Adapting to Climate Change

Port of London Authority
Report to the Secretary of State

March 2011

PORT OF LONDON AUTHORITY

Prepared with the support of
Jan Brooke Environmental Consultant Ltd

Adapting to Climate Change

Port of London Authority
Report to the Secretary of State

Contents

Adapting to Climate Change

Port of London Authority - Report to the Secretary of State

Executive Summary

1.0 Information on Organisation

1.1 The Port of London Authority (PLA) is the Statutory Navigation and Pilotage Authority for the tidal River Thames and its tributaries. Its administrative area extends from Teddington Lock to the outer Estuary.

1.2 The PLA's legislative basis is contained within the Port of London Act 1968 (as amended). Further powers and duties are provided to the PLA through a number of other Acts and non-statutory codes.

1.3 The PLA's Mission is that it works to: -

- Facilitate the safety of navigation on the tidal Thames;
- Deliver value for money services for our commercial customers and promote the potential of the Port of London;
- Respect the environment of the tidal Thames and pursue principles of sustainable development;
- Provide an efficient, professional and equitable service to commercial and leisure users and riparian owners on issues affecting the river; and
- Safeguard the navigational access to and viability of the Port of London and its infrastructure.

1.4 The PLA does not operate any cargo-handling facilities within the Port of London.

2.0 Business preparedness before Direction to report was issued

2.1 Prior to the Direction being issued, the PLA had no baseline assessment of the risks of climate change on its duties, activities and operations.

3.0 Identifying risks due to the impacts of climate change

3.1 Having assessed the PLA's duties, activities and operations, it was clear that a number of departments and functions could be affected by climate change. It was further apparent that the likely impacts of climate change may manifest

themselves differently in the river's lower reaches below the Thames Barrier than in its central and upper reaches.

3.2 In assessing the potential threats to the PLA's duties, activities and functions arising from climate change, the PLA used the UK CP09 projections, supplemented by the more detailed work on the tidal Thames undertaken by the Environment Agency (EA).

3.3 The primary expertise utilised in the evaluation has been PLA staff who are intimately aware of the tidal River Thames, its riparian environment and the range and extent of activities undertaken on it. In order to fully harness the expertise within the PLA, workshops were held where staff could consider, discuss and evaluate the extent and timing of climate change on the tidal River Thames; the PLA's operations and duties likely to be affected by climate change; the likely timing and severity of these climate change risks; and how the PLA should plan in the short and long-term.

4.0 Assessing risks

4.1 The evaluation judged the likelihood of the identified risks requiring appropriate adaptation within a short-term timescale of ten years as high (H). Where adaptation will be required in the long-term (to 2050 or 2080), the risk is currently assessed as low (L). This likelihood assessment was combined with an assessment of the significance of the impact arising from the risk to the PLA. Potential consequences were defined as being of either major significance (H) or minor significance (L).

4.2 Impacts that were evaluated to be H/H or H/L require the introduction of immediate adaptation measures. Those impacts evaluated at L/H or L/L require continued, or where data gaps exist, the introduction of a new programme of data collection and/or monitoring.

4.3 Due to the thorough assessment undertaken by the PLA, it has confidence in the assessment.

5.0 Uncertainties and assumptions

5.1 The principal uncertainty throughout the evaluation process was the evidence used, both in relation to the extent and the timing of any impact.

5.2 The main assumptions made by the PLA were that the forecasts within UK CP09 and the additional work undertaken by the EA occur as predicted. The PLA has also assumed that existing investment programmes, particularly

works necessary to implement the EA's TE2100 programme and Thames Water's Tideway Improvement Programme, will be completed in full and as currently envisaged.

6.0 Addressing current and future risks due to climate change

6.1 Examples of the risks identified in the evaluation and summary of the proposed actions identified include: -

- Vegetation management on the towpath between Putney and Kew owned by the PLA. Approaches to management and tree planting modified with adaptive species to ensure future-proofing.
- Corporate responsibility for climate change. Incorporation within risk registers, reporting to stakeholders on progress and internal capacity building.
- Variation in water depths as a result of changes in precipitation and abstraction in the non-tidal Thames. Monitoring PLA data to assess trends and requirement for adaptation measures. Awareness raising.
- Increased incidences of fog resulting in closure of the port. Monitoring data provided by the Met Office to assess trends and requirements for adaptation measures. Awareness raising.

7.0 Barriers to implementing adaptation programme

7.1 The PLA consider that a lack of awareness of the likely impacts of climate change, the risks associated with it and the adaptation measures that will be required to be put in place by those using the river is a potential barrier. This could be exacerbated by the number and diversity of the PLA's stakeholders. A further barrier may relate to data, particularly any possible data gaps.

7.2 The need for awareness raising (both internally and externally) has been identified as the primary measure by which the issues associated by climate change will be promulgated to the PLA's various stakeholders. It is likely that a variety of approaches will need to be adopted, dependent on the audience. The PLA will also need to engage in new dialogue with organisations that in the past it had few dealings with.

7.3 The PLA considers that the main interdependency is with the EA. The PLA also considers that the riparian local authorities have an important

interdependence, as are those users of the tidal Thames, both commercially and for leisure purposes.

8.0 Report and review

8.1 The extent of the proposed data collection and monitoring programme will enable the PLA to more accurately forecast the likely impact of climate change and therefore establish an appropriate basis for decision making on adaptation measures.

8.2 Senior Managers will consider and subsequently prepare an annual report of the PLA's activities be submitted to the Board and, subject to ratification, published within the PLA's Annual Report.

8.3 The PLA does not consider that there is a particular threshold above which climate change risks will pose any greater risk.

9.0 Recognising opportunities

9.1 Although considered to be of benefit only in the long-term, sea-level rise of up to one metre within the Thames Estuary would enable the safe passage of larger vessels to cargo-handling terminals within the Port of London.

9.2 Less directly, increased levels of river activity due to modal shift or increased tourism arising from climate change could also represent an opportunity to the PLA to facilitate an increase of activity on the tidal River Thames, subject to the maintenance of safe navigation.

10.0 Further comments / information

10.1 The production of this report has enabled the PLA to consider climate change as it will affect the organisation; to understand what it will mean for the tidal River Thames; and most importantly to ensure that action is taken on the basis of a sound evidence base which is provided by extant and new data collection and monitoring.

1.0 Functions impacted by climate change

1.1 *What are your organisation's functions, missions, aims and objectives?*

1.1.1 The Port of London Authority (PLA) is the Statutory Navigation and Pilotage Authority for the tidal River Thames and its tributaries. Its administrative area is shown at Appendix I and extends from Teddington Lock in the west to the outer Estuary in the east, a distance of approximately 150 kilometres.

1.1.2 The PLA's legislative basis is contained within the Port of London Act 1968 (as amended). The 1968 Act has been amended by means of Harbour Revision Orders, most recently through an Order approved by the Secretary of State for Transport in 2003.

1.1.3 The general duty of the PLA is contained at S.5(1) of the 1968 Act, which states that:

> *"It shall be the duty of the Port Authority to take such actions as they consider necessary or desirable for or incidental to the improvement and conservancy of the Thames"*

1.1.4 The PLA does not operate any cargo-handling facilities within the Port of London, although it does own the freehold (subject to a long lease) of one terminal on Canvey Island. Although it has no direct involvement in cargo-handling, the Authority works with terminal operators to improve and expand facilities within the Port of London. The cargo-handling terminals, extending from Fulham in the west to Canvey Island in the east, are all operated by the private sector and range in size from nationally important oil refineries and container terminals to small concrete batching plants utilising aggregates transported by barge serving local markets. The Port of London is the second largest port in the UK and the largest in the south. The tidal River Thames is also, by far, the largest freight carrying inland waterway in the UK. The London Gateway scheme, currently being developed by DP World at the former Shell Haven oil refinery site in Thurrock, will be the first new dedicated container port to open in the UK in over 30 years.

1.1.5 The geographical extent of the terminals comprising the Port of London is show at Appendix II.

1.1.6 The PLA's powers contained within the 1968 Act include the following: -

- Regulation of navigational by means of River Byelaws, General Directions and other associated Byelaws (S.108 - 117) (Part XI);
- Licensing of all river works and dredging (S.66 - 75);
- Hydrographic surveying (S.7);
- Inspection and licensing of commercial vessels (S.124 - 129);
- Removal of sunken vessels and other hazards to navigation (S.120 – 123); and
- Maintenance of Richmond Lock and Weir (S.88).

1.1.7 Further powers and duties have been provided to the PLA though other Acts and non-statutory codes and include the following: -

- The Pilotage Act 1987, which empowers the PLA to make Pilotage Directions as the Pilotage Authority for the London Pilotage District, the extent of which is show at Appendix III.
- The Merchant Shipping Act 1995, which empowers the PLA's Harbour Master to initiate proceedings against masters of vessels and owners of terminals and installations involved in oil pollution incidents. Furthermore, this Act also empowers the PLA to provide navigational lights, buoys and marks within the Port of London.
- The Harbours Act 1964, which provides the PLA with a number of powers and duties, including, at S.48(A), a general environmental duty which it must take into account when acting under any other statute.
- The Port Marine Safety Code 2000 (as amended), is non-statutory and establishes the principles underpinning a national standard for every aspect of port marine safety and enables harbour authorities to manage marine operations to nationally agreed standards. This code, together with the 1968 Act, provides the basis for the PLA's Vessel Traffic Services (VTS) System operating in the Port of London.
- Modernising Trust Ports (second edition) is a guide for Trust Ports such as the PLA published by the Department for Transport and represents best practice in the trust port sector. It is comparable to the Combined Code on corporate governance and, like the Combined Code, its precepts are not mandatory but it carries with it the same unwritten requirement to comply or explain if any particular standard is not met. It

covers Performance Indicators, accountability to stakeholders and the appointment and structure of Boards.

1.1.8 The PLA's Mission is that it works to: -

- Facilitate the safety of navigation on the tidal Thames;
- Deliver value for money services for our commercial customers and promote the potential of the Port of London;
- Respect the environment of the tidal Thames and pursue principles of sustainable development;
- Provide an efficient, professional and equitable service to commercial and leisure users and riparian owners on issues affecting the river; and
- Safeguard the navigational access to and viability of the Port of London and its infrastructure.

1.1.9 The PLA Board has furthermore adopted a number of policies on issues including security, environment, pilotage, navigational safety, planning, health & safety, VTS and consultation. These policies are shown at Appendix IV.

1.2 ***Which of these will be affected by the current and future impacts of climate change?***

1.2.1 Having assessed the PLA's duties, activities and operations, it was clear that – in principle - a number of departments and functions could be affected by climate change (i.e. a mechanism exists for a potential effect). It was further apparent that the impacts of climate change may manifest themselves differently in the lower reaches of the River Thames below the Thames Barrier than in the central and upper reaches upstream of the Thames Barrier. In broad terms, the PLA believes the following may be affected: -

- Navigational Safety. Ensuring safe navigation is fundamental to the PLA. Climate change may affect the amount and flow of water within the tidal River Thames, making the task of ensuring navigational safety more difficult. Furthermore, climate change may increase the number of people wanting to use the Thames and increase the range of uses;

- Navigational Aids. The provision of navigational aids, principally radar, is essential to maintaining navigational safety. A network of facilities throughout the river provides information to centres at Gravesend and the Thames Barrier operated by the PLA. Although predicted temperature increases appear unlikely to be so high so as to prejudice the operation of these facilities, they may be vulnerable to flooding and sea-level rise;

- PLA operational facilities. The PLA has a number of other operational facilities on the tidal Thames, from its main offices at Gravesend, which incorporate the Port Control Centre and facilities for Pilot boarding, its Marine Services base also at Gravesend and the Richmond Lock and Weir, which maintains the tidal Thames at a statutory height between Richmond and Teddington. Due to the riparian location of these facilities, they are vulnerable to flooding and sea-level rise;

- Marine Services. Marine Services, operating from a new facility at Denton downstream of Gravesend, provides the PLA with its marine operational capability. It is responsible for maintaining the PLA's extensive fleet of vessels and navigational buoys, servicing moorings and as a base for the PLA's diving capability - the facility has one of the few decompression chambers available within the south east – and one of the largest boat lifts on the Thames. As noted, above, the facility is considered to be vulnerable to flooding and sea-level rise;

- River regime and environment. The PLA is solely responsible under the 1968 Act to licence both maintenance and capital dredging on the tidal Thames. Furthermore, it is responsible for providing a first tier response to oil pollution incidents. A number of possible climate change impacts could affect the PLA as the conservancy authority, from changes in water volumes resulting in changes to turbidity to increased temperatures leading to increased incidents of algal blooms;

- River Works Licensing. The PLA is responsible for licensing all works in, on or over the Mean High Water mark of the tidal Thames within the PLA's administrative area. Changes in the use of the Thames arising from the impacts of climate change are likely to result in a corresponding requirement to assess and licence a greater number and more complex works.

1.3 ***Have you assessed the climate thresholds above which climate change and weather events will pose a threat to your organisation? If so, what were the main results?***

1.3.1 In assessing the potential threats to the PLA's duties, activities and functions arising from climate change, the projections within UK CP09 were used, although these were supplemented by the more detailed work on climate change impacts as they may affect the tidal River Thames and its Estuary undertaken by the Environment Agency (EA). These latter projections ultimately formed the evidence base underpinning the published TE2100 project on flood risk management for the tidal Thames.

1.3.2 The PLA considered it prudent, in terms of the various assumptions inherent within the UK CP09 forecasts, to base its evaluation on the medium emissions scenario and by using the forecast at 50% probability. The EA's work confirmed that more extreme scenarios, particularly those projecting very high sea-level rise, were unlikely within the Thames Estuary and were therefore discarded.

1.3.3 In addition to these base forecasts, the PLA used the UK CP09 additional products for projected future changes in fog and winds. Both of these climate change risks could have significant effects on the PLA's duties, primarily in relation to navigational safety and pilotage.

1.3.4 The EA's comprehensive research base, including its climate change projections, was primarily used in relation to sea-level rise and the frequency and intensity of storm events within the North Sea. Additionally, the EA undertook more detailed work on projected fluvial flows at Teddington as part of the TE2100 project and these supplemented the more general forecasts for precipitation within UK CP09.

1.3.5 The volume of water within the tidal River Thames is clearly of paramount importance to the PLA, due to the impacts too much or too little water (and its relative flow) can have on navigational safety. The volume of water within the tidal River Thames is provided by a combination of the tide moving upstream from the Estuary and from fluvial flow from the Thames Valley entering the tidal river at Teddington. Projections of sea level rise and changes in precipitation (both during summer and winter) are therefore particularly relevant to this report.

1.3.6 The PLA's assessment of the available evidence base concluded that a sea-level rise of +0.94 metres by 2100 was appropriate, with a projected maximum increase of +2.7 metres. Of particular interest was the EA's conclusion that climate change is less likely to result in increased storm frequency in the North Sea than had been thought, with a resultant decrease in predicted storm surge height and activity. The PLA has therefore worked with this projection of sea level rise in the long-term but for

the purposes of this report has not assumed that there will be any specific thresholds above which this climate change impact will pose a more significant risk to the PLA's duties, activities and operations. The PLA, as hydrographic surveyor for the tidal River Thames, collects data on tidal details from a range of locations on the river and estuary. This data will be assessed to understand any patterns forming within the river and estuary and thereby inform future decisions on long-term adaptation measures.

1.3.7 The PLA has also concluded that it is reasonable to assume an increase in mean precipitation in winter and a decrease in summer. The EA projected an increase in winter fluvial flow at Teddington by 2080 of up to 40% above that currently experienced. Without adaptation measures, it is likely that such an increase would have a significant impact on navigational safety in the upper reaches of the tidal Thames, particularly in relation to unpowered vessels and/or inexperienced river users.

1.3.8 A projected decrease of up to 30% in mean summer rainfall by 2080 would, subject to levels of water abstraction in the non-tidal Thames (which is itself identified as a potential risk in the evaluation), result in substantially reduced fluvial flow at Teddington. This would result in reduced water depths in the tidal river's upper reaches, with an increased frequency of vessel groundings and a resultant impact on navigational safety.

1.3.9 The PLA has therefore worked with these projections for precipitation as part of its forecast but, for the purposes of this evaluation, has not assumed there will be any specific thresholds above which this climate change impact will pose a more significant risk to the PLA's duties, activities and operations. As stated at 1.3.6 above, the PLA, as hydrographic surveyor for the tidal River Thames, collects tidal and other data from a range of locations on the river and estuary. This data, together with data collected by others on abstraction, will be assessed to understand any patterns within the river and therefore to inform future decisions on long-term adaptation measures.

1.3.10 Increased mean and peak temperatures during both summer and winter are projected within UK CP09 in both the short-term (to 2020) and the long-term (to 2050 and 2080). In the long-term, substantially warmer temperatures may have considerable effects on the environment of the river; its natural processes, and the activities undertaken on it. The PLA has therefore assumed the projections for temperature as part of its forecast but, for the purposes of this evaluation, has not

assumed that there will be any specific thresholds above which this climate change impact will pose a more significant risk to the PLA's duties, activities and operations. The PLA will need to initiate a programme to monitor data collected by others in order to understand the pattern of changes as they affect the tidal Thames and therefore to inform future decisions on long-term adaptation measures.

1.3.11 A summary of the climate change impacts assumed by the PLA and which formed the basis of the evaluation is provided at Appendix V.

1.4 *Who are your organisation's key stakeholders? Do you need to assess the impacts of climate change on them?*

1.4.1 The PLA, as Statutory Navigation and Pilotage Authority for the tidal River Thames, has a diverse range of stakeholders. For the purposes of this report, they can be divided into the following broad categories: -

- Commercial terminal owners/operators and shippers who are located principally in the lower reaches of the tidal Thames. This group of stakeholders provide the bulk of the PLA's income through port dues on cargoes and vessels and through pilotage fees;

- Operators of passenger and small freight vessels working primarily within Greater London;

- Recreational and leisure users, either individually or within organised clubs. Although these stakeholders are active throughout the tidal Thames, they are concentrated in the upper reaches upstream of Putney;

- An influence on the volume of water entering the tidal River Thames and hence on the depth of water available to vessels in the upper reaches is likely to be levels of abstraction undertaken in the non-tidal River Thames by water companies. Water companies are therefore considered to be another stakeholder insofar as their activities can affect the PLA's functions and activities;

- The public sector; a broad group ranging from Government Departments (as a Trust Port, the PLA reports to the DfT) and their executive agencies, principally the Maritime and Coastguard Agency, to the Mayor of London and associated London Governance (including Transport for London), to the 24 riparian local authorities (county, borough and unitary) bordering the tidal Thames. A number of Government Agencies can also be considered to be stakeholders of the PLA, principally the

Environment Agency (in relation both to flood risk management and its wider statutory duties on the tidal River Thames and additionally its navigation and other responsibilities upstream of Teddington), Natural England and also more recently the Marine Management Organisation.

- Members of amenity societies, local groups and the public more generally who enjoy or have an interest in the tidal Thames and the Thames Path. The PLA own the Thames Path between Barn Elms and Kew.

- Owners of works situated in, on, or over that part of the riverbed and foreshore of the tidal River Thames owned by the PLA. This group of stakeholders, which provide the PLA with its remaining income (the PLA receives no Government grant or other public funding) is diverse in itself, and extends from owners of piers to visitor attractions such as the London Eye, to houseboats.

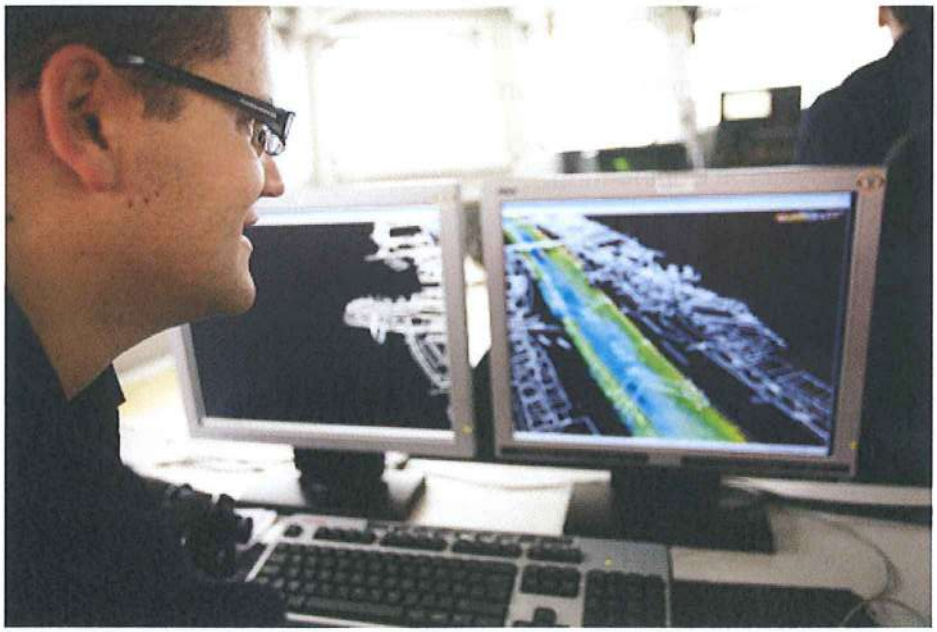
1.4.2 Whilst there are interdependencies between the PLA and these stakeholder groups and it is acknowledged that the PLA may need to undertake awareness raising in relation to climate change impacts may be required, the PLA considers that their range and number are so diverse that to include them within the PLA's evaluation would be impractical if not impossible.

2.0 Approach

2.1 *What evidence, methods and expertise have you used to evaluate future climate impacts? List sources and references.*

2.1.1 Prior to the evaluation being undertaken, research into the likely climate change impacts as they may affect comparable sectors was considered, together with discussions with the EA on the research it undertook as part of its work on flood risk within the Thames Estuary. Details of research paper and other information sources is attached at Appendix VI.

2.1.2 The primary expertise utilised in the evaluation process has been PLA staff, who are intimately aware of the tidal River Thames, its riparian environment and furthermore the range and extent of activities undertaken on it. PLA staff understand the changing dynamics of river activities and are therefore best placed to consider how such activities, and the PLA's operations, may be affected by climate change in the short and longer-term.



The PLA collects real-time daily tidal data from fourteen monitoring stations extending from Richmond Lock to Walton-on-the-Naze. This data is analysed, logged and subsequently archived and provides an extremely comprehensive picture of tidal patterns and dynamics throughout the River Thames and Estuary.

2.1.3 The PLA, in complying with its statutory duty to undertake hydrographic surveys of the bed of the River Thames, collects data on water flows and depths throughout the

river and estuary. The PLA also has access to substantial amounts of data on other conditions that are likely to be affected by climate change that could impact on the PLA's operations, including fog and wind speed and direction. Additionally, being exclusively responsible for licensing all dredging within the Port of London, the PLA holds and collects considerable information on the river's conservancy. This information will assist the PLA in monitoring the likely changes associated with climate change.

2.1.4 In order to fully harness the expertise within the PLA, workshops were held where staff could consider, discuss and evaluate the extent and timing of climate change on the tidal River Thames; the PLA's operations and duties likely to be affected by climate change; the likely timing and severity of these climate change risks; and how the PLA should plan in the short and long-term. Senior Managers from the following Departments were invited to the sessions: -

- Harbour Master for the Lower District;
- Harbour Master for the Upper District;
- Harbour Master (Safety Management System);
- Navigation Systems Engineering;
- Civil Engineering;
- Marine Engineering;
- Corporate Affairs;
- Hydrographic Surveying;
- Planning and Partnerships;
- Finance;
- Environment and Management Systems; and
- Marine Services

2.1.5 The workshop sessions were facilitated by an expert in climate change and the ports sector in order to ensure that the discussions and subsequent evaluation were appropriate. The result of these sessions, subsequently refined in further meetings

with individual staff members to test the assumptions reached, was a matrix that grouped the impacts into a number of headings; detailed where within the PLA these impacts were most likely to affect; assessed the likelihood of these impacts affecting operations in the short (to 10 years) or long (to 50/80 years) term and their likely significance on operations and statutory duties; and finally in the light of this assessment what actions and adaptation measures may be required.

2.2 ***How do you quantify, or otherwise estimate or characterise the impact and likelihood of risks occurring at various points in the future?***

2.2.1 In relation to the likely impacts, the PLA based its analysis on the UK CP09 medium emissions scenario at 50% probability and furthermore used the UK CP09 additional products in relation to fog and wind speed. The Marine Climate Change Impacts Annual Report Card 2010 – 2011 was also consulted. These general projections were supplemented by the much more specific research undertaken by the EA for the tidal Thames and its estuary. These projections were used to assess the likely impact on the PLA's duties, responsibilities and activities as Statutory Navigation and Pilotage Authority for the tidal River Thames, and the extent to which these activities would be affected. The assessment was based on the expertise of relevant and senior PLA staff across a diverse range of responsibilities.

2.2.2 Where this expert assessment indicated that an impact was possible, the evaluation further considered the likelihood of adaptation measures being required within the short-term to 2020, and the form these measures may take.

2.2.3 In the event the likelihood of impact was in the long-term (beyond 2020), the need for data collection and/or the initiation of a monitoring programme was addressed in order to ensure that future decisions would be well informed and expedited. Where significant data gaps were found to exist, monitoring or data collection will be instigated.

2.3 ***How have you evaluated the costs and benefits of proposed adaptation options?***

2.3.1 No specific assessment was undertaken for those actions required more than ten years into the future due to the uncertainty inherent which makes budgeting neither appropriate or possible. However, the identification of a programme of continued and new data collection and monitoring should enable more accurate predictions and hence budget forecasts to be made into the long-term.

2.3.2 Where a requirement, primarily in relation to capital expenditure, for future proofing has been identified through the evaluation process, it is expected that adaptation measures will ultimately save the PLA money.

2.3.3 Short term actions identified through the evaluation do not require significant new expenditure or require (already budgeted) expenditure to be used in ways that ensure necessary future proofing. Whilst the data collection or monitoring programmes to be continued or established may necessitate new resources, the total cost is not expected to be prohibitive.

3.0 Summary of risks which affect functions, mission, aims and objectives

3.1 *List all the organisation's strategic risks from climate change on a likelihood/consequence matrix – including thresholds where appropriate.*

3.1.1 The evaluation matrix undertaken by the PLA, which includes an assessment of the likelihood and significance of climate change risks, is attached at Appendix VII. The strategic risks fall primarily into the following categories: -

- Changes to water levels and volumes arising from a combination of sea level rise and changes in winter/summer precipitation. This risk directly affects the safe navigation of vessels throughout the river and is therefore of fundamental importance to the PLA. Additionally, water levels can affect the security of essential radar and VTS infrastructure and PLA operational facilities.

- Changes in precipitation also have the potential to change the pattern and nature of bankside vegetation, particularly in the more sylvan reaches above Putney, including that part of the Thames Path owned by the PLA. If these changes result in an increased number of trees falling into the river, safe navigation could be prejudiced and place additional pressures on the PLA to remove and dispose of them.

- Other climatic changes, particularly fog and wind, could increase the risk of the PLA being unable to land pilots on vessels in the outer estuary or result in navigation being severely curtailed both in the estuary and more particularly in Central London, where the projection is for a 20% increase in the number of fog days during the winter.

- Changes in water quality and temperature may occur from both changes in water volumes and warming temperatures during both summer and winter. In addition to direct risks, such as increasing algal blooms, indirect effects including increased water abstraction upstream of Teddington have been identified and evaluated.

- An increase in the use of the River Thames may result from temperature increases, including the attractiveness of London as a holiday destination in the light of projected increased temperatures and particularly any increase in the frequency of heatwaves in Southern Europe. This risk has been evaluated, particularly within London.

- There are a range of other potential risks arising from climate change, including the potential for the PLA to continue working through its business continuity processes.

3.1.2 As previously noted, the PLA does not consider there to be a single threshold at which major changes would be triggered and therefore require an adaptation response. Rather, it believes that its operations, duties and activities will be affected more gradually over time and therefore it will become more effective to undertake its activities differently; to ensure that additional capacity has been provided; or that future proofing has been incorporated, particularly in relation to infrastructure and capital equipment.

3.2 ***What short and long term impacts of climate change have you identified and how are each factored into the adaptation programme? Quantify the likelihood and consequence as far as possible (including an assessment of the level of confidence (e.g. high/medium/low) in the calculations) and disaggregate these risks to different locations where appropriate.***

3.2.1 The evaluation undertaken by the PLA at Appendix VII provides details of the various impacts of climate change that have been identified. These impacts have been assessed on a geographical basis, including where necessary a consideration of the approaches to the Port of London. The responsibility within the PLA for those impacts has also been assessed including, where appropriate, third parties.

3.2.2 The evaluation further considered the likelihood of the risk requiring appropriate adaptation within a short-term timescale of ten years as high (H). Where it is unlikely that adaptation will be required within ten years (i.e. any measures will not be required until 2050 or 2080), the risk is currently assessed as low (L). This likelihood assessment was combined with an assessment of the significance of the impact (consequence) arising from the risk to the PLA's duties, operations or activities. Potential consequences were defined as being of either major significance (H) or minor significance (L). Impacts that were evaluated to be H/H or H/L require the introduction of immediate adaptation measures. Those impacts evaluated at L/H or L/L require continued, or where data gaps exist, the introduction of a new programme of data collection and/or monitoring to ensure that appropriate adaptation measures can be planned for and taken in good time.

3.3 ***What are your high priority climate related risks and why (stating level of impact to business, likelihood, costs and timescales)?***

3.3.1 As can be seen from the evaluation matrix, the assessment identified two high priority risks, although neither of these was considered to be of major significance. These risks are as follows: -

- Tow Path Tree Management. The PLA has, in response to discussions with a range of stakeholders in the upper reaches of the Thames above Putney, commissioned a management plan for the trees and vegetation on that part of the Thames Path it owns between Barn Elms and Kew. The plan is expected to be implemented over at least 20 years and includes works to the revetment walls and replanting of trees.

- Corporate responsibility for climate change. The PLA has currently no specific policies and processes to measure and report on climate change at a corporate level.

3.3.2 There are a number of other risks identified through the evaluation process that have not been assessed as being of immediate high priority but could be of major significance to the PLA in the longer term. In these cases, monitoring or other preparatory measures will be required. These are recorded as issues in Appendix VII but examples of potentially significant longer term risks include: -

- increased risk of bank undermining due to higher winter flows or extreme rainfall events;

- changes in siltation associated with changes in flow rates leading to an increased dredging requirement; and

- changing demands on pilotage services associated with increased frequency of fog or increased wind severity/strength

3.4 *What opportunities due to the effects of climate change which can be exploited, have been found?*

3.4.1 Although considered to be of benefit only in the long-term, sea-level rise of up to one metre within the Thames Estuary would enable the safe passage of larger vessels to cargo-handling terminals within the Port of London. A comparable benefit may arise from increased volumes of water at Teddington during the winter months, but this is likely to be unpredictable, would affect the upper reaches primarily, and is therefore considered to be of less benefit to commercial shipping.

3.4.2 Less directly, increased levels of river activity due to modal shift or increased tourism arising from climate change could also represent an opportunity to the PLA to facilitate an increase of activity on the tidal River Thames, subject to the maintenance of safe navigation.

4.0 Actions proposed to address risks

4.1 *What are the adaptation actions for the top priority risks (stating timescales)?*

4.1.1 As can be seen from the evaluation matrix at Appendix VII, two high priority short term risks have been identified, although neither of these are considered to be of high significance. The PLA's towpath tree management plan includes an element of replanting to ameliorate the effects of tree removal, primarily undertaken from the revetment wall to prevent bank failure. These new trees have a life span of many decades, if not hundreds of years. The PLA's arboricultural consultants are advising on those species that can adapt to the likely impacts of climate change identified as part of the evaluation. The plan has been developed with the input of a number of stakeholders in the upper reaches of the tidal River Thames and they have endorsed the approach being taken, notwithstanding that the replanting will primarily be biased towards non-native species. The first tranche of replanting, in accordance with this new approach, is currently being undertaken.

The Mayor of the London Borough of Richmond upon Thames, the Chief Executive of the Port of London Authority and representatives of local community groups at a ceremony to mark the planting of the first tranche of trees jointly funded by the PLA and local stakeholders. Following extensive consultation, the trees have been chosen for their qualities in adapting to the likely effects of climate change.

4.1.2 The second high priority risk relates to the PLA's approach to the issue of climate change. There is currently no corporate responsibility for the issue, in relation to

either the risks or any necessary adaptation measures. Accordingly, climate change will be added to the PLA's relevant risk registers and an annual report made on progress towards the implementation of measures identified within this report. It is considered that such an approach will assist in embedding the subject of climate change, its associated risks and the necessary adaptation measures within the PLA. It is intended that this action will be implemented immediately.

4.1.3 In relation to the risks that are expected to affect the PLA's duties, operations and activities into the long-term, the proposed approach following the evaluation is to assess data collected by the PLA and monitor data collected by other parties. These measures will enable the PLA to put in place necessary adaptation measures when appropriate and necessary on the basis of sound evidence. Any patterns identified from this data will also be considered when new capital equipment is required or when new physical infrastructure is being designed, in order that these can be future proofed. Finally, the PLA will consider a programme both internally and externally to raise awareness of the relevant risks and the necessary adaptation measures.

4.2 *How will the adaptation actions be implemented (stating level of responsibility, investment and timescales)?*

4.2.1 High priority actions are already being undertaken or will be implemented immediately. The responsibility for their continued implementation will be at Executive Director level, reporting to the Chief Executive. The Chief Executive will report annually to the Board on progress and the report will, on ratification, be included with the PLA's Annual Report. Whilst the cost of implementing the high priority measures has not been assessed, they are not expected to be significant and would typically be met from existing budgets.

4.2.2 Costs associated with the monitoring programme are also expected to be relatively minor and monitoring will thus commence immediately in accordance with the evaluation. If substantial capital works to provide adaptation are required to PLA infrastructure, the longer term costs however could well be significant. By way of an example, if winter flows at Teddington do substantially increase to 40% above current levels by 2080 as the EA consider possible, then available air draft under bridges for leisure vessels in the upper reaches of the tidal Thames will reduce considerably. However, as it is not expected that any reduction will be sudden, it is likely that air draft gauges could be added, when necessary, to the navigable spans of all bridges as an appropriate adaptation measure. In addition to the costs of providing these gauges, the necessary consents have to be obtained (a number of the bridges are

statutorily listed) and an awareness-raising exercise will be needed, particularly aimed at users of leisure vessels who only occasionally navigate in the tidal reaches.

4.3 ***How much do you expect these adaptation measures to cost and what benefits do you anticipate will result from them?***

4.3.1 The majority of actions identified within the evaluation are preparedness measures and primarily involve monitoring data collected by the PLA or other organisations. It is not expected that the costs will be significant, but rather that this relatively modest investment will enable the PLA to take proportionate, well-informed and cost effective measures in the future. Due to likely timescales involved prior to the measures being required – the evaluation did not determine that expenditure would be required on adaptation measures in the short-term – it is not possible at this time to provide any realistic estimate of the costs of possible longer term adaptation measures.

4.3.2 The benefits arising from implementing the high priority measures in relation to the tree management programme are considered to be primarily financial by avoiding the need to fell and replace a large number of trees in the future. Potentially, these measures will also improve the safety of Thames Path and river users. Furthermore, it also demonstrates to the PLA's stakeholders that the issue of climate change is embedded within the organisation and that long-term decisions are being taken with the likely impacts and risks at the forefront of corporate thinking.

4.3.3 The benefits arising from implementing the high priority measures in relation to corporate responsibility for climate change are considered to be primarily reputational, i.e. providing a clear indication that the PLA has assessed the likely risks and that appropriate adaptation measures have been and will be put in place. In the longer-term, the results are also expected to be financial as savings are made through the implementation of 'just-in-time' adaptation measures.

4.3.4 The benefits of the other, long-term measures identified will be to ensure that the PLA's duties, operations and activities can continue without interruption. Further, the PLA will aim to ensure as far as possible, that any measures put in place are 'no regrets' measures, in order that other benefits are realised regardless of the eventual impact of climate change. Amongst the measures that may be required to adapt to climate change in the longer term are: -

- Changes in maintenance and management practices, including bank or wall repairs, more frequent dredging, etc;

- Modifications to working practices for pilots to adapt to any increased frequency of fog or strong winds;

- Increased levels of management, river patrols, etc. to ensure continued safety of navigation if (recreational) user numbers increase; and

- Upgrading or providing new moorings.

4.4 ***How much do you expect them to reduce risk by and on what timescales?***

4.4.1 The reduction in the level of risk that each measure will have depends on the issue itself and the projected significance of the impact. However, the overriding concern of the PLA and the main emphasis following the evaluation is to ensure that appropriate data is collected and monitored to ensure that any decision on adaptation is well-informed and 'just-in-time' (i.e. implemented in a way which reduces the risk to an acceptable level whilst optimising economic efficiency and cost-effectiveness).

4.5 ***How will you ensure the management of climate change risks is embedded in your organisation?***

4.5.1 The issues and risks connected with climate change, and the adaptation measures that will be required were not well understood within the PLA prior to the commencement of the evaluation process, so the process of embedding and managing the issue within the organisation has already commenced.

4.5.2 The examination of the organisation's performance annually by the PLA Board and the publication of a statement within the Annual Report will, it is expected, maintain the organisation's focus on both the short-term measures and, most importantly, robustly examine and maintain appropriate data in readiness for future adaptation actions.

5.0 Uncertainties and assumptions

5.1 *What are the main uncertainties in the evidence, approach and method used in the adaptation programme and in the operation of your organisation?*

5.1.1 The principal uncertainty throughout the evaluation process was the evidence used, both in relation to the extent and the timing of any impact. However, the use of the medium emissions scenario at a 50% probability is intended to limit the evaluation exercise from the more extreme, but unlikely, projections. Notwithstanding this, the PLA consider it more important to understand the direction and the approximate rate of change and therefore the likely magnitude of the associated impacts, rather than strive for total accuracy in the forecasts.

5.1.2 The PLA's approach to the evaluation process, based as it was on internal expertise and the development of a matrix based on 'brainstorming' through facilitated workshop sessions, was intended and designed so as to accommodate the uncertainties naturally inherent in climate risks and impacts and to base it in the realities of the PLA's activities and functions on the tidal River Thames.

5.1.3 The evaluation demonstrated that the majority of impacts, whilst potentially significant, do not require adaptation measures to be implemented in the short-term. As such, the PLA consider that there is sufficient time available to collect and assess data to enable the organisation to adapt. Additionally, the measures that will be taken to embed climate change within the organisation will, it is considered, assist in the modification of the organisation's future approach.

5.1.4 The PLA's operations and activities must continue regardless of likely climate change impacts and therefore the two issues should properly be considered in tandem. In particular, the PLA will seek to focus on 'no regrets' measures that will have benefits to existing operations in addition to any benefits in terms of adaptation. In order to ensure that this is the case, significant investment in long-term infrastructure or new assets will be made with an understanding of the likely impacts of climate change so that infrastructure is future-proofed to enable the risks to be accommodated without further investment.

5.2 *What assumptions have been made when devising the programme for adaptation?*

5.2.1 The main assumptions made by the PLA were that the forecasts within UK CP09 and the additional work undertaken by the EA within the Thames Estuary occur as

predicted. However, in the event these forecasts are substantially reviewed, the evaluation will likewise be reviewed. Furthermore, the PLA has assumed that existing investment programmes, particularly works necessary to implement the EA's TE2100 programme and Thames Water's Tideway Improvement Programme, will be completed in full and as currently envisaged.

6.0 Barriers to adaptation and interdependencies

6.1 *What are the barriers to implementing your organisation's adaptation programme?*

6.1.1 The PLA, as Statutory Navigation and Pilotage Authority for the tidal Thames, has little control over either the privately owned and operated cargo-handling terminals or recreational users of the river.

6.1.2 The PLA consider that a potentially significant barrier to be addressed is the lack of awareness of the likely impacts of climate change, the risks associated with it and the adaptation measures that will be required to be put in place by those using the river. This could be exacerbated by the number and diversity of the PLA's stakeholders. By way of example, those navigating in the upper reaches in the different conditions expected during summer or winter will need to understand how these can affect navigation and how the adaptation measures put in place by the PLA can help. This represents a significant exercise for a relatively small organisation such as the PLA and will need to be replicated for all the likely impacts.

6.1.3 A further barrier may relate to data, particularly any possible data gaps (i.e. areas where possible data requirements have not been considered as part of this evaluation). These may require additional resources to fill.

6.1.4 Additionally, the PLA has no control over water companies in relation to the amount of water abstracted in the non-tidal River Thames.

6.2 *How will these barriers be addressed?*

6.2.1 Awareness raising, both internally and externally, has been identified as the primary measure by which the issues associated by climate change and its adaptation will be promulgated to the PLA's various stakeholders.

6.2.2 It is likely that a variety of approaches to awareness raising will need to be adopted, dependent on the audience. These various approaches will need to be developed in parallel with the monitoring programme into the long-term in order to ensure appropriate timing. The evaluation matrix considers whether the awareness raising to be undertaken will be required internally, externally or both.

6.2.3 The PLA will also need to engage in new dialogue with organisations that in the past it had few dealings with. The water companies, as noted at paragraph 6.1.4, need to be engaged so as to understand what future abstraction strategies are as part of the

mix of providing water to the expanding population of the South East. This needs to be linked to the agreements already in place with the EA over the minimum flows over Teddington Lock.

6.3 ***What/who are the interdependencies (including the stakeholders stated in response to question 1d)?***

6.3.1 The PLA considers that the main long-term vulnerabilities to climate change impacts, and more particularly changes in precipitation, are likely to manifest themselves in the upper reaches of the tidal River Thames. Accordingly, it is in this area that it is particularly important to identify interdepencies. During the winter months, the projection to which the PLA is working predicts far greater rainfall (up to 40% by 2080), which as a result of runoff through the catchment will result in much larger fluvial flows entering the tidal River Thames at Teddington. Such an influx will increase water levels and result in strong flows throughout the upper reaches. As the main users in those reaches of the tidal River Thames likely to be most affected are leisure users, and more particularly those in unpowered craft (rowers and sailors) and those in powered craft that may be less used to conditions in tidal rivers (motor boaters from the non tidal Thames and narrow boaters from the canal network), the PLA must be prepared to implement adaptation measures to ensure that navigational safety is not compromised. The EA is the Navigation Authority and more generally responsible for the non tidal River Thames and there is a dependency between the PLA and the EA

6.3.2 During the summer months, it is expected that the projected reductions in precipitation will result in a reduction in fluvial flows in Teddington. This situation may be exacerbated, as a result of population growth, by increased levels of water abstraction in the non tidal Thames by water companies. Reductions in water volumes from either or potentially both of these factors in the upper reaches of the tidal River Thames will reduce available depths for navigation (particularly at low tide) and may result in vessel groundings, prejudicing navigational safety. Whilst there are extant agreements with the EA in place to ensure minimum levels of water flow at Teddington, climate change impacts may result in changes to this agreement being proposed. As such, the PLA recognises that both the EA and the water companies are relevant independencies in relation to any measures both to monitor and adapt to this impact.

6.3.3 The PLA considers that, in relation to the likely adaptation measures it may need to put in place as Statutory Navigation and Pilotage Authority for the tidal river Thames,

the main interdependency is with the EA. In addition to the two risks identified above, this is particularly the case with regard to flood risk management initiatives during the implementation of the TE2100 programme, which may have a considerable effect on the PLA's stakeholders. The PLA will, however, seek to build on its very good existing relationships with the EA to further progress matters related to climate change adaptation.

6.3.4 The PLA also considers that the riparian local authorities have an important interdependence, both in relation to measures they may undertake and, additionally, the impact the PLA's possible future adaptation measures may have on their local communities.

6.3.5 A further group of interdependencies exist with those users of the tidal Thames, both commercially and for leisure purposes. A number of stakeholders in the upper reaches of the tidal Thames have already been involved in the development of the tree management programme and through this the decision to introduce tree species more able to adapt to climate change as part of the replanting programme. Even at this very local level, those stakeholders wanting to participate in the PLA's work share an interdependency with the organisation and the PLA will seek to undertake future discussion on adaptation measures with the same degree of openness.

7.0 Monitoring and evaluation

7.1 *How will the outcome of the adaptation programme be monitored?*

7.1.1 The extent of proposed data collection and monitoring programme will enable the PLA to more accurately forecast the likely impact of climate change and therefore establish an appropriate basis for decision making on adaptation measures. Senior Managers will undertake an annual review meeting using a similar process to that which resulted in the evaluation matrix used to inform this report. This process will consider new data from internal or external sources. In the event that new data indicate likely patterns of climate change, the matrix will be reviewed. In particular, the likelihood/significance assessment will be amended to establish whether any additional adaptation measures need to be introduced. Managers who are responsible for planning major capital expenditure on infrastructure are part of this group and will consider the necessity for future proofing within the context of this annual review.

7.1.2 Senior Managers will consider and subsequently prepare a report of the PLA's activities which will be submitted for approval to the Executive Committee chaired by the Chief Executive. The report will then be submitted to the Board and, subject to ratification, will be published within the PLA's Annual Report.

7.2 *How will the thresholds, above which climate change impacts will pose a risk to your organisation, be monitored into future risk assessments?*

7.2.1 As noted previously, the PLA does not consider that there is a particular threshold above which climate change risks will pose any greater risk. Notwithstanding this, the annual review process will consider the evaluation and, if Officers consider the monitoring indicates that new adaptation measures need to be introduced (or proposed infrastructure works should be future proofed), then internal processes for the necessary works will be initiated. Additionally, the necessary awareness raising approaches connected with the adaptation measure will be considered in parallel.

7.3 *How will residual risks of impacts from climate change on your organisation and stakeholders be monitored?*

7.3.1 The evaluation matrix at Appendix VII illustrates the climate change risks considered relevant by PLA Managers. The PLA's proposed approach to monitoring will consider all climate change risks and determine whether any further risks should be

included. In this way, the PLA consider that all relevant risks will be properly monitored and, if necessary, appropriate adaptation measures initiated.

7.3.2 The PLA operates and participates in a number of fora for commercial and leisure users of the tidal Thames throughout its length. These fora will be used where necessary to disseminate and collect information on climate change risks and impacts on stakeholders. These fora will also be useful to disseminate awareness raising initiatives. Additionally, the PLA holds public meetings throughout the tidal River Thames and is planning an annual stakeholder meeting to be chaired by the PLA Chairman. These meetings provide an opportunity to discuss and monitor climate change impacts and for awareness raising. Public meetings have already been used successfully by the PLA throughout the development of the towpath tree management plan.

7.4 ***How will you ensure that the management of climate change is firmly embedded in your organisation?***

7.4.1 The PLA considers that the approaches it has detailed with this report, which include an annual review and subsequent publication of a report of the organisation's activities in addressing the matters within this report, will ensure that the management of climate change is adequately embedded within the organisation.

7.5 ***How will you enable your management of climate change risk to be flexible?***

7.5.1 The PLA believes the approaches it has detailed within this report will provide it with the necessary flexibility to cover any change in circumstances. In particular, the adoption of 'no regrets' adaptation measures together with future proofing new developments and assets, are considered to provide a degree of flexibility in the long-term.

7.6 ***Has the production of this report led to a change in your management of climate risks?***

7.6.1 The production of this report has resulted in the PLA considering climate change risk, and the necessary adaptation measures in something other than the abstract. When Managers met for the first workshop session, there was a general understanding of climate change, but little as to the actual forecasts and their possible implications for the PLA's duties, activities and functions. Following an assessment of the forecasts and the 'brainstorming' exercise, the potential risks identified were surprising - it was originally considered that the main risks, and hence need for adaptation measures,

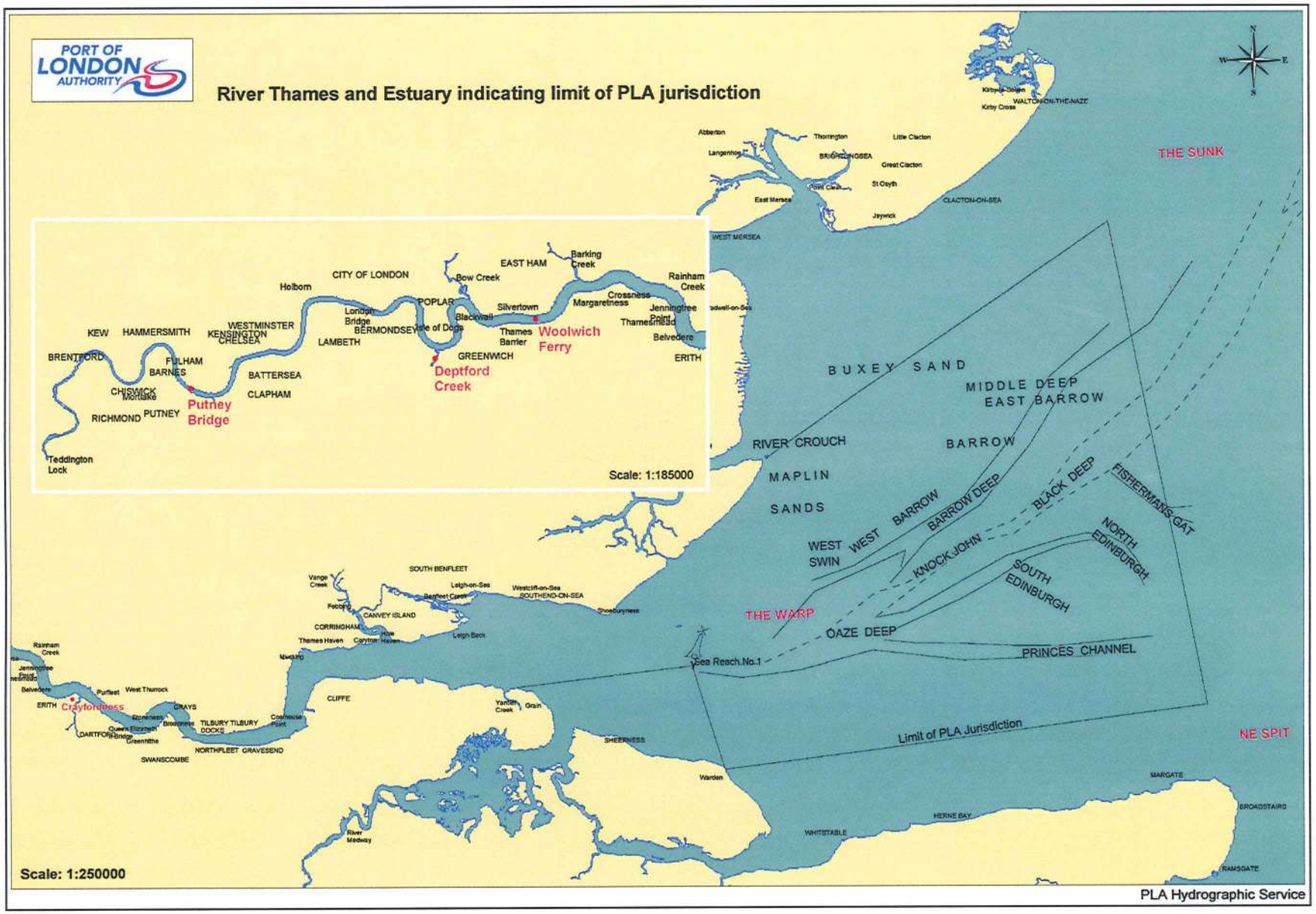
would be primarily if not exclusively focused in the lower reaches of the tidal Thames. Instead, the evaluation process demonstrated that by far the most serious risks were apparent within the upper reaches. This has resulted in a complete change in emphasis within the organisation as to where the greatest need for future adaptation activities will ultimately be focussed.

7.6.2 Similarly, the production of the report has resulted in a structure to the PLA's management of climate change risks. It has provided a framework for, in particular, the long-term data collection and monitoring necessary to provide an appropriate basis for future decision making. The processes required for review and reporting will also be initiated as a result of the preparation of this report.

7.6.3 The evaluation process has enabled Managers to obtain a meaningful understanding of the short and longer-term measures necessary for the PLA to manage climate change risks within the context of the organisation's activities. Most importantly, the production of this report has enabled the PLA to consider climate change as it will affect the organisation; to understand what it will mean for the tidal River Thames; and most importantly to ensure that action is taken on the basis of a sound evidence base which is provided by extant and new data collection and monitoring.

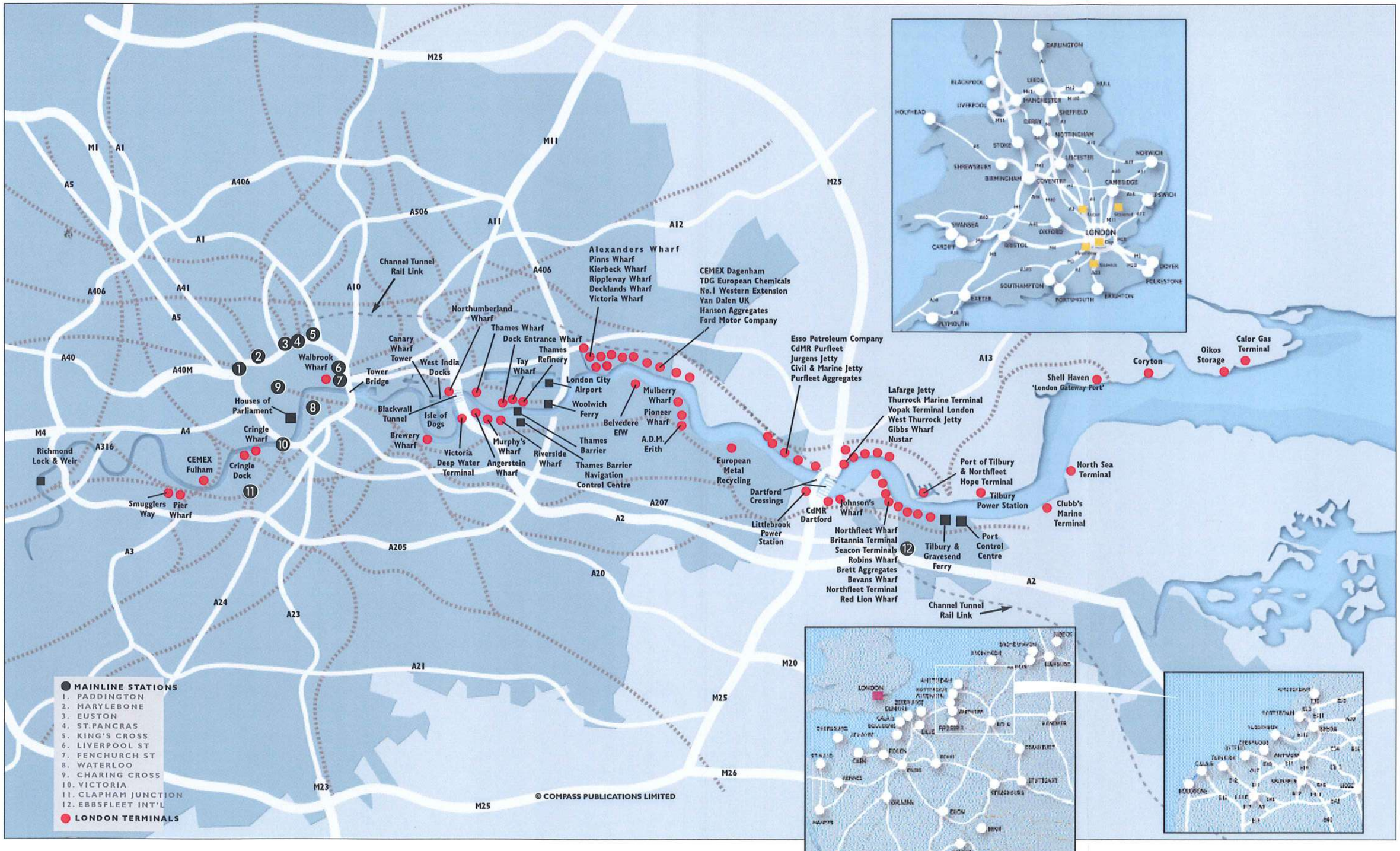
APPENDIX I

Geographical extent of the PLA's administrative limits


PORT OF LONDON AUTHORITY
River Thames and Estuary indicating limit of PLA jurisdiction
Scale: 1:185000
Scale: 1:250000
Putney Bridge
Deptford Creek
Woolwich Ferry
Crayfordness
Limit of PLA Jurisdiction
THE SUNK
THE WARP
NE SPIT
BUXEY SAND
MIDDLE DEEP
EAST BARROW
BARROW
RIVER CROUCH
MAPLIN SANDS
WEST SWIN
WEST BARROW
BARROW DEEP
KNOCK JOHN
BLACK DEEP
FISHERMANS GAT
NORTH EDINBURGH
SOUTH EDINBURGH
OAZE DEEP
PRINCES CHANNEL
Sea Reach No.1
CLACTON-ON-SEA
WALTON-ON-THE-NAZE
BRIGHLINGSEA
WEST MERSEA
EAST HAM
CITY OF LONDON
POPLAR
BERMONDSEY
LAMBETH
GREENWICH
ERITH
BATTERSEA
CLAPHAM
PUTNEY
RICHMOND
BRENTFORD
KEW
HAMMERSMITH
FULHAM
BARNES
CHISWICK
Teddington Lock
SOUTH BENFLEET
CANVEY ISLAND
CORRINGHAM
SOUTHEND-ON-SEA
CLIFFE
GRAYS
TILBURY
NORTHFLEET
GRAVESEND
SWANSCOMBE
SHEERNESS
Warden
MARGATE
BROADSTAIRS
RAMSGATE
HERNE BAY
WHITSTABLE
River Medway
PLA Hydrographic Service

APPENDIX II

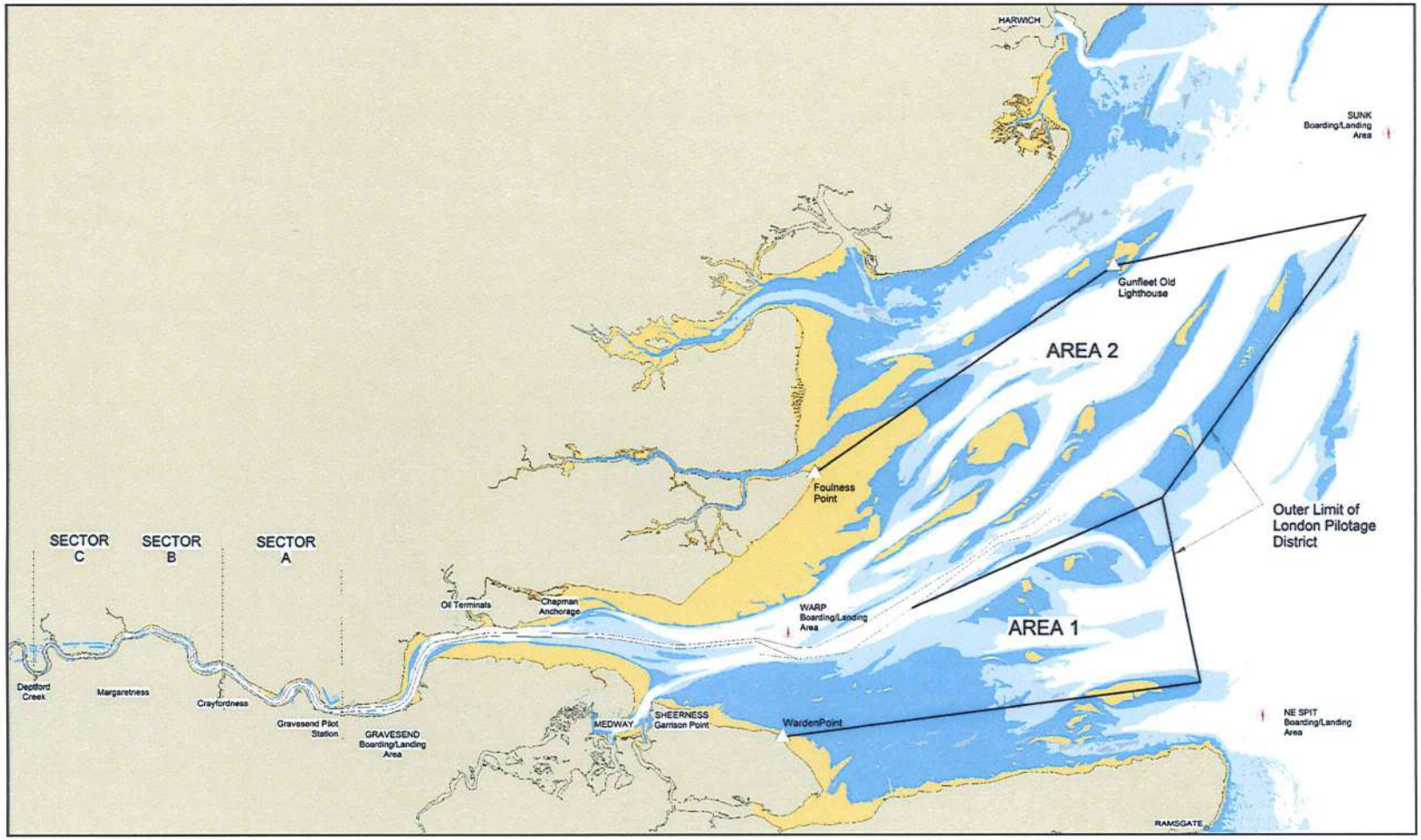
Geographical extent of the terminals within the Port of London


M25
M1
A1
A5
A406
A506
M11
A11
A12
A41
A10
A40
A40M
A4
A316
M4
A3
A24
A23
A21
A20
A205
A207
A2
A13
M20
M26
Channel Tunnel Rail Link
Alexanders Wharf
Pinns Wharf
Kierbeck Wharf
Rippleway Wharf
Docklands Wharf
Victoria Wharf
CEMEX Dagenham
TDG European Chemicals
No.1 Western Extension
Van Dalen UK
Hanson Aggregates
Ford Motor Company
Esso Petroleum Company
CdMR Purfleet
Jurgens Jetty
Civil & Marine Jetty
Purfleet Aggregates
Lafarge Jetty
Thurrock Marine Terminal
Vopak Terminal London
West Thurrock Jetty
Gibbs Wharf
Nustar
Northumberland Wharf
Thames Wharf
Dock Entrance Wharf
Thames Refinery
Tay Wharf
Canary Wharf Tower
West India Docks
Walbrook Wharf
Tower Bridge
London City Airport
Woolwich Ferry
Mulberry Wharf
Pioneer Wharf
A.D.M. Erith
Belvedere EfW
Blackwall Tunnel
Isle of Dogs
Brewery Wharf
Victoria Deep Water Terminal
Murphy's Wharf
Angerstein Wharf
Riverside Wharf
Thames Barrier
Thames Barrier Navigation Control Centre
European Metal Recycling
Houses of Parliament
Cringle Wharf
Cringle Dock
CEMEX Fulham
Richmond Lock & Weir
Smugglers Way
Pier Wharf
Dartford Crossings
CdMR Dartford
Littlebrook Power Station
Johnson's Wharf
Northfleet Wharf
Britannia Terminal
Seacon Terminals
Robins Wharf
Brett Aggregates
Bevans Wharf
Northfleet Terminal
Red Lion Wharf
Tilbury & Gravesend Ferry
Port Control Centre
Port of Tilbury & Northfleet Hope Terminal
Tilbury Power Station
Clubb's Marine Terminal
North Sea Terminal
Oikos Storage
Calor Gas Terminal
Coryton
Shell Haven
'London Gateway Port'
MAINLINE STATIONS
1. PADDINGTON
2. MARYLEBONE
3. EUSTON
4. ST.PANCRAS
5. KING'S CROSS
6. LIVERPOOL ST
7. FENCHURCH ST
8. WATERLOO
9. CHARING CROSS
10. VICTORIA
11. CLAPHAM JUNCTION
12. EBBSFLEET INT'L
LONDON TERMINALS
© COMPASS PUBLICATIONS LIMITED

APPENDIX III

Geographical extent of the London Pilotage District

PLA Pilotage Areas



APPENDIX IV

PLA Policies

Security Policy

The Port of London Authority (PLA) is the statutory harbour authority for the Port of London. It has also been designated a "strategic authority" by the UK Government, in respect of the requirements of the International Ship and Port Facility Security (ISPS) Code. This role includes responsibilities in respect of security matters in the wider port environment and impacts directly on the PLA's internal security culture and arrangements. The PLA, with the Metropolitan Police Service, is a founder member of the Thames Counter Terrorism Partnership.

Under the ISPS legislation, the PLA is obliged to:

- Develop and maintain an appropriate London Port Security Plan, which meets the requirements of the ISPS Code. Co-ordinate, communicate and facilitate the implementation of security measures required by the Plan to the port community as appropriate;
- Establish a Port Security Committee, comprising representatives of relevant port facility groups, regulators, agencies and other interested parties within the Port of London;
- Provide up to date advice, best practice and information on current security developments and on the implementation of the Port Security Plan, and Port Facility Security Plans to the port community;
- Co-ordinate and facilitate security training and testing of the Port Security Plan, and where necessary, co-ordinate the overall port response to a security incident; and
- Ensure the effective management and resourcing of internal security arrangements in order to meet the requirements of the London Port Security Plan.

In addition, in the wider context of the PLA's commitment to, and co-operation on security matters in the region, it is Board Policy that the PLA shall contribute effectively, as required and as circumstances permit:

- as a key player in the Thames Counter Terrorism Partnership, providing information, support and resources to the Partnership as appropriate; and
- to the co-ordination and improvement of national initiatives to deter, prevent and compromise maritime terrorist action.

---

www.pla.co.uk/pla 30/03/2011

Planning Policy

The PLA's planning policies seek to translate general UK governmental support for sustainable transport of freight to the specific context and policy environment existing within the Port of London.

Policies are based on comprehensive economic forecasting, undertaken in-house together with regular contact with terminal operators, to assess level of investment, throughput.

The PLA seek to ensure that policies within regional guidance and local development plans promote the transport of freight by water and the protection, and future expansion, of cargo handling terminals and riparian industry.

Within London, the PLA acts as adviser to the Mayor of London in relation to the current and proposed safeguarded sites. These sites are protected by ministerial direction for cargo handling including waste and aggregates, and for related activities. All planning application for uses other than these must be referred to the Mayor, who will consider the application with reference to extant policies and the views of the PLA.

The PLA seeks to increase trade within Port limits 'intraport trade' through maintaining an efficient safeguarding policy, ensuring consistent and positive development control decision making and lobbying for a positive grant regime from government to ensure water transport operates on a 'level playing field'.

The tidal Thames is home to over 55 sailing, rowing and canoeing clubs, apart from walking the Thames Path National Trail, yet the infrastructure essential to these activities, such as boatyards, drawdocks and other launching points are under intense threat from development. The PLA will seek to promote planning policies maintaining essential infrastructure at regional and local level.

The PLA also seek to ensure that new development adjacent to wharves and other 'working river' facilities, does not prejudice the river economy. Appropriate mitigation measures will be proposed and the PLA will also work closely with local planning authorities and developers on these, and all riparian sites.

---

www.pla.co.uk/pla 30/03/2011

Environmental Policy

As a statutory harbour authority, licensing authority and significant landowner for the Thames, the Port of London Authority (PLA) has environmental duties under the Harbours Act 1964 and is a competent authority under the Conservation (Natural habitats &c.) Regulations 1994 and the Countryside and Rights of Way Act 2000.

Government policy, set out in "Modern Ports", also requires harbour authorities to strike an appropriate balance between the long-term protection of the environment and the securing of sustainable economic growth.

In discharging its roles, the PLA remains committed to its continuing compliance with all applicable environmental legislation and other relevant requirements in the pursuit of its duties and powers and will take these fully into account in its actions and decisions, alongside its pursuit of the sustainability objectives established by government.

To this end it is Board policy that the PLA shall:

- Maintain an Environmental Management System (EMS) to assess the impacts of the PLA's activities on the environment, including the establishment of a suite of environmental measures.
- Monitor the EMS and its effectiveness through a detailed environmental monitoring programme for all significant PLA properties and areas of activity.
  Audit the EMS regularly, specifying both qualitative and quantitative objectives for the environmental programme and clearly focusing on the PLA's activities and services that may impact on the environment.
- Follow best environmental practice in regard to its own activities and provide appropriate management of those parts of its own estate within designated conservation sites.
- Be guided by the principles contained within the European Sea Ports Organisation's Environmental Code of Practice.
- Communicate with relevant authorities, regulators and stakeholders, consulting where there are areas of common interest.
- Communicate this environmental policy to all staff, contractors and suppliers and provide guidance and appropriate training where necessary.
- Work to prevent environmental damage and maintain a high level of preparedness to reduce the effects of occurrences within the port, with particular reference to oil pollution.
- Work to pursue efficiency in energy and waste management reductions where practicable.
- Publish periodic environmental data.

The PLA is committed to continuous improvement in its performance, in its use of resources to accomplish this, and to maintaining registration under the ISO 14001:2004 environmental standard.

This environmental policy was approved by the PLA Board on 3 March 2009 and will be reviewed at no longer than three-yearly intervals.

---

www.pla.co.uk/pla 30/03/2011

Pilotage Policy

The Port of London Authority (PLA) is a Competent Harbour Authority (CHA) within the meaning of the Pilotage Act 1987 and publishes Pilotage Directions. The Port of London Pilotage Directions define the London Pilotage District and the requirements for compulsory pilotage within it. They also lay down regulations under which Pilotage Exemption Certificates (PECs) are issued and administered in that District.

PLA Board policy in respect to pilotage is to:

- Ensure that the operation of the pilotage service is compliant with national regulations, guidelines and competency standards;
- Keep under review its Pilotage Directions to ensure that they are fully in accord with the current safety management system;
- Maintain a competent and authorised pilotage force;
- Maintain a fully supported Pilotage Service, able to respond to 99% of all properly notified pilotage requirements;
- Keep the means of boarding and landing pilots under review to ensure that these operations are always undertaken as safely as possible;
- Administer the PEC system to ensure that all PEC applicants and holders fully meet the requirements laid down in Pilotage Directions.

01/04/03

---

www.pla.co.uk/pla 30/03/2011

Navigational Safety Policy

The Port of London Authority (PLA) has a primary responsibility to facilitate the safety of navigation on the tidal Thames. To this end, it is Board policy that the PLA shall:

- Maintain an effective navigational Safety Management System based on a continuing, formalised assessment and mitigation of risk in consultation with river users;
- Review regularly the effectiveness of, and if necessary seek amendments to, its legal powers, Byelaws and Directions in respect of navigational safety;
- Monitor and manage vessel traffic within Port limits through the provision of an Information Service, a Traffic Organisation and a Navigational Assistance Service;
- Provide an appropriate level of pilotage services in accordance with the Pilotage Act 1987;
- Make and publish hydrographic surveys;
- Undertake maintenance dredging as appropriate;
- Remove sunken vessels and other obstructions that are, or may become, an impediment to safe navigation;
- Ensure the provision of necessary aids to navigation within port limits to the west of Sea Reach No.1 Buoy and maintain a close liaison with Trinity House in respect of the other aids which Trinity House maintains within PLA port limits to the east of Sea Reach No1 Buoy;
- Promulgate effectively navigational, tidal and other relevant information to all port and river users;
- Provide effective management and co-ordination in respect of the PLA's response to emergency incidents within its area of jurisdiction;
- Consult widely with port and river users and other relevant stakeholders in respect of navigational safety issues and proposed changes to navigational arrangements;
- Ensure that appropriate competency standards are laid down for passenger, freight and other commercial operations;
- Verify the fitness for purpose of registered craft and boats for hire by inspection, and where appropriate, define and enforce minimum crew competencies;
- Ensure, through risk assessment that the licensing of river works takes due regard of the safety of navigation.

06/12/05

---

www.pla.co.uk/navigation 30/03/2011

PORT OF LONDON AUTHORITY
OCCUPATIONAL HEALTH AND SAFETY POLICY

The PLA believes every accident and case of ill-health at work is preventable and the PLA regards good health & safety management and high standards of performance in health and safety as being of the utmost importance and integral to an efficient organisation. PLA is therefore committed to:-

- Preventing injury & ill-health and continuously improving health and safety performance and following Industry best practice.
- Developing and maintaining effective health, safety and welfare arrangements to protect its staff and all who come into contact with its operations.
- Complying with legal and other relevant requirements.
- Providing an effective Health and Safety Management System (HSMS) to help manage health & safety risks.
- Providing suitable resources to deliver these commitments.

The PLA recognises that effective health and safety arrangements improve operations by minimising time lost to injury or ill-health. They enable staff to work more efficiently and less stressfully in an environment where risks are effectively controlled, and health and welfare are promoted. As health and safety matters also affect the external environment, the successful implementation of the policy to control such issues enhances the PLA's reputation and standing.

The PLA requires that:-

- Health and safety is a line management responsibility. Effective implementation of the HSMS is one of the key responsibilities of all managers. All managers must demonstrate their commitment and leadership by regularly visiting the workplace to observe, discuss and seek ways to improve health and safety arrangements.
- Every employee is to recognise his/her responsibility to ensure the safety & health at work of themselves and others by following PLA's rules and guidance and by using their own experience and training.
- Effective systems of information and consultation are to be maintained, including those on incident reporting, investigation and taking corrective actions, plus near miss reporting.
- A systematic management of risk to which persons are exposed is in place.
- Every employee is to have appropriate health and safety training.
- A positive health and safety culture is developed and maintained.
- Suitable first aid arrangements are available.
- This Policy and the HSMS are brought to the attention of all employees.
- This Policy is to be reviewed annually or following any significant change to legislation or circumstances.

The HSMS defines in more detail the key responsibilities of duty holders. The following is a summary:-

- The Board of the PLA recognises its leadership and monitoring role in relation to health and safety throughout the PLA. This is achieved by reviewing the work of the various health and safety committees; through monthly reports from the Chief Executive and briefings from the Health and Safety Advisor.
- The Chief Executive is responsible to the Board for all health and safety matters affecting the PLA and its staff, in particular for the setting of objectives, formulation of health and safety policy, its development and implementation. The Chief Executive reports monthly to the PLA Board on a range of issues including incidents and accidents, auditing of performance and important operational and legislative developments.
- The Health & Safety Advisor administers and helps monitor and improve the HSMS. He reviews new legislation, standards and codes of practice as they are issued, and briefs management accordingly.
- Managers – to treat Health & Safety as a core responsibility.
- All staff – to take responsibility for their own health and safety and that of their colleagues and visitor/contractors to PLA work places.

Detailed Health and Safety arrangements are contained in the HSMS, which is accessible to all PLA employees.

Richard Everitt
Chief Executive
5th October 2010

PORT OF LONDON AUTHORITY

Consultation Policy

Both the Guide to Good Governance and the Port Marine Safety Code emphasise the importance of effective consultation by all ports with all stakeholders and beneficiaries. This includes all those who work in the port or use the tidal Thames in some way, as well as those that represent them.

It is therefore Board policy, that the PLA shall publish matters of relevance to, and encourage comment and contribution from, stakeholders and beneficiaries.

In particular, the PLA shall:

- Consult as early as is practicable with stakeholders and beneficiaries when changes to PLA legislation and policy are being considered;
- Include appropriate PLA staff in the consultation process;
- Maintain an effective consultation mechanism with appropriate stakeholders and beneficiaries on safety and other operational issues;
- Include appropriate practising port and river users in the ongoing work to identify navigational hazards, assess the risk of such hazards and recommend appropriate control and mitigation measures;
- Provide regular feedback on the Authority's performance, in particular its compliance with the Port Marine Safety Code, to all stakeholders and beneficiaries;
- Publish an annual review of PLA activity and achievements.

01.07.01

---

www.pla.co.uk/pla 30/03/2011

VTS Policy

In order to provide for safe navigation in the Thames, it is necessary to ensure that:

- an effective Vessel Traffic Service (VTS) operates throughout the port; and
- positive control of navigation is maintained in the vicinity of the Thames Flood Defence Barrier.

To this end it is Board policy that the PLA shall:

- Operate a 24-hour Vessel Traffic Service at the Gravesend PCC and Woolwich TBNC stations in accordance with its published Navigational Safety Policy;
- Provide a Traffic Information Service between the Outer Limits and Teddington Lock, a Traffic Organisation Service between the Outer Limits and London Bridge and a Navigational Assistance Service between the Outer Limits and Greenwich;
- Maintain VHF communication with all vessels of over 13.7 metres in length within its area of responsibility;
- Seek to ensure that the PLA VTS system operates at 99.9% availability;
- Review regularly the performance of the system and seek improvements through technical enhancement, staff development, training and effective management as necessary;
- Maintain standards for training and certification of VTS personnel in line with IALA recommendation V-103;
- Formally authorise all VTS personnel qualifying to the required IALA standard;
- Record all relevant radar video, VHF and telephone communications as an aid to enforcement and incident reconstruction and investigation; and
- Maintain comprehensive details and records of commercial vessel movements in the port using the POLARIS database.

01/07/2007

APPENDIX V

Summary of assumed climate change impacts

Summary of assumed climate change impacts

UK CP09 Climate Change Projections - medium emissions at 50% probability

	2020's	2050's	2080's
Winter mean temperature (degrees C)	**+1 to +2**	**+2 to +3**	**+3 to +4**
Summer mean temperature (degrees C)	**+1 to +2**	**+2 to +3**	**+3 to +4**
Winter mean max temperature (degrees C)	**+1 to +2**	**+1 to +3**	**+2 to +3**
Summer mean max temperature (degrees C)	**+1 to +2**	**+2 to +3**	**+4 to +5**
Winter mean min temperature (degrees C)	**+1 to +2**	**+2 to +3**	**+3 to +4**
Summer mean min temperature (degrees C)	**+1 to +2**	**+2 to +3**	**+3 to +4**
Change in annual mean precipitation (%)	**0 to +10**	**0 to +10**	**0 to +10**
Change in winter mean precipitation (%)	**0 to +10**	**+10 to +20**	**+10 to +20**
Change in summer mean precipitation (%)	**0 to -10**	**-10 to -20**	**-20 to -30**

In relation to rainfall, the projections above have been supplemented by the Environment Agency's (as part of the TE2100 work) forecast that 2080 flows over Teddington Lock could be increased by as much as +40%.

The assumption is, also from the EA's TE2100 work, that sea level rise on the tidal River Thames to 2100 will be between +0.2m to +0.9m, although the project has worked to the current Defra figure of +0.94m, with a maximum sea level rise at +2.7m. The TE2100 research also concluded that climate change is less likely to increase storm surge height and frequency in the North Sea than had been previously thought.

In terms of fog (from the UK CP09 additional product), at 2080's assuming a medium emissions scenario: -

	East of England	London	South East of England
Annual change (%)	**-25**	**-19**	**-24**
Winter change	**+7**	**+20**	**+7**

There are very substantial reductions throughout the rest of the year, but as the issue of fog is primarily a winter issue inasmuch as it affects operations within the Port of London it's only worth considering whether it will increase.

APPENDIX VI

Details of research papers and other information sources

Details of research papers and other information sources

- UK Climate Projections science report: Climate change projections. Defra *et al.* Version 3, updated 2010
- Future changes in fog frequency from the UKCP09 ensemble of regional climate model projections (UKCP09 additional product). Defra *et al.* 2010
- UKCP09: Probabilistic projections of wind speed (UKCP09 additional product). Defra *et al.* 2010
- Thames Estuary 2100: Technical Reports. Environment Agency. 2009
- Marine Climate Change Impacts Annual Report Card 2010 – 2011. Marine Climate Change Impacts Partnership. 2010
- Science report: SC030303 - Climate change, recreation and navigation. Environment Agency. 2007
- Climate change mitigation and adaptation: implications for inland waterways in England and Wales. Inland Waterways Advisory Council. 2009
- ETC/ACC Technical Paper 2010/6 – Guiding principles for adaptation to climate change in Europe. European Topic Centre on Air and Climate Change. 2010
- Adapting to climate change in the infrastructure sectors. PricewaterhouseCoopers LLP (for Defra). 2010
- Evaluating the risk assessments of Reporting Authorities under the Climate Change Act 2008. Cranfield University (for Defra). 2010

APPENDIX VII

Evaluation matrix

Climate change issue	PLA's interests and responsiblities Issue as recorded	Relevant to River and upstream	Estuary or downstream	Other	Responsibility or significant interest PLA Licensing Planning Environme	PLA Marine services Engineerin	PLA Harbour Masters VTS Pilotage	PLA Hydrograp	PLA Corporate	Third party	Risk	Requiring Preparation Data collection	Monitoring	Awareness raising	Capacity building	Future proofing	Action To reduce vulnerability or increase resilience
Changes to water level/volume/flow	PHYSICAL INFRASTRUCTURE																
	Greater variation in water depths	Y	Y				Y	Y	Y	Y	L/H	Y		INT/EXT			
	Effects on Richmond Lock and Wier	Y			Y	Y	Y	Y			L/H	Y		INT/EXT		Y	
	Depths on berths	Y	Y				Y	Y	Y	Y	L/H	Y		INT/EXT			
	Air draught issues	Y				Y	Y				L/H	Y					
	Increasing bank undermining	Y			Y	Y		Y			L/H	Y		INT	Y		Modify existing practice; change asset maintenance and management
	Changed siltation patterns/ increased dredging	Y	Y		Y	Y	Y	Y	Y		L/H	Y		INT	Y		
	Requirement to modify tide guages		Y		Y	Y		Y			L/L					Y	Replace assets to be able to continue collecting data
	Rewuirement to change navigation systems	Y	Y	Y		Y	Y		Y		L/H		Y		Y	Y	Change and modify VTS etc.
	Flooding/overtopping pontoons, pile moorings	Y	Y		Y	Y				Y	L/L		Y	INT/EXT		Y	
	Office car parking flooded			Y		Y			Y		L/L	Y		INT		Y	Modify as required
	Increase in flooding at Denton Wharf		Y			Y					L/L		Y				
	Bank and wall repair/flood risk				Y	Y				Y	L/H		Y	Y	Y	Y	Amend RWL processes
	Strengthening river moorings	Y	Y		Y	Y	Y			Y	L/H	Y		INT/EXT	Y	Y	
Increased temperatures	Additional visitor moorings required	Y	Y		Y	Y	Y				L/L		Y	INT/EXT	Y		Construct new moorings
	SAFETY; CHANGE IN USE																
Modal shift caused by climate change mitigation Temperature induced population changes Increased tourism due to temperature increase	New traffic study required	Y					Y				L/H	Y		EXT			More frequent surveys
	Increasing class V traffic in upper river	Y				Y	Y				L/H	Y		EXT			
	Increase in commuting by river	Y			Y		Y				L/H	Y					
	Consider adequacy of existing speed limits	Y					Y				L/L			EXT			
	Deeper draught ships		Y	Y			Y	Y		Y	L/L	Y		INT/EXT		Y	
	Commerical use crowding out recreational users		Y	Y			Y		Y	Y	L/H	Y		EXT/INT			
	Recreational users crowding out commercial u	Y		Y			Y		Y	Y	L/H	Y		EXT/INT			
	Increased swimming	Y	Y				Y		Y	Y	L/L	Y		EXT			Modify proposed HRO
	Increased navigational safety	Y	Y			Y	Y		Y	Y	L/H	Y		INT/EXT			
	Increased patrol requirement	Y				Y	Y		Y		L/H	Y			Y		
	VEGETATION																
Changes in precipitation/desiccation	Towpath Management	Y			Y	Y	Y		Y		H/L			INT		Y	Modify existing planting activities
	Increased tree fall	Y			Y	Y	Y		Y		L/L	Y		INT	Y		Increase existing activities
	Driftwood collection	Y				Y	Y				L/L	Y		INT	Y		Increase existing activities
	LICENSING																
	Permitting works more complex; increased restrictions	Y	Y		Y	Y	Y		Y	Y	L/L	Y		INT	Y		
Climate change mitigation; other effects	Compulsory licensing of all vessels	Y	Y				Y		Y	Y	L/L	Y		INT	Y		
	WATER QUALITY																
Changes in water quality/temperature	Increase in algal blooms	Y			Y		Y				L/L	Y	Y				
	Increasing up-river abstraction	Y					Y	Y		Y	L/H	Y	Y	EXT			
	Increased turbidity, reduced O2, impacts on marine life	Y	Y		Y						L/L		Y	EXT			
	Change in marine fauna	Y	Y		Y						L/L	Y	Y	EXT			
	Modify TOSCA (Thames Oil Spill Clearance Association) requirements		Y		Y	Y				Y	L/H		Y				
	NATURAL ENVIRONMENT																
	More frequent beneficial flooding of marshland, supporting migrating birds/wildlife		Y		Y			Y		Y	L/L		Y				Modify existing initiative to accommodate climate change
	Encroachment due to upgrading flood defences	Y	Y		Y					Y	L/L			EXT			
	Managed realignment opportunities	Y	Y		Y			Y		Y	L/L			EXT			
	BUSINESS CONTINUITY																
	Heating and ventilation unable to cope			Y	Y				Y		L/L	Y	Y	INT		Y	Modify systems as appropriate
	Business continuity/staff travel to work affected			Y					Y		L/L	Y	Y	INT	Y	Y	Modify systems as appropriate
	PLA communication systems based			Y		Y					L/L			INT	Y		
	GENERAL																
	Education and communication	Y	Y		Y		Y		Y		L/L			EXT			Develop and modify existing processes
	Corporate responsibility for climate change			Y					Y		H/L	Y		INT	Y		Add to risk registers, report on progress
Other climatic changes	PORT CLOSURE																
	Increased fog		Y	Y			Y		Y	Y	L/H		Y	INT/EXT			Modify working practices
	Increased wind		Y	Y			Y		Y	Y	L/H		Y	INT/EXT			Modify working practices