the most extensive source of groundwater. The groundwater level in London is being addressed by the General Aquifer Research Development and Investigation Team and through increased abstraction of groundwater, notably by Thames Water. Thames Water is opening 20 or more new pumping stations to extract groundwater to ensure the stability of water levels. With these management strategies in place the SFRA concludes that “flooding from rising groundwater is not considered to be a major problem in Westminster, however the current situation will be kept under review” (Westminster City Council, 2010).

The underlying bedrock geology at the Site is the London Clay Formation. Superficial deposits of Alluvium overlay the London Clay across the majority of the Site, except in the north-west corner where deposits of the Kempton Park Gravel Formation are found (British Geological Survey, 2017).

At the Scheme Site, The London Clay Formation forms the bedrock geology and Alluvium the main superficial deposit (British Geological Survey, 2017). These are both impermeable so will not transport groundwater, posing no risk to groundwater flooding. The Kempton Park Gravel Formation present in the north-west corner of the Site is a permeable layer and so could store and convey groundwater; however, its extent is very minor on this Site. Given very low levels of groundwater at the site, climate change is not anticipated to have any effect on the risk of groundwater flooding.

Design of the below ground element of this development should consider potential impact to groundwater and ensure no adverse effects are caused – particularly where the development extends into the north-west corner of the Site. With these measures in place, it is considered that groundwater flood risk to and from the Scheme is not significant and does not need further assessment.

The Scheme is not at risk from groundwater flooding

Data quality assessment

The assessment has indicated that the data quality score for this flood risk source is 1. The confidence in this data source is therefore high and unlikely to be improved soon and no further analysis is required to refine this data.

2.7. Flooding from surface water

Surface water flooding (sometimes referred to as pluvial flooding) can be caused by overland flow / runoff, and includes water flowing over the ground that has not reached a natural or artificial drainage channel. This can occur when intense rainfall exceeds the infiltration capacity of the ground because rainfall has fallen on ground so highly saturated that it cannot accept any more water.

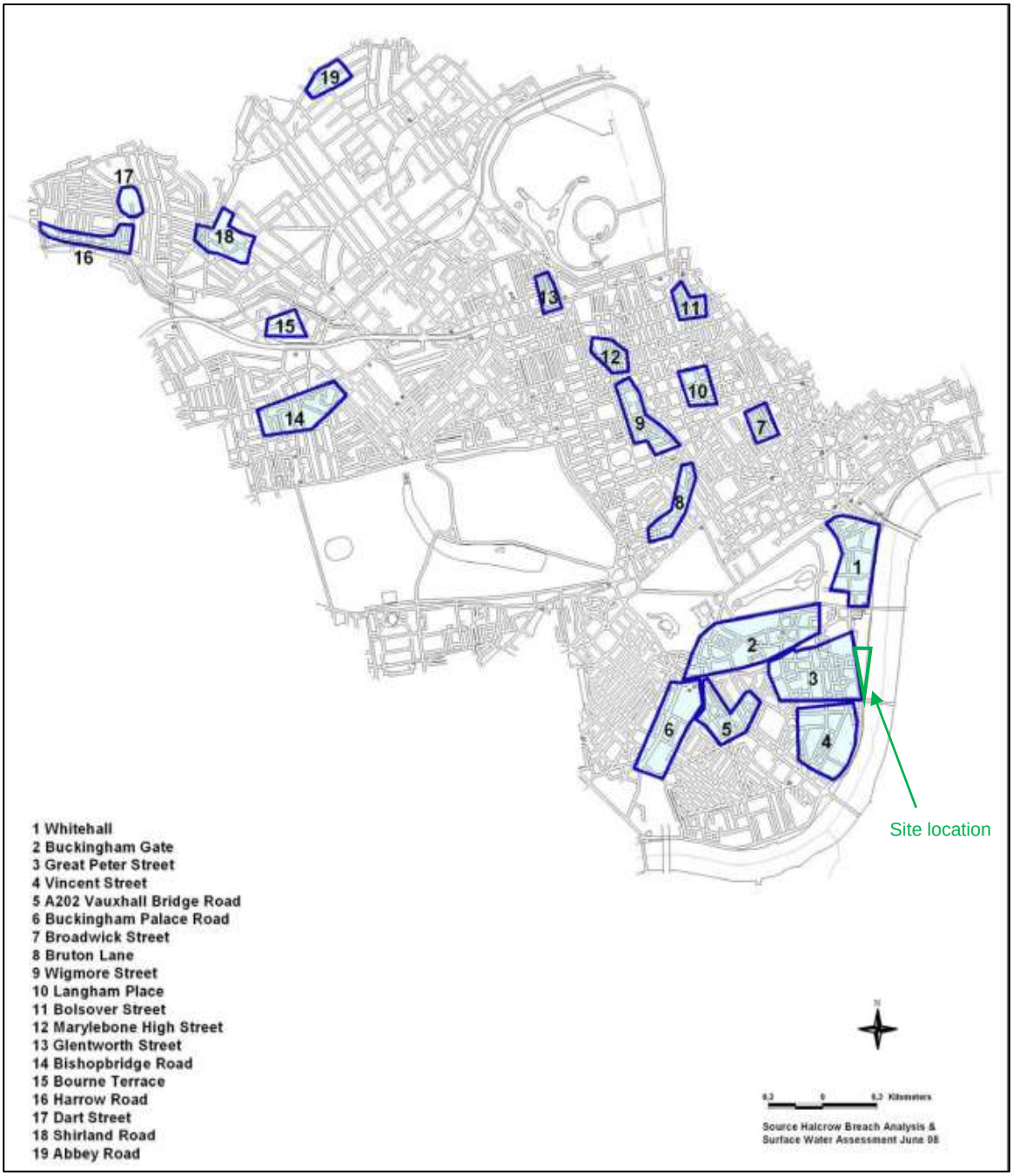
Surface water flooding can also be caused when intense rainfall exceeds the surface water drainage capacity in an urban area, such that ponding and overland flow occurs. This can also be referred to as surface water sewer flooding. Surface water flooding can be caused by water originating from either on-site or from adjacent sites.

Westminster City Council commissioned a surface water flooding hydraulic study (Halcrow Group Limited, 2008). The results of this study identified 19 areas as 'Critical Surface Water Flood Locations' due to depth or frequency with which they are expected to flood, as illustrated onFigure 2-6. While the development Site is not located within a Critical Surface Water Flood Location, it is adjacent to Location 3 (Great Peter Street).

The Site is also identified as being at low risk of surface water flooding on the Environment Agency Risk of Flooding from Surface Water maps (RoFSW) (Environment Agency, 2017), with an annual probability of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%) and flood depths below 300 mm (Figure 2-7).

Again, the impact of climate change on the risk of surface water flooding should be considered and appropriate mitigation taken. The potential increase in peak rainfall intensity for small, urban catchments is 40% for the upper end and 20% for the central allowance of the '2080's scenario (Environment Agency, 2017). The outline drainage strategy (WSP UK Limited, 2018) has demonstrated that the Site can accommodate surface water run-off during all events up to and including the 1 in 100 (1%) plus the upper end climate change allowance.

Figure 2-6 Critical Surface Water Flood Locations



Extract from Map 9 in the SFRA (Westminster City Council, 2010) taken from the Halcrow Breach Analysis & Surface Water Assessment (2008)

Figure 2-7 Risk of Flooding from Surface Water maps (RoFSW) (Environment Agency, 2017), with an annual probability of flooding between 1 in 1,000 (0.1%)

The Scheme is at low risk from surface water flooding and isn't in a Critical Drainage Area

Given the Site's current land use as gardens, the Scheme is likely to result in an increase in impermeable area. If unmitigated, this will increase the rate and volume of surface water run-off, increasing the risk of surface water flooding both on the Site and potentially in surrounding areas. As a consequence, it is proposed in the outline drainage strategy (WSP UK Limited, 2018) that as part of the Site's re-development, surface water will be managed to drain the proposed landscape areas of the surrounding footpaths via a combination of ways. The area has been divided into 5 catchments. Details of how surface water will be drained for each catchment is detailed in Table 2-2.

Table 2-2 Proposed surface water drainage for 5 catchments within the Site

Catchment	Catchment Area (m^2)	Catchment Description	Proposed Surface Water Drainage
1	1217	Landscaped areas with no basement extent	A minimum 75m trench drain to mitigate surface water flow at the lowest point across this catchment to ensure water is drained and ponding is minimised on site.

Catchment	Catchment Area (m^2)	Catchment Description	Proposed Surface Water Drainage
2	778	The courtyard area	Proposed to discharge around the perimeter to the permeable paving being provided, given the low infiltration rate it is proposed that any permeable paving will have a high level overflow to the River Thames. Levels that fall below the permeable paving external areas will need to be pumped directly to the River Thames and although not ideal in terms of sustainability, it is expected that this will be minimal.
3	2945	Landscaped areas above the basement slab	Some form of permavoid (or similar) product will be used above the basement slab to convey water away from the basement extent as well as provide suitable attenuation. This will then drain directly into the natural geology as the Site currently does. The proposed 2945m2 permavoid within 150m depth, will provided 420m3 of storage for attenuated flows. It is proposed that the permavoid will slope through the perimeter of the basement and drain into the natural geology by a series of perforated pipes. It will mimic the natural drainage previously for this park area.
4	1439	Landscaped areas with no basement extent.	A minimum 60m trench drain to mitigate surface water flow at the lowest point across this catchment to ensure ponding is minimised on site. Following the SuDS manual, it is proposed a filter strip 1.5 m depth by 0.65 m width.
5	3920	Landscaped areas with no basement extent.	A minimum 75m trench drain to mitigate surface water flow at the lowest point across this catchment to ensure ponding is minimised on site. Following the SuDS manual, it is proposed a filter strip 1.5 m depth by 0.50 m width.

The Scheme Site is greenfield and the increase in impermeable area will need to be managed through the application of SuDS.

Data quality assessment

The assessment has indicated that the data quality score for this flood risk source is 2. The confidence in this data source is therefore high and unlikely to be improved soon and no further analysis is required to refine this data.

The Scheme should consider using the following SuDS Infiltration

2.8. Flooding from sewers

Flooding from sewers (open or culverted) is caused by exceedance of sewer capacity and / or a blockage in the sewer network. In areas with a combined sewer network system there is a risk that land and infrastructure could be flooded with contaminated water. In cases where a separate sewer network is in place, sites are not sensitive to flooding from the foul sewer system.

Sewer flooding has been assessed for the outline drainage strategy report (WSP UK Limited, 2018). The existing Site has no current foul water flows

The local area is served by a Thames Water combined sewer system; a network of pipes which receive both foul and surface water and convey this in a northerly direction away from the Site under Millbank (A3212) and Abington Street.

Westminster is also served by a series of overflow outlets that transport excess water and sewerage from the combined sewers into the River Thames during periods of heavy rainfall. This network helps to reduce the risk of sewer flooding due to exceedance of capacity. There are two storm overflow sewers which cross the Site: one approximately 130 m south of the northern Site boundary, and the other in the southern-most corner. These sewers convey flow in an easterly directly before outfall to the River Thames.

The SFRA (Westminster City Council, 2010) provides information on historic sewer flood incidents in Westminster; fewer than 10 incidents were recorded by Thames Water within the SW1 postcode from 2000-2010.

The London Regional Flood Risk Appraisal (Greater London Authority, 2014) advises that foul sewer flooding occurs where sewers become blocked or overloaded and properties connected to the sewer system are located at a level below the hydraulic level of the sewage flow. These are often basement flats or premises in low lying areas. The Scheme includes a below-ground learning centre.

The installation of new sanitary fittings from this development will also increase the foul flow discharge in the area. Thames Water (Thames Water, 2017) advise that each development is assessed to ensure that discharge capacity exists or can be provided, without causing an increase in the risk of flooding. The proposed flow rates outlined in the drainage strategy have been calculated in accordance with the guidance from Thames Water (TW). The Scheme will function similar to that of a shopping centre in terms of foul water discharge with a peak flow rate of 2.03 l/s and will connect to the Thames Water sewer within Millbank. Thames Water have been consulted on the peak flow rate for a capacity check for the Site but WSP still await a response. The FRA will be updated accordingly once this confirmation is received.

The Scheme is at low risk from sewer flooding

Data quality assessment

The assessment has indicated that the data quality score for this flood risk source is 2. The confidence in this data source is therefore awaiting approval from Thames Water and will be replaced as soon as third parties re-issue.

2.9. Flooding from other sources

The following other sources of flood risk have been assessed:

- Reservoir flooding using the Environment Agency risk of flooding from reservoirs outlines;
- Failure of canal infrastructure via distance from nearest canal; and
- Breaching of defences through distance from a flood defence structure and the Areas Benefitting from Defence dataset.

The Serpentine and St James's Park, located 2.5 km and 810 m north-west of the Site respectively, are the remnants of the 'hidden' rivers in Westminster. The Serpentine falls under the Reservoirs Act 1975 and may pose a risk of flooding if breached (Westminster City Council, 2010). The "Risk of flooding from reservoirs" map, produced by the Environment Agency indicates that the Site is at low

risk of flooding should reservoirs overtop or breach. The stringent design, inspection and maintenance requirements of the Reservoirs Act (1975) results in the risk of overtopping and / or breach (and thus flooding of the Site) being considered as very low.

The Grand Union and Regent's Canals are located over 4 km north-west of the Site. The Canal & River Trust undertake an inspection and maintenance regime to manage their assets, canal water levels and ensure a low level of flood risk. There are no known records of these canals flooding in the Westminster region. Furthermore, the SFRA (Westminster City Council, 2010) states that these canals "present minimal flood risk as they have limited surface water inputs and none of the canals to our knowledge are on embankments".

The other source of flood risk is a burst water main, which could occur at any time and have a serious impact on the local area. Within the SW1 postcode, 48 burst water mains incidents have been recorded by Thames Water between 2003-2007 (Westminster City Council, 2010). Thames Water are undertaking a programme of work to reduce this risk of flooding.

There are no other known sources of significant flood risk at this Site and it is not anticipated that climate change with have a substantial effect on these factors; therefore, further assessment is not required.

The Scheme is 4 km away from a canal
The Scheme is within 20 m of a flood defence structure
The Scheme is within an Area Benefiting from Defence
The Scheme is outside the reservoir failure flood outlines

Data quality assessment

The assessment has indicated that the data quality score for this flood risk source is 1. The confidence in this data source is therefore high and unlikely to be improved soon and no further analysis is required to refine this data.

3. Flood risk policy

This section outlines flood risk planning policy and guidance, with further detail provided in Appendix B.

3.1. National planning policy overview

The Government published the NPPF in 2012 and revised in 2018 (Communities and Local Government, 2018). This is accompanied by the NPPF Planning Practice Guidance – Flood Risk and Coastal Change (Communities and Local Government, 2014). The NPPF aims to ensure that flood risk is taken into account by all relevant statutory bodies to avoid inappropriate development in areas at risk of flooding and through the Sequential Test, directing development away from areas of highest risk. Where new development is necessary in such areas, Government policy aims to make it safe, without increasing flood risk elsewhere and, where possible, to reduce overall flood risk.

Table 2 in the NPPF flood risk Planning Practice Guidance contains a classification of development types according to vulnerability to flooding. These classifications are used when determining whether the location (in terms of Flood Zone) is appropriate for the proposed scheme. Non-residential buildings intended for community use, such as museums, are classified as “Less Vulnerable” developments. This classification has been given to the Scheme and was confirmed by the Environment Agency (phone conversation with Edward Crome 06/04/2017).

The NPPF (Ministry of Housing, Communities and Local Government, 2018) also sets out the requirements for submission of FRAs with planning applications for sites located in Flood Zone 2 and 3 and those greater than 1 hectare in size. Given the location of this Site in Flood Zone 3, these requirements will need to be met in the Level 3 FRA submitted with the planning application for this development.

In April 2015 the Non-Statutory Technical Standards for Sustainable Drainage Systems (Defra, 2015) was published and should be used in conjunction with the NPPF and Planning Practice Guidance, particularly when preparing the drainage strategy.

The Environment Agency’s response (Appendix C, 06/04/2017) highlights that under the requirements of the Environmental Permitting Regulations (Secretary of State, 2010), a Flood Risk Activity Permit from the Environment Agency is required for any proposed works within 16 metres of the top of the bank of the River Thames. Given the location of the Site, bounded by the River Thames, it is assumed that a Flood Risk Activity Permit from the Environment Agency will be required before works on site can commence. The works are predominately not within 16 metres of the top of the bank of the River Thames however, the location of the new proposed café is within the 16 m setback and further discussion is needed as to whether an activity permit from the Environment Agency is required.

3.2. Flood Zones and Vulnerability Classification

The Environment Agency’s Flood Map is divided into three separate Flood Zones. These Flood Zones are used by NPPF in determining the appropriateness of proposed developments when considering flood risk through the application of the Sequential Test. They represent the probability of flooding without flood defences in place. The Flood Zones are defined in Table 3-1.

Table 3-1 Definitions of Environment Agency flood zones

Flood Zone	Definition
Flood Zone 1: Low Probability	Land where the annual chance of flooding is lower than 0.1% for either fluvial or sea flooding.
Flood Zone 2: Medium Probability	Land where the annual chance of flooding is between 0.1 and 1.0% for fluvial flooding. Or, land where the annual chance of flooding is between 0.1 and 0.5% for flooding from the sea.
Flood Zone 3a: High Probability	Land where the annual chance of flooding is 1.0% or greater for fluvial flooding. Or, land where the annual chance of flooding is 0.5% or greater for flooding from the sea
Flood Zone 3b: Functional Floodplain	Land where water has to flow or be stored in times of flooding. Local planning authorities identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

The Environment Agency's Flood Map also defines Areas Benefitting from Defences (ABDs) within Flood Zone 3, however this category is not expressly determined within NPPF or the Sequential Test process.

NPPF provides guidance on assessing the vulnerability of land uses in relation to flood risk and classifies new developments into one of five categories:

- Essential Infrastructure;
- Water Compatible;
- Less Vulnerable;
- More Vulnerable; and
- Highly Vulnerable.

The Scheme is considered by this FRA to be classified as Less Vulnerable

3.3. Compatibility

The table below sets out the NPPF flood risk vulnerability and flood zone compatibility assessment, as taken from Table 3 of the NPPF Planning Practice Guidance. The table indicates which development types are appropriate within each Flood Zone.

Table 3-2 Flood Risk Vulnerability and Flood Zone Compatibility

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

The Scheme has been assessed to be within Flood Zone 3a and is considered by this FRA to be less vulnerable. Based on the vulnerability classification and the Environment Agency flood outlines, Table 3-2 indicates that the Scheme assumed to be is appropriate.

3.4. Sequential test

The Sequential Approach is a simple decision-making tool designed to ensure that areas at little or no risk of flooding are developed in preference to areas at higher risk.

The NPPF states that the risk-based Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas with the lowest probability of flooding. Development should be directed to flood zone 1 wherever possible, and then sequentially to flood zones 2 and 3, and then to the areas of least flood risk within flood zones 2 and 3. Appendix E includes some extracts from the NPPF on this subject.

The Sequential Test is a key component of the hierarchical approach to avoiding and managing flood risk. It is a decision making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. The Sequential Test can be applied at a number of levels – from Local Authority Planning decisions to site specific flood risk assessments:

- Local Authority Level – the Sequential Test will assist in the defining of development zones, seeking to locate all new development to Flood Zone 1. If a development zone was selected that was in a higher flood risk zone, there would be a requirement to demonstrate that there are no less vulnerable sites available to accommodate the development, and that the development provides wider sustainability benefits which outweigh the risk from flooding (the Exception Test).
- Site Specific – A Sequential approach should also be applied on a site-specific basis, providing a tool to ensure the correct placement of development. Consideration of flood risk at the earliest opportunity in the planning process will enable the location, layout and design of the development to deliver maximum reductions in flood risk.

However, this process can be refined by the local SFRA, as is the case in Westminster. The SFRA (Westminster City Council, 2010) states that 'given the existing highly built form, general shortage of land and complexity of development pressures and land use in Westminster, the city council does not allocate land in this way'. Therefore, it is not necessary to demonstrate a passed Sequential Test for the Scheme.

Also, in support of this conclusion details from the UK Holocaust Memorial and Learning Centre public exhibition boards (UK Holocaust Memorial Foundation, 2018) stated that following an extensive site search, Victoria Tower Gardens was recommended as a location primarily because of its proximity to Parliament. The Government recognised that the Memorial and Learning Centre should stand as a reminder of the role of Parliaments in legitimising the rise of Nazism in Germany and also explore the dilemmas and challenges faced by Britain's own Parliament before, during and in the aftermath of the Holocaust. The view of Parliament from the Memorial will serve as a reminder that decisions have consequences.

After a carefully considered search for a suitable location, the cross-party UK Holocaust Memorial Foundation recommended Victoria Tower Gardens as the Site for the Holocaust Memorial and Learning Centre; owned by the Government and managed by Royal Parks, it has a central location

engaging directly with Parliament, standing as a reminder of the role of democracy, at home and abroad, in both legitimising and challenging hatred, intolerance and prejudice.

3.5. Exception test

The exception test should only be applied after the application of the Sequential test. In accordance with the NPPF Table 3-2, “Less Vulnerable” developments are appropriate in Flood Zones 1, 2, and 3 without the need to meet the requirements of the Exception Test. However, given the high risk of residual flooding and forgoing of the Sequential Test in Westminster, the SFRA recommends that “The Exception test will apply to social and community uses in Flood Zone 3.” As illustrated in

Figure 2-2, the Site is located in Environment Agency Flood Zone 3 and therefore evidence demonstrating the development meets the requirements of the Exception Test should is provided as part of this detailed Level 3 FRA.

3.5.1. Sustainability benefits

The wider sustainability benefits are identified and documented in the UK Holocaust Memorial Sustainability Statement (WSP Limited, 2018). Please refer to this document for the sustainable benefits this Site.

3.5.2. Safe from flood risk

This assessment is for the purpose of demonstrating that the development will be safe for its lifetime taking into account the vulnerability of its users and that it won’t increase flood risk elsewhere. A flood risk evacuation plan will need to be developed alongside any fire escape plan.

These plans will cover:

- Access and egress in the event of flooding,
- Operation and maintenance;
- Visitor awareness;
- Flood warning and Evacuation procedures.

The current October 2018 Environment Agency flood hazard map for the 2014 (Environment Agency, 2018), 1 in 1000 year event (0.1%) shows the majority of the . flooding up to a depth of <0.25m with the eastern side of the Site flooding to a depth of <1m (Appendix B).

It is anticipated that an evacuation route would be possible via the south of the Site and heading west on Horseferry Road which does not show to flood in the flood hazard mapping.

This flood risk assessment has demonstrated that the Site will be safe from flooding and will not increase the risk of flooding in the vicinity once the works are completed.

The Scheme is appropriate for this location

3.6. Climate Change

The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and supporting planning practice guidance on Flood Risk and Coastal Change explain when and how Flood Risk Assessments should be used. This includes demonstrating how flood risk will be managed now and over the development’s lifetime, taking climate change into account. Local planning authorities refer to this when preparing local plans and considering planning applications.

As of 19th February 2016, the government updated the climate change guidance which is to be considered during the planning process. This supersedes the climate change guidance within the Planning Practice Guidance, where typically a 20% allowance on river flows was given. Further details can be found at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

The updated percentage allowances for climate change required for consideration in development is dependent on several factors which are described in Appendix E. The following sets out which climate change allowance needs to be applied according to the development type and Flood Zone.

The impact of climate change across the lifetime of the development should be considered and appropriate mitigation taken. It is recommended to consider a range of allowances for a 'low vulnerability' development in Flood Zone 3. The potential change in peak river flow of the Thames over the next century has been modelled by the Environment Agency and for the '2080's scenario it is anticipated to be between 70% (upper end) and 25% (central) (Environment Agency, 2017). Following guidance of the Thames Estuary 2100 plan (TE2100) (Environment Agency, 2012), flood defences adjacent to the Site will need to be raised to account for this expected climate change.

The TE2100 plan outlines that sea level rise is a factor that will impact the flood defences. However, the Environment Agency states that they are confident the TE2100 plan can cope with the changing climate and sea level rise and can improve the existing defence system to manage flood risk on the Thames. The timing of defence raising will depend on the rate of sea level rise.

When looking at the impact of climate change, the 2100 flood hazard mapping for the 1 in 1000 year event (0.1%) with climate change shows the whole Site flooding to a depth of ≤1 m with a max velocity of ≤2.5 m/s (Figure 3-1). However, as part of the Thames Estuary project to manage flood risk from the River Thames to 2100 (TE2100) the Environment Agency is committed to adapting to climate change in this area so that flood risk does not increase.

Due to climate change it is anticipated that the riverwall will need to be raised by 0.5m in order to protect the site for the development's lifetime, when accounting for climate change. This would protect the site up to 2100. Ground investigations were undertaken to analyse the existing structure to demonstrate that raising is feasible on the existing structure (WSP UK Limited, 2019). The report concludes that *"The resulting increase in wall height results in a very limited (<1.0kPa) increase in soil bearing pressure, and as such this matter warrants no further assessment."*

The proposed site plan in Appendix I shows how vehicle access from the road for future wall maintenance and wall raising works is able to take place. The existing accesses to the current site will not be altered by the proposed development.

Therefore, the Site will remain at a low risk from fluvial and tidal flooding until at least 2100.

Figure 3-1 Thames Tidal Breach Hazard Mapping (1 in 1000. 0.1%, 2100 Scenario + climate change)

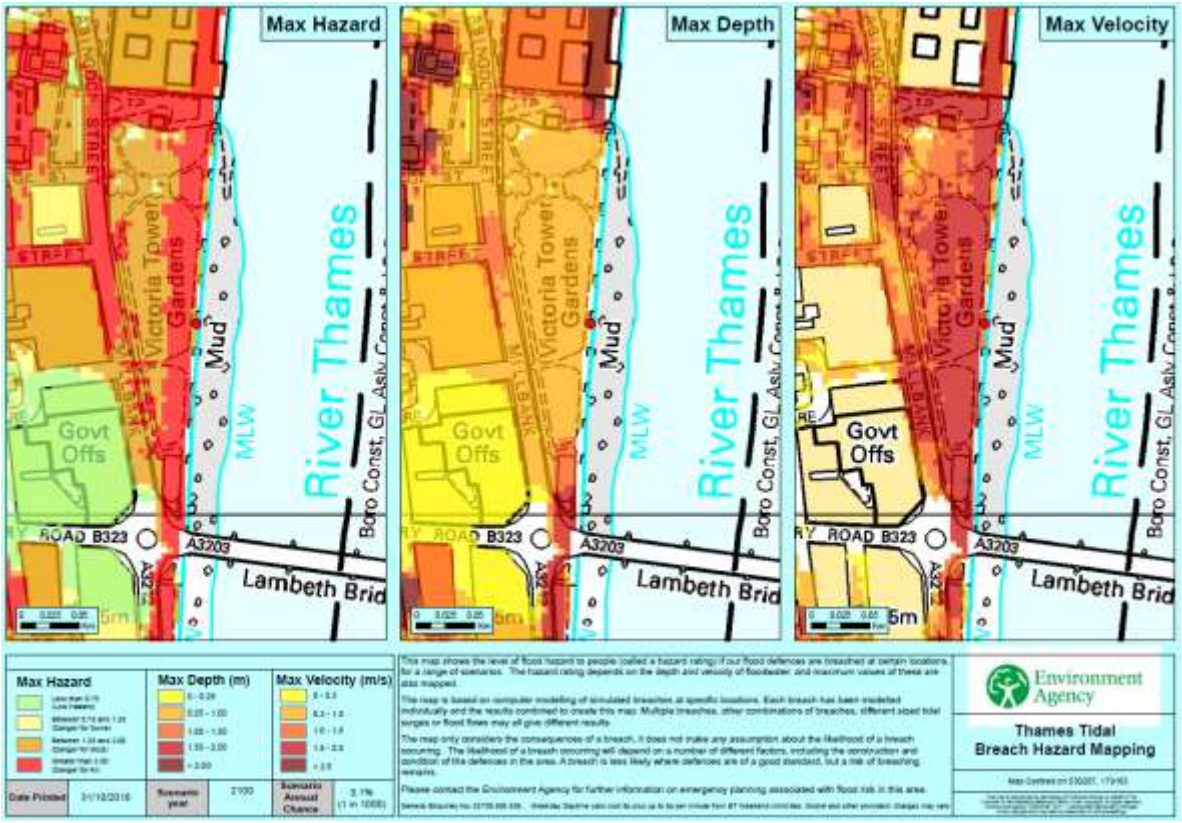


Table 3-3 Climate change allowances by Flood Zone

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	None	None	None	None	None
Zone 2	Higher Central and Upper End	Higher Central and Upper End	Central and Higher Central	Central	None
Zone 3a	Upper End	X	Higher Central and Upper End	Central and Higher Central	Central
Zone 3b	Upper End	X	X	X	Central

The table below contains the climate change allowances for the Thames River Basin district, which indicates the range of allowances which may need to be considered.

Table 3-4 Climate change predictions for the Scheme Site

Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Peak river flows			
Upper end	25%	35%	70%
Higher central	15%	25%	35%
Central	10%	15%	25%

Rainfall intensity			
Upper end	10%	20%	40
Central	5%	10%	20
Sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)			
Sea Level Rise	1990 to 2025	2026 to 2055	2056 to 2085
East, east Midlands, London, South East	4 (140 mm)	8.5 (255 mm)	12 (360 mm)

The Environment Agency provided updated breach maps on 31st October 2018 (Appendix B) which is considered to be up to date and accurate breach information. It confirms that the Site is at risk in a breach scenario. As previously mentioned in section 2.5, the current 2014 flood hazard map for the 1 in 1000 year event (0.1%) shows the majority of the Site flooding up to a depth of <0.25 m with the eastern side of the Site flooding to a depth of <1 m (

Figure 2-5).

3.7. Ministerial Statement (HCWS161)

Paragraph 103 of National Planning Policy Framework has been updated to give priority to the use of sustainable drainage systems. The requirements of the policy are set out in the Written Ministerial Statement (HCWS161), whereby all 'major' planning applications being determined from April 2015 must consider sustainable drainage systems.

Major development is defined by the Town and Country Planning (Development Management Procedure) (England) Order 2015 as development involving any one or more of the following:

a) the winning and working of minerals or the use of land for mineral-working deposits;
b) waste development;
c) the provision of dwelling houses where:
   (i) the number of dwelling houses to be provided is 10 or more; or
   (ii) the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph (c)(i);
d) the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or
e) development carried out on a site having an area of 1 hectare or more.

This report assesses the Scheme to be classified as "major". Consequently, a drainage strategy that considers the SuDS Hierarchy must be submitted with the planning application.

Approved document Part H of the Building Regulations 2010 defines the hierarchy for disposing of surface water as follows:

1. Discharge to the ground (for example using soakaways). Where the intention is to discharge to the ground it must be shown to be feasible through an assessment carried out under the Building Research Establishment Digest 365 (BRE 365).
2. Discharge to a surface water body (for example a river or lake).
3. Discharge to a surface water sewer, highway drain, or another drainage system. Discharge to a combined sewer.

The contents of the drainage strategy should be agreed with the Local Planning Authority in advance. The following contents provide a general overview of what is normally required:

- Site location plan, including the existing drainage layout and site levels.
- Details of the site's geology/drift material overlaying the site.
- Details of any contamination on the site and how this has been taken into account in the design.
- Layout of the proposed drainage system including post development site levels and the location of sustainable drainage infrastructure (for example the location of underground storage tanks).
- Demonstration that the SuDS hierarchy has been followed.
- Micro-drainage calculations of existing and proposed run-off rates and volumes unless full infiltration test in accordance with BRE 365 are submitted. Back-up attenuation scheme if on-site infiltration is proposed without undertaking infiltration tests.
- Details of the management and maintenance of the SuDS so it continues to meet the requirements (currently in the draft National Standards) for the lifetime of the development.

3.8. Local Planning Policy Overview

The Lead Local Flood Authority in the study area is Westminster City Council. Appendix F contains an extract of the Local Planning Policy relevant to this site:

- Policy S30 Flood Risk; and

- Policy S45 Flood-related Infrastructure.

The full Westminster City Plan (November 2016) can be found online at https://www.westminster.gov.uk/westminsters-city-plan-strategic-policies.

4. Conclusions & Recommendations

4.1. Conclusions

This Level 3 FRA has concluded that:

- The Scheme type is less vulnerable and lies within Environment Agency Flood Zone 3 and is heavily protected from the Thames River flood defences and this will significantly reduce the risk of flooding;
- In the event of a breach, the site would be susceptible to flooding in a 1 in 1000 (0.1%) event with the majority of the Site flooding to <1.5 m in the climate change scenario;
- This scheme does not impact upon the existing wall stability, ability for it to be raised in the future nor does it impede access and therefore it is recommended that the maintenance is undertaken in line with its current regime;
- In general the Site is located at low risk from surface water flooding;
- The Site is within an area at low risk of groundwater flooding;
- There are no other known sources of flood risk that would pose a significant risk to the Site;
- The Scheme is at risk from two flood risk sources as summarised below;

Table 4-1 Summary of flood risk sources

Flood risk Source	Yes/No	Level/severity	Quality Score	Further assessment required
Fluvial	Yes	Low	1	No further assessment required
Surface water	No		1	N/A
Groundwater	No		1	N/A
Coastal/tidal	Yes	Low	1	No further assessment required
Historical	No		1	N/A
Sewers	No		1	N/A
Other sources	No		1	N/A

- The Scheme Site is considered to have low risk of impacting on maintenance access requirements or affect the integrity of an existing flood defence;
- The Scheme Site is greenfield and the increase in impermeable area and thus runoff rates will need to be managed through the application of SuDS; and
- This FRA demonstrates that the development will not impact on the integrity of the flood defence or prevent any future inspections, maintenance or raisings. It also demonstrates that the development will be protected from flooding for its lifetime.

4.2. Recommendations

The investigations carried out for this Level 3 FRA recommend the following actions:

- The Scheme requires completion of the Exception Test;
- The riverwall stability is monitored during construction; and
- A flood risk evacuation plan should be developed alongside any fire escape plan to ensure early evacuation of the basement area, informed by the Environment Agency Flood Warnings.

5. References

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Appendices

Appendix A. Proposed Scheme

1 Proposed Site Plan
1 : 500

KEY:

1. Public WCs
2. Café / Bike storage / Generator
3. Playground
4. Spicer memorial
5. Entrance pavilion
6. Main entrance
7. Bag collection
8. Main exit
9. Emergency exit
10. Memorial courtyard
11. Memorial fins
12. Learning centre entrance
13. Passenger lift
14. Good lift entrance
15. Escape stair exit
16. Skylight
17. Learning centre below ground
18. Hostile vehicle perimeter
19. Victoria tower gardens
20. Buxton memorial
21. Buxton seating area
22. River Thames
23. Burghers of Calais
24. Parliamentary education centre
25. Monument to Emmeline Pankhurst
26. Houses of Parliament
27. Lambeth Bridge
28. Site Boundary
29. Garden entrance gates
30. Garden Bins
31. Hostile Vehicle perimeter
32. Existing Thames overflow sewer
33. Existing lamppost
34. Threshold
35. Plant room
36. Exit ramps
37. Mezzanine level
38. Feature stair
40. Relocated existing dance chimes
41. Relocated existing water pump
42. Relocated existing wooden horses
43. Existing sandpit
44. Relocated existing boulders

0 10 20 50 m

N

General Notes:

Drawing to be read in conjunction with the specification and all relevant drawings.

Do not scale from this drawing.

Contractor to check all dimensions on site. Adjaye Associates to be advised of any discrepancies between this drawing and site conditions immediately.

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Revision	Date	Description
P0.3	19.03.29	Planning Addendum
P0.2	18.11.28	Updates to Graphical Quality & Surrounding Environment Details
P0.1	18.11.16	Issue for Planning

Status: Stage 3 Plus

Rev.: P0.3

Client: United Kingdom Holocaust Memorial Foundation

Project: National Holocaust Memorial

Drawing Title: Proposed Site Plan

Drawing No.: UKHM-AA-XX-ZZ-DR-A-03-002

Scale: As indicated @ A1

Drawn By: GC

Date: 18/11/16

Checked By: JN

Appendix B. Product 4 (Detailed Flood Risk) for: 530260, 179250

Product 4 (Detailed Flood Risk) for: 530260, 179250
Reference: HNL102743JH
Date: 31/10/2018

Contents

The information provided is based on the best data available as of the date of this letter.

You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements to the data for this location have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

Please refer to the Open Government Licence which explains the permitted use of this information.

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Flood Map for Planning (Rivers and Sea)

The Flood Map:

Our Flood Map shows the natural floodplain for areas at risk from river and tidal flooding. The floodplain is specifically mapped ignoring the presence and effect of defences. Although flood defences reduce the risk of flooding they cannot completely remove that risk as they may be over topped or breached during a flood event.

The Flood Map indicates areas with a 1% (0.5% in tidal areas), Annual Exceedance Probability (AEP) - the probability of a flood of a particular magnitude, or greater, occurring in any given year, and a 0.1% AEP of flooding from rivers and/or the sea in any given year. In addition, the map also shows the location of some flood defences and the areas that benefit from them.

The Flood Map is intended to act as a guide to indicate the potential risk of flooding. When producing it we use the best data available to us at the time and also take into account historic flooding and local knowledge. The Flood Map is updated on a quarterly basis to account for any amendments required. These amendments are then displayed on the internet at https://www.gov.uk/check-flood-risk

At this Site:.

The Flood Map shows that this sitelies within Flood Zone 3 - with a 0.5% chance of flooding from the sea (tidal flooding) in any given year.

Enclosed is an extract of our Flood Map which shows this information for your area.

Method of production

The Flood Map at this location has been derived using detailed modelling of the tidal River Thames through the Thames Tidal Defences Study completed in 2006 by Halcrow Ltd.

Alchemy, Bessemer Road, Welwyn Garden City, Hertfordshire, AL7 1HE
Customer services line: 03708 506 506
Email: NETenquiries@environment-agency.gov.uk
Website: www.environment-agency.gov.uk

Thames Estuary 2100 (TE2100)

You have requested in-channel flood levels for the tidal river Thames. These have been taken from the Thames Estuary 2100 study completed by HR Wallingford in 2008. The modelled node closest to your site is ; the locations of nearby nodes are also shown on the enclosed map.

Details about the TE2100 plan

The TE2100 plan is now live and within it are a set of levels on which the flood risk management strategy is based. The plan is the overarching flood management strategy for the Thames Estuary and therefore any development planning should be based on the same underlying data.

Details about the TE2100 in-channel levels

The TE2100 in-channel levels take into account operation of the Thames Barrier when considering future levels. The Thames Barrier requires regular maintenance and with additional closures the opportunity for maintenance will be reduced. When this happens, river levels – for which the Barrier would normally shut for the 2008 epoch – will have to be allowed through to ensure that the barrier is not shut too often. For this reason, levels upriver of the barrier will increase and the tidal walls will need to be heightened to match.

Why is there no return period for levels upriver of the barrier?

The levels upriver of the barrier are the highest levels permitted by the operation of the Thames Barrier. If levels and flows are forecast to be any higher, the Thames Barrier would shut, ensuring that the tide is blocked and the river maintained to a low level. For this reason the probability of any given water level upriver of the Barrier is controlled and therefore any associated return period becomes irrelevant. The Thames Barrier and associated defence system has a 1 in 1000 year standard which means it ensures that flood risk is managed up to an event that has a 0.1% annual probability. The probability of water levels upriver is ultimately controlled by the staff at the Thames Barrier.

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TE2100 2008 levels:

Levels downriver of the Thames Barrier are 0.1% AEP (1 in 1000) and levels upriver are the highest levels permitted by the Thames Barrier, described as the Maximum Likely Water Levels (MLWLs). The defence levels (left defence, right defence) are the minimum levels to which the defences should be built.

Location	Node	Easting	Northing	Extreme water level (m)	Left defence (m)	Right defence (m)	Allow for future defence raising to a level of...	
							Left Bank (m)	Right Bank (m)
Battersea	2.30	529598	177749	4.86	5.41	5.41	6.35	6.35
	2.31	530333	178388	4.85	5.41	5.41	6.35	6.35
Westminster	2.32	530481	179473	4.84	5.41	5.41	6.35	6.35

TE2100 climate change levels:

				2065 to 2100		2100	
Location	Node	Easting	Northing	Design water level	Defence level (both banks)	Design water level	Defence level (both banks)
Battersea	2.30	529598	177749	5.35	5.85	5.81	6.35
	2.31	530333	178388	5.34	5.85	5.80	6.35
Westminster	2.32	530481	179473	5.33	5.85	5.79	6.35

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Thames Tidal Upriver Breach Inundation Modelling

The map attached displays site-specific modelled flood levels at your site. These have been taken from the Thames Tidal Upriver Breach Inundation Modelling Study 2017 completed by Atkins Ltd. in May 2017.

We have developed a modelling approach where all upriver breach locations along the Thames are equitably modelled, to ensure a consistent approach across London. This modelling simulates 5679 continuous tidal breaches along the entire extent of the Thames from Teddington to the Thames Barrier. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width.

For breaches upriver of the Thames Barrier, there is no return period for modelled levels as the levels are controlled by barrier closures. The levels used are referred to as Maximum Likely Water Levels (MLWLs). Therefore 2014 and 2100 epochs were modelled on that basis.

Defence Details

The design standard of protection of the flood defences in this area of the Thames is 0.1% AEP; they are designed to defend London up to a 1 in 1000 year **tidal** flood event. The defences are all raised, man-made and privately owned. It is the riparian owners' responsibility to ensure that they are maintained to a crest level of **5.41m** AODN (the Statutory Flood Defence Level in this reach of the Thames). We inspect them twice a year to ensure that they remain fit for purpose. The current condition grade for defences in the area is **2 (good),** on a scale of 1 (very good) to 5 (very poor). For more information on your rights and responsibilities as a riparian owner, please see our document 'Living on the edge' found on our website at:

https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities

There are no planned improvements in this area. Please see the 'Thames Estuary 2100' document on our website for the short, medium and long term Flood Risk Management strategy for London:

https://www.gov.uk/government/publications/thames-estuary-2100-te2100

Areas Benefiting from Flood Defences

This site is within an area benefiting from flood defences, as shown on the enclosed extract of our Flood Map. Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year, or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

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Recorded Flood Events Data

We hold records of historic flood events from rivers and the sea. Information on the floods that may have affected the area local to your site are provided in the enclosed map.

Due to the fact that our records are not comprehensive, we would advise that you make further enquiries locally with specific reference to flooding at this location. You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

We map flooding to land, not individual properties. Our historic flood event record outlines are an indication of the geographical extent of an observed flood event. Our historic flood event outlines do not give any indication of flood levels for individual properties. They also do not imply that any property within the outline has flooded internally.

Please be aware that flooding can come from different sources. Examples of these are:

- from rivers or the sea;
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system);
- overflowing or backing up of sewer or drainage systems which have been overwhelmed,
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding and drainage systems that have been overwhelmed.

Other Sources of Flood Risk

The Lead Local Flood Authority for your area are responsible for local flood risk (i.e. surface runoff, ground water and ordinary watercourse) and may hold further information .

You may also wish to consider contacting the appropriate relevant Local Planning Authority and/or water/sewerage undertaker for the area. They may be able to provide some knowledge on the risk of flooding from other sources.

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Additional Information

Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Important

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice, the technical guidance to the National Planning Policy Framework and the existing PPS25 Practice Guide for information about what flood risk assessment is needed for new development in the different Flood Zones. These documents can be accessed via:

https://www.gov.uk/flood-risk-standing-advice-frsa-for-local-planning-authorities

https://www.gov.uk/government/publications/national-planning-policy-framework-technical-guidance

https://www.gov.uk/government/publications/development-and-flood-risk-practice-guide-planning-policy-statement-25

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

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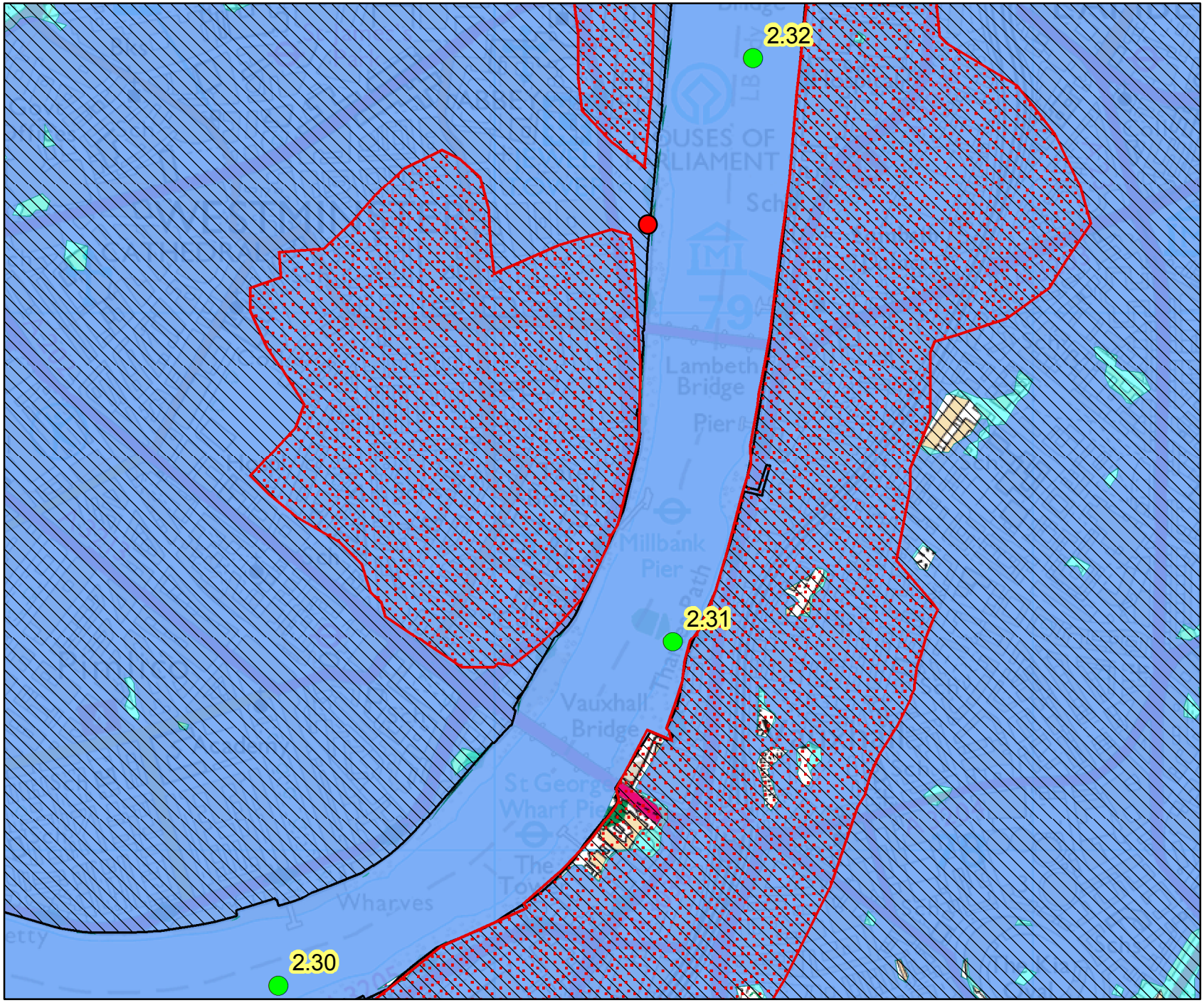
Detailed FRA/FCA for: 530260, 179250 - 31/10/2018 - HNL102743JH



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N

0 150 300 600
Metres

Legend

- TE2100Nodes
- 1707 Flood Outline
- 1928 Flood Outline
- 1953 Flood Outline
- Areas Benefiting from Flood Defences
- Flood Zone 3
- Flood Zone 2

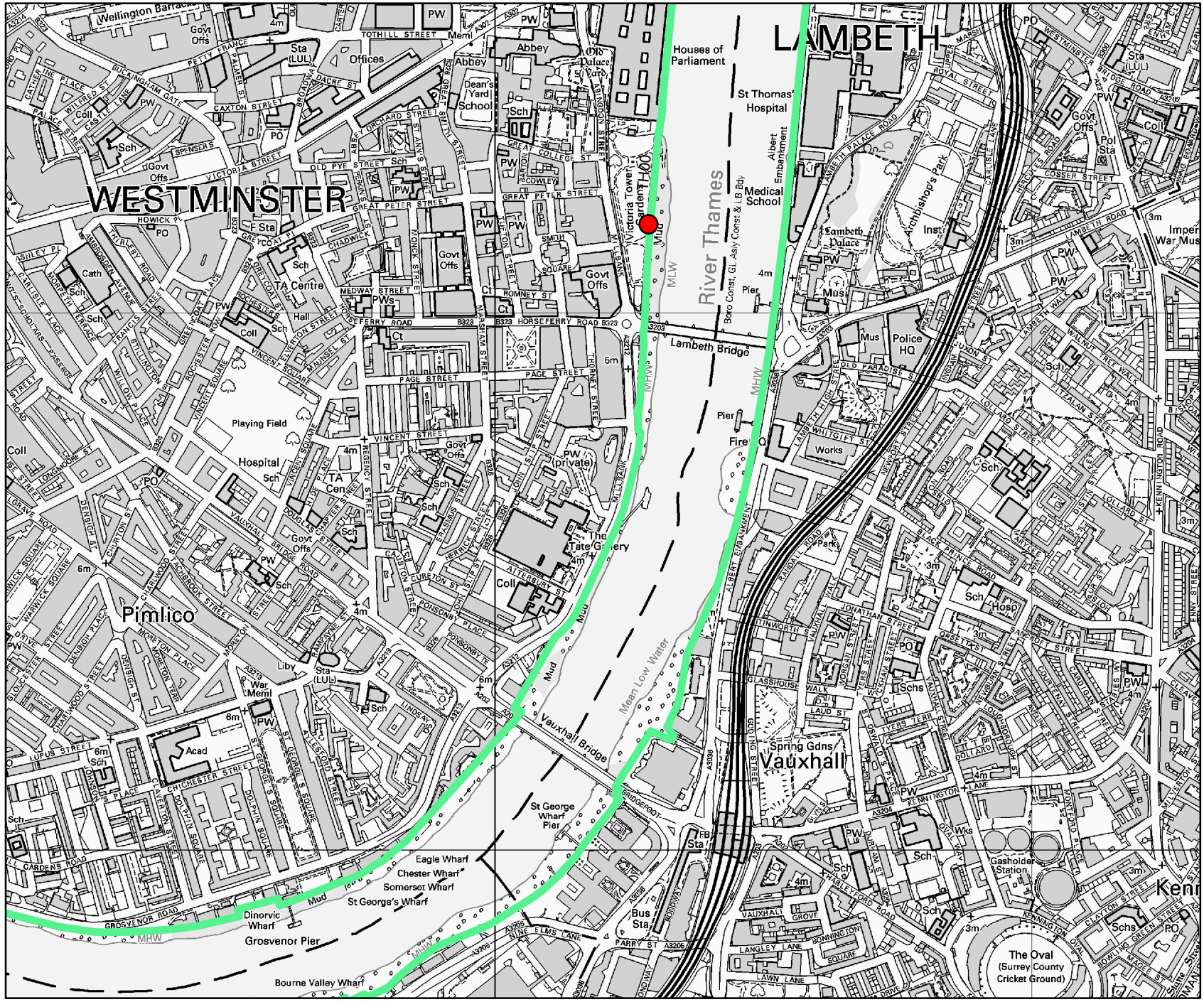
Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA/FCA for: 530260, 179250 - 31/10/2018 - HNL102743JH



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Metres

Legend

TTD Defences SDL (mAODN)

SDL

5.41

Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

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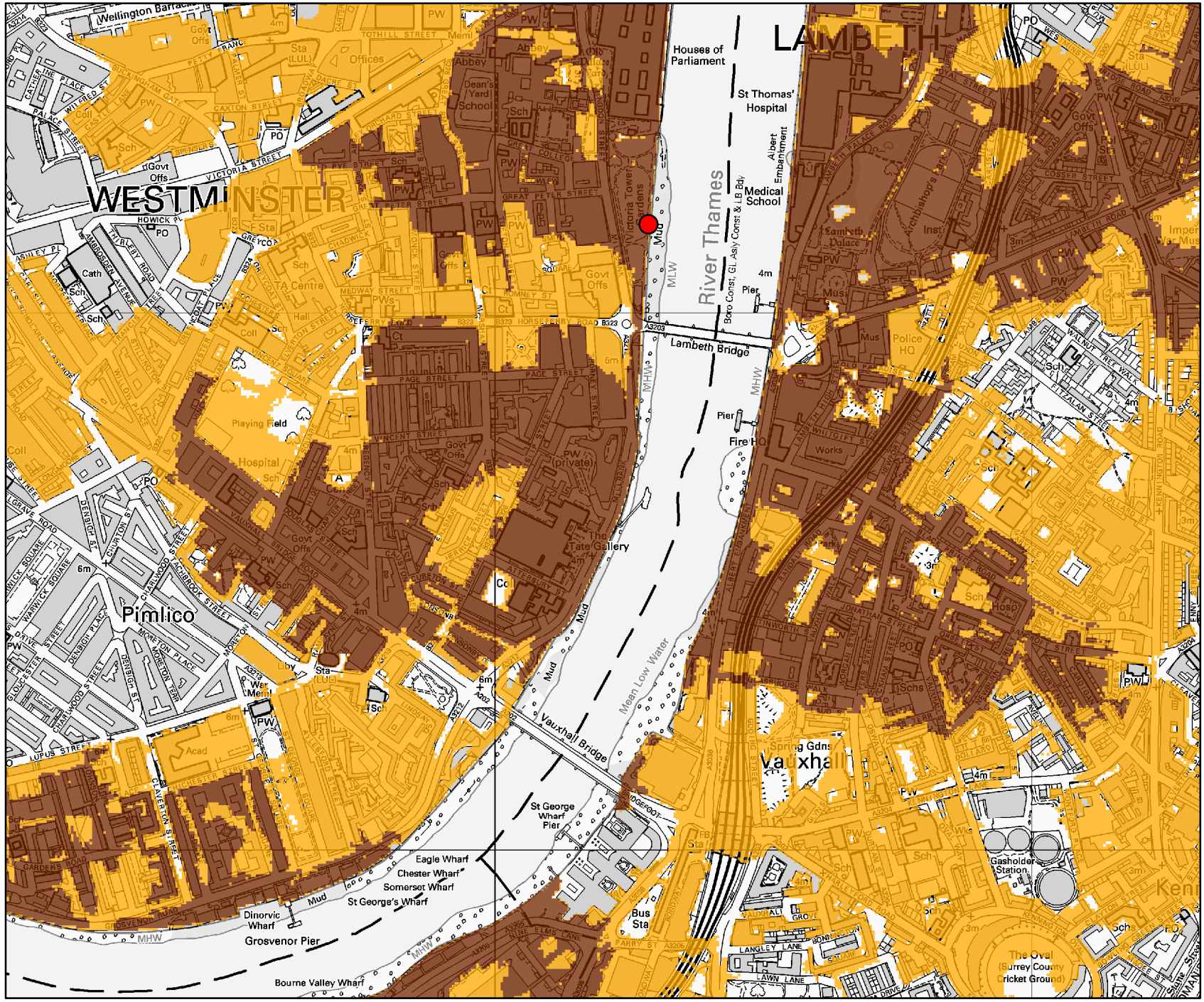
Breach Modelling Map for: 530260, 179250 - 31/10/2018 - HNL102743JH



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Metres

Legend

Upstream Breach Outlines

Epoch

- 2005
- 2100

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

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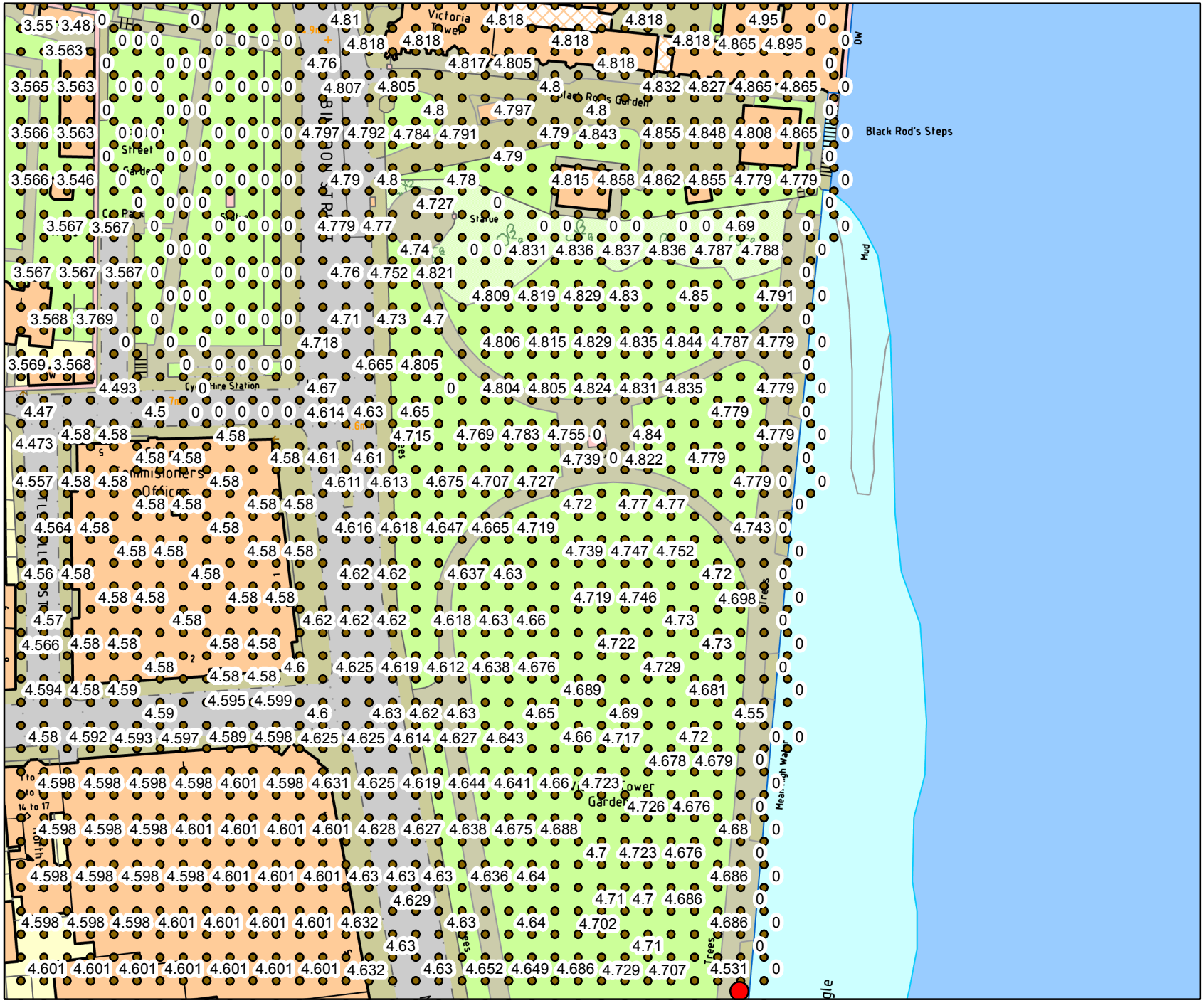
Modelled Flood Levels For: 530260, 179250 - 31/10/2018 - HNL102743JH



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Metres

Legend

- 2015 Thames Tidal Breach Node Points

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

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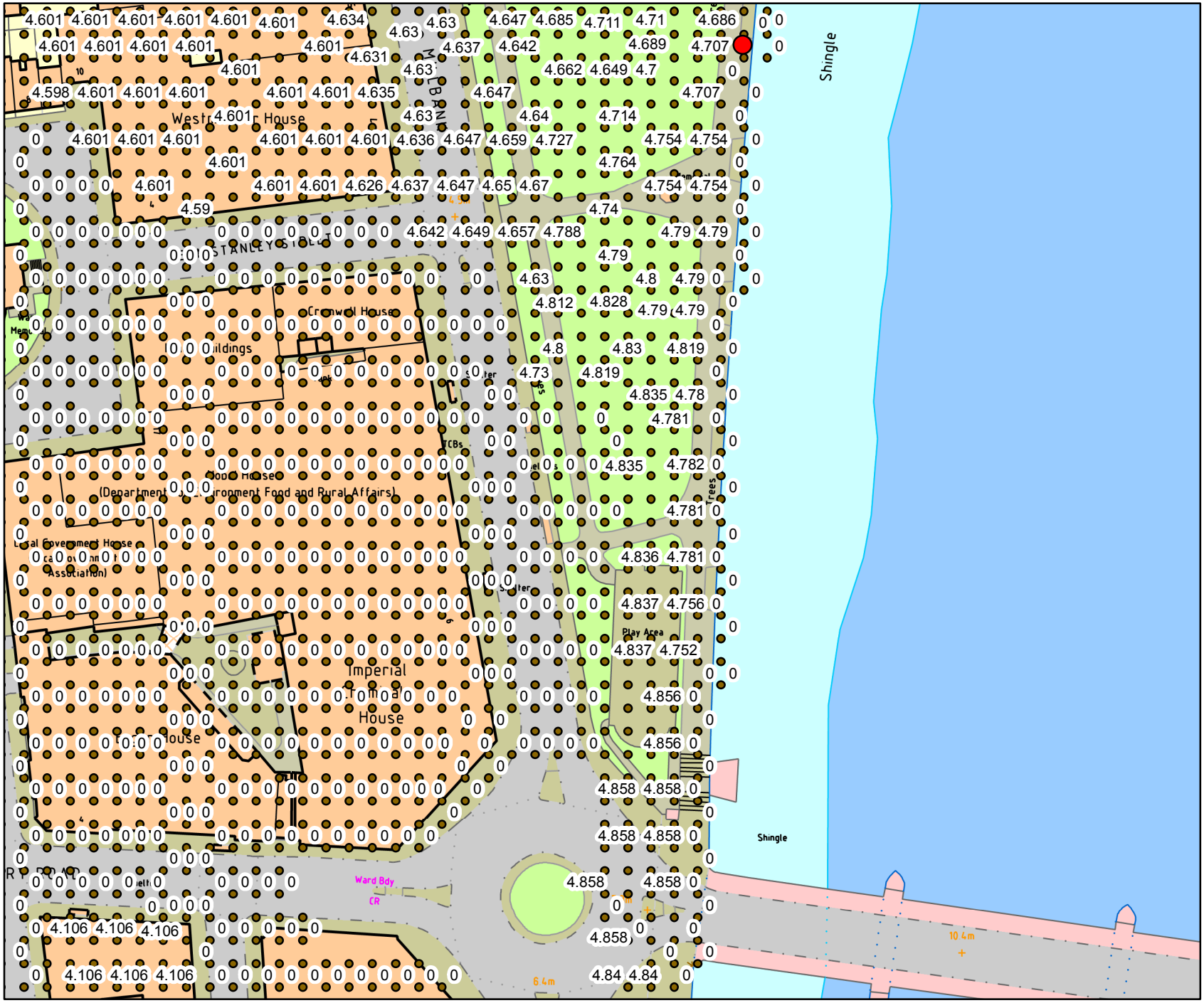

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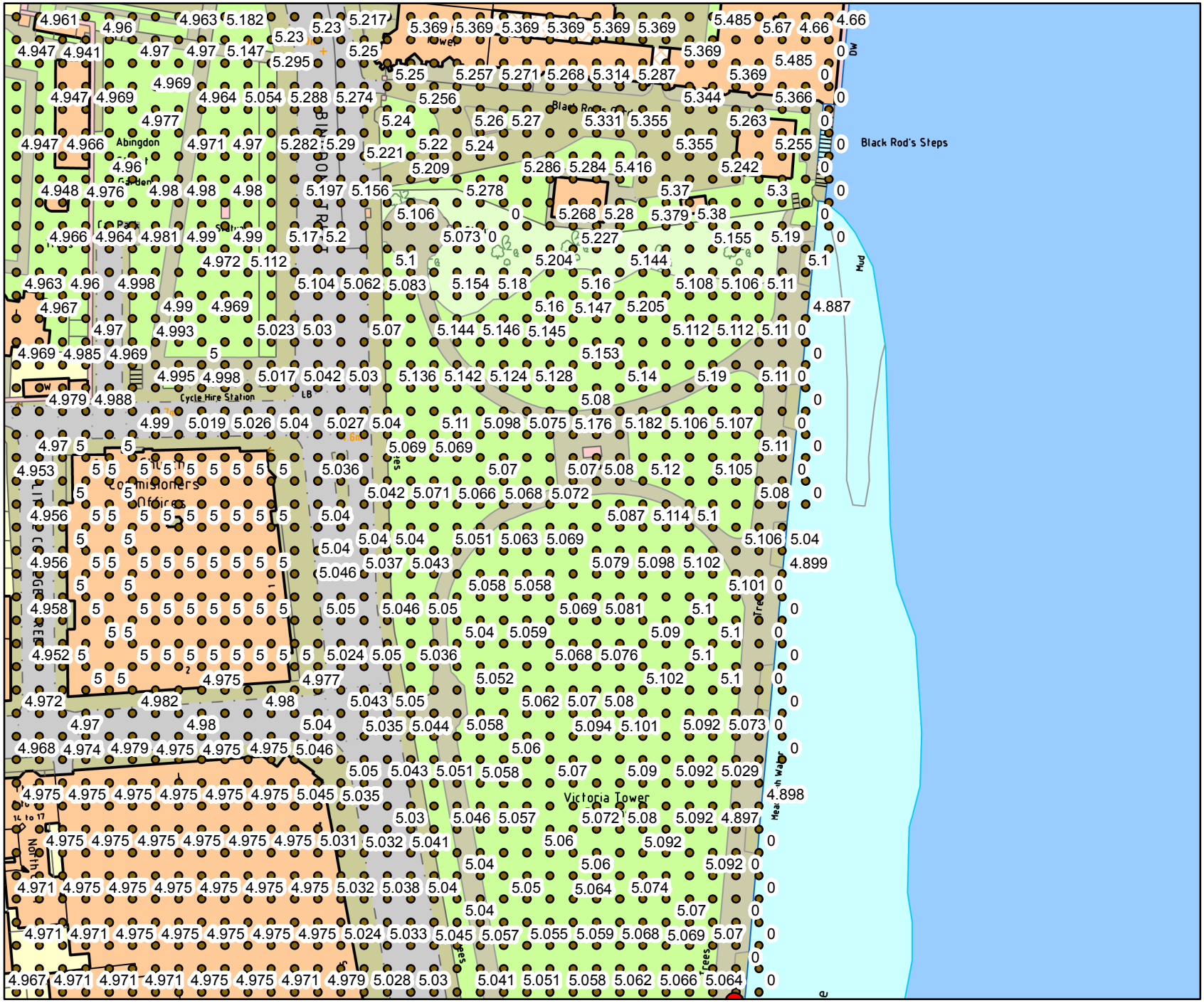

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Metres

Legend

- 2100 Thames Tidal Breach Node Points

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

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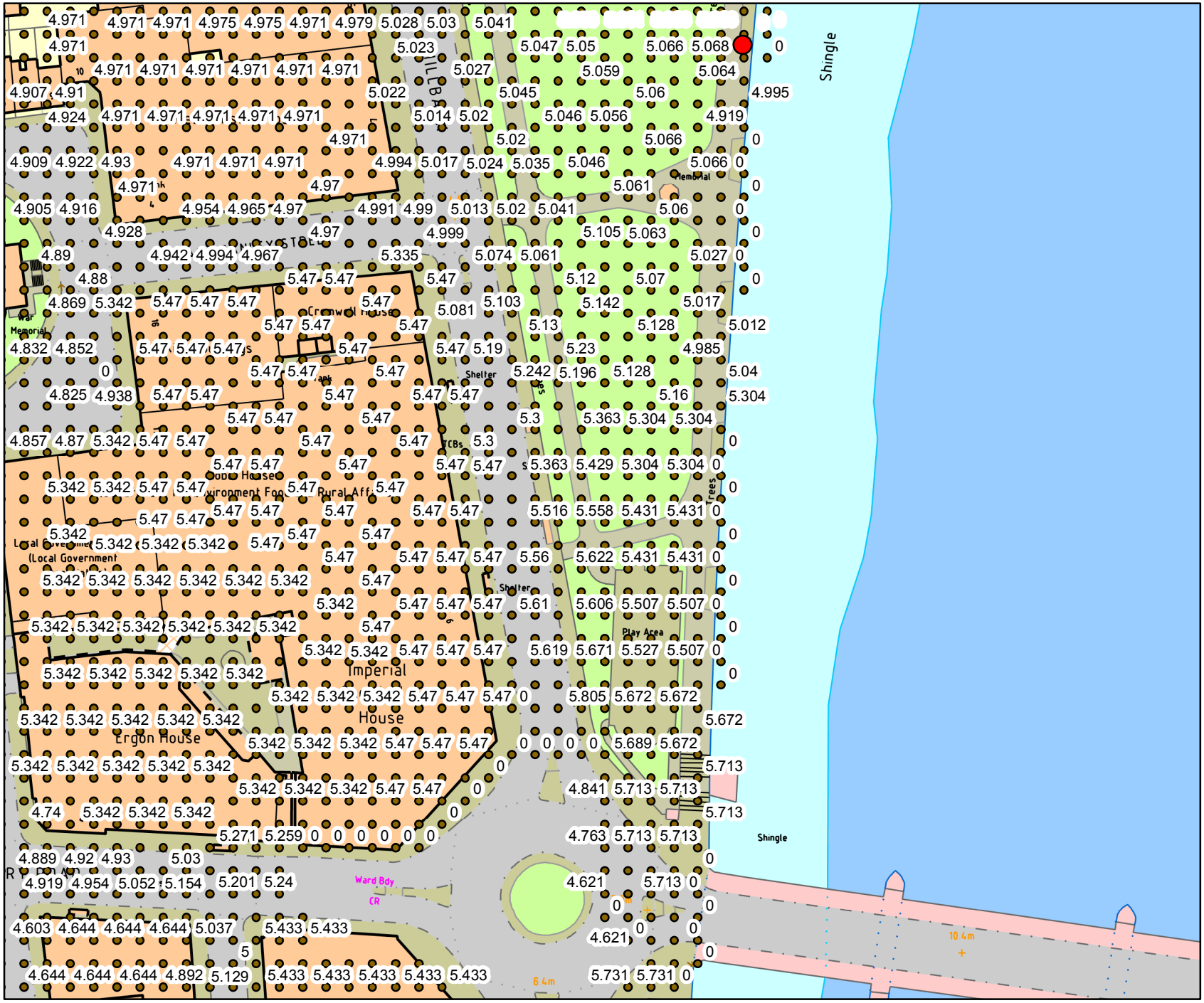
Modelled Flood Levels For: 530260, 179250 - 31/10/2018 - HNL102743JH



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Legend

- 2100 Thames Tidal Breach Node Points

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A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

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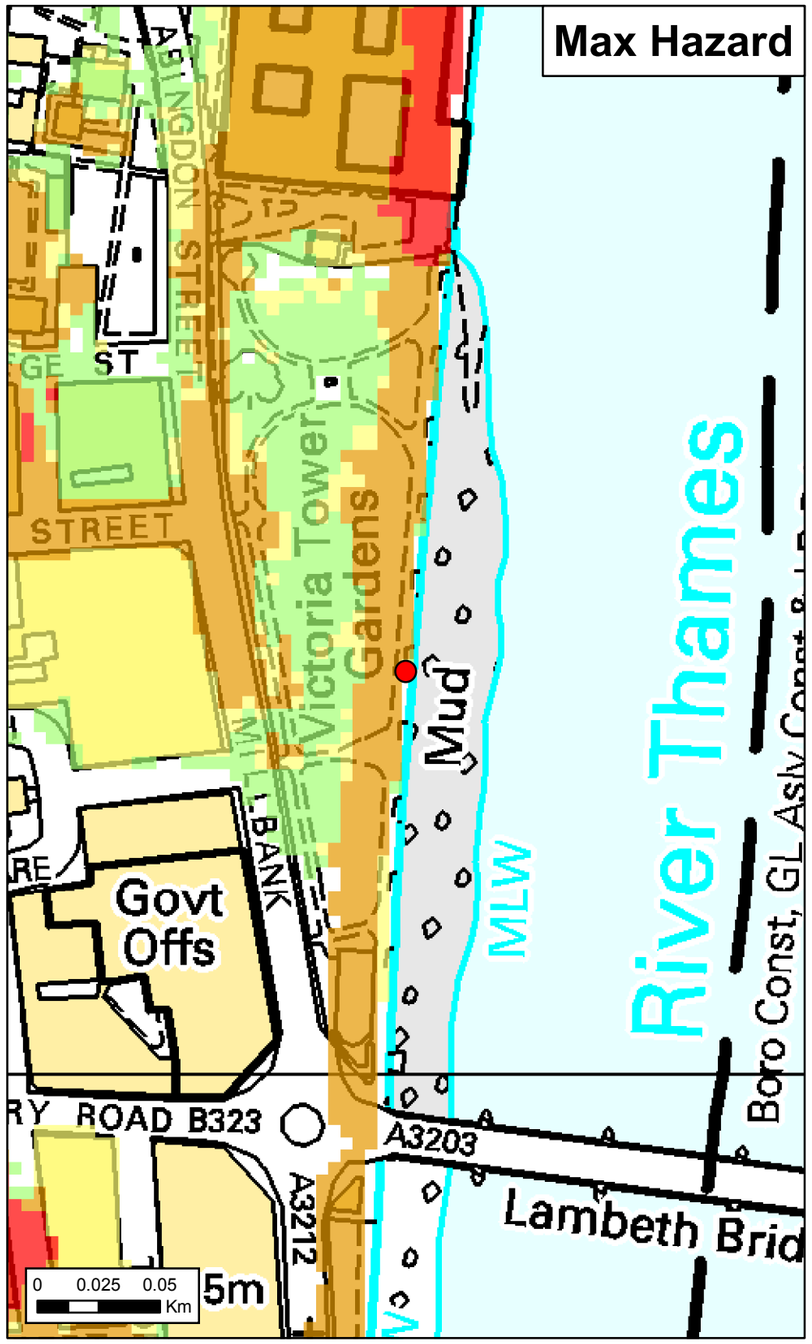

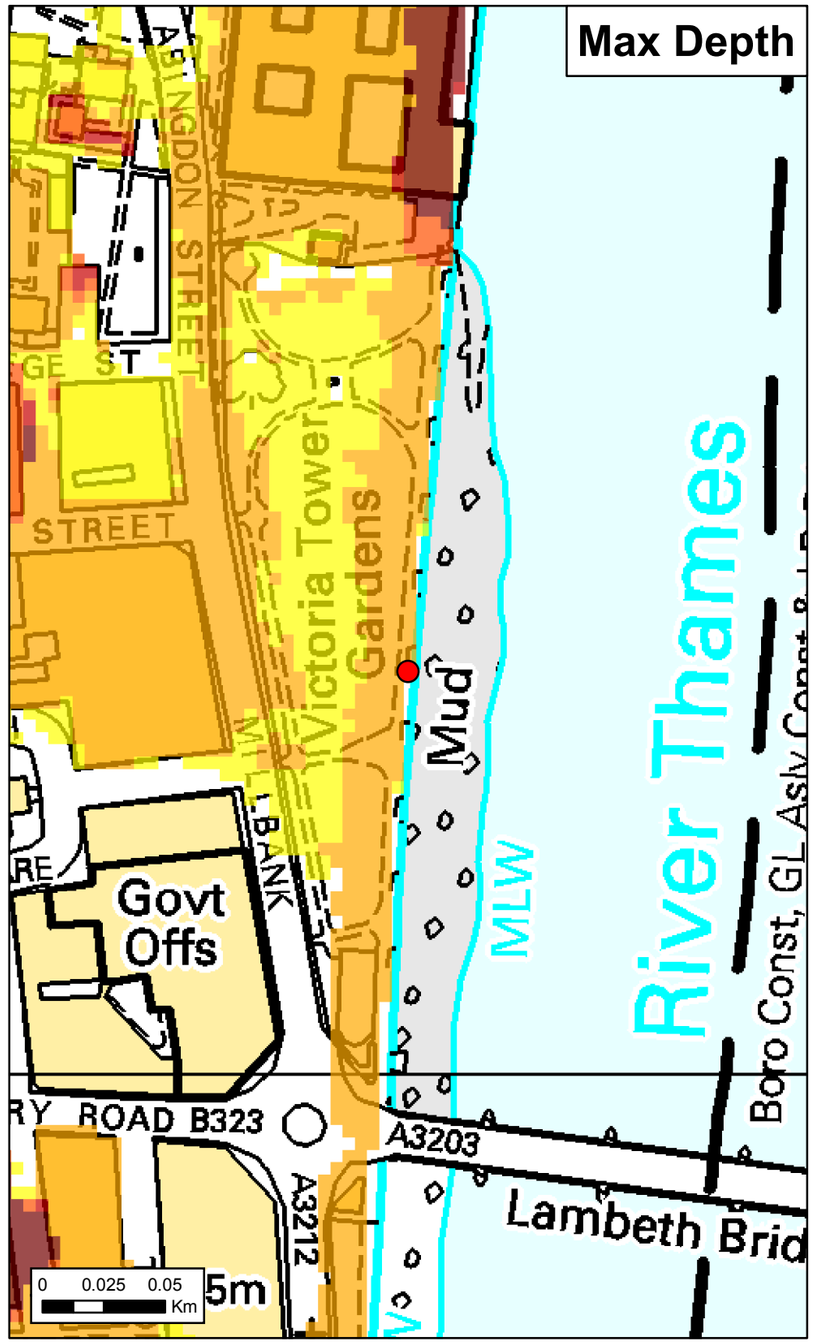

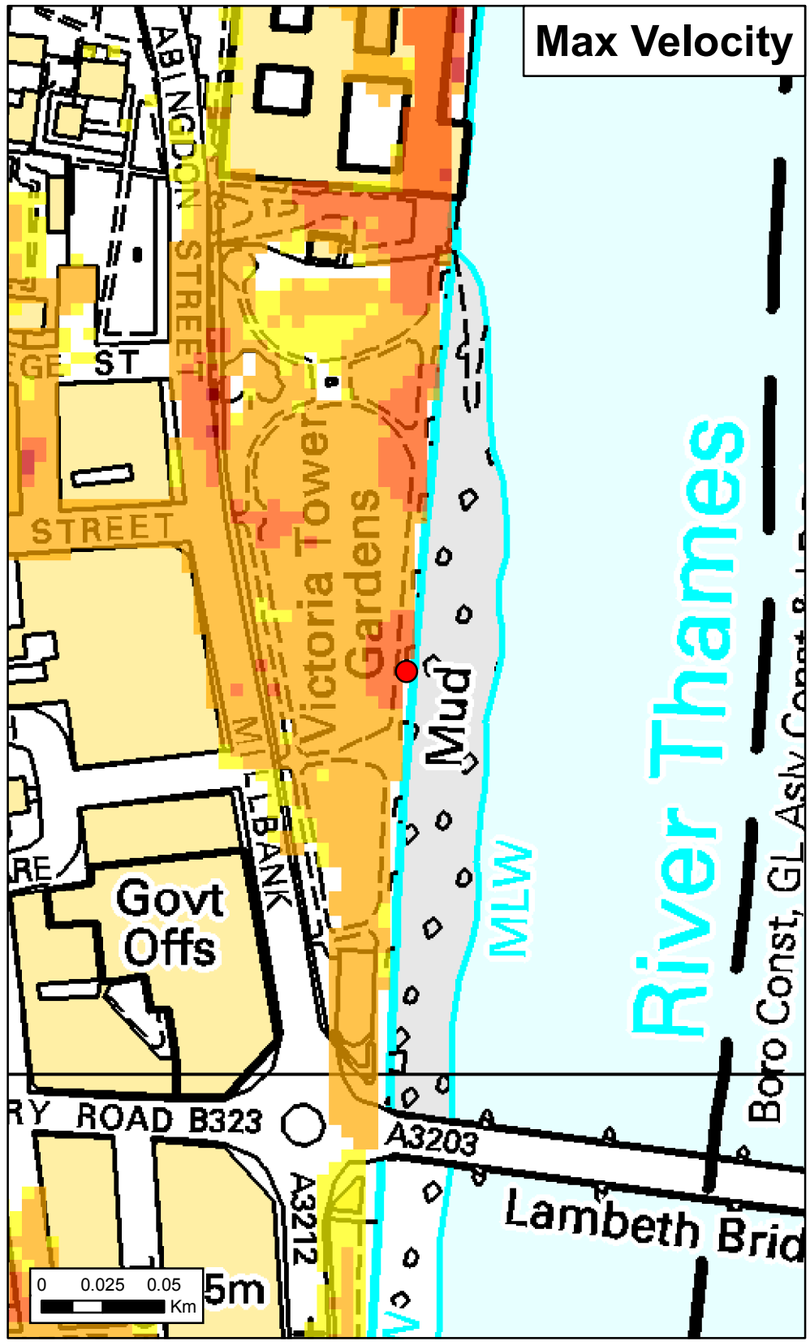

Max Hazard

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.00 (Danger for Most)
- Greater than 2.00 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- > 2.5

Date Printed	31/10/2018	**Scenario year**	2014	**Scenario Annual Chance**	0.1% (1 in 1000)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.

General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

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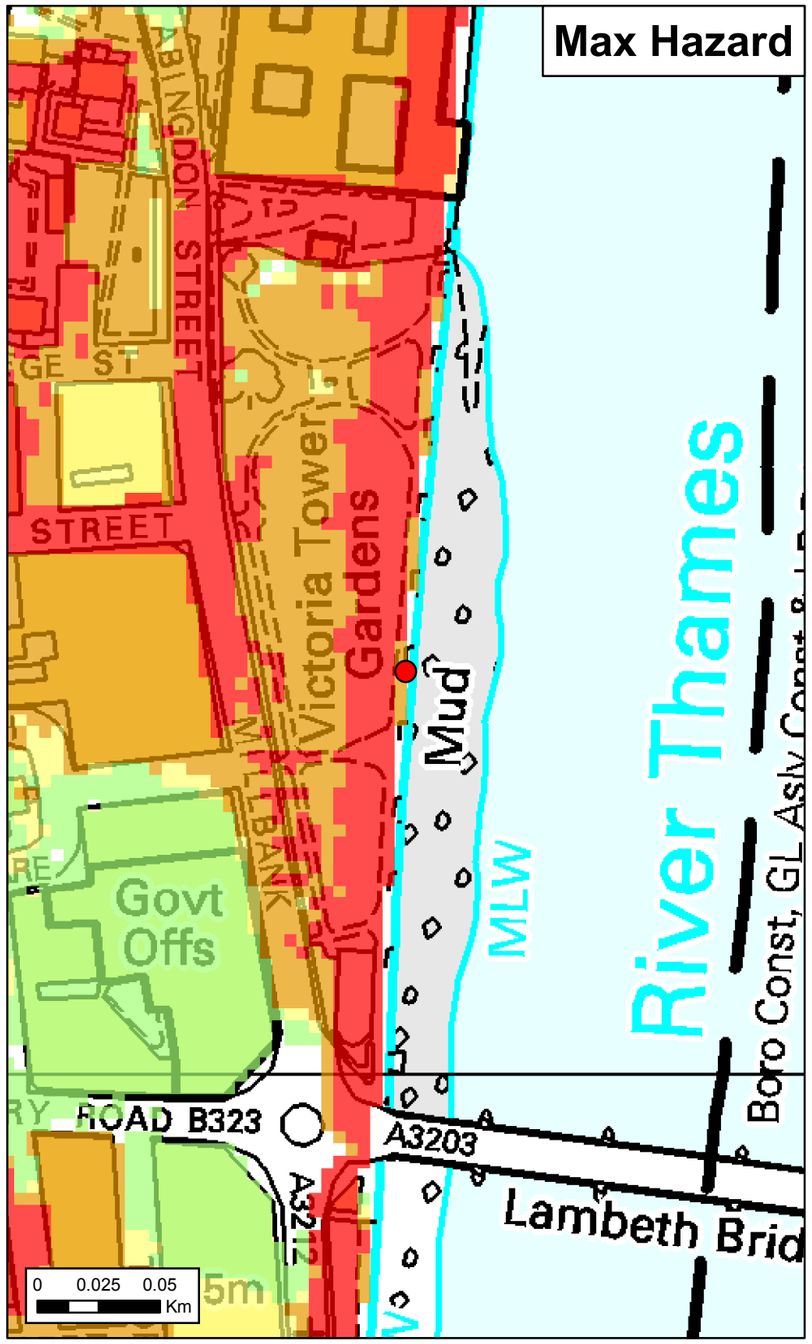
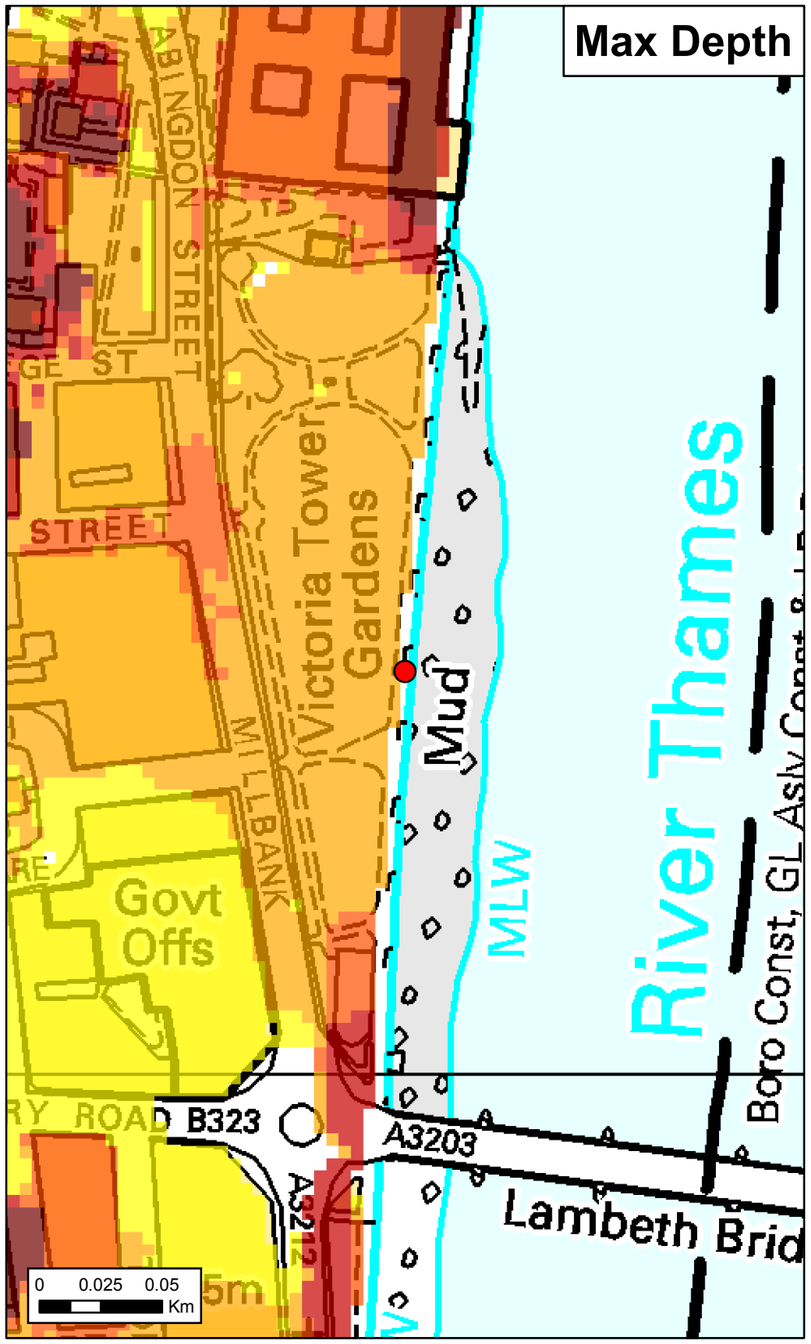
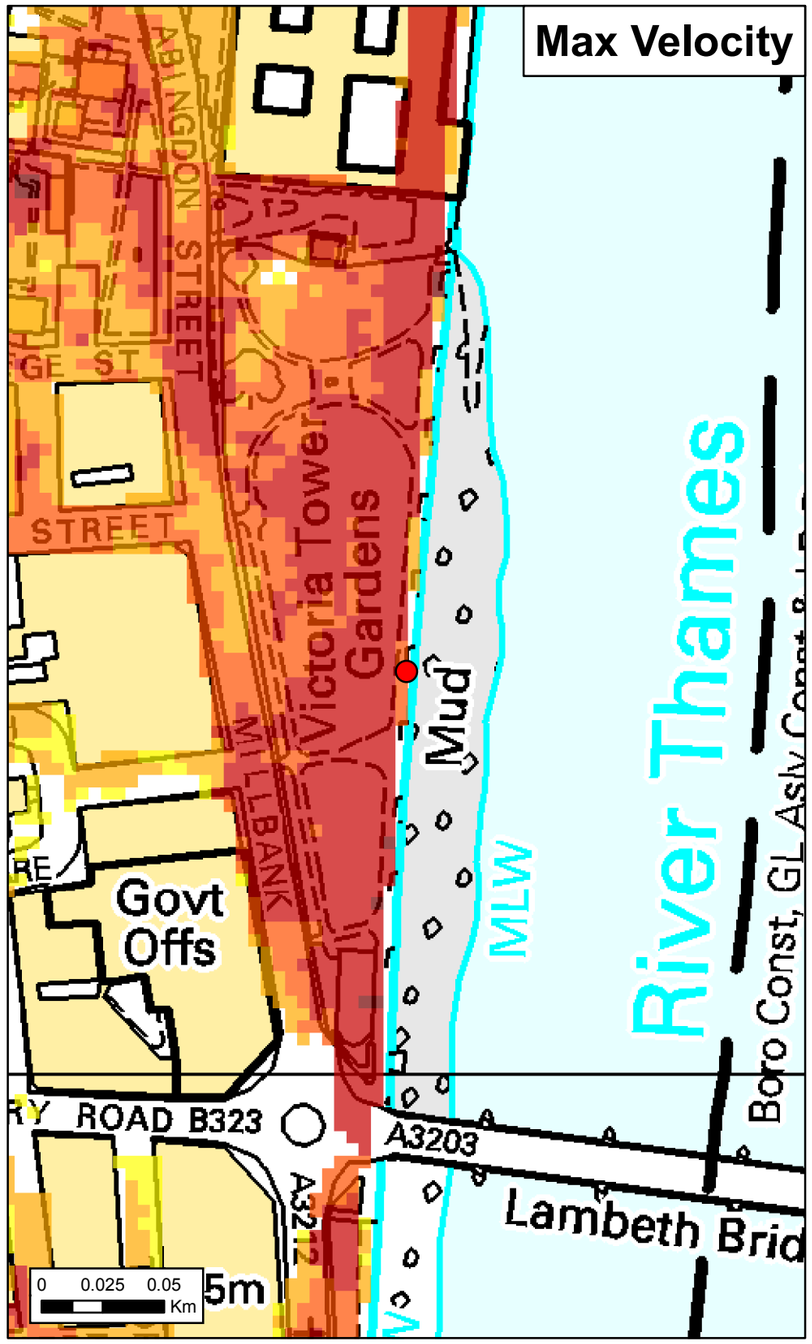
Thames Tidal Breach Hazard Mapping

Map Centred on 530287, 179163







Max Hazard

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.00 (Danger for Most)
- Greater than 2.00 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- > 2.5

Date Printed	31/10/2018	**Scenario year**	2100	**Scenario Annual Chance**	0.1% (1 in 1000)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.

General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

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Thames Tidal Breach Hazard Mapping

Map Centred on 530287, 179163

Appendix C. Environment Agency Pre Application Response

creating a better place

Environment Agency

Clare Grout
Atkins Limited
Strategy, Assessment and Management
By email: clare.grout@atkinsglobal.com

Our ref: NE/2017/126757/01-L01

Date: 6 April 2017

Dear Clare

Victoria Tower Gardens, Millbank, Westminster, London, SW1P 3JA

UK National Holocaust Memorial and learning centre.

Thank you for the above pre-application enquiry. The response below is a preliminary opinion of the constraints which should be considered for the proposed use at this site. I understand that you may only be focusing on one aspect of the development, however I have included all the environmental constraints and opportunities for the site within our remit. If you would like further advice, such as the review of a Flood Risk Assessment (FRA), we now charge for this service. Further information about this can be found on our website.

The proposals raise some environmental concerns/issues and the developer will need to undertake further work to show how these issues can be satisfactorily addressed to ensure no adverse environmental impacts.

We have identified, based on the information you have provided and our available records, the following constraints for this site:

- Within 16m of the river Thames designated a main river
- Is adjacent to the Thames tidal defences
- Is in flood zone 2/3

Flood Risk

The application site lies within Flood Zone 3, defined by Table 1 of the National Planning Practice Guidance: Flood Risk and Coastal Change (section 25) as having a high probability of flooding. Footnote 20 paragraph 103 of the National Planning Policy Framework (NPPF) requires applicants for planning permission to submit a Flood Risk Assessment (FRA) when development is proposed in such locations.

The FRA must demonstrate that the development does not increase flood risk on or off site and should include (but not necessarily be limited to) the following:

- Consideration of the level of flood risk and whether the proposed use would be appropriate in accordance with its vulnerability classification outlined within Table 2 of the Planning Practice Guidance: Flood Risk and Coastal Change (section 25).
- Identification of the level of flood risk on the site and consideration of the impact a range of flood events would have on the proposed development.
- Confirmation of any flood defences and standard of protection provided, to confirm the level of residual risk in accordance with the Strategic Flood Risk Assessment (SFRA) for Westminster City Council.

- Estimation of flood depths at the site for a range of flood events, to calculate internal flood depths and level of refuge required in the event of a breach or failure of the flood defences.
- Appropriate and realistic flood mitigation measures based on flood characteristics at site.
- Details of set back of the development from the riverbank / defence.

To request flood risk data, you can email: HNLenquiries@environment-agency.gov.uk.

For further information on our flood map products please visit our website.

Thames Estuary 2100 (Tidal Defences)
In line with requirements set out in the Thames Estuary 2100 (TE2100) plan, any application in this location will need to demonstrate how the flood defence could be raised in the future to meet the demands of climate change.

No activities on site should preclude access to the flood defence from maintenance or prevent the future raising of flood defences. In some cases we hold technical drawings of flood defence structures which may be of use in designing your scheme. To request these you should contact our customers and engagement team at HNLenquiries@environment-agency.gov.uk.

Flood Risk Activity Permit
Under the terms of the Environmental Permitting Regulations a *Flood Risk Activity Permit* is required from the Environment Agency for any proposed works or structures, in, under, over or within 16 metres of the top of the bank of the river Thames, designated a 'main river'.

Details of lower risk activities that may be Excluded or Exempt from the Permitting Regulations can be found on the gov.uk website. For further information please contact us at PSO-Thames@environment-agency.gov.uk.

Please note that the view expressed in this letter by the Environment Agency is a response to a pre application enquiry only and does not represent our final view in relation to any future planning application made in relation to this site.

We reserve the right to change our position in relation to any such application. You should seek your own expert advice in relation to technical matters relevant to any planning application before submission.

This opinion is based on the information submitted and current planning policy and guidance.

If you have any questions please contact me on 0208 474 5538 or email me at HNLSustainablePlaces@environment-agency.gov.uk, quoting the reference at the beginning of this letter.

If you have any further queries please contact us.

Yours sincerely

Edward Crome
Sustainable Places Planning Advisor
Telephone: 0208 474 5538
E-mail: HNLsustainableplaces@environment-agency.gov.uk

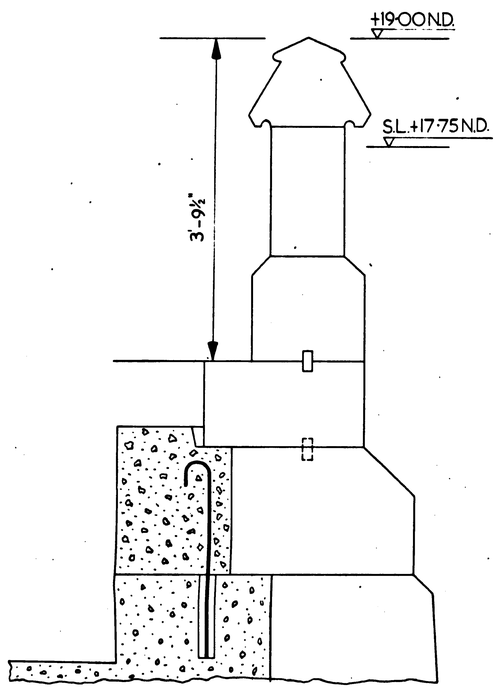
Appendix D. Technical Drawings

HE/TF/D. 1032

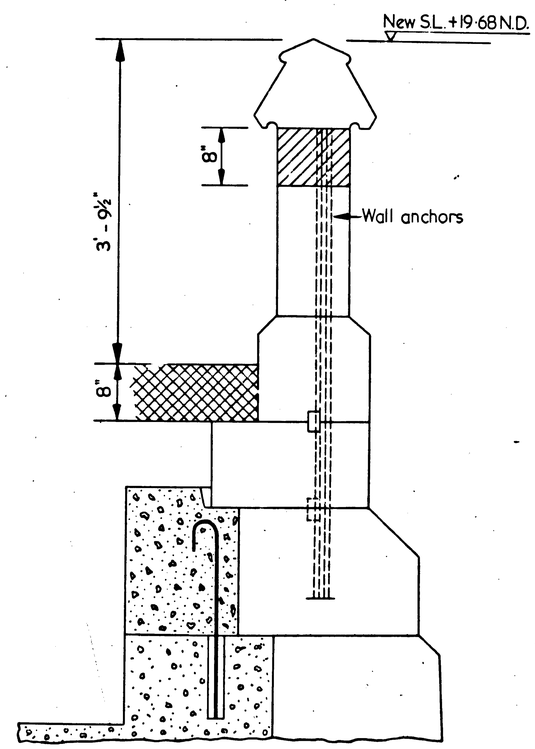
1. 11. 70

FIGURE 9.
EMBANKMENT WALL RAISINGS
VICTORIA TOWER GARDENS NORTH

EXISTING PARAPET



NOMINAL 2 FT RAISING AND
STRENGTHENING OF PARAPET



Strengthening only required for nominal 1 ft. raising.

Note :

Similar measures proposed for :
Victoria Tower Gardens South
Chelsea Embankment West
Chelsea Embankment East

Scale :- 1" to 1'

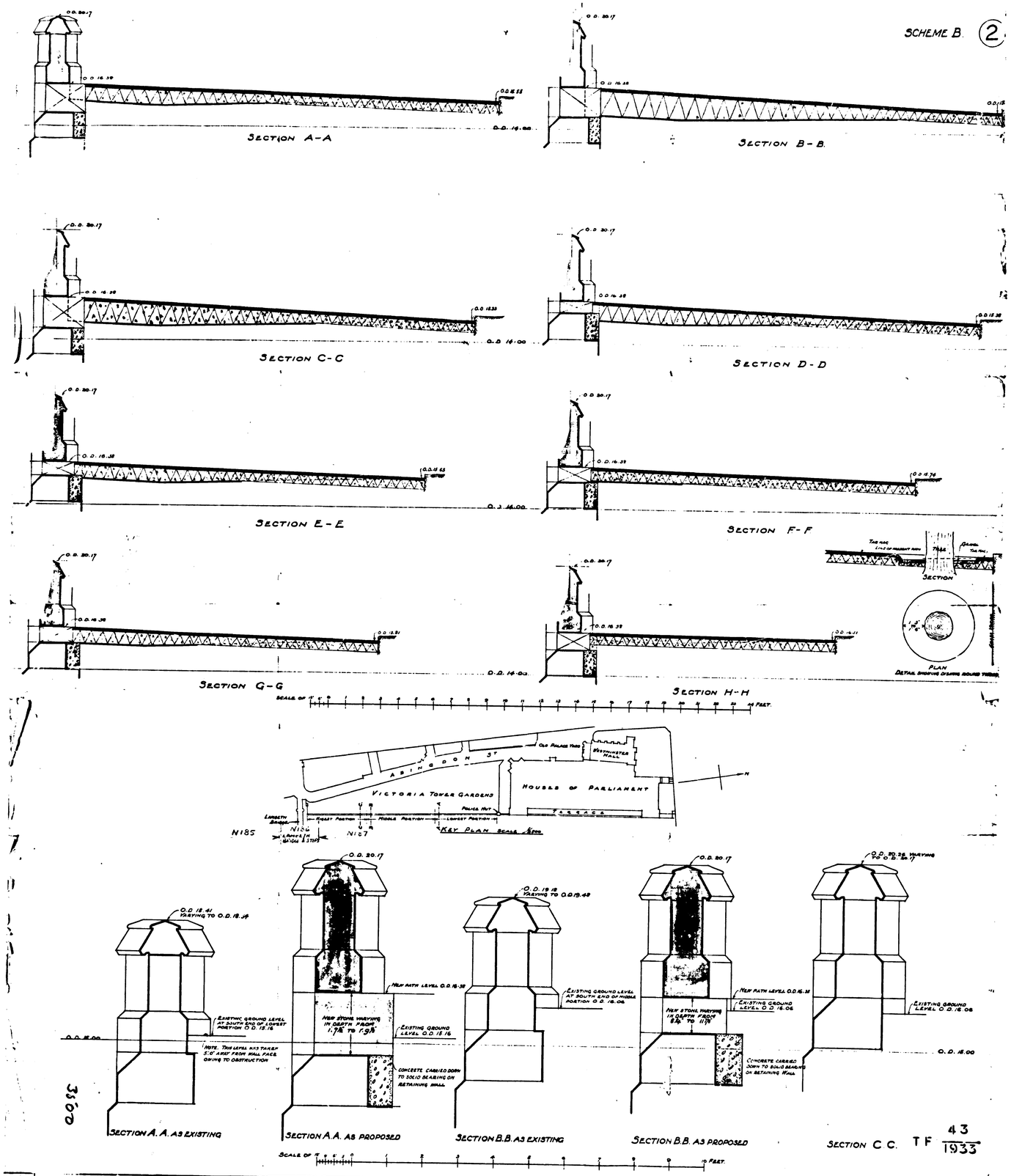
Granite insert

Pavement raising

OFFICE COPY

R

SCHEME B. (2)

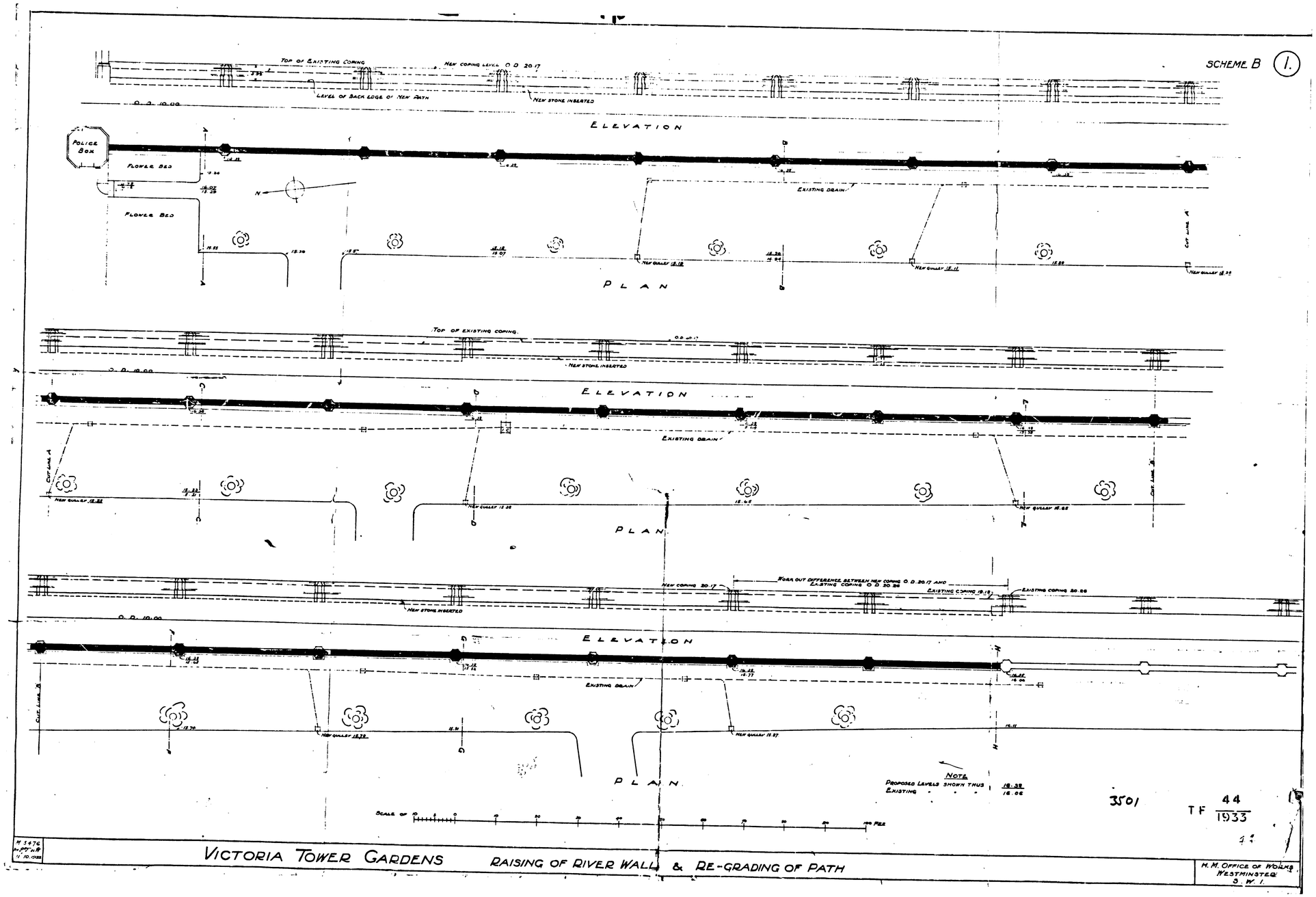


TF 43/1933

VICTORIA TOWER GARDENS RAISING OF RIVER WALL & RE-GRADING OF PATH

H. M. OFFICE OF WORKS WESTMINSTER

SCHEME B (1.)

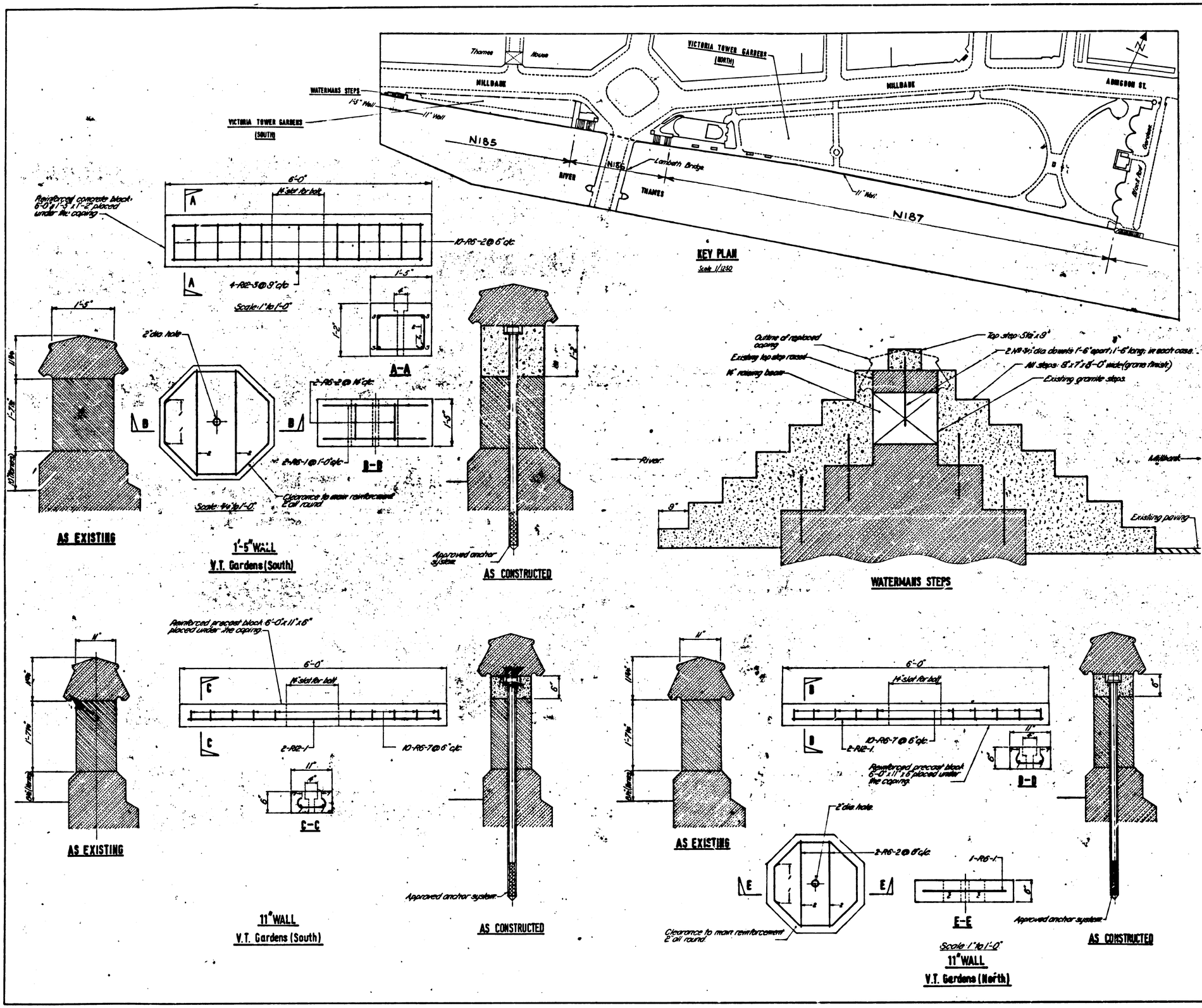


3501

TF 44/1933

ANGULA

MICROBOX



Notes:

TF 317/1981

Rev	Date	Subject

GREATER LONDON COUNCIL
DEPARTMENT of PLANNING and TRANSPORTATION

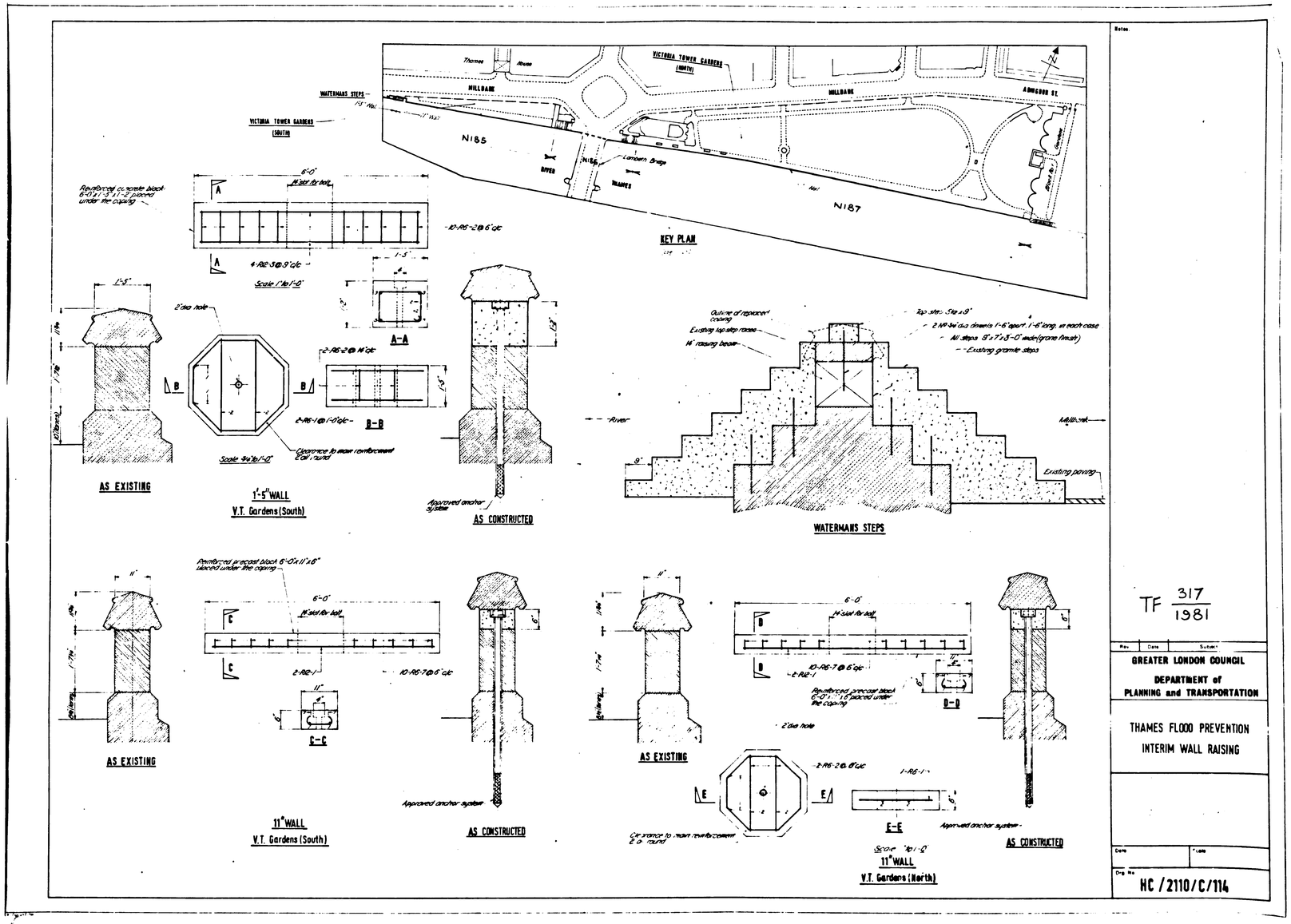
THAMES FLOOD PREVENTION
INTERIM WALL RAISING

Victoria Tower Gardens

Date | Scale

Drg No HC/2110/C/114

TF 317/1981



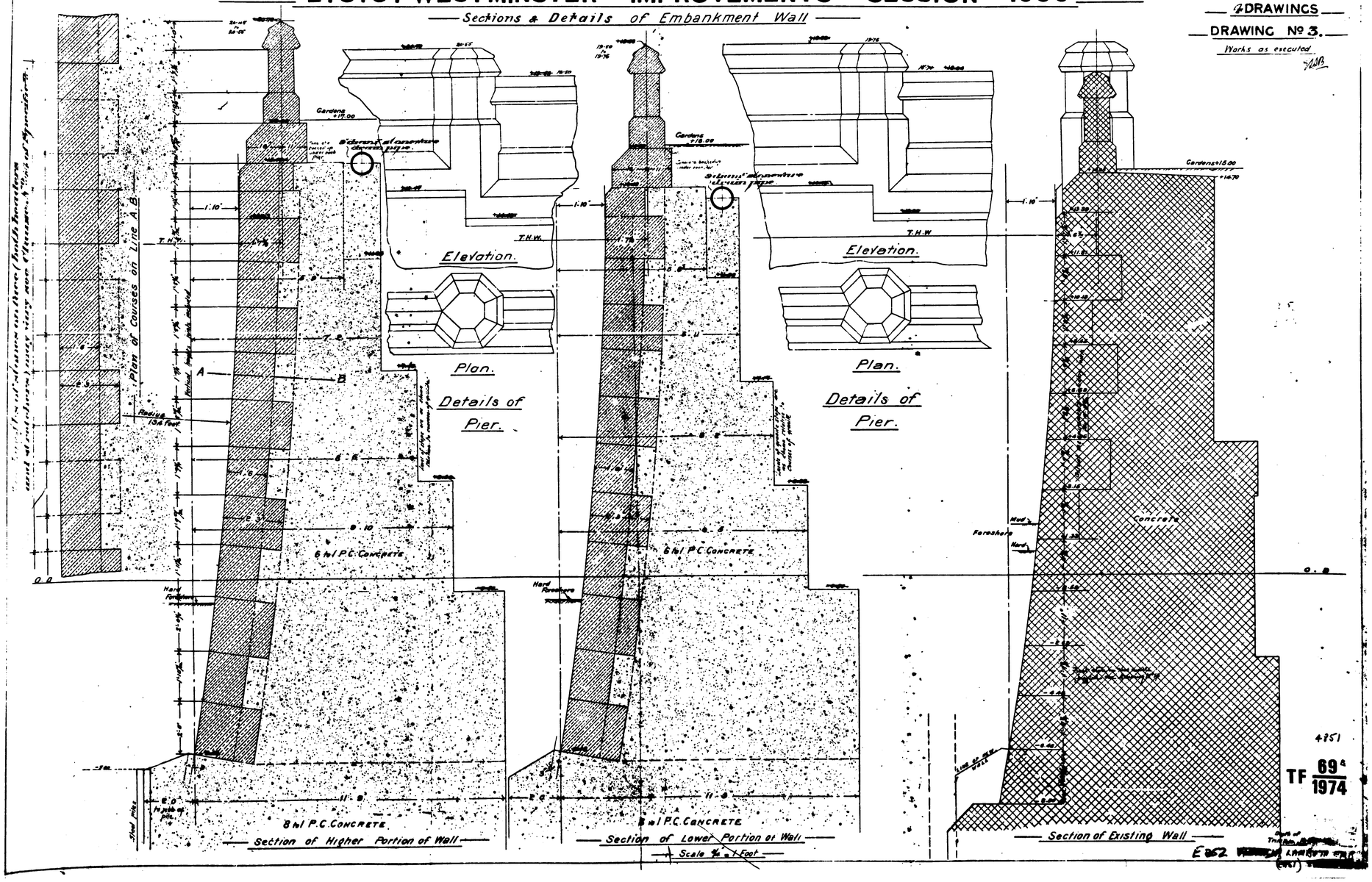
L.C.C. WESTMINSTER IMPROVEMENTS SESSION 1900

Sections & Details of Embankment Wall

4 DRAWINGS

DRAWING No 3.

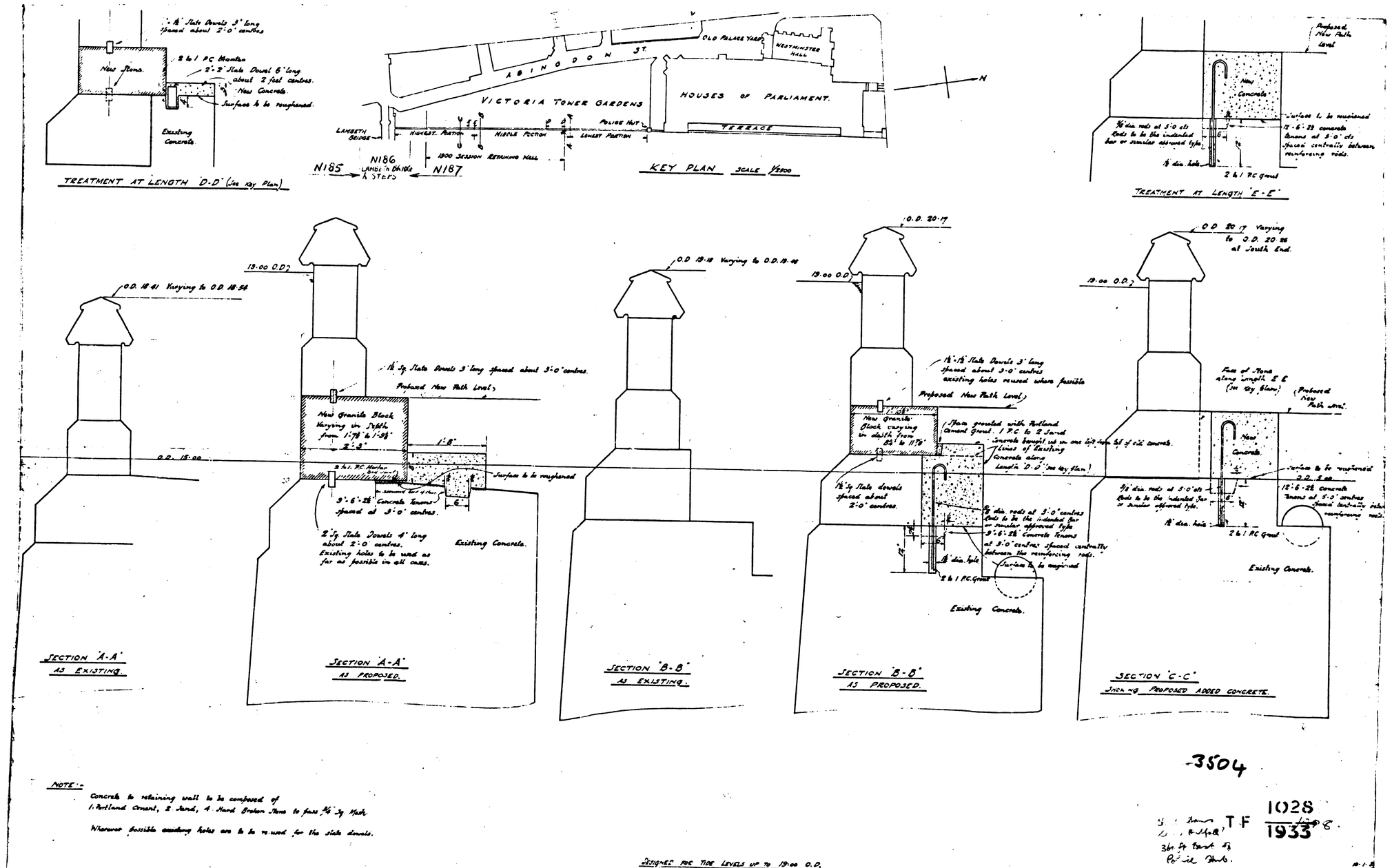
Works as executed



4851

TF 69a/1974

E 852



NOTE:-

Concrete to retaining wall to be composed of 1 Portland Cement, 2 Sand, 4 Hard Broken Stone to pass ¾" Sq Mesh.

Wherever possible existing holes are to be re-used for the slate dowels.

DESIGNED FOR TIDE LEVELS UP TO 19.00 O.D.

-3504

HOUSES OF PARLIAMENT. VICTORIA TOWER GARDENS.	PROPOSED RAISING OF RIVER WALL.	SCALE:- 1"=1'-0".	H.M.O.W. WESTMINSTER.	STR. SK. No. 515/78

DEC 1932.

Appendix E. Flood risk planning guidance

E.1. Flood Zone Definition

The Environment Agency's Flood Map is divided into three separate Flood Zones. These Flood Zones are used by NPPF in determining the appropriateness of proposed developments when considering flood risk through the application of the Sequential Test. They represent the probability of flooding without flood defences in place.

The Flood Zones are defined as:

- Flood Zone 1 – Areas with a 'Low Probability' of flooding and where the annual chance of flooding is lower than 0.1% for either fluvial or sea flooding;
- Flood Zone 2 – Areas with a 'Medium Probability' of flooding and where the annual chance of flooding is between 0.1 and 1.0% for fluvial flooding or between 0.5 and 0.1% for flooding from the sea; and
- Flood Zone 3 – Areas with a 'High Probability' of flooding and where the annual chance of flooding is 1.0% or greater for fluvial flooding or 0.5% or greater for sea flooding. Flood Zone 3 is sub divided into two further classifications:
  - Flood Zone 3a - High Probability
  - Flood Zone 3b - Functional floodplain where water has to flow or be stored in times of flood.

The Environment Agency's Flood Map also defines Areas Benefitting from Defences (ABDs) within Flood Zone 3, however this category is not expressly determined within NPPF or the Sequential Test process.

NPPF provides guidance on assessing the vulnerability of land uses in relation to flood risk and classifies new developments into one of five categories:

- Essential Infrastructure;
- Water Compatible;
- Less Vulnerable;
- More Vulnerable; and
- Highly Vulnerable.

E.2. Flood Risk Vulnerability Classification

Land Use Vulnerability	Type of Development
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk Essential utility infrastructure, which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly Vulnerable	Police Stations, Ambulance Stations and Fire stations, Command Centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent.
More Vulnerable	Hospitals.

Land Use Vulnerability	Type of Development
	Residential institutions such as care homes, children's homes, social services homes, prisons and hostels. Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs and hotels. Non-residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short let caravans and camping, subject to specific warning and evacuation plans.
Less Vulnerable	Police Stations, Ambulance Stations and Fire stations which are not required to be operational during flooding. Buildings used for: shops, financial, professional and other services; restaurants and cafes, hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except for landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment plants which do not need to remain operational during times of flood. Sewage treatment plants (if adequate pollution control measures in place).
Water Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and Gravel workings. Docks, Marinas and Wharves. Navigation facilities. MOD installations. Shipbuilding, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water based recreation (excluding sleeping accommodation). Lifeguard and coastguard operations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to specific warning and evacuation plans.

E.3. Flood Risk Vulnerability and Flood Zone Compatibility

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

Flood Zones			Flood Risk Vulnerability Classification		
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:
✓ Development is appropriate
✗ Development should not be permitted.

Notes to table:
•This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
•The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
•Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.
† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.
* In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:
•remain operational and safe for users in times of flood;
•result in no net loss of floodplain storage;
•not impede water flows and not increase flood risk elsewhere.

E.4. The Sequential and Exception Tests

E.4.1. Sequential Test

NPPF states that the 'Sequential Test' should be carried out when allocating land for development to demonstrate that there are no alternative sites available for development in areas that are at a lower risk of flooding. As outlined within the NPPF, for the purpose of the Sequential Test the Strategic Flood Risk Assessments (SFRA) flood maps should be used in preference to the Environment Agency flood mapping where available.
When an area is at risk from either fluvial or coastal flooding then development should be allocated outside Flood Zones 2 and 3 where possible. However, if there are no reasonable sites available for development within Flood Zone 1 then depending upon flood vulnerability, some developments can be permitted in Flood Zones 2 or 3 if they are designed to be safe without increasing flood risk elsewhere and remain operational in the event of flooding.

E.4.2. Exception Test

It is not always possible to locate development in areas that are at the lowest risk of flooding. In certain circumstances the Exception Test is therefore required, which if passed will allow development to go ahead.
The purpose of an Exception Test is to demonstrate that there are wider sustainability reasons for development at a specific location based on issues other than flood risk.

E.5. Demonstrating the flood risk Sequential Test

For Planning Applications the approach below is used by Local Planning Authorities (LPA) to apply the Sequential Test to planning applications located in Flood Zones 2 or 3. The approach provides an open demonstration of the Sequential Test being applied in line with NPPF and flood risk Practice Guide. Close working between LPA development control and forward planning departments will be required to implement the Sequential Test effectively.

Paragraph 101 of the NPPF states that "the aim of the Sequential Test is to steer development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the Scheme in areas with a lower probability of flooding."
Note: the Sequential Test does not apply to Change of Use applications.

E.5.1.1. Stage 1 - strategic application & development vulnerability

Q1.1 Has the Sequential Test already been carried out for this development at Local Plan level? If yes, reference should be provided for the site allocation and Local Plan document in question.
Q1.2 Is the flood risk vulnerability classification of the proposal appropriate to the Flood Zone in which the site is located according to tables 1 and 3 of technical guidance to the NPPF? The vulnerability of the development should be clearly stated.
Finish here if the answer is Yes to BOTH questions 1.1 and 1.2
Only complete stages 2 and 3 if the answer to EITHER questions 1.1 or 1.2 is `No'

E.5.1.2. Stage 2 - defining the evidence base

Q2.1 State the geographical area over which the test is to be applied.

Q2.2 If greater or less than the district boundary justify why the geographical area for applying the test has been chosen.

Identify the geographical area of search over which the test is to be applied - this will usually be over the whole of the LPA area but may be reduced where justified by the functional requirements of the development (e.g. catchment area for a school or doctors surgery) or relevant objectives in the Local Plan. For example, if a local need such as affordable housing or town centre renewal has been identified as part of the Sustainability Appraisal process that has reached `submission' stage, this might mean that the geographical area of search is restricted to a specific regeneration area. Equally, in some circumstances it may be appropriate to expand the search area beyond the LPA boundary for uses that have a sub-regional, regional or national market. For example, the location of an oil refinery serving the whole country should be determined on a countrywide basis
Q2.3 Identify the source of reasonably available sites, either:

- background/evidence base documents (state which), or if not available
- other sites known to the LPA that meet the functional requirements of the application.

Identify the source of `reasonably available' alternative sites - these sites will usually be drawn from the evidence base/background documents that have been produced to inform the emerging Local Plan.
In the absence of background documents, `reasonably available' sites would include any sites that are known to the LPA and that meet the functional requirements of the application in question, and where necessary, meet the Local Plan Policy criterion for windfall development (see box below).
Windfall sites
Windfall sites are those which have not been specifically identified as available in the Local Plan process. They comprise previously-developed sites that have unexpectedly become available.
The acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.
In the absence of a flood risk windfall policy, it may be possible (where the data is sufficiently robust) for the LPA to apply the Sequential Test taking into account historic windfall rates and their distribution across the district relative to Flood Zones. Where historic and future trends evidence indicate that housing need in the district through windfall can be met largely/entirely by development outside high flood risk areas, this may provide grounds for factoring this into the consideration of `reasonably available' alternative sites at the planning application stage.
Q2.4 State the method used for comparing flood risk between sites, either:

- Environment Agency Flood Map, or
- An up to date Strategic Flood Risk Assessment (SFRA) held by the LPA, or
- Site specific Flood Risk Assessments (FRA) where they are suitable for this purpose, or
- Another map or sources of flooding information not listed (state which).

Identify the means of comparing flood risk between each site - as a starting point this will be the Environment Agency Map showing the Flood Zones. If comparing sites within the same Flood Zone

it is necessary to use a SFRA showing a variation in risk throughout the Flood Zone or site specific FRAs where these are available and suitable for the purpose.

E.5.1.3. Stage 3 - applying the Sequential Test

Compare the reasonably available sites identified under stage 2 with the application site. Sites should be compared in relation to flood risk; development plan status; capacity; and constraints to delivery including availability, policy restrictions, physical problems or limitations, potential impacts of the development, and future environmental conditions that would be experienced by the inhabitants of the development.

Q3.1 State the name and location of the reasonably available site options being compared to the application site.

Q3.2 Indicate whether flood risk on the reasonable available options is higher or lower than the application site. State the Flood Zone or SFRA classification for each site.

Q3.3 State whether the reasonably available options being considered are allocated within the Local Plan. Confirm the status of the Plan.

Q3.4 State the approximate capacity of each reasonably available site being considered. This should be based on:

- The density policy within the Local Plan, and
- Past performance in this respect.

Q3.5 Detail any constraints to the delivery of identified reasonably available options; for example, availability within a given a time period or lack of appropriate infrastructure. This part of the test should include recommendations on how these constraints could be overcome and when.

E.5.1.4. Sequential Test conclusion

Are there any reasonably available sites in areas with a lower probability of flooding, that would be appropriate to the type of development or land use proposed?

E.6. Exception Test

Application of the Sequential Test should ensure that more vulnerable property types, such as residential housing, will not be allocated to areas at high risk of flooding. In exceptional circumstances, there may be valid reasons for a development type which is not entirely compatible with the level of flood risk at a particular site to nevertheless be considered. In these circumstances, it will be necessary for the LPA or developer to demonstrate that the site qualifies for development in the manor proposed by passing all elements of the Exception Test.

There are 3 stringent conditions that must be fulfilled:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk;
- the development must be on developable previously-developed land, or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and
- a site-specific FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall.

It is the responsibility of the developer to develop a comprehensive flood risk management strategy for the site in question, covering:

- the design of any flood defence infrastructure;
- access;
- operation and maintenance;
- resident awareness
- flood warning; and
- evacuation procedures and funding arrangements.

Where necessary, the Exception Test should now be applied in the circumstances set out by table 1 and 3 of the technical guidance to the NPPF.

Applying the sequential approach at site level

In addition to the formal Sequential Test, the NPPF sets out the requirement for developers to apply the sequential approach (see paragraph 103, first bullet point) to locating development within the site. As part of their discussions with planning applicants, LPAs should ask the following questions:

- Can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?
- Has the applicant demonstrated that less vulnerable uses for the site have been considered?
- Can density be varied to reduce the number or vulnerability of units located in higher risk parts of the site?

E.7. Climate Change

The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and supporting planning practice guidance on Flood Risk and Coastal Change explain when and how Flood Risk Assessments should be used. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account. Local planning authorities refer to this when preparing local plans and considering planning applications.

As of 19th February 2016 the government updated the climate change guidance which is to be considered during the planning process. This supersedes the climate change guidance within the Planning Practice Guidance, where typically a 20% allowance on river flows was given. Further details can be found at:

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

The updated percentage allowances for climate change required for consideration in development is dependent on the following factors:

- Regional/catchment location within the UK;
- Development type, in line with the planning practice guidance on Flood Risk and Coastal Change (see below);
- Flood Zone of development, as shown on the Environment Agency Flood Zone maps or Strategic Flood Risk Assessment; and
- Lifetime of development, allowances are provided up to 2115 and therefore the anticipated lifetime of the development will in part determine the allowance required.

Appendix F. Local Planning Policy

Westminster City Plan

Consolidated with all changes since November 2013

Revision to Westminster's City Plan

November 2016

City of Westminster

This November 2016 version incorporates all changes since November 2013, including those made as part of the Mixed Use Revision, Basements Revision, Special Policy Areas Revision and Policies Map Revision.

Land Use Pie Charts for areas in Part III are based on pipeline data from Westminster City Council's land use monitoring.

Photographic references:
Page 12: "Pumphouse, Pimlico District Heating Undertaking" by Jodi Squirmelia
Page 16: Image of Westminster by Wenzer Holler dated 1647 reproduced with permission of Westminster City Archives
Page 43: Photograph courtesy of Savile Row Bespoke
Page 46: 'A literary party at Sir Joshua Reynolds''
Page 63: Legible London photograph from Transport for London
Page 102: Carmine, Merchant Square, Paddington, W2 . Client: European Land & Property Ltd. Architect: Mossessian & Partners
Page 117: Gap House, Bayswater, W2. Client: Luke Tozer. Architect: Pitman Tozer
Page 137: Hybrid Bus from Volvo
Page 143: Westminster Academy, Harrow Road, W2. Client: Westminster Academy, Westminster City Council, DCSB and Exilarch Foundation. Architect: Tim Soar/Alford Hall Monaghan.
Page 146: Aerial photo from www.maps.live.com
Page 154: Composite image from CityWest Homes
Page 158: Oxford Street photograph from Transport for London taken by Ian Bell
Page 160: Underground photograph from Transport for London

FOREWORD

Welcome to Westminster's City Plan

Westminster is unique. It is not only home to parliament, the Monarchy and Royal Parks, but also world class tourist attractions, London's two International shopping centres, the highest number of historic buildings in the country, over 250,000 residents, and more businesses than the City and Canary Wharf combined. Westminster accommodates the lively West End, and areas dominated by offices and commercial uses; by nationally important tourism and cultural uses, and world famous specialist uses; all sitting cheek by jowl with residential areas and essential local community facilities.

Westminster City Council is committed to providing an excellent service to this wide and varied community. In this plan we will build on the things we value: we will improve our neighbourhoods; provide enhanced opportunities for our local communities; and deliver sustainable economic growth. We will make Westminster the foremost world class city, with exemplary sustainable design.

We are moving into a new era, where everyone can and should expect the best. Westminster's City Plan will rise to the challenge of managing this unique and complex environment for the next 20 years. It sets out a vision for the future of our unique city: a future of opportunity, improvement, and carefully managed growth and change.

Westminster's City Plan has been produced in conjunction with key stakeholders, partners and the local community, and is the 'spatial expression' of our vision of the future, including priorities for delivering a better city and better lives and the delivering the Sustainable Community Strategy. It has been written to see us through the next 20 years, whatever they may hold: environmental challenges: complex and changing economic circumstances: and outstanding international events, to further enhance Westminster's and London's world class city status: to recognise its global importance: and increase its international competitiveness.

I would like to thank all those involved in the production of this document and in the development of Westminster. We will continue to work with our partners, stakeholders, businesses and residents to deliver our vision, and achieve a city that we can all be proud of.

Councillor Robert Davis MBE DL
Deputy Leader of Westminster City Council
Cabinet Member for the Built Environment

Flood Risk

5.24 As a riverside borough, some parts of Westminster identified by the Environment Agency have been designated Flood Zone 2 and Flood Zone 3. Flood Zone 3, without defences, has a high probability of flooding (1 in 100 or greater annual probability of river flooding or a 1 in 200 or greater annual probability of flooding from the sea). Flood Zone 2, without defences, has a medium probability of flooding, and covers very small areas in Westminster. Local authorities must carry out a Strategic Flood Risk Assessment (SFRA) to assess all forms of flooding within their area and develop strong policies to reduce risk. Westminster's SFRA identifies areas in Flood Zones 2 and 3, areas most at risk of flooding within Flood Zone 3 and from other sources. The Embankment Wall and the Thames Barrier provide Westminster with excellent flood defences which decrease flood risk to about 1 in 1,000 annual probability. If however these defences were to be significantly breached, those low lying areas that are closest to the Thames would flood very quickly. This area is identified on the map below as the Rapid Inundation Zone. This was identified by Westminster's SFRA which modelled the timing and depth of flooding following breaches in the tidal flood defence wall.

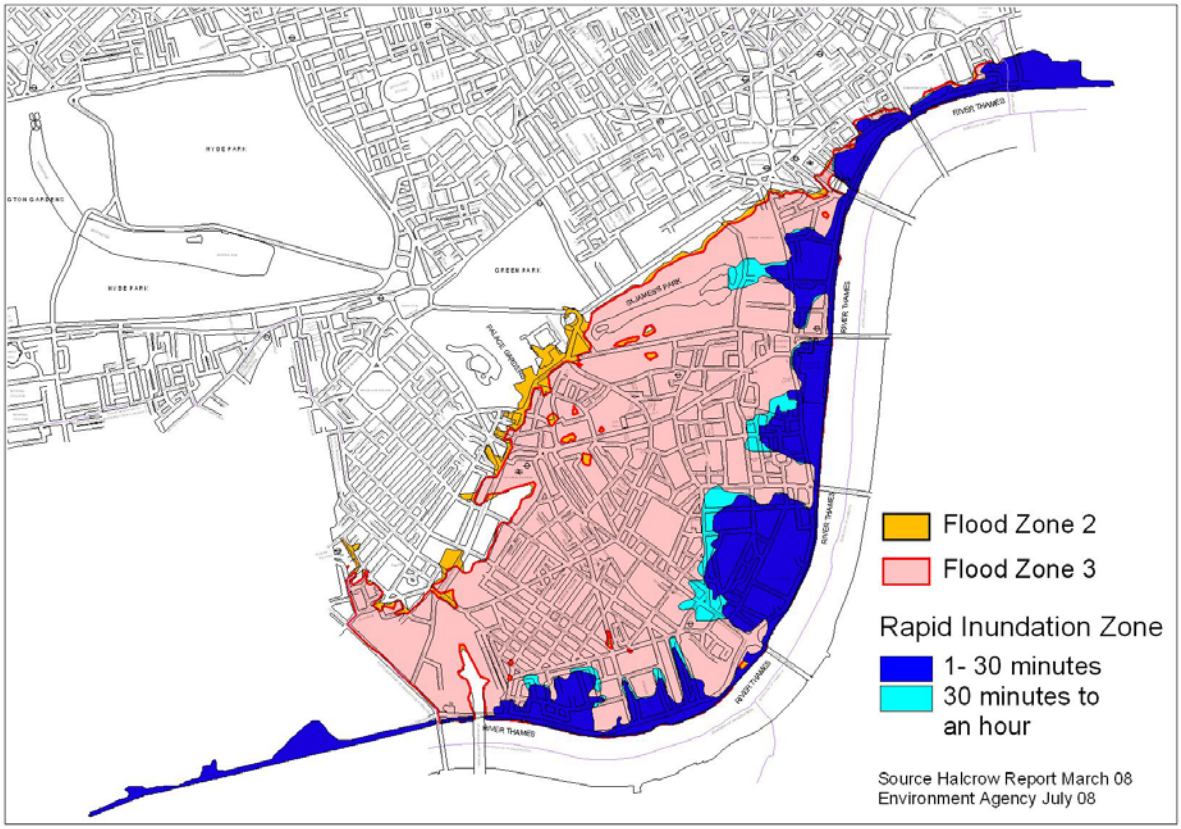


Figure 44 Flood Zone 3 and Areas most at risk of rapid inundation

5.25 Sites within Flood Zone 3 are not suitable for Highly Vulnerable Uses as defined by the Technical Guidance to the National Planning Policy Framework (NPPF). This includes:

basement dwellings; police, ambulance and fire stations and command centres and telecommunications installations that would be required to be operational during flooding and emergency dispersal points.

5.26 There are nine strategic sites identified for development within Flood Zone 3 which include a preferred use for residential accommodation and/or social or community use on part or all of the site, including one within the Victoria Opportunity Area. Residential accommodation is a More Vulnerable Use (as defined in the Technical Guidance to the NPPF) and, in terms of flood risk, should ideally be placed in the lowest possible risk area. To bring forward an adequate supply of housing, given the highly complex nature of the built environment and the general lack of available land in Westminster, the provision of residential accommodation is required in almost all schemes in Westminster.

5.27 To support residents and achieve sustainable communities, social and community uses also need to be located in areas where they serve the local population. Therefore, the identified sites within Flood Zone 3 and other sites that may come forward from windfall development are considered to have passed the Sequential Test set out in the NPPF. Proposals must then be considered against the Exception Test as set out in the NPPF for More Vulnerable Uses and for Essential Infrastructure. However, to build in resilience, ground and basement floor uses will be carefully considered.

5.28 In addition to flooding from the River Thames, there are other potential sources of flooding; from surface water, sewers, groundwater, canals, water features and water mains. Given the densely built-up nature of Westminster, a likely source is from surface water flooding where rainwater is unable to soak into the ground or drain away. This may become a more common occurrence in the future as climate change results in an increase in the incidence and severity of heavy rainfall.

POLICY S30 FLOOD RISK

Highly Vulnerable Uses will not be allowed within Flood Zone 3, and in Flood Zone 2 will be required to pass the Exception Test.

Proposals for Essential Infrastructure and More Vulnerable Uses within Flood Zone 3 will be required to pass the Exception Test. Within the Rapid Inundation Zone, new residential units below the tidal breach flood level and extensions to residential at basement level will not be acceptable.

All development proposals should take flood risk into account and new development should reduce the risk of flooding.

Reasoned Justification

This ensures that development is located in the most appropriate location in terms of risk of flooding from the River Thames and vulnerability classification, taking into account the constraints on development potential across the whole of Westminster and the lack of opportunities to develop in other parts of the borough.

Whilst there is a need to adapt to the effects of climate change, this approach also acknowledges the excellent flood defences in place, which will continue to be necessary in the future to protect the existing built infrastructure along the riverside.

The policy ensures that all sources of flooding are taken into account and that potential flood risk in Westminster is reduced through mitigation measures.

Proposals should provide Flood Risk Assessments as required by the National Planning Policy Framework.

Cross-reference to Policy S45 Flood-related Infrastructure; Appendix 1 Proposals Sites in Victoria Opportunity Area and Strategic Sites within Flood Zone 3.

Air Quality

5.29 Westminster has some of the poorest air quality in the country. For this reason, the whole borough was declared an Air Quality Management Area (AQMA) in 1999 for nitrogen dioxide (NO_2) and particulates (PM_{10}). In Westminster, concentrations of NO_2 and particulates regularly exceed the Air Quality Objectives as set out in the national Air Quality Strategy and in European legislation.

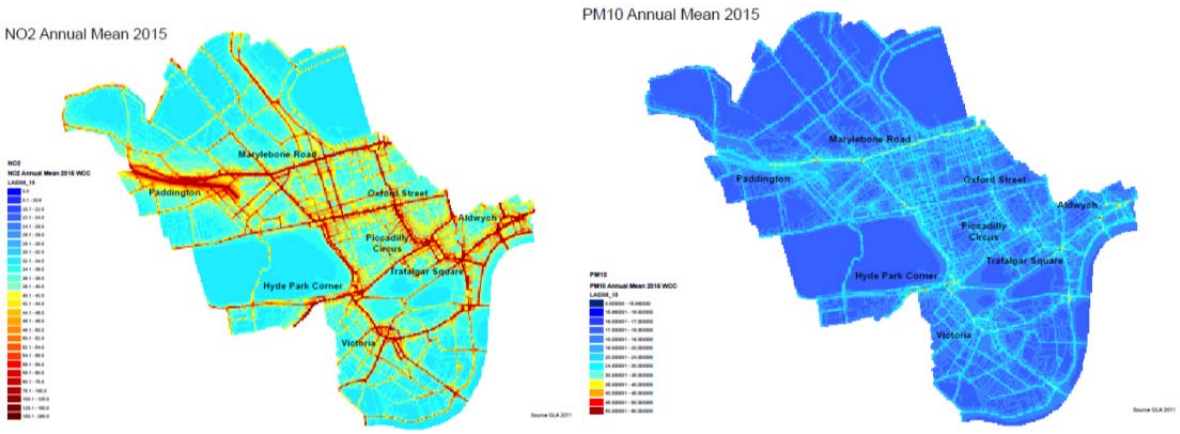


Figure 45 2010 Modelled Annual Average Pollution Exceedances for Nitrogen Dioxide (left) and Particulates (right)

Flood Related Infrastructure

5.83 As a riverside borough, Westminster is potentially susceptible to tidal and fluvial flooding from the River Thames. However, Westminster has excellent flood defences from the Embankment Wall and Thames Barrier which greatly reduce the risk of flooding. The Environment Agency is reviewing how flood risk will be managed over the next 100 years, including how flood defence infrastructure will need to be upgraded when existing infrastructure comes to the end of its useful life during the period 2030-2060. This will need to take potential impacts of sea-level rise as a result of climate change into account. The council will work with the Environment Agency to ensure flood defence infrastructure is in place to protect the city.

Policy S45 Flood-Related Infrastructure

Development will ensure that flood-related infrastructure is protected and access for maintenance is retained.

The council will work with its partners at a regional and, where necessary, multi-regional level to ensure flood-related infrastructure remains fit for purpose.

Reasoned Justification

This approach acknowledges the excellent flood defences in place, whilst acknowledging that there is a need to adapt to the effects of climate change in the long-term, which will continue to be necessary in the future to protect the existing built infrastructure along the riverside.

Thames Tunnel

5.84 Most of Westminster, like most of London, is served by combined sewers designed in the 1860s, which receive foul water, and water from roofs, hard standing and sometimes the highways. During rainy periods the sewers fill up and overflow through a series of overflow outlets from the combined sewers into the River Thames and its tidal tributaries. This overflow results in the release of 38 million tonnes of raw sewage each year into the river, affecting water quality and biodiversity. Specialist barges are currently used to oxygenate the river to mitigate for the impacts of

combined sewer overflows on wildlife; however this still results in a breach of the requirements of the EU Urban Waste Water Treatment Directive (1991).

5.85 In London, given the growth in development and population, the strain on the existing system can trigger an overflow in the combined sewers even from relatively modest rainfall. During wet spells, the sewers fill up with rainwater very quickly. The impact of climate change, in terms of intensified rainfall events, is likely to increase the number of combined sewer discharges in the River Thames.

5.86 Thames Water is developing plans for a Thames Tunnel, a scheme to reduce and limit pollution from the sewerage system for the whole of London, in order to comply with EU Urban Waste Water Treatment Directive (1991). The Thames Tunnel project, if approved, is due to commence after 2012 and be completed by 2025. The council supports necessary infrastructure of this nature, subject to their detail and assessment of impacts.

POLICY S46 THAMES TUNNEL

The council will work with Thames Water and the other relevant authorities to support the timely implementation of the Thames Tunnel project, including the connection of the combined sewer overflows in the city.

Reasoned Justification

The Thames Tunnel project will help to reduce and limit pollution necessary to comply with the EU Urban Waste Water Treatment Objective (1991).

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[i] Public Health Annual Report 2006/2007 pg 87 recommendations for health inequalities in Westminster
[ii] Adapted from Public Health Annual Report 2006/2007 including diagram from Dahlgren and Whitehead 1991
[iii] DEFRA Air pollution: Action in a Changing Climate 2010
[iv] Report on estimation of mortality impacts of particulate air pollution 2010
[v] Open Space Strategy Supplementary Planning Document, 2007
[vi] Retrofitting Soho, 2008, paragraphs 5.63 to 5.90
[vii] Retrofitting Soho, 2008, paragraphs 3.53 to 3.61 and 5.68 to 5.71, as well as other sections
[viii] Retrofitting Soho, 2008, paragraphs 5.107 to 5.117
[ix] Census 2001
[x] TfL London Travel Demand Survey
[xi] The Importance of the Historic Environment in Westminster, 2007
[xii] Draft Land for Industry and Transport SPG
[xiii] London Plan Policies 5.16 and 5.16

City of Westminster

Westminster City Hall, 64 Victoria Street, London SW1E 6QP
Planning policy helpline: 020 7641 2503
www.westminster.gov.uk/revision-westminsters-city-plan

Appendix G. River Wall Visual Condition Survey

UK Holocaust Memorial Foundation

RIVERWALL VISUAL CONDITION SURVEY

UK National Holocaust Memorial and Learning Centre

70040431-C-001
OCTOBER 2018

CONFIDENTIAL

UK **Holocaust Memorial Foundation**

RIVERWALL VISUAL CONDITION SURVEY

UK National Holocaust Memorial and Learning Centre

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. 70040431
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DATE: OCTOBER 2018

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Appendix A - Site Location

Appendix B - Background Data

Appendix C - Visual Inspection Summary

1 INTRODUCTION

1.1 PROJECT CONTEXT

1.1.1. On Behalf of the UK Holocaust Memorial Foundation, WSP has undertaken a visual condition assessment of the flood defences fronting Victoria Tower Gardens.

1.1.2. This visual condition assessment has been prepared to inform a Flood Risk Assessment (FRA) for the proposed development within Victoria Tower Gardens to demonstrate that the flood defence will be remediated or maintained in a robust and sustainable manner and to a suitable level (to reduce the risk of breach) over the development lifetime.

1.1.3. This report summaries the findings of a desk top study, visual condition assessment and the likely extent of works required to maintain the flood defence.

1.2 SITE LOCATION AND EXTENT

1.2.1. This report solely relates to the flood defence fronting Victoria Tower Gardens, referred to as the riverwall hereafter, as illustrated in Figure 1 and Figure 2.

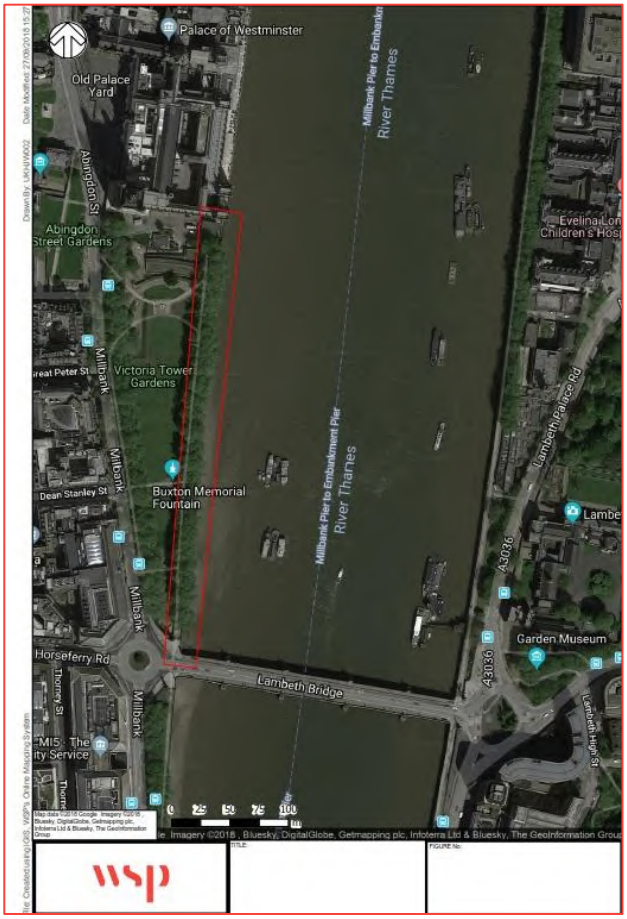


Figure 1: Site Location Plan (Survey Extent – Red)

Figure 2: General Arrangement of Riverwall at Victoria Tower Gardens

1.2.2. The riverwall, with a total length of approximately 350m, extends from the Palace of Westminster Police Post in the north down to Lambeth Bridge in the south.

2 SITE HISTORY

2.1 OVERVIEW

2.1.1. This section of the report summarises information obtained through a desk top study of the riverwall to help inform this assessment. Information obtained from the Environment Agency and internet sources including national archives have been used to inform this section of the report and can be found in Appendix A.

HISTORIC CONTEXT OF STRUCTURE

2.1.2. Sir Christopher Wren had conceived a riverside quay for the City as early as 1666. A Royal Commission was set up and in 1844 recommended an embankment should be built between Blackfriars and Chelsea. The Metropolitan Board of Works was later established in 1855, one of its main tasks being that of solving the sewage problem in London. An Act was subsequently passed in 1862 to approve the project, for a sewer to be built below the new tree-lined roadway, with a granite river wall.

2.1.3. Started in 1862, the present 'Thames Embankment' on the northern side of the River Thames was primarily designed by Sir Joseph Bazalgette. It incorporates the main low level interceptor sewer from west London, and an underground railway over which a wide road and riverside walkway were also constructed, works also included a retaining wall along the north side of the River Thames. The scheme reclaimed 22 acres of land from the river.

2.1.4. The riverwall is understood to be primarily formed of concrete and granite, with the granite primarily quarried from Lamorna Cove in Cornwall. The quarried stone was shaped into blocks before being loaded on to barges and transported up the English Channel into the Thames.

TIMELINE OF RIVERWALL WORKS AND FORMATION

1862

2.1.5. Based on information available it is understood that the original construction of the riverwall started in 1862. The original riverwall is understood to be a mass concrete gravity wall with stone (granite) façade. Based on drawings made available by the Environment Agency, reproduced in Appendix A, various works have been undertaken since the original construction as summarised below.

1900

2.1.6. Improvement works were undertaken to the river wall during 1900 to improve the formation of the riverwall. It is understood that inclined benching was introduced with sheet piles fronting the original mass concrete gravity wall with granite sets forming the inclined vertical façade of the riverwall seen today. Based on record drawings it is understood that the works covered two thirds of the riverwall length within Victoria Tower Gardens from the southern end adjacent to Lambeth Bridge.

1933

2.1.7. Works in 1933 were undertaken to raise the crest level of the riverwall from 18.41 feet (5.611m) Above Ordnance Datum (AOD) to a constant level of 20.17 feet (6.148m) AOD, it should be noted that the datum used is not referenced but assumed.

2.1.8. The increase in elevation was achieved by removing the parapet blocks and inserting a new granite block varying in height from 1ft 7in (482.6mm) to 1ft 9in (533.4mm) by 2ft 3in (685mm) in depth. The new blocks were bonded to the original granite blocks with slate dowels 9in (228.6mm) long, spaced at 3ft (914.4mm) centres. Concrete mortar was used as bedding above the existing concrete.

2.1.9. Within the middle and higher portion of the wall reinforcement was introduced to structurally bond the existing concrete and new concrete, see Figure 3.

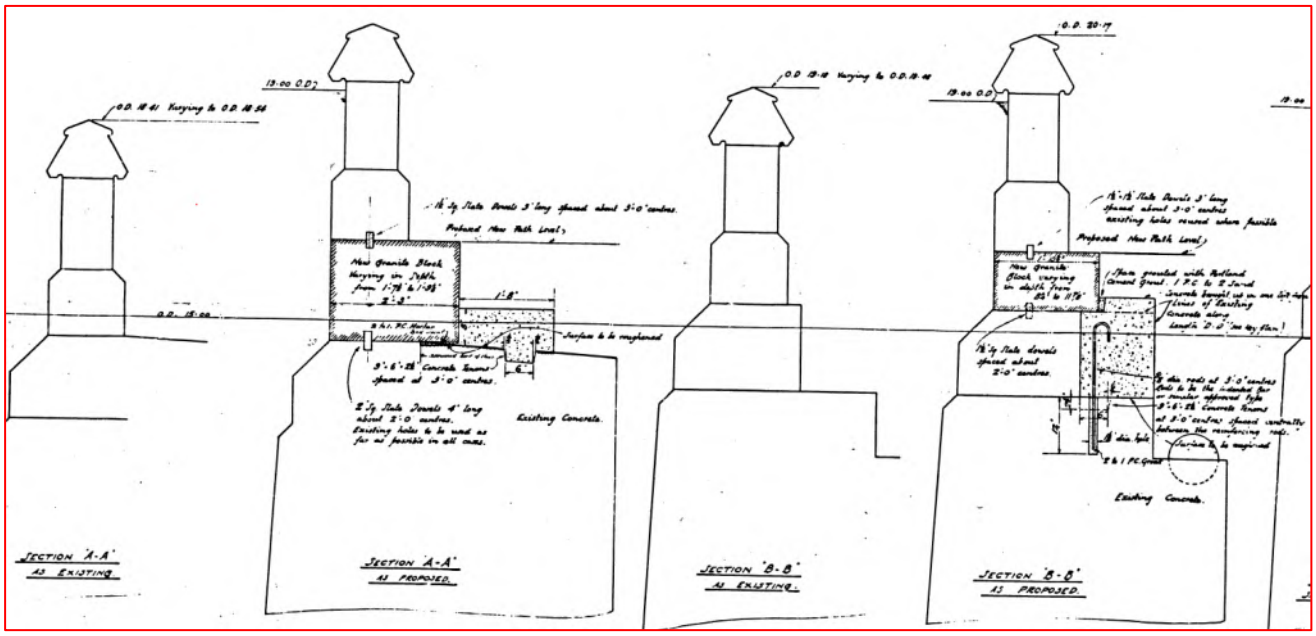


Figure 3: Extract of 1933 Proposed Raising of Riverwall Drawing

1981

2.1.10. Later in 1981 further raising to the riverwall was undertaken to raise the crest level of the parapet by 6in (152.4mm). This raising was achieved by installing a reinforced precast concrete beam above the top parapet granite block and below the coping stone with an anchor system installed into the existing parapet and riverwall.

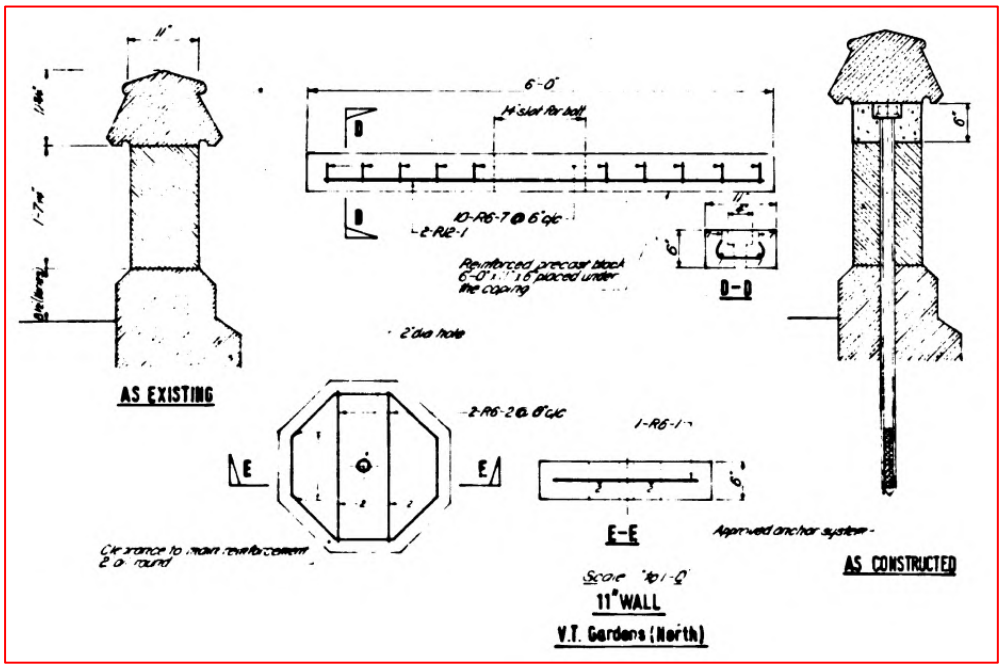


Figure 4: Extract from 1981 Interim Wall Raising Drawing

2.1.11. The new proposed crest level was not recorded on the drawings, however based on the 152mm raising it is anticipated the crest level would be increased to circa. 6.3m AOD, although other (more reliable) available records indicate the crest is lower (see below).

Present Day

2.1.12. Based on a topographic survey undertaken by MSA Survey (December 2016) the riverwall has a crest level of 5.9m AOD. Furthermore, the Environment Agency records detail that the defence crest level is 5.81m AOD

throughout. Possible reasons for the discrepancy with the historic levels stated/ inferred include the accuracy of measuring equipment, datums used and/ or settlement of the structure (although this would not be expected to be uniform along the length).

2.1.13. It is understood that the riverwall today is formed of a mass concrete gravity wall with a stone block façade. It is understood that the wall is founded on concrete benching typically 3 granite blocks (circa 2ft high) below the foreshore level and 10 full height stone blocks above the bed level (noting that the foreshore level varies slightly along the frontage). The riverwall is founded on a concrete foundation of unknown depth with steel piles fronting the toe of the structure.

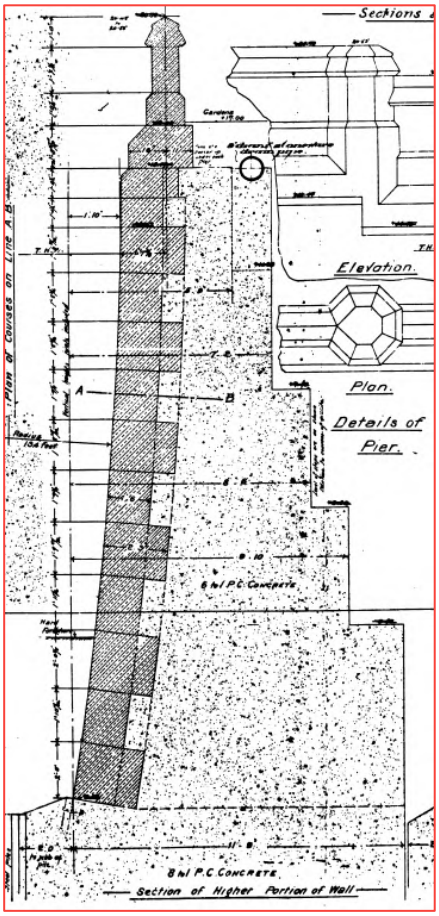


Figure 5: Riverwall General Arrangement (pre raising works)

WORLD WAR II BOMBING

2.1.14. Based on the London Metropolitan Archives it is understood that during the Blitz (September 1940 to May 1941) the River Thames riverwall was hit 84 times by bombing from the Luftwaffe's aircrafts.

2.1.15. During this time Sir Thomas Peirson Frank (1891-1951) was London County Council's Chief Engineer and was appointed as co-ordinating Officer for Road Repairs and Public Utility Services for the London area, and directed the Thames Flood Prevention Emergency Repairs Unit during the air raids.

2.1.16. It is understood that a section of the riverwall fronting the Victoria Tower Gardens was hit by a bomb on the 9th May 1941, breaching the defence, as photographed in Figure 6.

Figure 6: Photograph of Bomb Damage Causing Breach in Riverwall

2.1.17. The riverwall was repaired with concrete as can be seen today, see Figure 7. Some residual sections of the granite blocks remain on the foreshore today.

Figure 7: Photo of Concrete Repair to Bomb Damage

HISTORIC ENGLAND LISTING

2.1.18. The river embankment, from the Houses of Parliament to Lambeth Bridge, is listed under the Planning (Listed Buildings and Conservation Areas) Act 1990 as amended for its special architectural or historic interest.

- **List Entry Number**: 1357335
- **Date First Listed**: 01-Dec-1987
- **Statutory Address**: River Embankment from the Houses of Parliament to Lambeth Bridge, Millbank/ Victoria Tower Gardens SW1
- **National Grid Reference**: TQ 30299 79275
- **Listing Detail**: TQ 3079 SW and 3078 NW City of Westminster Victoria Tower Gardens, 101/58 Millbank, SW1 River Embankment from the Houses of Parliament to G.V. II Lambeth Bridge Embankment wall. Mid C.19, contemporary and of a piece with Barry and Pugin's Palace of Westminster. Granite. Battered river wall with mooring rings and weather coped parapet; to landward side a plinth, die and coping cranked in 2 stages. The mouldings break round canted buttresses at frequent intervals. Southernmost portion isolated by western abutment of Lambeth Bridge.

3 VISUAL CONDITION ASSESSMENT

3.1 OVERVIEW

3.1.1. The condition assessment was undertaken using the rating's described in the Environment Agency's (EA) condition assessment manual, as summarised in Table 1. Additional descriptions and interpretation of the ratings can be found within the EA report.

Table 1: Summary of Condition Rating

EA Rating	Condition	Description
1	Very Good	Refers to cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the asset.
3	Fair	Defects that could reduce performance of the asset.
4	Poor	Defects that significantly reduce the performance of the asset.
5	Very Poor	Severe defects resulting in complete performance failure.

3.1.2. This assessment has split the riverwall up into sub-sections (bays) along its length, denoted by the intermediate coping piers observed at regular (approximate 10.2m) intervals. 34 bays span between the Palace of Westminster Police Post in the north, with the most northerly bay denoted as 'Bay 1' consecutively up to 'Bay 34' located at the south end directly north of Lambeth Bridge.

3.1.3. At the time of the inspection the weather was fair / sunny. The inspection was conducted around low tide to ensure the foreshore would be exposed to allow access and inspection of the full extent of the wall. No significant rainstorm events were noted in the area in the 48 hours prior to the inspection. A summary of typical defects is detailed within this report with detail of all defects presented in Appendix B.

3.2 ENVIRONMENT AGENCY ASSESSMENTS

3.2.1. Based on information provided by the Environment Agency it is understood that they last inspected the structure 13th September 2018 with the asset rating at 2 (good) with the worst element condition of 3 (fair).

3.2.2. The following sections summaries the observations during the WSP inspection.

3.3 LANDWARD EXTENT OF WALL

3.3.1. The visible extent of the landward face of the riverwall, Figure 8, was observed to be in good condition with an element rating of 2. Staining was typically observed to the face of the blocks; however, no distortion, cracking or spalling was observed. Joints between bays and piers appeared to be infilled with a bituminous material.

Figure 8: Typical Condition of Landward Side of Riverwall

3.3.2. Within Bay 7, the location of the historic bomb damage resulting in a defence breach, the concrete repaired section, was generally found to be in good condition, with an isolated area of spalling which has exposed the reinforcement, Figure 9. The defect was noted to be localised only.

Figure 9: Spalling to Concrete Coping in Bay 7

3.4 RIVERWARD EXTENT OF WALL

3.4.1. A few defects were noted throughout the riverwall, and were often typical throughout. A summary of the key defects is provided below with further details of the defects within each bay within Appendix B.

VERTICAL FRACTURING

3.4.2. Three 'significant' vertical fractures and four 'less significant' vertical fractures have been noted throughout the length of the riverwall fronting the Victoria Tower Gardens, see Figure 10. None of the fractures showed visible evidence of recent movement and no obvious distortion within the typical riverwall alignment was observed.

Bay 12

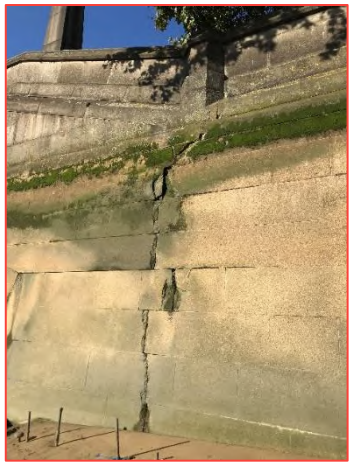
Bay 24 (S)

Bay 25

Bay 27

Bay 30 (S)

Bay 31



Bay 33 (S)

Bay 33 (S) Continued

Figure 10: Fractures, (S) Significant Fractures

3.4.3. Some of the more significant fractures had been locally repaired with what appeared to be bitumen, lead and/ or mortar/ grout.

3.4.4. Associated with the more significant vertical fractures are cracks in the stone blocks, causing the face of the block to pull away from the main block section. This delamination would not normally be expected with granite

blocks and possibly indicates a facing/ cladding added at some stage. The causes of the fractures are unknown and there are no obvious signs of displacement, distortion or settlement.

Figure 11: Spalling/ Delamination to the Face of Stone Blocks

STAINING

3.4.5. Bright green, dark green, brown and orange staining to the stone façade has typically been noted throughout the length of the structure primarily located at the high-water level and above the foreshore level, but also located sporadically throughout.

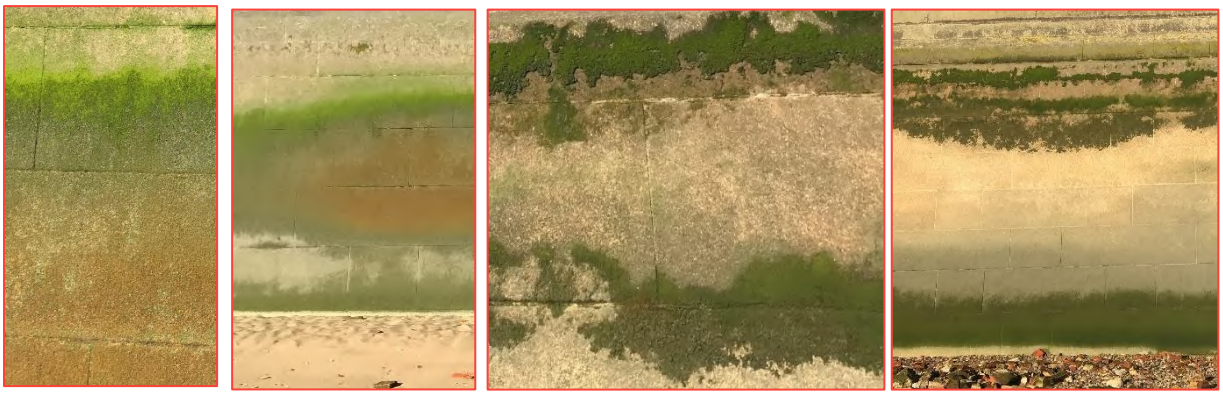


Figure 12: Typical Examples of Staining to Stone Façade

3.4.6. This staining is typical of an inter-tidal location and is limited to the surface of the stone façade. There is no visible evidence of the staining to have resulted in deterioration of the stone blocks (or to be caused by corrosion within the structure) and is considered to be an aesthetic deterioration only.

SEEPAGE

3.4.7. Seepage has been noted throughout the length of the structure. The seepage is primarily evident where there is mortar loss which enables water to seep into the structure during high water, which will subsequently seep out once the tide recedes (or groundwater originating from surface water infiltration to be drained). Where seepage is concentrated a build-up of residue below the area of seepage is evident.

3.4.8. The continued action of water seepage is likely to cause the exposed joint to increase in size resulting in an accelerated process of more water getting behind the façade resulting in more joints to open up, which if not maintained could lead to significant damage at some point (and should therefore be monitored).

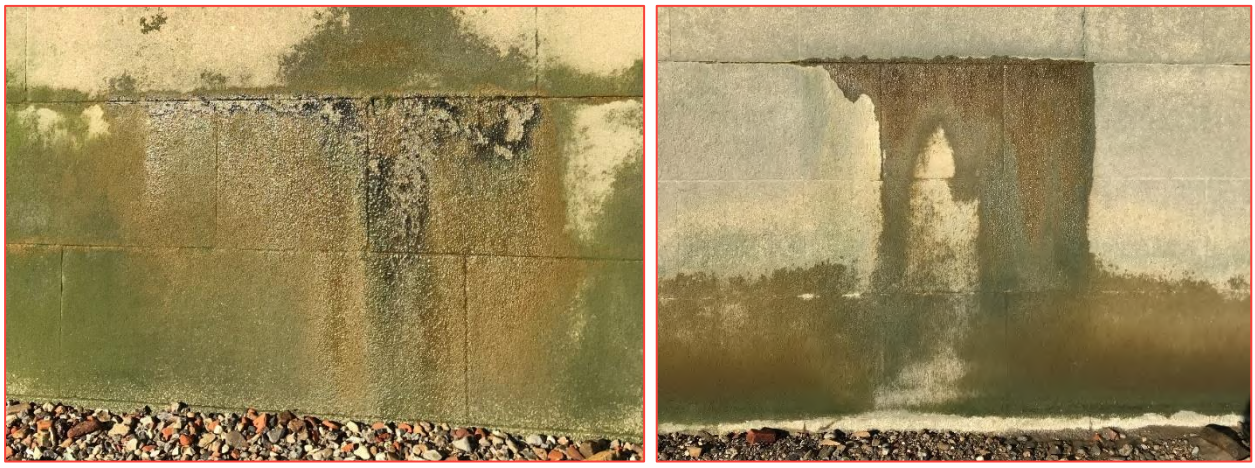


Figure 13: Seepage Between Stone Blocks

MORTAR LOSS

3.4.9. Mortar loss is also evident in dry patches, which in turn could lead to seepage behind the façade. Mortar loos was evident sporadically throughout the length of the structure, the depth of joint loss was not determined, however no mortar loss had evidently caused any stone blocks to displace.

Figure 14: Mortar Loss Between Stone Blocks

3.5 VICTORIA TOWER GARDENS

3.5.1. Cracking was observed to the pavement surfacing directly adjacent to the landward side of the riverwall, see Figure 15. Based on an understanding of the structures general arrangement it is understood that there is a movement interface between the backfill behind the riverwall and the concrete of the riverwall which will move at different rates. It is anticipated that the cracking is due to the bonding of the surfacing material over this movement joint and it is not anticipated that this is a result of any movement within the structure.

Figure 15: Typical view of Cracking to Pavement Surfacing

3.6 FORESHORE

3.6.1. Based on historic drawing information it is understood that 8 full blocks of the riverwall were located above the 'hard' foreshore level with a further 3 blocks to the concrete benching/ foundation. Based on recordings taken from Bay 11 where 8 full blocks were exposed, the height from crest level to foreshore level was approximately 6.8m (e.g. the approximate height from crest to bed in early 1900).

3.6.2. A summary of the current day distance from crest to bed is provided graphically in Figure 16.

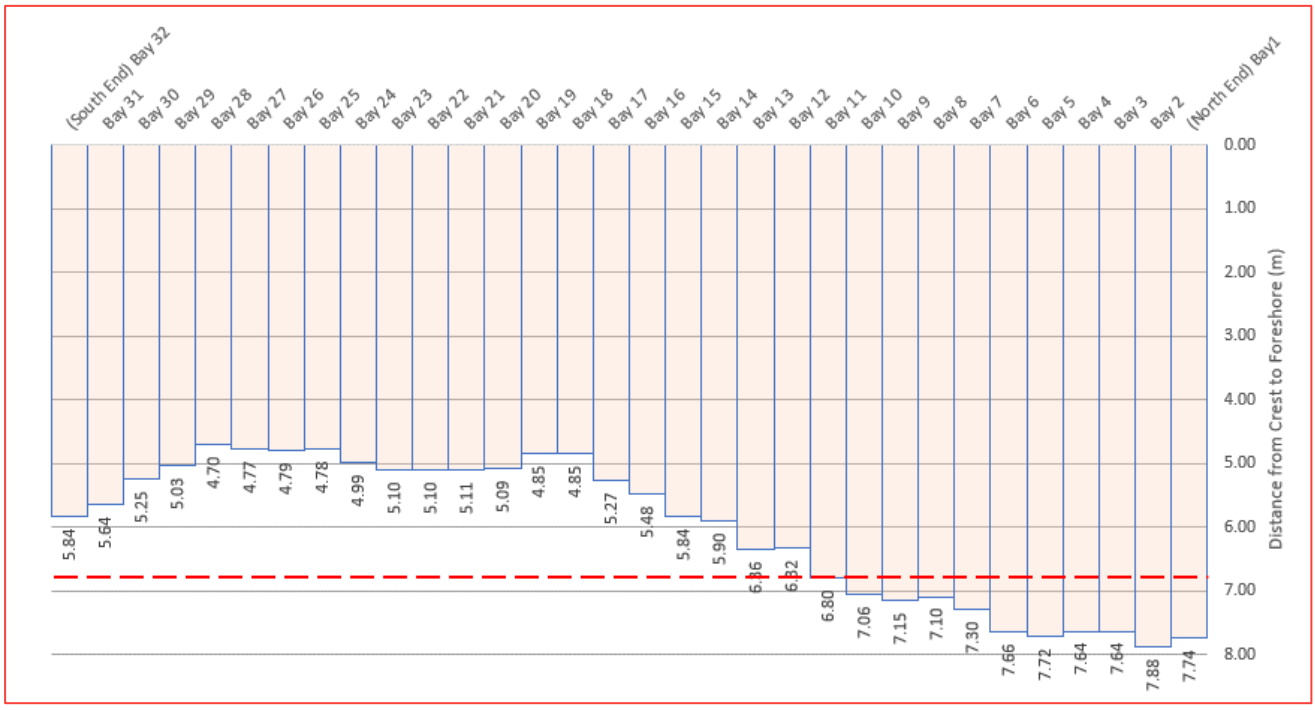


Figure 16: Distance from Crest of Riverwall to Foreshore at Bay Centres (1900 level in red dotted line)

3.6.3. The bed level is typically higher towards the south end towards Lambeth Bridge and typically lower towards the north end of the riverwall towards the Palace of Westminster and Westminster Bridge, this can also be seen in Figure 17.

Figure 17: View of Foreshore and Typical Variations

3.6.4. The River Thames is known to have an active bed with an ongoing process of sediment transport. The recorded foreshore levels and variations are qualitatively consistent with the Port of London Authority bathymetric survey data, a copy of which can be found in Appendix A.

3.6.5. It was also noted that higher foreshore levels tended to be formed of sand berms whilst the lower foreshore levels were formed of clay, which is anticipated to be the 'hard' foreshore referred to within the historic drawings. The toe of the riverwall was not exposed however this should be monitored to ensure that further scour does not expose more of the foundation which may be providing passive resistance to the riverwall during low tide conditions.

3.7 OUTFALLS

3.7.1. Three outfalls were noted along the length of the riverwall fronting the gardens. From north to south they are described as follows:

- **Bay 1** (Figure 18) – Redundant outfall (approximately 200mm in diameter) located at foreshore level. The outfall appeared to have been filled with concrete and the flap valve is stuck open. It is unclear if the concrete infill created a water tight seal or if some water seepage can pass behind the outfall.

  Bay 12 (Figure 19) – A small (approximately 100mm in diameter) outfall is located approximately 25m into the River Thames perpendicular to the riverwall. The outfall is partially blocked and formed within a concrete headwall. A concrete surround was noted above the foreshore between the riverwall and outfall. With a headwall and access ladder to the ground level above the riverwall.

  Bay 33 (Figure 20) – Is a storm relief sewer with two primary square outfalls with flap values. The outfalls are founded on a concrete apron with a weir at the downstream end prior to discharging into the River Thames. Evidence of overflow around the northern end of the concrete invert was noted which is causing cliffing in the foreshore. A small base flow was observed at the time of inspection however there had been no significant rainfall in the 48 hours prior to the survey. It is anticipated that the base flow is associated to a flow from the subterranean/ underground 'lost' rivers of London that remain as tributaries to the River Thames and were built over during the growth of London.

Figure 18: Bay 1 Outfall

Figure 19: Bay 12 Outfall; (Left) Outfall, (Middle) Outfall Headwall, (Right) Concrete Surround

Figure 20: Bay 33 Outfall; (Left) Outfall and Invert, (Right) Cliffing around North Side of Invert

CONCRETE REPAIR

3.7.2. The concrete repair within Bay 7 associated with the historic World War II bomb damage was found to be in fair condition within no significant deterioration. Staining was noted throughout with minor sporadic spalling. A small fracture was noted within the concrete repair, however there are no signs of recent movement.

Figure 21: Typical View of Concrete Repair to Bay 7

4 POTENTIAL FAILURE MODES

4.1 OVERVIEW

4.2 In broad terms a 'failure' of the structure to perform the flood defence function could occur as the result of:

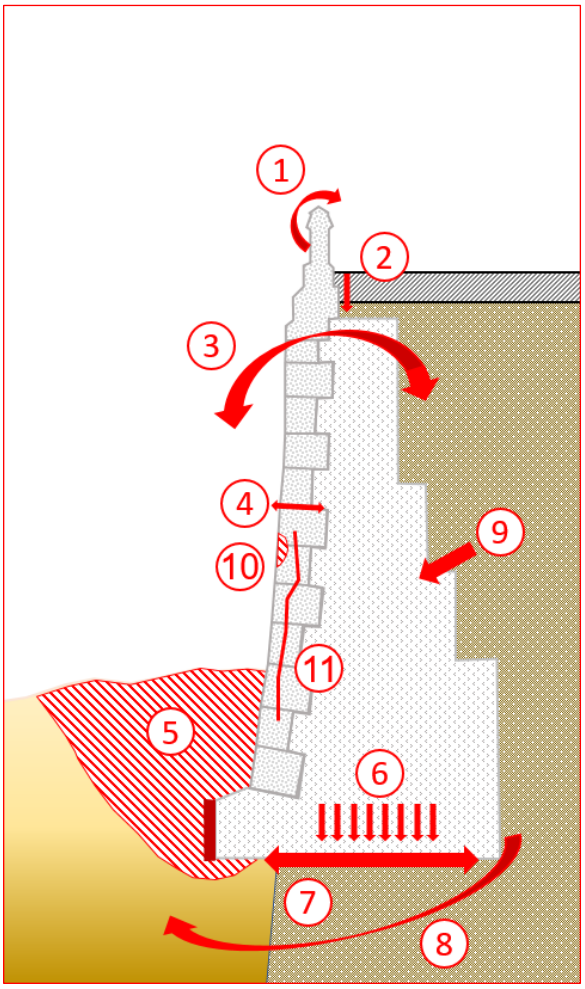
- Local damage – e.g. seepage through the wall;
- Global failure – e.g. substantial rotational collapse due to undermining; or
- Extreme flood level – e.g. overtopping/ inundation of the wall crest.

4.2.1. A number of localised structural defects were identified during the visual condition assessment, each of which could allow water seepage through the riverwall. Over time, the action of water seepage will increase the flow-path/ rate to a point where a localised collapse or breach could occur, leading to significant volumes of water passing through the flood defences.

4.2.2. Identification of failure modes can be used to help identify signs of deterioration that may lead to increased deterioration and local or global failure of the structure which may result in a breach of the defence. These anticipated failure modes are summarised below.

Table 2: Overview of Potential Failure Modes

Key Plan



Failure Mode	Comment
(1) Parapet **Overturning**	Increased tidal loading resulting in overturning of parapet.
(2) **Washout**	Water ingress through pavement resulting in washout of mortar (or groundwater seepage/ infiltration from grassed areas beyond).
(3) Global **Overturning**	Increased loading on landward side, foreshore lowering, removal of fill on landward side or soil failure resulting in overturning or rotational damage.
(4) **Washout**	Water ingress/ egress through joints between blocks resulting in washout of mortar.
(5) Foreshore **erosion/ scour**	Lowering of foreshore result in exposed foundation, reduces passive pressure and could undermine structure of unknown foundation depth.
(6) Global **Ground bearing**	Increased loading result in settlement and fracturing.
(7) Global **Sliding**	Increased loading on landward side or decrease of riverward pressure resulting in sliding.
(8) Global **Slip**	Change in saturation of founding material may result in a global slip failure.
(9) **Displacement**	Tree root growth may cause displacement of structural elements.
(10) Spalling/ Stone Fracturing/ Erosion	Weathering or impact damage may result in stone fracture further exposing the structure to water ingress.
(11) Fracturing	Fracturing due to settlement or distortion can create a hinge within the structure, reducing its structural integrity and further exposing the structure to water ingress.

5 RESIDUAL LIFE

5.1.1. Based on the visual observations only, the residual life of the existing defence has been assessed using the deterioration model provided within the Environmental Agency Report SC060078/R1 (Environment Agency, 2013) (Practical Guidance on determining asset deterioration and the use of condition grade deterioration curves, 2013).

5.1.2. Based on the findings of the joint Environment Agency and DEFRA study into the deterioration modelling of flood defences it is understood that a typical masonry wall in an estuarine environment would have a serviceable life of between 50 and 200 years depending on the rate of deterioration and level of maintenance conducted across the structures serviced life.

5.1.3. Figure 22 provides a rate of deterioration for a typical masonry wall in an estuarine environment looking at the condition rating, routine maintenance frequency and rate of deterioration. It should be noted that this guidance and deterioration model is general in nature and as such each structure should be assessed on its own merit.

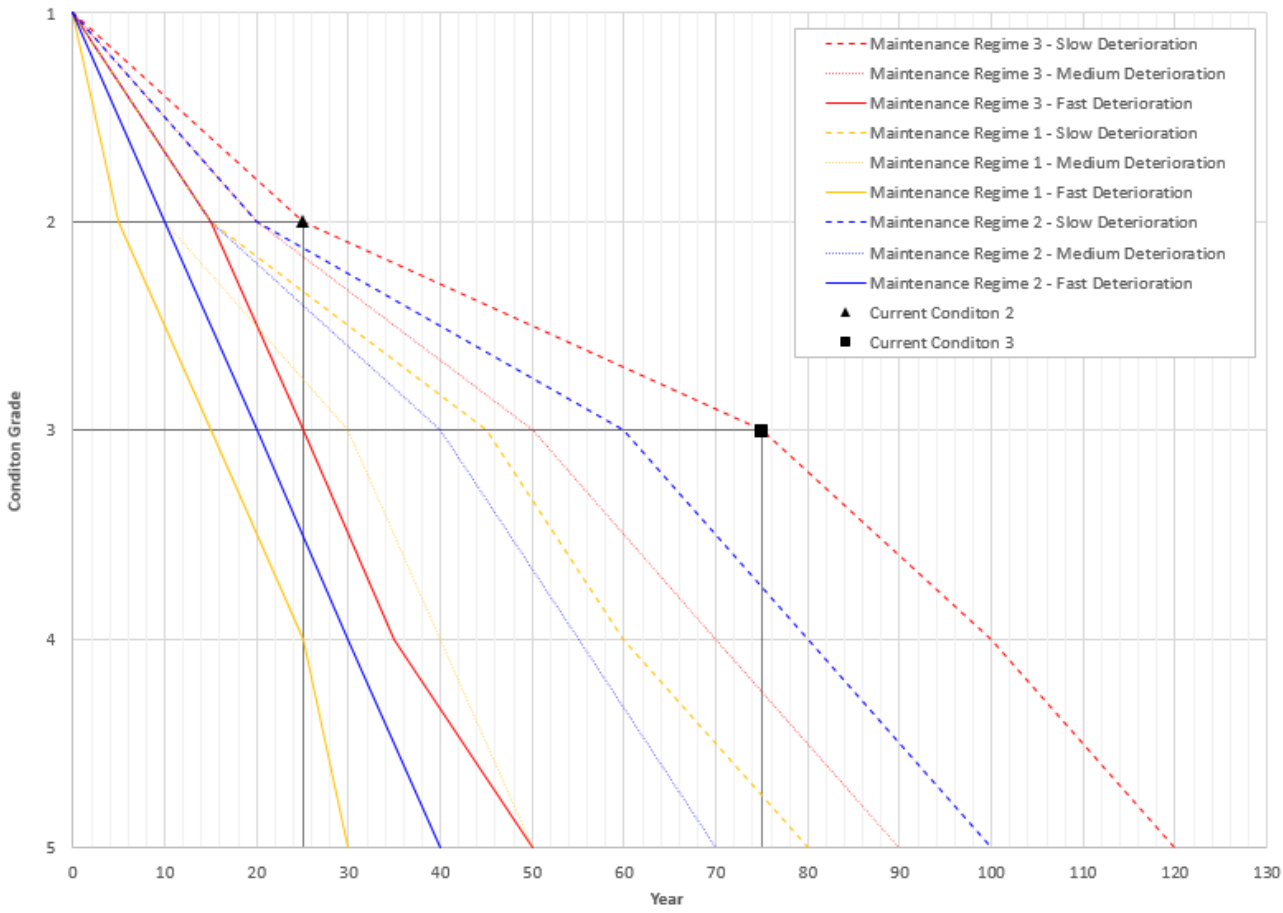


Figure 22: Summary of Typical Deterioration of Estuarine Masonry Wall Defences

5.1.4. The riverwall at Victoria Tower Gardens dates back to the late 1800's and is anticipated to have been first constructed from circa 1862, resulting in a potential approximate service life of 156 years to the current day (2018) suggesting that the riverwall might be reaching the end of, or surpassed its anticipated design life.

5.1.5. It should however be noted that a number of significant remediation/ improvements work have been undertaken to the structure over the last 100 years and the stone blocks within the wall are observed to be in an overall good condition suggesting there is a significant residual life remaining within the structure subject to routine maintenance being undertaken to reduce the rate of deterioration.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 CURRENT CONDITION

6.1.1. Visible sections of the riverwall are generally in good condition (rating 2), with localised defects of a fair condition (rating 3) which require maintenance. Waterfront riverwalls such as this require a programme of ongoing inspection and maintenance to prevent deterioration and minimise the need for significant intervention measures.

6.1.2. It is the riparian owner's responsibility to inspect and maintain the flood defence at the Statutory Flood Defence Level. An ongoing inspection and maintenance programme should be continued by the riparian owner.

6.1.3. The observed significant defects (e.g. vertical fractures) show no visible evidence of recent movement and no obvious distortion within the riverwall and should therefore be subject to maintenance and continued monitoring.

6.2 RECOMMENDED FUTURE MAINTENANCE/ REMEDIATION WORKS

6.2.1. Based on the current condition no urgent repairs are recommended, however a few repairs are recommended to be undertaken in the next 2 years to help maintain the current condition of the structure and to prevent any continued and/ or accelerated deterioration to occur. These recommended repairs include:

- Cleaning of all open joints (including fractures) and re-pointing;
- Removal of spalling blocks and replacement;
- Patch repair to spalled concrete; and
- Placement of appropriately sized rock armour/ scour protection around the storm relief channel.

6.3 RECOMMENDED FUTURE INSPECTIONS/ MONITORING

6.3.1. Based on the current condition it is recommended that bi-annual inspections are undertaken (currently undertaken by the Environment Agency) with a further detailed visual condition survey undertaken every second year to identify if any of the observed defects have significantly deteriorated and require immediate remediation.

6.3.2. It is recommended that, subject to the listing restriction, mortar tabs should be fitted to the fractures to monitor if any continued movement is occurring.

6.3.3. Furthermore, it is recommended to continue to monitor the foreshore level to understand if the foreshore level is changing. Attention should be given to the northern end of the riverwall where the clay foreshore has become exposed. Any further reduction in foreshore level may require the implementation of scour protection measures and to re-establish the passive pressure on the riverwall.

6.4 SUMMARY OF FLOOD RISK CONTEXT

6.4.1. The current Statutory Flood Defence Crest Level in this reach of the River Thames is 5.41m AOD however the current defence has an actual crest level of 5.81m AOD.

6.4.2. In accordance with the Thames Estuary 2100 Plan (TE2100) the Statutory Flood Defence Crest Level increases to:

- 2065
  - Statutory Flood Defence Crest Level = 5.85m AODN;
  - Design water level = 5.35m AODN;
- 2100
  - Statutory Flood Defence Crest Level = 6.35m AODN;
  - Design water level = 5.81m AODN

6.4.3. Based on the above the defence will be subject to increased pressure from the increased tidal level and will require raising in the future to maintain current proposed Statutory Flood Defence Crest Level. It is anticipated that the same methodology of raising that has been undertaken over the last 100 years would be suitable, however due consideration and assessment for the structural and geotechnical stability and durability will be required prior to implementing any proposed raising. It is recommended that raising is not undertaken until it is required in the future, however due consideration should be made to ensure there is suitable access to enable raising works.

6.5 ANTICIPATED POST-PLANNING DEVELOPMENT REQUIREMENTS

6.5.1. Works to the flood defence or directly adjacent to the flood defence will require appropriate consenting from regulating authorities. This section summaries the main typical requirements.

INTRUSIVE INVESTIGATIONS, WORKS ADJACENT TO AND WORKS TO THE FLOOD DEFENCE

6.5.2. Any proposed temporary, permanent and intrusive testing works within proximity of the riverwall including any works which could influence the structural support zone will require approval through permitting with the Environment Agency.

6.5.3. Furthermore, approval through permitting with the Port of London Authority and Marine Management Organisation may be required for any works below the mean high-water springs level.

6.5.4. Further details of the potential permitting for the Environment Agency, Port of London Authority and Marine Management Organisation is detailed below and it is recommended to consult with each regulator as early as possible in the design process to ensure they support the proposals.

6.5.5. Furthermore, it should be noted that the flood defence is listed under the Planning (Listed Buildings and Conservation Areas) Act 1990 as amended for its special architectural or historic interest and therefore any works (temporary and permanent) are likely to require consent with Historic England and further consultation should be undertaken to understand and listing restrictions.

FLOOD RISK ACTIVITIES PERMIT

6.5.6. The Flood Risk Assessment Permit (FRAP) which has recently replaced the Flood Defence Consent (FDC) is enforced by the EA and is a legal requirement for works within 16m of a tidal main river and flood defence.

6.5.7. Typical activities which require a FRAP include:

- Altering, repairing or maintaining any temporary or permanent structure in, over or under a main river, where the work could affect the flow of water in the river or affect drainage work;
- Quarrying or excavation within 16m of any main river, flood defence (including a remote defence) or culvert; and
- Activities which could affect flood risk or land drainage, or interfere with the Environment Agency's access and are carried out within 16m of any flood defence structure on a tidal river.

6.5.8. A number of activities are covered by exemptions and or a standard rules permit. If neither method applies a bespoke permit will be required. Once the scale of works are known within the proximity of the flood defence (temporary and permanent) and river, it is recommended to consult directly with the EA to determine what activities will need to be covered under the FRAP.

6.5.9. Typically, it will take eight weeks for the EA to process the FRAP once a 'duly made' application is submitted and fees are variable subject to confirmation of which activities and level of permit are required.

MARINE LICENCE

6.5.10. For works proposed below MHWS, the Marine and Coastal Access Act 2009 administered by the MMO applies. Prior to undertaking any work below MHWS (even if separated from the sea by a barrier) a Marine Licence is required. A licence is required for any works, including maintenance and ground investigation (a limited number of exemptions apply). In addition, the PLA as a statutory Harbour Authority have responsibility for licencing of all works in, on or over MHWS and for all dredging activity.

6.5.11. Marine licence/ consents applications can take several months to obtain from the time of application. An extract from the guidance on Marine Licencing and estimated timetable for applications is provided below:

Straightforward applications	
Receive application, quality check, assign, consultation letters sent	1 week
Receive consultation responses	4 weeks
Application reviewed, decision made, licence issued	1 week

More complex - non EIA applications	
EIA screening *	6 weeks
Receive application, quality check, assign, consultation letters sent	1 week
Receive consultation responses and receive public representations*	7 weeks
Issue resolution, iterative process, MMO facilitate, applicant led	Iterative
Complete any appropriate assessment required (done at any time on request)	4 weeks
Application reviewed, decision made, licence issued	2 weeks

More complex - EIA applications	
EIA screening & scoping*	6 weeks
Preparation of draft Environmental statement by applicant	
Pre-application review, iterative process, MMO facilitate, applicant led	Iterative
Receive application, quality check, assign, consultation letters sent	1 week
Receive consultation responses and receive public representations*	7 weeks
Issue resolution, dealing with public responses, MMO facilitate, applicant led	Iterative
Complete any appropriate assessment required (done at any time on request)	4 weeks
Application reviewed, EIA consent decision made; regulatory decision made	3 weeks

* The Marine Works (EIA) Regulations set out the timescales for consultation in relation to screening and scoping opinions, and for publication and consultation prior to the making of an EIA consent decision. The timetable assumes that screening and scoping are carried out together.

Figure 23: Marine Licence Application Timeframe

6.5.12. The minimum period outlined above for straightforward applications is six weeks. However, works such as piling are likely to be classified as More Complex non EIA or More Complex EIA applications if works below MHWS are proposed. Early consultation is advised to confirm this.

6.5.13. The statutory periods for these more complex projects are a minimum of 20-21 weeks and exclude the preparation of Environmental Reports (i.e. Screening Request; Scoping Report (if required) and Environmental Statement (if required)).

RIVER WORKS LICENSE

6.5.14. Under Section 66 of the Port of London Act, a River Works Licence is required for any works in the River Thames, riverward of the mean high water mark and regardless of ownership of the river bed, including any works under the river or overhanging the river. This process ensures that all developments in the river are assessed for their potential effect on safety of navigation and the environment.

6.5.15. Works of a temporary nature (such as scaffolding to facilitate redecoration and/or repair works to river walls, or sediment sampling) may not require a formal River Works Licence application but will require the written consent of the PLA. To apply for written consent for temporary works full details of the works must be sent to the Licensing Officer.

Appendix A

BACKGROUND DATA

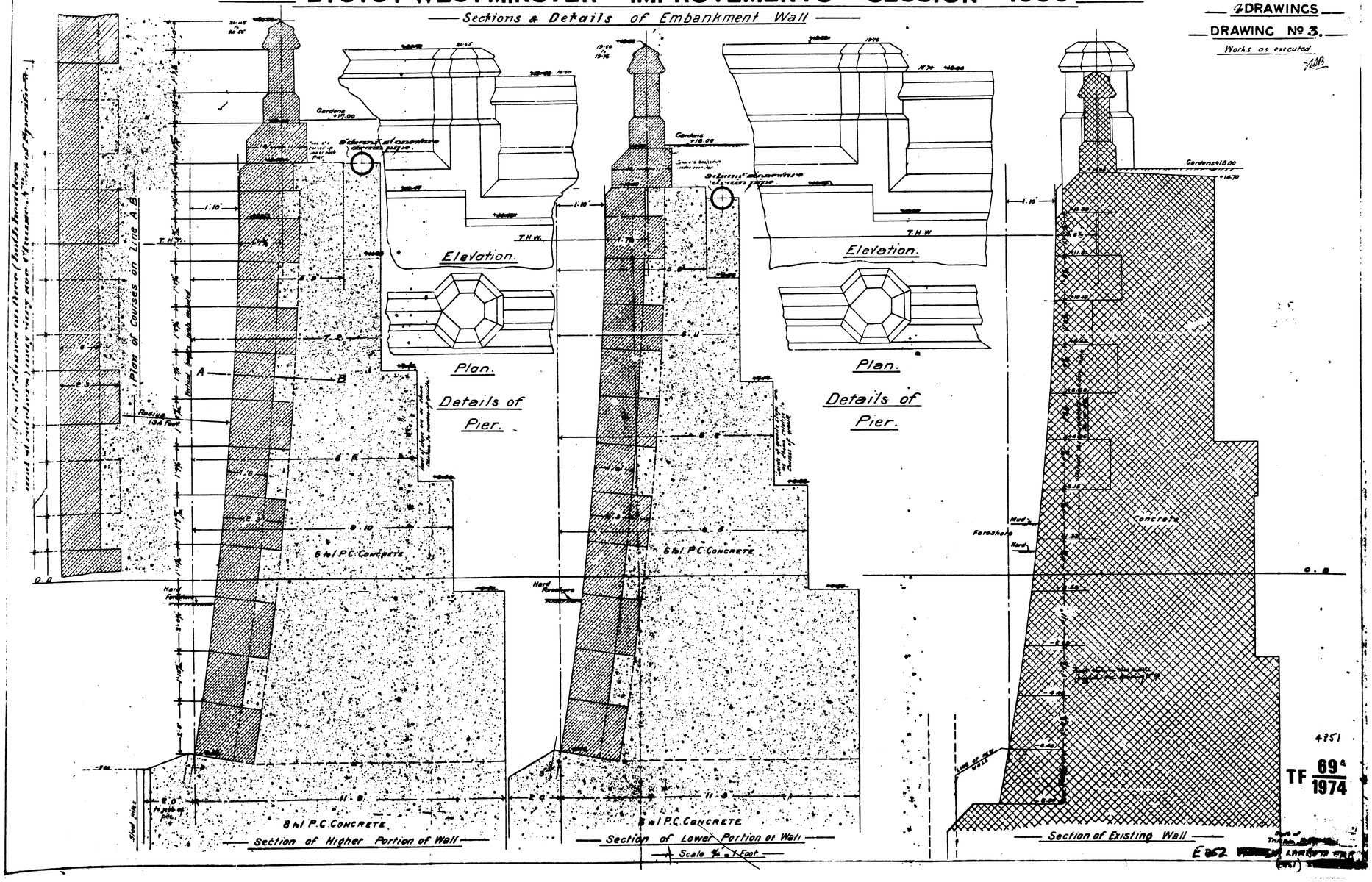
L.C.C. WESTMINSTER IMPROVEMENTS SESSION 1900

Sections & Details of Embankment Wall

4 DRAWINGS

DRAWING No 3.

Works as executed

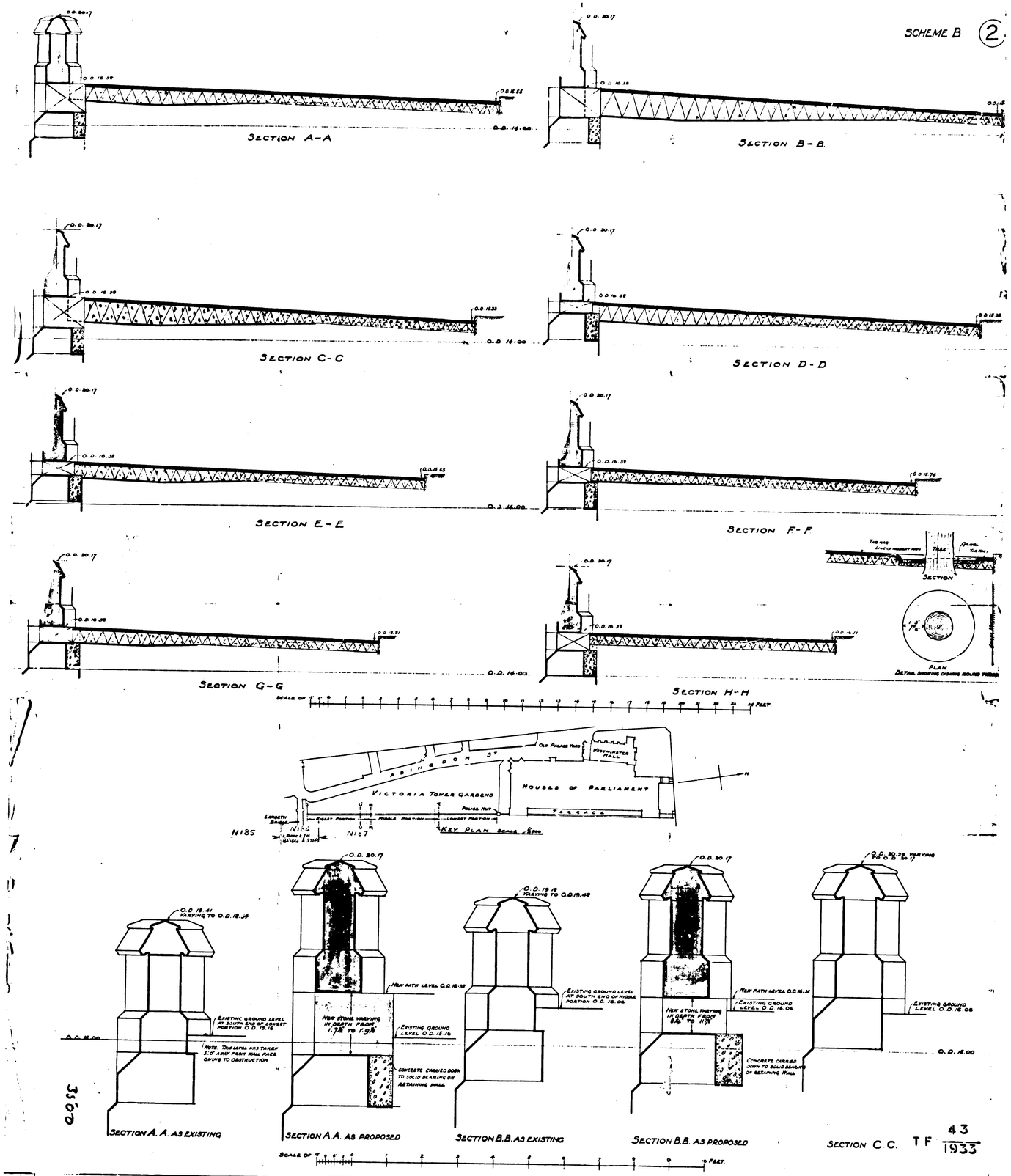


4851

TF 69a/1974

E 852

SCHEME B. (2)

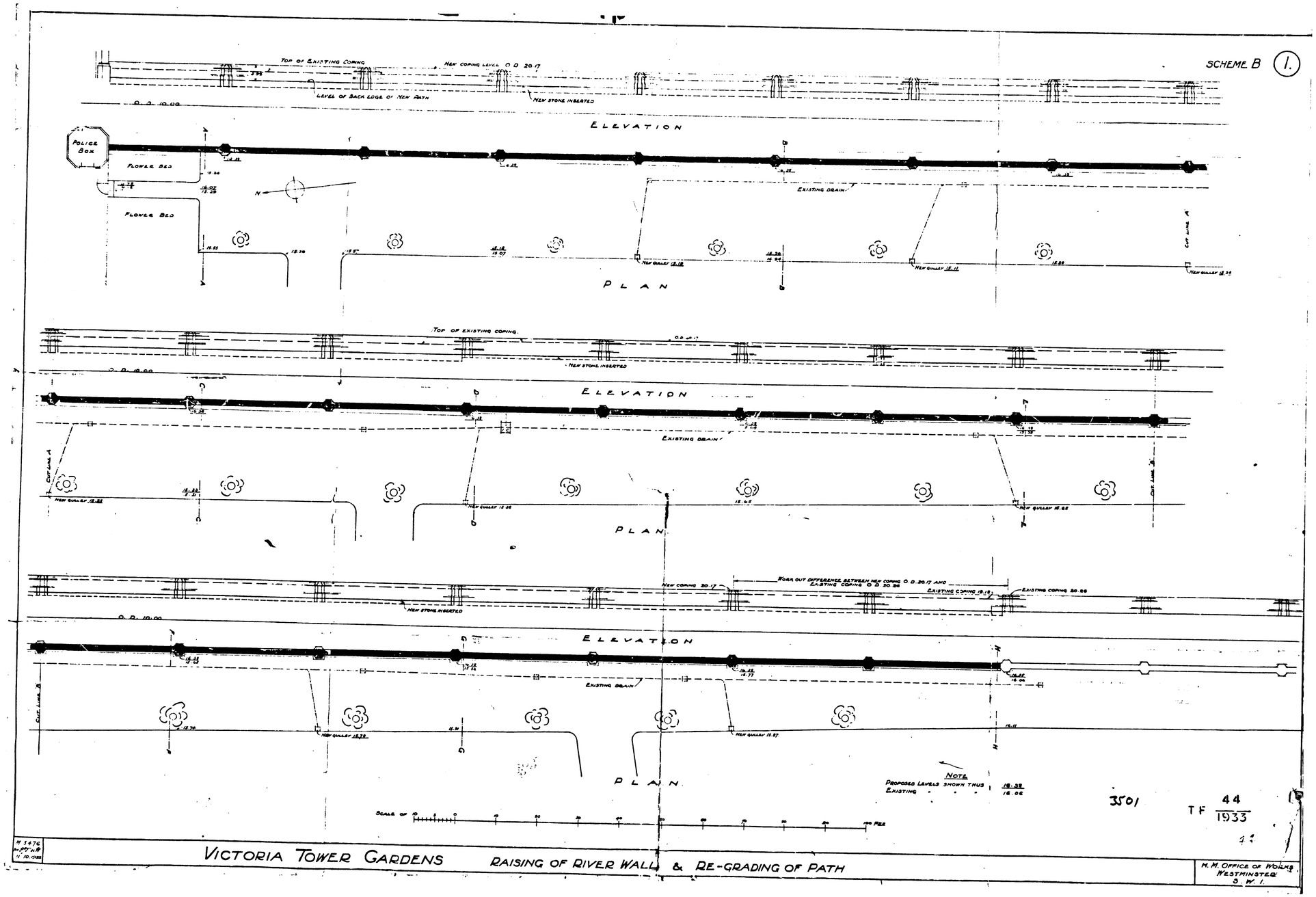


TF 43/1933

VICTORIA TOWER GARDENS RAISING OF RIVER WALL & RE-GRADING OF PATH

H. M. OFFICE OF WORKS WESTMINSTER

SCHEME B (1.)

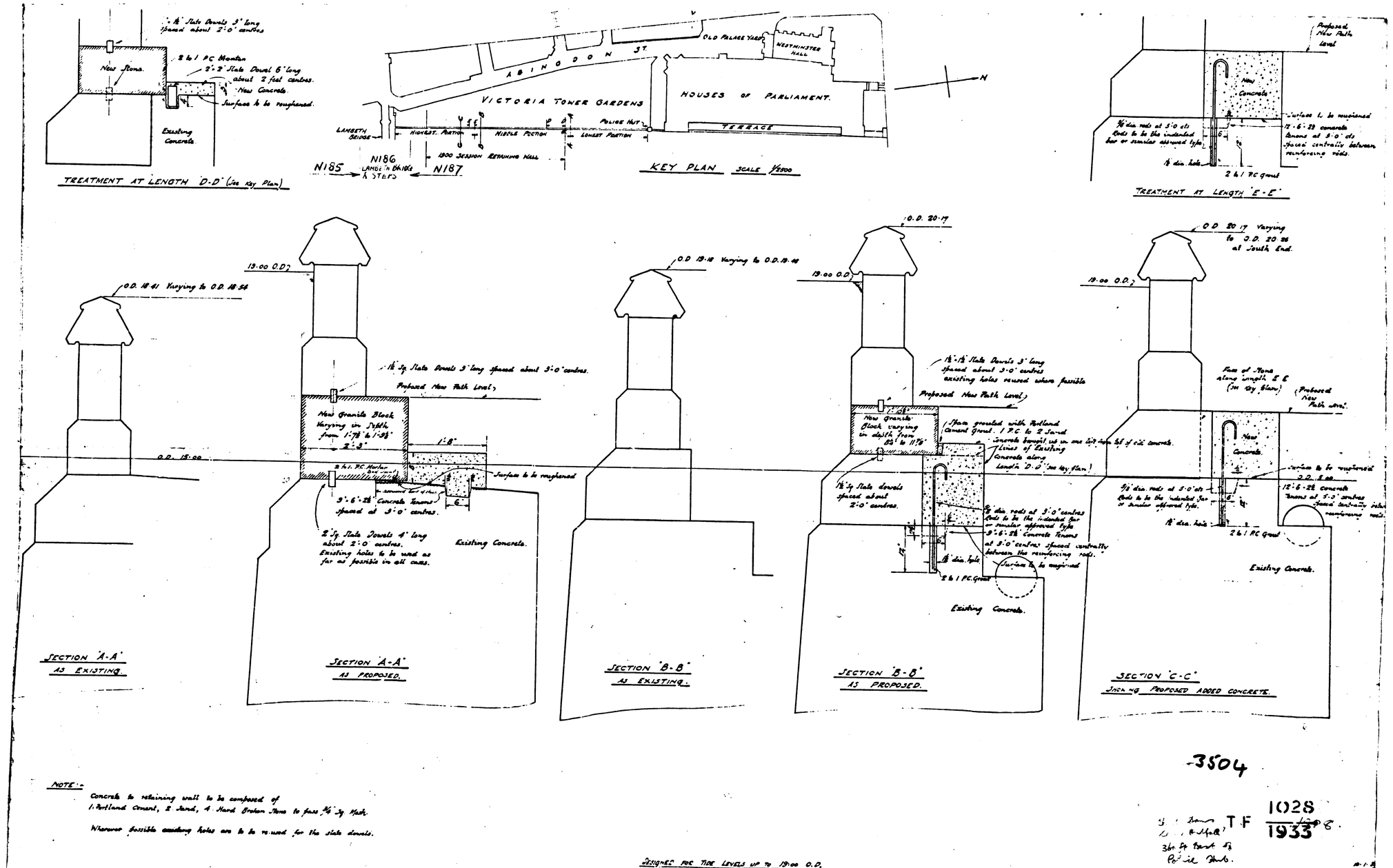


3501

TF 44/1933

ANGULA

MICROBOX



NOTE:-

Concrete to retaining wall to be composed of 1 Portland Cement, 2 Sand, 4 Hard Broken Stone to pass ¾" Sq Mesh.

Wherever possible existing holes are to be re-used for the slate dowels.

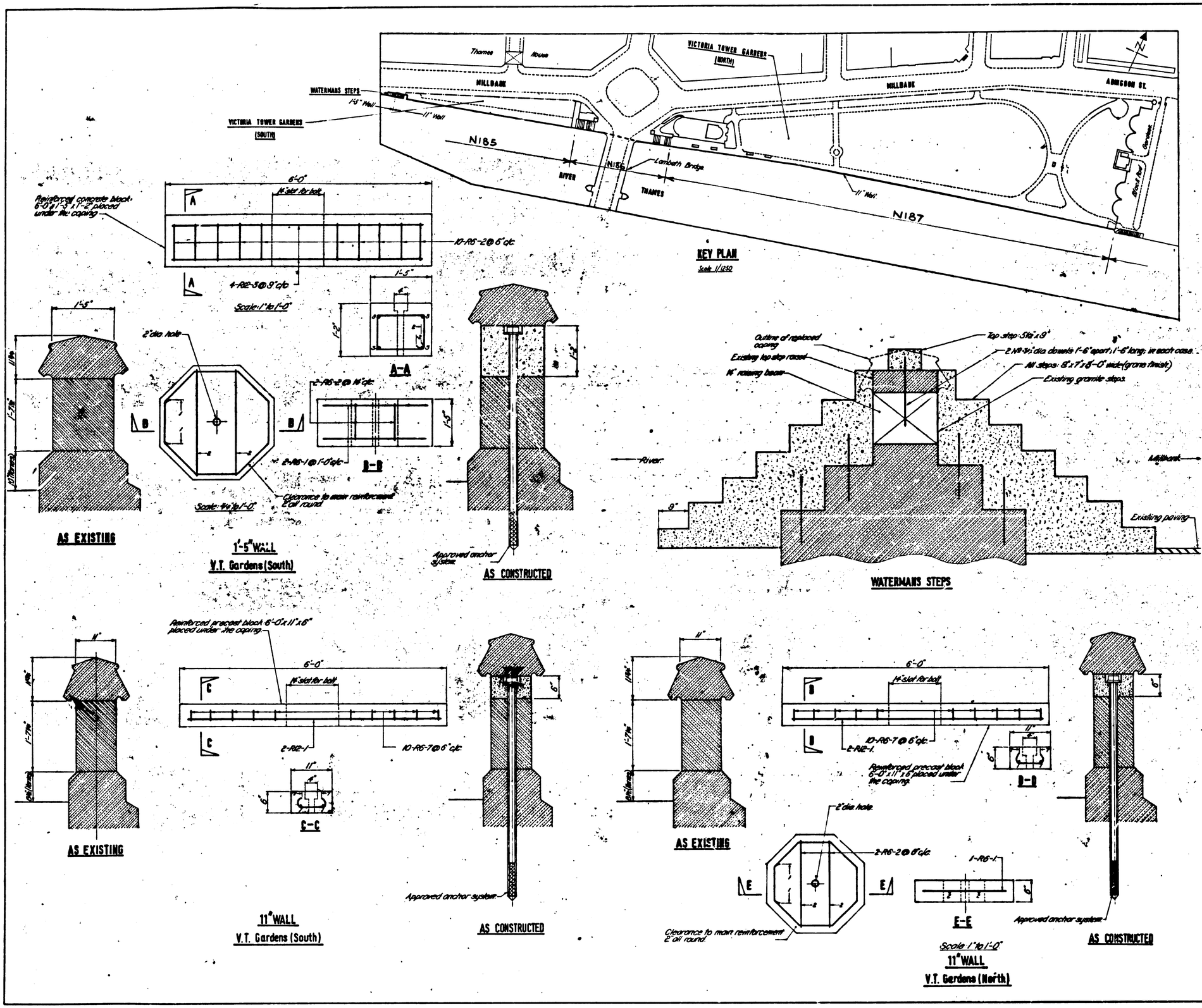
DESIGNED FOR TIDE LEVELS UP TO 19·00 O.D.

-3504

TF 1028/1933

HOUSES OF PARLIAMENT. VICTORIA TOWER GARDENS.	PROPOSED RAISING OF RIVER WALL.	SCALE:-1"=1'-0".	H.M.O.W. WESTMINSTER.	STR. SK. No 515/78

DEC 1932.



Notes:

TF 317/1981

Rev	Date	Subject

GREATER LONDON COUNCIL
DEPARTMENT of PLANNING and TRANSPORTATION

THAMES FLOOD PREVENTION
INTERIM WALL RAISING

Victoria Tower Gardens

Date | Scale

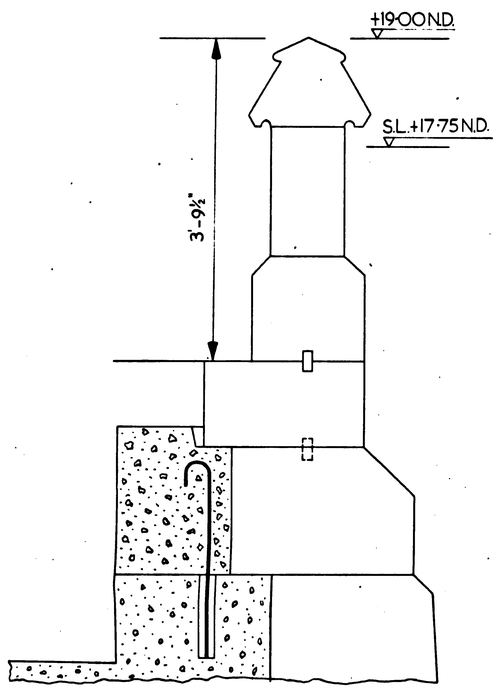
Drg No HC/2110/C/114

HE/TF/D. 1032

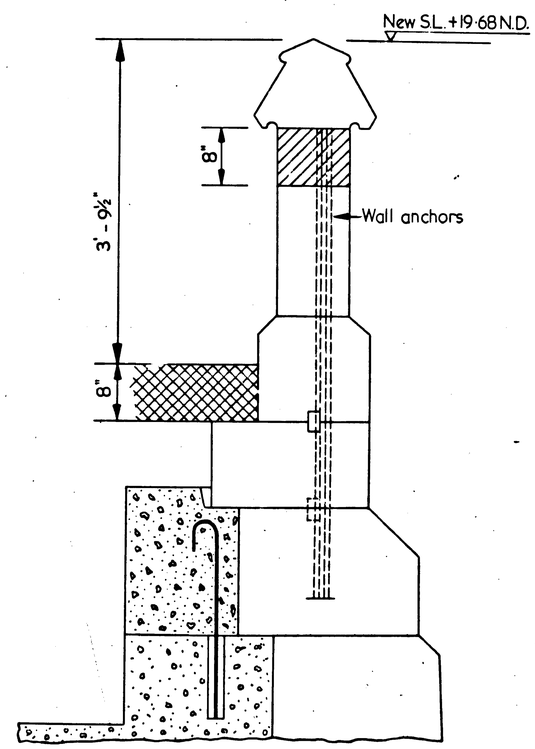
1. 11. 70

FIGURE 9.
EMBANKMENT WALL RAISINGS
VICTORIA TOWER GARDENS NORTH

EXISTING PARAPET



NOMINAL 2 FT RAISING AND
STRENGTHENING OF PARAPET



Strengthening only required for nominal 1 ft. raising.

Note :

Similar measures proposed for :
Victoria Tower Gardens South
Chelsea Embankment West
Chelsea Embankment East

Scale :- 1" to 1'

Granite insert

Pavement raising

OFFICE COPY

R

PORT OF LONDON AUTHORITY

River Thames

LAMBETH REACH

DEPTHS in METRES

Scale 1: 5000 at A2

Surveyed by the Port of London Authority Hydrographic Service

July 2015

DEPTHS
Depths are in metres, reduced to Chart Datum, being 2.59m 2.74 & 2.90 below Ordnance Datum (Newlyn), which is approximately the level of Lowest Astronomical Tide.

HEIGHTS
Heights are in metres. Underlined figures are drying heights above Chart Datum; all other heights are above MHWS.

SOUNDINGS
All sub-tidal areas are surveyed by MBES giving 100% coverage to IHO S44 order 1A

POSITIONS
Positions are referred to the WGS84 compatible datum, European Terrestrial Reference System 1989 Datum.

VARIATION
Magnetic Variation 1° 50'W (2009) decreasing 8' annually

AUTHORISED CHANNEL
The pecked lines indicate the limits of the authorised channel.

DISTANCES
Distances from London Bridge are shown along the N channel edge in Sea Miles and tenths against this symbol ▲.

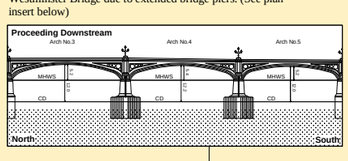
ANCHORING
Anchoring is prohibited in the fairway and within 60 metres of any tunnel under the river, except in an emergency.

LADDERS
Permanent ladders, the exact position or condition of which cannot be guaranteed, are shown thus ● .

RESTRICTED AREA - LAMBETH REACH
A 70m exclusion zone exists off the Houses of Parliament. See PLA Permanent Notice to Mariner P18.

BRIDGES - Headway at the centre span above MHWS:
LAMBETH BRIDGE = 6.4m
WESTMINSTER BRIDGE = 5.4m
CHARING CROSS RAILWAY BRIDGE = 7.0m
WATERLOO BRIDGE = 8.6m

NB. Submerged obstructions in Arches Nos.3, 4 and 5 at Westminster Bridge due to extended bridge piers. (See plan insert below)



LIGHTS ON BRIDGES
Light stars within a circle shown on bridges indicate a 2FY(hor) combined with Iso.W.4s(occas) / VQ traffic warning lights. White isophase light 4s shown from a bridge span warns of a reporting vessel navigating, or about to navigate, through the bridge. A very quick flashing light indicates two or more such vessels in the same vicinity. See PLA General Direction No.28.

An arch marked at the centre by day or night by two horizontal orange (or amber) lights, denote that the arch is one of the main working arches; these arches usually lie in the Authorised Channel normally used by commercial vessels. Other arches are available for navigation by vessels when height of tide, draft and air draft permit, unless marked as being closed for navigation.

LIGHTS ON JETTIES
Light stars without legends represent two fixed lights displayed vertically. They are seen as red to port and green to starboard when proceeding upriver.

TOPOGRAPHY
The shore features on this chart are based largely on Ordnance Survey digital map data with the permission of the Controller of Her Majesty's Stationery Office.

MOORINGS
Mooring screws are shown in their true position thus ⊙ and buoys shown as symbols.
Buoy numbers shown (32) are PLA references.

SPEED LIMIT
A speed limit of 12knts exists for all power driven vessels navigating unless authorised by HM for high speed above Lambeth Bridge. See PLA General Direction No.34.

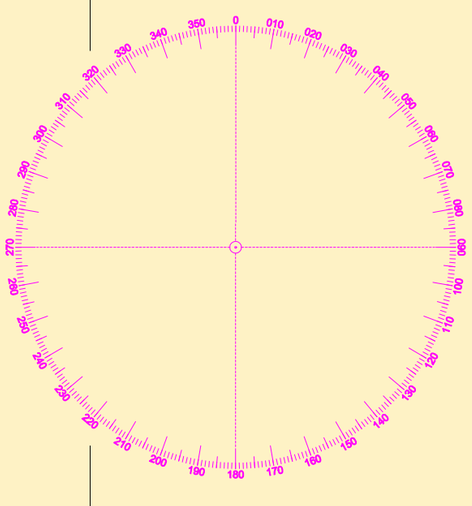
WORKS IN PROGRESS
Construction works will be progressing in the areas indicated, various restrictions will be in place from time to time, see PLA Notices to Mariners for latest information.

PLA REFERENCES
The numbers shown on the shore and in parentheses in the river adjacent to moorings refer to PLA licences.

PLA PUBLICATIONS
Refer to PLA Publications for further information:
1. PLA River Byelaws
2. General Directions for Navigation
3. PLA Tide Tables & Port Information
4. The River Thames Recreational Users Guide
5. Mariner's Guide to Bridges on the Tidal Thames

PLA HYDROGRAPHIC SERVICE WEBSITE
www.pla.co.uk/hydrohomepage

19/18



Tide Details, referred to levels at Westminster Bridge:	Ordnance Datum	Chart Datum
Highest Recorded (1953)	5.42	8.32
Highest Astronomical Tide (HAT)	4.47	7.37
Mean High Water Springs	3.98	6.88
Mean High Water	3.37	6.27
Mean High Water Neaps	2.76	5.66
Ordnance Datum (Newlyn)	--------	2.90
Mean Low Water Neaps	-1.60	1.30
Mean Low Water Springs	-2.38	0.52
Chart Datum	-2.90	-------

Port of London Authority Hydrographic Service
H.O.Ref. No....113-316-178....Date..31/05/2016

Edition Date: May 2016; Edition Version: (3); Corrections: (2017/2), (2017/6), (2017/10), (2017/18), (2017/21), (2017/22), (2017/28), (2018/9)

Product 4 (Detailed Flood Risk) for: Victoria Tower Gardens
Reference: HNL102344JH
Date: 17/10/2018

Contents

The information provided is based on the best data available as of the date of this letter.

You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements to the data for this location have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

Please refer to the Open Government Licence which explains the permitted use of this information.

Alchemy, Bessemer Road, Welwyn Garden City, Hertfordshire, AL7 1HE
Customer services line: 03708 506 506
Email: NETenquiries@environment-agency.gov.uk
Website: www.environment-agency.gov.uk

Flood Map for Planning (Rivers and Sea)

The Flood Map:

Our Flood Map shows the natural floodplain for areas at risk from river and tidal flooding. The floodplain is specifically mapped ignoring the presence and effect of defences. Although flood defences reduce the risk of flooding they cannot completely remove that risk as they may be over topped or breached during a flood event.

The Flood Map indicates areas with a 1% (0.5% in tidal areas), Annual Exceedance Probability (AEP) - the probability of a flood of a particular magnitude, or greater, occurring in any given year, and a 0.1% AEP of flooding from rivers and/or the sea in any given year. In addition, the map also shows the location of some flood defences and the areas that benefit from them.

The Flood Map is intended to act as a guide to indicate the potential risk of flooding. When producing it we use the best data available to us at the time and also take into account historic flooding and local knowledge. The Flood Map is updated on a quarterly basis to account for any amendments required. These amendments are then displayed on the internet at https://www.gov.uk/check-flood-risk

At this Site:.

The Flood Map shows that this sitelies within Flood Zone 3 - with a 0.5% chance of flooding from the sea (tidal flooding) in any given year.

Enclosed is an extract of our Flood Map which shows this information for your area.

Method of production

The Flood Map at this location has been derived using detailed modelling of the tidal River Thames through the Thames Tidal Defences Study completed in 2006 by Halcrow Ltd.

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Thames Estuary 2100 (TE2100)

You have requested in-channel flood levels for the tidal river Thames. These have been taken from the Thames Estuary 2100 study completed by HR Wallingford in 2008. The modelled node closest to your site is ; the locations of nearby nodes are also shown on the enclosed map.

Details about the TE2100 plan

The TE2100 plan is now live and within it are a set of levels on which the flood risk management strategy is based. The plan is the overarching flood management strategy for the Thames Estuary and therefore any development planning should be based on the same underlying data.

Details about the TE2100 in-channel levels

The TE2100 in-channel levels take into account operation of the Thames Barrier when considering future levels. The Thames Barrier requires regular maintenance and with additional closures the opportunity for maintenance will be reduced. When this happens, river levels – for which the Barrier would normally shut for the 2008 epoch – will have to be allowed through to ensure that the barrier is not shut too often. For this reason, levels upriver of the barrier will increase and the tidal walls will need to be heightened to match.

Why is there no return period for levels upriver of the barrier?

The levels upriver of the barrier are the highest levels permitted by the operation of the Thames Barrier. If levels and flows are forecast to be any higher, the Thames Barrier would shut, ensuring that the tide is blocked and the river maintained to a low level. For this reason the probability of any given water level upriver of the Barrier is controlled and therefore any associated return period becomes irrelevant. The Thames Barrier and associated defence system has a 1 in 1000 year standard which means it ensures that flood risk is managed up to an event that has a 0.1% annual probability. The probability of water levels upriver is ultimately controlled by the staff at the Thames Barrier.

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TE2100 2008 levels:

Levels downriver of the Thames Barrier are 0.1% AEP (1 in 1000) and levels upriver are the highest levels permitted by the Thames Barrier, described as the Maximum Likely Water Levels (MLWLs). The defence levels (left defence, right defence) are the minimum levels to which the defences should be built.

Location	Node	Easting	Northing	Extreme water level (m)	Left defence (m)	Right defence (m)	Allow for future defence raising to a level of...	
							Left Bank (m)	Right Bank (m)
Battersea	2.30	529598	177749	4.86	5.41	5.41	6.35	6.35
	2.31	530333	178388	4.85	5.41	5.41	6.35	6.35
Westminster	2.32	530481	179473	4.84	5.41	5.41	6.35	6.35

TE2100 climate change levels:

				2065 to 2100		2100	
Location	Node	Easting	Northing	Design water level	Defence level (both banks)	Design water level	Defence level (both banks)
Battersea	2.30	529598	177749	5.35	5.85	5.81	6.35
	2.31	530333	178388	5.34	5.85	5.80	6.35
Westminster	2.32	530481	179473	5.33	5.85	5.79	6.35

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Thames Tidal Upriver Breach Inundation Modelling

The map attached displays site-specific modelled flood levels at your site. These have been taken from the Thames Tidal Upriver Breach Inundation Modelling Study 2017 completed by Atkins Ltd. in May 2017.

We have developed a modelling approach where all upriver breach locations along the Thames are equitably modelled, to ensure a consistent approach across London. This modelling simulates 5679 continuous tidal breaches along the entire extent of the Thames from Teddington to the Thames Barrier. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width.

For breaches upriver of the Thames Barrier, there is no return period for modelled levels as the levels are controlled by barrier closures. The levels used are referred to as Maximum Likely Water Levels (MLWLs). Therefore 2014 and 2100 epochs were modelled on that basis.

Defence Details

The design standard of protection of the flood defences in this area of the Thames is 0.1% AEP; they are designed to defend London up to a 1 in 1000 year **tidal** flood event. The defences are all raised, man-made and privately owned. It is the riparian owners' responsibility to ensure that they are maintained to a crest level of **5.41m** AODN (the Statutory Flood Defence Level in this reach of the Thames). We inspect them twice a year to ensure that they remain fit for purpose. The current condition grade for defences in the area is **2 (good),** on a scale of 1 (very good) to 5 (very poor). For more information on your rights and responsibilities as a riparian owner, please see our document 'Living on the edge' found on our website at:

https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities

There are no planned improvements in this area. Please see the 'Thames Estuary 2100' document on our website for the short, medium and long term Flood Risk Management strategy for London:

https://www.gov.uk/government/publications/thames-estuary-2100-te2100

Areas Benefiting from Flood Defences

This site is within an area benefiting from flood defences, as shown on the enclosed extract of our Flood Map. Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year, or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

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Recorded Flood Events Data

We hold records of historic flood events from rivers and the sea. Information on the floods that may have affected the area local to your site are provided in the enclosed map.

Due to the fact that our records are not comprehensive, we would advise that you make further enquiries locally with specific reference to flooding at this location. You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

We map flooding to land, not individual properties. Our historic flood event record outlines are an indication of the geographical extent of an observed flood event. Our historic flood event outlines do not give any indication of flood levels for individual properties. They also do not imply that any property within the outline has flooded internally.

Please be aware that flooding can come from different sources. Examples of these are:

- from rivers or the sea;
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system);
- overflowing or backing up of sewer or drainage systems which have been overwhelmed,
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding and drainage systems that have been overwhelmed.

Other Sources of Flood Risk

The Lead Local Flood Authority for your area are responsible for local flood risk (i.e. surface runoff, ground water and ordinary watercourse) and may hold further information .

You may also wish to consider contacting the appropriate relevant Local Planning Authority and/or water/sewerage undertaker for the area. They may be able to provide some knowledge on the risk of flooding from other sources.

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Additional Information

Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Important

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice, the technical guidance to the National Planning Policy Framework and the existing PPS25 Practice Guide for information about what flood risk assessment is needed for new development in the different Flood Zones. These documents can be accessed via:

https://www.gov.uk/flood-risk-standing-advice-frsa-for-local-planning-authorities

https://www.gov.uk/government/publications/national-planning-policy-framework-technical-guidance

https://www.gov.uk/government/publications/development-and-flood-risk-practice-guide-planning-policy-statement-25

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

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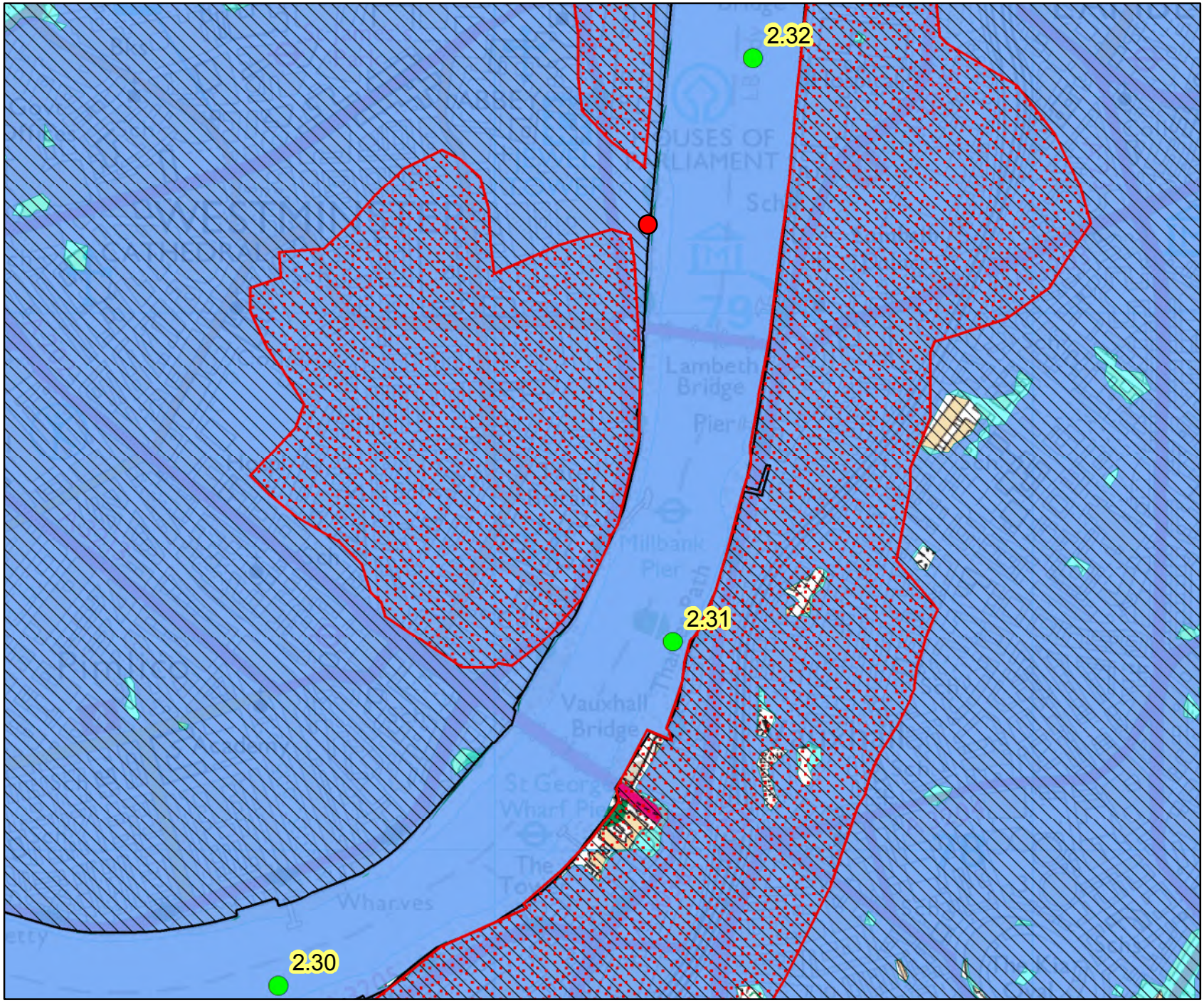
Customer services line: 03708 506 506
Email: NETenquiries@environment-agency.gov.uk
Website: www.environment-agency.gov.uk

Detailed FRA/FCA for: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



Environment Agency

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Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 150 300 600
Metres

Legend

- TE2100Nodes
- 1707 Flood Outline
- 1928 Flood Outline
- 1953 Flood Outline
- Areas Benefiting from Flood Defences
- Flood Zone 3
- Flood Zone 2

Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

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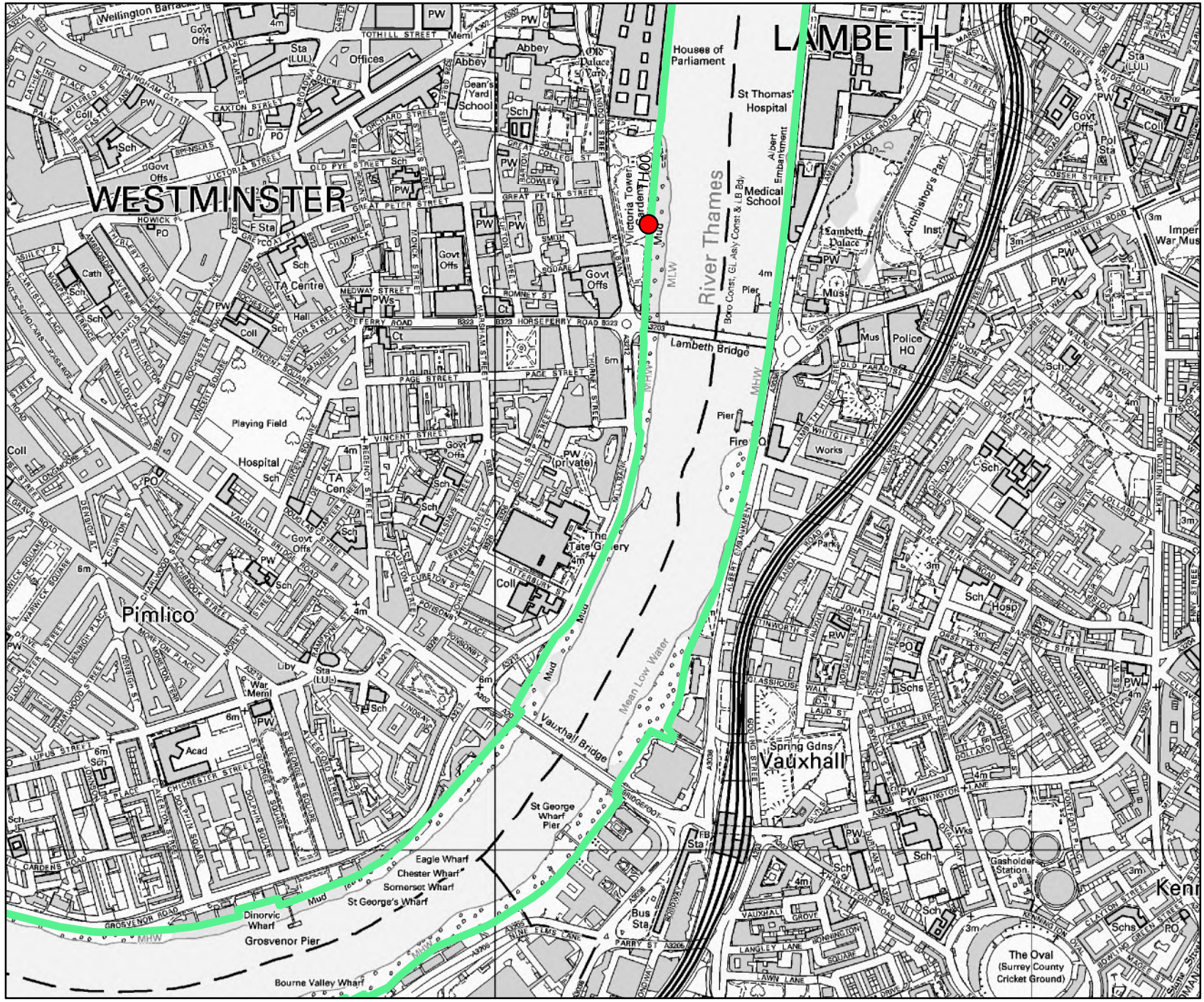
Detailed FRA/FCA for: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



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0 150 300 600
Metres

Legend

TTD Defences SDL (mAODN)

SDL

5.41

Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

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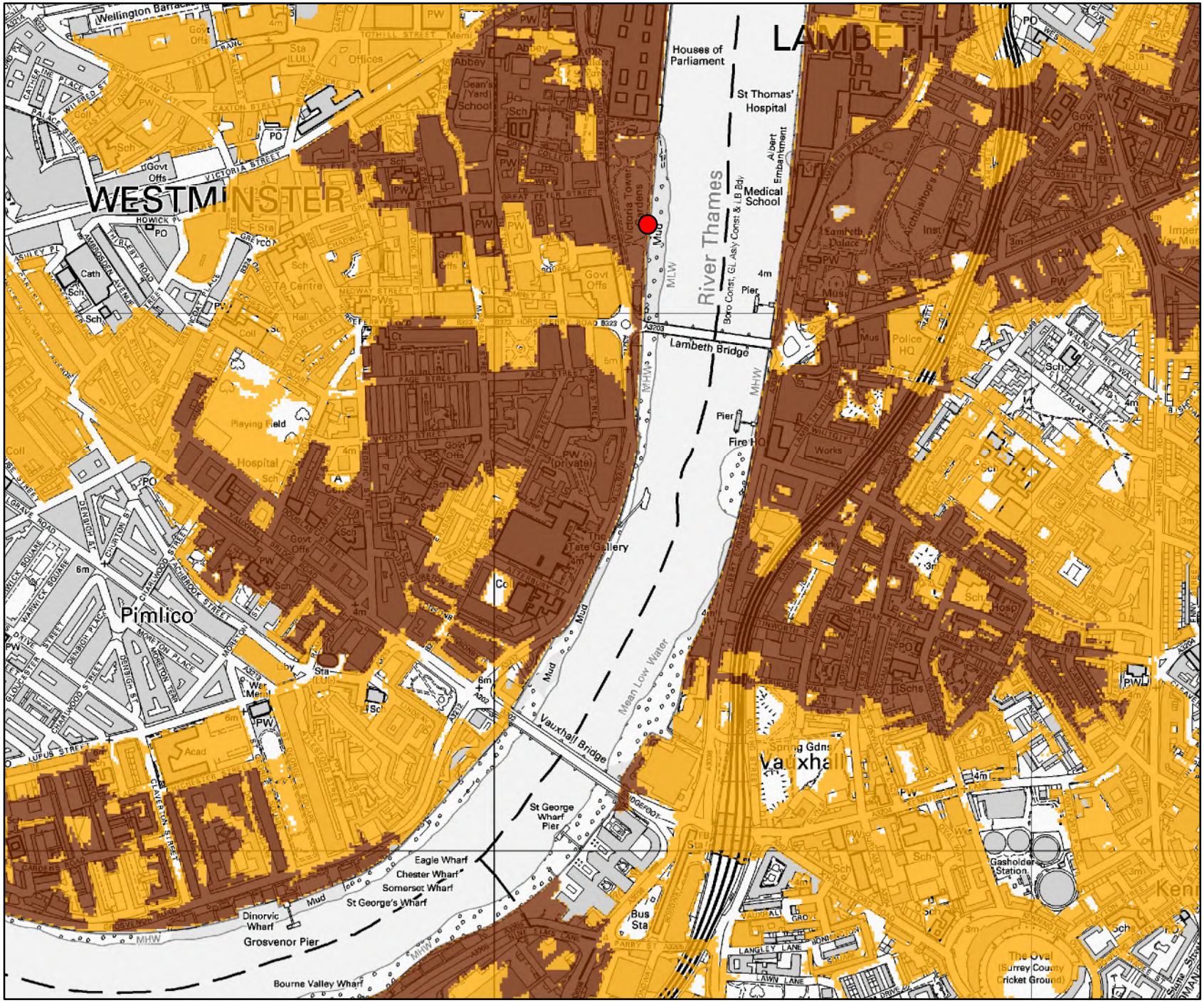
Breach Modelling Map for: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



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Metres

Legend

Upstream Breach Outlines

Epoch

- 2005
- 2100

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

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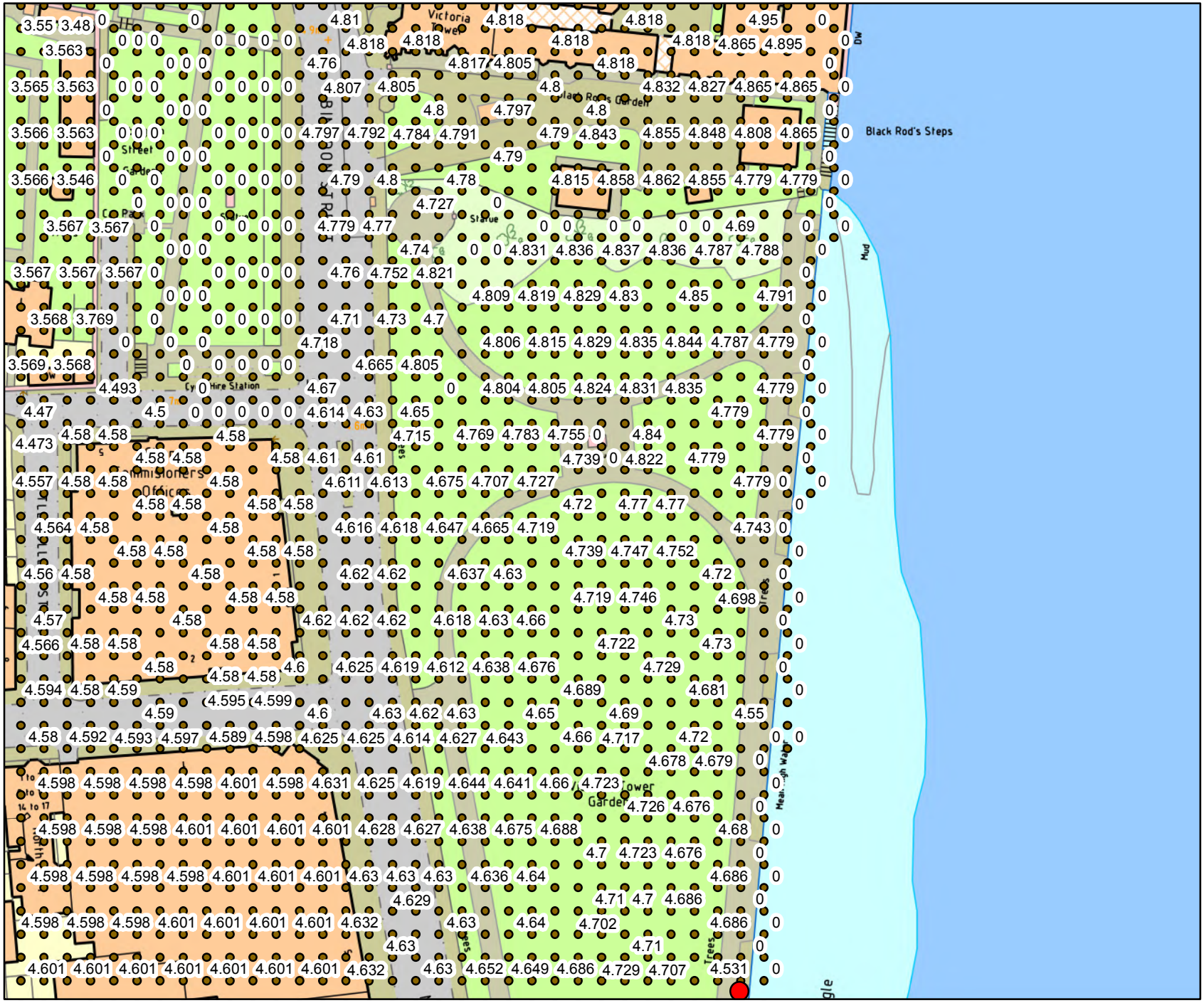
Modelled Flood Levels For: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



Environment Agency

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AL7 1HE

N

0 15 30 60
Metres

Legend

- 2015 Thames Tidal Breach Node Points

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

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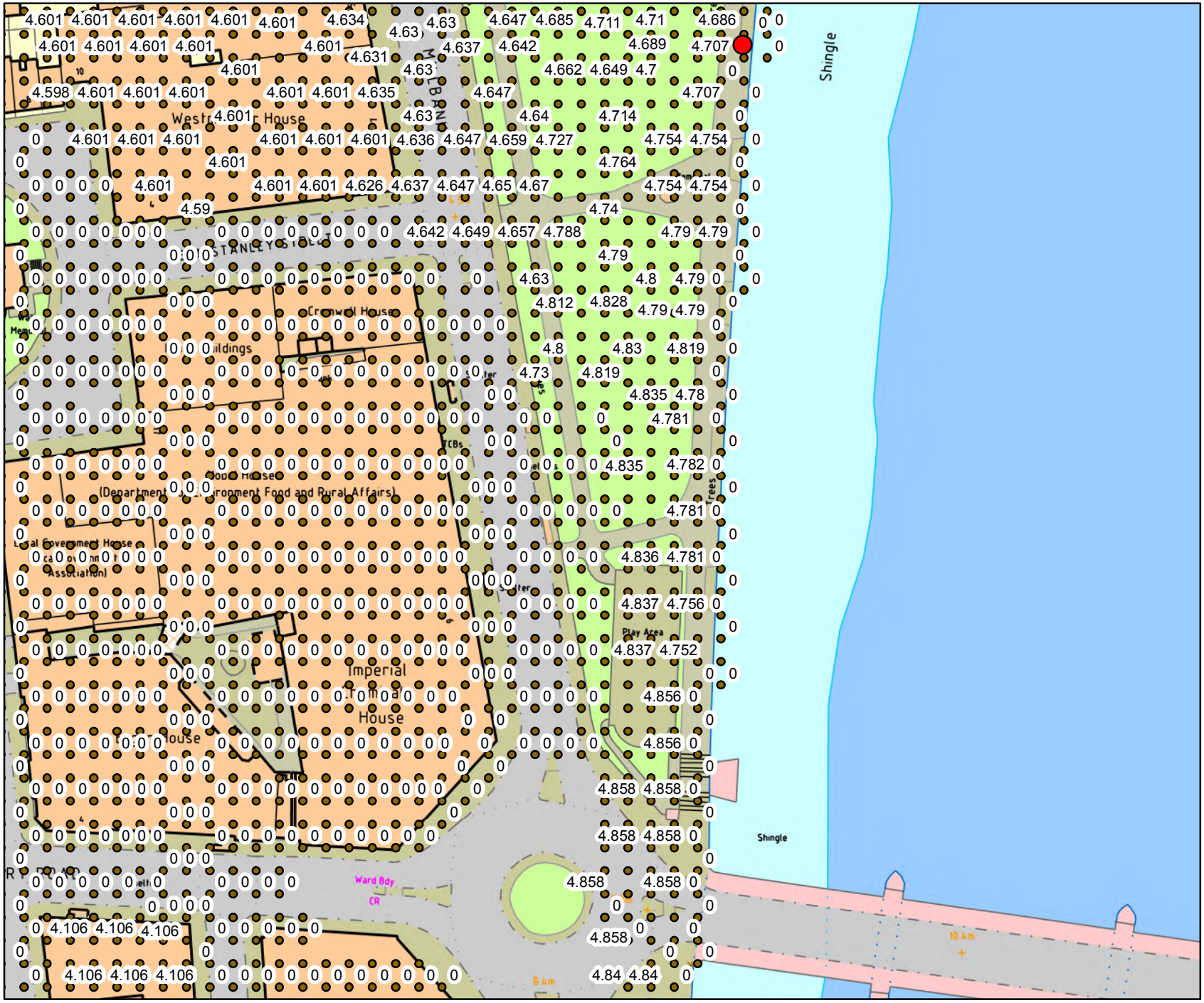
Modelled Flood Levels For: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



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Alchemy,
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N

0 15 30 60
Metres

Legend

- 2015 Thames Tidal Breach Node Points

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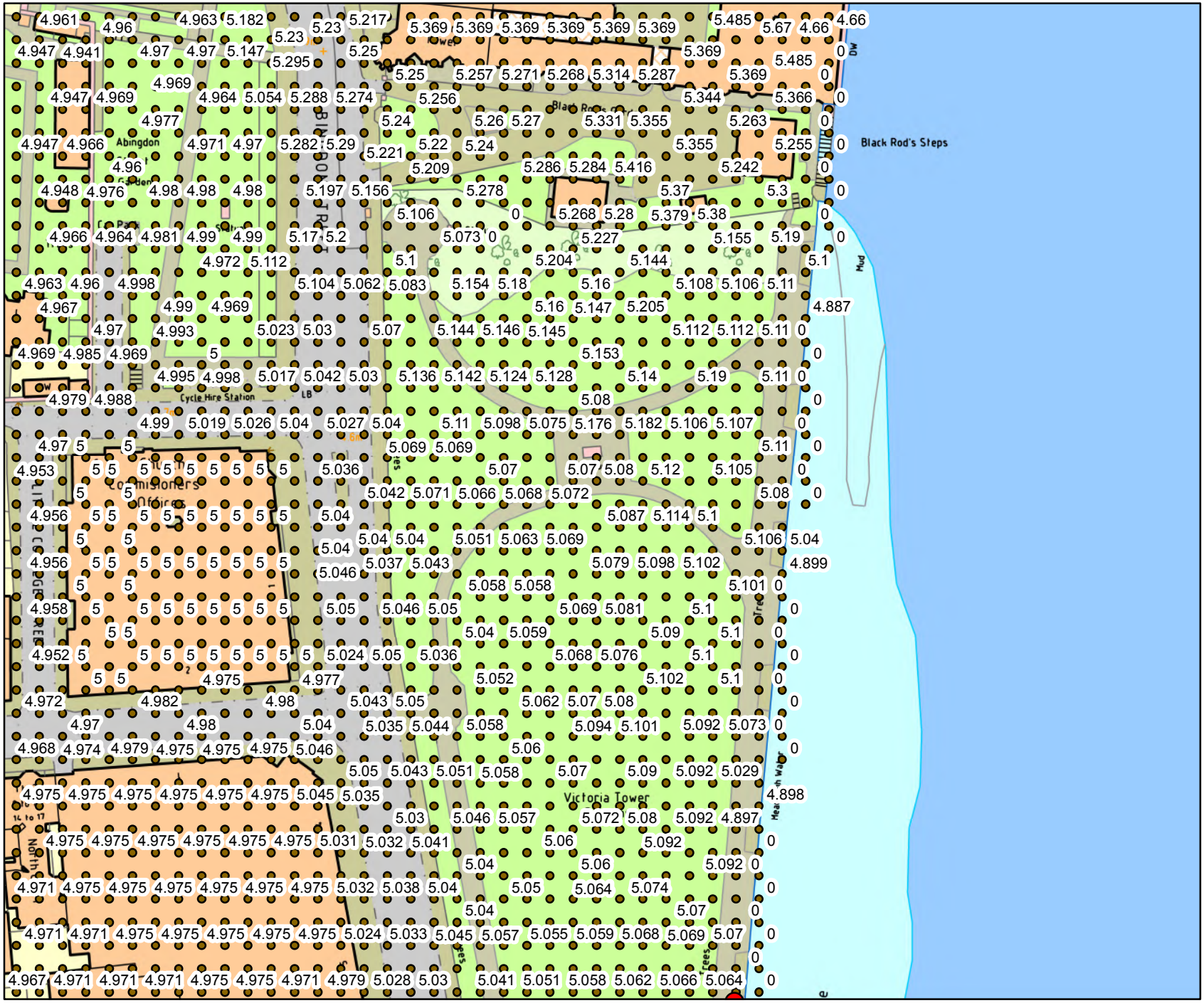
Modelled Flood Levels For: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



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N

0 15 30 60
Metres

Legend

- 2100 Thames Tidal Breach Node Points

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

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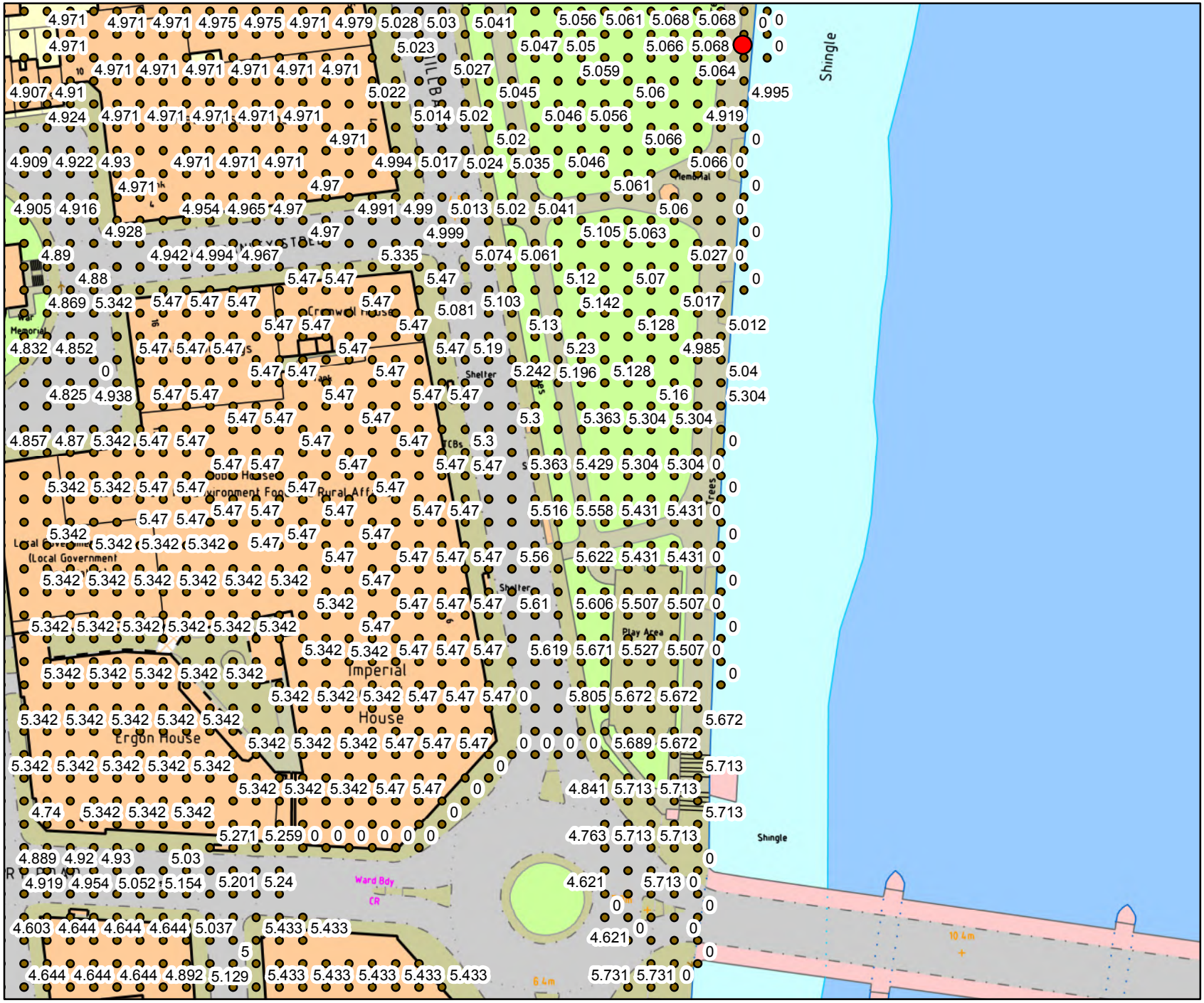
Modelled Flood Levels For: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



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0 15 30 60
Metres

Legend

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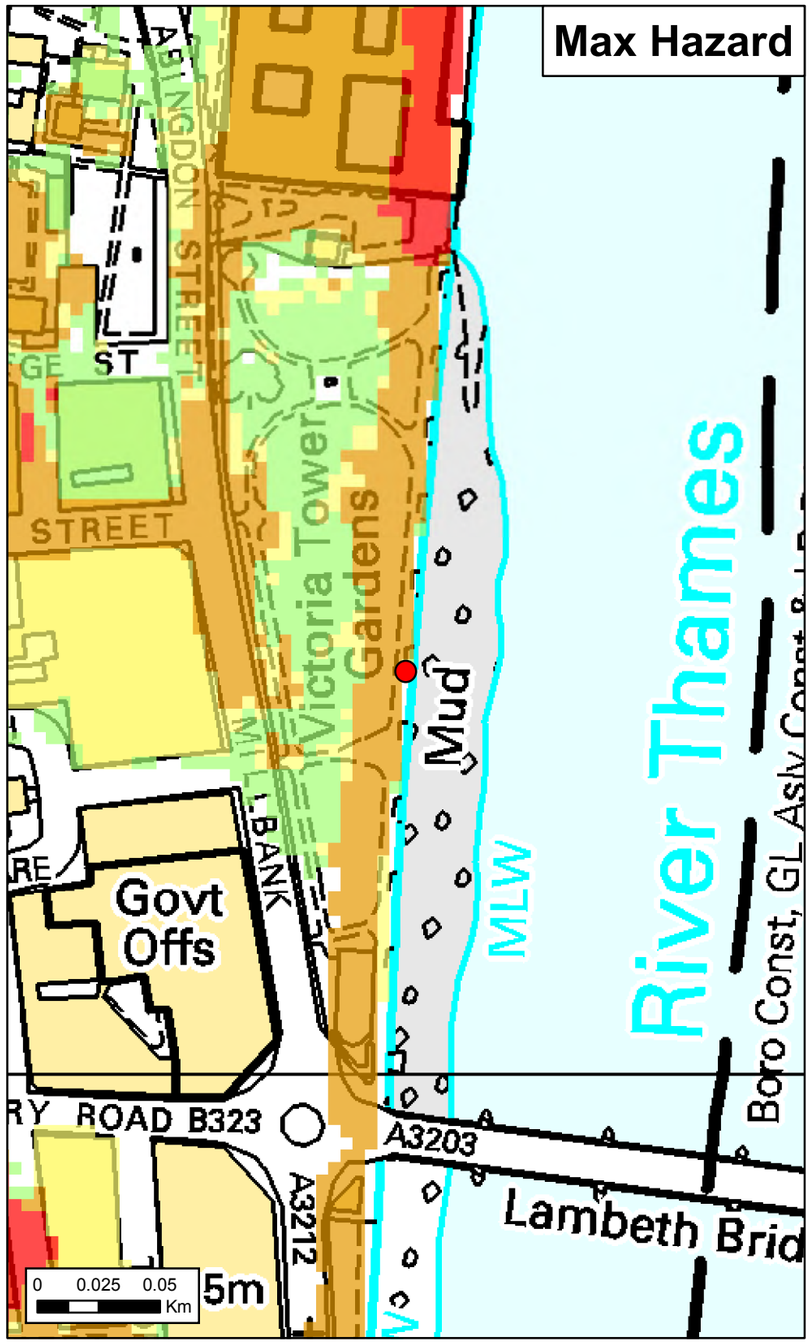
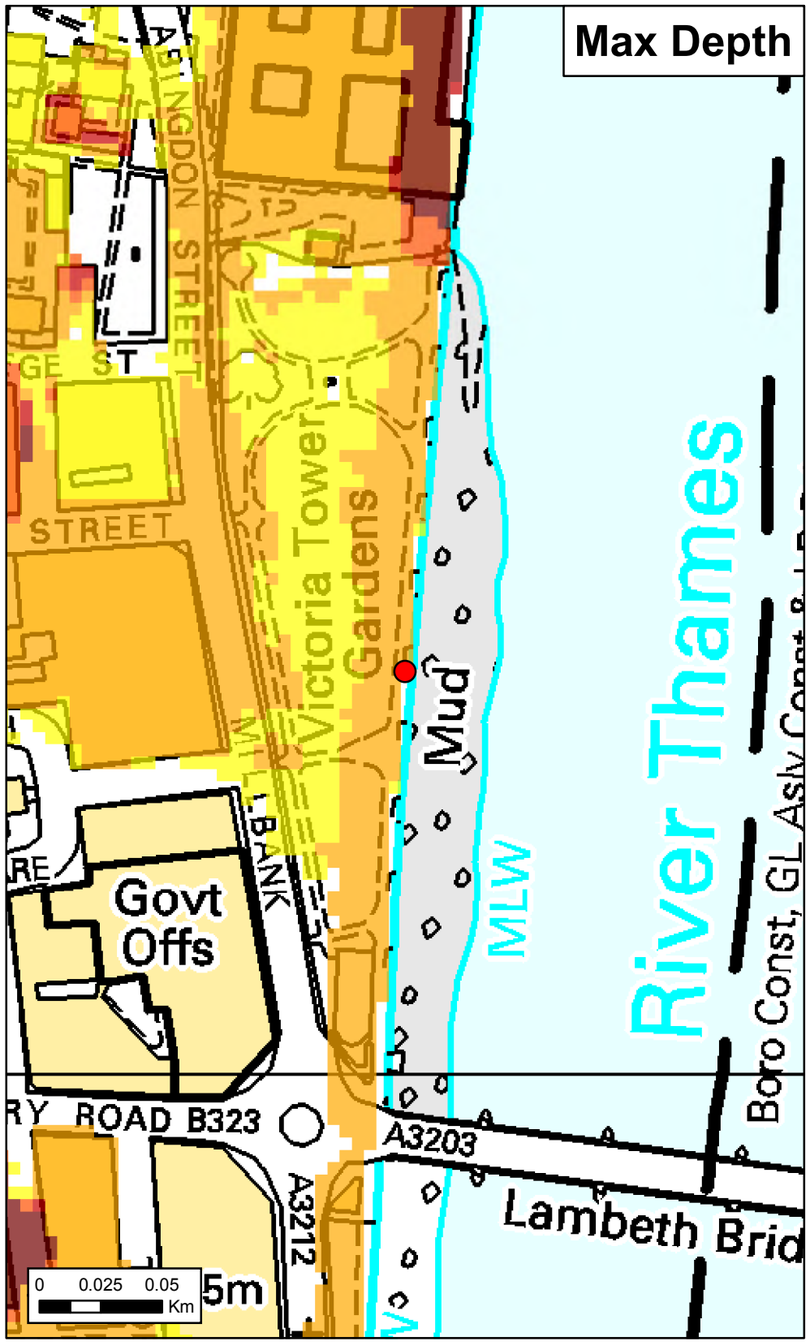
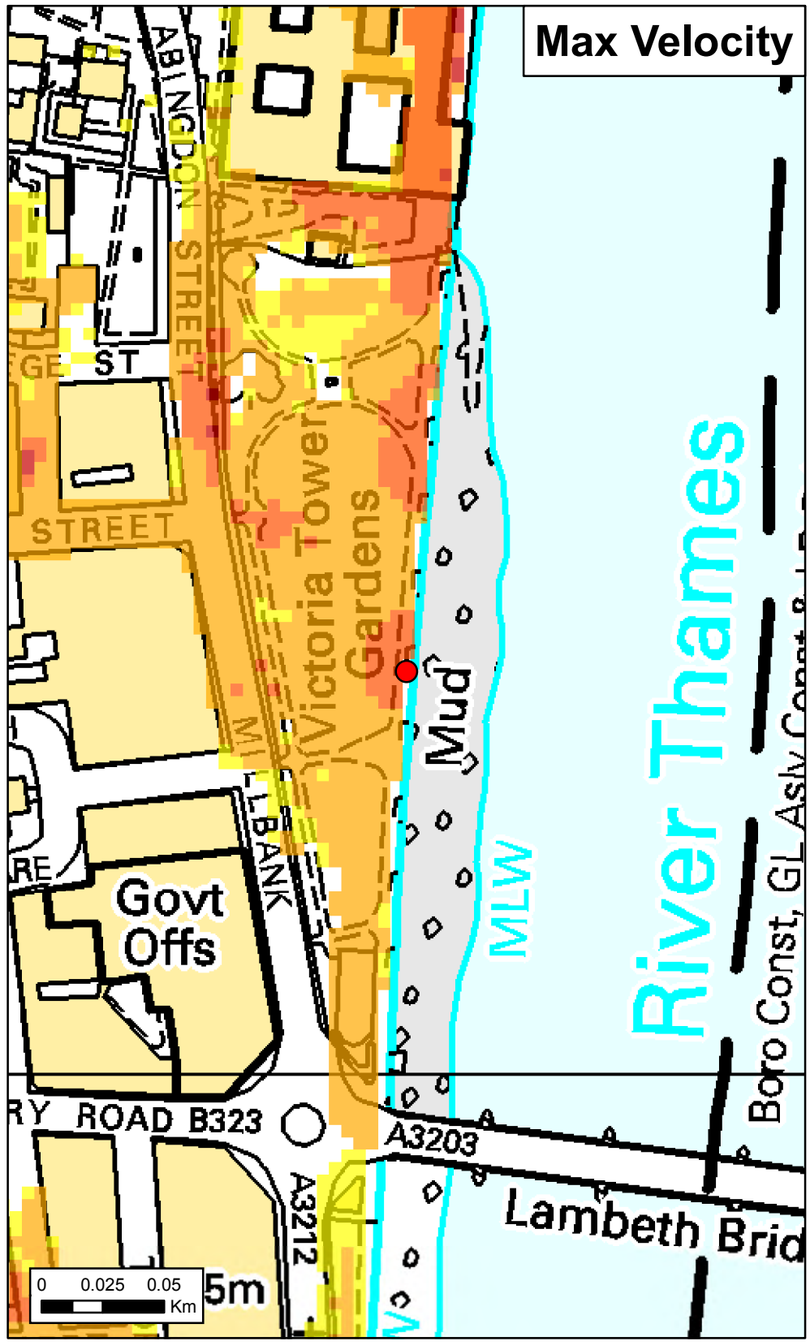






Max Hazard

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.00 (Danger for Most)
- Greater than 2.00 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- > 2.5

Date Printed	17/10/2018	**Scenario year**	2014	**Scenario Annual Chance**	0.1% (1 in 1000)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

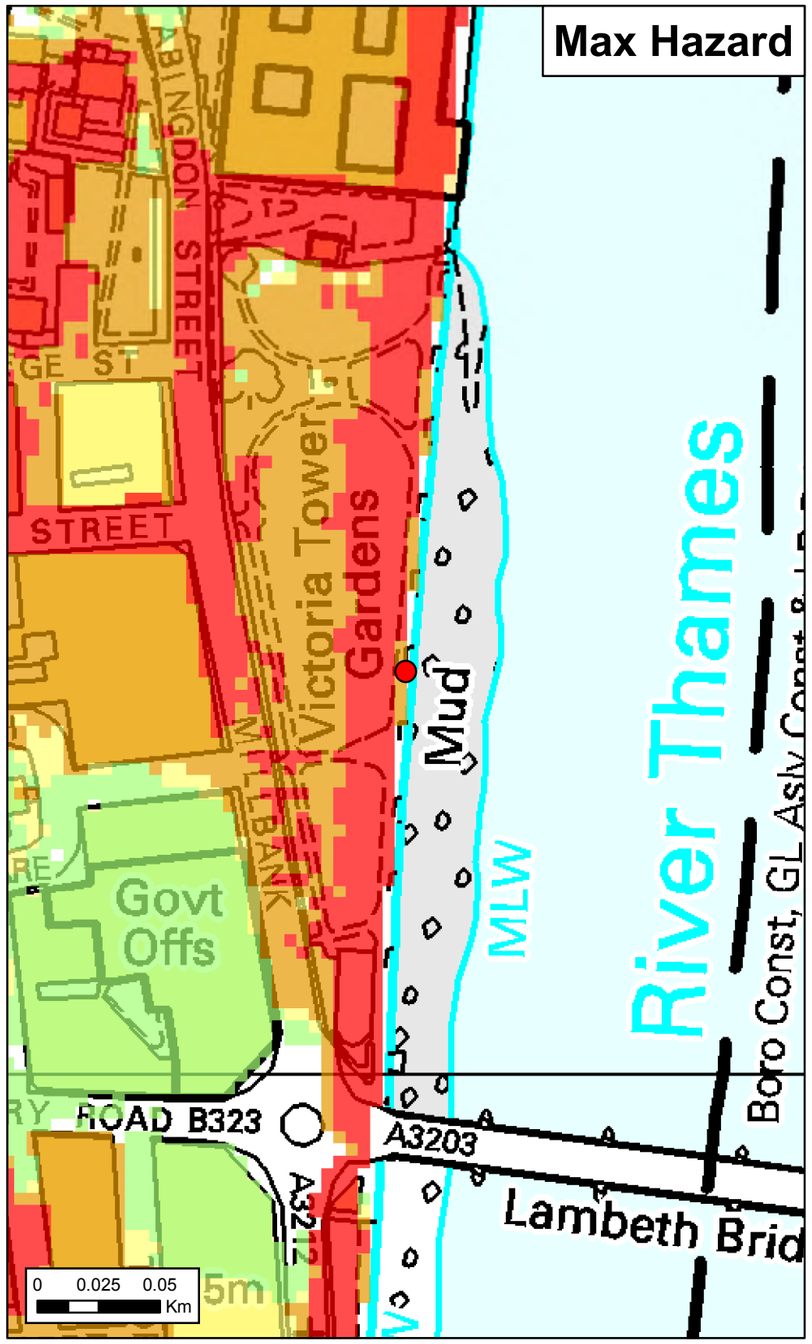
Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.

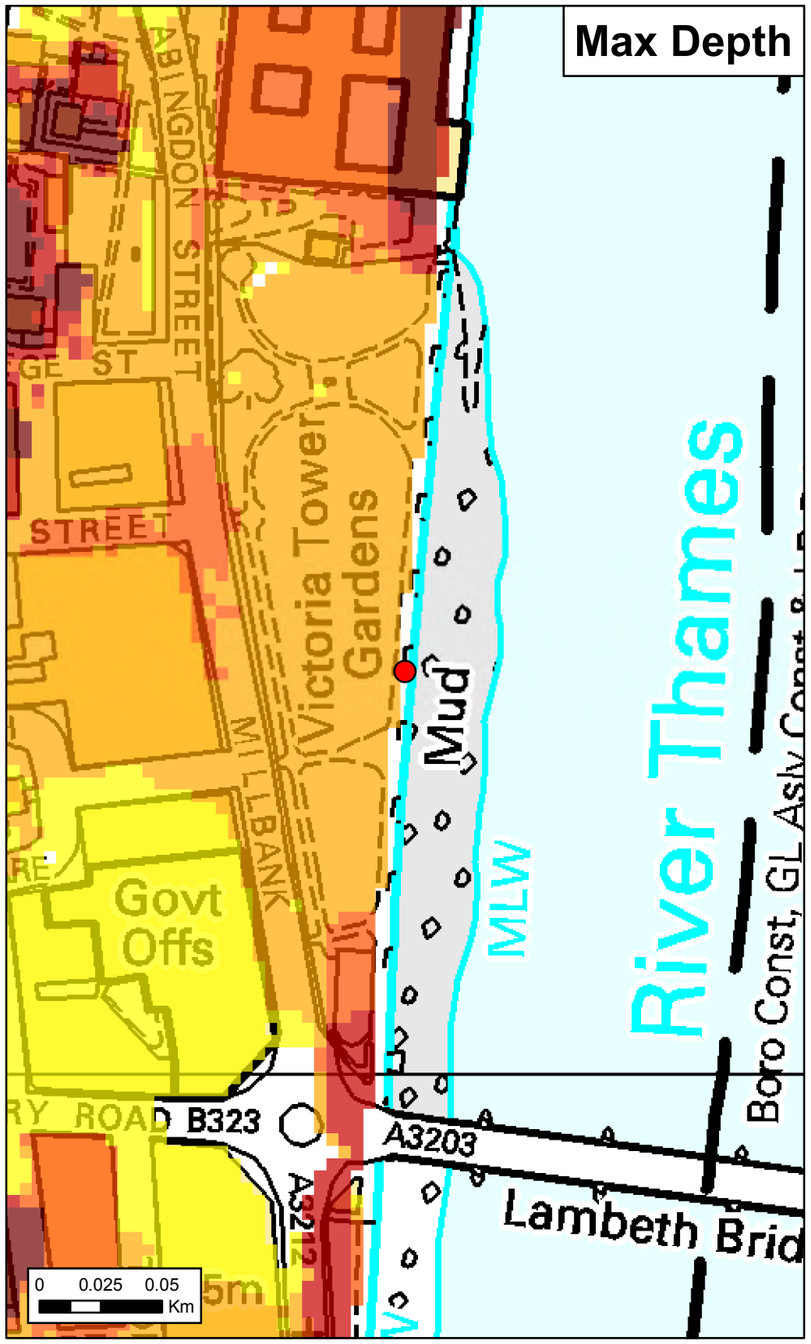
General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

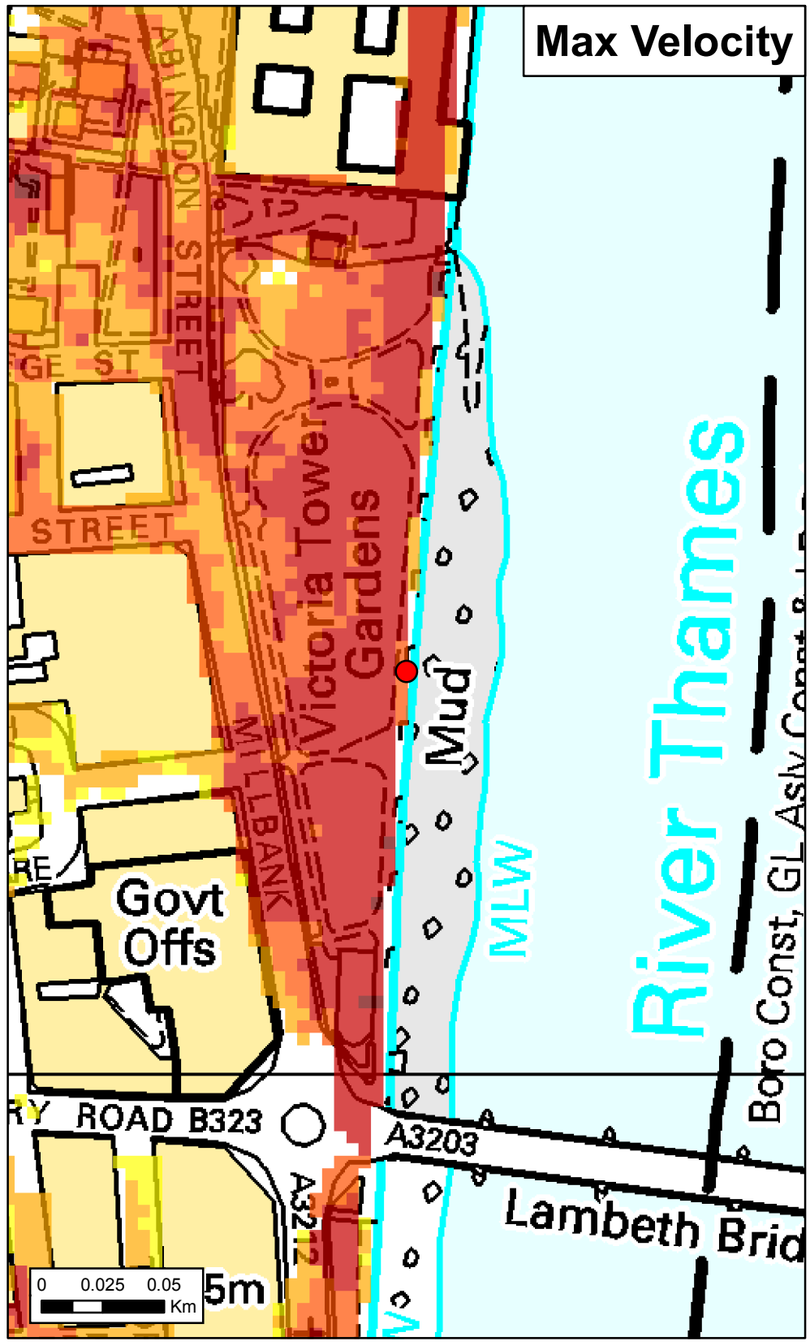
Environment Agency

Thames Tidal Breach Hazard Mapping

Map Centred on 530287, 179163







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Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- > 2.5

Date Printed	17/10/2018	**Scenario year**	2100	**Scenario Annual Chance**	0.1% (1 in 1000)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

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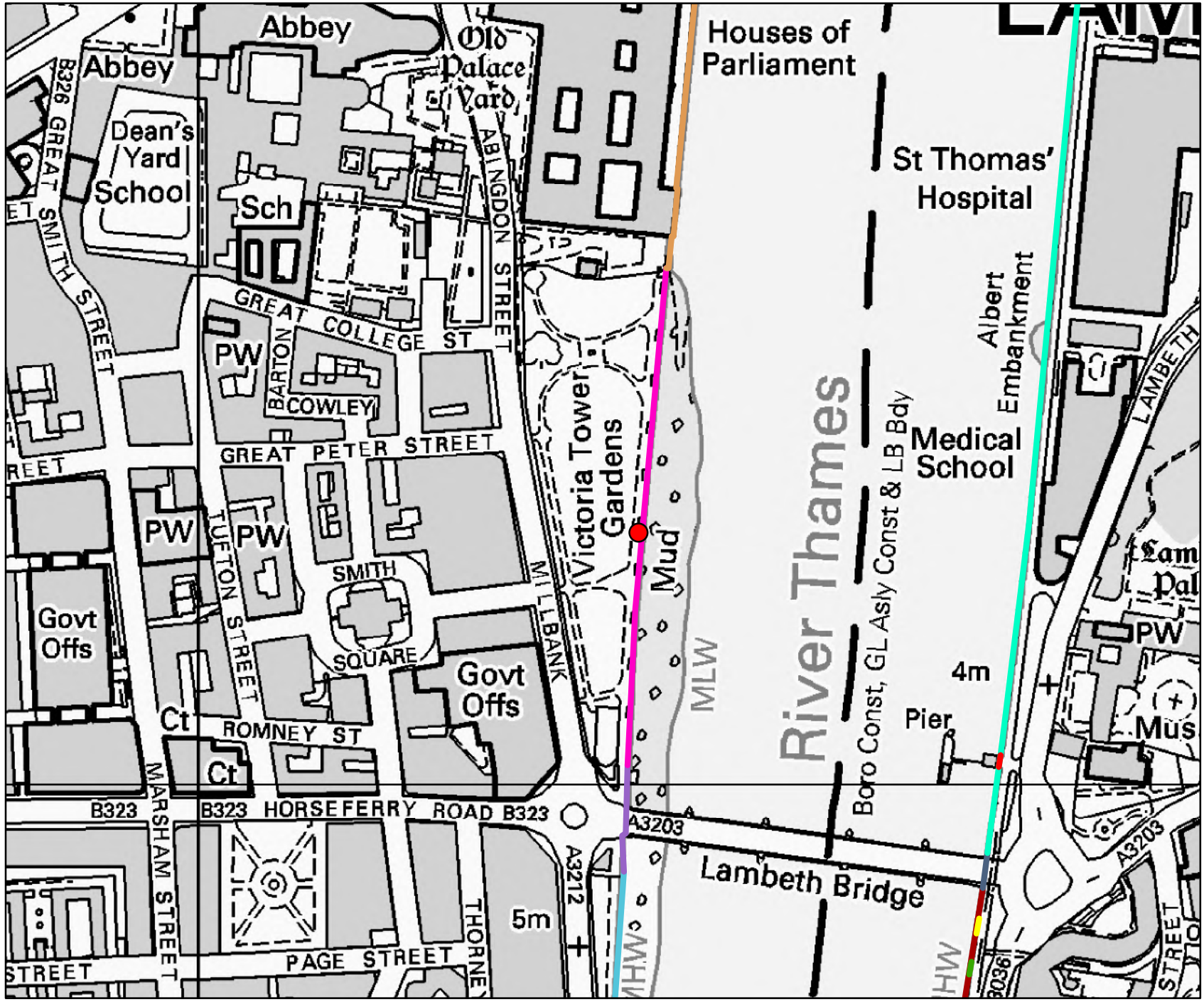
Environment Agency

Thames Tidal Breach Hazard Mapping

Map Centred on 530287, 179163

Structures and Defences centred on: Victoria Tower Gardens - 17/10/2018 - HNL102344JH



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AL7 1HE

N

0 50 100 200
Metres

Legend

ASSET_ID

- 8243
- 8244
- 8322
- 8323
- 14957
- 14997
- 14998
- 17101
- 17262
- 171216

The following information on defences has been extracted from the Asset Information Management System (AIMS)

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

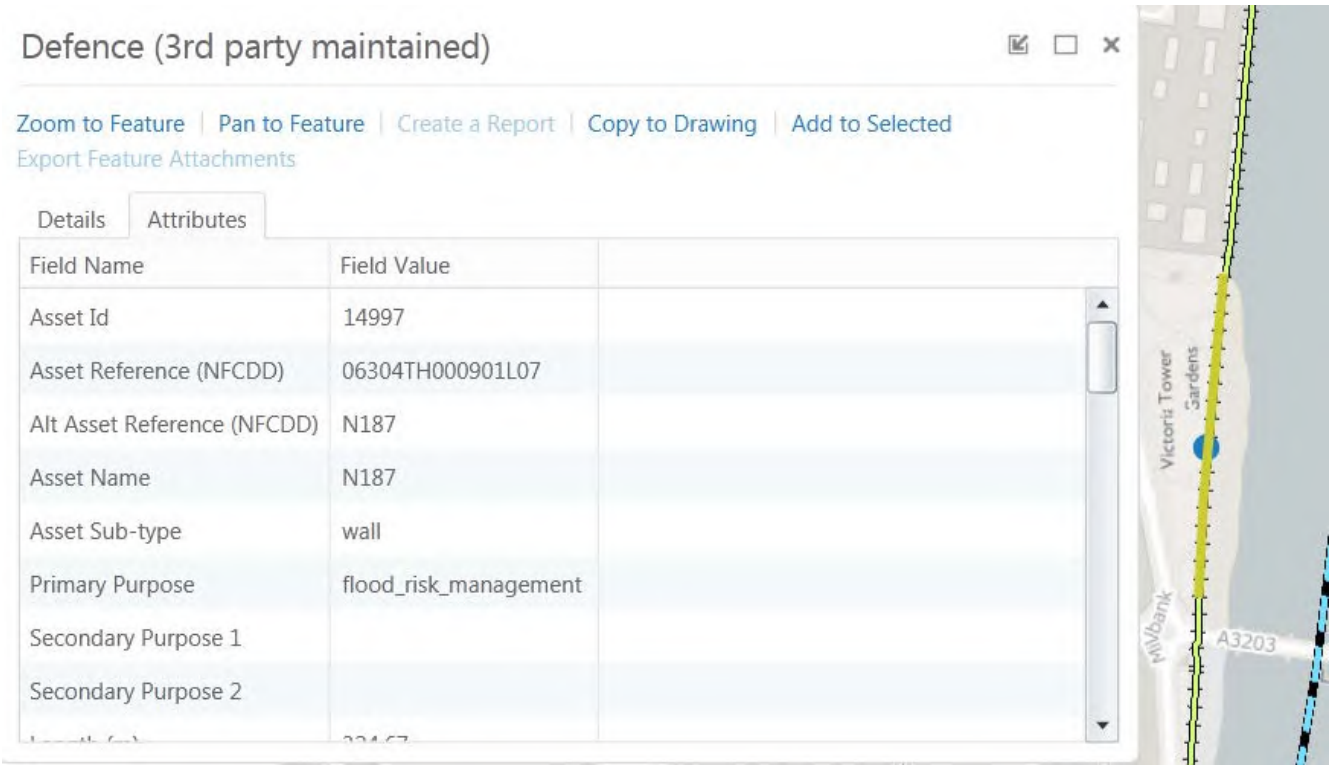
Environment Agency ref: HNL102344JH

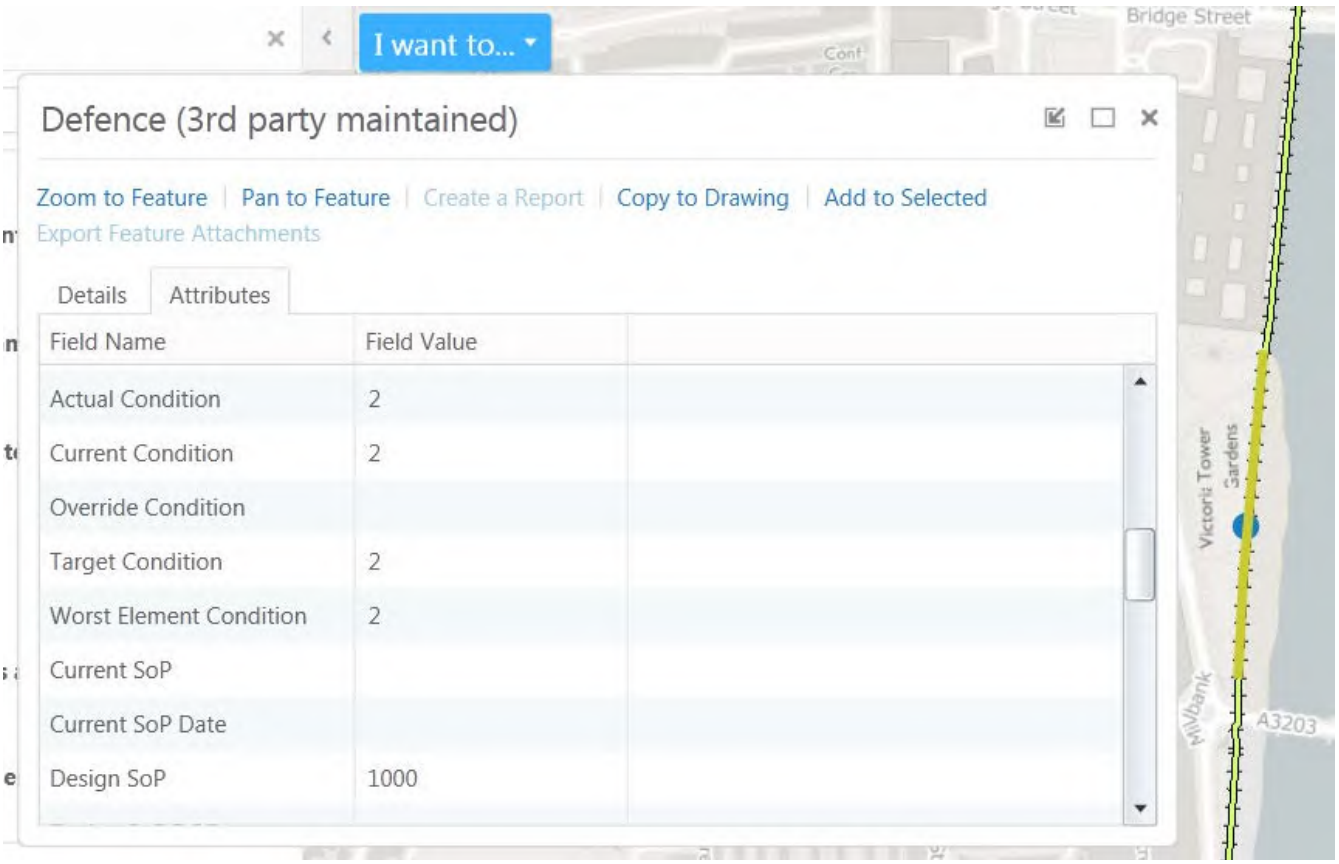
The following information on defences has been extracted from the Asset Information Management System (AIMS)

Defences

Asset ID	Asset Type	Asset Protection	Asset Maintainer	Asset Comment	Asset Description	Design Standard of protection (years)	Downstream Crest Level	Upstream Crest Level	Condition of Defences (1=Good, 5 = Poor)
171216	wall	tidal	private	None	The English Maid Albert Embankment	1000	5.83	5.83	2
17262	wall	tidal	private	None	Gardens & Approach Lambeth Brd	1000	5.41	5.41	2
8323	wall	tidal	unknown	Tunnel under Albert Embankment. Inspections by confined spaces operatives.	Doultons Dock	1000	5.61	5.61	3
8322	wall	tidal	unknown	Tunnel under Albert Embankment. Inspections by confined spaces operatives.	Blind Dock.	1000	5.63	5.63	3
8244	wall	tidal	private	None	Lambeth Bridge	1000	5.63	5.63	2
14998	wall	tidal	private	None	Lambeth Bridge	1000	5.41	5.41	2
17101	wall	tidal	private	None	Albert Embankment	1000	5.41	5.41	2
8243	wall	tidal	private	None	Lambeth Pier entrance.	1000	5.41	5.41	2
14997	wall	tidal	private	None	Victoria Tower Gardens	1000	5.81	5.81	2
14957	wall	tidal	private	Master at Arms Office have control. Any inspection visit contact to arrange.	Houses Of Parliament .	1000	5.41	5.41	2

Please see below extracts from the Easimap Asset Management layer.





I want to...

Defence (3rd party maintained)

Zoom to Feature | Pan to Feature | Create a Report | Copy to Drawing | Add to Selected
Export Feature Attachments

Details | Attributes

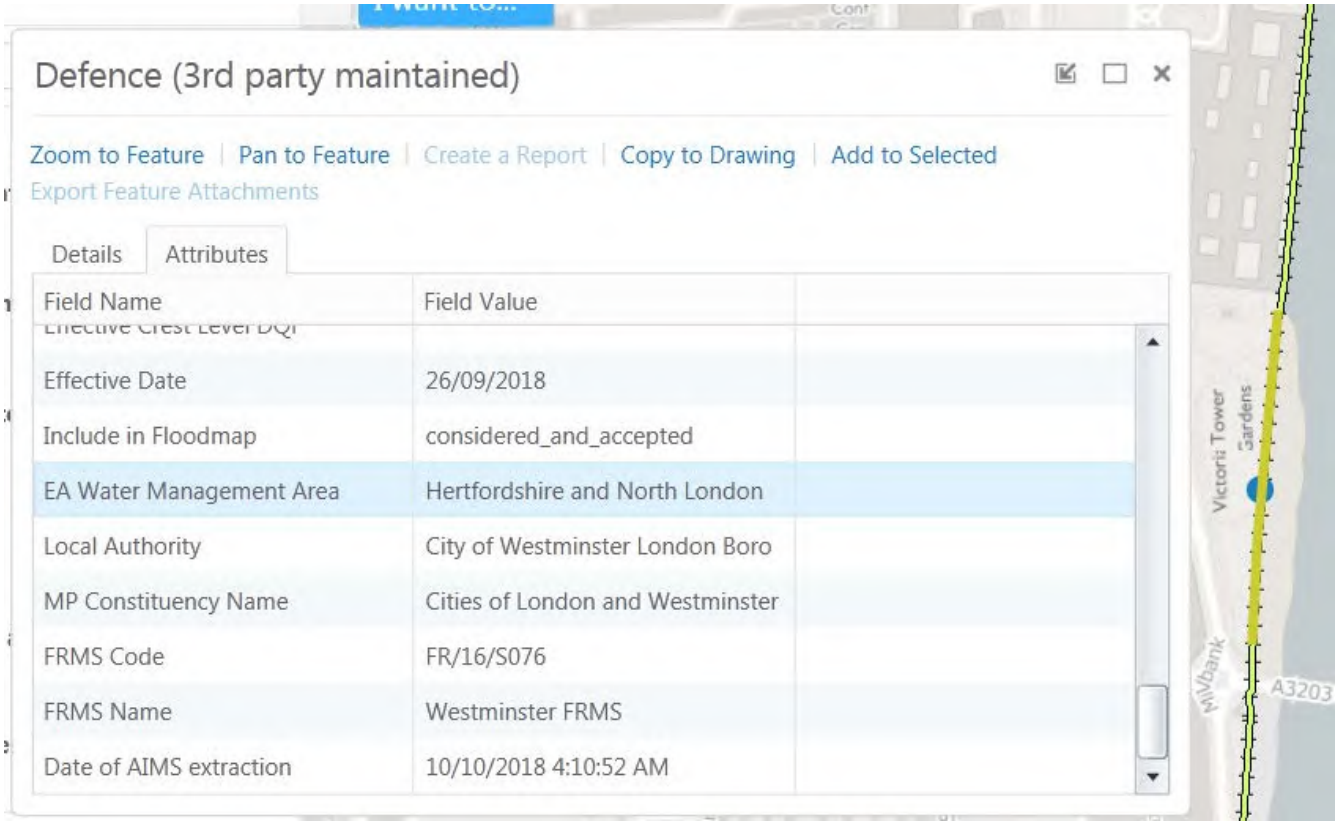
Field Name	Field Value
Design SoP	1000
Design SoP DQF	
Year Last Refurbished	
Last Inspection Date	13/09/2018
Next Inspection Date	
Date Asset opened/commissioned	
Actual DCL	5.81
Actual DCL DQF	crest_level_dqf_2

Defence (3rd party maintained)

Zoom to Feature | Pan to Feature | Create a Report | Copy to Drawing | Add to Selected
Export Feature Attachments

Details | Attributes

Field Name	Field Value
Bank	left
Design DCL	5.41
Design UCL	5.41
Effective Crest Level	
Effective Crest Level DQF	
Effective Date	26/09/2018
Include in Floodmap	considered_and_accepted
EA Water Management Area	Hertfordshire and North London
Local Authority	City of Westminster London Boro



It was last inspected on the 13th September 2018. These assets were graded at 2 with a worst element condition of 3.

A failing asset is a Flood Defence Structure, Bank, Culverted channel, Flood Storage Area or Footbridge classified as below target condition. The current condition grade for a failing asset is between 4 (poor) & 5 (very poor), on a scale of 1 (very good) to 5 (very poor).

Appendix B

VISUAL INSPECTION SUMMARY

Bay 1 – Photo 7125 & 7161

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Minor horizontal mortar loss at left had side of bay at high-water level, approx. total length of 1m.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 2 – Photo 7126 & 7164

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 3 – Photo 7127 & 7165

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at lower mid-level of wall, with associated increased staining.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 4 – Photo 7129 & 7166

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at mid-level and top of wall, with associated increased staining and residue build up in places.

Sporadic mortar loss noted to horizontal joints, approx. total length of 1m.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 5 – Photo 7130 & 7167

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at mid-level of wall, with associated increased staining and residue build up in places.

Sporadic mortar loss noted to horizontal joints, approx. total length of 1m.

Isolated minor area of spalling within parapet at left hand side of bay, adjacent to pier.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 6 – Photo 7131 & 7168

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at lower mid-level and top of wall, with associated increased staining and residue build up in places.

Sporadic mortar loss noted across most horizontal joints at a high level, approx. total length of 20m.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 7 – Photo 7132 & 7170

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at lower mid-level and top of wall, with associated increased staining and residue build up in places.

One vertical fracture and one diagonal fracture located within concrete repair. Crazing noted within stone blocks directly below area of concrete repair. No visible evidence of recent movement observed and no obvious distortion within riverwall.

Clay foreshore exposed below riverwall with remnants of stone blocks/ debris within the foreshore.

Landward face commentary:
General good condition.

Staining noted to concrete, with minor spalling and exposed reinforcement to coping, approximate length of exposed reinforcement 300mm. Manor cracking noted within pavement.

Bay 8 – Photo 7140 & 7176

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at top of wall, with associated increased staining and residue build up in places.

Sporadic mortar loss noted across most horizontal joints at a high level, approx. total length of 15m.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 9 – Photo 7141 & 7177

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at mid-level of wall, with associated increased staining and residue build up in places.

Sporadic mortar loss noted across some horizontal joints at a high level, approx. total length of 10m.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 10 – Photo 7143 & 7180

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Isolated sporadic seepage through horizontal joints at top-level of wall, with associated increased staining and residue build up in places.

Sporadic mortar loss noted across some horizontal joints at a high level, approx. total length of 10m.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 11 – Photo 7144 & 8171

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Sporadic mortar loss noted across some horizontal joints at a high level, approx. total length of 10m with minor associated seepage.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 12 – Photo 7058 & 7182

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Vertical fracture, located at right hand side of bay, extends primarily through vertical joints and 2 stone blocks. Minor associated seepage.

Headwall located within bay, appears to be a chamber from the landward side of the riverwall, with access ladder within chamber. Bed of chamber covered with rubble/ shingle. Outfall pipe extends out from headwall under foreshore encased in mass concrete surround.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 13 – Photo 7059 & 7186

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

Minor seepage located at high-water level at centre of bay with associated orange staining/ residue build up, colour of staining indicative of steel.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 14 – Photo 7060 & 7187

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically at high-water level and above foreshore level.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 15 – Photo 7061 & 7188

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 16 – Photo 7062 & 7189

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 17 – Photo 7063 & 7190

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 18 – Photo 7064 & 7191

Riverward face commentary:
General good condition (rating 2).

Sporadic staining throughout, with significant area of brown/ orange staining.

Mortar loss along horizonal at lower level of wall at right hand side of bay, approx. length of 1m, with one discrete area of seepage.

Landward face commentary:
General good condition.

Staining noted to stone blocks.

Bay 19 – Photo 7066 & 7192

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, with significant area of brown/ orange staining.

Mortar loss along horizonal at mid level of wall at right hand side of bay, approx. total length of 1m, with two discrete areas of seepage.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 20 – Photo 7068 & 7193

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, with significant area of brown/ orange staining.

Mortar loss along horizonal joint below the parapet, approx. total length of 2m.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 21 – Photo 7070 & 7194

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout.

Mortar loss along horizonal joint below the parapet, approx. total length of 2m.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 22 – Photo 7072 & 7195

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 23 – Photo 7073 & 7196

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically located around high-water level.

Sporadic loss of mortar from horizontal joint throughout (approx. total length of 3m) with associated signs of seepage and increased localised staining.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 24 – Photo 7076 & 7197

Riverward face commentary:

General good condition (rating 2), locally fair condition (rating 3) due to vertical fracture.

Sporadic staining throughout.

Mortar loss noted sporadically across bay along horizontal joints (approx. total length of 5m) with associated seepage through joints with increased staining/ residue build-up.

Significant vertical fracture noted to right hand side of bay across the full length of visible wall below parapet. 3 main blocks fractured, associated mortar loss within joints and spalling/ fracturing to face of stone blocks. No visible evidence of recent movement observed and no obvious distortion within riverwall.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 25 – Photo 7083 & 7198

Riverward face commentary:

General good condition (rating 2), locally fair condition (rating 3) due to vertical fracture.

Sporadic staining throughout.

Mortar loss noted sporadically across bay along horizontal joints (approx. total length of 5m) with associated seepage through joints with increased staining/ residue build-up.

Vertical fracture noted to left of bay centre below parapet for a length of 4 blocks, 3 blocks fractured and associated mortar loss. No visible evidence of recent movement observed and no obvious distortion within riverwall.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 26 – Photo 7087 & 7199

Riverward face commentary:
General good condition (rating 2).

Sporadic staining throughout.

At right of bay centre, mortar loss noted along horizontal joints (approx. length of 2m) with associated seepage through joints with increased staining/ residue build-up.

Landward face commentary:
General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 27 – Photo 7090 & 7200

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically located around high-water level.

At right hand side of bay, mortar loss noted along horizontal joints (approx. length of 3m) with associated seepage through joints with increased staining/ residue build-up.

Vertical fracture noted to left of bay centre below parapet for a length of 4 blocks, 2 blocks fractured and associated mortar loss. No visible evidence of recent movement observed and no obvious distortion within riverwall.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 28 – Photo 7093 & 7201

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically located around high-water level.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks, with cracking within pavement.

Bay 29 – Photo 7094 & 7202

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically located around high-water level.

No other notable signs of deterioration.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 30 – Photo 7095 & 7203

Riverward face commentary:

General good condition (rating 2), locally fair condition (rating 3) due to vertical fracture.

Sporadic staining throughout, typically located around high-water level.

Significant fracture noted at centre of bay (locally fair condition, rating 3). Vertical fracture full height of visible wall, with 5 cracked blocks. No visible evidence of recent movement observed and no obvious distortion within riverwall. Some grout repairs to fracture and spalled stone noted.

General sporadic loss of mortar within bay.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 31 – Photo 7100 & 7204

Riverward face commentary:

General good condition (rating 2), locally fair condition (rating 3) due to vertical fracture.

Sporadic staining throughout, typically located around high-water level.

Fracture noted at left hand side of bay (locally fair condition, rating 3). Vertical fracture full height of visible wall, with 7 cracked blocks. No visible evidence of recent movement observed and no obvious distortion within riverwall.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 32 - Photo 7102 & 7205

Riverward face commentary:

General good condition (rating 2).

Sporadic staining throughout, typically located around high-water level.

Loss of mortar from horizontal joint between parapet and buttress, approximate length of 5m.

Landward face commentary:

General good condition.

Staining noted to stone blocks.

Bay 33 – Photo 7103, 7206 & 7207

Riverward face commentary:

General good condition (rating 2), locally fair condition (rating 3) due to vertical fracture.

Sporadic staining throughout, typically located around high-water level.

Water was noted to spill over the north side of the storm relief sewer apron resulting in cliffing within the foreshore adjacent to the apron with some minor undermining along the northern edge of apron.

Significant fracture noted at right hand side of bay (locally fair condition, rating 3). Vertical fracture full height of visible wall, with 9 cracked blocks. Bitumen and lead infilled within cracks, no visible evidence of recent movement observed and no obvious distortion within riverwall.

Landward face commentary:

General good condition.

Minor staining noted to stone blocks.

Bay 34 – Photo 7115 & 7208

Riverward face commentary:

General fair condition (rating 2).

Minor mortar loss and seepage at left hand side of bay.

Sporadic staining throughout, typically located around high-water level.

Landward face commentary:

General good condition.

No significant staining noted to stone blocks.

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Appendix H. Ground Monitoring Assessment

UK Holocaust Memorial Foundation

UNITED KINGDOM HOLOCAUST MEMORIAL AND LEARNING CENTRE

Ground Movement Assessment - Thames River Wall

70040431
MAY 2019

CONFIDENTIAL

UK Holocaust Memorial Foundation

UNITED KINGDOM HOLOCAUST MEMORIAL AND LEARNING CENTRE

Ground Movement Assessment - Thames River Wall

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. 70040431

OUR REF. NO. 70040431

DATE: MAY 2019

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QUALITY CONTROL

Issue/revision	Revision 0	Revision 1	Revision 2	Revision 3
Remarks	Revision 0			
Date	May 2019			
Prepared by	Sarah Esper			
Signature				
Checked by	John Richmond			
Signature				
Authorised by	Matthew Sharratt			
Signature				
Project number	70040431			
Report number	0001			
File reference	Ground Movement Assessment - Thames River Wall			

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1 INTRODUCTION

1.1 AUTHORISATION

WSP (the Designer) on behalf of the UK Holocaust Memorial Foundation (the Client) has carried out an initial assessment of the impact of the construction works associated with the proposed United Kingdom Holocaust Memorial and Learning Centre on the adjacent Thames River Wall.

The impact of the additional loading on the current river wall as a result of increasing its height to +6.3m.O.D has also been discussed.

1.2 DEVELOPMENT PROPOSALS

The proposed UK Holocaust Memorial and Learning Centre consists of a 2-storey deep basement structure and semi-subterranean memorial in the form of bronze fins that also serve as the main entrance to the basement areas. The basement will be used to house permanent and temporary exhibitions as well as offices, meeting rooms, and associated facilities/amenities.

An entrance pavilion will be located at ground floor level to the south of the external courtyard. The external courtyard will step/ramp down from existing grade to the basement entrance which is through the memorial fins at mezzanine level.

The existing Thames River Wall which currently bounds Victoria Tower Gardens to the east, will be raised in height to an elevation of +6.3m.O.D.

1.3 REFERENCES

The following references have been reviewed in the preparation of this report:

1. WSP, 'Stage 3 Report – Civil and Structural Report, UK National Holocaust Memorial & Learning Centre', First issue, dated December 2018.
2. WSP, 'Structural Methodology Statement, United Kingdom Holocaust Memorial and Learning Centre', Revision 2, dated November 2018.
3. WSP, 'Preliminary Geo-Environmental Risk Assessment (Desk Study), United Kingdom Holocaust Memorial and Learning Centre', Document Reference: WSP-RP-S-001, Revision 1, dated July 2018.

1.4 LIMITATIONS

General limitations to this assessment are presented in Appendix F.

At the time of writing this report, the site-specific ground investigation has not yet been completed.

This is a general ground movement assessment and does not consider any sensitive finishes, or any areas of existing weakness in the Thames River Wall.

It is assumed that the proposed works will be undertaken in accordance with best practice and workmanship.

2 BASIS OF THE ANALYSIS

2.1 THE SITE

The site is approximately centred on National Grid Reference TQ302791 and is located at Victoria Tower Gardens, Millbank, Westminster, London, SW1P 3YB, covering a total area of circa 1.625 hectares. Victoria Tower Gardens is a public garden managed by the Royal Parks and is a designated Grade II listed garden.

The site is bounded by the River Thames to the east, Lambeth Bridge to the south, Millbank to the west, and the Houses of Parliament and the Palace of Westminster to the north as shown in Figure 2-1.

Victoria Tower Gardens is irregular in shape, and measures approximately 300m long by 85m wide (tapering down to 25m before reaching Lambeth Bridge). The ground level does not vary significantly across the site, ranging from approximately +4.5m.O.D to +5.0m.O.D.

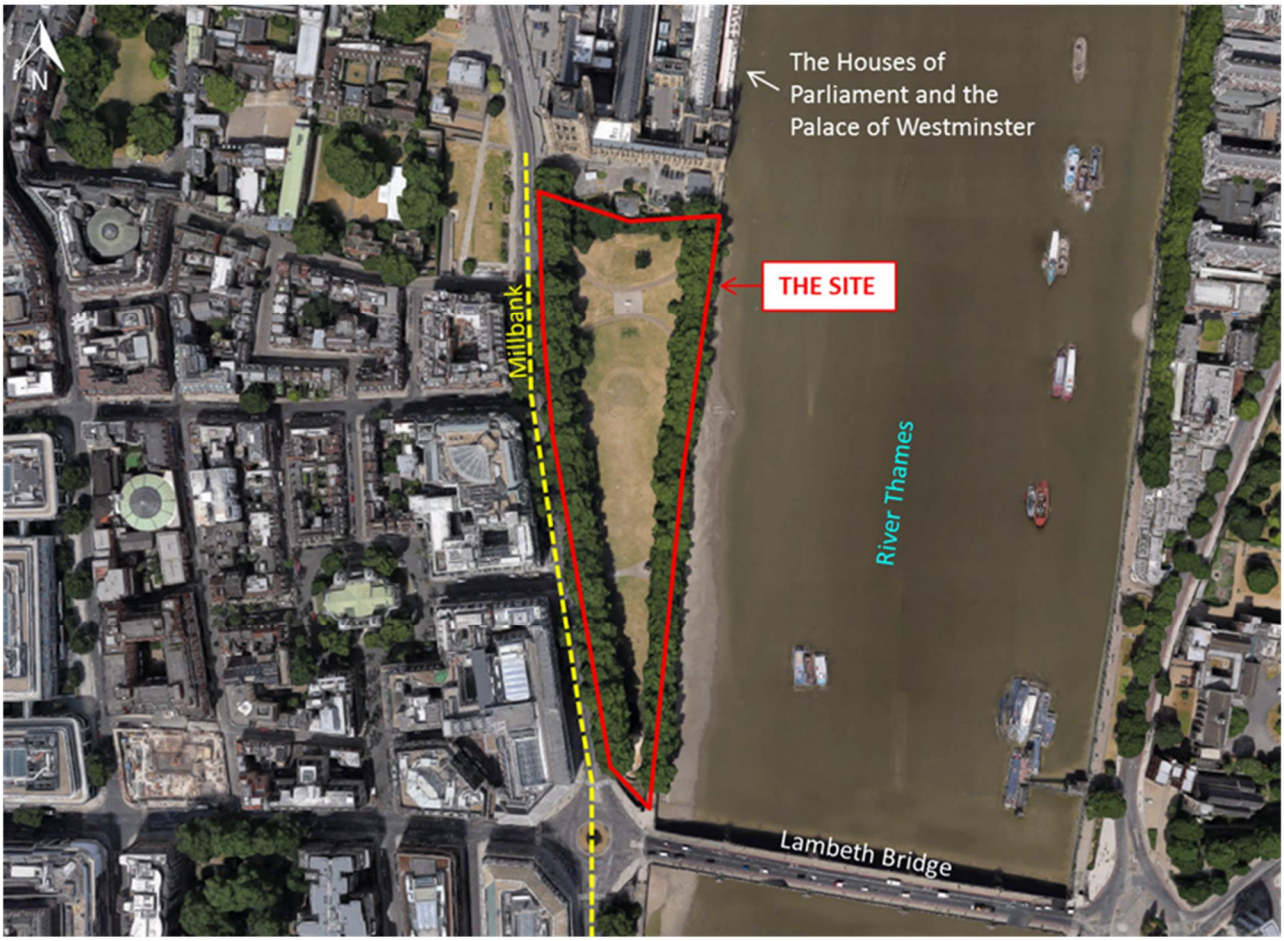

Figure 2-1 - Site Location Plan

2.2 EXISTING SITE USES

Victoria Tower Gardens is a public garden open daily from dawn to dusk and also hosts events throughout the year. The gardens currently comprise amenity grassland crossed by several formal tarmac paths that link