CLIMATE CHANGE ADAPTATION REPORT

December 2024

PORT OF LONDON AUTHORITY

Contents

1 Introduction

This report has been compiled by the Port of London Authority (PLA) in response to the UK Department for Environment, Food and Rural Affairs (DEFRA)'s request for voluntary climate adaptation reporting under the Climate Change Act (2008). The PLA submitted its Climate Change Adaptation Report and Risk Assessments in the first, second, and third rounds in 2011, 2015, and 2021, respectively.

This report relates to climate risks on the PLA's functions. This progress report has been produced under the fourth round of voluntary reporting under the Adaptation Reporting Power (ARP). It includes an introduction to the PLA, an updated understanding of risks and challenges, understanding of interdependent risks, and a revised adaptation action and implementation plan.

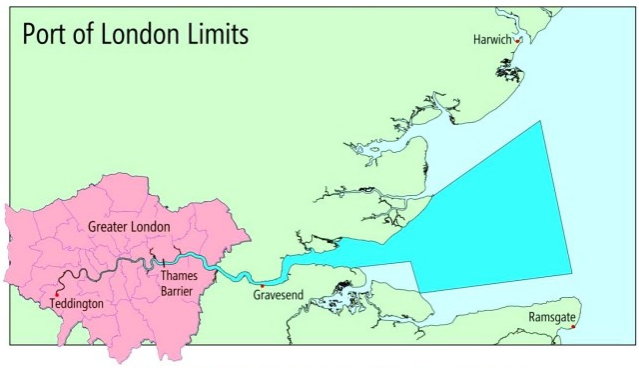
The objectives of the fourth round of reporting are to:

- Support integration of climate change risk management into organisations' work; and,
- Build understanding of the level of preparedness of key sectors to climate change, at a sectoral and national level, and inform other parts of the government's statutory cycle for climate adaptation, including Climate Change Risk Assessments (CCRAs) and National Adaptation Programmes (NAPs).

1.1 Organisational profile

1.1.1 The Port of London

The Port of London spans the entirety of the Tidal River Thames, from the Teddington Obelisk on the Surrey bank just downriver from Teddington Lock to the North Sea as pictured below. This is described in Schedule 1 of the Port of London Act 1968 (as amended) but in general terms include the tidal Thames from Teddington, encompassing both banks up to mean high water, eastward to Foulness Point in the north and Warden Point in the south. In the estuary the limits extend from Foulness point to Gunfleet Old Lighthouse, thence to a position 3 miles north of Margate, and back to Warden Point. The port limits exclude the River Medway and certain other creeks and rivers.



Visual depiction of Port of London Limits

Figure 1 The Port of London limits

The Port of London is characterised by an urban and natural estuary environment and includes a range of port and navigation facilities. The Port of London is the largest UK port by trade volume, acting as a hub for trade (51.6 million tonnes of goods handled in 2023) and passenger transport (approx. 9m passenger journeys in 2023), a space for leisure and culture (including 645 sporting events in 2023), and features an important natural environment.

The Port of London includes a diverse array of cargo terminals, with many independent operators handling a wide array of cargo types. These range from single berth jetties and quays to nationally significant ports such as the Port of Tilbury (operated by Forth Ports) and London Gateway (operated by DP World). A diverse range of domestic and international vessels call at the Port of London.

The Port of London also includes an array of passenger vessels including river bus services, river tour services and the cross-river Woolwich Ferry. These are supported by a passenger pier network owned and operated by a range of stakeholders. A range of private leisure vessels also use the Port of London.

Following a peak in 2022 of 54.9 million tonnes of trade through the port, in 2023 the Port of London followed UK-wide trends with an overall decrease in value and volume of imports coming through the port and a total of 51.6 million tonnes.

Volumes of oil, crude and related products increased slightly year on year, from 11.7 million tonnes to 12.0 million tonnes, whereas containers and trailers decreased from 24.2 million tonnes to 22.1 million tonnes. Aggregates and cement decreased 10% from 12.4 to 11.2 million tonnes, reflecting a reduction in construction activity across London and the South-East.

Between 2021 and 2023, 9.6 million tonnes of freight was moved inland between terminals on the Thames. As well as the movement of domestic and commercial waste, this comprises aggregates for, and waste arising from, construction projects in Greater London. The post pandemic recovery of passenger operations on the Thames continues, with the number of passenger trips (leisure, commuter and tourist) increasing to 9 million (estimated) in 2023, up from 4.5 in 2021 and 8.3 in 2022.

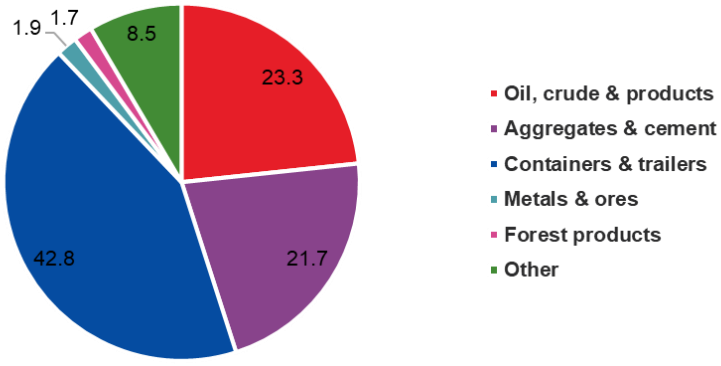


Figure 2 Port of London trade by type, 2023

1.1.2 The Port of London Authority

The PLA, a trust established in accordance with the Port of London Act 1908, is the custodian of the tidal Thames. It has no shareholders and operates for the benefit of customers and stakeholders now and in the future.

The PLA's roles include:

1. **Ensuring navigational safety**. The PLA has the primary responsibility for maintaining safe access and managing the safety of vessels, the general public and all users of the tidal River Thames. The PLA is committed to complying fully with the standards laid down in the Port Marine Safety Code (PMSC).
2. **Protecting and enhancing the environment**. As managers of the tidal Thames the PLA's mission is to conserve and improve the river alongside its use as a thriving port and waterway. As the statutory harbour authority, licensing authority and owner of the bed of the tidal Thames, the Port of London Authority (PLA) is committed to fostering the sustainable development and management of the estuary in accordance with the Government's Marine Policy Statement and environmental duties under the Harbours Act 1964
3. **Supporting port security**. The Port of London Authority (PLA) 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 offer a range of services to support the Port of London, including:

1. **Licensing and permits**. The PLA's Statutory Consents and Compliance Team administers our permitting process. They evaluate applications for works in or over the river to ensure compliance with environmental regulations and safety.
2. **Pilotage**. The PLA's pilotage department ensures the effective and economic provision of pilotage services 24 hours a day, 365 days a year. The team of over 100 pilots board and guide more than 10,000 ships through the Port of London every year.
3. **Marine Services.** A busy, safe river depends on the PLA's efficient Marine Services department. The team ensures that channels are clearly marked with lights and buoys, that any obstructions are quickly removed, that the driftwood is removed from the river. They also provide a base for boat lift out and repairs.
4. **Hydrography.** The PLA's hydrography team is responsible for the continuous monitoring of the river and estuary essential to safe navigation of the Thames. Surveys are primarily conducted for safety of navigation, but a significant effort goes into conservancy and environmental monitoring surveys, as well as detailed engineering works.

The PLA's assets include buildings, navigation radar, navigation infrastructure and equipment, piers and wharves, vessels and vehicles.

The PLA has implemented renewable energy systems across its operations, as part of its wider climate change mitigation efforts, including:

1. A 170kWh solar array at the Denton operational site
2. Support for tidal energy generation, with a demonstrator site at Thamesmead

Plans are in place to expand solar generation on PLA sites, further reducing reliance on fossil fuels and increasing energy independence.

Established as a wholly owned subsidiary in 2022, Estuary Services Limited (ESL) is owned by the Port of London Authority to provide a boarding and landing service for pilots joining and leaving ships trading to London and Medway. The company has 6 fast launches based at Ramsgate and Sheerness serve ships at the N.E. Spit Buoy, Margate Roads Anchorage, the Warps/Oaze Deep and the Anchorages at Southend and the Great Nore. Between 2022 and 2023, ELS completed over 20,000 pilot transfers to and from vessels transiting the Thames and Medway.

1.1.3 Key organisational goals pertinent to this report

Thames Vision 2050

The PLA's Thames Vision 2050 is an ambitious strategy aimed at transforming the tidal Thames into a thriving, sustainable, and resilient river. This vision focuses on enhancing the river's role in supporting economic growth, environmental sustainability, and community engagement. Key objectives include increasing river freight to reduce road congestion and emissions, promoting recreational use of the river, and improving water quality and biodiversity.

The PLA aims to achieve these goals through innovative infrastructure projects, partnerships with local communities and businesses, and robust environmental management practices. Thames Vision 2050 also emphasises the importance of adapting to climate change, ensuring that the river remains navigable and safe for all users. By fostering a collaborative approach and leveraging cutting-edge technologies, the PLA envisions a vibrant future for the Thames, balancing economic development with ecological preservation and enhancing the quality of life for those who live and work along the river.

Net Zero Ambitions

While distinct from climate change adaptation, delivering jointly on climate resilience and decarbonisation is critical in addressing the impacts and causes of climate change. The PLA remains committed to becoming the UK's leading Net Zero port by 2040. The Net Zero coalition, which brings together river operators to identify the actions that the PLA will take to reduce river-based emissions, has been established and through 2024 has worked with stakeholders on plans for decarbonising the river. The PLA continues to offer incentives to vessels supporting their Net Zero ambitions, including discounts on conservancy charges and/or port dues.

Thames Estuary 2100

Updated in 2023, the Thames Estuary 2100 Plan (TE2100) is a strategic plan for adapting to rising sea levels in the estuary, with 3 main aims; to take an adaptive approach to manage tidal flooding and create climate resilient communities, to protect and enhance the value of the Thames, its tidal tributaries and floodplain, by delivering social, cultural and commercial benefits for communities and support

resilient growth, and to tackle the climate and nature crises by putting sustainability at the heart of this Plan, by restoring ecosystems, reduce carbon emissions, and deliver environmental and biodiversity net gain. The PLA is working closely with the Environment Agency's TE2100 team to secure future improvements to London's flood defences.

1.2 PLA governance, management and strategy

As the highest governing body, the Board has overall responsibility for ensuring that the PLA's Risk Management Policy is established and for approving the functional strategy. The Board is committed to maintaining an integrated framework for risk governance, compliance and assurance. Each year the Board and Executive Committee undertakes a strategic review of the PLA's principal risks. To arrive at a settled position, the Committee considers long list of potential risks drawn from the internal risk management process and from the national risk register. In 2023, the principal risks were as follows:

1. Navigational safety
2. Health & safety
3. Economic
4. Financial
5. Cyber security
6. Climate change
7. Major pollution event

Climate risk is mitigated by the PLA's Climate Adaptation Plan, part of the voluntary National Adaptation Programme, of which this report is the fourth iteration, as well as through the PLA's involvement in the TE2100 London Flood Task Force to drive forward river-wide flood protection for the future. However, climate change also provides an opportunity through positioning and futureproofing the PLA for a low carbon future. The PLA capitalises on the opportunity side of the climate risk through initiatives such as stakeholder engagement, the Net Zero River Plan actions, and monitoring emissions across the river through our Maritime Emission Portal.

The PLA has integrated Climate Change management through ISO 14001:2015, incorporating the latest updates to determine the relevance of climate change issues into its governance structure. Climate Change considerations have been integrated into the assessment of internal significant aspects and impacts, as well as departmental risk registers. There is a strong commitment from top management under the ISO 14001 standard, with the Sustainability Policy targeting regular reviews of climate change impacts and the effectiveness of new adaptation measures.

The PLA's new Marine Safety Plan (2024-26) was published in 2023, following a thorough review of safety policies and procedures, as well as consultations with stakeholders in the marine industry, including PLA staff.

Further, in producing this report, publicly available adaptation guidance from across the maritime sector has been reviewed and integrated into the risk assessment and action plan where appropriate. These include:

- Resilience Rising's Resilience4Ports Port Resilience Framework for Action (2022)
- RTI International's Act Now or Pay Later: The Costs of Climate Inaction for Ports and Shipping (2022)
- DP World's Climate Proofing the Supply Chain: Using data to enhance infrastructure resilience (2023)
- PIANC's Climate Change Costs to Ports and Waterways: Scoping the Business Case Assessment for Investment in Adaptation (2024)
- Department for Transport's Climate Change Risk Assessment Guidance for the Transport Sector (2024)

2 Understanding risks and challenges

The impacts of climate change on PLA's operations have been identified and considered through the production of adaptation reports since 2011. Following the first submission, the PLA has been reviewing the risks regularly, undertaking appropriate adaptation measures, and collecting monitoring data of the changes. These have helped the PLA better understand the extent of the impacts and enable the evaluation of the action's effectiveness.

This report presents a revised risk assessment, that consolidates those previously submitted to DEFRA and updates them to reflect the PLA's latest knowledge. As far as possible, this report aligns with the template provided by DEFRA for ARP4 and meets the standards for a robust methodology for identifying and assessing risks. However, no new quantitative risk assessment has been undertaken as part of the ARP4, and consequently the climate scenarios included in this iteration reflect those included in ARP3. Consequently, UKCP18 climate projections beyond 2050 have not been assessed and are therefore not included as future scenarios.

In line with guidance provided by DEFRA, this report follows a widely adopted approach to assessing risks, where $Risk = Likelihood \times Impact$. Informed by the previously submitted ARP3 risk assessment, as well as extensive engagement across the organisation, an updated qualitative risk assessment is presented below.

2.1 Risk assessment scope

This report is led by the Port of London Authority and focusses on climate risks that could impact the delivery of their functions based on a defined list of climate hazards (droughts, extreme storms, heavy precipitation and pluvial floods, river floods, temperature extremes and sea level, including extreme still water). Refer to the introduction which outlines the roles and services of the PLA. Climate risks to the Port of London (and it's trade, transport and leisure functions), either directly or as a result of impacts on the PLA, are considered downstream interdependencies and are not covered in this report (refer to Section 3 for further information).

Fog has not been assessed as a climate hazard in this report due to the high uncertainty in projecting future fog patterns, though it does pose a risk to the PLA by disrupting visibility and navigation. The scope of this report is on more defined climate hazards.

2.2 Risk assessment scenarios

As in the previous iteration, current conditions and future climate projections have been used to assess the likely impact climate change has on the PLA's functions. Throughout, the assessment is based on the most recent UK Climate Projections data (UKCP18), which projections cover a range of variables, including changes in temperature, rainfall and sea level.

The PLA's ARP3, which analysed UKCP18 projections, identified that sea level anomalies are projected to be 0.22–0.27m under RCP4.5 and 0.26–0.31m under RCP8.5 by 2050. More intense rainfall events, notably in the winter months, an increased frequency of flood events[1] and an increase in peak river flows[2] are also projected. Further parameters are outlined in Table 1, which summarises the climate projections for the tidal Thames by 2050. The figures presented are taken from the PLA's ARP3.

Table 1 Summary of the Climate Projections for the tidal Thames by 2050, with winter defined as December, January, and February (DJF) and Summer defines as June, July, and August (JJA). The estimated anomalies are relative to the 1981-2000 baseline.

Parameter	RCP4.5	RCP8.5	Level of Confidence
Annual Mean Air Temperature Anomaly (°C)	0.9-2.0 (25th – 75th percentile)	1.2–2.5 (25th – 75th percentile)	High
Sea level Anomaly (m)	0.22–0.27 (30th – 70th percentile)	0.26–0.31 (30th – 70th percentile)	High
Seasonal Rainfall Anomaly (%)	DJF: -10.7–22.7 (25th – 75th percentile) JJA: -45.8–6.3 (25th – 75th percentile)	DJF: -9.0–26.6 (25th – 75th percentile) JJA: -50.3–2.8 (25th – 75th percentile)	Medium
River Flow	Annual: Decrease Peak: Increase		Medium
Flooding	Increase frequency		Medium

For this assessment, a score for each risk has been calculated for current conditions and an indication of how the score would change by mid-century under emissions scenarios RCP4.5 and RCP8.5 is provided. The PLA will remain active in reviewing projections, including future updates to the UKCP dataset, and will continue to collect relevant data, e.g., through hydrographic surveying.

In time, a quantitative revision of the PLA's CCRA will allow a broader set of future scenarios to be assessed in more detail, including end of century projections for 2 and 4°C rises, as recommended by DEFRA.

2.3 Risk screening

The hazard analysis combined a review of previously submitted CCARs, which used UKCP18 projections, and extensive engagement with relevant stakeholders from across the organisation. The relevant hazards that have been identified are droughts, extreme storms, heavy precipitation and pluvial floods, river floods,

[1] "UKCP18," Met Office, 2019.

[2] A. Kay, G. Watts, S. Wells and S. Allen, "The impact of climate change on UK river flows: a preliminary comparison of two generations of probabilistic climate projections," Hydrological Processes, vol. 34, no. 4, pp. 1081-1088, 2020.

temperature extremes and sea level, including extreme still water. The terminology used for these is in line with the climate variables identified by the IPCC's most recent assessment report[3].

Each risk that has been identified has been scored on a scale of one to five for both likelihood (1 = highly unlikely, 5 = highly likely) and impact (1 = minimal, 5 = catastrophic) to assess the current climate risk. The overall Risk is ranked between 1 and 25, with 1-3 as minor risk, 4 – 9 as moderate risk, 10 – 16 as major risk, and 20 – 25 as severe risk. Using expert judgement, informed by UKCP18, a qualitative assessment of the change to these risks under two future emissions scenarios (RCP4.5 and RCP8.5) has been undertaken for the year 2050. The following symbology has been used to demonstrate future change.

→ Risk score remains the same in the future

↗ Risk score increases moderately in the future

↑ Risk score increases significantly in the future

Table 2 Risk matrix

		Impact				
		Minimal	Minor	Moderate	Major	Catastrophic
Likelihood	Almost Certain	5 / moderate	10 / major	15 / major	20 / severe	25 / severe
	Likely	4 / moderate	8 / moderate	12 / major	16 / major	20 / severe
	Possible	3 / minor	6 / moderate	9 / moderate	12 / major	15 / major
	Unlikely	2 / minor	4 / moderate	6 / moderate	8 / moderate	10 / major
	Highly Unlikely	1 / minor	2 / minor	3 / minor	4 / moderate	5 / moderate

For this report, risks have been categorised as relating to either economic, safety, or environment aspects, or a combination of a number of these. Safety can lead to legal liabilities and damage the organisation's reputation. Environmental risks can result in regulatory fines, cleanup costs, and long-term damage to the ecosystem, affecting the sustainability of operations. Finally, economic risks refer to risks that could affect the financial performance and returns of the PLA. These risks can lead to reduced revenue, increased costs, and financial instability, impacting the overall economic health of the organisation.

Table 3 Examples of safety, environmental and economic risks

Safety	Environmental	Economic
Injuries Fatalities Health issues among staff	Pollution Habitat destruction Other environmental damage	Operational disruptions

[3] IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, 184 pp., doi: 10.59327/IPCC/AR6-9789291691647.

Once scored, the risks have been ranked based on their current risk score, to aid in risk prioritisation, as summarised in Table 4. In addition, for each of the risks outlined, the driving climate hazards have also been identified and are listed in the expanded risk table in Appendix A.

Table 4 Climate-related risk to the PLA

#	Risk Description	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050
R1	Increased safety incidents for PLA staff and river users when onboard vessels and during boarding and disembarkation.	Safety	3	4	12	↗	↗
R2	Changing depth of the river, berths, and navigation channels leading to reduced port efficiency/capacity, increased maintenance (dredging) and/or safety risks.	Economic Safety	3	3	9	↗	↑
R3	Disruption to Port of London vessel traffic, port/terminal operations and river users, due to changing river flows, changing met-ocean conditions and disruption to PLA river operations. Affects port efficiency/capacity.	Economic	3	3	9	↗	↑
R4	Decreases in the availability, increases in the cost, or emergence of new forms of climate-related insurance policies leading to possibly higher financial risks to the PLA or fewer opportunities to transfer climate-related risks.	Economic	3	3	9	↗	↗
R5	Increased runoff can lead to concentration of pollutants, litter and nutrients in water, contamination of potable water supply, affecting wildlife.	Safety Environment	3	3	9	↗	↗
R6	Increased flood risk for PLA sites affecting access as well as staff and port user safety.	Safety	4	2	8	↗	↑
R7	Accelerated deterioration of PLA assets leading to increased maintenance and replacement or decreased safety.	Economic Safety	2	4	8	↗	↗
R8	Sea level rise restricting vessel routes with limited air draft.	Economic Safety	2	4	8	→	↗
R9	Disruption to PLA river operations (surveying, pilotage, Richmond Lock and Weir) due to changing river flows and met-ocean conditions. Affects port efficiency/capacity.	Economic	3	2	6	↗	↑
R10	Exacerbated poor air quality and heat/UV exposure affects health, safety and wellbeing of PLA staff and river users, and also habitats.	Safety Environment	3	2	6	↗	↑

#	Risk Description	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050
R11	Increased change of habitat migration, damage, loss, or colonisation by invasive species due to changes in climate variables.	Environment	3	2	6	↗	↑
R12	Increased water temperature and decreased dissolved oxygen affecting the quality of the water and health of aquatic life and biodiversity.	Environment	3	2	6	↗	↑
R13	Increased numbers of and risk to recreational river users, especially swimmers, during drier, warmer summers.	Safety Environment	3	2	6	↗	↗
R14	Chance of bank erosion, affecting the stability of flood defence river walls and reducing intertidal habitats.	Economic Safety	2	3	6	→	↗
R15	Increased the risk of ground movement/subsidence, shrinkage and heave of high plasticity soils exacerbated by projected increases in drought conditions and periods of prolonged heavy rainfall. Affecting river structures throughout.	Economic Safety	2	3	6	→	↗
R16	Increase in water demand due to high temperature extremes, increasing operational costs.	Economic Environment	2	2	4	→	↗
R17	Increased number of tree falls, impacting habitat, bank erosion and river users.	Safety Environment	2	2	4	→	↗
R18	Increased fuel and energy consumption (e.g. aircons or vessel fuel) due to higher temperatures or increased river currents from river floods. Indirect impact - increase in emissions.	Economic Environment	2	1	2	↗	↗
R19	Wider range of salinity of the water affecting the quality of the water and health of aquatic life.	Environment	2	1	2	↗	↗

2.4 Risk analysis and evaluation

The majority of the risks identified are driven by, or could be caused by, more than one climate hazard. This is important to consider for a several reasons. Firstly, a multi-hazard approach provides a more comprehensive understanding of potential risks. And secondly, compound events, when hazards occur concurrently, can amplify the impact of a single risk. Understanding this can aid in more effective adaptation planning. For the seven climate hazards identified, Figure 3 summarises the number of times each of the hazards appears in the risk assessment. From this, temperature extremes, river floods and extreme storms represent the most frequently identified hazards. They each are relevant in 11 of the 19 identified risks.

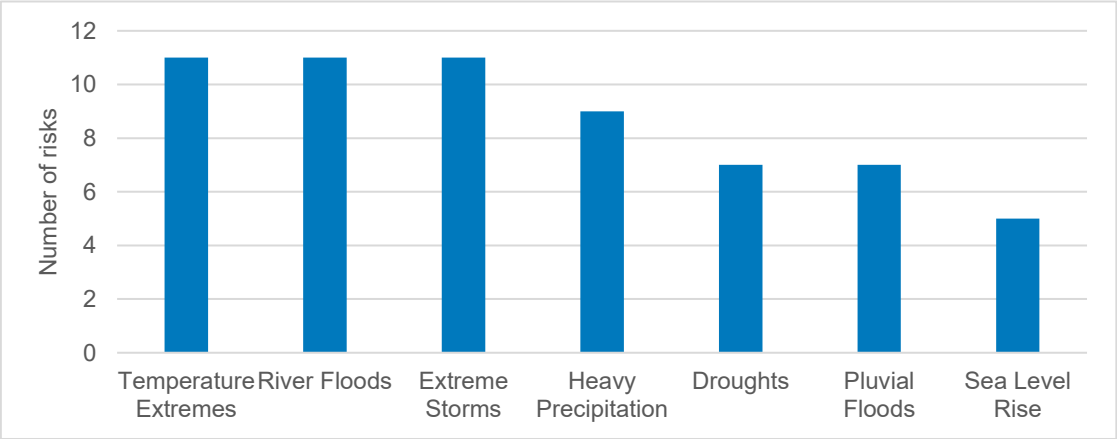


Figure 3 Number of times each of the hazards appears in the risk assessment

Overall, one major risk has been identified for the present day, with 16 classed as moderate and two as minor. By 2050, under RCP4.5 the assessment indicates that the number of major risks will increase to seven, with ten moderate and two minor risks. Under RCP8.5, the number of major risks rises to 13, with four moderate and two minor risks. The assessment has not identified any severe risks to the PLA or the Port of London.

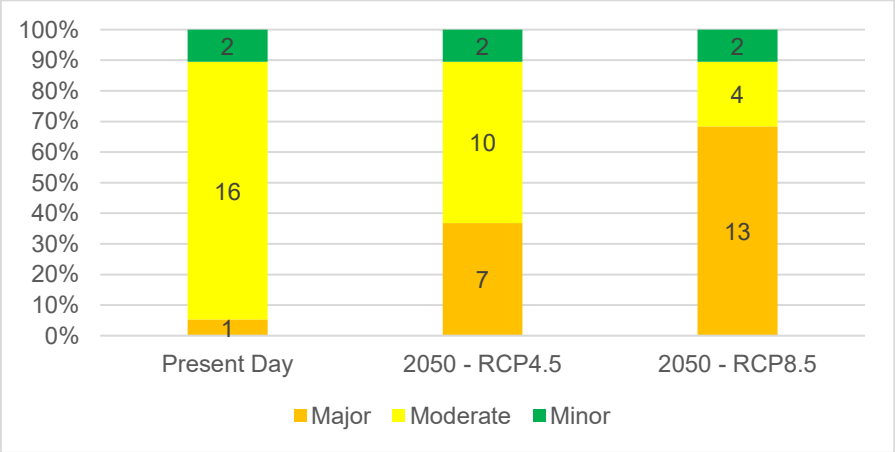


Figure 4 Summary of major, moderate, and minor risks

2.5 Risk management

Following the update of the climate change risk assessment, a workshop was conducted with representatives from across each of the PLA's departments whereby risk owners, risk modifications and risk controls were identified along with any PLA related plan, strategy or budget. The language used here, i.e., owner, modifications and controls, are familiar terms used widely across the PLA's broader risk management approach. The risk owner is defined as the person or directorate accountable for ensuring that a risk is managed.

The risk modification options considered are outlined below.

- Terminate - Avoiding, eliminating, or exiting an activity.
- Tolerate - Where no action is taken to affect risk likelihood or impact i.e., the risk is accepted by informed decision, albeit usually time bound.
- Transfer - Transfer to a 3rd party or share risk contractually with a 3rd party organisation, or via insurance.
- Treat - Action taken to reduce the likelihood or impact or both.

Risk controls are defined as preventive, corrective, or detective actions to mitigate risk.

Wider PLA plans and strategies that are influenced or impacted by climate risk were identified, to better support the integration of climate change risk management into the PLA's work. To better understand how to manage interdependencies and cascading risks, 3rd party collaborators were also identified, though these have not been engaged at this time.

3 Interdependent risks

This section outlines the approach to identifying and managing interdependencies for the PLA. Ports and port authorities operate within a complex system of systems, where disruptions can have cascading effects both upstream and downstream. Severe disruption, either upstream or downstream, can lead to cascading failures across broader systems.

Interdependencies have not been considered in previous CCARs submitted to DEFRA by the PLA. Given the complexities of identifying and mitigating interdependent risks, in this iteration of the CCAR, only upstream infrastructure dependencies have been considered. Figure 5, below, acts as a starting point for further action on interdependencies in the future. It outlines the upstream dependencies identified in this report related to critical infrastructure that providers services to the PLA. It outlines downstream dependencies to be considered in future iterations.

Figure 5 Indicative dependencies upstream and downstream of the PLA

3.1 Approach to identifying and managing interdependencies

Where appropriate, (inter-)dependent risks have been identified and integrated into the risk assessment, as summarised in Table 6. Most significantly, these risks relate to the interconnectedness with other infrastructure systems, such as transport networks, water and wastewater, and telecommunications. Below, risk controls that are within the PLA's sphere of control have been outlined and will be managed accordingly. The full interdependent risk table can be found in Appendix A.

Future iterations could expand this selection by undertaking a more thorough systems and interdependency assessment to include downstream dependencies as well as more complex interdependencies.

3.2 Interdependent risks faced by the PLA

Some of the most significant risks identified from the process outlined above come from the risks that climate change poses to other infrastructure systems on which the PLA depends and which, to varying

degrees, depend on the PLA, including energy supply, transport connections, domestic and international supply chains, digital services and water and wastewater services. Disruptions to any, or a number, of these services will likely compromise the PLA's economic, safety or environmental functions. Furthermore, the interconnectedness of these systems could also result in cascading failures that ultimately impact the PLA's operations. Under RCP4.5 and RCP8.5, the likelihood of these interdependent risks arising is likely to increase.

Furthermore, COVID-19 pandemic disrupted overall port trade volumes at the Port of London, which fell by 15% in early 2020, with the oil-derived fuels trade severely impacted during the first lockdown. In the future, climate change may increase the risk for pandemics like COVID-19, the loss of habitat bringing communities into contact with novel pathogens more often, increasing the chance of human infections. As above, pandemics have the potential to disrupt a variety of systems, beyond supply chains, with cascading impacts affecting the PLA's functions.

Table 5 Upstream (inter-)dependent risks to the PLA

#	Risk Description	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050
I1	Increased risks of damage and disruption to energy supply to the PLA. Economic, safety or environmental functions compromised.	Economic Safety Environment	3	4	12	↗	↑
I2	Increased risks of damage and disruption to transport (passenger and freight) services to/from the PLA. Economic, safety or environmental functions compromised.	Economic Safety Environment	3	4	12	↗	↑
I3	Climate change may increase the risk for pandemics like COVID-19. The encroachment of human settlements on natural habitats, as well as shifting patterns of species distribution due to changing climates will bring communities into closer contact with pathogens. Pandemics may disrupt port trade, passenger travel and global supply chains.	Economic Safety	2	5	10	↗	↗
I4	Increased risks of damage and disruption to domestic and international maritime supply chains connecting with the Port of London. Economic functions compromised.	Economic	4	2	8	↗	↑
I5	Increased risks of damage and disruption to digital/telecoms services supplying PLA. Economic, safety or environmental functions compromised.	Economic Safety Environment	2	4	8	↗	↑
I6	Increased risks of damage and disruption to potable and wastewater services to/from the PLA. Safety or environmental functions compromised.	Safety Environment	3	2	6	↗	↑
I7	Increased risks of damage and disruption to people who are required to operate the PLA. Economic, safety or environmental functions compromised.	Economic Safety Environment	2	3	6	↗	↑

4 Adaptation action plan and implementation

Due to the uncontrollable nature of the identified climate change related risks, risk *termination* is not a viable risk mitigation option. Therefore, risk controls that *treat* the risk have been identified in most instances, with a number of cases where risks are *tolerated*. Risk controls primarily address how to increase the safety of personnel and/or the public; monitor asset conditions against climate change; limiting environmental damage; and increase the resilience of supply chains and operations.

Many of the activities identified are high level, or require ongoing monitoring of climate change effects, with further review and feasibility studies required to deliver a more detailed action. This is linked to many of PLA policies and strategies which therefore allow for flexible and adaptable solutions to be sought often through engagement and collaboration with third parties.

Many of the risk controls have already been operationalised by the PLA, other will require actioning in the short-term (by 2030). Some actions require collaboration with other organisations. Where possible, 3rd party collaborators have been identified to facilitate action.

In partnership with others, further investigations into interdependencies and cascading risks are needed to define and implement a comprehensive action plan, including roles, responsibilities, and resources for these risks.

4.1 Adaptation action plan summary

The PLA has developed a high-level adaptation action plan to address the risks with the highest impact which are categorised around the following five themes like infrastructure resilience, operational flexibility, environmental stewardship, stakeholder collaboration, monitoring and review. The full list of actions is presented in Appendix B with a mixture of actions/controls that are already implemented or business as usual for the PLA, and also with a set of new actions.

4.1.1 Fuel and energy consumption

To reduce fuel and energy consumption increases due to higher temperatures or increased river currents from river floods, all vessels are to be Maritime and Coastguard Agency (MCA) coded vessels, which will enable engine efficiency. Vessels are to have fuel efficiency tablets on vessels to reduce fuel consumption (Reygar system). To further minimise fuel use and running engines at reduced revs the PLA aims to plan operation movements as close as possible to coincide with tidal flows, and to reduce repeat transits. These align with the Net Zero River Plan (NZRP), and Net Zero Action Plan (NZAP).

4.1.2 Asset deterioration and flood defence

To reduce accelerated deterioration of PLA assets, bank erosion and stability of flood defences the PLA have identified conducting more regular surveys (hydrographic primarily) to monitor changes and link to

asset replacement strategies; as well as collaborate with the EA to investigate changes and management through Thames Estuary 2100 (TE2100). These further align with controlling the increase in flood risk to PLA sites and public access areas, with inspection and monitoring of sites and improving sea defences.

4.1.3 Air quality and heat

Reducing poor air quality, heat exposure for the public and well-being of staff the PLA seek to incentivise "greener" vessels via a green tariff; to monitor air quality; and to review remote working possibilities and/or working hours to avoid working during certain weather conditions.

4.1.4 Habitats and biodiversity

The number of tree falls impacting habitat, bank erosion and river users will be reduced by regular inspections and maintenance. To control the detrimental effects to aquatic life, biodiversity, and water quality (via increased runoff of pollutants, water temperature increases, decreased water oxygen levels, etc.) a suite of actions have also been identified, including monitoring programmes and partnership building. The PLA's Biodiversity Net Gain (BNG) Strategy and Environment & Sustainability (E&S) Policy; Thames Environment Fund Project compliment all the above actions along with the EA Riverside strategy and TE2100.

4.1.5 River operations

To minimise the risk of disruption to vessel traffic, river operations and river users, due to changing river flows and changing met-ocean conditions the PLA aim to liaise with the EA regarding the closure of flood defence barriers. This action further aims to control sea level rise restricting vessel routes with limited air draft.

4.1.6 Recreational users

To control the increased numbers and risk to recreational users during the drier warmer summers an ebb flag warning system along with social media posting to warn about the climate related risks.

5 Economic Aspects

The Port of London delivers significant economic value (to London and the UK), including directly through its transport and recreational functions. This includes unlocking employment of 48,000 people and contributing more than £3bn to the economy annually.

Climate hazards affect both the PLA and the Port of London. Inaction on climate risks will result in disruption as summarised in Figure , with impacts on the local and national economy. Through adaptation, which also has a cost, the port's function can be maintained or enhanced, preserving economic value and potentially unlocking additional co-benefits.

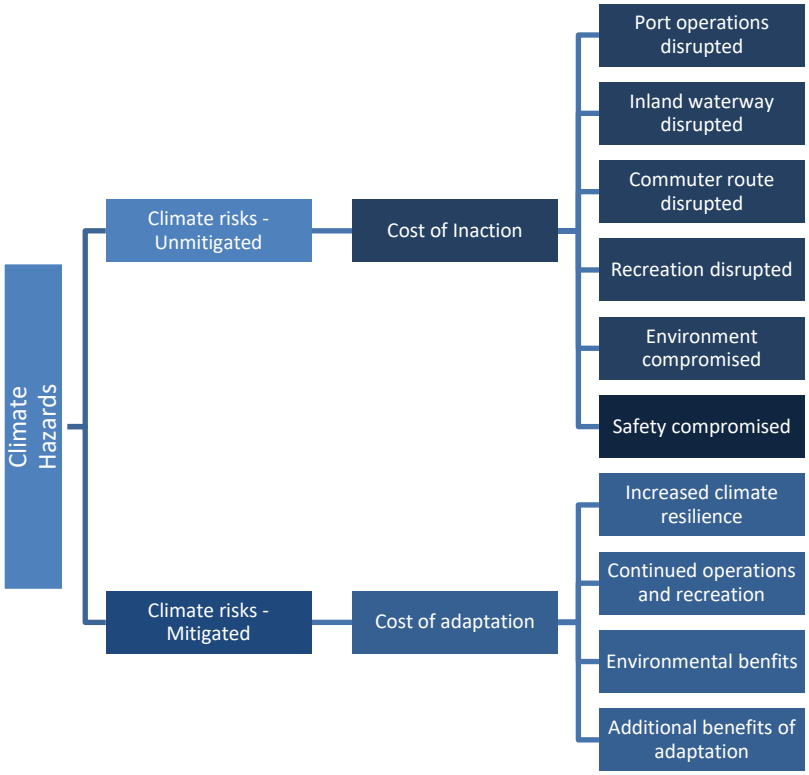


Figure 6 - The link from climate hazards to economic impacts at the Port of London.

This assessment makes clear that climate hazards – without appropriate risk mitigation - have the potential to significantly affect: the efficient and effective operation of the port, safe navigation within the port, and the protection and enhancement of the tidal Thames environment. These present a **cost of inaction**.

This assessment also describes actions to mitigate the risks. The mitigations require action by the PLA as well as other stakeholders. This presents the **cost of adaptation**.

Finally, there is potential for the actions required to mitigate the climate risks to deliver additional benefits, beyond resilience. For example, adaptation solutions that restore nature can deliver environmental benefits in addition to resilience benefits. These present **additional benefits of adaptation**.

5.1 Cost of inaction

The table below illustrates that the economic impacts (costs of inaction) linked to climate change at the Port of London are complex and diverse.

Table 6 - Cost of inaction

Climate hazards	Risks to PLA and Port of London (see CCAR for details)	Economic impacts – cost of inaction
• Droughts • Extreme storms • Heavy precipitation	• Disruption to PLA river operations • Disruption to Port of London vessel traffic • Increase in energy and water demand	• Port disrupted - impacts on international supply chains • Inland waterway disrupted - impact on domestic supply chains

Climate hazards	Risks to PLA and Port of London (see CCAR for details)	Economic impacts – cost of inaction
• Pluvial floods • River floods • Temperature extremes • Sea level rise	• Restrictions on vessel routes • Heat impacts on recreational users • Increased maintenance and repairs • Increased risks for vessel onboarding • Various risks to the environment and biodiversity	• Commuter and tourist route disrupted - impact on passengers and visitors • Recreational hub - impact on communities • Safety compromised - indirect impact on aspects above. • Environment compromised - impact on ecosystem and biodiversity

According to the IMF's PortWatch the predominant hazard for all London ports causing physical damage is coastal flooding[4]; with coastal, fluvial and tropical cyclones (strong wind, heavy rain and storm surge) the predominant hazards causing downtime. The present and RCP 8.5 scenarios for the ports of London are summarised in Table . Climate risk has been expressed as the annual expected physical asset damages; and the annual expected downtime (number of days per year). The import and export value at risk per year is derived by combining the country trade flows at the port-level with the annual expected downtime (based on data from 14 July 2024) (In most cases, this is trade that is delayed as shipments get rerouted to other ports; however in more extreme cases, it could be trade lost due to a permanent loss of exports or imports.). Data on the platform is updated on a regular basis and PortWatch accepts no liability for omissions or errors in the data or content but can be used as initial guidance.

Table 7 - Climate risk summary for the ports of London according to PortWatch.

Climate Risk	Grand Total	Climate Risk	Grand Total
Present		**RCP 8.5**	
Expressed as physical asset damages per year	£27.8 mil/yr	Expressed as physical asset damages per year	**$116.4 mil/yr**
Port downtime (days/year)	2.8 days/yr	Port downtime (days/year)	**7.1 days/yr**
Import value at risk per year *	$127.2 mil/yr	Import value at risk per year *	**$440.6 mil/yr**
Export value at risk per year*	$90.2 mil/yr	Export value at risk per year*	**$312.9 mil/yr**

*Data updated regularly.

[4] Oxford University & IMF, "PortWatch," IMF, 15 November 2023. [Online]. Available: https://portwatch.imf.org/.

5.2 Cost of action

There are a variety of adaptation actions that can be generally categorised as [5]:

- Hard solutions: engineered and nature-based solutions, like new flood defences, retrofitting existing infrastructure, or sustainable drainage.
- Behavioural solutions: changing shift patterns to avoid the hottest times of the day during heatwaves or severe weather safety plans, public awareness campaign or simply clearing the drains before a predicted storm.
- Institutional solutions: policy changes (e.g. updating engineering standards to account for climate change) or organisation-wide extreme weather scenario drills.
- Technological solutions: early warning systems, hazard mapping, or improved incident reporting systems with weather attribution.

The latter three types of solutions (also known as soft solutions) often require fewer resources when compared to hard strategies, making them a good initial step for ports to mitigate climate risks. The costs of these actions usually reflect a port's administrative or operational expenses, including insurance, regulations, budget reallocation, and document design. Therefore, they are best as an initial step in the climate change adaptation process[6].

The table below illustrates that the range of actions required to adapt to climate change at the Port of London are complex and diverse, likely requiring investment from a number of stakeholders.

Table 8 - Types of actions planned to adapt to climate change at the Port of London

Climate hazards	Risks to PLA and Port of London (see CCAR for details)	Examples of action planned
• Droughts • Extreme storms • Heavy precipitation • Pluvial floods • River floods • Temperature extremes • Sea level rise	• Disruption to PLA river operations • Disruption to Port of London vessel traffic • Increase in energy and water demand • Restrictions on vessel routes • Heat impacts on recreational users • Impacted maintenance and repairs • Increased risks for vessel onboarding • Deterioration of assets/infrastructure • Bank erosion	• Habitat improvement works • Improved remote and flexible working capacities • Public awareness raising campaigns • Modification to infrastructure to increase resilience • Increase maintenance teams (e.g. bank maintenance team) • Increase monitoring and assessment of weather-related incidents • Develop dynamic emergency response plans • Increased drainage capacity • Additional independent route connection planned to improve resilience

[5] Adapted from UITP's Climate Change Adaptation Framework

[6] G. Van Houtven, M. Callaher, J. Woollacott and E. Decker, "Act Now or Pay Later: The Costs of Climate Inaction for Ports and Shipping," RTI International , Raleigh, 2022.

5.3 Co-benefits

The table below illustrates some example co-benefits that actions described in this assessment could unlock.

Table 9 - Example co-benefits linked to PLA CCAR actions

Types of action planned	Example co-benefits
• Habitat improvement works • Installation of new piers to enhanced safety suitable for bigger vessels • Improved remote and flexible working capacities • Public awareness raising campaigns	• Reduced costs for heating and cooling • Opportunities for community involvement in conservation efforts, fostering a sense of stewardship • Accommodates larger vessels, potentially increasing trade and economic activity • Enhances work-life balance, leading to higher job satisfaction and productivity • Strengthens relationships with stakeholders, fostering collaboration and trust • Biodiversity net gain • Potential decrease in insurances • Reputation enhancements • Increase in overall operational resilience (less disruption to supply chains) (continued economic stability)

List of Acronyms

Acronym	Definition
ARP	Adaptation Report Power
ARP3	Third Round Adaptation Reporting Powers
ARP4	Fourth Round Adaptation Reporting Powers
CCAR	Climate Change Adaptation Report
CCRA	Climate Change Risk Assessment
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CHM	Chief Harbour Master
DCA	Director of Corporate Affairs
DEFRA	Department for Environment, Food and Rural Affairs
DHR	Director of Human Resources
DMO	Director of Marine Operations
DOS	Director of Sustainability
DPD	Director of Planning and Development
ESL	Estuary Services Limited
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GLA	Greater London Authority
HHA	Harwich Haven Authority
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
LA	Local Authority
MMO	Marine Management Organisation
NAP	National Adaptation Programme
PLA	Port of London Authority
RCP	Representative Concentration Pathway
TE2100	Thames Estuary 2100
UKCP	UK Climate Projections

Appendix A: Climate Change Risk Assessment

Table 10 Climate-related risks to the PLA

#	Climate Variables	Risk Description	Risk identified under ARP1-3?	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050	CCRA3 related risks
R1	Extreme Storms Heavy Precipitation	Increased safety incidents for PLA staff and river users when onboard vessels and during boarding and disembarkation.	No	Safety	3	4	12	↗	↗	-
R2	Droughts River Floods	Changing depth of the river, berths, and navigation channels leading to reduced port efficiency/capacity, increased maintenance (dredging) and/or safety risks.	Yes	Economic Safety	3	3	9	↗	↑	-
R3	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Temperature Extremes	Disruption to Port of London vessel traffic, port/terminal operations and river users, due to changing river flows, changing met-ocean conditions and disruption to PLA river operations. Affects port efficiency/capacity.	Yes	Economic	3	3	9	↗	↑	-
R4	Extreme Storms Pluvial Floods River Floods	Decreases in the availability, increases in the cost, or emergence of new forms of climate-related insurance policies leading to possibly higher financial risks to the PLA or fewer opportunities to transfer climate-related risks.	No	Economic	3	3	9	↗	↗	-
R5	Droughts Extreme Storms River Floods Temperature Extremes	Increased runoff can lead to concentration of pollutants, litter and nutrients in water, contamination of potable water supply, affecting wildlife.	Yes	Safety Environment	3	3	9	↗	↗	H10a H10b

#	Climate Variables	Risk Description	Risk identified under ARP1-3?	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050	CCRA3 related risks
R6	Extreme Storms Heavy Precipitation Pluvial Floods River Floods	Increased flood risk for PLA sites affecting access as well as staff and port user safety.	Yes	Safety	4	2	8	↗	↑	-
R7	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Sea Level Rise Temperature Extremes	Accelerated deterioration of PLA leading to increased maintenance and replacement or decreased safety.	Yes	Economic & Safety	2	4	8	↗	↗	I3 I4 H5
R8	Sea Level Rise	Sea level rise restricting vessel routes with limited air draft.	Yes	Economic Safety	2	4	8	→	↗	I4
R9	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Temperature Extremes Drought	Disruption to PLA river operations (surveying, pilotage, Richmond Lock and Weir) due to changing river flows and met-ocean conditions. Affects port efficiency/capacity.	Yes	Economic	3	2	6	↗	↑	I12 B1 B2 B5 B4
R10	Drought Temperature Extremes	Exacerbated poor air quality and heat/UV exposure affects health, safety and wellbeing of PLA staff and river users, and also habitats.	Yes	Safety Environment	3	2	6	↗	↑	H7a H7b

#	Climate Variables	Risk Description	Risk identified under ARP1-3?	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050	CCRA3 related risks
R11	Droughts Extreme Storms Heavy Precipitation Pluvial Floods River Floods Sea Level Rise Temperature Extremes	Increased change of habitat migration, damage, loss, or colonisation by invasive species due to changes in climate variables.	Yes	Environment	3	2	6	↗	↑	N1 N2 N11 N12 N16 N17
R12	Droughts Extreme Storms River Floods Temperature Extremes	Increased water temperature and decreased dissolved oxygen affecting the quality of the water and health of aquatic life and biodiversity.	Yes	Environment	3	2	6	↗	↑	N11 N14
R13	Drought Temperature Extremes	Increased numbers of and risk to recreational river users, especially swimmers, during drier, warmer summers.	Yes	Safety Environment	3	2	6	↗	↗	H10a
R14	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Sea Level Rise Drought	Chance of bank erosion, affecting the stability of flood defence river walls and reducing intertidal habitats.	Yes	Economic Safety	2	3	6	→	↗	I5

#	Climate Variables	Risk Description	Risk identified under ARP1-3?	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050	CCRA3 related risks
R15	Heavy Precipitation Drought	Increased the risk of ground movement/subsidence, shrinkage and heave of high plasticity soils exacerbated by projected increases in drought conditions and periods of prolonged heavy rainfall. Affecting river structures throughout.	No	Economic Safety	2	3	6	→	↗	-
R16	Droughts Temperature Extremes	Increase in water demand due to high temperature extremes, increasing operational costs.	Yes	Economic Environment	2	2	4	→	↗	I8
R17	Droughts Extreme Storms Heavy Precipitation	Increased number of tree falls, impacting habitat, bank erosion and river users.	Yes	Safety Environment	2	2	4	→	↗	-
R18	River Floods Temperature Extremes	Increased fuel and energy consumption (e.g. aircons or vessel fuel) due to higher temperatures or increased river currents from river floods. Indirect impact - increase in emissions.	Yes	Economic Environment	2	1	2	↗	↗	-
R19	Droughts Sea Level Rise Temperature Extremes	Wider range of salinity of the water affecting the quality of the water and health of aquatic life.	Yes	Environment	2	1	2	↗	↗	N11

Table 11 (Inter-)dependent risks to the PLA

#	Climate Variables	Risk Description	Risk identified under ARP1-3?	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050	CCRA3 related risks
I1	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Temperature Extremes	Increased risks of damage and disruption to energy supply to the PLA. Economic, safety or environmental functions compromised.	No	Economic Safety Environment	3	4	12	↗	↑	B7 I1
I2	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Temperature Extremes	Increased risks of damage and disruption to transport (passenger and freight) services to/from the PLA. Economic, safety or environmental functions compromised.	No	Economic Safety Environment	3	4	12	↗	↑	B7 I1
I3	All	Climate change may increase the risk for pandemics like COVID-19. The encroachment of human settlements on natural habitats, as well as shifting patterns of species distribution due to changing climates will bring communities into closer contact with pathogens. Pandemics may disrupt port trade, passenger travel and global supply chains.	Yes	Economic Safety	2	5	10	↗	↗	H8
I4	All, but typically occurring elsewhere	Increased risks of damage and disruption to domestic and international maritime supply chains connecting with the Port of London. Economic functions compromised.	No	Economic	4	2	8	↗	↑	ID7
I5	Extreme Storms Heavy Precipitation Pluvial Floods River Floods	Increased risks of damage and disruption to digital/telecoms services supplying PLA. Economic, safety or environmental functions compromised.	No	Economic Safety Environment	2	4	8	↗	↑	B7 I1

#	Climate Variables	Risk Description	Risk identified under ARP1-3?	Category	Likelihood	Impact	Present Day Risk	Future Risk RCP4.5 2050	Future Risk RCP8.5 2050	CCRA3 related risks
	Temperature Extremes									
I6	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Temperature Extremes	Increased risks of damage and disruption to potable and wastewater services to/from the PLA. Safety or environmental functions compromised.	No	Economic Safety Environment	3	2	6	↗	↑	B7 I1
I7	Extreme Storms Heavy Precipitation Pluvial Floods River Floods Temperature Extremes	Increased risks of damage and disruption to people who are required to operate the PLA. Economic, safety or environmental functions compromised.	No	Economic Safety Environment	2	3	6	↗	↑	B7 I1

Appendix B: Risk and adaptation action plan

Table 12 Risk assessment and adaptation action plan for risks to the PLA

#	Risk Description	3rd Party Collaboration	Risk Modification	Risk Controls/ Adaptation Action	Related PLA Plans, Strategies and Budgets
R1	Increased safety incidents for PLA staff and river users when onboard vessels and during boarding and disembarkation.	Estuary Services Limited (ESL) Harwich Haven Authority (HHA) Ship operators	Treat	For PLA staff: Training programme to improve safety, e.g. on-land pilot ladder training facility in Denton For river users: PLA raise risks and mitigations with wider stakeholders. Operate a Marine Safety Management System (SMS).	4-yearly refreshers for ladder training videos to accompany training Codes of practice & procedures PLA Safety Plan
R2	Changing depth of the river, berths, and navigation channels leading to reduced port efficiency/capacity, increased maintenance (dredging) and/or safety risks.	Dredging companies Marine Management Organisation (MMO) Terminal operators	Treat	Improve tide gauges coverage to minimise uncertainties Monitoring of specific berths and channels with frequent Hydro Surveys.	Dredging budget Hydrographic surveys Trade/income budgets
R3	Disruption to Port of London vessel traffic, port/terminal operations and river users, due to changing river flows, changing met-ocean conditions and disruption to PLA river operations. Affects port efficiency/capacity.	Broader stakeholder group London River Users Terminal operators Thames Clippers	Treat	Improve tide gauges coverage to minimise uncertainties Liaise EA regarding the closure of flood defence barriers to minimise disruption Develop contingency plans for extreme weather events	Thames Estuary 2100 (TE2100) trade/income budgets Codes of practice & procedures
R4	Decreases in the availability, increases in the cost, or emergence of new forms of climate-related insurance policies leading to possibly higher financial risks to the PLA or fewer opportunities to transfer climate-related risks.	PLA clients that will take over the increasing costs of insurance	Treat	Organisation business risk managed as detailed in the Risk Management Policy & Framework. Engage with insurance providers on possible insurance products relating to climate change risks.	Risk Management Policy & Framework

#	Risk Description	3rd Party Collaboration	Risk Modification	Risk Controls/ Adaptation Action	Related PLA Plans, Strategies and Budgets
R5	Increased runoff can lead to concentration of pollutants, litter and nutrients in water, contamination of potable water supply, affecting wildlife.	Environment Agency (EA) Developers Local Authorities, GLA Natural England Thames Water	Treat	Collaborate with Thames Tideway Tunnel to minimise the sewage and litter overspill. Collaboration with EA on water pollution risk mitigation and control. Collaborate with academia on water pollution risk mitigation and control.	Income budget Clean Thames Plan Clean Thames Partnership Clean Thames Manifesto
R6	Increased flood risk for PLA sites affecting access as well as staff and port user safety.	Environment Agency (EA) Landowners Local Authorities	Treat	Consider the need for and conduct feasibility of improving sea defences around Alexandra House (Gravesend) Consider more regular inspection and monitoring patrols to maintain public access routes.	EA Riverside Strategy Foreshore permits River user guidance Flood management procedure
R7	Accelerated deterioration of PLA leading to increased maintenance and replacement or decreased safety.	Environment Agency (EA) Local Authorities Private asset owners Terminal operators	Treat	Collaborate with EA on foreshore conditions and flood defence solutions through TE2100	Thames Estuary 2100 (TE2100) Asset replacement strategies
R8	Sea level rise restricting vessel routes with limited air draft.	Local Authorities Terminal operators GLA	Tolerate	Collaborate with the EA regarding the closure of flood defence barriers to regulate water levels and therefore available air draft. Monitoring of water levels and seabed levels.	Hydrographic surveys Trade/income budgets Thames Estuary 2100 (TE2100)
R9	Disruption to PLA river operations (surveying, pilotage, Richmond Lock and Weir) due to changing river flows and met-ocean conditions. Affects port efficiency/capacity.	Environment Agency (EA), e.g., Thames Barrier, Teddington Lock	Treat	Consider increase patrol requirements. Investigate incidents and agree actions in MS. Improve tide gauges coverage to minimise uncertainties - finding sites for the gauges	Consideration of autonomous vessels. Plan purchase of new pilot vessel for Gravesend. Project to replace tide gauges and met sensor due to commence in 2025.

#	Risk Description	3rd Party Collaboration	Risk Modification	Risk Controls/ Adaptation Action	Related PLA Plans, Strategies and Budgets
		Estuary Services Limited (ESL) Harwich Haven Authority (HHA) Thames Water		Investigate use of autonomous vessel technology afloat and aerial drones to undertake surveys Strive to ensure all vessels to be well maintained as per The Maritime and Coastguard Agency (MCA) coded vessels with certified crews (Chief Harbour Master (CHM))	PLA codes of practice & procedures.
R10	Exacerbated poor air quality and heat/UV exposure affects health, safety and wellbeing of PLA staff and river users, and also habitats.	Environment Agency (EA) Greater London Authority (GLA) Leisure groups Local Authorities Natural England	Treat	Continually improve the scope of these green incentives. Review working conditions in wheelhouse as part of the Occupational Hygienist review Facilitate remote working for extreme weather events where possible. Air Quality monitoring. Interventions to halt deterioration as per sites of special scientific interest (SSSI) management plan. Adoption of the Maritime Emission Portal to track and measure river-based emissions to identify the hot-spots and work with operators to reduce them.	London Climate Ready Partnership Codes of practice & procedures River user guidance Air Quality Strategy Biodiversity Net Gain Strategy and SSSI management plans.
R11	Increased change of habitat migration, damage, loss, or colonisation by invasive species due to changes in climate variables.	Environment Agency (EA) Local Authorities Natural England	Treat	Consider setting up environmental Fund to fund invasive species research projects. Monitoring programme allowing targeted and more regular monitoring of species and habitats on the Thames and PLA landholdings	Biodiversity Net Gain Strategy

#	Risk Description	3rd Party Collaboration	Risk Modification	Risk Controls/ Adaptation Action	Related PLA Plans, Strategies and Budgets
R12	Increased water temperature and decreased dissolved oxygen affecting the quality of the water and health of aquatic life and biodiversity.		Tolerate	As outlined in the Clean Thames Plan: Develop catchment plans to identify effective restoration opportunities. Investigate increasing biodiversity and restoring habitats on the Thames that lead to a positive impact on water quality. Map out opportunities to increase biodiversity in line with Net Gain requirements in the tidal Thames. Relaunching the London River Restoration Action Plan and developing an opportunity map. Building the Transforming the Thames – coastal habitat restoration plan with partners.	Clean Thames Plan Clean Thames Partnership Clean Thames Manifesto
R13	Increased numbers of and risk to recreational river users, especially swimmers, during drier, warmer summers.	Coast Guard Emergency Services Local Authorities National Governing Bodies for Sports Tidal Thames Water Safety Forum	Treat	Ebb flag warning system to help raise public awareness of the conditions of the river. Social media posting to warn public about climate related risks (particularly during warm summers).	Drowning Prevention Strategy Tidal Thames Water Safety Forum Foreshore permits Corporate Affairs external communication strategy.
R14	Chance of bank erosion, affecting the stability of flood defence river walls and reducing intertidal habitats.	Environment Agency (EA) Local Authorities Private landowners	Treat	Collaborate with EA to investigate foreshore changes and management. Continue the restoration of the West Thurrock marshes and other sites as natural flood defences. Monitor seabed changes with regular hydrographic surveys Contribute to the London Climate Resilience Review's action plan to set out financing and delivery options for raising sea defences, creating nature-based solutions and sacrificial zones before 2040.	Biodiversity Net Gain (BNG) Strategy Environment & Sustainability (E&S) Policy Thames Estuary 2100 (TE2100) Tidal Thames Masterplan

#	Risk Description	3rd Party Collaboration	Risk Modification	Risk Controls/ Adaptation Action	Related PLA Plans, Strategies and Budgets
				Conduct sea defence asset inspections with recommendations to changes noticed, in conjunction with the controls outlined for R7.	
R15	Increased the risk of ground movement/subsidence, shrinkage and heave of high plasticity soils exacerbated by projected increases in drought conditions and periods of prolonged heavy rainfall. Affecting river structures throughout.	PLA tenants Environnent Agency (EA) Local Authorities	Treat	Consider annual structural surveys and maintenance for ground-based navigation aids - to be identified with CE	
R16	Increase in water demand due to high temperature extremes, increasing operational costs.	ESL Fuel Suppliers	Tolerate	Monitor water consumption and weather temperature, observe corelation and impact. If significant changes investigate possible water reduction mechanisms. Investigate potential water losses and feasible repairs/upgrades for water efficiency.	Ensure annual deals with fuel suppliers (limited suppliers of HVO). "Net Zero River Plan (NZRP); Net Zero Action Plan (NZAP); Fuel efficiency tablets on vessels to reduce fuel consumption (Reygar system)
R17	Increased number of tree falls, impacting habitat, bank erosion and river users.	Local Authorities	Treat	Consideration for more regular inspection and monitoring patrols to maintain (and remove if required) tree fall risks or associated debris.	Thames Environment Fund Project Major Project would go through budget process for approval Foreshore permits
R18	Increased fuel and energy consumption (e.g. aircons or vessel fuel) due to higher temperatures or increased river currents from river floods. Indirect impact - increase in emissions.		Tolerate	Vessels to be MCA Coded - well maintained to ensure efficient engines (CHM). If possible, operations planned to coincide with tidal flows to minimise fuel use and running engines at reduced revs. Plan vessel movements to reduce repeat transits (Marine Services - MS).	
R19	Wider range of salinity of the water affecting the quality of the water and health of aquatic life.		Tolerate	Monitor salinity and aquatic life changes.	

Table 53 Risk assessment and 3rd party collaborators for (inter-)dependent risks to the PLA

#	Risk Description	3rd Party Collaboration	Related PLA Plans, Strategies and Budgets
I1	Increased risks of damage and disruption to energy supply to the PLA. Economic, safety or environmental functions compromised.	DNO Local Authorities UK Power Network	Net Zero River Plan - mapping current and future grid requirements Electric Thames project in collaboration with UKPN - investigation of boat to grid capacity building Hydrogen Highway - local hydrogen fuel cell offtake ZEVI/ZEPHR - local green hydrogen production
I2	Increased risks of damage and disruption to transport (passenger and freight) services to/from the PLA. Economic, safety or environmental functions compromised.	Department for Transport National Highways Network Rail Transport for London	DFT transport adaptation strategy - PLA focus in next CCAR reporting round. Destination Thames Tidal Thames Masterplan
I3	Climate change may increase the risk for pandemics like COVID-19. The encroachment of human settlements on natural habitats, as well as shifting patterns of species distribution due to changing climates will bring communities into closer contact with pathogens. Pandemics may disrupt port trade, passenger travel and global supply chains.	Department of Health and Social Care	
I4	Increased risks of damage and disruption to domestic and international maritime supply chains connecting with the Port of London. Economic functions compromised.	Thames Freeport Thames Estuary Growth Board UKMPG ad BPA Environment and Sustainability Policy Group Major Port Operators (e.g. DP World; Port of Tilbury).	Net Zero River Plan Tidal Thames Masterplan
I5	Increased risks of damage and disruption to digital/telecoms services supplying PLA. Economic, safety or environmental functions compromised.	Digital/Telecoms Services	

#	Risk Description	3rd Party Collaboration	Related PLA Plans, Strategies and Budgets
I6	Increased risks of damage and disruption to potable and wastewater services to/from the PLA. Safety or environmental functions compromised.	Thames Water	Clean Thames Manifesto Thames Tideway Tunnel Project Teddington Direct River Abstraction Project River Thames Scheme
I7	Increased risks of disruption to people who are required to operate the PLA. Economic, safety or environmental functions compromised.	Broader stakeholder group London River Users	HR strategy and policy.