Ministry of Defence

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[redacted]

[redacted]

27 June 2022

Ref: EIR 2022/05347

Dear [redacted]

Thank you for your email of 29 April 2022 requesting the following information:

> *"MOD minister Jeremy Quinn said that HM Naval Base Devonport has an extant Climate Infrastructure Risk Assessment that has modelled the potential impact of climate change on sea defences and site infrastructure. Under the Freedom of Information Act 2000 and/or Environmental Information Regulations 2004, please provide me with a full copy of the Climate Infrastructure Risk Assessment document referenced in this answer"*

I am treating your correspondence as a request for information under the Environmental Information Regulations 2004.

A search for the information has now been completed within the Ministry of Defence (MOD) and I can confirm that all the information in scope of your request is held and can be found at attached at Annex A.

The MOD is withholding some information under Regulation 12(5)(a) of the EIR.

Regulation 12(5)(a) states that a public authority may refuse to disclose information to the extent that its disclosure would adversely affect - (a) international relations, defence, national security or public safety.

If you have any queries regarding the content of this letter, please contact this office in the first instance.

If you wish to complain about the handling of your request, or the content of this response, you can request an independent internal review by contacting the Information Rights Compliance team, Ground Floor, MOD Main Building, Whitehall, SW1A 2HB (e-mail CIO-FOI-IR@mod.uk). Please note that any request for an internal review should be made in writing within 40 working days of the date of this response.

If you remain dissatisfied following an internal review, you may raise your complaint directly to the Information Commissioner under the provisions of Regulation 11 under the Environmental Information Regulations. Please note that the Information Commissioner will not normally investigate your case until the MOD internal review process has been completed. The Information Commissioner can be contacted at: Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF. Further details of the role and powers of the Information Commissioner can be found on the Commissioner's website at https://ico.org.uk/.

Yours sincerely,

DIO Secretariat

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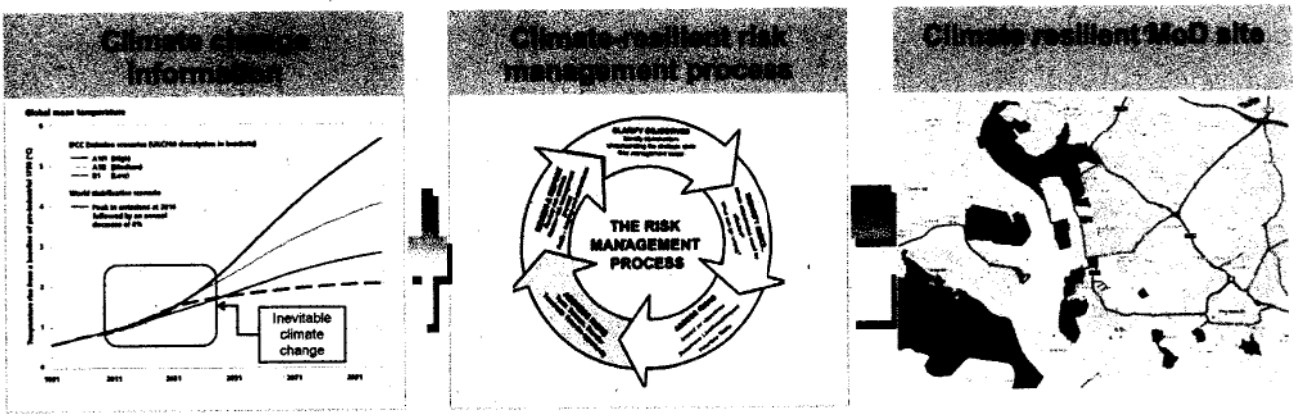
Ministry of Defence

Climate Impact Risk Assessment

Appendix 7A. Estate and Climatic Information Report
HMNB Devonport
DPDY



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Contents:

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Executive Summary

[Summary of key risks to the establishment to be inserted after workshop]

1 Introduction

1.1 Scope of CIRAM assessment at HMNB Devonport [1]

Climate change is a global issue, but its impacts are felt locally and are affected by physical, social and economic factors specific to a given area.

The UK National Security Strategy (NSS) 2010 A Strong Britain in an Age of Uncertainty highlights natural hazards such as floods as one of the national security priorities (Tier 1 risks), together with terrorism, cyber-attack and international military crises. The NSS emphasises the need to predict, prevent and build resilience to these risks and remain adaptable for the future.

Climate change has been identified as a risk multiplier likely to exacerbate existing vulnerabilities to natural hazards.

The Climate Impact Risk Assessment Methodology (CIRAM) aims to support the NSS and other Government commitments in climate resilience, by identifying the impact of climate change on the operational functionality of MOD sites. It also aims to identify any management mitigation measures needed to maintain operational capability and reputation of the site, whilst achieving better value for money, minimising maintenance costs and avoiding damage costs arising from climatic events.

This document summarises some of the current and future climate related findings for HMNB Devonport and the surrounding area and will help inform the CIRAM workshop.

1.2 Critical Operational Functions [2]

Site Overview
The Devonport site is a strategic Defence asset, being an Operating and Support Base for the Royal Navy and elements of the Royal Marines, delivering and enabling direct and indirect support services for the Naval Service. Comprising HMS DRAKE, significant industrial facilities and a range of military and non-military lodger units of which, Defence Equipment & Support, Submarine Delivery Agency, Flag Officer Sea Training, Commander Devonport Flotilla and Captain Submarine Flotilla (South) are the most substantial. It is supported by several key Industry Partners (IP's) including Babcock, Mitie and Serco. The Devonport site is characterised as a Base, Barracks, Port and Dockyard.

Base
The Naval Base provides waterfront support and services to ships of the Devonport Flotilla, ships undergoing Operational Sea Training (including many foreign navies) and ships and submarines entering or emerging from deep maintenance periods. It includes the provision of stores, administrative support, oversight of the Fleet Accommodation Centre, as well as all aspects of MOD on-site security, nuclear and non-nuclear infrastructure.

Barracks
HMS DRAKE provides facilities for 3000 service personnel and Single Living Accommodation for 1800, through the ARMADA PFI contract. It is, however, more than a barracks. HMS DRAKE is a self-contained service village providing: accommodation and catering facilities; a retail shopping outlet; medical, dental and welfare support; sport and recreation facilities including Adventurous Training; a library, education and resettlement centre, a learning and Development centre; and it facilitates a large and diverse range of hobbyist clubs.

[redacted]

Port

The Port of Plymouth covers an expanse of water in excess of 30 square miles and includes all of the waterways from the Tamar Estuaries, the Hamoaze, into Plymouth Sound and beyond the Breakwater out to Rame Head, encompassing 90 miles of coastline. The Naval Base has a waterfront extending over three miles with fourteen wharfs and jetties and is capable of berthing all classes of ships and submarines of the Royal Navy. The Queen's Harbour Master controls the port and manages in excess of 4,000 ship and submarine movements and in the region of 40,000 tug operations each year, enabled by Serco who provide a full range of vessels for pilotage, the on and off-load of stores and equipment, personnel transfers, ammunition and fuelling.

Dockyard

The Dockyard, large elements of which are owned by Babcock following the sale of the Dockyard in 1997, represents a UK strategic asset and are critical to the Devonport site outputs in Devonport's roles as a Centre of Deep Maintenance for surface ships, submarines and amphibious units (including landing craft) alongside significant Fleet Time Engineering Support capability. [redacted]

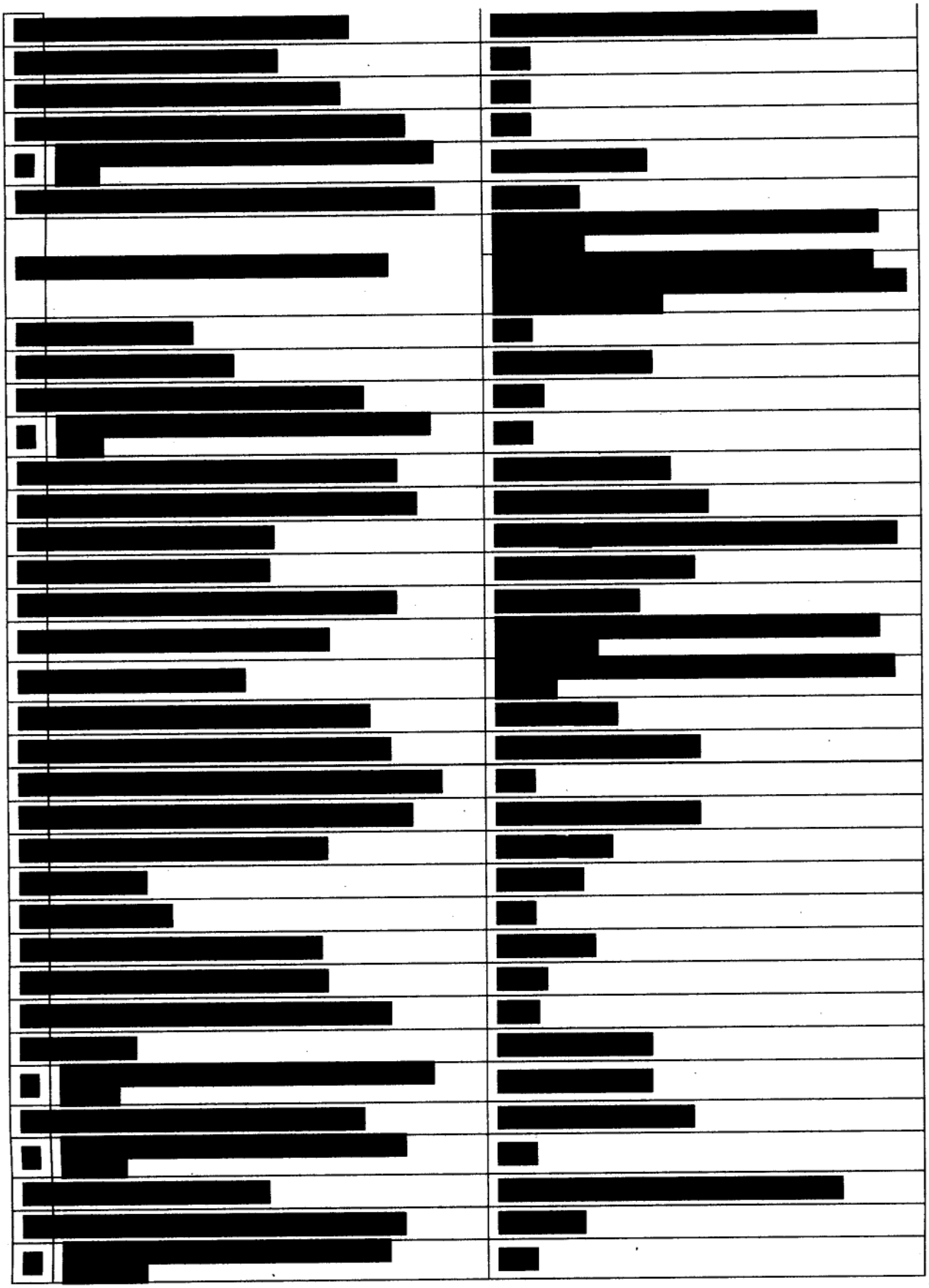
1.2.1 Contractors, lodger units and sister sites integral to delivering defence objective

The main contractors on the Devonport site are:

- Babcock Marine; who own parts of North Yard and operate the Licenced Site
- Mitie; who are the facilities management company for HMS Drake under the ARMADA PFI contract.
- SERCO; who provide on water services
- ESS; who are subcontracted through Mitie and provide soft FM and catering services in HMS Drake.

[redacted]

[redacted]



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2 Site Information

2.1 Site Location [2]

HMNB Devonport is the largest naval base in Western Europe. It covers more than 650 acres and has 15 dry docks, four miles of waterfront, 25 tidal berths and five basins. The site is situated to the west of Plymouth on reclaimed land on eastern banks of the tidal River Tamar

Figure 1: Image of HMNB Devonport
Source: Site POC

Outstations are located at Fort Staddon, Fort Bovisand, Oreston, Wembury and Torpoint.

[redacted]

Figure 2: Map of HMNB Devonport
Source: Site POC

2.2 Site Layout

As outlined in section 1.2, HMNB is characterised as Base, Barracks, Port and Dockyard.

2.3 Environmental Setting

2.3.1 Geology [3, 4]

Bedrock Geology: The majority of the site is underlain by 2 different types of bedrock - Saltash formation bedrock of slate and siltstone; and Torpoint formation of mudstone and siltstone. These are typical of an environment previously dominated by open seas with pelagite deposits. Towards the South Yard there is a small seam of Middle Devonian Limestone, typical of a local environment previously dominated by shallow carbonate seas.

Superficial Geology: The majority of the site has no superficial geology recorded. Along some of the inlets and basins from the River Tamar there is tidal river or creek deposits of clay and silt. This is typical of an area previously dominated by shorelines.

The site has large expanses of made ground due to infilling and reclaiming land, using imported material and dredging.

2.3.2 Hydrogeology [5]

The bedrock under Plymouth is designated a Secondary A aquifer with minor areas around the South Yard and extending east being classed as a Principal aquifer. Principal aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer. Secondary aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The groundwater vulnerability map for England shows the majority of the area to be at high vulnerability with land along the shoreline of the Tamar of medium vulnerability. The land under the

[redacted]

tributaries of the river Tamar is classed as at Medium-High vulnerability. These maps show the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within each square kilometre.

The soilscape for England classes the majority of the Devonport site as freely draining slightly acid loamy soils. The area at South Yard is classed a freely draining slightly acid but base-rich soils.

2.3.3 Hydrology [4, 6]

The main watercourse is the River Tamar which forms the border between Devon and Cornwall. The river's source is less than 6km from the North Cornwall coast, but it flows southwards where it flows into the Hamoaze (an estuarine section of the tidal Tamar) before entering the Plymouth Sound.

Surface water run-off from the site is likely to flow into the nearest dockyard basin or the River Tamar.

The nearest weather recording station is at Mount Batten. This records on average 1007.4mm of rainfall per annum which is slightly less than the average for south-west England and south Wales of 1263.4. Plymouth sees on average of 142.1 days where rainfall is ≥1mm which is less than the regional average of 154.8 days. Figure 3 shows the annual rainfall for the South West based on the average from 1971-2000.

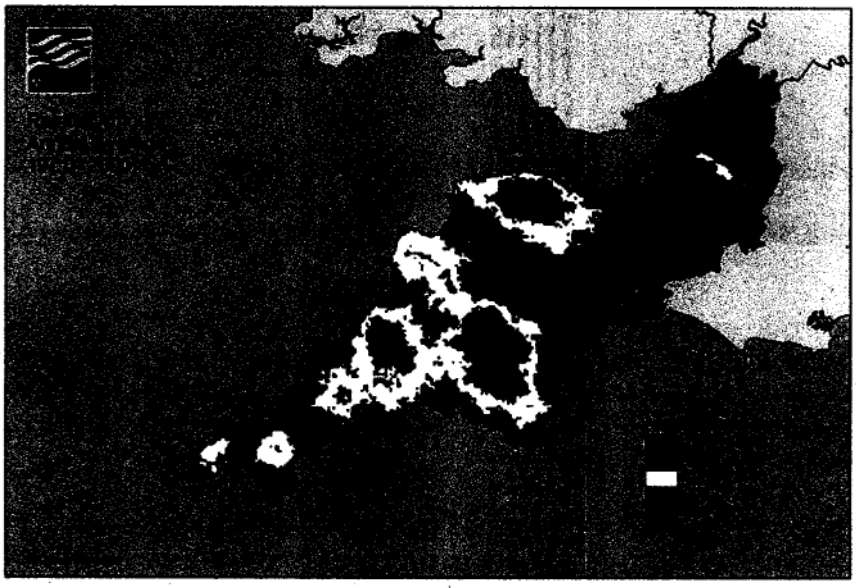

Figure 3: Average annual rainfall for the South West
Source: Met Office

2.3.4 Geological Hazards [7]

The British Geological Survey (BGS) GeoSure 5 km hex grid datasets provide a generalised overview of the susceptibility to six naturally occurring geohazards in Great Britain. Each hexagon in the maps covers an area of approximately 65km^2 and classifies the susceptibility to each hazard as either low, moderate or significant. A description of each hazard and the classification for the HMNB Plymouth area can be found in Table 3.

[redacted]

Category	Level of Susceptibility
Collapsible Deposits - the potential for a geological deposit to collapse (to subside rapidly) as a consequence of a metastable microfabric in loessic material. Such metastable material is prone to collapse when it is loaded (as by construction of a building, for example) and then saturated by water (as by rising groundwater, for example). Collapse may cause damage to overlying property.	Low
Compressible Ground - the potential for a geological deposit to compress under an applied load, a characteristic usually of superficial deposits such as peat or alluvium. Some types of ground may contain layers of very soft materials like clay or peat. These may compress if loaded by overlying structures, or if the groundwater level changes, potentially resulting in depression of the ground and disturbance of foundations.	Low
Landslides - an assessment of slope instability and landslides. Landslide hazard occurs due to particular slope characteristics (such as geology, gradient, sources of water, drainage, man-made constructions) combining to cause the slope to become unstable. Downslope movement of materials, such as a landslide or rockfall may lead to a loss of support and damage to buildings.	Moderate
Running Sand - the potential for a geological deposit to show running sand behaviour under the action of flowing water, a characteristic usually of saturated sand and silt grade material. Such sands can 'run', removing support from overlying buildings and causing potential damage.	Low
Shrink-Swell - the potential for a geological deposit to shrink and swell. Many soils contain clay minerals that absorb water when wet (making them swell) and lose water as they dry (making them shrink). This shrink-swell behaviour is controlled by the type and amount of clay in the soil, and by seasonal changes in the soil moisture content (related to rainfall and local drainage).	Low
Soluble Rocks – the potential for dissolution of soluble rocks. Ground dissolution occurs when certain types of rock contain layers of material that may dissolve if they get wet. This can cause underground cavities to develop. Engineering problems associated with this include subsidence, sinkhole formation, uneven rock-head and reduced rock-mass strength.	Low

Table 3: Geological Hazards
Source: British Geological Survey Geosure Natural Hazards Maps

2.3.5 Ecology [8, 9, 10, 11, 12, 13]

The Plymouth Sound and Estuaries is classed as a Special Area of Conservation (SAC). This designation covers 6386 hectares of marine areas, tidal inlets, tidal rivers, estuaries, mud flats, sand flat, lagoons and salt marshes. The primary reasons for the selection of this site as a SAC are:

- Extensive areas of sublittoral sandbanks
- One of the best examples of estuary habitats in the UK
- Large shallow inlets and bays which has a high diversity of habitats and communities
- Atlantic salt meadows
- Intertidal and subtidal reefs in Plymouth Sound
- One of the chief rocky shore strongholds for shore dock *Rumex rupestris*

The main threats to the SAC are urbanisation, industrial and similar activities; pollution to groundwater; human induced changes in hydraulic conditions; outdoor sports and leisure activities, recreational activities; and changes in abiotic conditions

Tamar Estuaries Complex Special Protection Area (SPA) is an area of extensive intertidal mudflat communities and saltmarsh communities found at St John's Lake to the south of Torpoint, the Lynher River Estuary and the Tamar-Tavy estuary north of the Tamar Bridge. These habitats provide important feeding and roosting areas for over wintering avocet and little egret. The mudflats support high densities and variety of invertebrates, a vital food source for birds.

[redacted]

Within the Tamar Estuaries SPA there is also

- St. John's Lake Site of Special Scientific Interest (SSSI). This is 266-hectare area forms part of the Tamar-Lynher estuarine system. At last survey the condition of this SSSI was classed as 94.73% unfavourable-declining and 5.27% favourable.
- The Tamar-Tavy Estuary SSSI has a southern border just north of the Tamar Bridge. This is a 1413 hectare area is of international important for nature conservation, in particular as a wintering site for wildfowl and waders. At last survey this SSSI was classed as 96.97% favourable condition.
- Lynher Estuary SSSI which is 672.63 hectares and contains fairly extensive saltmarsh and highly productive mudflats. At the time of last survey this SSSI was classed as 94.82% favourable condition.

The upper reaches of the Tamar and the Lynher are also designated under the Tamar Estuary Marine Conservation Zone (MCZ). These areas provide sheltered habitats of varying salinity levels and tidal exposures. This is a diverse marine environment which supports a number of features of ecological importance.

2.3.6 Forestry [5]

As the site is based in the urban city of Plymouth there are no significant areas of woodland. At Bull Point there is a small 0.15-hectare area of deciduous woodland, as classified under the national forest inventory 2014.

2.3.7 Archaeology and Historic Environment [5]

There are a number of scheduled monuments within or neighbouring the establishment boundary. These include but are not limited to:

- Bullpoint gunpowder magazines and camber
- Slip No 1 (The Covered Slip), South Yard, Devonport Dockyard
- The West Ropery (site of), South Yard, Devonport Dockyard
- Civil War fieldworks at Inswork Point

There is a significant amount of grade I, II and II* listed buildings across the HMNB Devonport site. Examples include the entrance gates to Bull Point, ammunition store at Bull Point, HMS Drake wardroom, officers' quarters and mess, No.'s 1-4 docks at South Yard and the swing bridge also at South Yard.

2.3.8 Access & Recreation [14]

Access to the site is restricted. There are no public footpaths or rights of way within the establishment or neighbouring the establishment boundary.

Devonport Heritage Trail, promoted by Plymouth City Council, is a self-guided walking tour that takes in some of the historic sites at the south of the establishment neighbouring Morice Yard and South Yard.

3 Brief Summary of Potential Climate Change Risks

This section outlines any identified climate change risks using current available data.

3.1 Devon Weather Impacts Assessment [15]

In 2010, Devon County Council (DCC) published a report into the impacts of weather on the county. For this report, a search was conducted in journalistic sources to explore the impacts of weather on Devon which revealed 141 reported weather impacts between January 2000 and September 2009, a breakdown of which can be seen in figure 4. Surface flooding was the most frequently reported weather impact in the county with a higher concentration of these occurring in the South and East.

[redacted]

Autumn is the most active season for all types of flood event in Devon whilst spring is the quietest season.

In the report Plymouth was highlighted as experiencing some of the highest gusts over the period being examined of 84 knots. The maximum hourly mean windspeed was 60 knots at Plymouth which caused widespread damage to buildings and overturned vehicles.

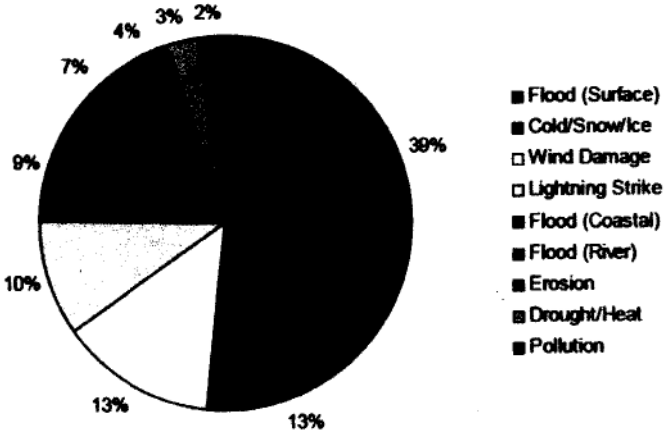

Figure 4: Percentage spread of weather impacts reported in the Weather Impacts Assessment
Source: Weather Impacts Assessment, Devon County Council

It is estimated that the February 2009 snowfall and extended cold period cost DCC £11 million more than a normal winter in road maintenance requirements and the clean-up bill for the November 2009 floods topped £1 million.

3.2 Plymouth Climate Emergency Action Plan [16]

On 18th March 2019, Plymouth City Council declared a climate emergency and pledged to make Plymouth carbon neutral by 2030. The Climate Emergency Action Plan was published December 2019 and sets out how the city plans to achieve this target.

The action plan highlights that due to climate change the city can expect to experience rising sea levels and heavier rain storms. Wider impacts include increased flooding, more heatwaves, loss of polar ice sheets, more droughts, species loss and loss of coral reefs.

3.3 Devon, Cornwall & Isles of Scilly Local Resilience Forum [17]

The Local Resilience Forum has a duty under the Civil Contingencies Act (2004) to produce a Community Risk Register. This document highlights risks that have the highest likelihood and potential to have significant impact to local communities resulting in wide scale disruption.

The top risks in the community risk register that can be impacted by climatic changes are:

- Failure of the electricity network – can be caused by a number of things including severe weather (strong winds, flooding and lightning)
- Flooding – changes in weather patterns, increasing temperatures and rising sea levels are likely to increase the likelihood of flooding
- Major air quality incident – short-term surges in poor air quality occur primarily due to weather conditions preventing pollution from dispersing i.e. low winds, or when warm air traps colder air close to the ground
- Prolonged low temperatures, heavy snow and/or ice

[redacted]

4 Flood Risk [18, 19, 20, 21. 22, 23, 24]

All the UK regions have already experienced an increase over the past 45 years in the contribution to winter rainfall from heavy precipitation events. Heavy precipitation events are projected to increase across the UK in both winter and summer, leading to an increase in fluvial and surface water flooding.

Flooding has been identified by the UK CCRA 2017 and Cabinet Office (CO) as one of the highest priority risks for the UK, with the government making substantial investments in increasing resilience in this area. One particular area of focus is to invest in natural management measures, sustainable urban drainage, and property-level resilience measures.

HMNB Devonport, and the city of Plymouth falls within the Tamar Catchment which covers 1,800 square kilometres extending 22km inland to Gunnislake. There is a recorded history of flooding within the Tamar catchment which dates back to the 19th Century. This is from a range of sources: rivers, the estuaries, surface water run-off and sewer systems. The estuaries contribute to flood risk in the Tamar catchment, making flooding from the rivers worse when high tides coincide with high rainfall. There are over 90km of flood defences in the catchment providing various levels of protection.

Currently, there are over 2,750 properties across this catchment at potential risk of flooding from rivers and the tide (excluding those behind defences) with the greatest concentration of properties at risk in Plymouth with 1,600 at risk of flooding within the fluvial 1% (and tidal 0.5%) annual probability. Also at risk are the police station at Tavistock, the A30 and A374, the mainline railway in at least 3 locations, two schools, a nursery and a health centre. There are also 7 electricity substations, 14 locations on other local railway lines, 17 A-roads and 1 water treatment works at risk.

In the future, the CFMP expects flood extents to increase slightly but this is limited in most places by the topography of the catchment. However, flood depths are likely to increase. This means that more people and property will be affected more frequently by flooding in the future. Plymouth is expected to see the greatest flood risk in the future with the number of properties at risk expected to increase to 2,800 by 2100 as a result of the impacts of climate change and proposed development planned within the catchment.

The flood risk maps in the following sections are provided by the Flood Warning Information Service and consider the effect of any flood defences in the area. These defences reduce but do not completely stop the chance of flooding as they can be overtopped or fail. The different levels of risk are categorized as follows:

- • High Risk - each year this area has a chance of flooding of greater than 3.3%.
- • Medium Risk - each year this area has a chance of flooding of between 1% and 3.3%.
- • Low Risk - each year this area has a chance of flooding of between 0.1% and 1%.
- • Very Low - each year this area has a chance of flooding of less than 0.1%.

It should be noted that none of the Flood Warning Information Service maps take climate change into consideration, and instead show existing flood risk. They additionally do not consider the impact of both river and surface water flooding together. All information, particularly the likelihood of surface water flooding, is a general indicator of an area's flood risk. As such it is not suitable for identifying whether an individual property will flood. This service uses computer models to assess an area's long-term flood risk from rivers, the sea, surface water and some groundwater. It does not include flood risk from sources such as blocked drains and burst pipes.

4.1 Flood Risk from Rivers and Seas (Fluvial)

Rivers flood when the amount of water in them exceeds the flow capacity of the river channel. Most rivers have a natural floodplain into which the water spills in times of flood. Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm and this is forecast to become increasing likely with climate change.

[redacted]

The city of Plymouth is bounded on 2 sides by water, Plymouth Sound and the River Tamar, and had 60km of coastline. In addition, the River Plym runs through the edge of the city. Tidal flooding affects residential and commercial property, key strategic transport links and critical infrastructure. Areas that have the greatest risk of tidal flooding are Barbican (Sutton Harbour), Marsh Mills and Stonehouse. The city has a total of 137km of watercourses, many of which are located in steep topography and therefore respond rapidly to rainfall often resulting in flash flooding.

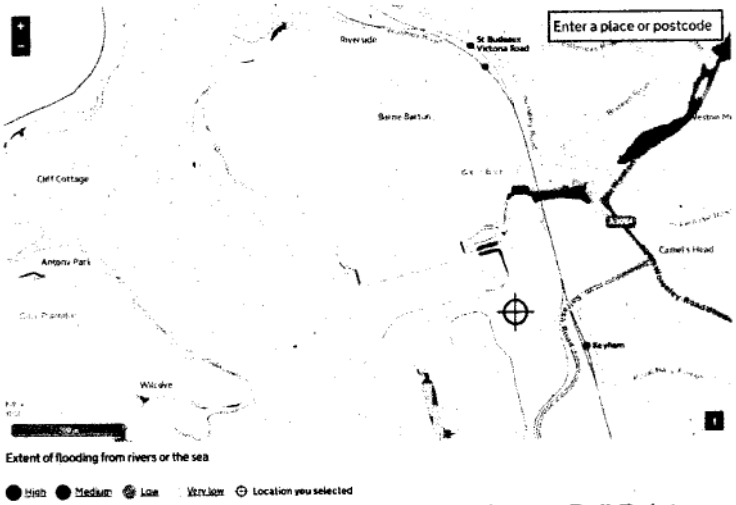

Figure 5: Extent of flooding from rivers and seas, Bull Point area
Source: Flood warning information service

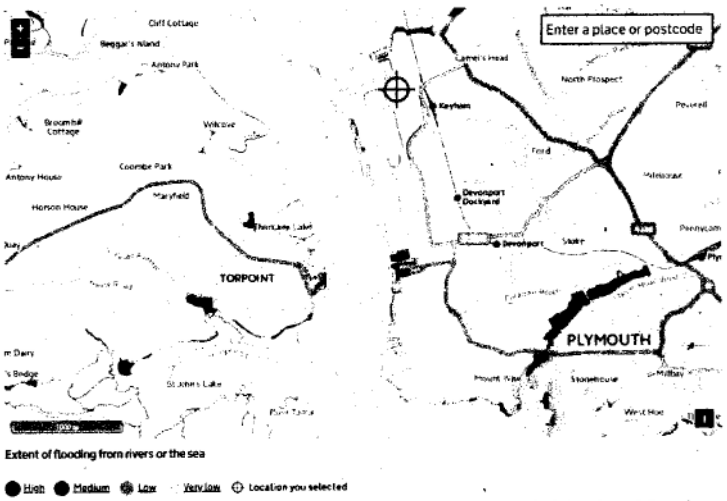

Figure 6: Extent of flooding from rivers and seas, North Yard, Morice Yard and South Yard
Source: Flood warning information service

There is limited extent of low risk flooding along the shoreline at Bull Point. Further south, fluvial flood risk is apparent at some of the basins and docks, particularly at the Torpoint ferry slipway at Tamar Wharf. At Morice Town the flood risk is more extensive but does not reach past the first line of buildings. There is some risk to the road network in the wider area, particularly the A374 due to flooding from Stonehouse Pool along the line of the old Stonehouse Creek. The Torpoint Ferry slipway has also been identified as a key area at risk of flooding from wave overtopping.

4.2 Flood Risk from Surface Water (Pluvial)

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas, this floodwater can

[redacted]

be polluted with domestic sewage. Local topography and built form can have a strong influence on the direction and depth of flow.

Plymouth is mainly urban with large impermeable areas which, combined with steep-sided catchments, leads to high rates and volumes of surface water run- off. This causes watercourse and drainage systems within the catchment to respond rapidly to rainfall events leading to the hydraulic overloading of the sewerage and drainage systems.

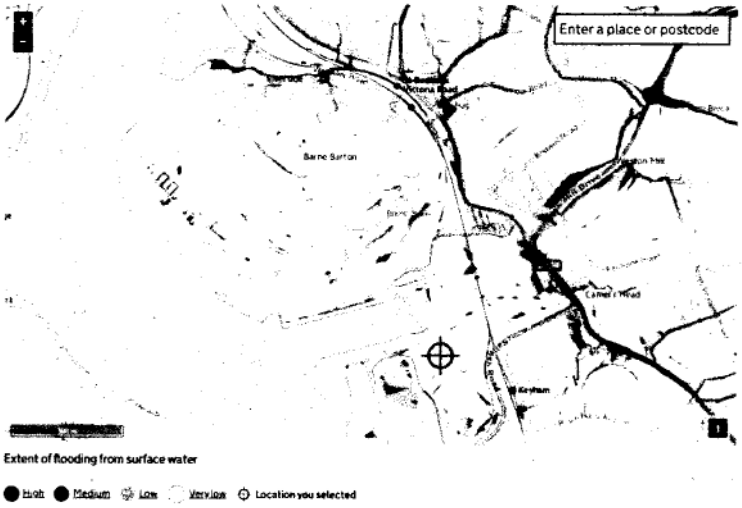

Figure 7: Flood risk from surface water, Bull Point area
Source: Flood Warning Information Service

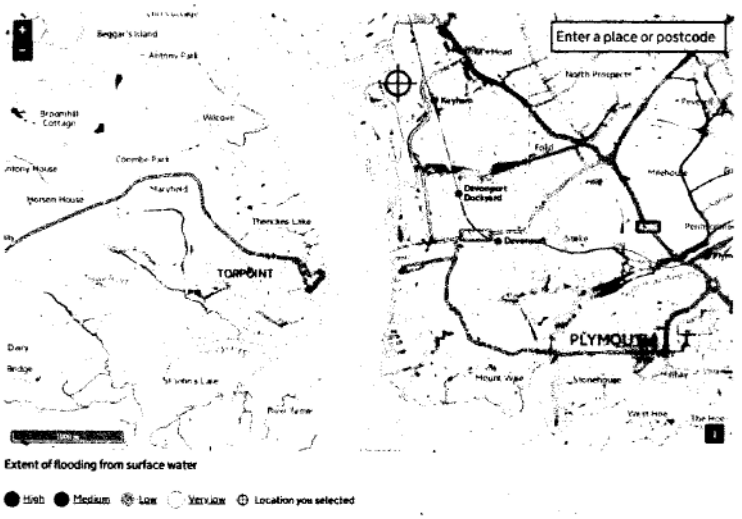

Figure 8: Flood risk from surface water, North Yard, Morice Yard and South Yard areas
Source: Flood Warning Information Service

Figures 7 and 8 show the flood risk from surface water flooding for the area of HMNB Devonport. The northern area around Bull Point has very little surface water flood risk but where it does occur, it is around the edges of buildings so may result in ingress. Further south, the area around the basins and docks it at risk of surface water flooding as well as some of the major access roads such as Saltash Road and the A3064 Wolseley Road. Again, Morice Yard and South Yard are likely to experience surface water flooding around the perimeter of buildings which may cause issues.

[redacted]

4.3 Flood Risk from Reservoirs

Non-natural or artificial sources of flooding can include reservoirs, canals and, lakes where water is retained above natural ground level. Reservoir or canal flooding may occur either as a result of the facility being overwhelmed or as a result of dam or bank failure. This can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage.

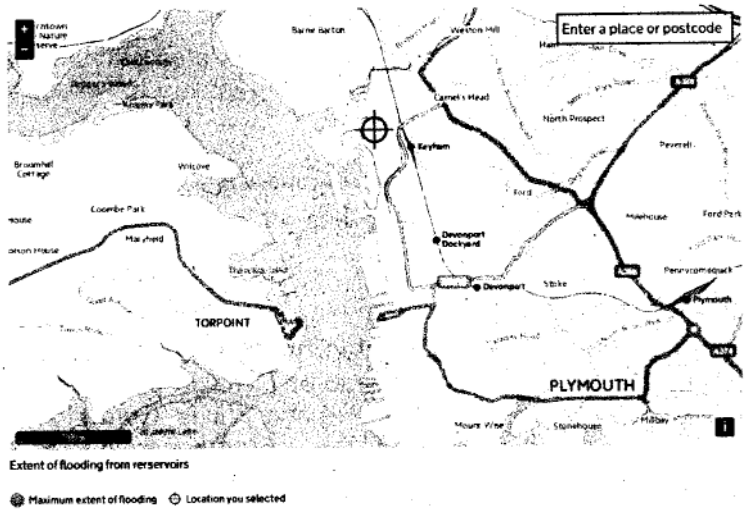

Figure 9: Extent of flooding from reservoirs
Source: Flood Warning Information Service

The River Tamar will receive the flood water in case of a reservoir breach or failure. This could lead to some flooding around the shoreline, particularly at the basins and docks along the eastern shore.

4.4 Flood Risk from Groundwater

Groundwater flooding occurs when water levels in the ground rise above surface elevations. It is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Groundwater flooding may take weeks or months to dissipate because it moves much more slowly than surface water and will take time to flow away.

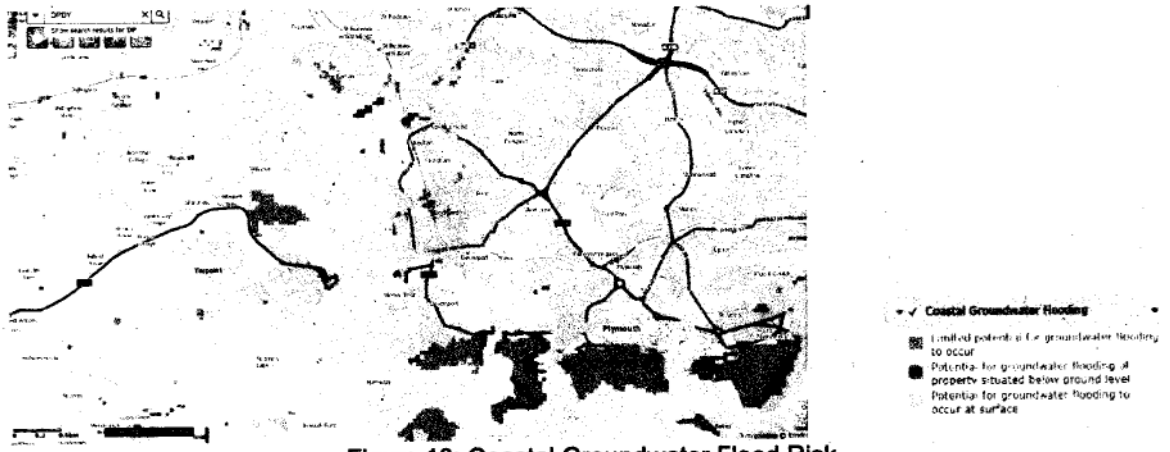

Figure 10: Coastal Groundwater Flood Risk
Source: DIO Environment and Planning Portal

Figure 10 shows the areas susceptible to coastal groundwater flooding. There are small areas within the establishment boundary where there is potential for groundwater to occur at the surface (blue) including around North Yard, Morice Yard and South Yard.

[redacted]

4.5 Coastal Erosion

The area of Devonport is covered under policy unit 6c31 – Tamar Estuary East Bank of the Shoreline Management Plan for South Devon and Dorset. This is an extensively defended and developed shoreline of the city of Plymouth. The long-term plan for this area is to continue to 'Hold the Line' of existing defences over the next 100 years. This may require defences to be improved or rebuilt to a higher standard, as sea levels rise, in order to continue to provide an adequate level of protection.

The defences and other structures along this section are associated with the development of the port and naval dockyard at Plymouth, which has also seen the estuary heavily modified in this area by dredging activity.

The effect of rising sea levels, particularly on the part of this section north of the Tamar bridge, would be likely to result in the further loss of inter-tidal areas as they are restricted from adapting by the ongoing presence of defences at Plymouth.

5 Water Resources [18, 19, 25, 26, 27, 28]

Environment Agency, Cabinet Office and UK Climate Change Risk Assessment 2017 have identified that UK water resources are already under pressure. Reliable supplies of additional water for abstraction are not available across much of England and Wales. Current water resource planning framework is likely to maintain water supplies by the 2020s, however the Committee on Climate Change Evidence Report 2017 estimates that by the 2050s, many catchments across the UK will need to manage water deficits and competing demands for water for public supply, industry, agriculture and the environment. The government is committed to reforming the current water abstraction system by the early 2020s in order to create a more flexible approach and manage these pressures.

Climate change together with population growth will increase existing pressures on water availability. Climate change is likely to alter the water cycle significantly as the amount and distribution of rainfall changes. Short duration droughts (12-18 months) are likely to become more frequent despite the increased resilience of public water supply and more winter storage.

Although the availability of water for abstraction varies through the year, the balance between available resource and demand for abstraction is of greatest significance during the summer. This is already a particular problem in the East and South East of England where water resource availability compares to that of drier countries like Spain and Italy, see Figure 11.

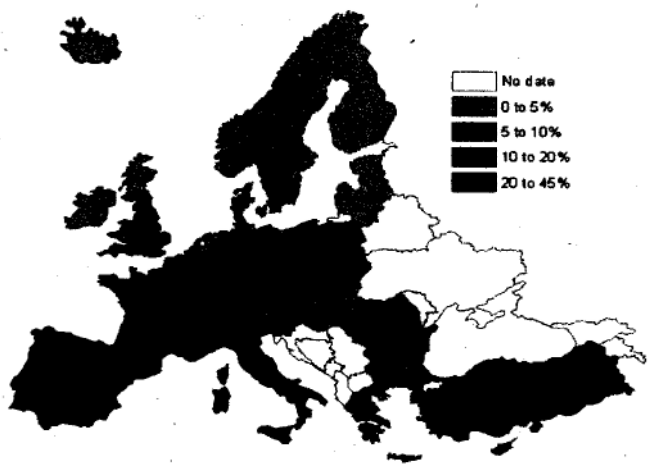

Figure 11: Water exploitation index (actual abstraction as a proportion of effective rainfall).
Source: European Environment Agency Water Exploitation Index

[redacted]

In the Climate Change Risk Assessment for the Water Sector (2012) each of the water authorities were scored for their stress to water resources. These stresses were calculated for the current water resources and for 4 different future scenarios. They were also given an overall stress rating.

HMNB Devonport is supplied with mains water and sewerage from South West Water. In the CCRA 2012 analysis this water company was classed as under moderate stress for current and all future scenarios with an overall classification of not serious.

The Water Resources Management Plan for South West Water was published in 2019 and looks at how the company are going to balance demand and supply over the next 25 years, taking into account population growth, housing developments, changing patterns of consumption and limitations on supply from factors such as environmental sensitivity and climate change.

South West Water carried out a climate change vulnerability assessment on future water supply. All 4 water resource zones (WRZ) in the supply area were classed as low vulnerability to the impacts of climate change. The impact of climate change on deployable output from groundwater was also considered to be insignificant. By the 2080s, it is expected that in the Roadford WRZ (which includes Plymouth) the Water Available for Use (WAFU) will reduce by 8.9%. It is predicted that climate change will only increase household demand by 0.99% in 2040 relative to 2012.

6 Wildfire Risk [18, 19, 28, 30]

Wildfires have been added to the National Risk Assessment and National Risk Register as a high priority risk for the UK. Cabinet Office (CO) and CCRA 2012 analysis identify that although wildfires are usually started by human activity hot, dry and windy weather conditions have a significant influence on the incidence for wildfires to start and/or spread. The Committee on Climate Change CCRA Evidence Report 2017 set out that this is still a key risk to the UK and that the government should continue to build resilience of ecosystems to drought, flood and fire, and continue current efforts to manage and respond to wildfires.

Existing data on wildfire indicates that fire season in the UK normally occurs between March – May and July – September. Data also indicates that in years where there has been a significant drought (1995, 2003 and 2006) the number of wildfires increased significantly.

Present risk is particularly high in heath, moorland and forests as grass, gorse and heather are prone to wildfires. Research undertaken by Manchester University suggests that a 1°C temperature increase in summer average temperatures will lead to a 17-28% increase in the number of outdoor fires in England and Wales and a 2°C increase will result in a 34-56% increase.

The 2012 CCRA analysis used the established McArthur Forest Fire Danger Index (FFDI), which looks at how the conditions that have the potential to lead to a wildfire might change. The outputs of the analysis indicate that the FFDI will increase across the whole of the UK by the 2080s, with the largest increase (over 40%) in the south east of England and extending into south Wales, and the smallest increase along the north coast of Scotland (Figure 12).

[redacted]

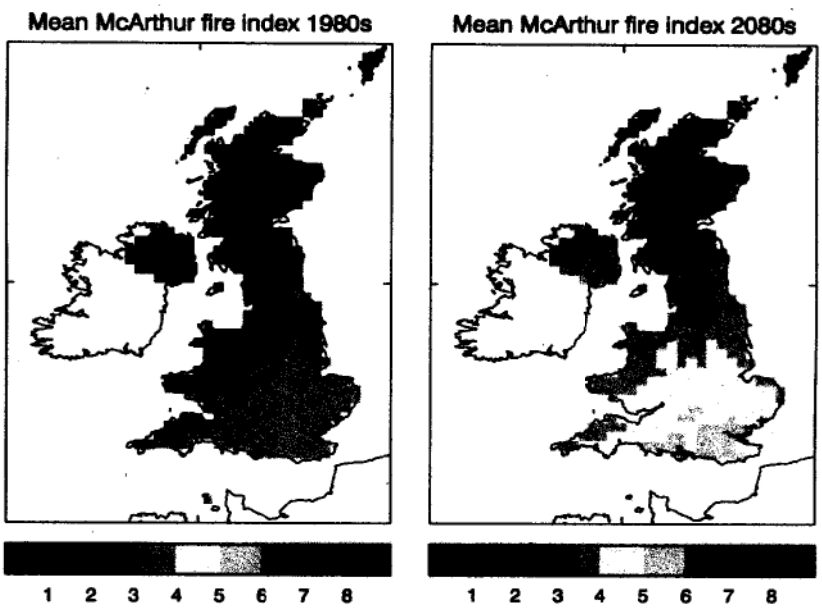

Figure 12: McArthur Forest Fire Danger Index for UK using UKCP09; 1 = fire will not burn; 5 to 12 = 'Moderate' risk.
Source: Met Office for the CCRA 2012

The McArthur FFDI in figure 12 shows that the area around Plymouth is expected to increase from a score of 2-3 to a score of 4-5 by the 2080s. Whilst this only just puts the area in the Moderate Risk score for wildfire, prolonged hot and dry weather coupled with driving winds could have a significant impact on the spread of any wildfire if it were to take hold.

[redacted]

7 Summary of Historic and Projected Climatic Information [31]

UK Climate Projections (UKCP18)

The MOD methodology for assessing climatic risks uses the UK Climate Projections (UKCP18) to inform the assessment. UKCP18 provides climate information designed to help those needing to plan how they will adapt to a changing climate. These projections are based on a methodology designed by the Met Office.

MOD has agreed to use UKCP18 high emissions scenario (representative concentration pathway RCP8.5). Unless otherwise stated the scenarios described below relate to the **projected changes by 2050s** relative to the 1961 – 1990 baseline.

7.1 Temperature

[redacted]	*Annual change:*	*Summer:*	*Winter:*
	+1.37°C	+1.41°C	+1.72°C

[redacted]	*10th Percentile*	*90th Percentile*
	+0.96°C	+4.53°C
	10th Percentile	*90th Percentile*
	+0.97°C	+5.35°C
	10th Percentile	*90th Percentile*
	+0.59°C	+3.39°C
	10th Percentile	*90th Percentile*
	+0.58°C	+3.62°C

7.2 Precipitation

[redacted]	Annual change:	Summer:	Winter:
	+9.7%	-8.8%	+15.9%

[redacted]	10th Percentile	90th Percentile
	-55.40%	+2.59%
	10th Percentile	90th Percentile
	-3.55%	+31.87%

7.3 Humidity

[redacted]	10th Percentile	90th Percentile
	+0.5%	+22.7%
	10th Percentile	90th Percentile
	+1.9%	+24.2%

[redacted]

7.4 Cloud Cover

[redacted]	10th Percentile	90th Percentile
	-25.8%	+1.0%
	10th Percentile	90th Percentile
	-1.7%	+3.7%

7.5 Sea Level Rise

[redacted]	10th Percentile	90th Percentile
	0.233m	0.380m

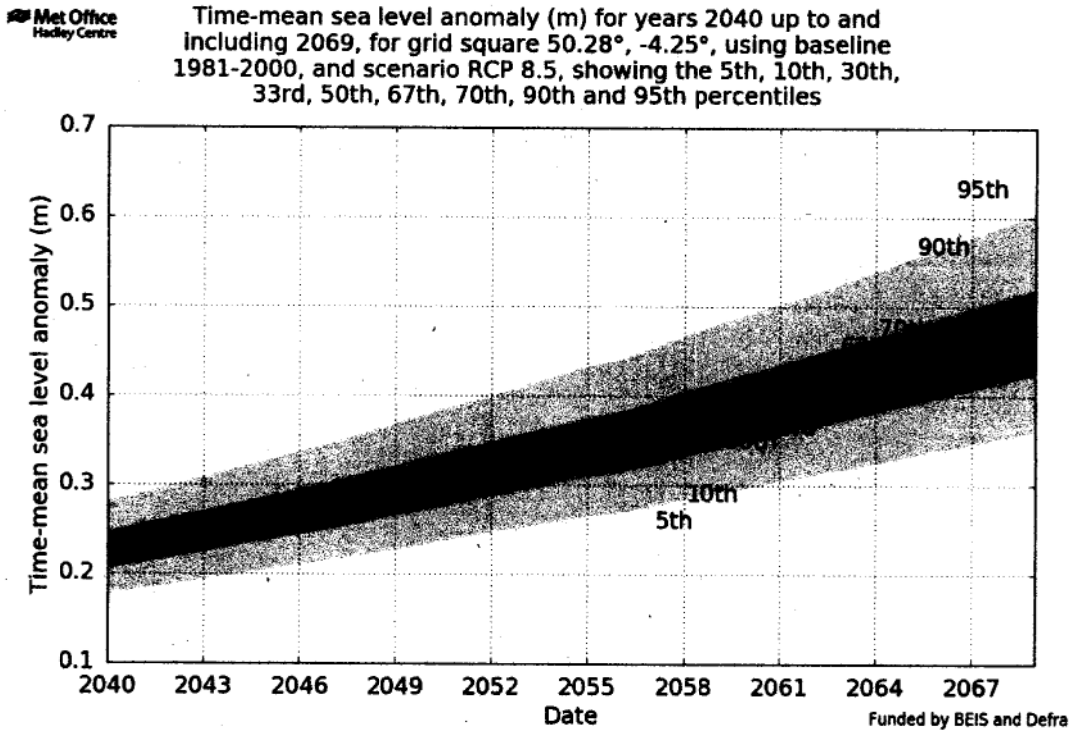

Figure 13: Plume plot of sea level rise to 2070
Source: UKCP18

7.6 Storm Surge

UKCP18 projections of change in extreme coastal water levels are dominated by increases in sea levels. However, there is potential for an additional contribution due to atmospheric storminess changes over the 21st Century.

Using analysis from 2 different climate models, the maximum change in storm surge was only projected to be 3mm, a rise which is significantly lower than projected sea level rise. It is also uncertain whether these changes were a result of greenhouse gas increases or natural long-term variability. For these reasons we cannot say that the analysis of storm surge data is statistically significant and therefore it has not been included in our climate resilience reporting.

7.7 Wind Speeds

The UK Climate Projections 2018 data concludes the following in relation to observe and future projected wind speeds:

[redacted]

- There are no compelling trends in storminess, as determined by maximum gust speeds, from the UK wind network over the last 4 decades
- Global projections were analysed using 2 different models. One showed an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant impacts of wind speed are experienced. This is accompanied by an increase in the frequency of winter storms over the UK. The second model showed no trend in wind speed over the UK.

Due to the uncertainty of the 2 different climate models, there is no statistically significant data available on potential projected increases in wind speeds and winter storms

[redacted]

8. References

1. UK National Security Strategy 2010 (NSS):
   https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61936/national-security-strategy.pdf
2. Critical Operational Functions, Lodger Units, Lease Holders
   Site POC
3. Geology of Britain Viewer, British Geological Society
   http://mapapps.bgs.ac.uk/geologyofbritain/home.html
4. LQA Phase 1 Desk Study, HM Naval Base Plymouth
   http://retrieve.dio.r.mil.uk/LQAReports/All%20PDFs/UCN000501.pdf
5. DEFRA Magic Map
   https://magic.defra.gov.uk/MagicMap.aspx
6. Met Office – Climate Averages
   https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gbvn6nxjm
7. British Geological Survey Geosure Natural Hazards Maps
   http://www.bgs.ac.uk/products/geosure/home.html
8. Plymouth Sound and Estuaries SAC
   https://sac.jncc.gov.uk/site/UK0013111
9. Tamar Estuaries Complex SPA
   https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9010141&SiteName=tamar&countyCode=&responsiblePerson=&HasCA=1&NumMarineSeasonality=2&SiteNameDisplay=Tamar%20Estuaries%20Complex%20SPA
10. St Johns Lake SSSI
    https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=s1000512
11. Tamar-Tavy Estuary SSSI
    https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=s1005917
12. Lynher Estuary SSSI
    https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=s1004001
13. Tamar Estuary Marine Conservation Zone
    http://publications.naturalengland.org.uk/publication/6037040860758016?category=1721481
14. Devonport Heritage Trail
    https://www.plymouth.gov.uk/sites/default/files/DevonportHeitageTrail.pdf
15. Weather Impacts Assessment, Devon County Council
    https://devoncc.sharepoint.com/sites/PublicDocs/Planning/_layouts/15/guestaccess.aspx?guestaccesstoken=CB88FeHIgvrGQUTu%2BHuzncwQvljoAcBeoZ4qh6RWa0I%3D&docid=00bcfea110043480d8150aadb0bbd3a71
16. Plymouth Climate Emergency Action Plan
    https://www.plymouth.gov.uk/sites/default/files/PlymouthsClimateEmergencyActionPlan01.pdf
17. Community Risk Register, Devon, Cornwall & Isles of Scilly Local Resilience Forum
    https://www.dcisprepared.org.uk/media/2238/public-facing-crr-print-lrf-dcios-20180713-v1.pdf
18. UK Climate Change Risk Assessment 2017 (CCRA):
    https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf
19. Cabinet Office National Risk Register 2013:
    https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211867/NationalRiskRegister2013_amended.pdf
20. Tamar Catchment Flood Management Plan
    https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/294024/Tamar_Catchment_Flood_Management_Plan.pdf
21. Flood Warning Information Service – Long Term Flood Risk

https://flood-warning-information.service.gov.uk/long-term-flood-risk
22. Plymouth Strategic Flood Risk Assessment
https://www.plymouth.gov.uk/sites/default/files/SfraSectionOne.pdf
23. South Devon and Dorset Shoreline Management Plan
http://southwest.coastalmonitoring.org/resources/smp/sdadcag-smp2/
24. DIO Environment and Planning Portal
https://diospatialportal.dio.r.mil.uk/portal/apps/webappviewer/index.html?appid=688c76f832b34073b23488b5f3bdde46
25. Environment Agency Water Stressed Areas - Final Classification:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf
26. Committee on Climate Change UK Climate Change Risk Assessment Evidence Report 2017:
https://www.theccc.org.uk/UK-climate-change-risk-assessment-2017/
27. European Environment Agency Water Exploitation Index
https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-2/assessment-3
28. UK Climate Change Risk Assessment 2012 (CCRA):
http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747
29. Water Resources Management Plan, South West Water
https://www.southwestwater.co.uk/environment/a-precious-resource/water-resources-management-plan/
30. Fire and Rescue Statistics User Group (FRSUG)
http://www.frsug.org/
31. UK Climate Projections 2018
https://ukclimateprojections-ui.metoffice.gov.uk/user/login