Gatwick Airport Northern Runway Project

Consultation Report Appendices – Part B – Volume 15

Book 6

VERSION: 1.0

DATE: JULY 2023

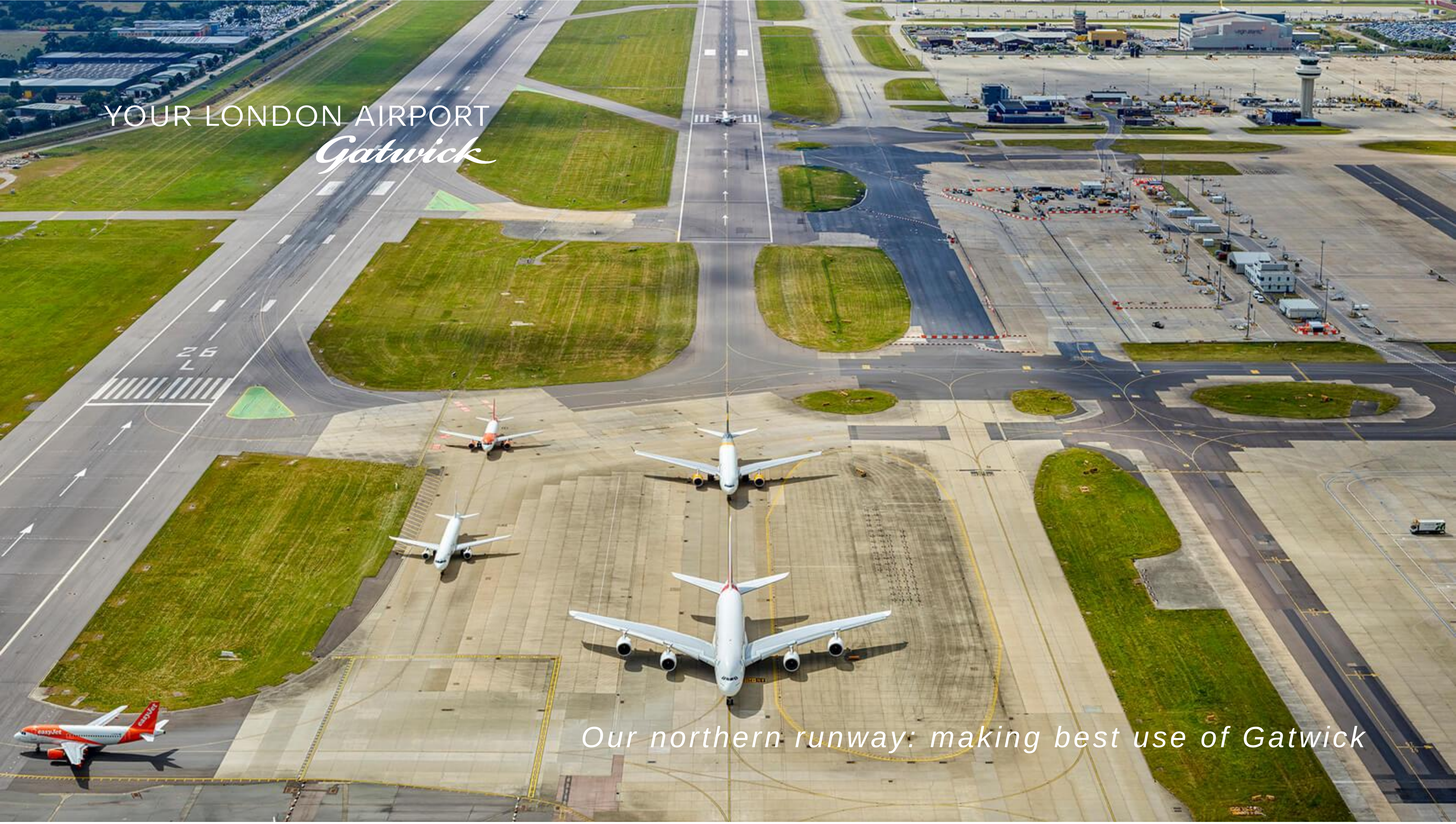
Application Document Ref: 6.2

PINS Reference Number: TR020005

APFP Regulations 5(2)(q) **Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009**

Contents – Part B – Volume 15

Appendix B.16 PEIR Appendices 10.3.1 – 12.3.1



Preliminary Environmental Information Report

Appendix 10.3.1: Summary of Stakeholder Scoping Responses - Geology and Ground Conditions

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This document forms Appendix 10.3.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description.

1.1.2 This document provides the summary of stakeholder scoping responses for geology and ground conditions for the Project.

2 Summary of Stakeholder Scoping Responses for Geology and Ground Conditions

Consultee	Date	Details	How/where addressed in PEIR
Environment Agency	20 September 2019	We have reviewed the EIA Scoping Report dated September 2019, specifically Sections 7.4 (Geology and Ground Conditions) & 7.5 (Water Environment). With respect to ground conditions and the potential for contamination to be present, it is noted that a desk-based Phase 1 Preliminary Risk Assessment (PRA) will be undertaken. The PRA will be used to determine whether an intrusive ground investigation will need to be undertaken to assess whether mitigation or remedial measures for the protection of Controlled Waters are required. These proposals are acceptable to us.	The Preliminary Risk Assessment is provided within Appendix 10.9.1.
Public Health England	30 September 2019	Land quality We would expect the applicant to provide details of any hazardous contamination present on site (including ground gas) as part of a site condition report. Emissions to and from the ground should be considered in terms of the previous history of the site and the potential of the site, once operational, to give rise to issues. Public health impacts associated with ground contamination and/or the migration of material off-site should be assessed and the potential impact on nearby receptors and control and mitigation measures should be outlined. Relevant areas outlined in the Government's Good Practice Guide for EIA include: ▪ effects associated with ground contamination that may already exist ▪ effects associated with the potential for polluting substances that are used (during construction /operation) to cause new ground contamination issues on a site, for example introducing /changing the source of contamination ▪ impacts associated with re-use of soils and waste soils, for example, re-use of site-sourced materials on-site or offsite, disposal of site-sourced materials offsite, importation of materials to the site, etc.	Risks associated with land contamination are assessed within the Preliminary Risk Assessment (Appendix 10.9.1) and the impact during construction and operational phase of the Project considered within the PEIR. Mitigation includes commitment to prepare additional documents as the Project develops (eg Remediation Strategy and CL:AIRE Materials Management Plan).
Crawley Borough Council	30 September 2019	CBC welcomes the opportunity to be involved in the scoping of the Phase 1 Preliminary Risk Assessment.	Consultation will continue with CBC through project development including the scoping of further ground investigation and assessment to verify risks arising from land contamination prior to construction as per para 10.4.7.
Crawley Borough Council	30 September 2019	In Table 7.4.2 construction phase effects should include any risks to public from the removal of any potential contaminants from the site.	It is the intention of the Project to maximise the reuse of materials and minimize the amount of material sent for off-site disposal. The cut/fill balance will be further considered throughout the Project design and EIA process and will be reported within Chapter 5: Project

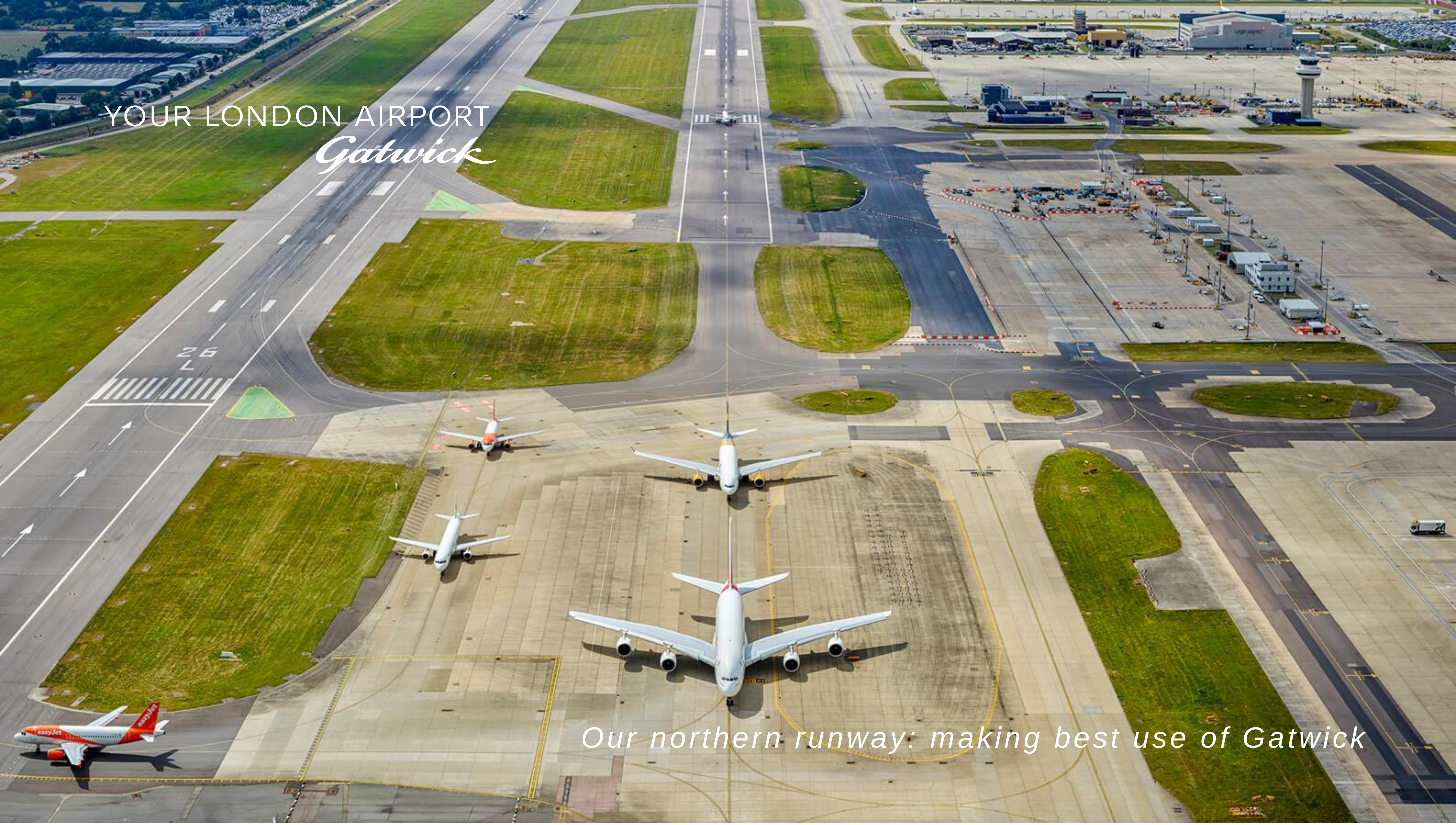
Consultee	Date	Details	How/where addressed in PEIR
			Description and in the Waste Strategy for the ES. The Waste Strategy (Draft Waste Strategy Appendix 5.3.2) will provide details on likely waste disposal volumes and the capacity of existing infrastructure in tandem with the Traffic Assessment and Remediation Strategy. The latter will provide details of procedures to be adopted during construction, which will include any measures required to protect members of the public, together with the relevant documentation to be provided by the Remediation Contractor.
Reigate and Banstead Borough Council	27 September 2019	References to saved Borough Local Plan Policy Pc2f "Regionally Important Geological Sites" should be removed from Paragraph 7.4.1 of the EIA Scoping Report following the adoption of the DMP.	Reference is excluded from the PEIR.
Reigate and Banstead Borough Council	27 September 2019	The Council notes that GAL is proposing to scope out from the assessment of geology and ground conditions the effects on geological SSSI and LGSs and effects on groundwater resources. From a borough perspective, we agree with the justification provided to scope out these issues. We would however welcome additional clarity as to whether consideration of potential for increased run-off during the operational phase is proposed to be assessed as part of potential contamination impacts. We consider that it should be assessed as part of the scope of the assessment.	Surface water runoff during the operational phase is considered within Chapter 11: Water Environment.
Tandridge District Council	30 September 2019	No specific comments are made on the proposed scope of the baseline studies, study area, affects proposed to be assessed, and the approaches to the assessment of effects, and mitigation, enhancement and monitoring in relation to this topic.	Noted
Surrey County Council	1 October 2019	The County Council would recommend, in the interests of completeness, that the adopted Surrey Minerals Plan (2011) be included in the list of relevant planning policy documents listed at paragraph 7.4.1 (pp.81-82) of section 7.4 'Geology & Ground Conditions' (pp.81-88) of the Scoping Report (Volume 1).	Included in Table 10.2.2 (Chapter 10: Geology and Ground Conditions of the PEIR).

3 Glossary

3.1 Glossary of terms

Table 3.1.1: Glossary of Terms

Term	Description
CBC	Crawley Borough Council
DMP	Development Management Plan
EIA	Environmental Impact Assessment
ES	Environmental Statement
GAL	Gatwick Airport Limited
LGS	Local Geological Site
PEIR	Preliminary Environmental Information Report
PRA	Preliminary Risk Assessment
SSSI	Site of Special Scientific Interest



Preliminary Environmental Information Report
Appendix 10.9.1: Preliminary Risk Assessment

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This document forms Appendix 10.9.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in Chapter 5: Project Description.

1.1.2 This document provides the Preliminary Risk Assessment for the Project.

1.2 Preamble

1.2.1 The Preliminary Risk Assessment provides an appraisal of potential areas of land contamination likely to be affected by the Project. It utilises desk based information and data from previous ground investigations to determine whether potential contamination sources resulting from historical/existing activities could cause a risk to future site users, construction workers, adjacent site users, controlled waters and the environment during the construction and operation of the Project. This Preliminary Risk Assessment has been undertaken to identify areas of land contamination that would plausibly cause a risk and thus determine whether control measures or remediation are necessary.

1.3 Legislation, Policy and Guidance

1.3.1 This report has been produced in general accordance with the following:

- Water Environment (Water Framework Directive) Regulations 2017;
- Contaminated Land (England) Regulations 2006 (as amended 2012);
- Environmental Protection Act 1990;
- Environment Act 1995;
- Environmental Permitting (England and Wales) Regulations 2016 (as amended (EU Exit) 2019);
- National Planning Policy Framework (2021);
- Airports National Policy Statement (2018);
- National Networks National Policy Statement (2015);
- Department for Environmental, Food and Rural Affairs (DEFRA) Environmental Protection Act 1990: Part 2A - Contaminated Land Statutory Guidance (2012);
- Environment Agency (2020) Land Contamination Risk Management (LCRM)
- Construction Industry Research and Information Association (CIRIA) Document C665: Assessing Risks Posed by Hazardous Ground Gases to Buildings (CIRIA, 2007);
- CIRIA Document C552 – Contaminated land Risk Assessment: A Guide to Good Practice (CIRIA, 2001a);
- CIRIA Document C532 – Control of Water pollution from Construction Sites: Guidance for Consultants and Contractors (CIRIA, 2001b)
- British Standard requirements for the 'Investigation of potentially contaminated sites - Code of practice' (ref. BS10175:2011+A2:2017);
- British Standard requirements for the 'Code of practice for ground investigations' (ref. BS5930:2015); and
- British Standard requirements for the 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' (ref BS8485:2015+A1:2019).

1.3.2 Where appropriate, consideration has also been given to the following:

- The potential for environmental liabilities to occur under other associated regimes, for example the Water Resources Act 1991 (as amended 2009) and the Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (as amended 2019); and
- Key constraints on site redevelopment.

1.3.3 Details of the limitations of this type of assessment are described in Annex 1.

1.4 Data Sources

1.4.1 The assessment utilises information obtained from the following sources:

- British Geological Survey (BGS), Geology of Britain Viewer (Website: http://mapapps.bgs.ac.uk/geologyofbritian/home.html);
- Geological Survey of England and Wales, Sheet 302 Horsham, 1:50,000 scale;
- Environment Agency (EA) Groundwater Vulnerability mapping, 1:100,000 scale);
- Groundsure GeoInsight Report (geological and hydrogeological information provided by the BGS and EA;
- Groundsure EnviroInsight Report (landfills and other contaminative land use information provided by the EA, local planning authorities and the BGS);
- Groundsure EnviroInsight Report (recent and historical OS mapping);
- Previous geo-environmental investigation and assessment reports;
- Local Planning Authority records;
- Sussex Geodiversity Partnership records; and
- A walkover survey.

2 Baseline Information

2.1 Site History

2.1.1 A site history for Gatwick Airport has been established through review of historical mapping. A brief summary is provided in Table 2.1.1.

Table 2.1.1: Site History

Date	Description
From 1870	The site comprised numerous fields bound by trees and hedgerows with wooded areas. A number of farms were present across the site. Charlwood Park was present in the north of the Project site. Several rivers and tributaries ran across the Project site. A large 'Fish Pond' is indicated in the north of the Project site. An engine tower and gasometer were indicated to the north of Timberham Lodge and south of the Fish Pond. The London, Brighton and South Coast Railway ran north to south through central site where Gatwick Station is identified.
From 1879	An unnamed road bisected the site, orientated approximately north to south. A nursery was present in the south west of the site in 1895.

Date	Description
By 1896	Gatwick Race Course had been constructed in the north east with orchards indicated in the south east.
By 1913 to 1920s	Gatwick Race Course was now labelled as a Golf Course and residential dwellings were now present along the unnamed road. By 1914, a number of cottages and a wind pump were indicated across Westfield Common in the south west of the site. Between 1914 and 1919, numerous additional tracks were indicated along the rail line through the centre of the site.
1930s to 1940s	The Project site had predominantly been developed as an aerodrome. By 1946, numerous possible drains and/or ditches were indicated across the west of the Project site.
1950s	Major airport development had occurred by this time. However, no substantial development was indicated in the east of the site.
From 1960s	Various industrial and commercial land uses were indicated around the airport including 'Works' (Crawley Sewage Treatment Works). Crawter's Brook and the River Mole were indicated to have been partially culverted under the airport development. The course of Crawter's Brook was indicated to have been diverted by approximately.1965. Several farms across Westfield Common were no longer indicated with both the northern and main runways partially occupying this area. Gatwick Golf Course was indicated to have been expanded. Gatwick Rail Station had been renamed Gatwick Airport Station by 1961 and the A23 and A217 were first shown at this time. The central southern portion of the site was labelled as Gatwick Airport between 1961 and 1963.
From 1970s	Further development of the airport had occurred. The runways had been extended across Westfield Common and the traffic control tower was now indicated. The extensive drainage and balancing pond network, and embankments were indicated to be present from around 1973. Between 1973 and 1978, a Timber Yard was indicated in the south east corner of the site along with a Greyhound Training Track. By 1976, the M23, roundabouts and car parks have been constructed to the east of the Project site with embankments either side. The M23 was indicated running westerly from the east into the A23. Main roads had been constructed into the north east and central area of the Project site by around 1976. Further car parks and a large balancing pond were indicated to be present alongside the River Mole in the north east of the site. The London Road (A217) had become more established in the 1970s. By 1977 the Fish Pond in the north of the site was no longer identified as present (potentially infilled).
From 1980s	Land drains were indicated to divert into a surface water feature in the north, and embankments had been constructed south of Charlwood Road, and along the eastern edge of the River Mole. By 1989, the surface water feature in the north, adjacent to Charlwood Park Farmhouse, had been potentially infilled and developed with several carparks. An electrical substation was indicated in the west of the site along with possible bunded areas (likely associated with the fire training area). The eastern most roundabout (named Airport Way Roundabout East) and several commercial buildings have been constructed including a computer centre and a further electrical substation. Further car parking areas had been constructed in the south east. Further expansion of the airport had occurred by this time, including main access roads (Airport Way Roundabout West) and South Terminal Satellite Pier, and fuel depots in the north east. Large embankments were identified to the north of the North Terminal Building along with Pier 5 and ancillary buildings / areas associated with the airport. A fire station was indicated in the central southern area of the airport development by around 1987.
From 2000s	A reservoir bound by embankments was indicated in the south east (adjacent to Crawley Sewage Treatment Works). Further expansion/development of the North Terminal area had occurred.

2.2 Site Walkover

2.2.1 A site walkover was undertaken on the 25 September 2019, the findings of which are presented in detail within Annex 2.

2.3 Environmental Setting

Geology

2.3.1 The stratigraphic sequence beneath the Project site is shown in Table 2.3.1 and on Figures 10.6.1 and 10.6.2 (Volume 2 of the PEIR).

Table 2.3.1: Geology

Strata	Description and Approximate Thickness
Alluvium	This stratum is indicated to comprise clay, silt, sand and gravel. Indicated to be present across parts of the west and north of the site (likely associated with the River Mole) and also in the east (likely associated with Gatwick Stream). Likely to be up to several metres in thickness, where present.
Head Deposits	This stratum is indicated to comprise clay, silt, sand and gravel. Only indicated to be present in a small area in the centre of the site. Likely to be of very limited thickness, where present.
River Terrace Deposits (River Mole)	This stratum is indicated to comprise sand and gravel and is indicated to be present across parts of the west, centre and east of the site. Likely to be up to several metres in thickness, where present.
Weald Clay Formation	This stratum is indicated to comprise mudstone with seams of clay-ironstone in the south east and far east of the site. It is indicated to be absent in the far south of the site. Likely to be of significant thickness beneath the site.
Upper Tunbridge Wells Sand Formation	This stratum is indicated to comprise sandstone and mudstone and is only indicated to be present in the far south of the site. Likely to be of significant thickness.

2.3.2 No geological Sites of Special Scientific Interest (SSSIs) or Local Geological Sites (LGSs) are located within 1 km of the site.

2.3.3 The site is located within a Brick Clay Resource Mineral Safeguarding Area, relating to the Weald Clay Formation.

2.3.4 Further details on site specific geology, based on site investigations carried out across the site to date are provided in the Previous Ground Investigations section.

Hydrogeology

2.3.5 The aquifer classification for each geological stratum are presented in Table 2.3.2.

Table 2.3.2: Aquifer Classification

Strata	Aquifer Classification
Alluvium	Secondary A Aquifer
Head Deposits	Secondary Undifferentiated Aquifer
River Terrace Deposits (River Mole)	Secondary A Aquifer
Weald Clay Formation	Unproductive Stratum
Upper Tunbridge Wells Sand Formation	Secondary A Aquifer

2.3.6 The site is not located within a Source Protection Zone and there are no potable groundwater abstraction licences within the vicinity of the Project site.

2.3.7 One active groundwater abstraction license is recorded approximately 1 km south of the airport boundary. This is licensed for general usage (non-potable) with a permitted maximum annual volume of 47,450 m^3 and maximum daily volume of 130 m^3.

2.3.8 Further details on site specific hydrogeology, based on site investigations carried out across the site to date are provided in the Previous Ground Investigations section.

Hydrology

2.3.9 The main watercourse flowing through the site is the River Mole. It flows from the south and is culverted under both the main runway and existing northern runway. Upon exiting the culvert, it forms the western and northern boundary of the airport before heading north away from the airport at Hookwood.

2.3.10 Tributaries of the River Mole including Crawter's Brook, the Gatwick Stream, Man's Brook, Burstow Stream and Westfield Stream all flow through or close to the site.

2.3.11 The study area is located within a Surface Water Nitrate Vulnerable Zone (NVZ) and a Surface Water Safeguard Zone (SgZ). A NVZ is an area of land draining into water known to be polluted by nitrates. A SgZ is an area that influences the water quality at water abstraction sites at risk of failing the drinking water protection objectives.

2.3.12 There are no surface water or potable surface water abstraction licences within the vicinity of the Project site.

Environmental Information

2.3.13 Industrial land uses, landfills and other waste facilities, and pollution incidents recorded on site and within an approximate 500 metre buffer are presented in Table 2.3.3.

Table 2.3.3: Environmental Data

Environmental Data	Approx. Distance and Direction
Part A1 and IPPC Authorised Activities	
Installation Name and Detail	
Shell Hydrogen Refuelling Station – issued 2017	On site - north
Gatwick Power Station – issued 2006	On site - south
Crawley Sewage Treatment Works CHP – issued 2010	Adjacent – south east
Control of Major Accident Hazards	
Name and Detail	
Shell UK Oil Products Ltd – Gatwick Fuel Farm – Upper Tier	On site - north
Registered Waste Sites	
Name and Description	
Gatwick Waste Care Centre – Special Waste Transfer Station - <25,000 tonnes – issued 2010	On site - central
Austins Land – Landfill accepting Non-Biodegradable Wastes - >25,000 to <75,000 tonnes – issued 1978	On site - east
Platinum International Ltd – Metal Recycling Site - <25,000 tonnes – issued 2017	90 metres - south
Crawley Sewage Treatment Works – Landfill - <25,000 tonnes – issued 2013	Adjacent – south east
DJ Grab Services Ltd – Physical Treatment Facility - >25,000 to <75,000 tonnes – issued 2016	50 metres - north
Simmonds Donald Richard Thomas – Metal Recycling Site - <25,000 tonnes – issued 1994	140 metres - east
Jupp Peter – Treatment of waste to produce soil - <25,000 tonnes – issued 2013	280 metres - east
United Grab Hire Ltd - Physical Treatment Facility - <25,000 tonnes – issued 2013	390 metres - east
National Incidents and Records of Pollution*	
Impact Details	
Significant impact to Gatwick Stream – List 1 substance - 1999	On site – north east
Major impact to water – List 2 substance - 2001	On site – south west
Major impact to water – List 2 substance (surfactants and detergents) - 2002	On site - north
Major impact to water – List 2 substance (biodegradable material or waste) - 2018	On site - north
Major impact to water – List 2 substance (sewage materials) - 2017	On site - east
Significant impact to land and water – List 2 substance (oil or fuel) - 2014	20 metres - south
Significant impact to water – List 2 substance (unspecified) - 2016	On site – south east
Significant impact to water – List 2 substance (gas and fuel oils) - 2002	90 metres - east
Historical Landfill Sites	
Name and Description	
Gatwick Brickworks – inert waste – 1983 to 1984	240 metres north
Blackcomer Wood – inert waste - 1976	330 metres south east

* Significant/major incidents identified only

2.3.14 A number of potential sources of contamination have also been identified from historical mapping. Potential sources of contamination are shown as potential areas of concern (PAOC) in Figure 10.6.3 (Volume 2 of the PEIR).

Ground Stability

2.3.15 The site is indicated to have the potential for small scale underground mining in relation to iron ore.

2.3.16 Areas at moderate risk for compressibility are present across the site which appear to correspond to BGS mapped areas of Alluvium.

2.3.17 A moderate risk of slope instability has been identified for a small area along the A23 embankment.

Previous Ground Investigations

Introduction

2.3.18 A number of ground investigations and assessments have been undertaken across the Project site. A summary of the reports available is provided in Annex 3 and the location of the exploratory holes shown in Figure 10.6.4 (Volume 2 of the PEIR).

Site Specific Geology

Made Ground

2.3.19 Made Ground has been encountered across the majority of the site, averaging approximately 1 m thickness (generally <2 metres). Localised deeper Made Ground was encountered at between 3 metres and 3.7 metres and up to a maximum of 6.45 metres directly west of the North Terminal Building.

2.3.20 The greatest depth of Made Ground was considered to be a result of the removal of superficial deposits associated with the original course of the Gatwick Stream during construction of Pier 5.

Superficial Deposits

2.3.21 Superficial deposits of Alluvium, Head and River Terrace Deposits have been encountered across the site associated with former and existing watercourses. These deposits appear to have been commonly excavated to facilitate airport development.

2.3.22 The Alluvium has been encountered up to approximately 2.9 metres in thickness with an average thickness of approximately 1 metre. Localised layers of peat were identified within these deposits.

2.3.23 The River Terrace Deposits were reported to be up to 1.1 metres thickness where present.

Solid Geology

2.3.24 The Weald Clay Formation has been encountered across the site as part of previous investigations to a maximum depth of 35.5 metres (unproven). This comprised mudstone/siltstone with a weathered upper horizon typically comprising a stiff clay.

Site Specific Hydrogeology

2.3.25 Shallow groundwater was generally identified between approximately 0.8 metres and 3 metres below ground level (bgl) within the Made Ground, superficial deposits or weathered Weald Clay Formation.

2.3.26 Groundwater was identified to generally be perched and discontinuous with these deposits.

Reported Evidence of Contamination

2.3.27 In 2013, an investigation of a fuel leak around Pier 4 (Atkins, 2013) was undertaken due to observations of fuel impacted flood water and free phase contamination within a utilities chamber.

2.3.28 The investigation identified hydrocarbon impacted soils and groundwater with the potential source attributed to underground fuel lines. It is not known if any remediation was completed following this investigation.

2.3.29 In 2017, a ground investigation at the Boeing hangar identified loose asbestos fibres (chrysotile) within a sample of shallow Made Ground and hydrocarbon impacted perched shallow groundwater along with elevated Volatile Organic Compounds (VOCs) in soil gas samples.

2.3.30 Activities within the firefighting area have involved the burning of pools of kerosene fuel and gas in two separate basins. Firefighting foam is used to extinguish the fires.

Soil and Groundwater Contamination Encountered as Part of Previous Investigation

2.3.31 Historical soil and groundwater data obtained as part of the previous investigations have been compared to contemporary assessment criteria, where available. This has been undertaken using historical ground investigation data associated with exploratory holes located within those parts of the Project site where development is proposed.

2.3.32 In order to assess risks to future site users, concentrations of contaminants of concern have been compared to Suitable 4 Use Levels (S4UL) for Human Health Risk Assessment published by Land Quality Management: Chartered Institute of Environmental Health in 2015. In accordance with the copyright notice the Publication Number for RPS Group is S4UL3177.

2.3.33 The redevelopment of the Project site comprises a commercial scheme and therefore, S4ULs for a commercial land use have been used.

2.3.34 A notable exclusion from the S4ULs is lead. In the absence of a S4UL for lead, the Category 4 Screening Level (C4SL) has been selected, published by DEFRA in 2014. It is noted that the C4SL are based on the acceptance of a low level of toxicological concern, rather than the more conservative standard adopted in the derivation of S4ULs, which are based on a tolerable or minimal level of risk.

2.3.35 The site is located above Secondary A Aquifers relating to the. Alluvium and River Terrace Deposits. Therefore, the results of the groundwater analysis have been compared with Environmental Quality Standards (EQS) freshwater values and where these are not available, the UK Drinking Water Standard (DWS) values. In the absence of both of the aforementioned World Health Organisation (WHO) values have been used.

2.3.36 Screening criteria used for the protection of human health and groundwater are provided in Annex 4.

2.3.37 The available ground gas data included as part of historical ground investigations has been qualitatively assessed.

2.3.38 It is of note that a number of boreholes located within the area of the northern runway recorded a pungent odour, potentially associated with organic materials, within the Alluvium.

Human Health Risk Assessment

2.3.39 Soil sample chemical results have not exceeded the relevant screening criteria protective of future site users.

Controlled Waters Screening Assessment

2.3.40 Table 2.3.4 details exploratory holes for which groundwater samples have exceeded the relevant screening criteria.

2.3.41 Certain laboratory detection levels in samples used in previous ground investigations are higher than the screening criteria. However, for the purposes of a water quality screening exercise this is considered acceptable.

Table 2.3.4: Groundwater Chemical Results Exceeding Screening Criteria

Project Element	Report ID and date (refer Annex 3)	Exploratory Hole and (Target Geology)	Contaminant and Concentration (ug/l) (pH in pH units)	Screening Criterion (ug/l) - Exceedances in Bold		
				EQS	DWS	WHO ATO
Relocation of Fire Training Ground	11 - 1999	TP11 (Made Ground)*	Copper – 20	**1**	2,000	-
			Nickel – 130	**4**	**50**	-
			Nitrite – 1,400	-	**100**	-
MA1 Main Contractor Compound	18 - 2010	BH03 (Made Ground/ RTD (RPS interpretation)/ Weald Clay)	Cadmium – 1.3	**0.08**	5	-
			Nickel – 99	**4**	**50**	-
			Lead – 5	**1.2**	10	-
			Selenium – 17	-	**10**	-
			Zinc – 18	**10.9**	5,000	-
			Ammoniacal Nitrogen – 1,900	**15**	-	-
			Sulphate – 776,220	**400,000**	**250,000**	-
			Nitrite - 110	-	**100**	-
			1,1 Dichloroethane – 12	NA	NA	NA
			Tetrachloroethene – 16	**10**	**10**	-
			1,4 Dichlorobenzene – 15	20	-	**0.3**
			1,2 Dichlorobenzene 48	**20**	-	**1**
MA1 Main Contractor Compound	17 - 2007	NB1 (Weald Clay)	Ammoniacal Nitrogen – 210	**15**	-	-
			MBAS – 90	NA	NA	NA
			pH – 9.7	**>9**	NA	NA
			Total Alkalinity – 72,000	NA	NA	NA
			EPH (C10-C20) – 380	-	**10**	-
			EPH (C20-C30) – 40	-	**10**	-
		NB2 (Weald Clay)	MBAS – 270	NA	NA	NA
			Nickel – 5	**4**	50	-
			Total Alkalinity – 260,000	NA	NA	NA
			EPH (C10-C20) – 1,200	-	**10**	-
			EPH (C20-C30) – 70	-	**10**	-
			1,1 Dichloroethane – 5	NA	NA	NA
Taxiway Victor	36 - 2013	WS19 (Clay)*	pH – 9.1	**>9**	NA	NA
			Potassium – 130,000	-	**12,000**	-
			Manganese – 8,800	**123**	**50**	-

NA = not available

*Groundwater sample taken as grab sample

2.3.42 Exceedances of screening criteria for a number of contaminants of concern, including heavy metals, hydrocarbons and VOCs, have been identified within perched / groundwaters.

2.3.43 Table 2.3.5 identified exploratory holes for which soil leachate samples have exceeded the relevant screening criteria.

Table 2.3.5: Chemical Leachate Results Exceeding Screening Criteria

Project Element	Report ID and date (refer Annex 3)	Exploratory Hole, Depth and (Geology)	Contaminant and Concentration (ug/l)	Screening Criterion (ug/l) – Exceedances in Bold		
				EQS	DWS	WHO ATO
Charlie Box	31 - 2013	WS08 – 0.9 metres (Made Ground) WS09 – 0.9 metres (Made Ground) WS05 – 2.15 metres (Made Ground)	Fluoranthene – 0.22	**0.0063**	-	-
			Benzo(a)pyrene – 0.04	**0.00017**	**0.01**	-
			Chromium - 63	**4.7**	**50**	-
			Copper - 30	**1**	2,000	-
			Lead - 2	**1.2**	10	-
			Nickel - 40	**4**	50	-
			Zinc - 200	**10.9**	5,000	-
			Fluoranthene – 0.1	**0.0063**	-	-
			Chromium - 28	**4.7**	50	-
			Nickel - 26	**4**	50	-
			Zinc - 66	**10.9**	5,000	-
			Ethylbenzene - 69	-	-	**2**
			m/p Xylene - 270	**30**	-	-
			TPH (C6-C8 aliphatic) – 2,600	-	**10**	-
			TPH (C8-C10 aliphatic) – 14,000	-	**10**	-
		WS06 – 0.9 metres (Made Ground)	TPH (C8-C10 aromatic) – 4,800	-	**10**	-
			TPH (C8-C10 aliphatic) – 1,800	-	**10**	-
			Chromium - 10	**4.7**	50	-
			Copper - 60	**1**	2,000	-
			Lead – 3	**1.2**	10	-
			Nickel - 10	**4**	50	-
			Zinc - 66	**10.9**	5,000	-
			Fluoranthene – 1.4	**0.0063**	-	-
			Benzo(b)fluoranthene – 0.47	**0.00017**	-	-
			Benzo(k)fluoranthene – 0.63	**0.00017**	-	-
			Benzo(a)pyrene – 0.54	**0.00017**	**0.01**	-
			Indeno(123-cd)pyrene – 0.38	**0.00017**	-	-
			Benzo(ghi)perylene – 0.4	**0.00017**	-	-
		WS06 – 1.6 metres (Clay)	TPH (C8-C10 aliphatic) – 590	-	**10**	-

2.3.44 Slight hydrocarbon odours were noted within the Made Ground encountered at WS05 and moderate hydrocarbon odours at WS08. A slight organic odour was noted within the Made Ground encountered at WS06.

2.3.45 The identified exceedances indicate leachable concentrations of heavy metals and hydrocarbons. It is considered that the exceedances for hydrocarbons are generally confined to the Made Ground and close to the boundary of the Made Ground / underlying Weald Clay Formation interface.

2.3.46 The results of leachate analysis suggest that the general quality of Made Ground identified on the site may represent a potential source in the generation of low quality perched groundwater therein.

2.3.47 The locations of the soil, leachate and groundwater exceedances are shown in Figure 10.6.5 (Volume 2 of the PEIR).

Ground Gas Monitoring

2.3.48 Ground gas monitoring data is available from approximately seven previous phases of ground investigations. Elevated methane (up to approximately 32.4 %), carbon dioxide (up to approx. 11%), carbon monoxide (up to approximately 313 parts per million (ppm)) and depleted oxygen have been recorded in various parts of the site together with high ground gas flow rates (up to 43.1 litres per hour (l/hr)).

2.3.49 Additionally, soil vapour sampling recorded elevated hydrocarbon vapours during a ground investigation for the construction of the Boeing hangar.

2.3.50 Potential sources of elevated ground gas were attributed to the infilled balancing pond at the North Terminal and a former fuel line at the South Terminal.

2.3.51 Characteristic Situations (CS) assigned to areas across the Project site ranged between CS1 (very low risk) and CS3 (moderate risk). The CS is determined by the modified Wilson and Card classification (CIRIA, 2007). The method uses both gas concentrations and borehole flow rates to define a CS for a site based on the limiting gas volume flow for methane and carbon dioxide.

Unexploded Ordnance

2.3.52 The risk of Unexploded Ordnance (UXO) has been reported for Gatwick Airport and a summary provided below.

UXO Hazard Summary

2.3.53 The main sources of UXO hazard arise from munitions storage/disposal activities undertaken at Gatwick and in the surrounding area during and immediately after World War II. There were munitions supply depots surrounding Gatwick Airport supporting the Royal Air Force (RAF), Home Guard, Special Operations Executive (SOE) and the regular Army prior to the D-Day invasions in 1944.

2.3.54 At the end of World War II, some of the unused munitions at the depots were disposed of locally. This included ordnance returned to the depots which were not required in combat but were primed and fused.

UXO in Made Ground

2.3.55 Post-World War II, during the extension of Gatwick Airport, significant earthworks were undertaken in construction of the airfield.

2.3.56 A large number and wide range of live ordnance was found when excavating within Made Ground across much of the airfield. There is consequently a potential for UXO to be present within the Made Ground across the airport and just outside the airfield perimeter, as proven by these post-World War II UXO finds.

2.3.57 Records of finds to date indicate that such ordnance is likely to comprise close combat munitions such as grenades, mortars, smoke bombs, small arms ammunition, Projector, Infantry, Anti Tank (PIATs) alongside anti-tank mines and a variety of other ammunition.

2.3.58 The UXO hazard is considered to be confined to the Made Ground. However, potential for some localised munitions stores dating from World War II buried at shallow depth in the natural ground cannot be totally discounted.

3 Preliminary Risk Assessment

3.1 Introduction

3.1.1 An outline conceptual site model (CSM) consists of an appraisal of the source-pathway-receptor 'contaminant linkages' which is central to the approach used to determine the existence of 'contaminated land' according to the definition set out under Part 2A of the Environmental Protection Act 1990. For a risk to exist (under Part 2A), all three of the following components must be present to facilitate a potential 'pollutant linkage'.

- Source referring to the source of contamination (Hazard).
- Pathway for the contaminant to move/migrate to receptor(s).
- Receptor (Target) that could be affected by the contaminant(s).

3.1.2 Receptors include human beings, other living organisms, crops, controlled waters and buildings / structures. The National Planning Policy Framework (Ministry of Housing, Communities and Local Government, 2021) used to address contaminated land through the planning process, follows the same principles as those set out under Part 2A. Further details on the Part 2A regime are presented within Annex 5.

3.1.3 Each stage of the potential pollutant linkage sequence has been assessed individually on the basis of information obtained during the walkover and desk study exercise.

3.2 Potential Sources

On-site - Existing

3.2.1 Existing on-site potential sources of contamination representing PAOC are outlined in the following Table 3.2.1 with their locations indicated on Figure 10.6.3.

Table 3.2.1: Potential Areas of Concern (On Site - Existing)

PAOC ID	Name	Activities
On Site - Existing		
1	Enterprise rent-a-car, Europcar and Herts	Maintenance of hire vehicles, car wash and vehicle refuelling (three individual refueling points). Potential petrol and diesel underground storage tanks (USTs).
2	Europcar	Maintenance of hire vehicles, vehicle refueling. Potential petrol and diesel USTs.
3	Avis	Maintenance of hire vehicles, car wash. Potential diesel and petrol USTs.
4	BP petrol filling station (PFS)	PFS – petrol and diesel USTs.
5	BA hangar	Servicing of aircraft.
6	Babcock warehouse	Engineering works, Potential aircraft de/anti-icing practice.
7	Shell PFS	PFS – petrol and diesel USTs.
8	Stands 4 and 5	Maintenance of aircraft, storage of waste fuel, chemicals and oils.
9	Stand 130 to 136 and 140 to 145	De/anti-icer above ground storage tanks (ASTs) and vehicle filling points.

PAOC ID	Name	Activities
10	Fire Station	Maintenance vehicle storage area.
11	TCR	Repair of ground support vehicles, oil ATSs.
12	DHL	Waste treatment plant
13	Fuel Farm	Aviation fuel ASTs and potential underground pipeline.
14	Wet tip	Sewage waste septic tank, lined storage lagoons for contaminated surface water runoff.
15	Fire Fighting Area	Fire training, propane AST and underground pipe, kerosene.
16	Oscar Remote Stands	Refuelling area and vehicle wash. Fuel USTs, gas oil AST, soap AST, engine and hydraulic oil ASTs, Adblue IBCs.
17	Stand 574	Maintenance of aircraft, storage of waste fuel, chemicals and oils.
18	Stand 558	Large fuel spill (2019)
19	Esso PFS	PFS – petrol and diesel USTs.
20	Texaco PFS	PFS – petrol and diesel USTs.
45 to 48, 50, 51, 53 to 55, 57, 60 to 77	Electricity substations	Electricity substations

3.2.2 Made Ground, likely to be present across the Project site as a result of construction/demolition activities, is also considered to represent a potential source of contaminants of concern.

3.2.3 Made Ground and superficial deposits (in particular Alluvium including peat and organic clays) may represent potential sources of ground gas generation.

On-site – Historical

3.2.4 Historical on-site potential sources of contamination representing PAOC are outlined in the following table with their locations indicated on Figure 10.6.3 (Volume 2 of the PEIR).

Table 3.2.2: Potential Areas of Concern (On Site - Historical)

PAOC ID	Name	Activities
On Site - Historical		
21	Timber Yard	Potential timber treatment
22	Fuel Depots	Potential fuel tanks and pipework
23	Smithy, Engine House and Tramway Sidings	Smithy, Engine House and Tramway Sidings
24	Railway Sidings	Railway Sidings
25 to 32	Tank(s)	Unknown use
33	Tanks	Unknown use, dates from 1960s / 1970s
34	Gasometers	Potential pipework, sumps
35 to 39	Water bodies/ponds	Potential backfill unknown
40	Balancing Pond	Potential backfill unknown
41	Reservoir/pond	Potential backfill unknown
42	Pit	Potential backfill unknown
43, 44, 49, 52 and 56	Electricity substations	Electricity substations
58	Pollution Incident	Significant impact to water – List 2 substance (unspecified) - 2016

Off-site – Existing

3.2.5 The only existing off-site potential source of contamination representing a PAOC is outlined in the following table with its location indicated on Figure 10.6.3 (Volume 2 of the PEIR).

Table 3.2.3: Potential Areas of Concern (Off-Site - Existing)

PAOC ID	Name	Activities
Off Site - Existing		
59	Crawley STW	Sewage Treatment Works, CHP Plant

Off-site – Historical

3.2.6 No potentially significant historical off-site sources of contamination have been identified.

3.3 Potential Pathways

3.3.1 The risks to future on site human health receptors via the pathways of dermal contact and ingestion will be mitigated in areas of proposed building or hardstanding as the pathway will be inactive. However, in any areas of proposed soft landscaping, the pathways of dermal contact and ingestion could still be active. In addition, there would be potential for the airborne migration of soil/dust from these areas.

3.3.2 There is the potential for ground gas (from on or off-site sources) and volatile contaminants of concern in soil and/or groundwater (if present) beneath the site to impact future site users where buildings are proposed via the inhalation pathway in indoor areas.

3.3.3 There is the potential for contaminants of concern (if present) beneath the site to migrate beneath the Project site via perched groundwater (if present) within granular horizons of the Made Ground, the superficial deposits and the weathered Weald Clay Formation. These contaminants may impact either controlled waters receptors or off-site human heath receptors via the dermal contact, ingestion and vapour inhalation pathways.

3.3.4 The surface water drainage system (where discharging to controlled waters) service corridors and/or subterranean infrastructure corridors could act as preferential pathways for the migration of any potential contaminants of concern.

3.3.5 The Weald Clay Formation is considered to be sufficiently impermeable and thick as to prevent the downward vertical migration of any contaminants within groundwater (if present) to the underlying Tunbridge Wells Sand Formation. This pathway may require consideration where piles that breach the thickness of the Weald Clay Formation are required as part of building construction.

3.4 Potential Receptors

3.4.1 Potential human receptors include future site users, construction workers during site development works and off-site human receptors including workers, residents and general public users on land within or adjacent to the Project site.

3.4.2 Elevated levels of ground gas and depleted oxygen levels have been detected as part of previous investigations. In addition, asbestos has been identified within Made Ground sampled from beneath the Project site. These findings would be taken into account in the design of further ground investigations and remediation strategy (where required) and Health and Safety risk assessments.

3.4.3 Head deposits are indicated to be present in a small area in the centre of the Project site. This stratum are classified as a Secondary Undifferentiated Aquifer. Given this classification, it is not considered to represent potential controlled waters receptor.

3.4.4 The Alluvium (indicated to be present across parts of the north, east and west) of the Project site and River Terrace Deposits (indicated to be present across parts of the west, centre and east) are classified as Secondary A Aquifers and, as such, are considered to be potential controlled waters receptors.

3.4.5 The Tunbridge Wells Sand Formation Secondary A Aquifer at depth is not generally considered a potential receptor given the upper level of protection afforded by the significant thickness of the overlying impermeable Weald Clay Formation. However, this stratum may become a potential receptor where piles that breach the thickness of the Weald Clay Formation are required as part of building construction.

3.4.6 Surface water receptors are considered to comprise the River Mole (flowing through the Project site) and its associated tributaries including Crawter's Brook, the Gatwick Stream, Man's Brook, Burstow Stream and Westfield Stream (which either flow through or close to the Project site).

3.4.7 The groundwater abstraction located approximately 1 km to the south of the site, is not considered a potential receptor due to the distance and it is located hydraulically up-gradient from the Project site.

4 Conceptual Site Model

4.1 Outline Conceptual Site Model

4.1.1 An outline CSM has been developed for the overall Project site on the basis of the site reconnaissance and desk study. It considers each element of the Project and identifies potential sources, pathways and receptors (ie potential pollutant linkages). The outline CSM is summarised in Table 4.1.1 below.

Table 4.1.1: Outline Conceptual Site Model

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
On site – existing: PAOC 1 to PAOC 20, PAOC 45 to 48, PAOC 50, PAOC 51, PAOC 53 to 55, PAOC 57, PAOC 60 to 77 **On site – historical:** PAOC 21 to PAOC 58, PAOC 44, PAOC 49, PAOC 52, PAOC 56	Metals, inorganics, hydrocarbons, glycols, VOCs, SVOCs, PCBs, PFOS/PFAS, pesticides, herbicides and asbestos	Soil	Direct contact/ingestion	✓[1]	Future site users Construction workers
			Inhalation of volatiles	✓[2]	Future site users Construction workers
			Airborne migration of soil or dust	✓[1] ✓[1]	Future site users Construction workers Off-site users
			Leaching of mobile contaminants	✓ ✓ x[3]	Alluvium Secondary A Aquifer River Terrace Deposits Secondary A Aquifer Tunbridge Wells Sand Formation Secondary A Aquifer
		Ground water	Direct contact/ingestion	✓[1] ✓	Future site users Construction workers Off-site users
			Inhalation of volatiles	✓[2] ✓	Future site users Construction workers Off-site users
			Lateral migration in permeable strata	✓ ✓ ✓	Alluvium Secondary A Aquifer River Terrace Deposits Secondary A Aquifer River Mole and associated tributaries
Off-site – existing: PAOC 59	Metals, inorganics, pesticides, PCBs, treatment chemicals, pathogens, hydrocarbons and asbestos	Ground water	Lateral migration and subsequent inhalation of volatiles	✓[2]	Future site users Construction workers
On and off-site: Made Ground / natural strata (including superficial deposits), PAOC 35 to PAOC 42 and PAOC 14 and PAOC 58 or bio-degradation of contamination	Carbon dioxide and methane	Ground Gas	Vertical and lateral migration and subsequent inhalation of ground gas	✓[2] ✓	Future site users Construction workers Off-site users
			Explosive risks	✓[2] ✓	Future site users Construction workers Off-site users

Notes:

1 Pathway will be inactive in areas of proposed building cover and hardstanding

2 Pathway will be inactive in areas where buildings/confined spaces are not proposed

3 This pathway may be active where piles that breach the thickness of the Weald Clay Formation are required as part of building construction

5 Conclusions and Recommendations

5.1.1 The Preliminary Risk Assessment has identified a number historical and current potential sources of contamination representing PAOC across the Project site. The outline CSM produced as part of the assessment has identified a number of potential pollutant linkages associated with these sources that may be active where areas of the Project site are proposed for development.

5.1.2 In order to determine requirements for further assessment, the locations of PAOC have been overlain on the boundaries of the proposed development areas and are indicated on Figure 10.6.4 (Volume 2 of the PEIR).

5.1.3 Recommendations for each development area have been derived in consideration of:

- PAOC located within the development area boundary;
- whether any buildings are proposed as part of the development (thus requiring consideration of the ground gas/vapour inhalation pathway); and
- pre-existing site investigation data, where available.

5.1.4 A flowchart detailing the recommendation strategy for further works is provided in Annex 6 together with a table detailing recommendations for each development area.

5.1.5 Where recommended, the scope of any further ground investigation will be determined on a case-by-case basis and will be agreed with the Environment Agency/relevant local planning authority prior to its implementation. Investigations may include some of the following:

- drilling of boreholes or excavation of trial pits, targeting identified PAOC and pollutant linkages;
- installation of groundwater and gas monitoring wells;
- collection of soil and groundwater samples with chemical analysis of these samples for contaminants of concern;
- ground gas monitoring from wells installed at the site; and
- assessment of ground conditions and generic quantitative risk assessment of soil and groundwater chemical analysis results to determine the potential for the identified potential pollutant linkages to remain active upon development of the area.

5.1.6 Where appropriate, the investigations will include geotechnical testing to provide information on land stability and inform detailed design. Following the ground investigation, a remediation strategy will be implemented, where necessary. At this stage, the strategy is anticipated to comprise the following:

- the proposed remediation technique;
- implementation plan setting out the objectives and requirements of the remediation;
- validation sampling to confirm that remediation objectives have been met; and
- verification report.

5.1.7 The scope of the remediation strategy will be agreed with the Environment Agency/relevant local planning authority prior to its implementation. On completion of the remediation works, a verification report will be sent to the Environment Agency/relevant local planning authority for approval. Subject to the scope of the remediation strategy, the following will be undertaken where appropriate to inform construction activities and the detailed design of the buildings:

- Piling risk assessment (in accordance with the Environment Agency guidance) including control measures (where appropriate) to mitigate risk to controlled waters during piling installation;
- Detailed ground gas risk assessment and gas control measures during construction and to be incorporated into building design (where appropriate); and
- Groundwater and/or surface water monitoring.

5.1.8 The remediation strategy will be supported by a Project wide Material Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011).

5.1.9 Where, further ground investigation is not recommended at this stage, a discovery strategy would be implemented for that development area as a watching brief for any unanticipated or previously un-encountered contamination. RPS or another suitably trained personnel would be contacted, where any significant visual or olfactory evidence of contamination, not previously encountered, is identified by construction workers during the development works. The following shall be considered indicative of soil contamination that may require remediation:

- the presence of free phase contamination (liquid oils);
- fibrous or cement bound materials (potentially asbestos containing materials);
- significant staining and discolouration of exposed soils; and / or
- olfactory evidence of hydrocarbon contamination.

5.1.10 Any construction activities in the area of this material would cease until an appropriate plan for dealing with the contamination has been put in place.

5.1.11 In terms of construction workers, prior to construction works taking place specific risk assessment will be required in line with Health & Safety requirements. This will enable control measures and appropriate levels of PPE to be implemented.

6 References

Legislation

Contaminated Land (England) Regulations 2006 (as amended 2012).

Environmental Damage (Prevention and Remediation) Regulations 2015.

The Water Resources Act 1991.

Published Documents

British Geological Survey [n/d] Geology of Britain Viewer [online] Available at: [redacted] Accessed: 18 December 2019

British Standards Institution (2011) British Standard BS 10175:2011+A2:2017: Investigation of Potentially Contaminated Sites: Code of Practice.

British Standards Institution (2015) Code of practice for ground investigations (BS5930:2015).

British Standards Institution (2015) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BS8485:2015+A1:2019).

DEFRA (2012) Environmental Protection Act 1990: Part 2A - Contaminated Land Statutory Guidance.

DEFRA (2014) Category 4 Screening Levels

Department of the Environment (1995) Industry Profile – Airports.

Department for Transport (2015) National Policy Statement for National Networks. [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387223/npsnn-web.pdf

Department for Transport (2018) Airports National Policy Statement: New Runway Capacity and Infrastructure at Airports in the South East of England. [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714106/airports-nps-new-runway-capacity-and-infrastructure-at-airports-in-the-south-east-of-england-web-version.pdf

CL:AIRE (March 2011) Definition of Waste. Development Industry Code of Practice, Version 2.

Construction Industry Research and Information Association (CIRIA) (2007) C665: Assessing Risks Posed by Hazardous Ground Gases to Buildings.

CIRIA Document C552 – Contaminated land Risk Assessment: A Guide to Good Practice (CIRIA, 2001a).

CIRIA Document C532 – Control of Water pollution from Construction Sites: Guidance for Consultants and Contractors (CIRIA, 2001b).

Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. NC/99/73.

Environment Agency (February 2002) Piling into contaminated sites. National Groundwater and Contaminated Land Centre.

Environment Agency (2020) Land Contamination: Risk Management

Highways Agency (2008) Design Manual for Roads and Bridges. Vol 4. Geotechnics and Drainage. Section2. Earthworks, Part 2. HD22/08. Managing Geotechnical Risk.

Land Quality Management and Chartered Institute of Environmental Health (LQM/CIEH) (2015) S4ULs for Human Health Risk Assessment

Ministry of Housing, Communities and Local Government (2021) National Planning Policy Framework (NPPF). [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

Nathanail, C.P., McCaffrey,C., Gillett, A.G., Ogden, R.C. & Nathanail, J.F. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment, Land Quality Press, Nottingham.

7 Glossary

7.1 Glossary of terms

Table 7.1.1: Glossary of Terms

Term	Description
AST	Above ground Storage Tank
AC	Assessment criteria
BGL	Below ground level
BGS	British Geological Survey
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
C4SL	Category 4 Screening Level
CO	Carbon Monoxide
CS	Characteristic Situation
CSM	Conceptual Site Model
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EA	Environment Agency
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standard
GAC	Generic Assessment Criteria
GAL	Gatwick Airport Limited
IBC	Integrated Bulk Container
KM	Kilometers
L/Hr	Litres per hour
LGS	Local Geological Site
mb	Millibars
MBAS	Methylene Blue Active Substances
NVZ	Nitrate Vulnerable Zone
OS	Ordnance Survey
PAOC	Potential Areas of Concern
PCB	Polychlorinated Biphenyl
PFAS	Perfluoroalkyl substances
PFOS	Perflyorooctane sulphonic acid
PPE	Personal Protective Equipment
PPM	Parts per million
RAF	Royal Air Force
S4UL	Suitable 4 Use Levels
SgZ	Safeguard Zone
SOE	Special Operations Executive
SSSI	Site of Special Scientific Interest
SVOCs	Semi Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VOCs	Volatile Organic Compounds
WHO	World Health Organisation
WHO ATO	World Health Organisation Appearance Taste Odour
WFD	Water Framework Directive

Annex 1

Assessment Limitations

Phase 1 - Environmental Risk Assessment / Desk Study Environmental Review

General Notes

1. A "desk study" means that no site visits have been carried out as any part thereof, unless otherwise specified.
2. This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the Client.
3. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.
4. The accuracy of maps cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.
5. No sampling or analysis has been undertaken in relation to this desk study.
6. Any borehole data from British Geological Survey sources is included on the basis that: "The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation".
7. Where any data supplied by the Client or from other sources, including that from previous site investigations, have been used it has been assumed that the information is correct. No responsibility can be accepted by RPS for inaccuracies in the data supplied by any other party.
8. This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or in part after its original submission.
9. The copyright in the written materials shall remain the property of the RPS Company but with a royalty-free perpetual licence to the Client deemed to be granted on payment in full to the RPS Company by the Client of the outstanding amounts.
10. The report is provided for sole use by the Client and is confidential to them, their professional advisors, no responsibility whatsoever for the contents of the report will be accepted to any person other than the Client. [Unless otherwise agreed]

These terms apply in addition to the RPS "Standard Terms & Conditions" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. (In the event of a conflict between these terms and the said Standard Terms & Conditions, the said Standard Terms & Conditions shall prevail.) In the absence of such a written contract the Standard Terms & Conditions will apply.

Annex 2

Walkover Observations

Site visit was completed of Gatwick airport on the 25th of September 2019

Table A2.1: Summary of on site activities

Section	Description
Site Layout:	The site comprised Gatwick Airport and associated infrastructure including a number of hotels, offices and a railway station. The airport operations included two runways (main and central) located in the south of the site. A number of carparks, two commercial buildings, a British Airways Hangar and warehouse were located to the south of the runways. The land to the far north west of the runway comprised a fire training ground with undeveloped, (likely agricultural) land beyond. The main airport operations area to the north of the runways comprised a Boeing Hangar, Virgin Hangar, a number of aircraft stands and a maintenance area in the north west with car parking areas for long stay parking further to the north west. The central north area comprised a number of taxiways and aircraft stands, a cargo centre, the fire station, storage areas, a fuel farm and further car parking areas. To the north east of the runways were further aircraft stands and taxiways, the two airport terminals and a number of offices and hotels. The airport also comprised an eastern area located beyond the railway line and A23, which comprised a number of car parks, vehicle hire offices and workshops, hotels, offices and fast food restaurants.
Activity / Operations:	For ease of description the site has been separated into the below areas. **Eastern area:** This area is located to the east of the main airport, beyond the railway line and A23. The southern portion of the eastern area comprised woodland with two ponds in the south (likely associated with adjacent sewage treatments works). The center of the eastern area was occupied by a number of long stay car parks, including self-park south, south valet and valet courtyard, as identified on Figure 5.2.1b. The long stay car parks were accessed from Ring Road South. Also located adjacent to the Ring Road to the north of the car parking areas (between self-park south robotics and the coach park on Figure 5.2.1b) were two buildings comprising maintenance areas occupied by Enterprise rent-a-car, Europcar and Herts for the maintenance of hire vehicles. The buildings were also noted to comprise car wash areas and vehicle refueling areas with three individual refueling points noted. Labelling on the refueling points indicated that underground storage tanks of petrol were located below. Two further vehicles hire company maintenance areas were noted within the south valet car parking area. One (located adjacent to the east of Pond G (Figure 5.2.1e) was occupied by Europcar and also appeared to include a refueling area with likely underground fuel storage tanks. An Avis vehicle maintenance area was also located in the east of the site to the south of the forecourt, leading from the south terminal. The maintenance area also appeared to be utilized for the repair of hire vehicles and included a car wash and vehicle refueling facilities with labelling on the dispensing pumps indicating both diesel and petrol underground tanks were present. The northern area of the east of the site comprised a multi-store car park and forecourt area (leading via aboveground covered walkways to the south terminal), a Hilton Hotel, a Marriott Hotel, two office buildings a drive in McDonalds and KFC restaurant and a petrol filling station operated by BP and associated car parking areas. **South of the runways:** Car parking areas were located to the southwest of the runways which predominantly appeared to be utilised as long stay parking for customers. The south east of the runway included a staff car park area (car park z on Figure 5.2.1b) with a material store to the north of the car park for storage of grit and other hardcore materials reported to be currently utilised for the development of a new slipway. A British Airways hangar was located adjacent to the east of the car park and was reported to be utilised for the servicing of aircraft. The hangar was not permitted to be accessed as part of the site walkover but appeared to comprise warehouse / maintenance area on the airside with offices to the rear. Two large above ground tanks were noted to the rear of the hangar and appeared to be sprinkler water storage tanks, however this was not confirmed. Further car parking and a warehouse noted to be occupied by Mitie (facility management) and Babcock (engineering services) were located to the south east of the runways. A disused aircraft was also located in this area, reported to be utilised for the practising of de/anti-icing however only water was reported to be used. **Northeast of the runways:** The north east of the runway comprised the South and North Airport Terminals and associated piers and aircraft stands. Hotels, offices and commercial buildings were also located in the landside area of the north east of the site including a police station and a Shell petrol filling station. The airside in the north east of the airport included small engineering areas (one of which was located to the south of stands 4 and 5) and another adjacent to stand 574. The engineering areas were utilised by each air firm for the maintenance of airplanes at the stands and included the storage of waste from the airplanes such as waste fuel and also small amounts of chemicals and oils for use in airplane maintenance. The majority of the non-waste chemicals were noted to be stored on bunds or in bunded stores. Above ground de/anti-icer storage tanks and materials were stored in the area of stands 136 to 140 just north east of the runways. **Centre north of the runways:**

Section	Description
	A fire station and airside maintenance vehicle storage area were located to the immediate north centre of the runways. Further aircraft stands and a cargo centre (comprising of terraced warehouse units) were present beyond this. The cargo centre occupants included Royal Mail, World Freight Service and Animal Aircare Ltd and TCR (air industry ground support equipment servicing). The unit occupied by TCR was utilised for the repair of ground support vehicles. Further car parking and a waste treatment plant occupied by DHL were located to the north of the Cargo Centre with a fuel farm comprising five large above ground tanks for the storage of aviation fuel located in the far north. The aviation fuel was reported to be transported directly to the tanks via an underground pipeline. Access was not permitted to the fuel farm as part of the site walkover. Adjacent to the fuel farm was a small waste area (referred to as the “wet tip”) where sewage waste from the aircraft was disposed of to a septic tank. In addition, the waste area comprised two lined pools for the storage of surface water from the runways / external areas and contaminated water from the runways / external areas. **North west of the runways:** The far northwest of the runways included an area utilised by the fire service for training purposes with undeveloped, likely agricultural land beyond. Two dummy aircraft were located in this area for fire training purposes. An above ground propane storage tank was present in the south west of the fire training area with beneath ground pipework supplying the large dummy aircraft in the centre. A land drain was noted around the fire service training area. The area to the north west of the runways also included a Boeing hangar, currently under development and not yet in use, a Virgin hangar, aircraft stands and a maintenance area (Oscar Remote Stands on Figure 5.2.1a), including refuelling area for ground service vehicles and vehicle wash facilities. A large long stay car parking area was also located beyond the Virgin hangar to the north west of the runways. The majority of the airside vehicles on-site were noted to be electric powered with numerous recharging points located around the airport.
Drainage:	Slot drains were observed in the runway, taxiway and aircraft stand areas. The site representative reported that all drainage within the airside area and possible also the landside area operated by Gatwick drains to a number of ponds located around the airport. The ponds then connect to a water treatment plant located in the north of the site, above stand 64, where the surface water is treated and tested before being discharged to the River Mole. The site representative reported that all drainage within the airside area can be controlled and either closed off or directed to a dedicated pond in the event of a spill. A vehicle refuelling and adjacent car wash were located in the landside maintenance area (Oscar Remote Stands), surface water drains were noted surrounding the vehicle refuelling area and below the vehicle wash. It was not known where the drains discharged to or if an interceptor was present, however, the site representative reported that, similarly to all drainage on-site, the drains entered an on-site pond for treatment. Three adjacent drain covers were noted in the refuelling area vicinity indicating the potential presence of an interceptors. Further refuelling areas and vehicle washes were noted in the eastern area of the site operated by vehicle hire firms. Dedicated surface water drainage was not noted in the vicinity of the vehicle hire maintenance areas in the east of the site excluding the Europcar maintenance area adjacent to the east of Pond G where surface water drains were noted in the vicinity of the refuelling area. It was not known if an interceptor was present in these areas. A septic tank for foul waste from the airplanes was reported to be located in the north of the site north of the fuel farms. This was reported to be collected and disposed of off-site.
Bulk Storage / Tanks:	Five above ground bulk storage tanks of aviation fuel were observed in the fuel farm in the north of the site. The capacity of the tanks was not provided, however, given their size it is considered to be in the millions of litres. It was also not clear if the tanks extended below ground. The tanks were reported to be directly filled from an underground pipeline which was reported to extend from a dedicated port to the airport. Fuel was then reported to be connected to the airplane stands via underground pipework with a refuelling point at each aircraft stand. The fuel was reported to be piped through the underground pipework at high pressure. A refuelling area for the fuelling of airside support vehicles was located in the maintenance area (Oscar Remote Stands) in the centre north of the site. The refuelling area was noted to comprise eight dispensing points and five ventilation pipes indicated the presence of approximately five underground fuel storage tanks. The tanks were reported to contain diesel, petrol and gas oil. A refill point for an unleaded petrol underground storage tank was noted with labelling indicating the tank was 29,100 litres in capacity. No other refill points were identified. An above ground bulk storage tank of gas oil (48,500 litres capacity) was also noted in the Oscar Remote Stands area. The tank was noted to comprise an integrally bunded tank with the refill and dispensing points / hose located behind a roller shutter door within the bund. No significant staining was noted in the area. An integrally bunded tank of Adblue was also noted. A 6,500 litre aboveground storage tank reported to comprise soap (SC08 Stand Cleaner) was also noted in this area. The tank was located within a brick bund. The bund was not covered and was filled with an approximately 5cm deep layer of green coloured liquid. It was not clear if this represented a leak from the tank or the combination of a leak and rainwater or other contamination. Adjacent to the refuelling area in Oscar Remote Stands was a maintenance warehouse for the servicing of airside support vehicles. Three above ground tanks were noted on a mezzanine level within the warehouse. The tanks were reported to comprise engine and hydraulic oil and were connected by aboveground pipework to refilling and dispensing points. A bunded external store of drums of oil and intermediate bulk containers of Adblue were also noted.

Section	Description
	Two petrol filling stations were noted on site. A Shell operated PFS was located in the north east of the site, adjacent to the Premier Inn. The forecourt area of the Shell PFS was not accessed and therefore, the number, capacity and contents of the underground tanks was not identified. The second PFS was located in the north east of the site adjacent to the McDonalds restaurant and was operated by BP. Labelling on the refill points for the underground storage tanks indicated the presence of five tanks as below: ▪ 57,730 litres diesel; ▪ 43,120 unleaded petrol; ▪ 14,610 diesel; ▪ 31,120 unleaded petrol; and ▪ 14;610 unleaded petrol. Underground fuel storage tanks containing petrol and diesel are also considered likely to be present beneath the refuelling areas operated by vehicle hire companies in the east of the site. RPS considers that there is the potential for approximately ten underground tanks to be present between the five hire car facilities. Above ground de/anti-icer tanks were noted in the centre of the site in the area of stand 130 to 145. The de/anti-icer tanks comprised four 80,000 litre tanks of ECO2 and two 80,000 litre tanks of KONSIN for the de/anti-icing of the runways, taxi areas and aircraft stands. Above ground pipework connected to small generators was located between the tanks which was operated to fill de/anti-icing vehicles with the de/anti-icer when required, each vehicle was reported to hold 6,000 litres of de/anti-icer. Granular de/anti-icing material (Safegrip SF) was also stored in a covered area adjacent to the tanks. Both ECO2 and KONSIN were utilised for the de/anti-icing of the runways with Type IV reported to be utilised for the de/anti-icing of planes. Three 80,000 litre above ground storage tanks of Type IV for the de/anti-icing of planes were also located in this area. Further above ground storage tanks of de/anti-icer for the aircraft were located in integrally bunded tanks to the south of the fuel farm. The TCR maintenance area included two above ground oil storage tanks of 2,000 litre capacity. The tanks were located internally to the unit. Some staining of the underlying hardstanding was noted.
Waste:	Waste contaminated water from spills and similar events was reported to be cleaned up by a dedicated cleaning vehicle with a vacuum function with the contaminated water then disposed of in the wet tip area, located in the north of the site immediately beyond the aviation fuel farm. The wet tip comprised two pools / pit which appeared to be concrete lined. One pool was for contaminated water and the other was for littered surface water. The surface water pool was reported to be discharged to the drainage system with any litter waste within the pool collected and crushed. Contaminated water was reported to be collected by a waste tanker and disposed of off-site. The waste tanker was reported to be operated by Sweeptank. Contaminated mats and granules following a spill event were also stored in the wet tip area in a covered store in metal 205 litre drums located on plastic bunds. DHL were reported to collect the waste contaminated materials. Containers (metal drums, boxes and intermediate bulk containers) of contaminated rags, waste oil filters, waste oil and waste chemical containers were noted on-site, stored in the air firm maintenance areas, the airside vehicle maintenance area in Oscar Remote Stand and within the TCR maintenance warehouse. An above ground metal waste oil tank and intermediate bulk containers of adblue were located externally to the airside vehicle maintenance area. Both were reported to be collected by DHL. An above ground waste oil tank was also located internally to the TCR maintenance warehouse. The tank was reported to be approximately 2,000 litres in capacity. Contaminated waste from the TCR unit was reported to be collected by Oakwood.
Electricity Substations /Transformers:	Electricity substations were reported to be present on site and were understood to be the responsibility of Gatwick Airport. The site representative was not aware of the location of all the substations however one was noted in the south west and one in the east of the site, adjacent to Pond G. The substation adjacent to Pond G was labelled as the responsibility of UK Power Networks.
Visual Evidence of Contamination:	The site representative reported that, on occasions, the refuelling of planes has resulted in small spills of fuel. Spill kits were located throughout the site and all airside support vehicles were noted to carry spill kits with absorbent booms, granules and specialist clay to block drains. A recent large fuel spill (in 2019) was reported to have occurred in the area of stand 558. The spill was the result of ground works damaging an aviation fuel pipe which caused a large geyser of fuel given the pressure of the pipes. The airport fire service and airside support were reported to have attended the event.
Statutory Nuisance:	The site representative reported no knowledge of any statutory nuisances in relation to the site.
Other Issues:	No Japanese Knotweed or Giant Hogweed (invasive plant species) were readily identified on or adjacent to the site at the time of the survey. (It should be noted that the identification can be limited by the seasons and in areas of dense vegetation growth).

The Surrounding Area

The site is located in an area of mixed commercial, agricultural and residential area land uses. At the time of the site inspection, neighbouring land consisted of the following:

Table A2.2: Neighbouring Land Uses

Direction	Description
North:	Agricultural land with residential properties beyond.
East:	Agricultural land and residential properties.
South:	Agricultural land and industrial estate.
West:	Agricultural land and residential properties.

The River Mole was observed to run along the northern edge of the site.

Annex 3

Previous Ground Investigation Reports Summary

Table A3.1: Summary of Existing Ground Investigation Reports

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
1	A380 On Stand 125 – Site Investigation Report (appendix to document)	2A125-00-C-911-SUR-000001	14/03/2012	N (Stand 125)	Determine structural strength of concrete and ability to handle traffic	4 concrete cores 4 WS holes 4 DCP tests	2 (metals, total TPH, PAH 16)	N	N	N	N
2	Geotechnical Design Report – Airfield Operations Building (AOB)	2S169-XX-C-XXX-PDR-00007	04/04/2012	N (AOB)	GDR for new AOB	6 WS holes 2 GW/Gas MW	N	N	Y (2 rounds - March 2012)	Y (2 rounds – March 2012)	N - No gas RA undertaken
3	Airfield Taxiway Papa November (P&N)– Pavement Investigation Test Report	2AFLD-00-C-911-SUR-000001	17/04/2018	N (taxiway P&N – no plan or coordinates for locations of core samples)	Pavement investigation	11 concrete cores	N	N	N	N	N
4	South Terminal Northern Extension Structural Assessment of Spare Capacity in the Existing Structure	20206-XX-S-247-BOD-000026	05/06/2018	N (extension to Bloc hotel, located in South Terminal)	Structural assessment for proposed extension to the existing Bloc hotel, includes SI and associated GDR (as appendices to the main report)	2 dynamic sampling and RC follow on boreholes 2 GW MW 2 CPT 4 TP	2 (metals, speciated PAH, phenol, cyanide and asbestos screen)	N	N	N	N
5	Phase I Environmental Site Assessment	10509471	June 2017	N (Boeing Hangar)	Desk study prior to construction of Boeing Hanger	None – included review of previous Arcadis SI report	NA	NA	NA	NA	NA
	Phase II Environmental Site Assessment	No reference	June 2017		SI prior to construction of Boeing Hangar	19 WS 2 surface water samples 2 sediment samples 4 TP 12 vapour boreholes 5 spoil heap samples	42 (metals, cyanide, VOCs, SVOCs, PAH, phenol, EPH, asbestos, PCBs, pesticides/ herbicides	21 (metals, VOCs, SVOCs and EPH) Surface water were also analysed for cyanide, PCBS, PFAS, PFOS and PFOA	Y (1 round)	N but vapour samples collected (ground gases, TPH and VOCs)	Y
	Focused Soil and Groundwater Investigation for PFAS	41525212	09/11/2019		Provide further information on PFAS, following Phase II SI	5 WS 5 MW 2 surface soil samples	12 (PFAS and asbestos screen)	4 (PFAS)	Y (1 round)	N	Y
	Phase 2 Gatwick Boeing Hangar Geo Environmental Interpretative Report	20000-XX-B-911-PDR-000006	July 2017		SI prior to construction of Boeing Hangar	15 RC boreholes 22 TP 22 CPT	46 (metals, cyanide, speciated PAH, banded TPH, VOCs, AC and asbestos) and 10 leachate tests	19 (metals, cyanide, phenols, speciated PAH, TPH CWG and VOC)	Y (6 rounds over 2.5 months)	Y (6 rounds)	Y
	GDR – Boeing Hangar	20760-00-C-915-TDT-000001	10/11/2017		GDR to enable design of hangar	23 CPT 4 TP	N	N	N	N	N

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
	Gatwick Boeing Hangar - Ground Investigation Report	20000-XX-B-911-PDR-000001	February 2017		SI prior to construction of Boeing Hangar	13 dynamic sampling and RC boreholes 7 TP	10 (metals, asbestos, PAH and TPH CWG)	3 (Metals, PAH, phenols). GW samples collected during drilling	N	N	N
	Gatwick Boeing Hangar – Geo Environmental Interpretative report	20760-XX-R-911-SUR-000002	February 2017		Interpretation of 20000-XX-B-911-PDR-000001 report	NA	As above				Y
	Gatwick Hangar – Geotechnical Interpretative Report	20760-XX-R-911-SRC-00002	March 2017		Interpretation of 20000-XX-B-911-PDR-000001 report	NA	NA	NA	NA	NA	NA
6	Crawters Brook Bird Netting - Ground Investigation Report	20000-XX-C-871-SRC-000001	14/03/2016	N (along Perimeter Road South)	Provide information for bird netting over Crawters Brook Stream	5 WS	4 (metals, PAHs, TPH CWG, asbestos, cyanide, phenol and WAC)	N	N	N	N
7	Report on a Geotechnical Investigation - Dax	20206-00-C-911-SUR-000001	November 2012	N (in Southern Terminal, next to end of shuttle)	Geotechnical SI for new building	2 WS	N	N	N	N	N
8	Factual Ground Investigation Report - De-Icing tanks	J13784 v2	22/10/2018	N	Proposed to locate new free-standing bunded de-icing tanks	3 WS 2 PBT 4 concrete cores 4 DCP	2 (metals, banded TPH, phenol, PAHs, WAC)	N	N	N	N
9	Ground Investigation - South Terminal International Departures Lounge (IDL)	20206-00-SR-900-000001 rev 1	August 1998	Unknown – not likely as relates to existing IDL	Geotechnical SI for proposed extension to IDL	2 CP	N	N	N	N	N
10	South Terminal External Security Building – Ground Investigation Specification	22152-XX-C-911-SPE-000004/5	11/10/2017	Not relevant – specification document, no GI undertaken		NA	NA	NA	NA	NA	NA
11	Fire Training Ground – Geotechnical and Contamination Assessment	106400/0100	September 1999	Y (fire training area)	Proposed to redevelop current fire training ground with a fire training rig	12 TP	17 (metals, PAH, phenol, asbestos, TPH and TEM)	5 (metals, TOC, nitrate, iron, manganese, BOD and COD) from trial pits	N	N	Y
	Laboratory Analysis Letter Report	No reference	22/08/2002		Unknown – very little information provided		N	4 (inorganics and oil fingerprinting)	N	N	N
12	Long Term Storage Lagoon Nr 1	22150-XX-C-870-UDT-000017	03/12/2013	N (to east of South Terminal)	Refurbish existing storage lagoon (Pond D) – drainage calculations	6 WS	N	N	N	N	N

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
13	Report on a Ground Investigation at New Engineering Stores	12255	March 2011	N	Provide information for foundation design of stores	14 Concrete cores 12 DCP 8 WS	N	N	N	N	N
14	Gatwick Batcher Plant – land contamination results and Trial Pit Narrative Document	22196-00-C-864-TDT-000001	29/01/2018	Y (one of construction compounds)	Provide information of geotechnical properties of soil	5 TP	5 (metals, asbestos, PAHs and TPH CWG)	N	N	N	Y
15	Gatwick Stream Flood Attenuation – Contaminated Soil Sampling from the Control structure & Haul Road Results	22089-XX-U-871-REP-000004	13/12/2013	N	Not provided	3 soil samples	3 (metals, phenol, e-coli, PAHs, TPH CWG	N	N	N	N
16	Gatwick Taxiway and AGL Rehabilitation – Pavement Site Investigation	20000-XX-R-XXX-SUR-000002	05/06/2013	N (TPs on north side of Taxiway 42 S)	Not provided	25 Concrete cores 2 TP	N	N	N	N	N
17	Gatwick Airport Maintenance Base – Groundwater Monitoring and Risk Assessment	20064-XX-C-911-SUR-000001	January 2007	Y (one of the construction compounds	Monitoring before, during and after demolition of buildings on the maintenance base	4 CP 4 MW	16 soil and 3 sediment samples (metals, asbestos, cyanide, EPH, PAH, VOCs and SVOCs)	3 rounds carried out from 4 newly installed wells and 8 pre-existing wells (metals, EPH, PAH, VOCs and SVOCs)	3 rounds (only 1 completed at time of reporting)	N	Y
18	Report on a Ground Investigation at London Gatwick Airport South Terminal - Hangar 5 & Building P7	20062-00-SR-247-000001 Rev 1.0	15/02/2010	Y (one of the construction compounds)	Prior to demolition of buildings, to be replaced by a logistics centre	3 CP and 3 MW 2 WS	12 (metals, cyanide, asbestos PAH, VOC, SVOCs)	3 (metals, cyanide, PAH, VOC, SVOCs)	1 round	N	N
19	Jubilee House Coach Parking – Ground Investigation Test Report	20700-00-S-200-TST-000001	11/11/2016	N	Proposed construction of new bus/coach pick-up area	3 WS 3 CBR	1 (WAC)	N	N	N	N
20	Main and North Runway Rehabilitation – Ground Investigation Report	2000-XXC-4191-REP-00003	08/12/2017	Y (northern runway)	Rehabilitation of runways	22 Cores with WS follow-on	N – Hydrocarbon contamination noted on logs	N	N	N	N
21	Maintenance Base – Hangar Decommission	Y– duplicate of Report 17									
22	MSCP 7 – Ground Investigation Report	20000-XX-C-734-SUR-000001	09/01/2017	N	Proposed construction of new car park	6 dynamic sample with RC follow-on	10 (WAC)	N	N	N	N

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
	MSCP 7 – Geo-environmental Desk Study	20700-XX-U-911-TDT-0000022070 0-XX-U-911-TDT-000002	August 2016			Desk Study	N	N	N	N	N
	MSCP 7 – Ground Investigation Report	20700-XX-C-911-TDT-000001	12/10/2016			As report 20000-XX-C-734-SUR-000001	10 (WAC)	N	N	N	Y
	MSCP 7 Site Investigation – Additional Groundwater Monitoring and Reporting	20700-XX-C-911-TDT-000002 Rev02	23/07/2017				N	N	4 rounds (8 months)	N	N
23	MSCP 4 – Geo-environmental Desk Study	22081-XX-U-911-TDT-000001	20/06/2017	N	Proposed construction of new car park	Desk Study	N	N	N	N	N
	MSCP 4 – Ground Investigation Report	20000-XX-B-911-TDT-000001	17/01/2018			3 dynamic samples 2with RC follow-on 3 MW 9 WS	18 (metals, PAH, TPH CWG, phenols, asbestos and WAC)	3 (pH, sulphate, magnesium)	3 rounds (4 months)	N	N
	MSCP 4 – Ground Investigation Report	22081-XX-C-911-TDT-000001	05/03/2018			As report 20000-XX-B-911-TDT-000001					Y
24	NT Car Park J Ditch Remediation Design Report	20724-XX-X-864-ROP-000002	18/11/11	N	Investigation of ditch instability and settlement in car park	2 RC 1 WS 4 TP 3 ditch water sample points	7 (metals, PAH, TPH, SVOCs, VOCs, TEM, asbestos and WAC)	3 (metals, PAH, TPH, SVOCs and VOC)	N	N	Y
25	North Terminal Extension – Interpretative Geoenvironmental Report	20700-XX-RP-900-000003	27/03/2009	N	Proposed extension to North Terminal	9 RC + 7 MW 10 WS + 8 MW 14 DP 16 Cores 20 DCP	28 (metals, RPH, PAH, TPH CWG, VOCs, SVOCs and WAC) – no laboratory certificates	5 (metals, VOCs, SVOCs, EPH and PAH) – no laboratory certificates	4 rounds (over 1.5 months)	4 rounds (over 1.5 months)	Y
	North Terminal Redevelopment – Geotechnical Desktop Site Appraisal	20700-XX-S-247—BOD-0000241	01/07/52013			None – desktop review	N	N	N	N	N

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
26	Gatwick Car Park Survey Zones F&G Factual Report	20000-XX-B-911-PDR-000005	July 2017	N	Proposed overdecking of car park	5 RC + 3 MW 10 WS	14 (metals, PAH, TPH CWG, asbestos, cyanide)	3 (inorganics)	3 rounds (over 1 month)	N	N
	Car Park Decking – Ground Investigation Report	20600-XX-C-911-TDT-000001	20/07/2019			As report 20000-XX-B-911-PDR-000005					Y
	South Terminal Decking Zones F&G – Geotechnical Design Report	20600-020-U-247-SPE-000001	18/01/2018								N
	South Terminal Decking Zones F 7 G – Geotechnical Design Report Sprinkler Tank	20600-00-U-247-SPE-000002	09/07/2018		Proposed sprinkler tank base at car park F&G	1 WS + 1 MW 2 TP	N	N	2 rounds (2 weeks)	N	NA
27	Pier 1 and Pier 2 Developments – Contaminated Land Site Investigation Interpretative Report	20209-XX-SR-200-000002 & 20340-XX-SR-200-000002	January 2010	N	Proposed redevelopment of Pier 1 and Pier 2	1 CP + 1 MW 9 WS + 2 MW 3 TP	12 (metals, EPH, TPH CWG, PCBS, VOCs, PAH, WAC)	N (wells dry)	1 round	N	Y
28	Pier 4	Not relevant – specification document, no ground investigation undertaken									
29	Report on a Ground Investigation at Gatwick North Terminal Pier 5	SE-RRG-F-001	26/01/2011	N	Redevelop Pier 5 – new link bridges, 2nd floor extension	2 RC + 2 MW 3 WS	5 (metals, cyanide, TPH CWG, PAH, VOC, PCB, asbestos and WAC)	N	1 round	N	N
	Pier 5 Reconfiguration – Environmental and Geotechnical Interpretative Report	20704-XX-BR-XXX-000001	12/09/2011			As report SE-RRG-F-001					Y
30	Pier 6 Surveys – Log & HWD report	2TQ01-00-R-911-SUR-000003	31/07/2018	N	Proposed realignment of Quebec Taxiway	14 Cores 14 DCP 11 TP	N	N	N	N	NA
31	Pier 6 Extension – Trial Pit Testing Report	20709-00-R-911-SUR-000003	June 2013	N	Redevelopment of Pier 6	7 TP	2 (metals, asbestos, cyanide, PAH, TPH CWG)	N	N	N	N
	Gatwick Pier 6 Extension – Fuel Leakage Investigation	20709-00-C-911-STD-000001	June 2013			8 CP – 8 MW 5 WS – 5 MW	N	2 rounds of sampling (metals, PAH, TPH CWG) –	6 rounds (2 months)	N	Y

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
								no laboratory certificates			
	Ground Gas Investigation – Pier 6 Extension	20709-00-C-911-STD-000002	February 2013			4 CP – 4 MW 8 WS – 8 MW	N	N	6 rounds (over three months)	6 rounds (over three months)	Y
	Gatwick North Terminal Pier 6 Extensions – Pavement Investigation Report	20709-00-R-911-SUR-000007	10/07/2013			42 Cores	N	N	N	N	N
	Pier 6 Extension – Factual Ground Investigation Report	20709-00-R-911-SUR-000005	June 2013			As report 20709-00-C-911-STD-000001 (includes laboratory certificates)					N
	Pier 6 Survey Works – Stand 103 – Borehole 10 & 11 Report	2S103-00-R-911-SUR-000004	05/07/2018			2 WS with RC follow on – 2 MW	3 (metals, TPH CWG, PAH, SVOCs, VOCs and asbestos)	N	N	N	N
32	Project Engineering List	Not relevant – no reports in folder									
33	Public Transport DDA Access – Ground Investigation Report	20000-XX-C-734-SUR-000002	09/01/2017	Y (potential area for junction improvement works)	Improving access to local transport	1 WS with RC follow on – 1 MW 1 trial trench 4 TP	7 (metals, PAH, BTEX, PCB, WAC)	N	2 rounds (1 week)	N	N
	Public Transport DDA Access – Combined Ground Investigation Report & Geotechnical Design Report	20000-XX-R-734-SUR-000001	11/04/2017			As report 20000-XX-C-734-SUR-000002					Y
34	Redevelopment of Hangar 5 & Building P7	Y – duplicate of report 18									
35	Geotechnical Report on Ground Investigation – Sub-Station G	20226-00-C-734-SRC-000001	July 2015	N	Redevelop the sub-station and relocated within a car park	7 Cores 2 TP with DCPs	7 (metals, PAH, TPH CWG and WAC)	N	N	N	N
36	Southern Terminal Baggage & Pier 1 – Factual Site Investigation Report	20209-XX-C-XXX-REP-000001	28/03/2012	N	Redevelop the current Pier 1 – include changes to the existing piers and taxiways and new baggage facility	22 RC 6 WS 14 CBR	N	N	N	N	N
	Pier 1 & Baggage Project Report on a Ground Investigation – Phase 3	20220-00-R-911-SUR-000004	21/06/2013			4 CP with RC follow on – 2 MW 4 WS	N	N	4 rounds (weekly)		N

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
	ST Baggage & Pier 1 Project – Contamination Survey Phase A Report	20220-00-R-911-SUR-000001	29/04/2013			7 dynamic sample and RC follow on – 6 MW 9 TP 3 surface water samples from Gatwick Stream	28 (metals, asbestos, TPH CWG, VOCs and SVOCs)	10 (metals, inorganics, TPH CWG, VOCs and SVOCs)	1 round		N
	ST Baggage + Pier 1 Geoenvironmental Conceptual Site Model	20209-XX-C-900-REP-000001	28/09/2012			None – desk based assessment	N	N	N	N	N
	Contaminated Strategy Report – Gatwick Airport South Terminal Baggage & Pier 1 Project	20220-00-H-XXX-TDT-000001	23/09/2013			None – desk based assessment	N	N	N	N	N
	South Terminal Baggage and Pier 1 Contaminated Land Risk Assessment and Remediation Strategy	20220-XX-C-911-BOD-000001	31/05/2013			12 WS with RC follow on – 12 MW 7 TP 3 surface water samples 19 WS 7 TP	38 (metals, BTEX, VOC, SVOCs, PAH, TPH CWG, PCBs and asbestos)	19 (VOCs, SVOCs, PAH, TPH CWG and metals)	4 rounds (weekly)		Y
	ST Baggage & Pier 1 – Contaminated Land Verification Report	Report corrupted – illegible				Report corrupted – illegible					
	Drawing – Findings of Contaminated Land Assessment	20220-XX-C-911-GA-000013	30/05/2013			Drawing					
	Drawing – Existing Geological Conditions Layout	20220-XX-C-915-GA-000001	13/12/2012			Drawing					
	Drawing – Ground Investigation Hole Location Plan	20220-XX-C-911-GA-000012	13/12/2012			Drawing					
37	Southern Terminal Baggage Project – Report on a Ground Investigation	20203-00-SR-911-000014	18/02/2010	N	Redevelop area as strategic hub	2 CP – 2 MW 1 RC – 1 MW 1 WS 8 TP	5 (metals, PCBs, PAH, EPH, VOCs, phenol and asbestos)	N	1 round	1 round	N
38	Southern Terminal ULD External Storage Facility – Ground Investigation Report	22118-00-C-915-TST-000001	18/10/2017	Y (one of the construction compounds)	New pavement and additional stillage units	5 TP	N	N	N	N	N

No	Report Title	GAL Reference	Date	In Genesis Area?	Purpose	GI Scope	Soil Samples?	GW Samples?	GW Level Monitoring? Long term?	Ground Gas Monitoring?	Interpretation of Environmental Results?
	ULD External Storage Facility – Trial Pit Test Results	22118-00-C-915-TST-000003	18/10/2017			As above (comprised the 5 trial pit logs)					
39	Gatwick STAD Project – Ashdown House Ramp and Canopy area Report	20362-00-C-911-SUR-000001	16/01/2013	N	Determine bearing capacity for canopy structure	1 WS	N	N	N	N	N
40	Strategic Power Resilience Project (Control Tower) – Site Investigation Report	20473-XX-C-XXX-SRC-000001	14/11/2018	Unknown	Determine whether leaching of diesel fuels from adjacent underground fuel tanks had occurred	2 WS	2 (metals, PAH, EPH, GRO, BTEX, PCBs, asbestos and WAC)	N	N	N	Y
41	Taxiway and AGL Rehabilitation	N – duplicate of report 16									
42	UXO and EXO Surveys – New Hangar	20760-XX-R-911-SRC-000001	18/11/2016	N	Undertaken prior to construction of Boeing Hangar	NA	NA	NA	NA	NA	NA
43	Westfield Stream Gatwick – Ground Investigation Report	No reference on report	January 2015	Y (Pond A and potential area for flood compensation)	Design of diversion of the Westfield Stream	3 WS with RC follow on – 1 MW 11 TP	20 (metals, asbestos, cyanide, PAH and TPH) – no laboratory certificates provided	N	1 round	N	Y
44	Main and North Runway Rehabilitation	Y – original version (v0) of report 20									
45	Public Transport and DDA Access	Y– duplicate of report 33 (Ground Investigation Report, ref: 20000-XX-C-734-SUR-000002									

WS – window sample borehole

TP – trial pit

CPT – cone penetration test

MW – monitoring well

GDR – Geotechnical Design Report

RC – rotary core

PBT – plate bearing tests

DCP – dynamic cone penetrometer test

CP – cable percussion borehole

CBR – California Bearing Ratio

Annex 4

Screening Criteria

Table A4.1: Groundwater Screening Criteria

Contaminant	AA-EQS (micrograms per litre)	UK Drinking Water Standards (micrograms per litre)	WHO Health (micrograms per litre)	WHO ATO (micrograms per litre)
Aluminium	-	200	-	-
Ammonia (NH3 as N)	15	-	-	-
Ammonium (as NH4+)	-	500	-	-
Anthracene	0.1	-	-	-
Antimony	-	5	-	-
Arsenic	50	-	-	-
Barium	-	1000	-	-
Benzene	10	-	-	-
Benzo(a)pyrene	0.00017	-	-	-
Benzo(b)flouranthene	0.00017	-	-	-
Benzo(k)fluoranthene	0.00017	-	-	-
Benzo(g,h,i)perylene)	0.00017	-	-	-
Benzyl butyl phthalate	7.5	-	-	-
Biphenyl	25	-	-	-
Boron	2,000	-	-	-
Cadmium and its compounds - dissolved (< 40 mg/l calcium carbonate)	<=0.08	-	-	-
Cadmium and its compounds - dissolved (40 - <50 mg/l calcium carbonate)	0.08	-	-	-
Cadmium and its compounds - dissolved (50 - <100 mg/l calcium carbonate)	0.09	-	-	-
Cadmium and its compounds - dissolved (100 - <200 mg/l calcium carbonate)	0.15	-	-	-
Cadmium and its compounds - dissolved (>200 mg/l calcium carbonate)	0.25	-	-	-
Calcium	-	250,000	-	-
Carbon tetrachloride	12	-	-	-
Chloride	250,000	-	-	-
Chlorine (total residual oxidant)	2	-	-	-
Chloroform	12	-	-	-
4-chloro-3-methylphenol	40	-	-	-
Chloronitro toluenes	10	-	-	-
2-chlorophenol	50	-	-	-
3-chlorophenol-4-chlorophenol total (or individual monochlorophenols)	50	-	-	-
Chromium III (dissolved)	4.7	-	-	-
Chromium VI (dissolved)	3.4	-	-	-
Copper (dissolved)	1 (bioavailable)	-	-	-
Cyanide	1	-	-	-
Dibutyl phthalate	8	-	-	-
3,4-dichloroaniline	0.2	-	-	-
Dichlorobenzene - total dichlorobenzene isomers	20	-	-	-

Contaminant	AA-EQS (micrograms per litre)	UK Drinking Water Standards (micrograms per litre)	WHO Health (micrograms per litre)	WHO ATO (micrograms per litre)
Dichloro-methane	20	-	-	-
1,2-dichloroethane	10	-	-	-
1,1-dichloroethene	-	-	30	-
1,2-dichloroethene	-	-	50	-
1,2-dibromo-3-chloropropane	-	0.1	-	-
1,2-dichlorobenzene	-	-	-	1 to 10
1,2-dichloropropane	-	0.1	-	-
1,3-dichloropropene	-	0.1	-	-
1,4-dichlorobenzene	-	-	-	0.3 to 30
2,4-dichlorophenol	4.2	-	-	-
Diethyl phthalate	200	-	-	-
Dimethyl phthalate	800	-	-	-
Dioctyl phthalate	20	-	-	-
Di(2-ethylhexyl)-phthalate (DEHP)	1.3	-	-	-
Ethylbenzene	-	-	-	2 to 200
Fluoranthene	0.0063	-	-	-
Fluoride - dissolved (<50 mg of Calcium carbonate per litre of water (mg/l))	1,000	-	-	-
Fluoride - dissolved (>50 mg/l of calcium carbonate)	5,000	-	-	-
Hexachloro-benzene	0.03	-	-	-
Hexachloro-butadiene	0.10	-	-	-
Hexachloro-cyclohexane	0.02	-	-	-
Hydrocarbons (dissolved/emulsions)	-	10	-	-
Hydrogen Sulphide	0.25	-	-	-
Indeno(1,2,3-cd)pyrene	0.00017	-	-	-
Iron - dissolved	1,000	-	-	-
Lead and its compounds (dissolved)	1.2 (bioavailable)	-	-	-
Magnesium	-	50,000	-	-
Manganese - dissolved	123 (bioavailable)	-	-	-
Mercury and its compounds (dissolved)	1	-	-	-
Methylbenzene	50	-	-	-
Naphthalene	2	-	-	-
Nickel and its compounds (dissolved)	4 (bioavailable)	-	-	-
Nitrate (as NO3)	-	50,000	-	-
Nitrite (as NO2)	-	100	-	-
pH (6 - 9)	-	-	-	-
Pentachloro-benzene	0.007	-	-	-
Pentachloro-phenol	0.4	-	-	-

Contaminant	AA-EQS (micrograms per litre)	UK Drinking Water Standards (micrograms per litre)	WHO Health (micrograms per litre)	WHO ATO (micrograms per litre)
Phenol	7.7	-	-	-
Phosphorous	-	2200	-	-
Potassium	-	12,000	-	-
Selenium	-	10	-	-
Sodium	170,000	-	-	-
Sulphate	400,000	-	-	-
Sulphide	0.25	-	-	-
Styrene	50	-	-	-
Tetrachloroethane	140	-	-	-
Tetrachloroethene (PCE)	10	-	-	-
Tetrachloro-ethylene	10	-	-	-
Tetrachloromethane (PCM)	12	-	-	-
Toluene	74	-	-	-
Tributyl phosphate	50	-	-	-
Trichloro-benzenes	0.4	-	-	-
Trichloroethene	10	-	-	-
Trichloro-ethylene	10	-	-	-
Trichloro-methane (chloroform)	2.5	-	-	-
1,1,1-trichloroethane	100	-	-	-
1,1,2-trichloroethane	400	-	-	-
2,4,6-trichlorophenol	-	-	200	-
Vanadium (0-200 mg/l of calcium carbonate)	20	-	-	-
Vanadium (>200 mg/l calcium carbonate)	60	-	-	-
Vinyl Chloride	-	0.5	-	-
Xylene	30	-	-	-
Zinc - dissolved plus ambient background concentration	10.9 (bioavailable)	-	-	-

Table A4.2: Soils

Metals		
Arsenic	640	S4UL(a)
Beryllium	12	S4UL(a)
Boron	240000	S4UL(a)
Cadmium	190	S4UL(a)
Chromium III	8600	S4UL(a)
Chromium VI	33	S4UL(a)
Copper	68000	S4UL(a)
Lead	2300	pC4SL
Elemental Mercury	58$^{vap (25.8)}$	S4UL(a)
Inorganic Mercury	1100	S4UL(a)
Methylmercury	320	S4UL(a)
Nickel	980	S4UL(a)
Selenium	12000	S4UL(a)
Vanadium	9000	S4UL(a)
Zinc	730000	S4UL(a)
Petroleum Hydrocarbons		
	1% SOM	
Aliphatic EC 5-6	3200 (304)^{sol}	S4UL(a)
Aliphatic EC >6-8	7800 (144)^{sol}	S4UL(a)
Aliphatic EC >8-10	2000 (78)^{sol}	S4UL(a)
Aliphatic EC >10-12	9700 (48)^{sol}	S4UL(a)
Aliphatic EC >12-C16	59000 (24)^{sol}	S4UL(a)
Aliphatic EC >16-35	1600000	S4UL(a)
Aliphatic EC >35-44	1600000	S4UL(a)
Aromatic EC5-7 (benzene)	26000 (1220)^{sol}	S4UL(a)
Aromatic EC >7-8 (toluene)	56000(869)^{vap}	S4UL(a)
Aromatic EC >8-10	3500 (613)^{vap}	S4UL(a)
Aromatic EC >10-12	16000 (364)^{sol}	S4UL(a)
Aromatic EC >12-16	36000 (169)^{sol}	S4UL(a)
Aromatic EC >16-21	28000	S4UL(a)
Aromatic EC >21-35	28000	S4UL(a)
Aromatic EC >35-44	28000	S4UL(a)
Aliphatic + Aromatic EC >44-70	28000	S4UL(a)
TPH Ali/Aro	-	
BTEX		
Benzene	27	S4UL(a)
Toluene	56000 (869)^{vap}	S4UL(a)
Ethylbenzene	5700 (518)^{vap}	S4UL(a)
o-xylene	6600 (478)^{sol}	S4UL(a)
m-xylene	6200 (625)^{vap}	S4UL(a)
p-xylene	5900 (576)^{sol}	S4UL(a)
MTBE	-	
PAHs		
Acenaphthene	84000 (57.0)^{sol}	S4UL(a)
Acenaphthylene	83000 (86.1)^{sol}	S4UL(a)
Anthracene	520000	S4UL(a)
Benzo(a)anthracene	170	S4UL(a)
Benzo(a)pyrene	35	S4UL(a)
Benzo(b)fluoranthene	44	S4UL(a)
Benzo(g,h,i)perylene	3900	S4UL(a)
Benzo(k)fluoranthene	1200	S4UL(a)
Chrysene	350	S4UL(a)
Dibenzo(a,h)anthracene	3.5	S4UL(a)
Fluoranthene	23000	S4UL(a)
Fluorene	63000 (30.9)^{sol}	S4UL(a)
Indeno(1,2,3-c,d)pyrene	500	S4UL(a)
Naphthalene	190 (76.4)^{sol}	S4UL(a)
Phenanthrene	22000	S4UL(a)
Pyrene	54000	S4UL(a)
PAH	-	
Phenols		
Phenol	440 (26000)^{dir}	S4UL(a)
Chlorophenols	3500	S4UL(a)
Pentachlorophenol	400	S4UL(a)
Chloroalkanes & alkenes		
Chloroethene (vinyl chloride)	0.059	S4UL(a)
Dichloroethane	0.67	S4UL(a)
Chlorinated Hydrocarbons		
Tetrachloroethanes	270	S4UL(a)
Tetrachloroethene	19	S4UL(a)
Tetrachloromethane (Carbon Tetrachloride)	2.9	S4UL(a)
Trichloroethane	660	S4UL(a)
Trichloroethene	1.2	S4UL(a)
Trichloromethane (Chloroform)	99	S4UL(a)
Explosives		
Trinitrotoluene	1000	S4UL(a)
RDX	210000	S4UL(a)
HMX	110000	S4UL(a)
Pesticides		
Aldrin	170	S4UL(a)
Dieldrin	170	S4UL(a)
Atrazine	9300	S4UL(a)
Dichlorvos	140	S4UL(a)
Endosulfan	5600 (0.003)^{vap}	S4UL(a)
Hexachlorocyclohexane	170	S4UL(a)
Beta-Hexachlorocyclohexane	65	S4UL(a)
Chlorobenzenes		
Chlorobenzene	56	S4UL(a)
2- Dichlorobenzene	2000 (571)^{sol}	S4UL(a)
4- Dichlorobenzene	4400 (224)^{vap}	S4UL(a)
1,2,3-Trichlorobenzene	102	S4UL(a)
1,2,4-Trichlorobenzene	220	S4UL(a)
1,3,5-Trichlorobenzene	23	S4UL(a)
1,2,3,4-Tetrachlorobenzene	1700 (122)^{vap}	S4UL(a)
1,2,3,5-Tetrachlorobenzene	49 (39.4)^{vap}	S4UL(a)
1,2,4.5 Tetrachlorobenzene	42 (19.7)^{sol}	S4UL(a)
Pentachlorobenzene	640 (43.0)^{sol}	S4UL(a)
Hexachlorobenzene	110 (0.20)^{vap}	S4UL(a)
Others		
Carbon Disulphide	11	S4UL(a)
Hexachlorobutadiene	31	S4UL(a)
1,2 - Dichloroethane	0.67	S4UL(a)
1,1,1 - Trichloroethane	660	S4UL(a)
1,1,1,2 - Tetrachloroethane	110	S4UL(a)
Chlorobenzene	56	S4UL(a)
1,2 - Dichlorobenzene	2000 (571)sol	S4UL(a)
1,3 - Dichlorobenzene	30	S4UL(a)

1,4 - Dichlorobenzene	4400 (224)vap	S4UL[(a)]
2,4,6 Trinitrotoluene (TNT)	1000	S4UL[(a)]

Notes

Soil chemical concentrations should initially be screened against the screening criteria value outside of brackets.

[vap] Vapour Saturation Limit. Concentration at which soil gas within pore space reaches staruarion limit. Increases in soil concentration above this criteria will not lead to increased soil gas concentrations with pore spaces. This value should not be used within the assessment it is an informative.

[sol] Solubility Saturation Limit. Concentration at which soil water becomes saturated with contaminant. Where this concentration is exceeded, free product may be present with pore spaces. If soils are below the water table exposure to free product upon the water table should be considered qualitatively where it may be present at the ground surface.

[dir] Screening criteria based on a threshold protective of direct skin contact with phenol. Values in brackets are based on health effects following long term exposure provided for illustration only.

pC4SLs have been used for lead in absence of S4ULs. Value selected is based on LLTC 2: Intake leading to blood lead concentration of 3.5 µg dL-1

When assessing total xyxlene oncentrations these should be compared to the lower of the lowest of the three isomers for the particular land use.

The screening values for the metals are based on a sandy loam with a SOM of 6%

S4ULs assume no free phase contamination is present.

References

[(a)] The LQM/CIEH S4ULs for human Health risk Assessment, 2015

[(b)] CL:AIRE SP1010 Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination (Rev. 2), September 2014

Annex 5

Part 2A (The Contaminated Land Regime)

Contaminated Land Definition

A5.1 Under Section 57 of the Environmental Act 1995, Part 2A was inserted into the Environmental Protection Act 1990 to include provisions for the management of contaminated land.

A5.2 Subsequent regulations were first implemented in England in April 2000, Scotland in July 2000 and Wales in July 20011, providing a definition of 'contaminated land' and setting out the nature of liabilities that can be incurred by owners of contaminated land and groundwater.

A5.3 According to the Act, contaminated land is defined as 'any land which appears to the local authority in whose area the land is situated to be in such a condition, by reason of substances in, on or under the land that:

a. *significant harm* is being caused or there is a *significant possibility* of such harm being caused; or

b. *significant pollution* of controlled waters[2] is being caused or there is a significant possibility of such pollution being caused[3]'

A5.4 The guidance on determining whether a particular possibility is significant is based on the principles of risk assessment and in particular on considerations of the magnitude or consequences of the different types of significant harm caused. The term 'possibility of significant harm being caused' should be taken, as referring to a measure of the probability, or frequency, of the occurrence of circumstances that could lead to significant harm being caused.

A5.5 The following situations are defined where harm is to be regarded as significant:

i. Chronic or acute toxic effect, serious injury or death to humans

ii. Irreversible or other adverse harm to the ecological system

iii. Substantial damage to, or failure of, buildings

iv. Disease, other physical damage or death of livestock or crops

v. The pollution of controlled waters[4].

A5.6 With regard to radioactivity, contaminated land is defined as 'any land which appears to be in such a condition, by reason of substances in, on or under the land that harm is being caused, or there is a significant possibility of such harm being caused5'.

The Risk Assessment Methodology

A5.7 Risk assessment is the process of collating known information on a hazard or set of hazards in order to estimate actual or potential risks to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected with the hazard via one or several exposure pathways (e.g. the pathway of direct contact). Risks are generally managed by isolating or removing the hazard, isolating the receptor, or by intercepting the exposure pathway. Without the three essential components of a source (hazard), pathway and receptor, there can be no risk. Thus, the mere presence of a hazard at a site does not mean that there will necessarily be attendant risks.

The Risk Assessment

A5.8 By considering where a viable pathway exists which connects a source with a receptor, this assessment will identify where pollutant linkages may exist. A pollutant linkage is the term used by the DEFRA in their standard procedure on risk assessment. If there is no pollutant linkage, then there is no risk. Therefore, only where a viable pollutant linkage is established does this assessment go on to consider the level of risk. Risk should be based on a consideration of both:

- The likelihood of an event (probability) - takes into account both the presence of the hazard and receptor and the integrity of the pathway.
- The severity of the potential consequence - takes into account both the potential severity of the hazard and the sensitivity of the receptor.

A5.9 For further information please see the Contaminated Land section on the DEFRA website (www.defra.gov.uk).

[1] In England by The Contaminated Land (England) Regulations 2000, updated by The Contaminated Land (England) (Amendment) Regulations 2012; in Scotland by The Contaminated Land (Scotland) Regulations 2000, updated by the Contaminated Land (Scotland) Regulations 2005; and in Wales by The Contaminated Land (Wales) Regulations 2001, updated by the Contaminated Land (Wales) Regulations 2006.

[2] In Scotland the term "controlled water" has been updated to "water environment" under the Contaminated Land (Scotland) Regulations 2005 in line with the Water Environment and Water Services (Scotland) Act 2003.

[3] The definition was amended in 2012 by implementation of the Water Act 2003.

[4] Groundwater in this context does not include waters within underground strata but above the saturated zone.

[5] The Radioactive Contaminated Land (Modification of Enactments) (England) Regulations 2006 and Contaminated Land (Wales) Regulations 2006.

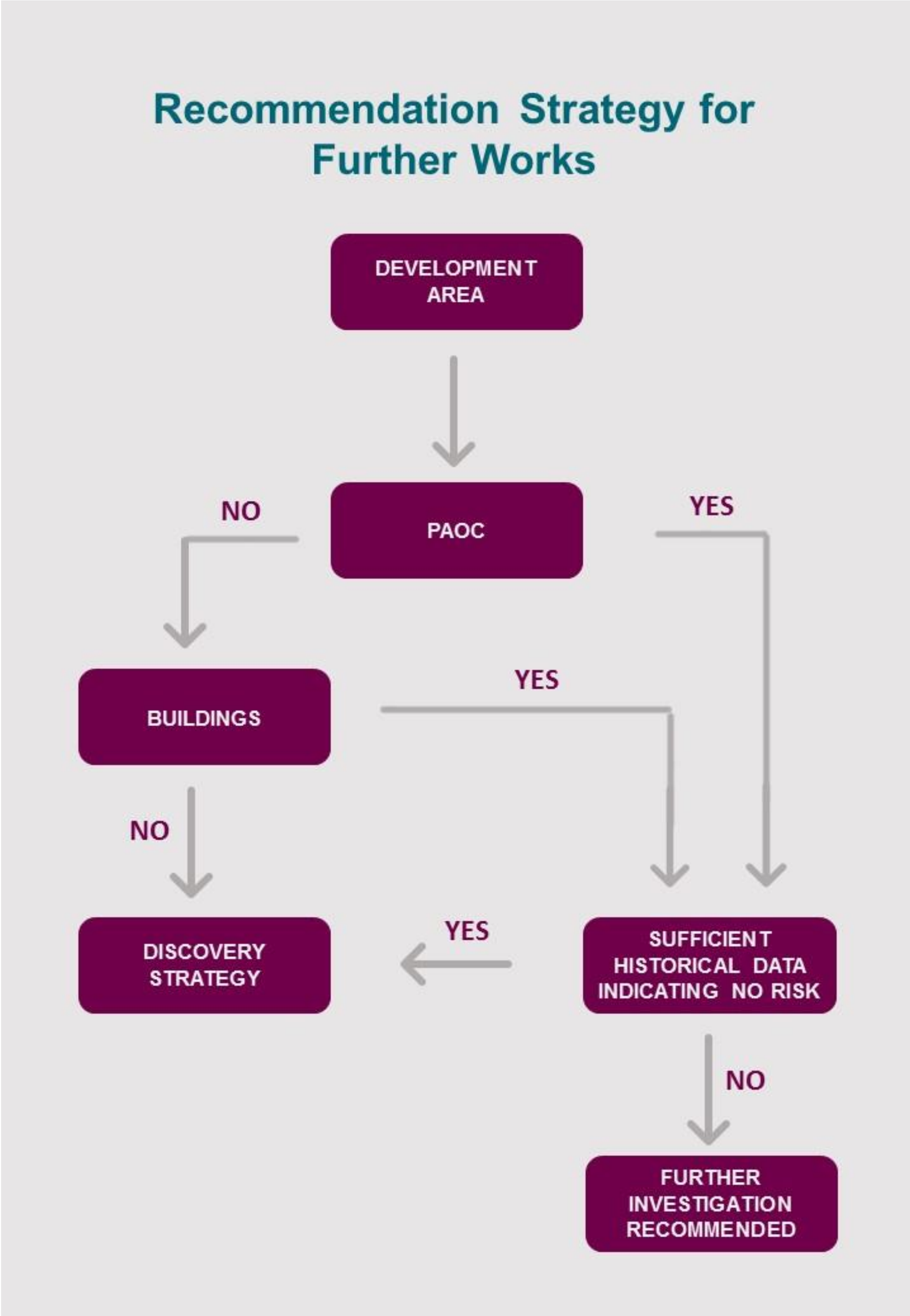
Annex 6

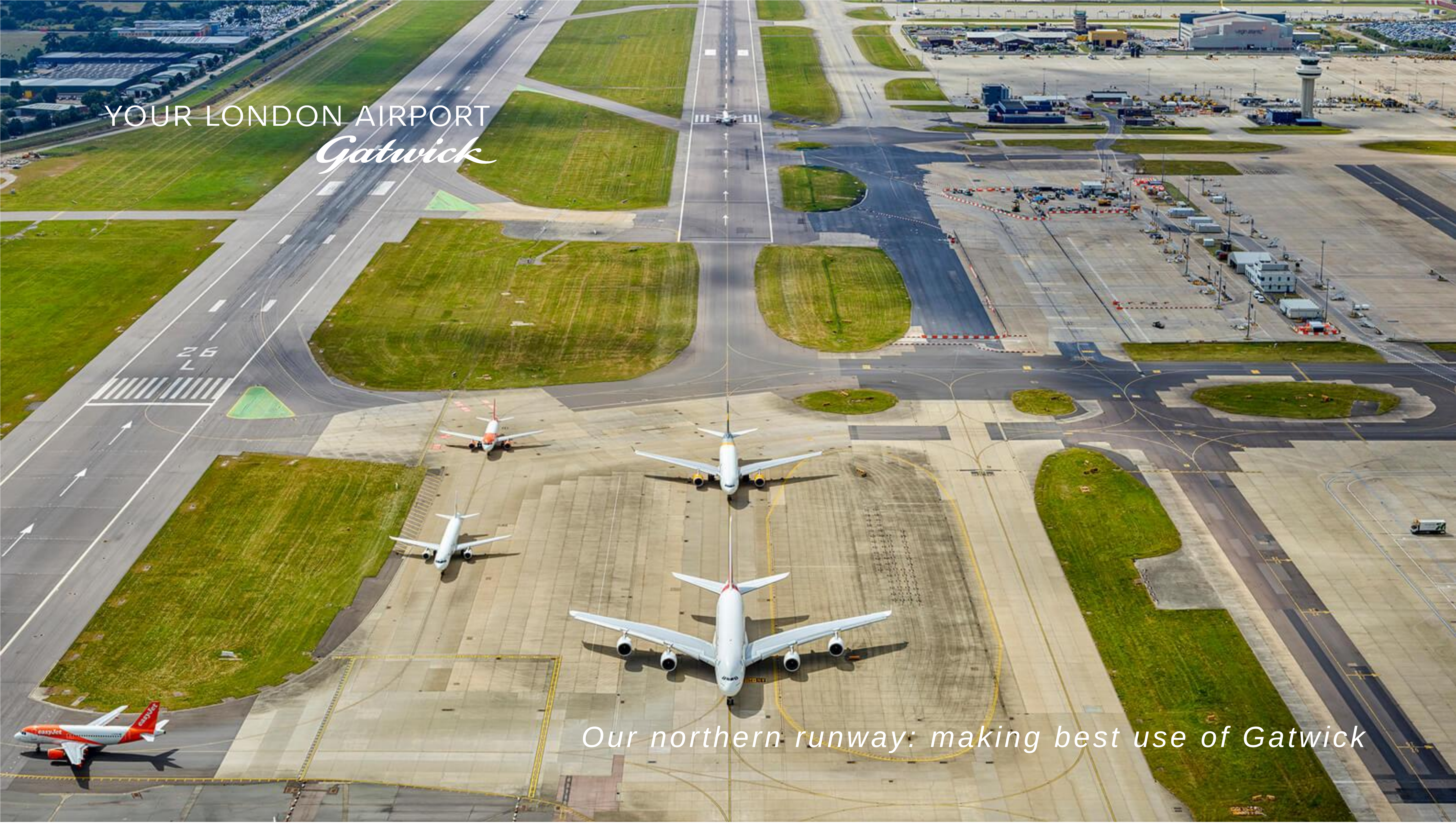
Requirement for Further Works

Table A6.1: Recommendation Strategy for Further Works

Development Area	PAOC ID	Buildings Proposed?	Previous Site Investigation	Potential for pollutant linkages to remain active upon development	Recommendation for Further Assessment
Relocation of Virgin Estate Infrastructure	12	No	No	Yes	Further Ground Investigation
Virgin Hangar - Pavement	16, 45	No	No	Yes	Further Ground Investigation
Converting 40s Stands	22, 28, 52, 65	No	No	Yes	Further Ground Investigation
South Terminal Coaching Gates	74	No	Yes	Yes	Further Ground Investigation
Car Park Y Storage	36	No	No	Yes	Further Ground Investigation
Motor Transport Facility	None	Yes	No	Yes	Further Ground Investigation
Rendezvous Point North	None	No	No	None identified.	Discovery Strategy
Satellite Airport Fire Service Facility	None	Yes	No	Yes	Further Ground Investigation
Future Waste Water Treatment	59	No	No	Yes	Further Ground Investigation
Longbridge Road Roundabout Compound	None	No	No	None identified.	Discovery Strategy
Flood Compensation Zone at Car Park X and V	None	No	Yes	None identified.	Discovery Strategy
Flood Compensation Area 3	None	No	No	None identified.	Discovery Strategy
Gatwick Stream FAS 2	None	No	No	None identified.	Discovery Strategy
Museum Field Flood Plain	None	No	No	None identified.	Discovery Strategy
Pond A & River Mole Reconfiguration	None	No	No	None identified.	Discovery Strategy
Relocation Substation J	None	Yes	No	Yes	Further Assessment
Relocation Substation A	None	Yes	No	Yes	Further Assessment
Environmental Mitigation and Enhancement (Brook Farm East)	None	No	No	None identified.	Discovery Strategy
Environmental Mitigation and Enhancement (Brook Farm South)	None	No	No	None identified.	Discovery Strategy
Environmental Mitigation and Enhancement (Brook Farm West)	None	No	No	None identified.	Discovery Strategy
Environmental Mitigation and Enhancement (New Woodland)	None	No	No	None identified.	Discovery Strategy
Environmental Mitigation	None	No	No	None identified.	Discovery Strategy
Relocation of Fire Training Ground	15	Yes	Yes	Yes	Further Ground Investigation.
Taxiway Juliet West (Spur)	None	No	Yes	None identified.	Discovery Strategy
Taxiway Juliet	37, 41	No	Yes	Yes	Further Ground Investigation.
Taxiway Juliet East	None	No	No	None identified.	Discovery Strategy
Runway Exits (Northern to Juliet)	9	No	No	Yes	Further Ground Investigation.
Northern Runway 08L/26R	None	No	Yes	None identified.	Discovery Strategy
End Around Taxiway West	None	No	No	None identified.	Discovery Strategy
Exit Taxiway Main to East	None	No	No	None identified.	Discovery Strategy
Exit Taxiway Main to North	None	No	Yes	None identified.	Discovery Strategy
Crawter's Road Car Park	43	No	No	None identified.	Further Ground Investigation.
Airfield Satellite Welfare Contractor Compound	None	No	Yes	None identified.	Discovery Strategy
Taxiway Uniform	None	No	No	None identified.	Discovery Strategy
Cuckoo Remote Stands – Phase 1	16	No	No	Yes	Further Ground Investigation
Tango Cut Through	None	No	No	None identified.	Discovery Strategy
Taxiway Tango	None	No	No	None identified.	Discovery Strategy
Lima Extension	None	No	Yes	None identified.	Discovery Strategy

Development Area	PAOC ID	Buildings Proposed?	Previous Site Investigation	Potential for pollutant linkages to remain active upon development	Recommendation for Further Assessment
Taxiway Whiskey-Victor-Zulu (Code C to Code E - 08)	None	No	Yes	None identified.	Discovery Strategy
Reconfigure Code 150's to Code C (Phase 2)	12	No	No	Yes	Further Ground Investigation
Pier 7	35, 60	No	No	Yes	Further Ground Investigation
Pier 7 New Stands	35	No	No	Yes	Further Ground Investigation
Code E Hangar	None	Yes (assumed open structure)	Yes	None identified.	Discovery Strategy
Relocate Larkins Road Phase 2 (Diverted road surfacing and utilities)	None	No	No	None identified.	Discovery Strategy
Care – Option 1	35	Yes	No	Yes	Further Ground Investigation
North Terminal long stay decking	None	No	No	None identified.	Discovery Strategy
CARE Waste Facility Option 2 - landside relocation	46	Yes	No	Yes	Further Ground Investigation
Charlie Box	9	No	Yes	Yes	Further Ground Investigation
MA1 Main Contractor Compound	6	No	Yes	Yes	Further Ground Investigation
End Around Taxiway Yankee	None	No	No	None identified.	Discovery Strategy
Taxiway Victor	None	No	Yes	None identified.	Discovery Strategy
Taxiway Whiskey	None	No	Yes	None identified.	Discovery Strategy
South Terminal IDL Expansion	None	Yes	Yes	Yes	Further Ground Investigation
South Terminal Autonomous Vehicle Station	None	Yes	No	Yes	Further Ground Investigation
Parking - MSCP J	None	No	Yes	None identified.	Discovery Strategy
Hotel and Office – MSCP H	None	Yes	No	Yes	Further Ground Investigation
North Terminal Forecourt	None	No	Yes	None identified.	Discovery Strategy
North Terminal IDL Expansion	None	Yes	No	Yes	Further Ground Investigation
North Terminal Reclaim	None	Yes	No	Yes	Further Ground Investigation
North Terminal Make up Points (MUPs)	None	No	No	None identified.	Discovery Strategy
North Terminal Autonomous Vehicle Station	None	Yes	No	Yes	Further Ground Investigation
MSCP Y Hotel and Parking	40	No	No	Yes	Further Ground Investigation
MSCP Y elements	40	No	No	Yes	Further Ground Investigation
Parking X and V	None	No	Yes	None identified.	Discovery Strategy
Surface access	4, 7, 19,, 40, 53, 73, 77	No	Yes	Yes	Further Ground Investigation
Environmental mitigation and enhancement (Church Meadow)	None	No	No	None identified.	Discovery Strategy
Reigate Field Welfare Contractor Compound	None	No	No	None identified.	Discovery Strategy
South Terminal Forecourt	1, 2, 4	No	Yes	Yes	Further Ground Investigation
Hotel – South Terminal (Car Rental FOH Site)	70	Yes	No	Yes	Further Ground Investigation
Environmental mitigation and enhancement (Riverside)	None	No	No	None identified.	Discovery Strategy
Environmental mitigation and enhancement (Noise Bund)	None	No	No	None identified.	Discovery Strategy
Hotel and office provision	None	Yes	No	Yes	Further Ground Investigation
Construction compounds	None	No	No	None identified.	Discovery Strategy
Parking - Pentagon Field Decking	None	No	No	None identified.	Discovery Strategy


Recommendation Strategy for Further Works
DEVELOPMENT AREA
PAOC
NO
YES
BUILDINGS
YES
NO
DISCOVERY STRATEGY
YES
SUFFICIENT HISTORICAL DATA INDICATING NO RISK
NO
FURTHER INVESTIGATION RECOMMENDED



Preliminary Environmental Information Report
Appendix 11.2.1: Summary of Local Planning Policy: Water Environment

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This document forms Appendix 11.2.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description.

1.1.2 This document provides the Summary of Local Planning Policy: Water Environment for the Project.

Administrative Area	Plan	Policy
Adopted Policy		
Crawley	Crawley 2030: Crawley Borough Local Plan 2030	Policy ENV8 sets out the requirements for proposed developments in terms of flood risk. It states that development proposals should be avoided in areas at risk of flooding and should not increase the risk of flooding elsewhere. To achieve this, developments should be directed to areas at low flood risk, considering the suitability of their intended use for the area and demonstrating that the Sequential Test and, where required, the Exception Test, can be passed. The Environment Agency Flood Map for Planning should be used to assess flood risk to the area and a site-specific flood risk assessment should demonstrate how appropriate mitigation measures will ensure flood risk is acceptable for the site and will not be increased elsewhere. The policy states that peak surface runoff rates and annual volumes of runoff should be reduced through the effective implementation, use and maintenance of Sustainable Drainage Systems (SuDS), unless it can be demonstrated that these are not technically feasible or financially viable.
		Policy ENV9 - Development should plan positively to minimise its impact on water resources and promote water efficiency. Non-residential development (where technically feasible) should meet Building Research Establishment Environmental Assessment Methodology (BREEAM) Excellent including addressing maximum water efficiencies under the mandatory water credits.
		Policy ENV10 - Development would be permitted where the proposed use does not lead to a significant increase in levels of pollution or hazards, and as far as possible reduce them, and would not result in unacceptable disturbance or nuisance to the amenity of adjacent land uses and occupiers.
Reigate and Banstead	Reigate and Banstead Local Plan: Core Strategy 2014	Policy CS10 states that development should be located to minimise flood risk, through the application of the Sequential Test and, where necessary, the Exception Test, taking account of all sources of flooding, as well as the impact of climate change. It also encourages the use of SuDS and flood resistant/ resilient design features. It is highlighted that, where necessary, floodplain compensation should be provided.
	Reigate and Banstead Borough Development Management Plan 2018-2027	Policy CCF2 highlights that development proposals must not increase the existing and future flood risk elsewhere. Proposals should seek to secure opportunities to reduce both the cause and impact of flooding for existing and proposed development. It also states that development should reduce surface water runoff rates using SuDS where necessary, suitable to the scale and type of the development. Where SuDS are proposed, schemes should include appropriate arrangements for the ongoing maintenance for the lifetime of the development.
Mole Valley	Mole Valley Local Plan 2000	Policy ENV65 states that development will normally be permitted where foul sewers and sewage treatment works of adequate capacity and design are or will be available to serve the development. Therefore, before granting planning permission for development requiring connection to a public sewer, the Mole Valley District Council will require that the necessary agreements between sewage undertakers and the developers have been completed.
		Policy ENV67 states that development will not be permitted, which in the opinion of the Council, after consultation with the Environment Agency, may have an adverse impact on the quality of groundwater. Applicants will be required to submit details of measures designed to ensure that proposed development would not have a detrimental effect on surface and groundwater. The 2000 Mole Valley District Council (MVDC) Local Plan included policies ENV64 and ENBV66 that were referenced in the scoping report. However, the council has confirmed that they were not retained by their 2007 update of the plan.
	Mole Valley Core Strategy 2009	Policy CS20 states that the Council expects the use of SuDS as part of development proposals. It also highlights that applications which relate specifically to reducing the risk of flooding (eg defence/ alleviation work) will be supported so long as they do not conflict with other objectives, for example, those relating to landscape and town centre character.

Administrative Area	Plan	Policy
Horsham District	Horsham District Planning Framework (excluding SDNP) 2015	Policy 38 states that where there is the potential to increase flood risk, proposals must incorporate the use of SuDS where technically feasible or incorporate water management measures that reduce the risk of flooding and ensure that flood risk is not increased elsewhere. New developments should undertake detailed assessments to consider the most appropriate SuDS methods for each site. Drainage techniques that mimic natural drainage patterns and manage surface water as close to its source as possible will be required where technically feasible.
Tandridge District	Tandridge District Core Strategy 2008	Policy CSP15 includes requirements to include SuDS where necessary and to encourage innovate construction methods such as 'green roofs' to 'impede' surface water runoff, encourage development to make provision for grey water recycling, separate surface and wastewater drainage flows.
	Tandridge Local Plan Part 2: Detailed Policies 2014-2029	Policy DP21 states that development proposals should seek opportunities to reduce both the cause and the impact of flooding, for example through the use of SuDS, ensuring the discharge of surface water runoff is restricted to pre-development values. The policy also sets out when a site-specific flood risk assessment is required, in accordance with NPPF requirements.
Emerging Policy		
Crawley	Draft Crawley Borough Local Plan 2021-2037, January 2021	Policy EP1 repeats the current Policy ENV8 and includes and that development is not permitted within 8 metres of a main river and 12 metres from an ordinary watercourse without prior consent form the Environment Agency or within 3 metres of a Thames Water sewer system without their prior consent. Post construction council certification is required to ensure the drainage has bene constructed in line with the planning application.
		Policy EP3 requires that development will adhere to the appropriate local and national standards, procedures and principles in relation to land and water quality.
		Strategic Policy GAT1 states that the council will support the development of facilities which contribute to the sustainable growth of Gatwick Airport as a single runway, two terminal airport provided that the impacts of the operation of the airport on the environment, including flooding and climate change are minimised and mitigated
		Policy GI1 requires that large development proposals will be required to provide new and/or create links to green infrastructure, consider the use of SuDS and blue infrastructure, in part to reduce surface water runoff
		Policy SDC1: All developments are required to submit a sustainability statement to contribute to tackling serious water stress in accordance with Policy SD3
		Policy SDC3: Requires that non-residential buildings will be required to meet the minimum standards for BREEAM 'Excellent' within the water category in order to combat water stress
Mole Valley	Future Mole Valley 2018-2033 Consultation Draft Local Plan	EN10: Regionally Important Geological and Geomorphological Sites: Development proposals within, or adjacent to, a Regionally Important Geological and Geomorphological Site, will be required to respect the landform that is protected and, where possible, enhance it and its setting
		EN13: Promoting Environmental Quality: Developments should maintain or improve the environmental quality of any watercourses, groundwater and drinking water supplies, and prevent contaminated run-off.
		EN14: Measures to mitigate the effects of, and adapt to, climate change will be supported. Such measures can include: Other measures, including the provision of Sustainable Drainage Systems (SuDS) and improving water efficiency.
		INF2: Managing Flood Risk: All development should seek to avoid, reduce or minimise flood risk by applying the sequential approach and have regard to all sources and being designed to be safe for the lifetime of the development
Horsham District	Draft Horsham District Local Plan 2019-2036 (Regulation 18 Submission)	Policy 25 highlights that development proposals must ensure they: Maintain or improve the environmental quality of water supplies and prevent contaminated run-off to surface water sewers.
		Policy 27 sets out that proposals will be expected to provide details to demonstrate that the whole life management and maintenance of the SuDS are appropriate, deliverable and will not cause harm to the natural environment and/or landscape.
		Policy 37 outlines that all major development must demonstrate how it has been designed to adapt to the impacts of climate change and reduce vulnerability, particularly in terms of flood risk and water supply changes to the District's landscape.
		Policy 39 states that proposals must seek to improve the sustainability of development (including): ▪ New Non-domestic floorspace must achieve and minimum standard of BREEAM 'Very Good' with a specific focus on water efficiency. ▪ All new residential development must limit water use to 100 liters/person/day Development should incorporate measures which enhance the biodiversity value of development.
		Policy 40 includes the requirements to:

Administrative Area	Plan	Policy
		▪ Comply with the Horsham District Strategic Flood Risk Assessment. ▪ Incorporate measures to reduce the risk of flooding and not increase flood risk elsewhere. ▪ Consider the ecological impacts of SuDS. ▪ Mimic natural drainage patterns. Meet the requirements of the WFD and the findings of the Gatwick Sub Region Water Cycle Study to maintain water quality.
Tandridge District	Emerging Our Local Plan 2033 (Regulation 22 Submission) 2019 Tandridge District Council	Policy TLP47 aims to ensure that development in the District reduces flood risk and minimises the impact of flooding by steering development to areas with a lower risk of flooding, taking account of all sources of flooding, including an allowance for climate change, applying the Sequential and Exception Tests and assessing cumulative impacts of development on flood risk. It also highlights the requirement to use SuDS, where practical.

2 References

Crawley Borough Council (2015) Crawley 2030: Crawley Borough Local Plan 2015 – 2030.

Crawley Borough Council (2021) Draft Crawley Borough Local Plan 2021-2037, January 2021

Horsham District Council (2015) Horsham District Planning Framework (excluding SDNP) 2015

Horsham District Council (2020) Draft Horsham District Local Plan 2019-2036 (Regulation 18 Submission)

Mole Valley District Council (2000) Mole Valley Local Plan 2000 (saved policies)

Mole Valley District Council (2009) Mole Valley Core Strategy

Mole Valley District Council (2020) Future Mole Valley 2018-2033 Consultation Draft Local Plan

Reigate and Banstead Borough Council (2014) Reigate and Banstead Local Plan: Adopted Core Strategy

Reigate and Banstead Borough Council (2019) Reigate and Banstead Borough Development Management Plan 2018-2027

Tandridge District Council (2008) Tandridge District Core Strategy

Tandridge District Council (2014) Tandridge Local Plan Part 2: Detailed Policies 2014 – 2029

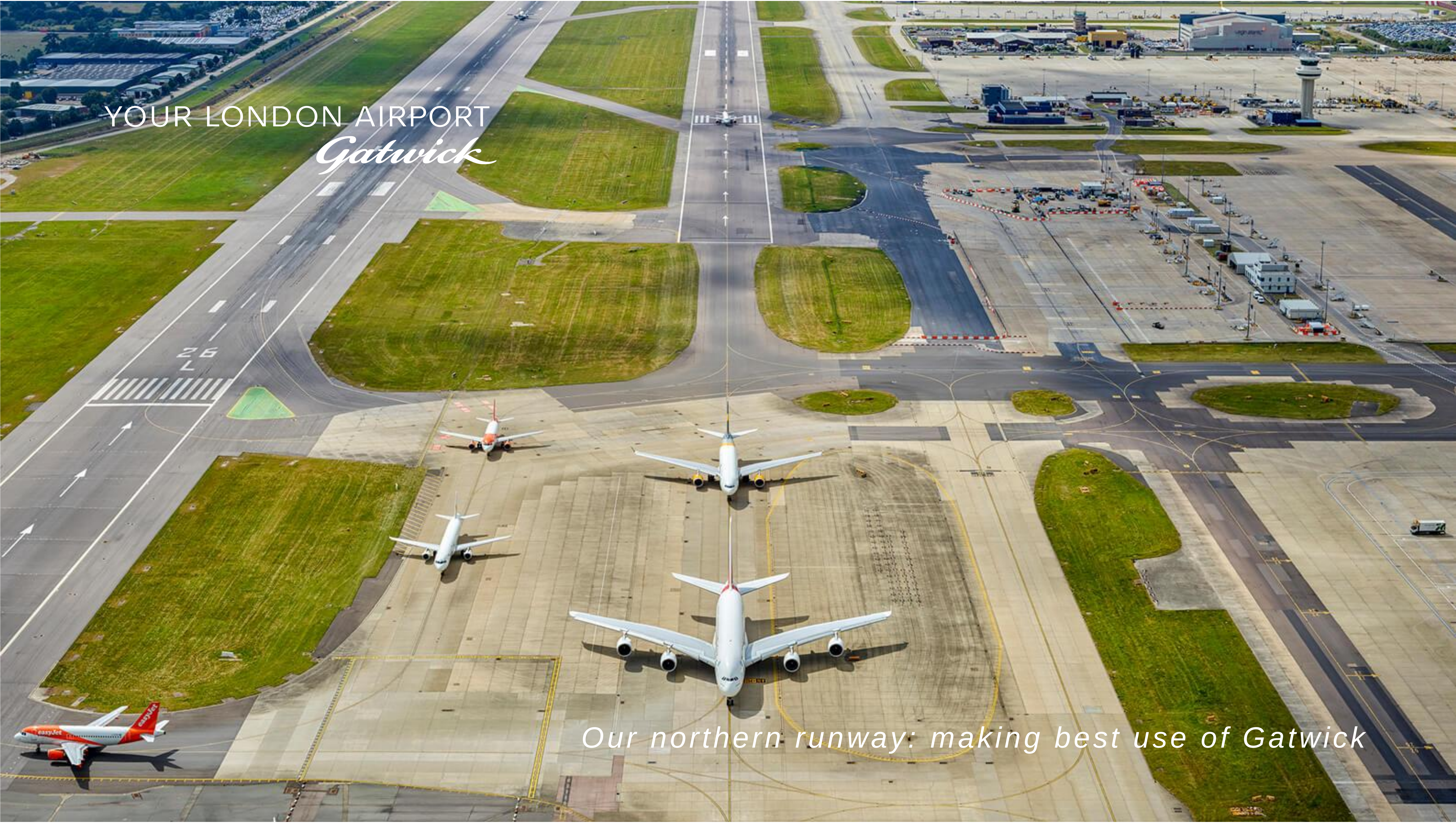
Tandridge District Council (2019) Our Local Plan: 2033

3 Glossary

3.1 Glossary of terms

Table 3.1.1: Glossary of Terms

Term	Description
BREEAM	Building Research Establishment Environmental Assessment Methodology
EIA	Environmental Impact Assessment
PEIR	Preliminary Environmental Information Report
SuDS	Sustainable Drainage System
WFD	Water Framework Directive



Preliminary Environmental Information Report
Appendix 11.3.1: Summary of Stakeholder Scoping Responses - Water Environment

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This document forms Appendix 11.3.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description.

1.1.2 This document provides the summary of stakeholder responses for the water environment for the Project.

Consultee	Details	How/where addressed in PEIR
Crawley Borough Council (CBC)	The Environmental Statement (ES) should be clear on the clear synergies between drainage and ecology impacts	See paragraph 11.1.2 (Chapter 11 of the PEIR)
Crawley Borough Council	Paras 7.5.17 /18 in the Environmental Impact Assessment Scoping Report (EIASR) suggest that there is existing under capacity in pollution storage lagoons and the pumping system	See Planning Inspectorate (PINS) comment 4.5.2, responded to in Table 11.3.1 (Chapter 11 of the PEIR)
Crawley Borough Council	CBC would welcome engagement with GAL to agree appropriate modelling scenarios to address climate change	The potential impacts of climate change have been taken into account within the Flood Risk Assessment (Appendix 11.9.1 of the PEIR). The latest Environment Agency guidance on climate change has been adopted for this assessment. This guidance is based on UKCP09. If the guidance is updated for UKCP18 then the impact of this on the Project will be considered at that time.
Crawley Borough Council	In para 7.5.25 there appears to be an error in the water quality baseline data as the 2017 target has been passed?	Surface water bodies generally have a deadline of up to 2021. Where it is deemed that the water body cannot achieve that, particularly if some of the status elements are at 'Bad', then the deadline shifts to 2027.
Crawley Borough Council	Are the drainage patterns described in para 7.5.45 [of the scoping report] correct?	The description is correct
Crawley Borough Council	The surface water drainage strategy should be based on sustainable principles (SuDS) except where it can be proven that this cannot be achieved because of airport safety considerations	The outline drainage strategy is summarised in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR)
Crawley Borough Council	CBC would also wish to ensure that any drainage strategy for the Project can demonstrate through the ES that there is no likelihood of increased flooding occurring upstream (south) of Gatwick	The potential increase in flows due to changes in hardstanding/impermeable areas is considered in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR). An assessment of the impact on water quality is provided in Section 11.9 (Chapter 11 of the PEIR).
Crawley Borough Council	It is essential to understand how pluvial and fluvial flows will be managed during the construction phase of the development	Construction phase flood risk is considered within the Flood Risk Assessment (Appendix 11.9.1 of the PEIR) and in Section 11.9 (Chapter 11 of the PEIR).
Crawley Borough Council	The ES should highlight and needs to carefully consider the environmental impacts of increased flows on watercourses especially the increase in sediment loading to surface water and water quality /pollutants as a result in of the significant increase in impermeable area	The potential increase in flows due to an increase in hardstanding/impermeable areas is considered in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR). An assessment of the impact on water quality is given in Section 11.9 (Chapter 11 of the PEIR).
Crawley Borough Council	CBC consider that there could be an increase in sediment loading and pollutant deposition due to increase in aircraft and ground vehicle operation. This should be assessed in the ES.	The potential increase in flows due to an increase in hardstanding/impermeable areas is considered in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR). An assessment of the impact on water quality is given in Section 11.9 (Chapter 11 of the PEIR).

Consultee	Details	How/where addressed in PEIR
Crawley Borough Council	The approach taken to water supply in respect of mitigation, enhancement and monitoring paragraph 7.5.87 is not considered robust	In the 'Gatwick Sub-region' Joint Water Cycle Study (2010), Sutton and East Surrey Water (SESW) expressed concerns about the 'over-abstraction' of catchments and a deficit to meet peak water supply demands during dry years. However, at a meeting with Gatwick on 3/10/19 SESW stated that this would be unlikely as a result of the proposed works at the airport.
Environment Agency	Reference is also made to the possible extension of the existing culvert that carries the River Mole/Crawters Brook beneath the runway, this is an aspect of particular interest as further information to demonstrate that flood risk will not be increased will be necessary	The existing culvert and syphon that convey the River Mole beneath the airport runways will need to be extended to accommodate the new Northern Runway. However it is considered that the realignment (including renaturalisation) of the River Mole slightly further downstream from the culvert will offset the culvert extension.
Environment Agency	The FRA should incorporate the latest guidance on climate change, this aspect is referenced as part of section 7.5.15. The Flood Risk Assessment (FRA) should clearly demonstrate how the risk to flooding from both fluvial and surface water will not be increased as a result of any development on the site	The potential impacts of climate change have been taken into account within the Flood Risk Assessment. The latest Environment Agency guidance on climate change has been used for this assessment, which is based on UKCP09. If the guidance is updated for UKCP18 then the impact of this on the Project will be considered at that time.
Environment Agency	It would be prudent to understand how the flood storage area owned and operated by GAL situated on the Gatwick Stream close to Crawley Sewage Treatment Works is viewed in relation to the risk to flooding from reservoirs	Flood risk from reservoirs is addressed in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR). Gatwick are currently undertaking a study to investigate the risk of failure from this feature that will inform the ES.
Environment Agency	We would like to see stronger links and references made between the sections on ecology and water environment	See paragraph 11.1.2 (Chapter 11 of the PEIR).
Forestry Commission	It is essential that the ancient woodland identified is considered appropriately to avoid changes to the water table affecting ancient woodland	Potential changes to the water table are addressed in Tables 11.8.1 and 11.8.2 (Chapter 11 of the PEIR).
Mid Sussex District Council	Flood risk from sewers should be reviewed in more detail and reported in the ES	Flood risk from sewers is addressed in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR). The assessment of flood risk from sewers has been informed by the development of a surface water drainage and a wastewater hydraulic model.
Mid Sussex District Council	A review of existing on-site ground investigations should be included in the ES	Land quality issues are addressed in Chapter 10 of the PEIR.
Mid Sussex District Council	The assessment should consider the effect of sediment from construction on surface water drainage in terms of blockage and reduced capacity.	Mitigation measures are set out in Section 11.8 (Chapter 11 of the PEIR). .
Mole Valley District Council	Following review of the 2000 Local Plan in 2007. Policies ENV64 and ENV66 were not saved and are therefore not applicable.	Noted and reference is made to Local Planning Policies relevant to the Water Environment in Table 11.2.3 (Chapter 11 of the PEIR).
Mole Valley District Council	The suggested under-capacity in the pumping system and pollution storage lagoons in times of heavy rainfall must be addressed	The potential increase in flows due to an increase in hardstanding/impermeable areas is considered in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR). An assessment of the impact on water quality is given in Section 11.9 (Chapter 11 of the PEIR).
Mole Valley District Council	The cumulative effects on water supply from the Proposed Development and other known development in the area are considered through the EIA	Cumulative effects are considered and presented within Chapter 19 of the PEIR.
Reigate and Banstead Borough Council	We question whether there is enough evidence/ justification at this stage to screen out changes in water quality at European designated sites	This is addressed in the Water Framework Directive (WFD) assessment included as Appendix 11.9.2 of the PEIR.
Reigate and Banstead Borough Council	We would however welcome additional clarity as to whether consideration of potential for increased run-off during the operational phase is proposed to be assessed as part of potential contamination impacts	The potential increase in flows due to an increase in hardstanding/impermeable areas is considered in the Flood Risk Assessment in Appendix 11.9.1 of the PEIR. An assessment of the impact on water quality is given in Section 11.9 and 11.11 (Chapter 11 of the PEIR)
Reigate and Banstead Borough Council	References to saved Borough Local Plan policies Ut4 "Flooding" and Ut3 "Foul and Surface Water" should be removed	Noted and reference is made to Local Planning Policies relevant to the Water Environment in Table 11.2.3 (Chapter 11 of the PEIR).
Reigate and Banstead Borough Council	The Burstow Stream and Burstow Stream Tributary are incorrectly labelled as 'non-main river' when they are actually identified by the Environment Agency as main rivers	This figure has been updated as PEIR Figure 11.6.1.

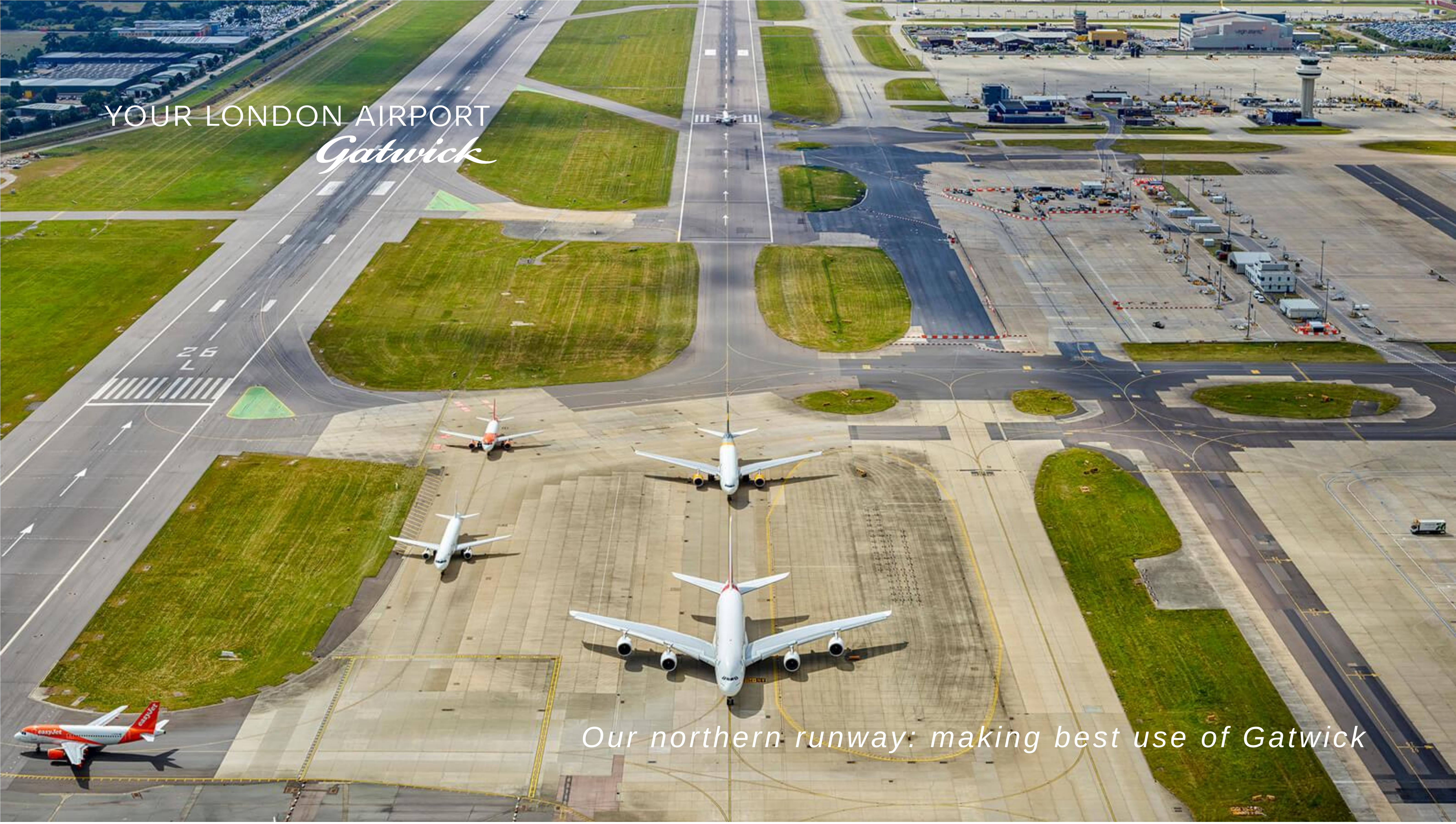
Consultee	Details	How/where addressed in PEIR
Reigate and Banstead Borough Council	With regards to the proposed study area, the Council notes that Paragraph 7.5.72 [of the scoping report] states that "*the study are will generally be defined by a 2km radius beyond the Project site boundary*". The Council considers that it is unclear what the justification is for the delineation of this study area	Additional information has been provided in this PEIR on the definition of the study area in paragraphs 11.4.5-11.4.10 (Chapter 11 of the PEIR).
Reigate and Banstead Borough Council	It is unclear from the information provided in the EIA as to whether this [Upper Mole] model has been prepared in consultation with the Environment Agency and whether it has the agreement of the Environment Agency with regards to its robustness/ methodology	The Upper Mole hydraulic model has bene developed collaboratively by GAL and the Environment Agency. The additional modelling undertake by GAL to assess the impact of the Project will be reviewed by the Environment Agency as part of their review of the Flood Risk Assessment. This approach is stated in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR).
Reigate and Banstead Borough Council	We expect this evidence document [Reigate & Banstead SFRA] to be acknowledged and given due regard in the EIA	The sources of information pertinent to the Project and potential receptors are set out in the Flood Risk Assessment (Appendix 11.9.1 of the PEIR).
Reigate and Banstead Borough Council	Crawley Borough Council, Reigate & Banstead Borough Council and Mid Sussex District Council are in the process of undertaking a water cycle study, that could inform the ES	The Water Cycle Study dated August 2020 and January 2021 addendum have informed the PEIR assessment, see Table 11.3.1 (Chapter 11 of the PEIR).
West Sussex County Council	Reference should be made to the West Sussex LLFA Policy for the Management of Surface Water.	Refer to the Flood Risk Assessment (Appendix 11.9.1 of the PEIR).
West Sussex County Council	LLFAs do not hold data regarding unlicensed groundwater and surface water abstractions.	Noted

2 Glossary

2.1 Glossary of terms

Table 2.1.1: Glossary of Terms

Term	Description
CBC	Crawley Borough Council
EIA	Environmental Impact Assessment
EIASR	Environmental Impact Assessment Scoping Report
ES	Environmental Statement
FRA	Flood Risk Assessment
GAL	Gatwick Airport Limited
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
SESW	Sutton and East Surrey Water
WFD	Water Framework Directive



Preliminary Environmental Information Report
Appendix 11.9.1: Flood Risk Assessment

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This Flood Risk Assessment (FRA) forms Appendix 11.9.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description.

1.1.2 All technical terms and abbreviations used within this FRA report are defined in the Glossary included in Section 11.

1.2 Objectives

1.2.1 The purpose of this FRA is to demonstrate that the Project complies with flood risk requirements of relevant national and local planning policy, including the Airports National Policy Statement (Airports NPS) and the National Planning Policy Framework (NPPF). Mainly, that the Project would not exacerbate existing levels of flood risk on or off site and that it would be safe for users for its lifetime including a consideration of the predicted impacts of climate change.

1.2.2 To achieve this, the FRA:

- includes an assessment of flood risk to the Project, demonstrating that the intended land use is appropriate in terms of flood risk;
- includes an assessment of the predicted impact of the Project upon flood risk, taking account of future climate change impacts;
- demonstrates that the Project would not increase flood risk to surrounding areas and third parties and would be safe for its lifetime; and
- details mitigation measures required to achieve this outcome.

1.3 FRA Structure

1.3.1 This section describes the main objectives of the FRA and provides a brief summary of the report structure and contents.

1.3.2 Section 2 briefly describes the study area and provides the overview of the Project elements that could affect or be affected by flood risk. This section also describes some specific study area characteristics that are of interest to flood risk in general, including topography, local watercourses, rainfall, geology and hydrogeology, as well as land use. Further information on the study area and Project is included in PEIR Chapter 4: Existing Site and Operation and PEIR Chapter 5: Project Description. Only information that underpins this FRA is summarised in this chapter.

1.3.3 Section 3 provides an overview of the national and local planning policy that applies to the application for development consent for the Project. It refers to national guidance and drivers, as well as specific requirements for nationally significant infrastructure. It also explains the flood risk vulnerability classification for proposed developments and the application of the Sequential and Exception Tests as set out in the NPPF and its supporting guidance. Finally, Section 3 describes guidance and requirements regarding the impact of climate change on flood risk, throughout the lifetime of the Project.

1.3.4 Section 4 defines the scope of the assessment and any issues that have been scoped out of this FRA. This section also includes the assumptions made during the assessment and any related limitations that could potentially affect the conclusions of this document.

1.3.5 Section 5 describes the existing level of flood risk to the Project, considering all potential sources of flooding. The assessment includes fluvial, surface water and groundwater flooding, as well as flooding due to reservoir failure, flood defence failure and sewer/ water distribution infrastructure flooding. The data used include publicly available information and site-specific hydraulic modelling that has been developed by GAL (surface water drainage and wastewater) and in partnership with the Environment Agency (fluvial). This section also briefly describes historic flood events that have affected Gatwick.

1.3.6 Section 6 describes how the Project could affect flood risk to the Project site, as well as to third parties, assuming no mitigation was in place. Hydraulic modelling results have been used to determine the degree of fluvial and surface water drainage flood risk due to the Project, providing the basis for the assessment to be made. A desktop study has also been undertaken to consider potential Project qualitative impacts on groundwater flooding.

1.3.7 Section 7 describes the flood mitigation strategy that has been developed as part of the Project. This includes flood compensation areas, syphons, watercourse diversions and where required, the introduction, relocation and reconfiguration of surface water storage and attenuation features. Hydraulic modelling results have been used to determine the effectiveness of the proposed measures in mitigating fluvial, wastewater and surface water flooding.

1.3.8 Section 8 describes the planning and development requirements that have been considered as part of this assessment and explains how these have been addressed within the FRA document. This section covers relevant national planning policies, local planning requirements and Strategic Flood Risk Assessment (SFRA) recommendations for the study area.

1.3.9 Finally, Section 9 provides the summary and conclusions of this FRA.

2 Project and Environmental Overview

2.1 Study Area

2.1.1 A full description of the study area and Project is provided in Chapter 4: Existing Site and Operation and Chapter 5: Project Description. Only information that underpins this FRA is summarised in this chapter.

2.1.2 The land subject to the application for development consent extends to approximately 838 hectares, of which approximately 760 hectares lie within the ownership of Gatwick. The Project site boundary and study area for the purposes of this assessment is shown in Figure 2.1.1.

2.1.3 The study area used for this FRA is defined by a 2 km radius beyond the Project site boundary. Taking into account the nature of the Project, impacts are expected to occur in close proximity to the Project site and it is considered that a 2 km study area would be sufficient to identify any significant flood risk effects to third parties. In the case that impacts are identified at the edge of the study area, this would be locally extended until the point where no impacts are identified.

2.2 Project Description

2.2.1 The Project includes a number of proposed elements which are shown in Figure 2.2.1. The following key components are considered most likely to affect or be affected by flood risk and are considered relevant to this assessment:

- amendments to the existing northern runway including repositioning its centreline 12 metres further north to enable dual runway operations;
- reconfiguration of taxiways;
- pier and stand alterations (including a proposed new pier);
- reconfiguration of other airfield facilities;
- extensions to the existing airport terminals (north and south);
- provision of additional hotel and office space;
- provision of reconfigured car parking, including new car parks;
- surface access (including highway) improvements;
- reconfiguration of existing utilities, including surface water, foul drainage and power; and
- landscape/ecological planting and environmental mitigation.

2.2.2 The details of construction methods, timing and phasing are broad at this stage and would be dependent on securing development consent and the discharge of associated requirements. The indicative construction programme is based on construction commencing in 2024, although some preliminary works may commence in 2023. The programme for the core airfield construction works would be of approximately five years duration enabling the altered northern runway and taxiways to be complete and fully operational in combination with the main runway in 2029. The indicative phases of the project are described in Chapter 5: Project Description of the PEIR.

2.3 Study Area Characteristics

Topography

2.3.1 Gatwick Airport is generally flat, at an average ground level of around 58 to 59 metres Above Ordnance Datum (AOD). However, areas around the North and South Terminals have ground levels ranging from approximately 56 metres to 58 metres AOD.

Local Watercourses

2.3.2 Gatwick Airport is located within the Upper Mole catchment within the River Thames River Basin District. The River Mole flows through the airport, south to north, passing under the main and existing northern runways in culvert and a syphon. Tributaries of the River Mole, including Burstow Stream, Crawter's Brook, the Gatwick Stream, Man's Brook and Westfield Stream all run through or close to the Project site. Most of these watercourses, including the River Mole, have been previously diverted. Main Rivers and Ordinary Watercourses in the vicinity of the Project are shown in Figure 2.1.1.

2.3.3 The Burstow Stream rises to the east of the South Terminal roundabout and flows northwards under the M23 spur before turning north-westwards skirting the east and north of Horley to join the Mole north west of the town, approximately 2 km north of Gatwick airport.

2.3.4 Crawter's Brook enters the airport boundary to the east of the industrial area of Lowfield Heath and has been previously diverted into an engineered channel, along the southern edge of the airside operational area. Its confluence with the River Mole is located just upstream of the culvert under both existing runways.

2.3.5 The Gatwick Stream runs along the eastern airport boundary, between the eastern end of the airside operational area and the London to Brighton mainline railway. It is culverted under the South Terminal before running north through Riverside Garden Park and joining the River Mole.

2.3.6 Man's Brook runs along a small part of the north-west airport boundary before discharging directly into the River Mole, west of the Boeing Hangar and Pond M.

2.3.7 Westfield Stream runs through Gatwick airport, north of the existing fire training ground, from its source to the west of the airfield. The watercourse comprises open channel sections with earth banks and a number of culverts with associated headwalls where the channel passes under obstructions such as access roads and airport boundary fences. The watercourse has previously been diverted to its current location discharging to the River Mole north of the existing Pond A.

Geology and Hydrogeology

2.3.8 The study area is underlain by made ground, superficial deposits and bedrock strata.

2.3.9 Made ground is widespread near the surface, particularly beneath airport buildings and associated infrastructure. This varies in thickness, composition and extent.

2.3.10 The superficial deposits comprise Alluvium, Head and River Terrace Deposits (RTD). The Alluvium and RTD are primarily associated with existing and former courses of the River Mole, Crawter's Brook and Gatwick Stream, to the west, centre and east of the airport. These deposits occur in broad, but mostly separated 'bands' beneath the airport. These are primarily orientated south to north, although toward the northern perimeter of the airport there is a band of Alluvium and RTD aligned east west, parallel with a former course of the River Mole. Away from the airport, to the north east of the A23, there is a wider expanse of RTD.

2.3.11 The Alluvium comprises clay, silt, sand and gravel and where present is likely to be relatively thin, perhaps up to 2 metres thick. The RTD comprises sand and gravel and is likely to be thicker, of the order of 5 metres. Both deposits are likely to thin toward their margins. Head deposits, comprising clay, silt, sand and gravel occur only in a small area to the centre of the airport.

2.3.12 For the large majority of the study area, these superficial deposits are underlain by the Weald Clay Formation. This comprises mudstone, with seams of clay-ironstone in the south east and west. Although absent from the far south and east of the study area, this formation is likely to be of significant thickness.

2.3.13 To the south east of the study area, the underlying bedrock is the Upper Tunbridge Wells Sand Formation. This comprises sandstone, siltstone and mudstone, but only occurs with very limited sub-crop within the extreme south east of the Project boundary (to the south and east of the A23 London Road/ Perimeter Road South).

2.3.14 The Alluvium and RTD, in combination, are classified by the Environment Agency as a Secondary A aquifer. Groundwater is likely to occur in these deposits although this is unlikely to comprise a continuous body of groundwater and there may be isolated pockets of groundwater, with both vertical and horizontal discontinuity.

2.3.15 Typically, groundwater levels within the superficial deposits are shallow, less than 1 metre deep in some locations, although this varies significantly (typically 0.8 metres to 3 metres, but up to 5 metres deep and perhaps deeper) across the study area.

2.3.16 Close by and adjacent to the main surface watercourses (River Mole, Gatwick Stream, Crawter's Brook) groundwater in the superficial deposits maybe in hydraulic continuity with the surface water.

2.3.17 The Weald Clay Formation is classified by the Environment Agency as Unproductive Strata and generally contains little groundwater, however, near surface weathering of this formation may allow some groundwater storage and flow, perhaps in hydraulic continuity overlying superficial deposits. Groundwater has been encountered at depths of around 10 metres within this formation.

2.3.18 The Upper Tunbridge Wells Sand Formation is classified as a Secondary A aquifer, although the mudstones within the formation are classified as unproductive strata. Locally, depth to groundwater is unknown, but layering in the aquifer may lead to some vertical stratification of water bodies within this formation.

Land Use

2.3.19 Gatwick Airport covers an area of approximately 760 hectares. The airport has two main passenger terminals – South Terminal, which is located on the eastern side of the airport and North Terminal on the north side. In addition to the two main passenger terminals it is characterised by substantial areas of built development comprising an airfield environment of stands, taxiways and runways which are separated by extensive grassed areas; the airport's road network; surface and decked car parking; and ancillary developments such as hotels, maintenance and cargo facilities.

3 Legislation and Policy

3.1 National Planning Policy

Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England

3.1.1 NPSs set out the Government's objectives for the development of nationally significant infrastructure and are therefore relevant sources of planning policy against which applications for development consent are determined by the Secretary of State.

3.1.2 The Airports NPS (Department for Transport, 2018), although primarily provided in relation to a new runway at Heathrow Airport, remains a relevant consideration for other applications for airport infrastructure in London and the south east of England.

3.1.3 Paragraphs 5.147 to 5.171 of the Airports NPS refer to flood risk and set out the policies regarding climate change impacts, FRA requirements, flood risk management bodies and responsibilities, sustainable drainage systems and the application of the Sequential and Exception Tests.

3.1.4 Paragraph 5.154 states that:

'In preparing a flood risk assessment the applicant should:

- *Consider the risk of all forms of flooding arising from the development comprised in the preferred scheme, in addition to the risk of flooding to the project, and demonstrate how these risks will be managed and, where relevant, mitigated, so that the development remains safe through its lifetime;*
- *Take into account the impacts of climate change, clearly stating the development lifetime over which the assessment has been made;*
- *Consider the need for safe access and exit arrangements;*
- *Include the assessment of residual risk after risk reduction measures have been taken into account, and demonstrate that this is acceptable for the development;*
- *Consider if there is a need to remain operational during a worst case flood over the preferred scheme's lifetime; and*
- *Provide evidence for the Secretary of State to apply the Sequential Test and Exception Test, as appropriate.'*

3.1.5 These FRA requirements have been addressed within this report. Compliance with planning policy recommendations is set out in Section 8.

National Policy Statement for National Networks

3.1.6 The NPS for National Networks (Department for Transport, 2015) covers flood risk within paragraphs 5.90 to 5.115. These paragraphs refer to the same flood risk policies as the Airports NPS (Department for Transport, 2018) and add some specific considerations for linear infrastructure. These would be relevant to surface access (including highways) improvements works that are proposed as part of the Project. Paragraphs 5.102 to 5.104 of the NPS for National Networks (Department for Transport, 2014) state that:

'The Secretary of State should expect that reasonable steps have been taken to avoid, limit and reduce the risk of flooding to the proposed infrastructure and others. However, the nature of linear infrastructure means that there will be cases where:

- *Upgrades are made to existing infrastructure in an area at risk of flooding;*
- *Infrastructure in a flood risk area is being replaced;*
- *Infrastructure is being provided to serve a flood risk area; and*
- *Infrastructure is being provided connecting two points that are not in flood risk areas, but where the most viable route between the two passes through such an area.*

The design of linear infrastructure and the use of embankments in particular, may mean that linear infrastructure can reduce the risk of flooding in the surrounding area. In such cases, the Secretary of State should take account of any positive benefit to placing linear infrastructure in a flood-risk area.

Where linear infrastructure has been proposed in a flood risk area, the Secretary of State should expect reasonable mitigation measures to have been made, to ensure that the infrastructure remains functional in the event of predicted flooding.'

National Planning Policy Framework

3.1.7 The National Planning Policy Framework (NPPF) (Ministry of Housing, Community and Local Government, 2021) sets out the planning policies for England. It sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed. The main steps are designed to ensure that if there are better sites in terms of flood risk, or a proposed development cannot be made safe, it should not be permitted.

3.1.8 Paragraphs 159 to 169 set out flood risk policies to be followed by all proposed developments.

3.1.9 The National Planning Practice Guidance (NPPG) (Ministry of Housing, Communities and Local Government, 2019b) supports the NPPF and provides guidance across a range of topic areas, including flood risk.

3.2 Local Planning Policy and Guidance

3.2.1 Gatwick Airport lies within the administrative area of Crawley Borough Council and adjacent to the boundaries of Mole Valley District Council to the north west, Reigate and Banstead Borough Council to the north east and Horsham District Council to the south west. The administrative area of Tandridge District Council is located approximately 1.9 km to the east of Gatwick. Gatwick is located in the county of West Sussex and immediately adjacent to the bordering county of Surrey.

3.2.2 Relevant local planning policies applicable to flood risk, as well as supporting documents regarding flood risk are summarised in this section.

Crawley Local Plan 2015-2030

3.2.3 Crawley Local Plan, Crawley 2030, was adopted in December 2015. It forms the Council's development plan and sets out the planning policies under which development control decisions are taken. Policy ENV8 refers to flood risk considerations for development applications.

Policy ENV8: Development and Flood Risk

Development proposals must avoid areas which are exposed to an unacceptable risk from flooding and must not increase the risk of flooding elsewhere. To achieve this, development will:

i. be directed to areas of lowest flood risk having regard to its compatibility with the proposed location in flood risk terms, and demonstrating (where required) that the sequential and exceptions tests are satisfied;

ii. refer to the Environment Agency Flood Map for Planning and Crawley Strategic Flood Risk Assessment to identify whether the development location is situated in an area identified as being at risk of flooding;

iii. where identified in the SFRA, demonstrate through a Flood Risk Assessment how appropriate mitigation measures will be implemented as part of the development to ensure risk is made acceptable on site, and is not increased elsewhere as a result of the development;

iv. ensure that proposals on all sites of 1 hectare or greater are accompanied by a Flood Risk Assessment, to include detail of mitigation demonstrating how surface water drainage from the site will be addressed;

v. reduce peak surface water run-off rates and annual volumes of run-off for development through the effective implementation, use and maintenance of SuDS, unless it can be demonstrated that these are not technically feasible or financially viable;

Crawley Emerging Local Plan 2021-37

3.2.4 Crawley Borough Council is currently consulting on a draft Local Plan to reflect national policy updates and local change.

Policy EP1: Development and Flood Risk

3.2.5 Policy EP1 repeats the current Policy ENV8 and includes that development is not permitted within 8 metres of a main river and 12 metres from an ordinary watercourse without prior consent form the Environment Agency or within 3 metres of a Thames Water sewer system without their prior consent. Post construction council certification is required to ensure the drainage has bene constructed in line with the planning application.

Policy GI1: Green Infrastructure

3.2.6 Policy GI1 requires that large development proposals will be required to provide new and/or create links to green infrastructure, consider the use of Sustainable Drainage Systems (SuDS) and blue infrastructure, in part to reduce surface water runoff.

Crawley Borough Council Strategic Flood Risk Assessment 2020

3.2.7 Crawley Borough Council, as the local planning authority, is responsible for producing a SFRA as part of the evidence base that supports the development of its Local Plan.

3.2.8 Therefore, the Crawley SFRA (Crawley Borough Council, 2020) was published in 2020 and is a key background document to the Local Plan. It is intended to be used in conjunction with Local Plan Policy ENV8, in order to ensure that development is directed to the most sustainable location in flood risk terms. A key outcome of the SFRA process is to enable the application of the Sequential Test (see Section 3.4) and to provide an indication of the feasibility of the proposed development passing the Exception Test (see Section 3.5).

3.2.9 The SFRA document provides advice for areas of the borough that are susceptible to flood risk and outlines development management recommendations that should be considered in determining planning applications. These have been addressed within the Project and compliance is demonstrated in Section 8.3.

West Sussex County Council Local Flood Risk Management Strategy 2013

3.2.10 West Sussex County Council as Lead Local Flood Authority (LLFA) is required to set out how it will deliver local flood risk management under the Flood and Water Management Act 2010. The Local Flood Risk Management Strategy (LFRMS) (West Sussex County Council, 2014) summarises historical, current and future flood risk knowledge for West Sussex and defines flood risk management roles and responsibilities. It covers the period from 2013 to 2018 and its principal aim is to oversee and direct the reduction of flood risk for the Council's residents.

Reigate and Banstead Borough Council, Mole Valley Distrct Council and Tandridge District Council Level 1 Strategic Flood Risk Assessment 2017

3.2.11 This joint SFRA report has been prepared as a planning tool that will assist the Councils in their selection and development of sustainable development sites away from vulnerable flood risk areas in accordance with the NPPF (Ministry of Housing, Community and Local Government, 2019a). The SFRA is a supporting document to Councils' local plans; flood risk policies within local plans relevant to the Project are included in Table 8.2.1.

3.2.12 The SFRA includes an appraisal of all potential sources of flooding, provides mapping of the location and extent of functional floodplain, reports the standard of protection provided by existing flood risk management infrastructure and considers the potential increase of flood risk due to climate change. It also provides an assessment of flood warning and emergency planning procedures and includes recommendations for future development considerations.

3.2.13 The area covered within this SFRA does not encroach on Gatwick itself but includes part of the study area as defined for this FRA. Therefore, if there are any residual effects within these neighbouring districts, the SFRA requirements and recommendations should be considered.

3.3 Vulnerability Classification

3.3.1 Table 2 of the Flood Risk and Coastal Change section of the NPPG (Ministry of Housing, Community and Local Government, 2019b) classifies the flood risk vulnerability of all land uses. In Table 3 of the same document (reproduced here as Table 3.3.1), these vulnerability classes are aligned against Flood Zones to indicate where a development is 'appropriate', where it should only be permitted if the Exception Test is passed and where it should not be permitted. The flood risk compatibility of the Project for its proposed location is considered in Table 5.9.1.

Table 3.3.1: Flood Risk Vulnerability Classification (reproduced from the NPPG, Table 3)

Flood Risk Vulnerability Classification		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zones	1	✓	✓	✓	✓	✓
	2	✓	Exception Test required	✓	✓	✓
	3a	Exception Test required	×	Exception Test required	✓	✓
	3b	Exception Test required	×	×	×	✓

✓ = 'appropriate'

× = 'not permitted'

3.4 The Sequential Test

3.4.1 The Sequential Test is defined in paragraphs 158-159 of the NPPF as follows:

'The aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance.'

3.4.2 The Sequential Test has been applied to the Project, refer to paragraphs 5.9.3 to 5.9.7.

3.5 The Exception Test

3.5.1 If a development is proposed that is not 'appropriate' as defined in Table 3 of the NPPG (and reproduced at Table 3.3.1), the Exception Test is used to demonstrate and ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

3.5.2 Paragraph 160 of the NPPF sets out the two elements that need to be satisfied for the Exception Test to be passed:

'For the exception test to be passed it should be demonstrated that:

a) The development would provide wider sustainability benefits to the community that outweigh flood risk; and

b) The development will be safe for its lifetime taking account of the vulnerability of its users without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.'

3.5.3 Compliance with the Exception Test is addressed in paragraphs 5.9.8 to 5.9.10 and Section 7.

3.6 Climate Change

3.6.1 There is clear scientific evidence that global climate change is happening now and cannot be ignored. Increases in rainfall depth or fluvial flows due to climate change will increase the probability of a given magnitude of flood. This means that a site currently located within a lower risk zone (Flood Zone 1 or 2) could in the future be re-classified as lying within a high-risk zone (Flood Zone 3a or 3b). This in turn could have implications for the type of development that is appropriate according to its vulnerability to flooding.

3.6.2 Therefore, any increase in surface water runoff or fluvial flooding as a result of the Project should be attenuated on-site and the capacity should be provided for the design flood event, including an appropriate allowance for climate change. According to the NPPG (Ministry of Housing, Communities and Local Government, 2019b), the design event is generally taken as the 1 per cent (1 in 100) annual exceedance probability (AEP[1]) event.

3.6.3 The Airports NPS (Department for Transport, 2018) refers to the NPPF and its supporting guidance as the key source of policies regarding climate change impacts on flood risk. Paragraph 5.168 also states that:

'The applicant should take into account the potential impacts of climate change using the latest Climate Change Risk Assessment, the latest UK Climate Projections, and other relevant sources of climate change evidence.'

3.6.4 The UK Climate Projections 2018 (UKCP18), (Met Office et. al., 2018) are a set of climate change projections that replace the previous set: UKCP09. These new projections have informed the update of the current guidance from the Environment Agency as to how the predicted impact of climate change should be considered as part of the spatial planning process, published in July 2021. The update incorporates new guidance for the consideration of future changes to peak river flow, the allowances for rainfall intensity are yet to be reviewed and potentially amended.

3.6.5 Due to project timescales this FRA adopts the climate change allowances published in February 2016 and last updated in July 2020 (Environment Agency, 2020) are the best national representation of how climate change is likely to affect flood risk for peak river flow and peak rainfall intensity available (from a policy and guidance perspective). It is anticipated that this FRA will be updated to support the ES and will incorporate the latest guidance (published in July 2021). A review of the latest guidance indicates that the requirements for peak river flow have reduced compared to those based on UKCP09 data, therefore the current assessment is considered to be conservative and mitigation requirements for the scheme are likely to reduce. The uplift factor to be applied is determined by the location, design life and vulnerability classification of the proposed development.

3.6.6 For this Project the design life and therefore the allowance for climate change varies. For the surface access works the adopted lifetime for the Project is 100 years (up to 2132) and for the rest of the works (airfield and associated elements) 40 years (up to 2069). It is considered that a longer design life would not be realistic given it is likely there will be further significant changes to the Airport in that timescale. Gatwick Airport has changed considerably during the past 40 years and this rate of change is anticipated to continue. Assessment of climate change allowances over a longer design life is therefore considered disproportionate.

3.6.7 The uplift factors to be applied for peak rainfall intensity in small urban catchments are indicated in Table 3.6.1.

Table 3.6.1: Predicted potential change of peak rainfall intensity

Applies to across all of England	Total potential change anticipated for 2015 to 2039	Total potential change anticipated for 2040 to 2069	Total potential change anticipated for 2070 to 2115 (and beyond)
Upper End	10%	20%	40%
Central	5%	10%	20%

3.6.8 When determining the potential impact of climate change on rainfall, the guidance states that both the 'Upper end' and 'Central' allowances as outlined in Table 3.6.1 should be considered, to understand the range of the impact.

3.6.9 Therefore, the 10 per cent and 20 per cent climate change allowances can be applied for peak rainfall intensity. However, as a conservative approach, the 20 per cent value has been used as the main design climate change allowance, while the 40 per cent has also been tested as an exceedance scenario (as a sensitivity analysis), in order to test the impact of a larger potential change as a result of climate change. Given their longer lifetime the surface access works incorporate a 40 per cent allowance applied to their design life to 2032.

3.6.10 The allowance to be made for the predicted impact of climate change on peak river flows is subject to the river basin district, in this case identified as the Thames River Basin. Table 3.6.2 details the applied uplift factors for the Thames River Basin, in line with the current Environment Agency climate change allowances.

Table 3.6.2: Recommended climate change allowance for peak river flow

Applies to Thames River Basin	Total potential change anticipated for 2015 to 2039	Total potential change anticipated for 2040 to 2069	Total potential change anticipated for 2070 to 2115
Upper End	25%	35%	70%
Higher Central	15%	25%	35%
Central	10%	15%	25%

3.6.11 According to relevant guidance (Environment Agency, 2016), the Higher Central and Upper End allowances should be used for Essential Infrastructure in Flood Zone 2, in this case 25 per cent and 35 per cent. When in Flood Zone 3, the Upper End allowance, in this case 35 per cent, should be used. For the purposes of this assessment, given that elements of the Project are in Flood Zone 3, the effects of core airfield works on fluvial flood risk have been assessed against the 35 per cent increase in peak river flow for the one per cent (1 in 100) AEP event. The 70 per cent climate change allowance has been tested as an exceedance scenario (as a sensitivity analysis), in order to assess the impact of a larger potential increase in peak river flow.

3.6.12 Again, given their longer lifetime the surface access elements have been assessed against a 70 per cent allowance. The use of the 35 per cent and 70 per cent climate change allowances for the design event(s) peak river flow (see Table 3.6.2) has been confirmed in discussions between GAL and the Environment Agency.

[1] Annual Exceedance Probability (AEP) refers to the chance that a flood event of a particular magnitude is experienced or exceeded during any one year.

4 Assessment Methodology

4.1 Scope of the Assessment

4.1.1 This FRA considers all sources of flooding including flooding to the Project site, as well as impacts elsewhere due to the development of the Project. The assessment of residual risk arising from exceedance events has been considered on the basis of higher climate change uplift factors being applied. This approach allows the assessment of a larger potential increase in flood risk due to climate change and provides insight on the risk of flooding to, and as a result of, the Project after 2069.

4.1.2 Tidal flooding has been scoped out of this assessment. The watercourses that flow through the study area are the River Mole and its tributaries and are ultimately a tributary of the River Thames. The River Mole confluence with the River Thames is upstream of the tidal extent of the Thames at Teddington Lock. The airport is approximately 35 km north of the nearest coastline and ground levels are generally above 55 metres AOD and therefore are not at tidal/coastal flood risk. No impact pathway has therefore been identified that could lead to an effect on flood risk.

4.2 Assumptions and Limitations

4.2.1 This FRA has been prepared as a preliminary information document and includes best available information at the time of writing. Determination of flood risk from all sources to the Project is based on published flood risk mapping as well as detailed hydraulic modelling results produced specifically for Gatwick Airport.

4.2.2 The Upper Mole Hydraulic Model has been produced in partnership with the Environment Agency to allow for assessment of fluvial flood risk in the study area. The model has been further developed since its original approval by the Environment Agency in order to incorporate recent changes to the airport infrastructure (including Larkins Road and Boeing Hangar) and refinements made upstream in Crawley by the Environment Agency. The 1D-2D model, which applies current best practice and makes use of quality reviewed local data, is considered to produce reliable model results. The model has been calibrated based on three historic events (between 2000 and 2002) and an additional 2013 event has been used as the verification event.

4.2.3 The Project design development is currently ongoing. Minor changes to the proposed works have been completed since hydraulic modelling was undertaken. However, these are not considered to affect the overall conclusion of the assessment on flood risk.

4.2.4 Any changes to ground levels due to proposed car parks (except those used as flood compensation areas) have not been incorporated in the model at this stage. However, the design of the proposed car parks is intended to ensure that no loss of floodplain occurs for each site.

4.2.5 The assessment of surface water flood risk was undertaken using a drainage and surface model built with the Infoworks™ ICM software.

4.2.6 In order to validate the model for its surface water flooding performance, an existing model was rebuilt and revalidated against an extensive flow survey of 32 monitors.

4.2.7 At this stage, the elevations of the development are not finalised, and therefore it is not possible to develop a full post development drainage model, and the post development model is therefore conceptual in nature. A more detailed assessment will be undertaken alongside detailed design. Therefore, the mapped surface water flood extents and depths that are included in supporting figures of this FRA should only be used as an indication of the scale of the change in surface water flooding. In particular, the alterations in ground levels within the airfield due to the Project have not been assessed as the model is still being prepared. Therefore, the exact locations of flooding for the development cannot be verified. The surface water flood extents and depths will be updated following the finished ground levels being available and will be taken into account within the FRA accompanying the application for development consent.

4.2.8 It has been assumed, at this stage, that the Project would introduce up to approximately 17.9 hectares of additional hardstanding areas within the airport boundary. That represents a 7% increase above the current development. This will be refined based on the final Project design for the FRA to accompany the application for development consent. Any changes to the Project will be incorporated into the updated FRA that supports the ES.

4.2.9 Overall, the fluvial and surface water hydraulic modelling results successfully allow consideration of the effectiveness of the proposed flood mitigation strategy. However, at this stage, the design of flood mitigation measures is subject to discussion with the LLFA and/or the Environment Agency. Therefore, details regarding their location and arrangements are subject to change.

4.2.10 Where a new surface water discharge to a Main River is proposed (eg the River Mole) or where existing discharge arrangements are altered, this would be subject to discussions with the Environment Agency.

4.2.11 GAL has developed a model of the wastewater network within its estate to assess the impact of the Project. This model has been utilised to determine the risk of wastewater flooding.

4.2.12 At this stage, groundwater and water supply flood risk have been assessed based on existing available information and previous known flooding incidents within the study area. Additionally, a qualitative assessment has been undertaken to inform the indication of areas that are likely to be vulnerable to groundwater flooding.

5 Existing Flood Risk

5.1 Basis of the Assessment

5.1.1 In accordance with the NPPG (Ministry of Housing, Community and Local Government, 2019b), an assessment of flood risk to the Project site has been undertaken based on the following sources of information.

- Flood risk information available from the Environment Agency website (Flood Map for Planning, Risk of Flooding from Surface Water, Reservoir Flood Risk Map, Historic Flood Map).
- Crawley Borough Council Strategic Flood Risk Assessment, 2020.
- West Sussex County Council Local Flood Risk Management Strategy, 2013.
- Groundwater Flooding Susceptibility Areas and Groundwater Flooding Confidence Areas mapping (British Geological Survey).

5.1.2 The Upper River Mole fluvial hydraulic model recently completed by GAL and the surface water drainage model have also been used to confirm existing flood risk to the site.

5.1.3 Overall, the risk of flooding from all relevant sources has been considered, covering:

- fluvial;
- surface water;
- sewer and water distribution infrastructure flooding;
- groundwater flooding;

- reservoirs failure; and
- flood defence failure.

5.2 Fluvial Flood Risk

5.2.1 Gatwick is located in the Thames River Basin District (RBD) and within the Upper Mole catchment. The River Mole flows through the airport, passing under the main and existing northern runways in culvert. Tributaries of the River Mole, including Crawter's Brook, the Gatwick Stream, Man's Brook and Westfield Stream all run through or adjacent to the Project site.

5.2.2 Therefore, fluvial flood risk is one of the main sources of flood risk to the Project.

5.2.3 This section provides an assessment of existing fluvial flood risk within the Project site. The assessment is based on a number of data sources including:

- Environment Agency Flood Zones; and
- Gatwick Upper Mole Hydraulic Model.

Environment Agency Flood Zones

Overview

5.2.4 The classification of Flood Zones is used as the basis on which the Sequential Test is applied. It identifies the probability of flooding in each Flood Zone. Flood Zones 1, 2 and 3a are defined by the Environment Agency, ignoring the presence of flood defences and without taking account of the possible impacts of climate change to the future probability of flooding. Flood Zone 3b should be defined by local planning authorities in agreement with the Environment Agency and should consider the presence of defences. Table 5.2.1 sets out the classification of Flood Zones in accordance with the NPPG (Ministry of Housing, Community and Local Government, 2019b).

Table 5.2.1: Environment Agency Flood Zones Definition

Flood Zone	Definition
Flood Zone 1 – Low Probability of Flooding	Land having a less than 1 in 1,000 AEP of river or sea flooding.
Flood Zone 2 - Medium Probability of Flooding	Land having between a 1 in 100 and 1 in 1,000 AEP of river flooding; or land having between a 1 in 200 and 1 in 1,000 AEP of sea flooding.
Flood Zone 3a - High Probability of Flooding	Land having a 1 in 100 or greater AEP of river flooding; or land having a 1 in 200 or greater AEP of sea flooding.
Flood Zone 3b – Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood (typically a 1 in 20 or greater AEP event). Local planning authorities should identify in their SFRAs, areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

5.2.5 In this case, the Crawley SFRA (Crawley Borough Council, 2020) includes the following approach regarding Flood Zone 3b: "*Flood Zone 3b, unlike other Zones, does show flood risk that takes account of the presence of existing flood risk management features and flood defences, as land afforded this standard of protection is not appropriately included as functional flood plain*".

5.2.6 The Gatwick Upper Mole Hydraulic Model, includes results for the 5 per cent (1 in 20) AEP event.

Assessment

5.2.7 The Environment Agency Flood Zones have been mapped in Figure 5.2.1. This demonstrates that there are areas of Flood Zone 3 (areas at risk of flooding in a 1 per cent (1 in 100) AEP event) and Flood Zone 2 (area at risk of flooding in between a 1 per cent and 0.1 per cent (1 in 100 to 1 in 1000) AEP event) within the Project site boundary. These are associated with the River Mole, Westfield Stream, Man's Brook and Crawter's Brook on the western and southern sides of the airport and with the Gatwick Stream on the eastern side.

5.2.8 Outside of the airport, there are extensive areas of Flood Zones 2 and 3 in which are situated a number of third party receptors for the Project, including residential areas and transport infrastructure that serves both Gatwick and the wider study area. These flood extents are generally associated with the River Mole and/or Gatwick Stream and, therefore, could potentially be affected by the Project.

Upper Mole Hydraulic Model

Overview

5.2.9 The Upper Mole Fluvial Modelling study was undertaken as a partnership between GAL and the Environment Agency. The purpose of the study was to develop a better understanding of flood risk in the area, particularly to Gatwick Airport, and provide updated flood risk information for the catchment. The objectives of the study were to develop an updated model which reflects the urban nature of the catchment, including Crawter's Brook and Gatwick Stream and the more rural nature of Man's Brook and the Upper Mole, and to calibrate this model against at least three historic high flow events.

5.2.10 The model was run for design events between 20 per cent (1 in 5) AEP and 0.1 per cent (1 in 1000) AEP, including climate change scenarios for the 1 per cent (1 in 100) AEP event of +35 per cent and +70 per cent. The 20 per cent (1 in 5) AEP flood event would often be adopted to determine the extents of Flood Zone 3b (refer to Figure 5.2.3). The Crawley SFRA 2020 confirms this approach but indicates that where 5 per cent data is not available, 1 per cent (1 in 100) AEP event results are used following a precautionary principle.

5.2.11 The study focuses on the Upper Mole catchment, up to its downstream extent to the west of Horley, in West Sussex. The main watercourses considered are the Upper Mole, Gatwick Steam, Crawter's Brook and Man's Brook.

5.2.12 Two models have been created. The first model represents the catchment without any formal defences as per the situation before the Upper Mole Flood Alleviation Scheme (FAS). This is the undefended scenario and was used as a calibration model. The second model represents the situation once the Upper Mole FAS had been completed. The Upper Mole FAS is an Environment Agency project, in partnership with GAL, designed to reduce flooding at Gatwick Airport and to nearby areas including Horley and Crawley. According to the Crawley Infrastructure Plan (Crawley Borough Council, 2021), the Upper Mole FAS has now been completed and comprises the following items:

- Raising of Tilgate Dam;
- Worth Farm storage area;
- Grattons Park stream enhancements; and
- Clay's Lake storage reservoir.

5.2.13 The study built a new 1D-2D hydrodynamic model of the catchment using Flood Modeller 1D and TUFLOW 2D software. This combined 1D-2D model was selected as the most suitable approach on the basis of the following.

- Using a single 1D model in combination with linked 2D domains on the floodplain allows for interactions between individual watercourses and structures to be accurately modelled and mapped. This approach therefore represents an effective way to describe the complex flow routes expected through urbanised parts of the study area.

- The use of a 1D-2D linked model provides an accurate simulation of in-channel hydraulics, coupled with detailed out-of-bank representation of flood routes, depths, flows and velocities. The combined model therefore enables robust simulation of the effect of key hydraulic features (such as bridges, culverts, flood relief areas and flood defences) both in-bank and out-of-bank.
- A combined 1D-2D approach enables robust estimation of hazards in the floodplain, including the combined impact of coincident velocities and depths.

Assessment

5.2.14 According to results from the baseline scenario of the Upper Mole Fluvial Model recently completed by GAL, flooding occurs within the Project site boundary for the 1 per cent (1 in 100) AEP event. As with the Environment Agency Flood Zones, flooding is mainly associated with the River Mole and Crawter's Brook on the western and southern sides of the airport, and with the Gatwick Stream on the eastern side, around the South Terminal building. However, the actual flooding extents are significantly different to the Environment Agency Flood Zones. The flooding extent for the 1 per cent (1 in 100) AEP event based on the Upper Mole Hydraulic model is mapped against Flood Zone 3 in Figure 5.2.2. The differences between the two models and extents are discussed in more detail in paragraphs 5.2.19 to 5.2.22.

5.2.15 According to Figure 5.2.3, all areas of the Project site falling within flood extents for the 5 per cent (1 in 20) AEP event are directly related to watercourses and do not encroach in areas that would be developed for the Project except for a small area at the western end of the airport, where parts of the proposed Taxiway Juliet West Spur and along the edge of Taxiway Juliet fall into the 5 per cent (1 in 20) flood extent and the surface access works to the A23 at the northern terminal access roundabout and at the Longbridge roundabout.

5.2.16 The requirements for considering the potential future impacts of climate change on fluvial flooding are described in Section 3.6. Suitable climate change allowances are chosen based on the specified River Basin (in this case, the Thames River Basin), the vulnerability of the development and the lifetime of the Project. Based on that information a 35 per cent allowance for climate change has been applied within the baseline scenario of the Upper Mole Hydraulic Model. A 70 per cent climate change allowance has also been tested, as an exceedance scenario (as a sensitivity analysis). Results are illustrated in Figure 5.2.3.

5.2.17 For the 35 per cent allowance, extents are increased compared to the 1 per cent (1 in 100) AEP event in areas south of the main runway and areas around the North Terminal and adjacent infrastructure.

5.2.18 For the 70 per cent allowance, flooding extends to several proposed and existing elements in the northern part of the airport and flood extents also encroach on the south-east part of the airport, including on runways and taxiways.

Differences Between the Environment Agency Published Flood Zones and Gatwick Model

5.2.19 This section compares the Environment Agency Flood Zone Mapping with the Upper Mole Hydraulic Model baseline scenario results, as shown in Figure 5.2.2, in order to identify the differences that should be considered within this assessment.

5.2.20 The overall pattern of flooding is significantly different for the Upper Mole model and the Environment Agency Flood Zones, with the first indicating flood extents that are more confined and, in some cases, diverted from the Environment Agency flood extents. This can be explained considering the fact that the Upper Mole model has considered local flood defence schemes that were being constructed or had recently been built within the catchment.

5.2.21 The new model also better reflects the urban nature of the catchment, including Crawter's Brook and Gatwick Stream and the more rural nature of Man's Brook and the Upper Mole, and has been calibrated against historic high flow events. Therefore, it is considered that it provides a more realistic understanding of flood extents and depths within the catchment.

5.2.22 In summary, it is considered that the Upper Mole Hydraulic Model outputs offer a more realistic and informative approach to assessing fluvial flood risk to the Project. However, in most cases, the Environment Agency Flood Zones would offer the worst-case scenario for the assessment. Therefore, the assessment undertaken has been based on a combination of both models, bearing in mind that the Upper Mole model offers the most up-to-date approach where the undefended scenario has also been considered.

5.3 Surface Water Flood Risk

Existing Surface Water Management Strategy

5.3.1 There are currently eight surface water drainage catchments within the Project site that directly receive runoff as shown in Figure 5.3.1. Generally, four of these serve the main airfield, discharging to Pond A, Pond M, the Dog Kennel Pond and Pond D. During cold weather, de-icer is regularly used, which, together with other pollutants, enters the surface water drainage system. When there is sufficient storage capacity in the system, the four attenuation ponds provide a degree of treatment through aeration and settlement. Figure 2.1.1 includes the main attenuation features of the existing surface water drainage network.

5.3.2 Pond D receives the majority of runoff from Gatwick including that transferred from Pond A, Pond M, and the dirty side of Dog Kennel Pond. Runoff from the Pond D catchment drains to Pond D (lower) and is then raised by three Archimedes screws to Pond D (upper). In general, when runoff meets the required water quality standard of a biochemical oxygen demand (BOD) below 10 mg/l, water is discharged to the River Mole, via the attenuation ponds at a consented rate controlled by a series of vortex flow control devices and pumps. When water quality falls below the required standard, the ponds discharge to the polluted water pumped main which conveys runoff for further treatment and temporary storage at two Long Term Storage Lagoons (Old and New Lagoons) with storage capacities of 220,000 m^3 and 100,000 m^3 respectively and then ultimately to Crawley Sewage Treatment Works (STW), which is operated by Thames Water. There are restrictions placed on the peak flow that can be transferred to the STW under a trade effluent consent agreed with Thames Water. In very heavy rainfall events, contaminated water diluted by rainfall may be pumped directly to the River Mole from Pond D if the incoming runoff is greater than the capacity of Pond D and there is insufficient capacity in the pumping system that transfers it to the pollution storage lagoons.

5.3.3 Pond E, Pond F, and Pond G provide attenuation for car parks east of the Railway line, and discharge to the Gatwick Stream. The clean side of Dog Kennel pond provides attenuation for the car parks north of Larkins Road, and is pumped into the River Mole.

5.3.4 The assessment of existing surface water flood risk to the Project site has been based on the Environment Agency Risk of Flooding from Surface Water mapping as well as surface water drainage modelling produced by GAL.

Environment Agency Risk of Flooding from Surface Water Mapping

5.3.5 The Environment Agency Risk of Flooding from Surface Water (RoFSW) mapping has been used to make an overarching assessment of the existing surface water flood risk to the Project. It has been used to determine overall patterns of surface water flooding and therefore to steer the assessment of risks, impacts and mitigation measures that follow.

5.3.6 According to the Environment Agency RoFSW flood extents mapping, illustrated in Figure 5.3.2, surface water flooding occurs in several areas of the airport. Areas at high risk (greater that 3.3 per cent (1 in 30) AEP of flooding) are predominately associated with areas around existing watercourses or drainage features, although there are isolated pockets of high risk likely to be the result of rainfall filling local depressions rather than overland flow paths. Areas at medium risk (between 3.33 per cent and 1 per cent (1 in 30 and 1 in 100) AEP of flooding) are generally small and adjacent to the areas at high risk. A large area at medium risk is located near the River Mole and south of the existing main runway. This flooding is likely to occur due to the existing River Mole culvert's capacity being exceeded. There are larger areas predicted to be at low risk (between 1 per cent and 0.1 per cent (1 in 100 and 1 in 1000) AEP of flooding) within the airport, particularly to the south of the main runway and in proximity to existing terminal buildings.

Gatwick Surface Water Hydraulic Model

5.3.7 The assessment of surface water flood risk was undertaken using a drainage and surface model built with the InfoWorks™ ICM software. An existing model was rebuilt and revalidated against an extensive flow survey of 32 monitors.

5.3.8 At this stage, the finished elevations of the development are not finalised, and therefore it is not possible to develop a full post development drainage model, and the post development model is conceptual in nature. A more detailed assessment will be undertaken alongside detailed design.

5.3.9 Therefore, the mapped surface water flood extents and depths that are included in supporting figures of this FRA should only be used as an indication of the scale of the change in surface water flooding. In particular, the alterations in ground levels within the airfield due to the Project have not been assessed as the model is still being prepared. Therefore, the exact locations of flooding cannot be verified. The surface water flood extents and depths will be updated following the finished ground models being available and will be taken into account within the FRA accompanying the application for development consent.

5.3.10 It has been assumed, at this stage, that the Project would introduce up to approximately 17.9 hectares of additional hardstanding areas within the airport boundary. That represents a 7% increase above the current development. This will be refined based on the final Project design for the FRA to accompany the application for development consent. Any changes to the Project will be incorporated into the ES.

5.3.11 The model has been run for the baseline (existing condition) scenario as well as the with-Project scenario, including the proposed surface water mitigation measures. The baseline scenario is based on current land use, asset location and ground model data.

5.3.12 There are two critical return periods for the surface water drainage system at Gatwick. The first is a 30-minute summer event, which generates the maximum flood volume and extent in a convective type storm event across the entire airfield. Typically, a 60-minute or 30-minute storm event would be expected to be the critical event for a land area of hardstanding such as Gatwick. However, because Gatwick has a controlled outlet at Pond D, influencing flood risk in the North Terminal and apron during longer, higher volume, less intense rainfall events, a second 1440-minute winter event has also been used. The critical return periods will be reassessed when the with development model is built for the ES.

5.3.13 The model results of the baseline scenario for the 1 per cent (1 in 100) AEP event, including a 20 per cent climate change allowance have been mapped in Figure 5.3.3 and Figure 5.3.4 for the 30-minute and 1440-minute storm durations respectively.

5.3.14 It is apparent that the 30-minute duration is the worst-case scenario in terms of flood extent. This is likely to be due to flow control measures and attenuation ponds within Gatwick Airport that would restrain flow paths for longer events. Therefore, the 30-minute event with a 1 per cent (1 in 100) plus 20 per cent climate change AEP can be used to provide a comparison with the patterns illustrated in Environment Agency RoFSW extents. Generally, both extents seem to follow a similar pattern, with ponding mainly forming between taxiways, around runways and towards the South Terminal.

5.3.15 An area of surface water flooding included in the Environment Agency maps is located south of the existing main runway, around the River Mole. This area is not included in the GAL surface water modelling results. However, it is included in the Upper Mole Hydraulic Model extents as being at risk of fluvial flooding for the 1 per cent (1 in 100) AEP event.

5.3.16 Flood extents for the 1440-minute event with a 1 per cent (1 in 100) plus 20 per cent climate change AEP are much more confined and mainly located at the North Terminal.

5.3.17 The model has also been run for the 1 per cent AEP event, including a 40 per cent climate change allowance, as shown in Figures 5.3.3 and 5.3.4, in order to examine a potential larger impact of climate change to existing conditions. The extents of surface water flow paths and ponding areas are wider in some areas, but mostly follow the same pattern as the lower climate change allowance. This is due to topographical conditions and existing drainage infrastructure directing surface water flows within the airport.

5.4 Groundwater Flood Risk

5.4.1 Groundwater is present in the superficial deposits beneath the site. This may occur in relatively small discreet and discontinuous bodies, or, particularly adjacent to watercourses, may form more continuous groundwater bodies.

5.4.2 Groundwater levels respond to direct recharge from rainfall but also, adjacent to water bodies, may respond to changes in river and stream levels. The rate of this response and the 'outward' propagation of these levels from surface waters, may vary considerably across the site, depending upon the transmissivity and storage properties of the aquifer.

5.4.3 Groundwater levels in superficial deposits adjacent to watercourses are likely to mimic the water level response in those surface waters, although there may be a lag in, and attenuation of, the water level response.

5.4.4 There are relatively sparse data for groundwater levels, but where these are available, they suggest groundwater levels are close to the surface (and may be less than 1 metre depth). Annual groundwater level fluctuation may be of the order 0.5 metres - 1.5 metres, but this is based on a very limited data set, mostly away from the influence of surface watercourses.

5.4.5 Groundwater flooding may be defined as the emergence of groundwater at the ground surface or the rising of groundwater into underground infrastructure (such as basements) under conditions where the normal range of groundwater level and flow is exceeded.

5.4.6 Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (superficial deposits flooding), or with unconfined aquifers ("clearwater" flooding).

5.4.7 Mapping developed by the British Geological Survey (BGS) identifies areas of groundwater flooding susceptibility, with associated mapping identifying the confidence level in the data used to develop the susceptibility mapping. The groundwater flooding susceptibility mapping correlates geological data and water level data held by BGS and has been included in Figure 5.4.1.

5.4.8 The mapping identifies that there is susceptibility to groundwater flooding throughout the areas underlain by superficial deposits (ie superficial deposits flooding), with a moderate level of confidence.

5.4.9 There is also identified susceptibility to groundwater flooding from the Tunbridge Wells Sand (clearwater flooding), but with a low level of confidence.

5.4.10 Given the normally recorded range of groundwater levels within the superficial deposits, which show shallow depth to groundwater, the mapped susceptibility to flooding is unsurprising, however this does not necessarily mean groundwater flooding will occur (ie as per the definition, groundwater flooding is associated with groundwater levels above "the norm").

5.4.11 Based on the Crawley SFRA there have been only two occurrences of groundwater flooding recorded in the Crawley Borough Council administrative area. These are not located near the airport. The SFRA identifies groundwater flood risk as being low for the Crawley Borough Council administrative area as a whole and that there is no conclusive evidence of elevated susceptibility to groundwater flooding within the Borough.

5.4.12 There are anecdotal reports of flooding of basements and other buried infrastructure in parts of the site which may be the result of the inundation of shallow groundwater. Furthermore, there is anecdotal evidence of surcharging of sewers (eg in pipework to Crawley STW) discharges by infiltrating groundwater. However, these events, if they have occurred, do not necessarily constitute groundwater flooding.

5.4.13 Although groundwater levels beneath Gatwick Airport may be at shallow depth, there is no conclusive evidence of groundwater flooding occurring at the airport. Although it is not possible to fully quantify, it is concluded that the current risk from groundwater flooding at the airport site is low.

5.5 Flood Risk from Reservoir Failure

5.5.1 According to the Environment Agency Risk of Flooding from Reservoirs Maximum Outline data[2], much of the western side of the airport would be at risk of flooding in the event of failure of the Ifield Mill Pond, while the eastern side, including sections of both terminal buildings, would be at risk from a failure of the pollution lagoons adjacent to Crawley STW. The reservoir flood risk flood extents are illustrated in the map shown in Figure 5.5.1. However, as large, raised reservoirs, these structures are maintained and operated in accordance with the Reservoirs Act (1975) and therefore the risk of failure is considered very low due to their monitoring and inspection regime.

5.5.2 A number of flood storage reservoirs have also been created as part of the Upper Mole Flood Alleviation Scheme on tributaries of the Gatwick Stream to the south and east of Crawley. These appear to be included in the Environment Agency Risk of Flooding from Reservoirs mapping, available online[2].

5.5.3 GAL undertook a study in 2019 to assess the potential failure of the two storage lagoons to the east of Crawley STW (see Figure 2.1.1). The hydraulic modelling produced flood depth and hazard mapping that could result from the potential failure of each lagoon. A worst-case scenario was assumed that each lagoon would be full (impounded water would be at crest level) and that the pumps sending water to them from Pond D would continue to operate. Three breach locations were tested and the results are included in Figure 5.5.1. They indicate that the resultant flow path would travel northwards primarily through the airport car parks to the east of the London to Brighton mainline railway. The flow path does not cross the railway and would pass under the M23 spur via the B0236 bridge and then towards the residential areas to the north of the motorway. The A23 and M23 would not be flooded. In the unlikely event of a breach of the lagoons during construction, the project elements that would be affected would be those that are east of the railway line, principally the Surface Access works to the South Terminal, works to the car parks located in this area and the hotel and office provision after 2032.

5.5.4 The residual risk of failure of the Gatwick Stream Flood Storage Area has not been considered as part of the current assessment but will be assessed for the updated FRA that will support the ES. However, similarly to other structures that fall under the auspices of the Reservoirs Act, the strict inspection and maintenance regime results in a very low likelihood of failure.

5.6 Sewer/Water Distribution Infrastructure Flooding

5.6.1 Gatwick Airport has a complex water distribution and sewerage network that should be considered as a potential source of flood risk.

5.6.2 The failure of sewerage or water distribution infrastructure within or upstream of the Project site could result in flooding, although the risk of this is likely to be low given the maintenance and monitoring activities undertaken by Gatwick Airport to avoid this.

5.6.3 The hydraulic model built by GAL to assess the impact of the Project on the wastewater network has not identified any locations predicted to flood based on current and future flows as a result of the Project.

5.6.4 At the time of writing of this FRA it was reported that part of the Thames Water network, located in Horley, periodically has reached its capacity, causing flows to back up to the airport.

5.6.5 The Crawley SFRA (2020) includes a specific section on recorded sewer or water distribution infrastructure flooding events based on the Thames Water Sewer Flooding History Database. This records that there have been 102 instances of flooding in postcodes covered by the Crawley SFRA although some may be outside the boundary as the postcodes cover a wider area. For the Postcode area covering Gatwick Airport (RH6 0), only one incident is recorded and this may be outside the area of the airport as the postcode area covers a much larger area of land.

[2] Long term flood risk information. Available from: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

Overall, the risk of sewer flooding at the Project site is considered to be low.

5.7 Risk of Flood Defence Failure

5.7.1 According to the Environment Agency Flood Map for Planning, the Project is partly located in an area benefiting from flood defences. As described in Section 5.2, the Upper Mole Fluvial Model has considered local flood defence schemes that were being constructed or had recently been built within the catchment. Both the defended and undefended scenarios have been modelled and compared to understand the risk associated with flood defence failure.

5.7.2 The mitigation for the scheme has been developed based on the defended scenario (continued operation of existing flood defences). However, the Flood Threat Plan being developed by GAL will provide a management system of how to ensure the safety of airport operatives and passengers in the event of a flood defence failure.

5.8 Historic Flooding

5.8.1 There is a history of flooding from different sources at the airport, most notably in the December 2013 flood event, which led to major air traffic disruption.

5.8.2 According to the West Sussex LFRMS (West Sussex County Council, 2013):

'Historically the River Mole and its tributary the Gatwick Stream have come out of bank and flooded, and there are a number of recorded incidents that have damaged property.'

5.8.3 In September 1968, the airport was closed for several days due to flooding of the main runway. According to the Crawley SFRA (Crawley Borough Council, 2020), in 2000 over 70 properties in Crawley and Maidenbower were flooded during the reported 6.67 per cent (1 in 15) AEP event. Gatwick Airport was also affected by this fluvial event, as Gatwick Stream exceeded the capacity of the culvert alongside the South Terminal building. This caused flooding along the A23 and into the South Terminal. The most recent fluvial flood within the catchment occurred in December 2013 when high river levels caused the loss of three airfield electrical substations and led to significant disruption, particularly to Gatwick North Terminal (McMillan, 2014). The flooding event was the culmination of unprecedented levels of rainfall over proceeding weeks and months. River flows in three waterways in the immediate vicinity of the airport were at record levels.

5.8.4 There are limited reports of surface water flooding within the catchment, however given the level of urbanisation in parts of the catchment it seems likely that some localised surface water flooding would occur. Part of the cause of the December 2013 flooding is classed as surface water, as rainfall caused the North Terminal basement to be flooded, damaging a number of systems and causing disruption to the airport (McMillan, 2014).

5.8.5 Figure 5.8.1 illustrates the Environment Agency Historic Flood Map for the Project study area.

5.9 Flood Risk Compatibility of the Project

5.9.1 Table 5.9.1 categorises the different types of land uses of the Project elements, as described in the PEIR Chapter 5: Project Description, according to their vulnerability to flood risk. It then aligns these vulnerability classes against Flood Zones (based on Table 3 of the NPPG) to determine where development is 'appropriate', where it should only be permitted if the Exception Test is passed and where it should not be permitted. For Flood Zone 2, compatibility has been assessed based on the Environment Agency published Flood Zones. However, for Flood Zones 3a and 3b, compatibility has been assessed based on the Gatwick Upper Mole model as it offers the most up to date basis for the assessment and due to the fact that the Environment Agency Flood Zones do not specifically delineate Flood Zone 3b.

5.9.2 Table 5.9.1 indicates the flood zone compatibility of the Project elements, indicating whether they are deemed 'appropriate' or if they need to pass the Exception Test.

Table 5.9.1: Project Elements Vulnerability and Flood Zone Compatibility

Project Element Type	Vulnerability Classification	Flood Zone Compatibility			
		FZ1	FZ2	FZ3a	FZ3b
Runways Taxiways Terminals Piers and Stands Internal Access Routes and Surface Access (including highway improvements)	Essential Infrastructure	✓	✓	Exception Test Required	Exception Test Required
Waste Management Facilities	Highly Vulnerable	✓	Exception Test Required	✗	✗
Hotel and Commercial Facilities	More Vulnerable	✓	✓	Exception Test Required	✗

Project Element Type	Vulnerability Classification	Flood Zone Compatibility			
		FZ1	FZ2	FZ3a	FZ3b
Fire Training Ground Hangars Maintenance Facilities Car Parking	Less Vulnerable	✓	✓	✓	×
Flood Control Infrastructure Flood Storage Areas	Water Compatible	✓	✓	✓	✓

✓ = 'appropriate'

× = 'not permitted'

The Sequential Test

5.9.3 The Sequential Test, as described in Section 3.4, ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones, as defined by the Environment Agency Flood Map for Planning, provide the basis for the test to be applied. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision-making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas at high probability of river and sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

5.9.4 According to the Environment Agency Flood Zones (Figure 5.2.1), the majority of the altered northern runway and proposed taxiways located in the western part of the airport fall within Flood Zone 2. Existing infrastructure, including runways and taxiways as well as the South and North Terminals also fall within Flood Zone 2 and partly, Flood Zone 3. Both the existing main runway and the proposed altered northern runway are located outside of Flood Zone 3, but there are small strips of taxiways, both existing and proposed, around the western end of the airfield that fall within Flood Zone 3.

5.9.5 In applying the Sequential Test, it should be considered that the adopted approach has been to make best use of existing infrastructure. This is a strategic decision by the Airports Commission but also an approach to minimise wider environmental impacts by Gatwick.

5.9.6 The Airports Commission: Final Report (Airports Commission, 2015) concluded that a new runway at Heathrow would be the most beneficial long-term expansion solution for London airports and did not propose to take forward the proposal of a new runway in Gatwick Airport at this time. A number of alternative options for the runway and other Project elements have been considered (see PEIR Chapter 3: Need and Alternatives Considered). The final selection for the location of these options has taken account of various factors, including flood risk. Therefore, it can safely be assumed that alternative locations for the Project, outside of Flood Zone 2 and 3 are not available and that the Sequential Test would be passed.

5.9.7 Table 5.9.1 shows that the Exception Test needs to be applied for some elements of the Project.

The Exception Test

5.9.8 The Exception Test is described in Section 3.5. Essentially, there are two parts to the Exception Test that require the applicant to demonstrate that a proposed development will provide wider sustainability benefits to the community that outweigh flood risk and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reducing flood risk overall.

5.9.9 The first part of the Exception Test will be considered through the planning and EIA processes and within the Sustainability Statement that will accompany the application for development consent. Gatwick's sustainability policy goals and objectives lie at the heart of the Project sustainability framework. In addition, the framework reflects both the objectives used by the Government in the Airports NPS (Department for Transport, 2018) and the sustainability priorities relevant to the host local authorities within the context of local aspects. More information on wider aspects of sustainability can be found within the PEIR, with a brief description of Gatwick's ongoing sustainability objectives included in Chapter 5: Project Description.

5.9.10 The second part of the Exception Test is addressed in Section 7, where it is demonstrated how a flood mitigation strategy is in place that would ensure the Project remains safe throughout its lifetime and does not increase flood risk elsewhere.

6 Flood Risk due to the Project

6.1 Introduction

6.1.1 The development of the Project could itself affect flood risk within the wider study area, if no mitigation was in place. This section describes how and where flood risk would be increased due to the Project, with regards to types of flooding that have the potential to be affected by new development. These include fluvial, surface water, groundwater and sewer/ water distribution infrastructure flood risk. The Project would not increase the likelihood of reservoir and/ or flood defence failure, or change the magnitude of impact, if these occurred. Therefore, these types of flooding have been scoped out of this assessment.

6.2 Fluvial Flood Risk

6.2.1 According to the Environment Agency Flood Zones and the Upper Mole Hydraulic Model results, areas downstream and upstream of Gatwick are also at risk of fluvial flooding and hence, further development within the airport has the potential to influence flood risk upstream and downstream.

6.2.2 This section provides an assessment of the Project's effect on fluvial flood risk, assuming no mitigation would be in place. This assessment is based on the comparison of flood extents and flood depths between the baseline 1 per cent (1 in 100) AEP event including a 35 per cent climate change allowance and the with-Project results for the same event, Figure 6.2.1, and the comparison of flood extents and flood depths between the baseline 1 per cent (1 in 100) AEP event including a 70 per cent climate change allowance and the with-Project results, Figure 6.2.2.

6.2.3 Where differences are indicated between the two scenarios, these are discussed in the context of the magnitude of change of flood depth as well as the vulnerability of the potential receptor/ land use.

6.2.4 According to Figure 6.2.1, the with-Project scenario would result in an increase in flood depths south of the existing main runway, including in areas outside of the airport boundary, around the River Mole (>10 mm and up to 50 mm increase) and Crawter's Brook (mainly up to 100 mm flood depth increase), where a number of industrial properties are located. Moreover, flood depths would increase within the airport (>100 mm), around the western part and an area in the north, where the proposed Taxiway Lima extension is located. Figure 6.2.2. shows that the 1 percent (1 in 100) AEP event including a 70 per cent climate change allowance would result in more significant flooding south of the main runway, on the east side of the End Around Taxiway East, in and immediately north of Taxiway Lima, and west of the Longbridge roundabout. There is some increased betterment south of the runway, in Crawter's Brook and west of Taxiway Lima.

6.2.5 The surface access improvements would result in the loss of floodplain at Longbridge Roundabout and to the south of the A23, north-east of North Terminal as a result of the construction of an embankment for the A23 flyover. These would result in an increase in flood risk if no mitigation was provided by the Project.

6.2.6 An increased risk of flooding would also result around the Riverside Garden Park area from the Gatwick Stream and would affect residential properties within Horley. Therefore, it is essential that a flood mitigation strategy is developed as part of the Project. This is described in Section 7.

6.3 Surface Water Drainage Flood Risk

6.3.1 This section provides an assessment of the Project's impact on local surface water flood risk. At this stage, detailed design of the drainage system has not been undertaken, and finished ground levels of the development are still being finalised. Therefore conceptual modelling has been undertaken to examine the effects that the Project would have on surface water flows and an evaluation of the storage required to prevent any increase in discharge rates from the development has been undertaken.

6.3.2 The Project includes the addition of up to approximately 17.9 hectares of hardstanding area and new roof area within the airport and would therefore increase surface water runoff. Furthermore, the introduction of new infrastructure has the potential to block or divert existing surface water flow paths through landform changes, potentially increasing flood risk elsewhere.

6.3.3 Existing surface water flow paths and ponding areas show the patterns of surface water flooding within the airport. Assuming no changes to the drainage system and no mitigation strategy, the addition of impermeable area would exacerbate flood risk within areas already at risk and flooding would be expected to extend to adjacent low-lying areas.

6.3.4 This assessment therefore highlights the need for the development of a flood mitigation strategy that would mitigate surface water flood risk within the airport (refer to Section 7).

6.4 Groundwater Flood Risk

6.4.1 Some elements of the Project include structures or other elements that are likely to penetrate into shallow groundwater. These may have a local impact on groundwater flow paths and levels in their immediate vicinity.

6.4.2 Furthermore, some buried services (such as cabling ducts) may be susceptible to impacts from high groundwater levels (whether or not these are due to groundwater levels higher than the norm).

6.4.3 These risks may be addressed by adopting appropriate design practices, for example by adopting resilience measures. These measures may be passive (using sealing materials to exclude the entry of groundwater) or active (by building in sumps and pumping arrangements) and overall it is considered that the risk from groundwater flooding would not be adversely affected by the Project, and the risk from groundwater flooding would remain low.

6.5 Sewer/ Water Distribution Infrastructure Flooding

6.5.1 During the operational phase of the Project, peak daily passenger numbers would increase, introducing additional loading to the foul sewerage system of the airport. This could have a potential long-term impact on sewer flood risk. However, modelling of this increase, undertaken for the PEIR (Chapter 11: Water Environment), has shown that the sewerage system would not be significantly affected by the Project. The foul sewerage system (with mitigation) would have adequate capacity to accommodate the increase in flows expected to be caused by the Project.

6.5.2 Additional water distribution infrastructure would also have to be installed as part of the Project, in order to accommodate new buildings and infrastructure. However, this would be new infrastructure and would be considered to be at low risk of failing and causing flooding. In the case that parts of the existing water distribution network are replaced as part of the Project, this could provide an overall betterment in terms of flood risk.

6.6 Flood Risk During Construction

6.6.1 The precise location and layout of construction compounds would be determined by the Principal Contractor. However, at this stage, the principal expected compounds have been described and mapped in the PEIR Chapter 5: Project Description. In terms of flood risk, the location of construction compounds would be compared against the 1 per cent (1 in 100) AEP event flood extents, with a 25 per cent allowance for climate change as the compound would only be in place during years within the 2015-2039 period referenced in Table 3.6.2.

6.6.2 The satellite airfield construction compound, which would be located adjacent to the River Mole, falls within the 1 per cent (1 in 100) AEP floodplain. However, this compound has been considered in the timing of the construction of compensatory floodplain storage (see Section 7.2) and the proposed mitigation adequately replaces that lost to ensure no increase in flood risk. At this stage, other proposed construction compounds are expected to be located outside of the extent of the 1 per cent AEP +25 per cent event.

6.6.3 Overall, construction methods are necessarily broad at this stage. It is assumed that a construction flood management plan (FMP) and appropriate drainage strategy would be developed to ensure all flood risks related to construction activities would be mitigated or safely managed within the Project boundary. This FRA provides information that can be used as a basis when preparing the construction FMP in order to ensure that people and infrastructure remain protected from identified flood risks to the Project site.

7 Flood Mitigation Strategy

7.1 Introduction

7.1.1 As described in Section 6.2, the Project would encroach on existing floodplain areas and therefore result in a net reduction in flood storage that would require mitigation. There are also additional areas of pavement and other changes that alter surface water runoff. Therefore, a flood mitigation strategy has been developed as part of the Project, focused on fluvial and surface water flood risk.

7.1.2 The overall approach for fluvial flood risk mitigation has been to maximise the compensatory flood storage capacity within the airport. For surface water flood risk, the approach is focused on providing additional attenuation storage and flow control measures where possible.

7.2 Fluvial Flood Mitigation Strategy

7.2.1 A number of flood mitigation measures have been proposed as part of the Project, to ensure it would remain safe from flooding throughout its lifetime and would not increase flood risk elsewhere. All mitigation measures proposed for inclusion within the Project have been mapped in Figure 7.2.1 and are described in this section.

7.2.2 All the embedded fluvial mitigation measures of the Project are represented in the Upper Mole Hydraulic Model for the with-Project, with-mitigation scenario, which provides the basis for assessment of the mitigation strategy.

7.2.3 All of the proposed flood mitigation measures are planned to be constructed during the early years of the project to ensure that mitigation is provided in advance of the associated encroachment and loss of floodplain, including the temporary construction compound (see Section 6.6.2).

Proposed Fluvial Flood Mitigation Measures

7.2.4 Preliminary designs for the flood compensation areas, relocated Pond A and the River Mole reconfiguration are included in Annex 1. These are likely to evolve as the Project design progresses, but they do provide an indication of the intended features.

Floodplain Compensation Areas

7.2.5 The Project would encroach on existing floodplain areas and therefore result in a net reduction in flood storage that would need to be compensated for. The overall approach has been to maximise the compensatory flood storage capacity of the airport as close to where it has been lost due to the Project. This would be achieved with the development of new Flood Compensation Areas (FCAs) to ensure there is no increase in flood risk arising from the Project. The proposed FCAs have been mapped in Figure 7.2.1 and include; the Museum Field FCA (including east of Museum Field FCA) which is located north of the proposed relocated fire training ground and west of the River Mole; car park X FCA, located south of the main runway and adjacent to Crawter's Brook; and the east of Gatwick Stream FCA, located south of the Crawley STW.

Pond A Relocation and River Mole Reconfiguration

7.2.6 The proposed extension of the airfield encroaches on the existing Pond A, which would therefore require relocation or replacement. It has been proposed that Pond A is relocated directly to the north of its existing location. The volume of the relocated Pond A would take into account any additional storage requirements due to the introduction of new impermeable area as part of the Project.

7.2.7 The proposed relocation of Pond A north of its existing location, also requires the realignment of the River Mole such that the Pond would lay on the left bank of the river, to allow gravity drainage from the catchment serving the western airfield.

Syphons

7.2.8 The new taxiway levels are governed by the need to tie into existing taxiway or runway levels, potentially impacting on areas of floodplain. Areas of lost floodplain storage would result not only from the new taxiways, but also by hydraulically isolating part of a floodplain where the taxiway crosses it. This would be addressed by connecting both sides of the floodplain with syphon structures under the taxiways. This approach has been adopted due to the areas of lost floodplain that would be difficult to compensate for within the vicinity of where the floodplain is lost. There are two proposed syphons, as shown in Figure 7.2.1.

Assessment of Proposed Fluvial Mitigation

7.2.9 The Gatwick Upper Mole Hydraulic Model has been run for the with-mitigation scenario in order to determine the effectiveness of the proposed mitigation strategy in keeping all Project elements safe for their lifetime and in mitigating all flooding to third parties due to the Project. This assessment allows for a judgement to be made on whether the second part of the Exception Test can be passed (refer to paragraphs 5.9.8 to 5.9.10).

7.2.10 Figure 7.2.2 illustrates flood extents within Gatwick, for the mitigated, with Project scenario, for the 5 per cent (1 in 20) and 1 per cent (1 in 100) AEP fluvial event, as well as the 1 per cent (1 in 100) AEP event including 35 per cent and 70 per cent climate change allowances. This illustrates that the proposed runways and new taxiways would not be at risk of flooding during the design event (1 per cent (1 in 100) AEP event, including a 35 per cent climate change allowance). However, some Project elements, including the edge of the end around taxiway next to Taxiway Yankee, the edge of the reconfigured Taxiway Zulu, the edge of the fire training ground and Crawter's Field car park, which is located south east of the main runway, would fall within flood extents for the 1 per cent (1 in 100) AEP event including 35 per cent climate change design event for the airfield. These areas of flooding are not expected to affect the ability of the airport to remain operational and safe. The planned response to an event of this magnitude will be laid out in the Gatwick Flood Threat Plan to ensure continued safe operation.

7.2.11 At the fire training ground, flood depths would be <200 mm for the design event (1 per cent (1 in 100) AEP event including a 35 per cent climate change allowance) and the flood extents are very localised and would not block any access and egress routes. The facility would not be expected to be used during extreme flooding events. Therefore, the facility would remain safe for its lifetime.

7.2.12 Similarly, for the end around taxiway and Taxiway Zulu, flood depths would be <200 mm (mainly <100 mm), and these parts of the airfield are not expected to be required to remain operational during the design flood event. Therefore, there would be no safety risk to users of the airfield.

7.2.13 Finally, for Crawter's Field Car Park, flood depths for the design event would be mainly <400mm. The car park would be expected to remain closed in extreme flooding events, and users would be informed of the risk of flooding. Overall, the majority of the car park area would experience no flooding or flooding up to 300 mm for the design event. Access and egress routes would not be blocked during such an event and there are no dry islands that would represent a significant risk for users.

7.2.14 Figure 7.2.3 illustrates the difference in fluvial flood depths between the baseline and with-scheme, with-mitigation scenarios, for the 1 per cent (1 in 100) AEP event, including a 35 per cent allowance for climate change, allowing for a more detailed assessment of potential impacts. It shows that there are much greater areas benefiting from the development of the Project compared to the areas where flood risk is increased. The most obvious new areas of flooding are intentional and are associated with the proposed FCAs; Museum Field, Car Park X and the Gatwick Stream FCA (see Figure 7.2.1). Another flood depth increase shown is located at the north-west edge of the proposed fire training ground. However, the fire training ground facility would not be classified as 'Essential Infrastructure' and would not have to remain fully operational during such an extreme event. In any case, the flood extents are located on the edge of the facility and are not expected to affect its ability to remain operational, and therefore, this is acceptable from an Exception Test perspective.

7.2.15 Directly south of the fire training ground there is a narrow strip of increased flood depths. However, this area remains unused and does not encroach on any infrastructure and therefore, the change is not considered to result in a significant effect.

7.2.16 The South Terminal building would be at risk of flooding during the 1 per cent (1 in 100) AEP event including a 35 per cent climate change allowance, as for the baseline scenario (less than 10 mm betterment). However, dry access and egress routes from above flood levels, via high-link bridges and multi-storey car parks are in place for the terminal buildings.

7.2.17 Similarly, for the 5 per cent (1 in 20) AEP event, Figure 7.2.4 illustrates the difference in fluvial flood depths compared to the baseline scenario. As for the 1 per cent (1 in 100) AEP event, Figure 7.2.4 shows that the only areas where flood depths would be increased are associated with the proposed FCAs, the area on the edge of the fire training ground and the small undeveloped area directly south of the fire training ground. For all other areas flood depths would be reduced significantly.

7.2.18 Overall, there would be large areas with reduced fluvial flood risk within Gatwick Airport and the wider study area after the development of the Project with the mitigation measures proposed and it is estimated that approximately 100 residential properties in the area of Horley would benefit from the Project (ie

>10 mm reduction in peak flood depth for the 1 per cent (1 in 100) AEP event, including a 35 per cent allowance for climate change). An additional 40 industrial properties would also be likely to benefit.

7.2.19 Small areas of increase in flood depths would be located within the airport boundary and would not affect its ability to remain operational during times of flood, or to operate safely. The runways would remain operational for the design event (ie the 1 per cent (1 in 100) AEP event, including a 35 per cent allowance for climate change). For the terminal buildings, flooding would be equivalent to existing. For taxiways and supporting airport infrastructure, flood risk would be reduced or equivalent to existing, with the exception of small areas of locally increased flood risk. These areas have been described in paragraphs 7.2.10 to 7.2.16, where it is shown that these would not result in safety or operational risks. There would be no increase in flooding to third parties due to the Project.

7.2.20 The mitigation measures included to address changes in fluvial flood risk on the airfield would also provide mitigation for the surface access elements of the Project. Given its longer lifetime the impact of the surface access proposals on fluvial flood risk have considered the design event to be the 1 per cent (1 in 100) AEP event, including a 70 per cent allowance for climate change. Figure 7.2.5. demonstrates that the fluvial mitigation measures would also ensure that there would be no increase in fluvial flood risk beyond the airport boundary for this event (other than the floodplain compensation areas that would be deliberately designed to flood safely).

Exceedance Scenario

7.2.21 The 1 per cent (1 in 100) AEP event, including a 70 per cent climate change allowance, has been tested as an exceedance scenario for the airfield (as a sensitivity analysis) and results are mapped in Figure 7.2.5. It is shown that flood risk is not increased by the Project outside the Project boundary and that there is betterment to third parties (flood depths decreased by up to 100 mm in some areas). Flooding within Gatwick Airport is locally increased compared to the design event (1 per cent (1 in 100) AEP event including a 35 per cent climate change allowance), affecting some taxiways and stands but not the existing and proposed main runways or terminal buildings. Safe access and egress routes as described in paragraph 7.2.16. would not be affected by flooding and available for use.

7.2.22 As a further, worst case scenario, the impact of failure of the flood defences has been assessed to understand the potential impacts. Figure 7.2.6. shows the Mitigated with Project Scenario (1 per cent AEP +35 per cent climate change) together with the Undefended with Project 1 per cent AEP +35 per cent climate change and +70 per cent with climate change scenarios. In the +35% climate change scenario, the impacts of increased flood from flood defence failure are restricted to the airport for which management response procedures will be implemented. There is one area East of the Railway that is at risk of flooding from the failure of defences. In the +70 per cent climate change scenario, there are small additional areas south of the runway, across the runway at the eastern end which may represent an operational risk, but it is likely that aircraft operation would be stopped in this scenario. Small areas of additional risk are on the Gatwick Stream east of the railway, near the Longbridge roundabout and to the edge of the River Mole south of the airport. Safe access and egress routes as described in paragraph 7.2.16 would not be affected by flooding.

7.3 Surface Water Drainage Mitigation Strategy

Proposed Surface Water Drainage Measures

7.3.1 A surface water drainage strategy has been developed as part of the Project. The objective of the strategy has been to make best use of the existing surface water management network, while providing additional attenuation facilities and/ or floodplain compensation where needed and reconfiguring existing infrastructure where that would provide wider flood risk benefits.

South West zone attenuation tank and pumping station

7.3.2 A new surface water attenuation tank and pump station is proposed south of the existing runway. This underground attenuation tank and pumping station will be sized based on the final design of the Project and will ensure new impermeable area from the runway and taxiways within the existing Pond M Catchment is controlled to greenfield runoff rates. This is shown in Figure 7.3.1. This pumping station will discharge into Pond M, which has a controlled discharge rate.

Pond A discharge control improvements

7.3.3 Pond A currently has a free outfall to the River Mole, with no designed discharge control. The Northern Runway fringes will impinge on Pond A, meaning that it will reduce in area, reducing its potential volume. However, the new outlet control will ensure that Pond A acts as surface water attenuation. Figure 7.3.2. shows the conceptual design of Pond A.

7.3.4 Table 7.3.1 summarises the additional storage provided by the Project.

Table 7.3.1: Additional Storage (m^3) Provided by the Development

Storage	Baseline	Project
Pond A	0	16,000
New Pumping Station	0	2,800
Dog Kennel Pond Clean Side	525	525
Pond Mclean Side	19,268	19,268
Pond D (Lower)	20,400	20,400
Total Storage	39,668	55.668

Surface Access Improvements Drainage Strategy

7.3.5 The surface access improvements proposed as part of the Project would include North Terminal and South Terminal roundabout works and works to improve capacity at the Longbridge roundabout and to provide better integration with the North Terminal roundabout improvements. As part of these works, it is proposed that a drainage network is installed, consisting of carrier drains, filter drains, ditches and attenuation ponds, along with flow control arrangements to limit discharges to watercourses. Therefore, surface water drainage runoff from new areas of highway would be restricted to pre-development rates, and where possible, greenfield runoff rates. This would ensure no increase in flood risk as a result of these works. Further details of the surface access outline drainage design are included in Annex 2.

7.3.6 The proposed works would locally encroach on areas currently at risk of surface water ponding. However, this would be safely managed by the road drainage network associated with the highway works. No major surface water flow paths would be expected to be interrupted as part of the surface access improvements proposed.

Assessment of Proposed Surface Water Mitigation

7.3.7 Figures 7.3.3 and 7.3.4 illustrate the surface water flood extents for the 1 per cent (1 in 100) AEP event, including a 20 per cent and a 40 per cent climate change allowance, applied to both a short duration (30 minutes) and a long duration (1440 minutes) event for the with mitigation scenario. The 20 per cent allowance defines the design event for the Project, while the 40 per cent allowance has been tested as an exceedance scenario.

7.3.8 Similar to the baseline scenario, the short duration presents the worst case in terms of flood extents. Overall, it is shown that for the short duration event, several areas of local ponding encroach on proposed and existing runways and taxiways.

7.3.9 Figures 7.3.5 and 7.3.6 illustrate the difference in surface water flood depths between the baseline and with-Project scenarios and for the 1 per cent (1 in 100) AEP event, including a 20 per cent climate change allowance, for the 30-minute duration event and the 1140-minute duration event.

7.3.10 According to Figure 7.3.5, overall surface water flow paths would not significantly change or be interrupted by the Project and the level of risk would remain similar to existing. There are some local areas of betterment (10 mm to 50 mm flood depth decrease) on existing taxiways around the terminal buildings. However, surface water flood depths are shown to increase for the short duration 1 per cent (1 in 100) AEP event, including a 20 per cent allowance for climate change, at some localised areas of runways, taxiways and stands at the western part of the airport. In most cases the increase of flood depths would be <50 mm or even <10 mm, and in all cases is <100mm.

7.3.11 According to Figure 7.3.6, for the longer duration event (1440 minutes) there is a minor beneficial impact to surface water flood depths around North Terminal after the development of the project (<1 mm betterment), except for a very localised area of increase, at Pier 4 and adjacent stands, that would not be expected to impact airport operations.

7.3.12 However, as discussed in Section 4, the model has not been validated for surface water flooding performance and therefore, care must be taken with the model outputs with respect to above ground surface water flooding. In particular, the alterations in ground levels within the airfield due to the Project have not been assessed as the model is currently undergoing further development. Therefore, the exact locations of flooding cannot be verified at this time. However, the proposed runways and taxiways would be raised and therefore, flooding would not occur at the locations that the flood extents currently indicate. Areas for air traffic would be designed with suitable drainage to prevent surface water flooding of the type shown in Figure 7.3.5. Any increases would be anticipated to be localised and restricted to grassed areas outside of general use.

7.3.13 Overall, considering the localised nature of these effects as well as the uncertainties of the surface water model, it is not anticipated that surface water flooding would affect the ability of the airport to remain functional during such an event.

7.3.14 For the exceedance scenario, ie the 1 per cent (1 in 100) AEP event, including a 40 per cent allowance for climate change, the model shows that there would be betterment or negligible change at all locations that previously experienced flooding, for both durations modelled (see Figures 7.3.7 and 7.3.8), except for a very localised area of increase near the North Terminal that would not be expected to impact airport operations (Figure 7.3.8).

7.3.15 At this stage, and given the above assessment of effects (ie the 1 per cent (1 in 100) AEP event, including a 40 per cent climate change allowance) after taking into account the proposed mitigation measures, it is considered that the Project would not adversely impact surface water flood risk or increase surface water flooding elsewhere. However, during detailed design and after the surface water model has been validated, areas within the airport that are highlighted here as potentially flooded should be further investigated and further mitigation should be provided where necessary. The risk of potential pipe/ culvert blockages has not been considered within this assessment and should be taken into account when the detailed surface water drainage design is developed.

Pre- and Post-development Discharge Rates and Volumes

7.3.16 The Crawley SFRA (Crawley Borough Council, 2015) states that surface water runoff from the site should not be increased due to proposed developments and should be reduced where possible. Similarly, the Airports NPS (Department for Transport, 2018) includes the requirement that:

'The surface water drainage arrangements for any project should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the project, taking into account climate change, unless specific off-site arrangements are made and result in the same net effect.'

7.3.17 The proposed and existing runoff volumes and maximum discharge rates are included in Table 7.3.2 and Table 7.3.3 for the 1 per cent (1 in 100) AEP event, including a 20 per cent allowance for climate change and for the 30-minutes duration. These rates assume free discharge at all locations. For the same event and for the longer, 1440-minutes, duration, results are included in Table 7.3.4 and Table 7.3.4. The runoff rates and volumes have been calculated for three discharge locations; Pond A, Pond M and Pond D. These ponds discharge to the same watercourse (River Mole) within approximately 3km and therefore the total discharge values are of interest, rather than individual pond discharges. This is because any minor localised increase in the vicinity of the discharge points would not be anticipated to increase flood risk to receptors as the watercourse generally floods onto grassed areas of Gatwick Airport during fluvial flood events in these locations. However, in order to pass the Exception Test and comply with the above-mentioned Airports NPS requirement, total discharge volumes and runoff rates should not be increased.

7.3.18 For the short duration (30 minutes) it is shown that total peak runoff rates would be reduced by 0.4 per cent, and the volume would increase by 1%. With respect to the volume increase it is considered that such a limited increase in surface water discharge rates and volumes could be managed by increasing the attenuation capacity of some proposed features during future design stages. Modelling results would be validated and re-run after the mitigation strategy is finalised to confirm this.

Table 7.3.2: Pre- and post- development volume of discharge for the 1% (1 in 100) AEP event, including a 20 per cent climate change allowance, for a 30-minute storm duration

Volume (m^3)	Discharge Locations			
	Pond A	Pond M	Pond D	Total
Pre-development	1,299	9,768	69,946	81,013
Post-development	1,440	11,887	68,703	82,030
Difference	141	2119	-1,243	1,017
Difference (%)	11%	22%	-2%	1%

Table 7.3.3: Pre- and post-development runoff rate for the 1% (1 in 100) AEP event, including a 20 per cent climate change allowance, for the 30-minutes duration

Peak runoff rate (m^3/s)	Discharge Locations			
	Pond A	**Pond M**	**Pond D**	**Total**
Pre-development	0.75	0.20	1.70	2.65
Post-development	0.72	0.22	1.70	2.64
Difference	-0.03	0.02	0	-0.01
Difference (%)	-4%	10%	0	-0.4%

7.3.19 For the long duration (1440 minutes) event it is shown that total peak runoff rates would be reduced by 28 cent, and the volume would reduce by 9%.

7.3.20 For the long duration (1440 minutes) it is shown that total discharge volumes and peak runoff rates would be decreased by 9 per cent and 28 per cent respectively.

7.3.21 Overall, the level of change noted here is not considered significant and subject to the described additional mitigation being provided it is considered that the Project would successfully pass the second part of the Exception Test, ie remain safe for its lifetime and not increase flood risk elsewhere.

Table 7.3.4: Pre- and post- development volume of discharge for the 1% (1 in 100) AEP event, including a 20 per cent climate change allowance, for the 1440-minutes duration

Volume (m^3)	Discharge Locations			
	Pond A	**Pond M**	**Pond D**	**Total**
Pre-development	27,357	27,192	176,739	231,288
Post-development	4,342	30,011	175,243	209,596
Difference	-23,015	2,819	-1,496	-21,692
Difference (%)	-84%	10%	-1%	-9%

Table 7.3.5: Pre- and post-development runoff rate for the 1% (1 in 100) AEP event, including a 20 per cent climate change allowance, for the 1440-minutes duration

Peak runoff rate (m^3/s)	Discharge locations			
	Pond A	Pond M	Pond D	Total
Pre-development	1.087	0.44	1.71	3.237
Post-development	0.12	0.51	1.71	2.34
Difference	-0.97	0.07	0	-0.90
Difference (%)	-89%	16%	0%	-28%

7.4 Construction Phasing Mitigation

7.4.1 Hydraulic modelling has been undertaken to understand the potential flood risk impacts during the construction phases of the Project. There are four mitigation construction phases that have been assessed with the Upper Mole Hydraulic Model, as shown in Table 7.4.1. These phases are different to the PEIR assessment dates and were created based on the construction sequence of works that could impact the floodplain, as well as the timing of proposed mitigation measures.

7.4.2 Table 7.4.1 also includes a high level estimate of the impact of each phase on available floodplain storage, including:

- The volume of floodplain that would be lost during each phase as a result of the new infrastructure or construction compounds within the floodplain.
- The volume of 'formal' floodplain compensation provided in designated compensation areas.
- The volume of additional 'informal' floodplain storage on the airfield site within areas not designed as floodplain compensation areas but which experience deeper flooding as a result of the Project.
- The floodplain that remains available but with reduced connectivity and therefore lower peak water levels for an equivalent flood event due to the Project.

7.4.3 Results are illustrated for the 1 per cent (1 in 100) AEP event including a 25 per cent climate change allowance for phase 1 and the design year, and for the 1 per cent (1 in 100) AEP event including a 25 per cent climate change allowance for phases 2, 3 and 4. These values only refer to floodplain lost/ gained within Gatwick Airport; downstream betterment has not been included in the estimate.

Assessment of flood risk during construction

7.4.4 Figure 7.4.1 shows the difference in flood depths (compared to the baseline scenario) during phases 1 and 2, for the 1 per cent (1 in 100) AEP event, including a 25 per cent climate change allowance. This adopted climate change allowance follows Environment Agency guidance for the predicted increase in peak river flows to 2039 (see Table 3.6.2). Small areas of increased flooding (10mm-50mm) are shown immediately south of the runway but they are surrounded by significantly larger areas of betterment (10mm-50mm and greater than 100mm). Two other small areas of increased flooding occur just north of Taxiway Juliet and near the River Mole which are again surrounded by much larger areas of betterment and do not interfere with operation of the airport. There would be several areas of betterment (10 mm to 100 mm betterment), both inside the airport and off-site.

7.4.5 For phases 3 and 4 (see Figures 7.4.2 and 7.4.3), results are shown for the 1 per cent (1 in 100) AEP event including a 25 per cent allowance and are similar to phases 1 and 2

Table 7.4.1: Mitigation construction phases

Construction phases	Primary works impacting floodplain	Proposed mitigation in place prior to construction within the floodplain	Event		Loss of Floodplain (m^3)	Floodplain Compensation		Change in Floodplain Storage (m^3)
				Direct	Due to Lost connectivity	Formal	Informal	
Phases 1 & 2: 2024-2028	▪ Satellite airfield construction compound ▪ Juliet West Taxiway ▪ End Around Taxiways (Compound remains in place)	Museum Field FCA and River Mole diversion plus car park X FCA RET9 and RET10 Syphons	1% + 25%cc	23,500	300	155,000	2,500	+133,700
Phase 3: 2029-2032	▪ Surface access works	As above	1% + 25%cc	40,000	14,500	155,000	3,000	+ 103,500
Phase 4: Up to 2038 (Design Year)	▪ Compound removed ▪ Further mitigation required due to climate change adaptation	As above plus east of Gatwick Stream FCA	1% + 25%cc	81,000	28,000	162,500	5,000	+58,500

Note: Syphons RET 9 and RET 10 will be constructed to ensure full connectivity which will result in no loss of floodplain. However, the flood plain compensation has been calculated and presented assuming the reduced connectivity (ie without any impact from the Syphons) as a conservative approach.

8 Planning and Development Considerations

8.1 National Planning Requirements

Table 8.1.1: National Planning Requirements and Project Compliance

Summary of requirement	How and where this is considered in the FRA
Airports NPS	
Considering the risk of all forms of flooding to the Project or arising from the Project and demonstrating how these risks will be managed and, where relevant, mitigated, so that the Project remains safe through its lifetime.	Section 5 of this FRA considers all risk of flooding to the Project, with the exception of tidal flooding which has been scoped out (see Section 4.1). In addition, Section 6 describes how the Project would impact fluvial, surface water, groundwater and sewer/ water distribution infrastructure flood risk if no mitigation was in place. Section 7 demonstrates how these risks would be managed with appropriate flood mitigation measures and how the Project would remain safe for its lifetime without increasing flood risk elsewhere.
Taking into account the impacts of climate change, clearly stating the Project lifetime over which the assessment is made.	The Project lifetime is defined as 40 years to 2069 for the airfield works and 100 years to 2132 for surface access elements (see Section 3.6). Climate change impacts have been assessed and included in fluvial and surface water flood risk assessment. Relevant guidance that has been followed within this FRA is described in Section 3.6.
Assessing any residual risks after risk reduction measures have been taken into account and demonstrating how these are acceptable for the Project.	Potential residual risks are discussed in Section 7, where it is demonstrated that these will be managed successfully and will not increase flood risk to the Project or third parties within the study area.
Considering if there is a need to remain operational during a worst-case flood event during the Project's lifetime and the need for safe access and exit arrangements.	For this assessment, the design event for the airfield elements of the Project from fluvial flood risk is the 1 per cent (1 in 100) AEP event, including a 35 per cent allowance for climate change and for rainfall (for drainage design) 1 per cent (1 in 100) AEP event, including a 20 per cent allowance for climate change. It has been demonstrated within this FRA that the runways would remain operational for such an event, as both the main and northern runways would not be flooded. In terms of the terminal buildings and their surrounding areas, existing flooding would potentially have an operational impact, however, flood risk is not adversely impacted from the Project. Dry access and egress routes from above flood levels, via high-link bridges and multi-storey car parks are in place for the terminal buildings. As the surface access elements will have a longer lifetime the embedded allowance for climate change is greater than that for the airfield elements. For the surface access elements, the fluvial design event is the 1 per cent (1 in 100) AEP event, including a 70 per cent allowance for climate change. The highways drainage design has been based on a 1 per cent (1 in 100) AEP event plus 40 per cent climate change allowance for rainfall intensity. The new highways would not be flooded under such an event and the Project would not increase flood risk to other parties. Increases on the airfield would be safely managed by GAL's emergency response plan.
Providing evidence for the Secretary of State to apply the Sequential Test and Exception Test, via a suitable flood risk assessment.	Evidence to apply the Sequential Test have been included in paragraphs 5.9.3 to 5.9.7. Application of the Exception Test is included in paragraphs 5.9.8 to 5.9.10 and Section 7.
The surface water drainage arrangements for any project should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project, taking into account climate change, unless specific off-site arrangements are made and result in the same net effect.	The pre- and post- development discharge volumes and peak runoff rates are included and discussed in Section 7. These are based on the 1 per cent (1 in 100) AEP event, including a 20 per cent climate change allowance. Where discharge rates are shown to increase, it is anticipated that any increase will be mitigated through the proposed drainage strategy. For the surface access elements the highways drainage design has been based on a 1 per cent (1 in 100) AEP event plus 40 per cent climate change allowance for rainfall intensity given its longer lifetime than the airfield elements. Increases in discharge due to increases carriageway impermeable areas would be attenuated to ensure no increase in peak outflow and no increase in flood risk.
NPS for National Networks	
Requirements of the Airports NPS mentioned above are also included in the NPS for National Networks.	As above

Summary of requirement	How and where this is considered in the FRA
Where linear infrastructure has been proposed in a flood risk area, the Secretary of State should expect reasonable mitigation measures to have been made to ensure that the infrastructure remains functional in the event of predicted flooding.	Where surface access improvements are proposed, these are accompanied by a proposed drainage strategy (see Annex 2) that includes the introduction of carrier drains, filter drains, ditches and attenuation ponds, along with flow control arrangements. Therefore, surface water runoff would be safely managed and restricted to pre-development or greenfield values, subject to detailed design. Moreover, the Project and proposed mitigation measures would decrease flood depths in the vicinity of the area where surface access improvements are proposed. Therefore, these are expected to remain functional during the 1 per cent (1 in 100) AEP event, including a 70 per cent allowance for climate change.

8.2 Local Planning Requirements

Table 8.2.1: Local Planning Requirements and Project Compliance

Policy	Summary of requirement	How and where this is considered in the FRA
Crawley 2030: Crawley Borough Local Plan 2030		
Policy ENV8	Developments should be directed to areas at low flood risk, considering the suitability of their intended use for the area and demonstrating that the Sequential Test and, where require, the Exception Test can be passed.	Evidence to apply the Sequential Test have been included in paragraphs 5.9.3 to 5.9.7. Application of the Exception Test is included in paragraphs 5.9.8 to 5.9.10 and Section 7.
	The Environment Agency Flood Map for Planning should be used to assess flood risk to the area and a site-specific flood risk assessment should demonstrate how appropriate mitigation measures will ensure flood risk is acceptable for the site and will not be increased elsewhere.	Environment Agency Flood Zones (as shown in Flood Map for Planning at the time of writing of this FRA, May 2021) have been mapped and used for the assessment of fluvial flood risk. The proposed flood mitigation strategy is described in Section 7.
	Peak surface runoff rates and annual volumes of runoff should be reduced through the effective implementation, use and maintenance of SuDS, unless it can be demonstrated that these are not technically feasible or financially viable.	The proposed surface water drainage strategy and associated discharge volumes and rates have been described in Section 7.3 of this report.
Reigate and Banstead Borough Local Plan 2005		
Policy Ut4: Flooding	Development (including redevelopment) in floodplains should be avoided and appropriate flood protection and mitigation measures should be considered as part of development in areas at risk of flooding.	Where development in floodplains is proposed as part of the Project, this would be compensated for via the introduction of new floodplain compensation areas, providing, where possible, level-to-level compensation.
Reigate and Banstead Borough Development Management Plan 2019		
Policy CCF2: Flood Risk	Development proposals must not increase the existing and future flood risk elsewhere. Proposals should seek to secure opportunities to reduce both the cause and impact of flooding for existing and proposed development.	The proposed flood mitigation strategy is described in Section 7, demonstrating that the Project would not increase flood risk elsewhere and, where possible, decrease overall flood risk.
	Where SuDS are proposed, schemes should include appropriate arrangements for the ongoing maintenance for the lifetime of the development.	At this preliminary stage, a detailed maintenance strategy has not been proposed. However, guidance from the SuDS Manual, CIRIA C753 (CIRIA, 2015) is to be followed for the effective maintenance of the proposed surface water drainage systems. Maintenance activities would be dependent on the final drainage strategy, subject to detailed design and manufacturer's recommendations. It is anticipated that maintenance activities would be the responsibilities of Gatwick and would be included within general airport maintenance arrangements.
Horsham District Planning Framework 2015		
Strategic Policy 38: Flooding	Where there is the potential to increase flood risk, proposals must incorporate the use of SuDS where technically feasible or incorporate water management measures that reduce the risk of flooding and ensure that flood risk is not increased elsewhere. New developments should undertake detailed	As above

Policy	Summary of requirement	How and where this is considered in the FRA
	assessments to consider the most appropriate SuDS methods for each site. Drainage techniques that mimic natural drainage patterns and manage surface water as close to its source as possible are required, where technically feasible.	
Tandridge District Council Local Plan Part 2 – Detailed Policies		
Policy DP21: Sustainable Water Management	Development proposals should seek opportunities to reduce both the cause and the impact of flooding, ensuring the discharge of surface water runoff is restricted to pre-development values.	As above

8.3 SFRA Recommendations

8.3.1 The Crawley SFRA (Crawley Borough Council, 2020) states that all development falling within Flood Zone 3 should be conditioned in accordance with the development management considerations included in Table 8.3.1.

Table 8.3.1 Crawley Borough Council Strategic Flood Risk Assessment Development Management Recommendations and Project Compliance

Crawley Borough Council SFRA Recommendation	How and where this is considered in the FRA
All proposed future development within Zone 3a High probability will require a detailed Flood Risk Assessment (FRA).	Detailed Flood Risk Assessment has been produced.
Floor levels must be situated above the 1% (100 year) predicted maximum flood level plus climate change, incorporating an allowance for freeboard.	Figure 7.2.2 shows that for the 1 per cent (1 in 100) AEP event, including a 35 per cent allowance for climate change, proposed runways, taxiways and associated infrastructure are not at significant risk of fluvial flooding. Existing taxiways, stands and buildings would experience flood depths equivalent to current situation (<0.01 mm decrease in flood risk). For new taxiways, consideration has been given to elevating taxiway levels above the peak floodplain levels of the baseline event, including an allowance for uncertainty of 300 mm.
Dry access is to be provided (above flood level) to enable the safe evacuation of residents and/or employees in case of flooding. In exceptional circumstances where this is not achievable, safe access must be provided at all locations, defined in accordance with the Defra/EA research project FD2320[1]. It is essential to ensure that the nominated evacuation route does not divert evacuees onto a 'dry island' upon which essential supplies (ie food, shelter and medical treatment) will not be available for the duration of the flood event.	For terminal buildings, dry access and egress routes from above flood levels are in place, via high-link bridges and multi-storey car parks.
Basements are not to be utilised for habitable purposes. All basements must provide a safe evacuation route in time of flood, providing an access point that is situated above the 1% AEP peak design plus climate change flood level.	The Project does not include basements that are intended for habitable purposes. Several new pumping stations and substations are proposed as part of the Project that may include elements up to 10 m below ground level and may need to be accessed for maintenance purposes. Dry access and exit points would be provided. However, these pumping stations would not be accessed frequently. The proposed waste management, motor transport maintenance and surface transport facilities would also include elements below ground level (up to 5 m). However, flood extents for the design event mentioned above do not encroach on these facilities.
Implement SuDS to ensure that runoff from the site (post redevelopment) is not increased and is where possible reduced. Any SuDS design must take due account of groundwater and geological conditions.	At this preliminary stage, proposed designs have been produced at a high-level and have not considered groundwater or geological conditions. However, further design development will be based on site-specific conditions and survey results.
Ensure that the proposed development does not result in an increase in maximum flood levels within adjoining properties. This may be achieved by ensuring (for example) that the existing building footprint is not increased, and/or compensatory flood storage is provided within the site (or upstream)[2].	Where the Project would encroach on existing floodplain, floodplain compensation is provided as close to the where it has been lost. It is shown in Figure 7.2.3, that there are no flood impacts to third parties due to the Project for the design event. In several areas, betterment is provided as a result of the Project.

Crawley Borough Council SFRA Recommendation	How and where this is considered in the FRA
A minimum 8 m buffer zone must be provided to 'top of bank' within sites immediately adjoining the main river corridor. This requirement may be negotiated with the Environment Agency in heavily constrained locations.	This Project and its associated flood mitigation strategy propose works being undertaken within Main River channels, including the realignment of the River Mole. Discussions with the Environment Agency will continue throughout the EIA process to mitigate the impacts.

[1] FD2320 "Flood Risk Assessment Guidance for New Development" (Defra/EA, 2005)

[2] Compensatory flood storage should be located as close as practically possible to the proposed development.

9 Summary and Conclusions

9.1.1 This FRA represents Appendix 11.9.1 to the PEIR Chapter 11: Water Environment and is a preliminary assessment of flood risk for the Project. It also includes the assessment of potential flood effects on external receptors due to the Project and describes the flood mitigation strategy proposed as part of the Project to mitigate these risks.

9.1.2 Fluvial flooding is the main source of flooding to the Project. When determining the Project location, the adopted approach has been to make best use of existing runways and airport infrastructure. Therefore, the levels of flood risk are equivalent to existing and it is anticipated that the Sequential Test (refer to paragraphs 5.9.3 to 5.9.7) would be successfully passed.

9.1.3 Part of the proposed, as well as existing, taxiways fall within Flood Zone 3. According to Table 5.9.1, the Exception Test would have to be passed for these elements to be deemed suitable for development in Flood Zone 3. Based on the provision of wider sustainability benefits, the first part to the Exception Test would be passed (refer to paragraphs 5.9.8 to 5.9.10).

9.1.4 Hydraulic modelling results show that the Project would also increase the risk of flooding to other areas if no mitigation was in place. Therefore, flood mitigation measures have been proposed, mainly in the form of Flood Compensation Areas (FCAs). These mitigation measures have been incorporated into the Gatwick fluvial hydraulic model and it has been shown that the Project would remain safe for its lifetime without increasing flood risk elsewhere.

9.1.5 Surface water flooding is also a key source of flooding for the Project. However, in most cases surface water flow paths and ponding areas are small in extent and do not encroach on proposed elements of the Project. The development of the Project would introduce new impermeable areas and could also increase surface water flooding if no mitigation was in place. Therefore, a surface water management strategy has been proposed and incorporated into the Gatwick surface water hydraulic model in order to assess their effectiveness.

9.1.6 At this stage, the finished elevations of the development are not finalised, and therefore it is not possible to develop a full post development drainage model. A more detailed assessment will be undertaken alongside detailed design. However, it has been shown that the Project would decrease peak runoff rates offsite. Change in flood risk to the Gatwick property itself will be re-evaluated alongside detailed drainage design for the development.

9.1.7 Therefore, it is considered that the Exception Test would successfully be passed for the Project.

9.1.8 At this stage, it has not been possible to fully quantify groundwater flood risk to the Project site; however, it is considered that the current risk from groundwater flooding at the airport site is low. Any groundwater flood risk that could occur elsewhere due to the Project would be addressed by adopting appropriate design practices. Overall, it is considered that the risk from groundwater flooding would not be adversely affected by the Project and risk from groundwater flooding would remain low.

9.1.9 The risk of flooding from other sources, including reservoirs, water distribution infrastructure and sewers, is considered medium to low. The reference to "medium" is because whilst there is lack of recorded sewer/ water distribution infrastructure flooding events and the Gatwick maintenance regime would be expected mitigate any issues that could lead to flooding, there are some known problems relating to flows backing up to the airport from the Horley Thames Water network.

9.1.10 Overall, the Sequential and, where required, Exception Tests have been applied to the Project. It has been shown that there are no alternative sites for the Project which would have a lower risk of flooding than the proposed location, that the development would be safe for its lifetime and that, once further mitigation is applied, there would be no increase in flood risk to third parties.

10 References

Legislation

Reservoirs Act, 1975

Published Documents

Airports Commission (2015) Airports Commission: Final Report, July 2015. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf

British Geological Survey (n.d.) Groundwater Flooding Susceptibility Areas and Groundwater Flooding Confidence Areas mapping (Digital Data). Available at: [redacted]

CIRIA C753 (2015) The SuDS Manual. Available at: [redacted]

Crawley Borough Council (2020) Strategic Flood Risk Assessment. Available at: https://crawley.gov.uk/sites/default/files/2020-09/Strategic%20Flood%20Risk%20Assessment.pdf

Crawley Borough Council (2015) Crawley 2030: Crawley Borough Local Plan 2015-2030 Available at: http://www.crawley.gov.uk/pw/Planning_and_Development/Planning_Policy/Crawley2029/index.htm

Crawley Borough Council (2019) Draft Infrastructure Plan. Available at: http://crawley.gov.uk/pw/index.htm

Crawley Borough Council (2021) Draft Crawley Borough Local Plan 2021-2037. Available at: https://crawley.gov.uk/sites/default/files/2021-

01/Submission%20Draft%20Local%20Plan%20January%202021.pdf

Defra/ EA (2005) Flood Risk Assessment Guidance for New Development. Available at: http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=FJPProjectView&Location=None&ProjectID=12015

Department for Transport (2015) National Policy Statement for National Networks. Available at: https://www.gov.uk/government/publications/national-policy-statement-for-national-networks

Department for Transport (2018) Airports National Policy Statement: new runway capacity and infrastructure at airports in the south-east of England. Available at: https://www.gov.uk/government/publications/airports-national-policy-statement

Environment Agency (2016) Flood risk assessments: climate change allowances. Available from: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Environment Agency (n.d.) Flood map for planning. [Online] Available at: https://flood-map-for-planning.service.gov.uk/

Environment Agency (n.d.) Long term flood risk map. [Online] Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

Horsham District Council (2015) Horsham District Planning Framework 2015. Available at: https://beta.horsham.gov.uk/__data/assets/pdf_file/0016/60190/Horsham-District-Planning-Framework-2015.pdf

Met Office, Department for Environment, Food and Rural Affairs (Defra), Department for Business, Energy and Industrial Strategy (BEIS) and Environment Agency (2009) UK Climate Projections 2009/ Available at:https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/ukcp09-users

McMillan D (2014) Disruption at Gatwick Airport. Report to the Board of Gatwick Airport Limited. Available at: h[redacted]

Ministry of Housing, Communities and Local Government (2021) National Planning Policy Framework (NPPF), HMSO. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2

Ministry of Housing, Communities and Local Government (2019) National Planning Practice Guidance (NPPG). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

Reigate and Banstead Borough Council (2005) Reigate and Banstead Borough Local Plan 2005. Available at: http://www.reigate-banstead.gov.uk/downloads/file/4120/reigate_and_banstead_borough_local_plan_2005

Reigate and Banstead Borough Council (2019) Reigate and Banstead Borough Development Management Plan. Available at: http://www.reigate-banstead.gov.uk/info/20380/current_planning_policy/888/development_management_plan

Reigate and Banstead Borough Council, Mole Valley District Council and Tandridge District Council (2017) Level 1 Strategic Flood Risk Assessment. Available at: https://www.molevalley.gov.uk/media/pdf/o/f/2017s5672_-_Three_Authorities_Level_1_SFRA_v5.0.pdf

Tandridge District Council (2015) Tandridge Local Plan Part 2 – Detailed Policies. Available at: https://www.tandridge.gov.uk/Portals/0/Documents/Planning%20and%20building/Planning%20strategies%20and%20policies/Current%20and%20adopted%20planning%20policies/Core%20strategy/Local-Plan-part-2-Detailed-policies.pdf

West Sussex County Council (2013) West Sussex Local Flood Risk Management Strategy. Available at: https://www.westsussex.gov.uk/media/1596/west_sussex_lfrms_strategic_environmental_assessment_final.pdf

11 Glossary

11.1 Glossary of Terms

Table 11.1.1: Glossary of Terms and List of Acronyms

Term	Description
AEP	Annual Exceedance Probability, eg 1 per cent AEP is equivalent to 1 in 100 probability of flooding occurring in any one year (or, on average, once in every 100 years).
AOD	Above Ordnance Datum
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
Defra	Department for Environment, Food and Rural Affairs. The government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the UK. Among its responsibilities, Defra publishes guidance on, for example, flood modelling approaches and approaches to accounting for climate change in flood studies.
Development	The carrying out of building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land.
DCO	Development Consent Oder
Environment Agency (EA)	The Environment Agency is a non-departmental public body, established in 1995 and sponsored by DEFRA. Its responsibilities relate to the protection and enhancement of the environment in England. Environment Agency
EIA	Environmental Impact Assessment
ES	Environmental Statement
Exception Test	The Exception Test should be applied if, following application of the Sequential Test, it is not possible for the development to be located in Flood Zones with a lower probability of flooding. For the Exception Test to be passed it must be demonstrated that:

Term	Description
	▪ The development provides wider sustainability benefits to the community that outweigh flood risk; and ▪ That the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible will reduce flood risk overall.
FWMA	Flood & Water Management Act. Part of the UK Government response to Sir Michael Pitt's Review on the Summer 2007 floods, the aim of which (partly) is to clarify the legislative framework for managing surface water flood risk in England.
FCA	Flood Compensation Area. Land which provides a volume of floodplain that compensates for the loss of floodplain elsewhere, where practicable to an equal volume as that lost and on a level-to-level basis.
Flood Map for Planning (Rivers and Sea)	Nationally consistent delineation of 'high', 'medium' and 'low' probability of fluvial and tidal flooding, published on a quarterly basis by the Environment Agency.
Flood Zone 1 Low Probability (FZ1)	NPPG Flood Zone, defined as areas outside Zone 2 Medium Probability. This zone comprises land assessed as having a less than 1 in 1,000 annual exceedance probability of river or sea flooding (<0.1 per cent) in any year.
Flood Zone 2 Medium Probability (FZ2)	NPPG Flood Zone which comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual exceedance probability of river flooding (1 per cent – 0.1 per cent) or between a 1 in 200 and 1 in 1,000 annual exceedance probability of sea flooding (0.5 per cent - 0.1 per cent) in any year.
Flood Zone 3a High Probability (FZ3a)	NPPG Flood Zone which comprises land assessed as having a 1 in 100 or greater annual exceedance probability of river flooding (>1 per cent) or a 1 in 200 or greater annual exceedance probability of sea flooding (>0.5 per cent) in any year.
FMP	Flood Management Plan

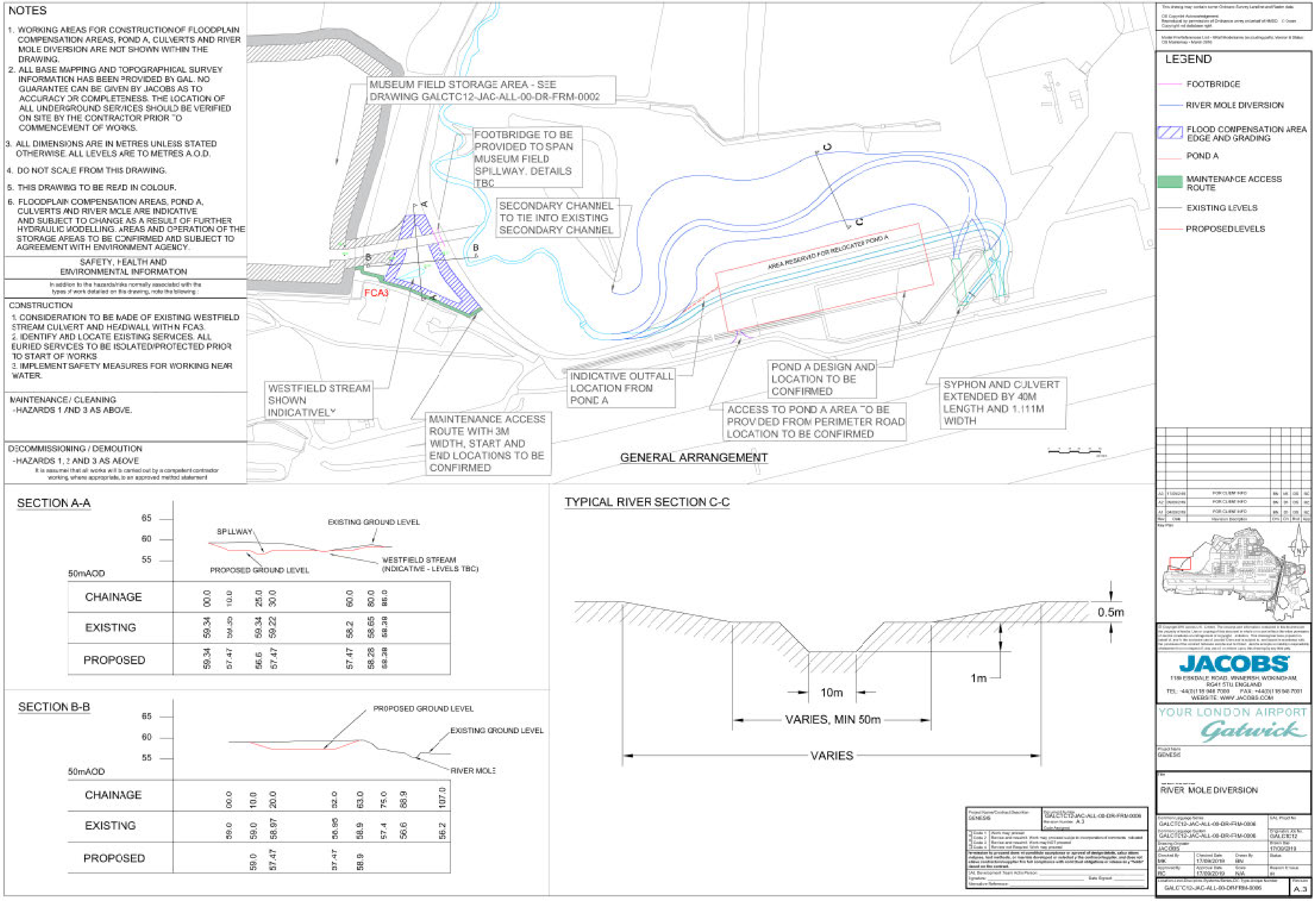
Term	Description
FRA	Flood Risk Assessment. A site-specific assessment of flood risk. This is a statutory report for submission with planning applications in England.
Functional Floodplain (Flood Zone 3b) (FZ3b)	NPPG Flood Zone, defined as areas in which water has to flow or be stored in times of flood.
GAL	Gatwick Airport Limited
Groundwater Flooding	Emergence of groundwater at the ground surface or the rising of groundwater into underground infrastructure (such as basements) under conditions where the normal range of groundwater level and flows is exceeded.
LLFA	Lead Local Flood Authority. Unitary Authorities or County Councils responsible for developing, maintaining and applying a strategy for local flood risk management in their areas and for maintaining a register of flood risk assets. Also, responsible for managing local flood risk (flooding from surface water, groundwater and ordinary watercourses).
LFRMS	Local Flood Risk Management Strategy. LLFAs produce Local Flood Risk Management Strategies as part of their duty to manage local flood risk under the Flood and Water Management Act 2010.
LPA	Local Planning Authority. A local planning authority is the local authority or council that is empowered by law to exercise statutory town planning functions for a particular area of the UK.
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers. N.B. Main River designation is not necessarily an indication of size, although it is often the case that they are larger than Ordinary Watercourses.
NPPF	National Planning Policy Framework.

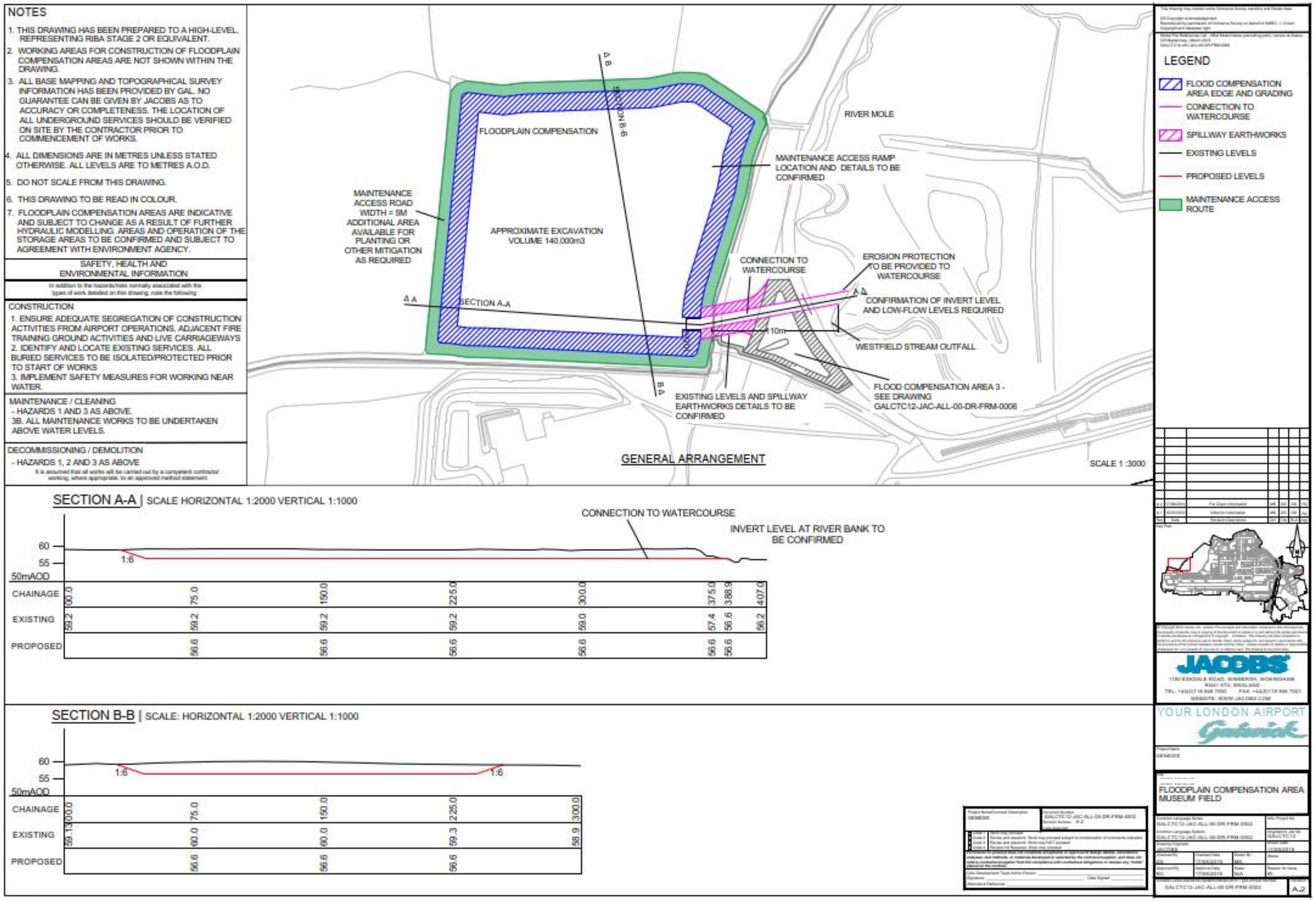
Term	Description
	National planning policy published by the Government, most recently in July 2021. It replaces most of the previous Planning Policy Statements, including that regarding flood risk (PPS25).
NPPG	National Planning Practice Guidance. Supporting guidance to the NPPF, published by the Government in March 2014 and updated since as an online resource, available at: (http://planningguidance.planningportal.gov.uk/). It replaces previously published Government guidance, including that regarding flood risk.
NPS	National Policy Statement
Ordinary Watercourse	All watercourses that are not designated Main Rivers, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards. Note that Ordinary Watercourse does not imply a "small" river, although it is often the case that Ordinary Watercourses are smaller than Main Rivers.
PEIR	Preliminary Environmental Investigation Report
RBD	River Basin District
Residual Risk	A measure of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the design process.
RoFSW	Risk of Flooding from Surface Water
RTD	River Terrance Deposits
Sequential Test	A national planning policy requirement that seeks to steer new development to areas with the lowest probability of flooding. In demonstrating that the requirements of the sequential test have been met, proposals should refer to the NPPF and Planning Practice Guidance, and the Environment Agency Flood Zones.
SFRA	Strategic Flood Risk Assessment. There are two levels of SFRA. All local planning authorities need to carry out a Level 1 assessment at least and it may be necessary to expand the scope of this assessment to a more

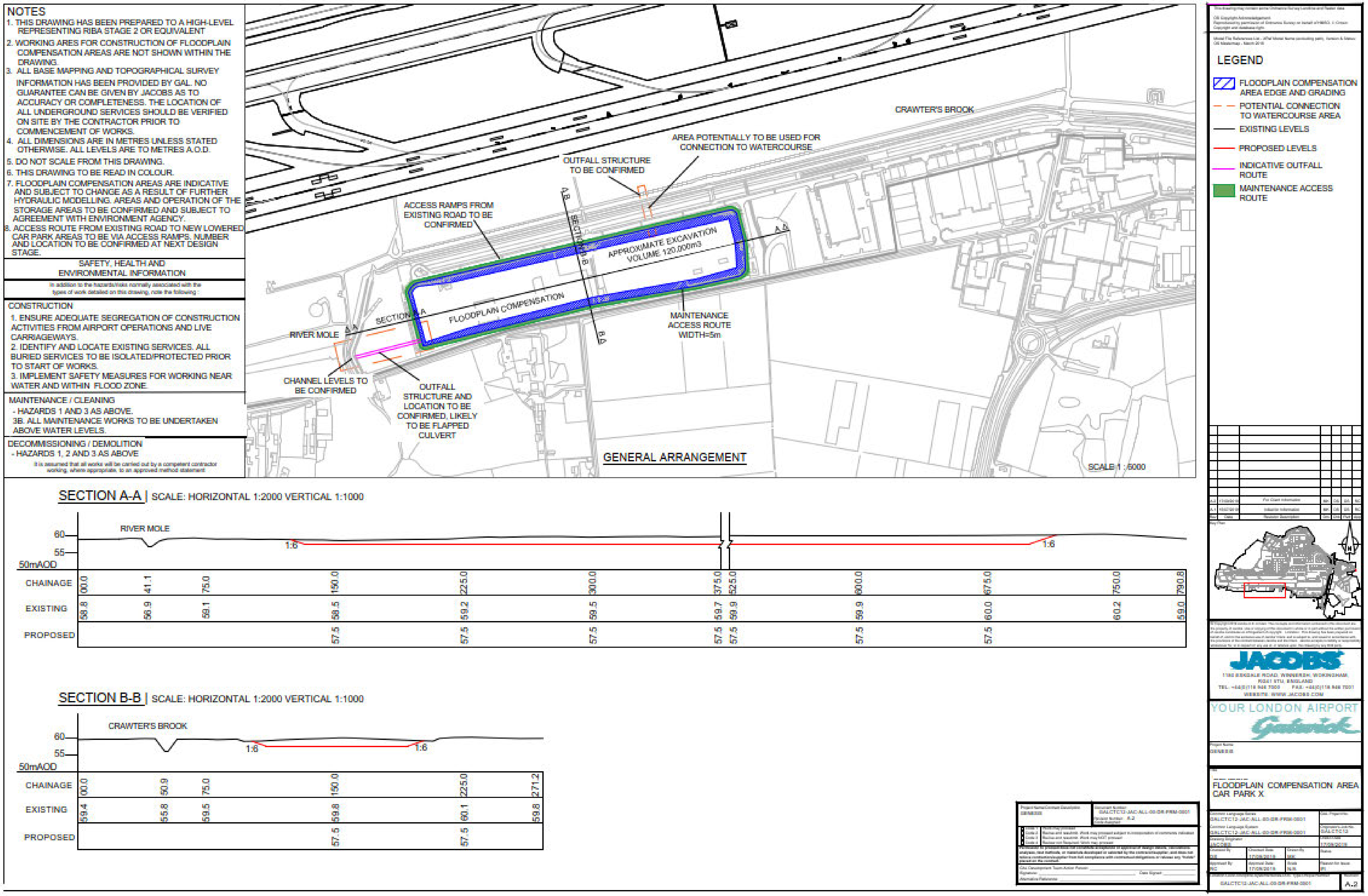
Term	Description
	detailed Level 2 assessment. A Level 1 SFRA should provide sufficient detail to apply the Sequential Test. A Level 2 SFRA should build on the information in the Level 1 assessment and include sufficient information for the Exception Test to be applied. Where a Level 2 SFRA is produced, the Sequential Test should also be applied to identify sites with the lowest risk of flooding within Flood Zones 2 and 3.
STW	Sewage (waste/foul water) treatment works
SuDS	Sustainable Drainage System. Term covering the whole range of sustainable approaches to surface drainage management. These are designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible.

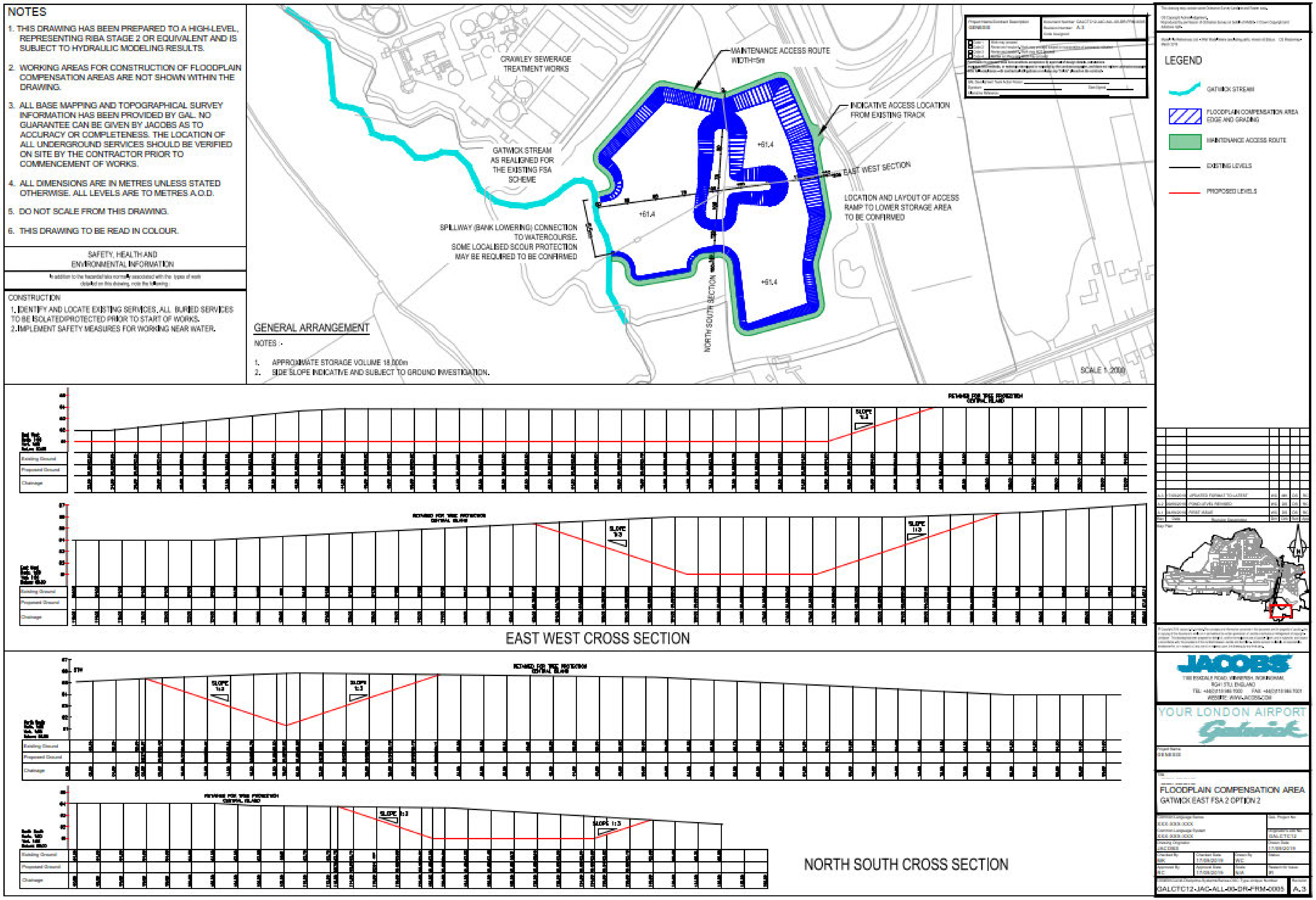
Annex 1

Fluvial Mitigation Measures Indicative Designs


NOTES
1. WORKING AREAS FOR CONSTRUCTION OF FLOODPLAIN COMPENSATION AREAS, POND A, CULVERTS AND RIVER MOLE DIVERSION ARE NOT SHOWN WITHIN THE DRAWING.
2. ALL BASE MAPPING AND TOPOGRAPHICAL SURVEY INFORMATION HAS BEEN PROVIDED BY GAL. NO GUARANTEE CAN BE GIVEN BY JACOBS AS TO ACCURACY OR COMPLETENESS. THE LOCATION OF ALL UNDERGROUND SERVICES SHOULD BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.
3. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE. ALL LEVELS ARE TO METRES A.O.D.
4. DO NOT SCALE FROM THIS DRAWING.
5. THIS DRAWING TO BE READ IN COLOUR.
6. FLOODPLAIN COMPENSATION AREAS, POND A, CULVERTS AND RIVER MOLE ARE INDICATIVE AND SUBJECT TO CHANGE AS A RESULT OF FURTHER HYDRAULIC MODELLING. AREAS AND OPERATION OF THE STORAGE AREAS TO BE CONFIRMED AND SUBJECT TO AGREEMENT WITH ENVIRONMENT AGENCY.
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
CONSTRUCTION
1. CONSIDERATION TO BE MADE OF EXISTING WESTFIELD STREAM CULVERT AND HEADWALL WITHIN FCA3.
2. IDENTIFY AND LOCATE EXISTING SERVICES. ALL BURIED SERVICES TO BE ISOLATED/PROTECTED PRIOR TO START OF WORKS.
3. IMPLEMENT SAFETY MEASURES FOR WORKING NEAR WATER.
MAINTENANCE / CLEANING
-HAZARDS 1 AND 3 AS ABOVE.
DECOMMISSIONING / DEMOLITION
-HAZARDS 1, 2 AND 3 AS ABOVE
MUSEUM FIELD STORAGE AREA - SEE DRAWING GALCTC12-JAC-ALL-00-DR-FRM-0002
FOOTBRIDGE TO BE PROVIDED TO SPAN MUSEUM FIELD SPILLWAY. DETAILS TBC
SECONDARY CHANNEL TO TIE INTO EXISTING SECONDARY CHANNEL
AREA RESERVED FOR RELOCATED POND A
FCA3
WESTFIELD STREAM SHOWN INDICATIVELY
MAINTENANCE ACCESS ROUTE WITH 3M WIDTH, START AND END LOCATIONS TO BE CONFIRMED
INDICATIVE OUTFALL LOCATION FROM POND A
POND A DESIGN AND LOCATION TO BE CONFIRMED
ACCESS TO POND A AREA TO BE PROVIDED FROM PERIMETER ROAD LOCATION TO BE CONFIRMED
SYPHON AND CULVERT EXTENDED BY 40M LENGTH AND 1.111M WIDTH
GENERAL ARRANGEMENT
LEGEND
FOOTBRIDGE
RIVER MOLE DIVERSION
FLOOD COMPENSATION AREA EDGE AND GRADING
POND A
MAINTENANCE ACCESS ROUTE
EXISTING LEVELS
PROPOSED LEVELS
SECTION A-A
SPILLWAY
EXISTING GROUND LEVEL
PROPOSED GROUND LEVEL
WESTFIELD STREAM (INDICATIVE - LEVELS TBC)
50mAOD
CHAINAGE 00.0 10.0 25.0 30.0 60.0 80.0 85.0
EXISTING 59.34 59.59 59.34 59.22 58.2 58.65 58.38
PROPOSED 59.34 57.47 56.6 57.47 57.47 58.28 58.38
SECTION B-B
PROPOSED GROUND LEVEL
EXISTING GROUND LEVEL
RIVER MOLE
50mAOD
CHAINAGE 00.0 10.0 20.0 52.0 63.0 75.0 88.9 107.0
EXISTING 59.0 59.0 58.97 56.95 58.9 57.4 56.6 56.2
PROPOSED 59.0 57.47 57.47 58.9
TYPICAL RIVER SECTION C-C
0.5m
1m
1m
10m
VARIES, MIN 50m
VARIES
JACOBS
YOUR LONDON AIRPORT Gatwick
GENESIS
RIVER MOLE DIVERSION
GALCTC12-JAC-ALL-00-DR-FRM-0006
A3


NOTES
1. THIS DRAWING HAS BEEN PREPARED TO A HIGH-LEVEL, REPRESENTING RIBA STAGE 2 OR EQUIVALENT.
2. WORKING AREAS FOR CONSTRUCTION OF FLOODPLAIN COMPENSATION AREAS ARE NOT SHOWN WITHIN THE DRAWING.
3. ALL BASE MAPPING AND TOPOGRAPHICAL SURVEY INFORMATION HAS BEEN PROVIDED BY GAL. NO GUARANTEE CAN BE GIVEN BY JACOBS AS TO ACCURACY OR COMPLETENESS. THE LOCATION OF ALL UNDERGROUND SERVICES SHOULD BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.
4. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE. ALL LEVELS ARE TO METRES A.O.D.
5. DO NOT SCALE FROM THIS DRAWING.
6. THIS DRAWING TO BE READ IN COLOUR.
7. FLOODPLAIN COMPENSATION AREAS ARE INDICATIVE AND SUBJECT TO CHANGE AS A RESULT OF FURTHER HYDRAULIC MODELLING. AREAS AND OPERATION OF THE STORAGE AREAS TO BE CONFIRMED AND SUBJECT TO AGREEMENT WITH ENVIRONMENT AGENCY.
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
CONSTRUCTION
1. ENSURE ADEQUATE SEGREGATION OF CONSTRUCTION ACTIVITIES FROM AIRPORT OPERATIONS, ADJACENT FIRE TRAINING GROUND ACTIVITIES AND LIVE CARRIAGEWAYS
2. IDENTIFY AND LOCATE EXISTING SERVICES. ALL BURIED SERVICES TO BE ISOLATED/PROTECTED PRIOR TO START OF WORKS
3. IMPLEMENT SAFETY MEASURES FOR WORKING NEAR WATER.
MAINTENANCE / CLEANING
- HAZARDS 1 AND 3 AS ABOVE.
3B. ALL MAINTENANCE WORKS TO BE UNDERTAKEN ABOVE WATER LEVELS.
DECOMMISSIONING / DEMOLITION
- HAZARDS 1, 2 AND 3 AS ABOVE
FLOODPLAIN COMPENSATION
SECTION B-B
RIVER MOLE
MAINTENANCE ACCESS RAMP LOCATION AND DETAILS TO BE CONFIRMED
MAINTENANCE ACCESS ROAD WIDTH = 5M ADDITIONAL AREA AVAILABLE FOR PLANTING OR OTHER MITIGATION AS REQUIRED
APPROXIMATE EXCAVATION VOLUME 140,000m3
CONNECTION TO WATERCOURSE
EROSION PROTECTION TO BE PROVIDED TO WATERCOURSE
SECTION A-A
CONFIRMATION OF INVERT LEVEL AND LOW-FLOW LEVELS REQUIRED
10m
WESTFIELD STREAM OUTFALL
FLOOD COMPENSATION AREA 3 - SEE DRAWING GALCTC12-JAC-ALL-00-DR-FRM-0006
EXISTING LEVELS AND SPILLWAY EARTHWORKS DETAILS TO BE CONFIRMED
GENERAL ARRANGEMENT
SCALE 1 :3000
LEGEND
FLOOD COMPENSATION AREA EDGE AND GRADING
CONNECTION TO WATERCOURSE
SPILLWAY EARTHWORKS
EXISTING LEVELS
PROPOSED LEVELS
MAINTENANCE ACCESS ROUTE
SECTION A-A | SCALE HORIZONTAL 1:2000 VERTICAL 1:1000
CONNECTION TO WATERCOURSE
INVERT LEVEL AT RIVER BANK TO BE CONFIRMED
60
55
50mAOD
1:6
CHAINAGE 00.0 75.0 150.0 225.0 300.0 375.0 388.9 407.0
EXISTING 59.2 59.2 59.2 59.2 59.0 57.4 56.6 56.2
PROPOSED 56.6 56.6 56.6 56.6 56.6 56.6
SECTION B-B | SCALE: HORIZONTAL 1:2000 VERTICAL 1:1000
60
55
50mAOD
1:6
1:6
CHAINAGE 000.0 75.0 150.0 225.0 300.0
EXISTING 59.1 60.0 60.0 59.3 58.9
PROPOSED 56.6 56.6 56.6
JACOBS
YOUR LONDON AIRPORT Gatwick
FLOODPLAIN COMPENSATION AREA MUSEUM FIELD
A.2


NOTES
1. THIS DRAWING HAS BEEN PREPARED TO A HIGH-LEVEL REPRESENTING RIBA STAGE 2 OR EQUIVALENT
2. WORKING ARES FOR CONSTRUCTION OF FLOODPLAIN COMPENSATION AREAS ARE NOT SHOWN WITHIN THE DRAWING.
3. ALL BASE MAPPING AND TOPOGRAPHICAL SURVEY INFORMATION HAS BEEN PROVIDED BY GAL. NO GUARANTEE CAN BE GIVEN BY JACOBS AS TO ACCURACY OR COMPLETENESS. THE LOCATION OF ALL UNDERGROUND SERVICES SHOULD BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.
4. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE. ALL LEVELS ARE TO METRES A.O.D.
5. DO NOT SCALE FROM THIS DRAWING.
6. THIS DRAWING TO BE READ IN COLOUR.
7. FLOODPLAIN COMPENSATION AREAS ARE INDICATIVE AND SUBJECT TO CHANGE AS A RESULT OF FURTHER HYDRAULIC MODELLING. AREAS AND OPERATION OF THE STORAGE AREAS TO BE CONFIRMED AND SUBJECT TO AGREEMENT WITH ENVIRONMENT AGENCY.
8. ACCESS ROUTE FROM EXISTING ROAD TO NEW LOWERED CAR PARK AREAS TO BE VIA ACCESS RAMPS. NUMBER AND LOCATION TO BE CONFIRMED AT NEXT DESIGN STAGE.
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
CONSTRUCTION
1. ENSURE ADEQUATE SEGREGATION OF CONSTRUCTION ACTIVITIES FROM AIRPORT OPERATIONS AND LIVE CARRIAGEWAYS.
2. IDENTIFY AND LOCATE EXISTING SERVICES. ALL BURIED SERVICES TO BE ISOLATED/PROTECTED PRIOR TO START OF WORKS.
3. IMPLEMENT SAFETY MEASURES FOR WORKING NEAR WATER AND WITHIN FLOOD ZONE.
MAINTENANCE / CLEANING
- HAZARDS 1 AND 3 AS ABOVE.
3B. ALL MAINTENANCE WORKS TO BE UNDERTAKEN ABOVE WATER LEVELS.
DECOMMISSIONING / DEMOLITION
- HAZARDS 1, 2 AND 3 AS ABOVE
CRAWTER'S BROOK
AREA POTENTIALLY TO BE USED FOR CONNECTION TO WATERCOURSE
OUTFALL STRUCTURE TO BE CONFIRMED
ACCESS RAMPS FROM EXISTING ROAD TO BE CONFIRMED
APPROXIMATE EXCAVATION VOLUME 120,000m3
FLOODPLAIN COMPENSATION
SECTION A-A
SECTION B-B
RIVER MOLE
MAINTENANCE ACCESS ROUTE WIDTH=5m
CHANNEL LEVELS TO BE CONFIRMED
OUTFALL STRUCTURE AND LOCATION TO BE CONFIRMED, LIKELY TO BE FLAPPED CULVERT
GENERAL ARRANGEMENT
SCALE 1 : 5000
LEGEND
FLOODPLAIN COMPENSATION AREA EDGE AND GRADING
POTENTIAL CONNECTION TO WATERCOURSE AREA
EXISTING LEVELS
PROPOSED LEVELS
INDICATIVE OUTFALL ROUTE
MAINTENANCE ACCESS ROUTE
SECTION A-A | SCALE: HORIZONTAL 1:2000 VERTICAL 1:1000
RIVER MOLE
60
55
50mAOD
1:6
1:6
CHAINAGE 00.0 41.1 75.0 150.0 225.0 300.0 375.0 525.0 600.0 675.0 750.0 790.8
EXISTING 58.8 56.9 59.1 58.5 59.2 59.5 59.7 59.9 59.9 60.0 60.2 59.0
PROPOSED 57.5 57.5 57.5 57.5 57.5 57.5 57.5
SECTION B-B | SCALE: HORIZONTAL 1:2000 VERTICAL 1:1000
CRAWTER'S BROOK
60
55
50mAOD
1:6
1:6
CHAINAGE 00.0 50.9 75.0 150.0 225.0 271.2
EXISTING 59.4 55.8 59.5 59.8 60.1 59.8
PROPOSED 57.5 57.5
JACOBS
YOUR LONDON AIRPORT Gatwick
FLOODPLAIN COMPENSATION AREA CAR PARK X
A.2


NOTES
1. THIS DRAWING HAS BEEN PREPARED TO A HIGH-LEVEL, REPRESENTING RIBA STAGE 2 OR EQUIVALENT AND IS SUBJECT TO HYDRAULIC MODELING RESULTS.
2. WORKING AREAS FOR CONSTRUCTION OF FLOODPLAIN COMPENSATION AREAS ARE NOT SHOWN WITHIN THE DRAWING.
3. ALL BASE MAPPING AND TOPOGRAPHICAL SURVEY INFORMATION HAS BEEN PROVIDED BY GAL. NO GUARANTEE CAN BE GIVEN BY JACOBS AS TO ACCURACY OR COMPLETENESS. THE LOCATION OF ALL UNDERGROUND SERVICES SHOULD BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.
4. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE. ALL LEVELS ARE TO METRES A.O.D.
5. DO NOT SCALE FROM THIS DRAWING.
6. THIS DRAWING TO BE READ IN COLOUR.
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
CONSTRUCTION
1. IDENTIFY AND LOCATE EXISTING SERVICES, ALL BURIED SERVICES TO BE ISOLATED/PROTECTED PRIOR TO START OF WORKS.
2. IMPLEMENT SAFETY MEASURES FOR WORKING NEAR WATER.
CRAWLEY SEWERAGE TREATMENT WORKS
MAINTENANCE ACCESS ROUTE WIDTH=5m
INDICATIVE ACCESS LOCATION FROM EXISTING TRACK
GATWICK STREAM AS REALIGNED FOR THE EXISTING FSA SCHEME
EAST WEST SECTION
LOCATION AND LAYOUT OF ACCESS RAMP TO LOWER STORAGE AREA TO BE CONFIRMED
SPILLWAY (BANK LOWERING) CONNECTION TO WATERCOURSE. SOME LOCALISED SCOUR PROTECTION MAY BE REQUIRED TO BE CONFIRMED
+61.4
+61.4
+61.4
NORTH SOUTH SECTION
GENERAL ARRANGEMENT
NOTES :-
1. APPROXIMATE STORAGE VOLUME 18,000m
2. SIDE SLOPE INDICATIVE AND SUBJECT TO GROUND INVESTIGATION.
SCALE 1:2000
LEGEND
GATWICK STREAM
FLOODPLAIN COMPENSATION AREA EDGE AND GRADING
MAINTENANCE ACCESS ROUTE
EXISTING LEVELS
PROPOSED LEVELS
Existing Ground
Proposed Ground
Chainage
EAST WEST CROSS SECTION
NORTH SOUTH CROSS SECTION
JACOBS
YOUR LONDON AIRPORT Gatwick
FLOODPLAIN COMPENSATION AREA
GATWICK EAST FSA 2 OPTION 2
GALCTC12-JAC-ALL-00-DR-FRM-0005
A.3

Annex 2

Surface Access Drainage Summary

Introduction

11.1.1 The project at Gatwick Airport to make the best use of their runways ('the Project') incorporates improvements to surface access that are planned to manage the expected increase in passenger numbers and associated movements in and out of the airport. These improvements are planned to be constructed between 2029 and 2032.

11.1.2 The improvements to surface access incorporate three elements:

- South Terminal Roundabout Improvements (constructed between 2029-2030)
- North Terminal Roundabout Improvements (2029-2032)
- Works to Longbridge Roundabout (2030-2032)

11.1.3 The surface access improvements do include encroachment into the River Mole and Gatwick Stream floodplains that are mitigated via the provision of compensatory floodplain storage as part of the Project. These measures would be installed in advance of any encroachment as part of the surface access works. Further information on this element is included in the main body of the Flood Risk Assessment.

Existing Drainage

South Terminal Roundabout

11.1.4 The southern terminal roundabout has three arms, M23 motorway (on the east), Airport Way (on the west) and Airport Ring Road (on the south). Highways England are the highway authority.

11.1.5 Information is available for the existing highway drainage in Highways England's asset records (HADDMS) (see Figure 11-1). The existing surface runoff is mainly collected by kerb and gully system and combined kerb drainage (CKD) as visible in aerial photography and outlined in HADDMS.

11.1.6 The existing highway east of the B2036 Balcombe Road overbridge outfalls to a tributary of the Burstow Stream via an attenuation pond (Pond 8-5 in Figure 11-1) on the north side of the M23 Spur approximately 950 metres to the east of the roundabout.

11.1.7 Aside from one gully at the overbridge, there are no connections from the motorway drainage to the Burstow Stream tributary.

11.1.8 The roads west of the B2036 Balcombe Road overbridge outfall to the Gatwick Stream approximately 600 metres west of the existing roundabout. Based on available records this is via a 675 metre diameter surface water pipe that starts on the north side of the M23 Spur immediately east of the existing roundabout, crosses the Spur from north to south, and then elbows east around the south side of the roundabout and then under the Airport ring road. It then runs from east to west parallel to the A23 Airport Way along the south side and crosses under the railway line and outfalls to the Gatwick Stream. Available as built record drawings indicate that this pipe may be a Public Sewer, however this is not yet confirmed. The Sewerage Undertaker in this area is Thames Water.

11.1.9 The record drawings for the original road construction (dated 1972) also indicate provision for connection from an attenuation basin for "BAA" immediately to the east of the railway line. There is now a large pond (Pond F) at this location, so it reasonable to assume that this is a facility serving the airport and does not fulfil an attenuation function for the highway drainage systems.

North Terminal Roundabout

11.1.10 Limited information is available for the existing highway drainage (0-20% in HADDMS), see Figure 11-2. The gullies appear to outfall to existing ditches for the slip roads connecting the north terminal roundabout to A23 London road. The ditches appear to fall towards the River Mole. Therefore, existing drainage assumed to discharge to River Mole (section possibly discharges through Gatwick Stream). The proposed drainage is also proposed to outfall to same watercourse as existing site.

Longbridge Roundabout

11.1.11 The existing roundabout and road levels are approximately 57 to 56 mAOD. The roads appear to fall away from the roundabout. The existing level of the watercourse passing underneath the bridge on Brighton Road is approximately 52 mAOD.

11.1.12 There is very limited available information on the highway drainage at this stage. The highway authority responsible for maintaining the existing highway drainage systems is West Sussex County Council for the A23 and Surrey County Council for the Longbridge roundabout and the other three associated roads, ie Brighton Road, A217 and Povey Cross Road.

11.1.13 The runoff for the central island and the south and western side of the existing junction is collected by kerb and gully systems. The eastern limbs are served by CKD. The dedicated slip lane on the eastern side of the junction is an underbridge with a parapet. This slip lane is served by iron shallow bridgedeck type units (Figure 11-3).

11.1.14 The site is bounded on the east side by the River Mole which passes underneath a bridge on Brighton Road (see Figure 11-3). It is assumed that the runoff from the roundabout, Brighton Road and A23 south approach outfall to the River Mole to the east and south east.

Surface Access Improvement Works

11.1.15 Full details of the surface access improvements are included in Chapter 5 of the PEIR: Project Description.

South Terminal Roundabout Improvements

11.1.16 The proposed improvements to the south terminal roundabout will incorporate a flyover which would carry the M23 Spur Motorway/Airport Way over the existing roundabout. Access to the terminal, car parking and hotels/offices would be maintained as existing whilst four slip roads would be provided to link the existing roundabout circulatory to the elevated section. The existing drainage culvert under the M23 Spur Road will be extended to accommodate the new slip roads.

North Terminal Roundabout Improvements

11.1.17 In order to provide for the predicted growth in passengers associated with the Project, a grade-separated junction design is required. The outline concept for this junction is to replace the existing roundabout with a signalised junction arrangement. This would provide extra capacity for movements to and from the airport and would separate airport and non-airport traffic, reducing conflict in peak periods, thereby reducing congestion. As part of this solution, an elevated flyover would be built to carry traffic between Airport Way (from South Terminal and the M23) and the A23 towards Horley. Additional improvements would be made to Gatwick Way to accommodate an increase in traffic flow towards Northgate Road.

11.1.18 The flyover structure is anticipated to require three separate spans to cross at-grade carriageways and is expected to comprise a typical steel beam superstructure with a concrete slab deck on concrete abutments and piers, with piled foundations. The overall structure would be approximately 200 metres long. Retaining walls would be required to separate adjacent links at different levels or gradients.

Works to Longbridge Roundabout

11.1.19 The Longbridge junction is an existing signalised roundabout to the north of Gatwick Airport and becomes congested at peak times. Increases in traffic associated with future growth of the airport would further increase congestion and delays at the junction.

11.1.20 To increase capacity at the Longbridge roundabout and future proof the junction for further growth an enlarged signalised roundabout layout has been progressed that would widen the ICD and central island of the roundabout, providing wider circulatory lane widths and improved deflection to facilitate increased traffic demand and accommodate turning movements of HGV's. Additionally, increased stacking capacity has been applied to the arms of the junction.

Drainage Design Proposals

Calculation of Greenfield Runoff Rate

11.1.21 The control of runoff from sites is prescribed in the joint Defra and Environment Agency Flood and Coastal Erosion Risk Management R&D Programme document: Rainfall runoff management for developments Report –SC030219. The Institute of Hydrology IH124 (Institute of Hydrology, Report 124, Flood Estimation for Small Catchments, 1994) method has been adopted to estimate greenfield runoff). The results of this calculation have been checked against the 'greenfield runoff estimation for sites' online tool found at [redacted]. The key parameters are summarised in Table 11.1.2.

Table 11.1.2: Calculation of Greenfield Runoff

Catchment	NT	ST	LB
Hydrological Region	6		
Soil Type (S)	4 – Heavy Clay		
Annual Rainfall (SAAR) (mm)	760	760	754
Soil Runoff Coefficient (SPR)	0.47		
Mean annual peak flow per unit area (QBar/A) (l/s/ha)	5.3		
QBar/A x 0.85 1 year (l/s/ha)	4.52		4.06
QBar/A x 2.3 30 year (l/s/ha)	12.23		12.08
QBar/A x 3.19 100 year (l/s/ha)	16.96		16.75

Allowance for Climate Change

11.1.22 In accordance with Environment Agency requirements the volume of attenuation storage required to achieve greenfield runoff rates has been sized to accommodate the 1 per cent AEP event plus a 40 per cent increase in rainfall intensity to accommodate the predicted impact of climate change.

South Terminal Roundabout - East

11.1.23 It is assumed that the Project would maintain the existing outfalls and principal catchment areas. Consequently areas east and west of the Balcombe Road overbridge would continue to be treated as separate sub catchments.

11.1.24 The existing outfall to the watercourse next to pond no 8-5 would be maintained. The additional paved area drained by the Project would be 0.5ha which would require an estimated attenuation volume of 500m^3 to achieve a greenfield runoff rate.

11.1.25 It is assumed that any attenuation storage would be provided within the pipe network near the connection to existing systems and upstream of the existing pond. The current assumption is that the storage would be provided in the form of tank sewers within the road cross-section (see image below). Alternatively, off-line geocellular storage outside the carriageway can be proposed if land is available. It is estimated that a box culvert of 2m x 2m; 125m long would be required.

11.1.26 There would be opportunities to modify the existing basin to remove the need for this storage. For example, it could be possible to replace the existing control which is thought to be a pipe or orifice plate (150mm diameter or less) with a proprietary device such as a Hydrobrake that would provide more efficient usage of the existing storage volume in the pond. This may enable the surface water management requirements of the LLFA to be met without the need for new storage infrastructure in the upstream network.

South Terminal Roundabout - West

11.1.27 The existing outfall to Gatwick Stream via the Public Sewer would be maintained. The additional paved area drained would be 2.16ha requiring an estimated storage volume of 2,200m^3 to achieve greenfield runoff rates.

11.1.28 The surface water collection systems from the highway would be discharged to a perimeter drainage ditch to the north of the proposed road embankment.

11.1.29 This ditch would have a conveyance function but may be enlarged to serve a storage function. At this stage, the storage volume within the ditch has been discounted for the purposes of these calculations. The ditch will convey the runoff into a new attenuation pond (with 2,200m^3 attenuation capacity) adjacent to Balcombe Road. The attenuation pond will possess a flow control on its outfall to limit the discharge flows to the 1-year greenfield runoff rate of 9.76l/s. The outfall pipe will connect to the existing Public Sewer at the north side of the roundabout.

North Terminal Roundabout

11.1.30 The drainage proposals at North Terminal roundabout will drain the combined existing and proposed highways layout of 4.39ha to greenfield rates to the Gatwick Stream and River Mole. The layout will consist of four separate catchments each with their own attenuation storage (tanks or ponds) as indicated in Figure 11-5. The estimated attenuation storage volumes required are summarised in Table 11.1.3.

Table 11.1.3: North Terminal Roundabout Catchment Characteristics and Attenuation Volumes

Catchment	1	2	3	4
Area (ha)	0.56	2.09	1.23	0.53
1yr Storm Peak Outflow Rate (l/s)	2.53	9.44	5.56	2.39
Minimum Attenuation Volume Required (m^3)	404	1505	882	381
Maximum Attenuation Volume Required (m^3)	564	2103	1234	532
Adopted Attenuation Volume Required (m^3)	600	2100	1300	600

Longbridge Roundabout

11.1.31 The surface area of the proposed upgraded Longbridge Roundabout is estimated to be 15,200m^2 (1.52 hectares) that includes an increase in impermeable area of 1,800m^2 (0.18 hectares) compared with the current layout. The preferred solution is for all storm water runoff to be collected for all proposed works (1.520ha) discharged at greenfield runoff rate to the River Mole. The discharge rate will be 6.78l/s being the 1-year greenfield run off rate for a 1.520ha site that would require a volume of attenuation of between 1,096m^3 and 1,531m^3 attenuation – for the purposes of high-level design this has been assumed as 1,600m^3 including the allowance for climate change.

11.1.32 Four catchments are proposed at Longbridge roundabout, each with a separate outfall and avoiding new cross-drains under live carriageways, as shown in Figure 11-6. The characteristics and the estimated attenuation volumes including climate change required to achieve greenfield runoff rates are included in Table 11.1.4.

Table 11.1.4: Longbridge Roundabout Drainage Catchment Characteristics and Attenuation Volumes

Catchment	1	2	3	4
Area (ha)	0.29	0.76	0.23	0.25
1yr Storm Peak Outflow Rate (l/s)	2.00	3.39	2.00	2.00
Minimum Attenuation Volume Required (m^3)	184	584	136	151
Maximum Attenuation Volume Required (m^3)	261	766	194	215
Adopted Attenuation Volume Required (m^3)	300	800	200	200

11.1.33 The estimated storage volumes required will be provided by two new attenuation ponds to the north of the roundabout that would outfall to the River Mole and two attenuation tanks that would drain to existing ditches that are assumed to receive existing highways runoff.

Conclusions

11.1.34 The surface access works to be undertaken as part of the Project would require an increase in impermeable area to accommodate the expected increase in passenger numbers and associated movements in and out of the airport. Surface access improvement works will be required at three locations:

- South Terminal Roundabout
- North Terminal Roundabout
- Longbridge Roundabout

11.1.35 The additional runoff that would result from the increased impermeable areas would be stored in new facilities and attenuated to achieve greenfield runoff rates. The storage facilities have been sized to accommodate the 1 per cent AEP event plus an allowance for climate change of +40 per cent in accordance with Environment Agency requirements.

Figure 11-1: Existing South Terminal Roundabout Highways Drainage Layout

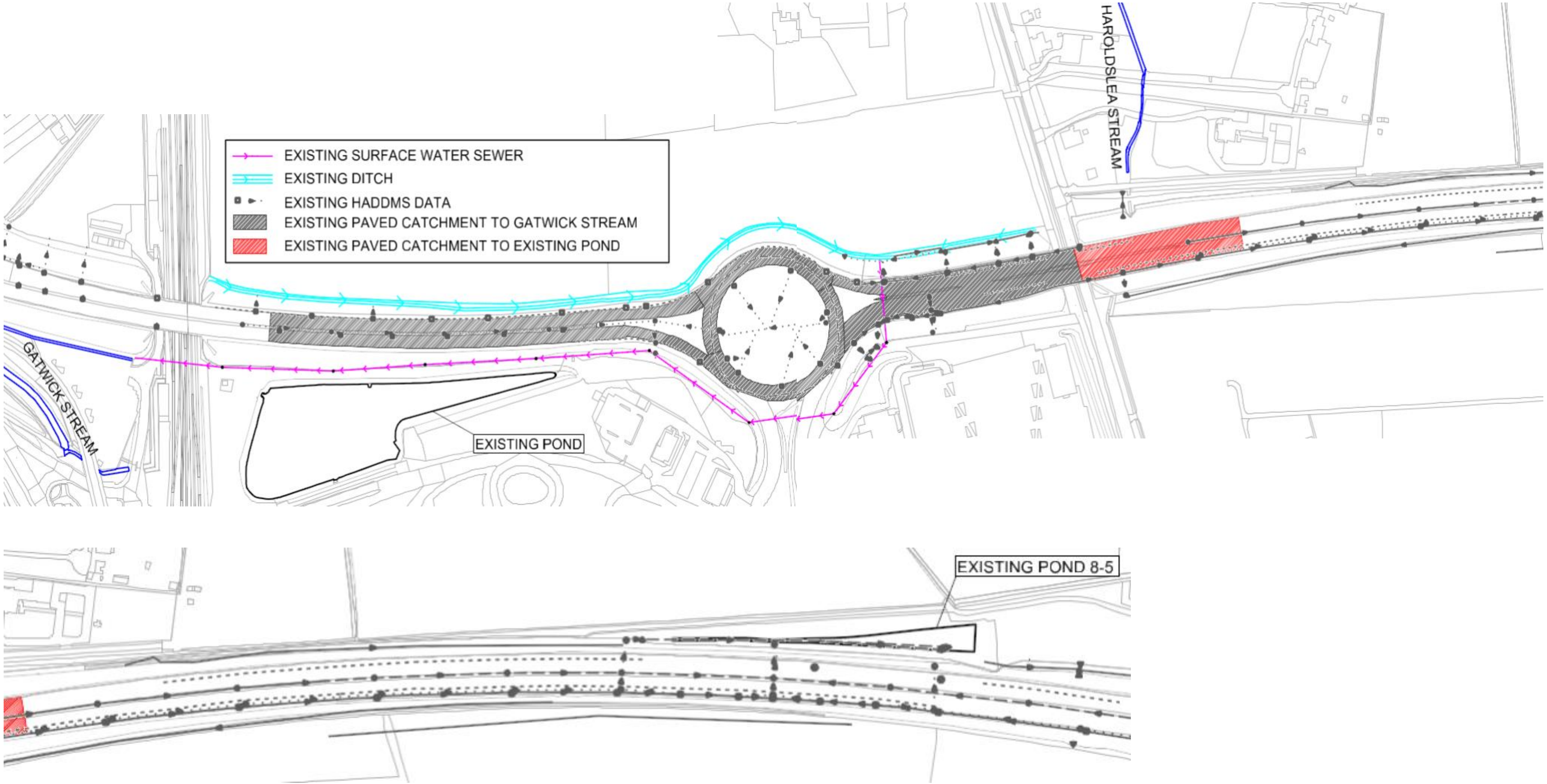


Figure 11-2: Existing North Terminal Roundabout Highways Drainage Layout

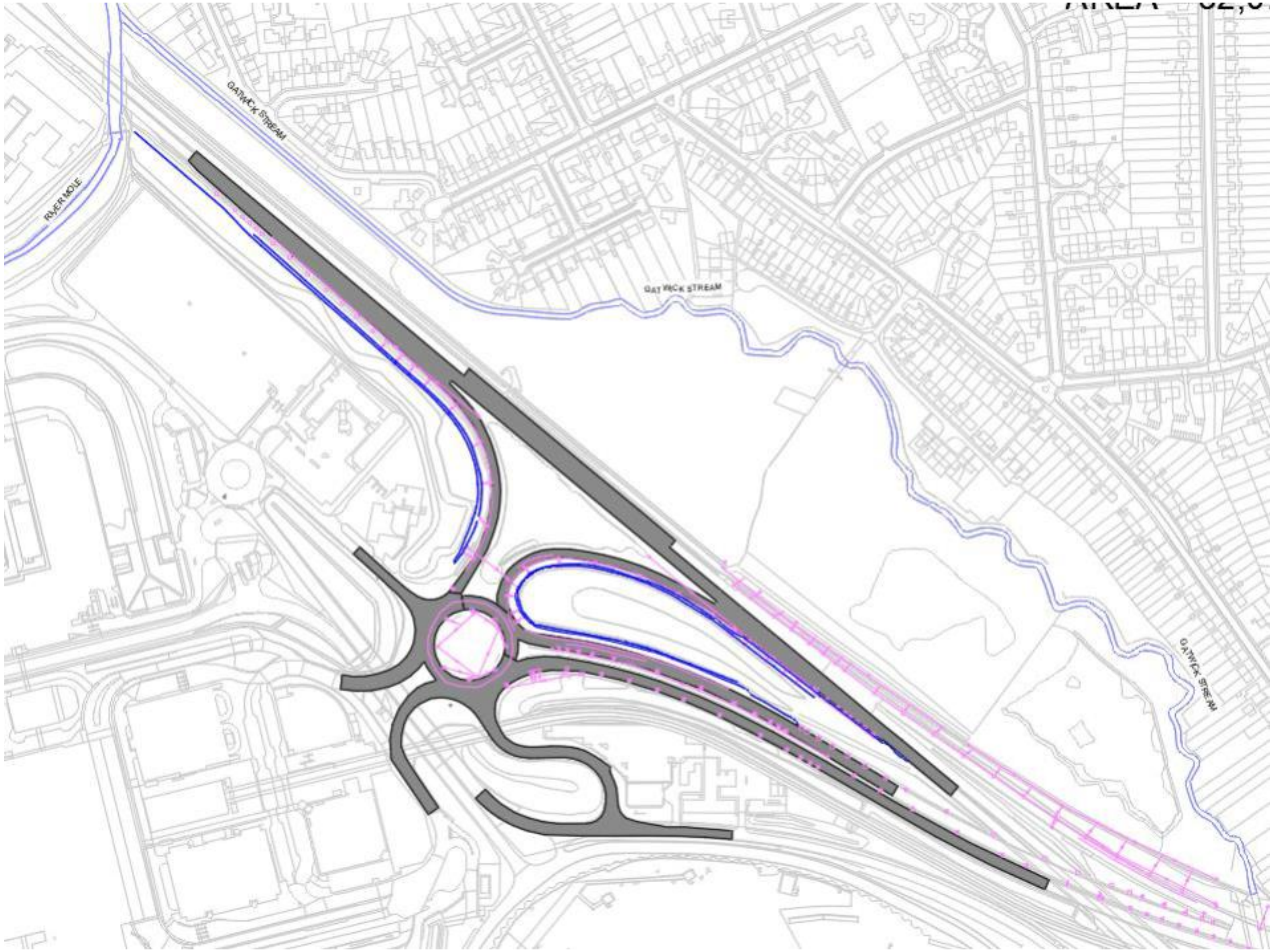


Figure 11-3: Existing Longbridge Roundabout Highways Drainage Layout

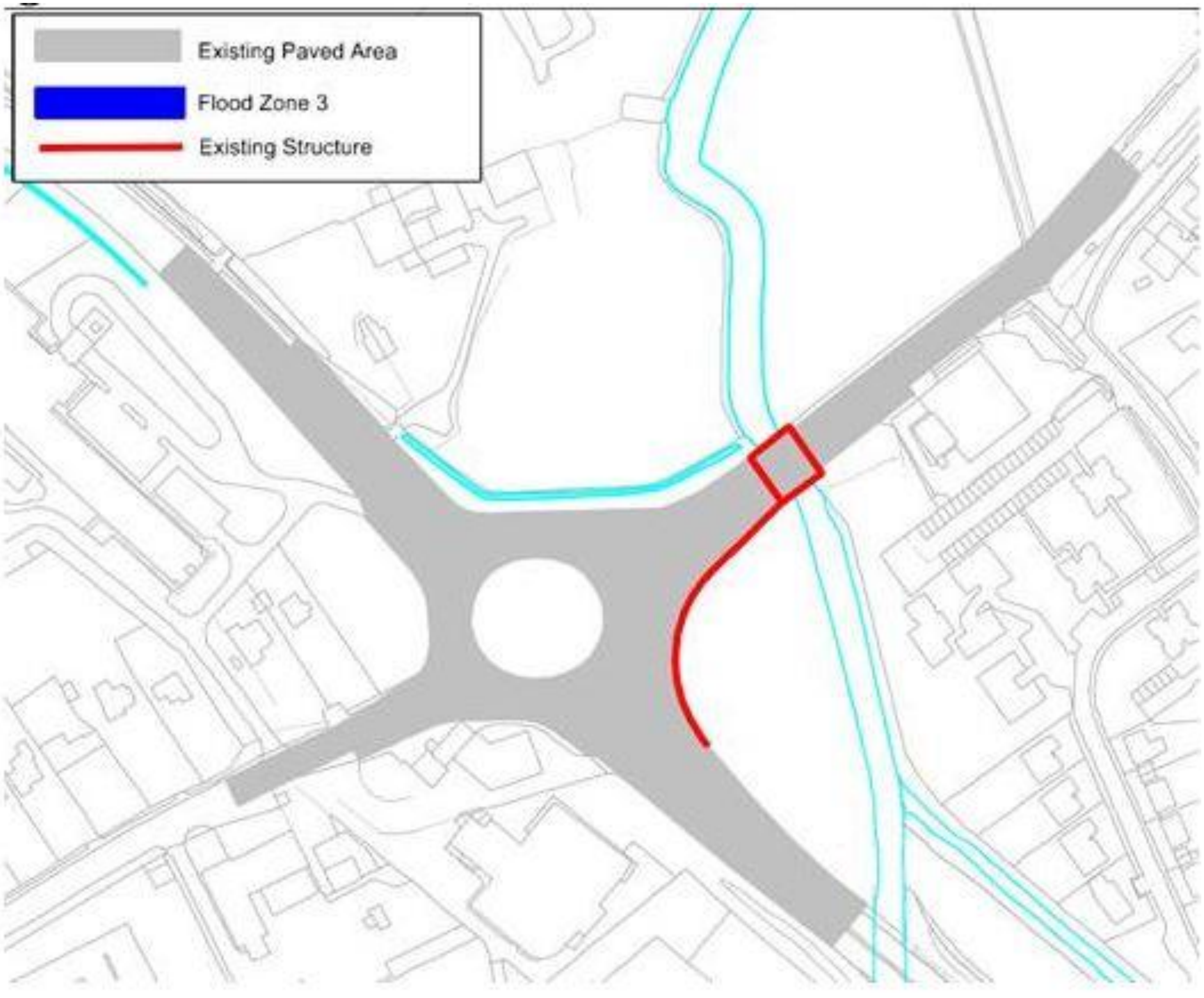
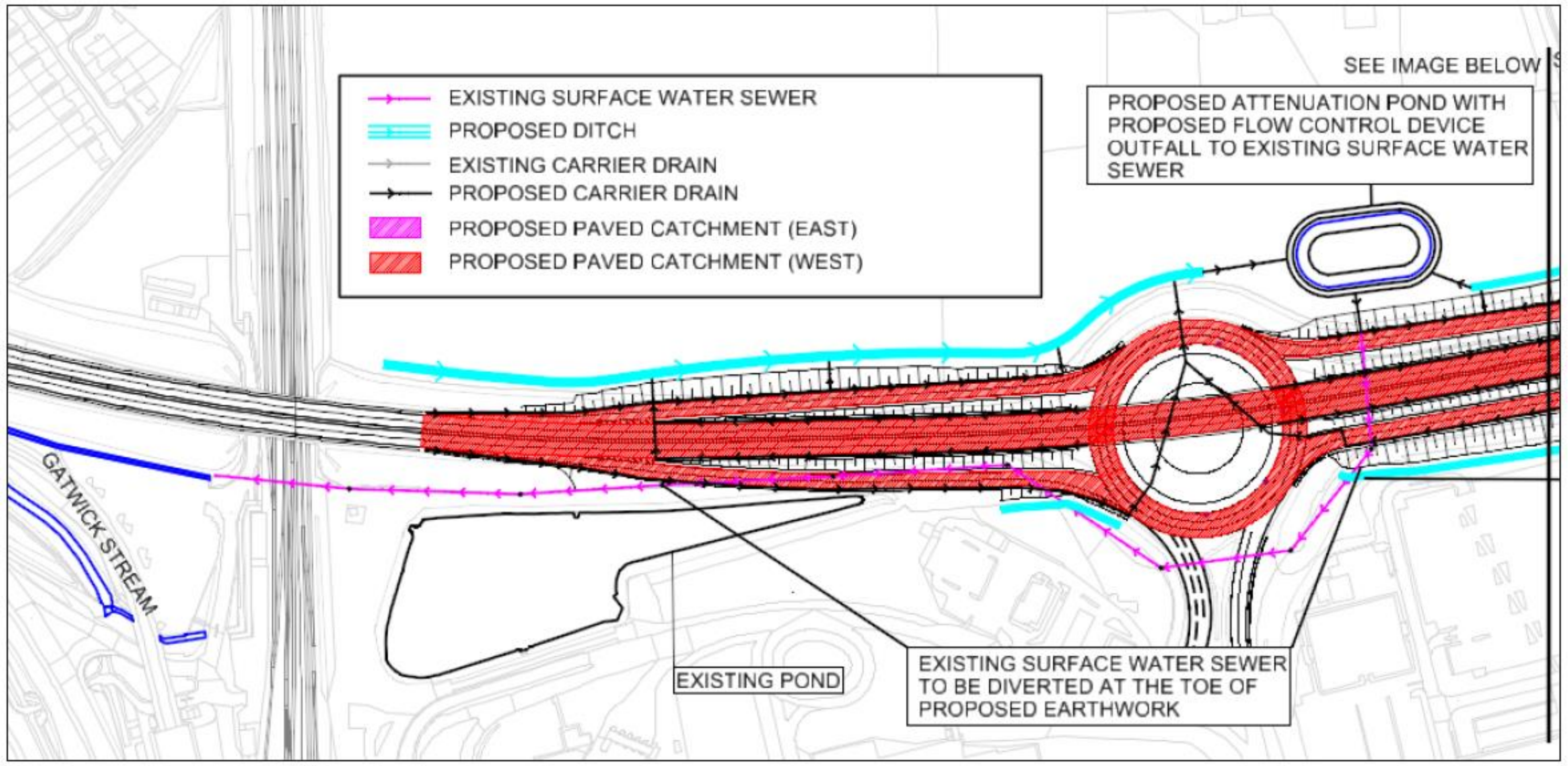


Figure 11-4: Indicative Proposed South Terminal Roundabout Drainage Layout



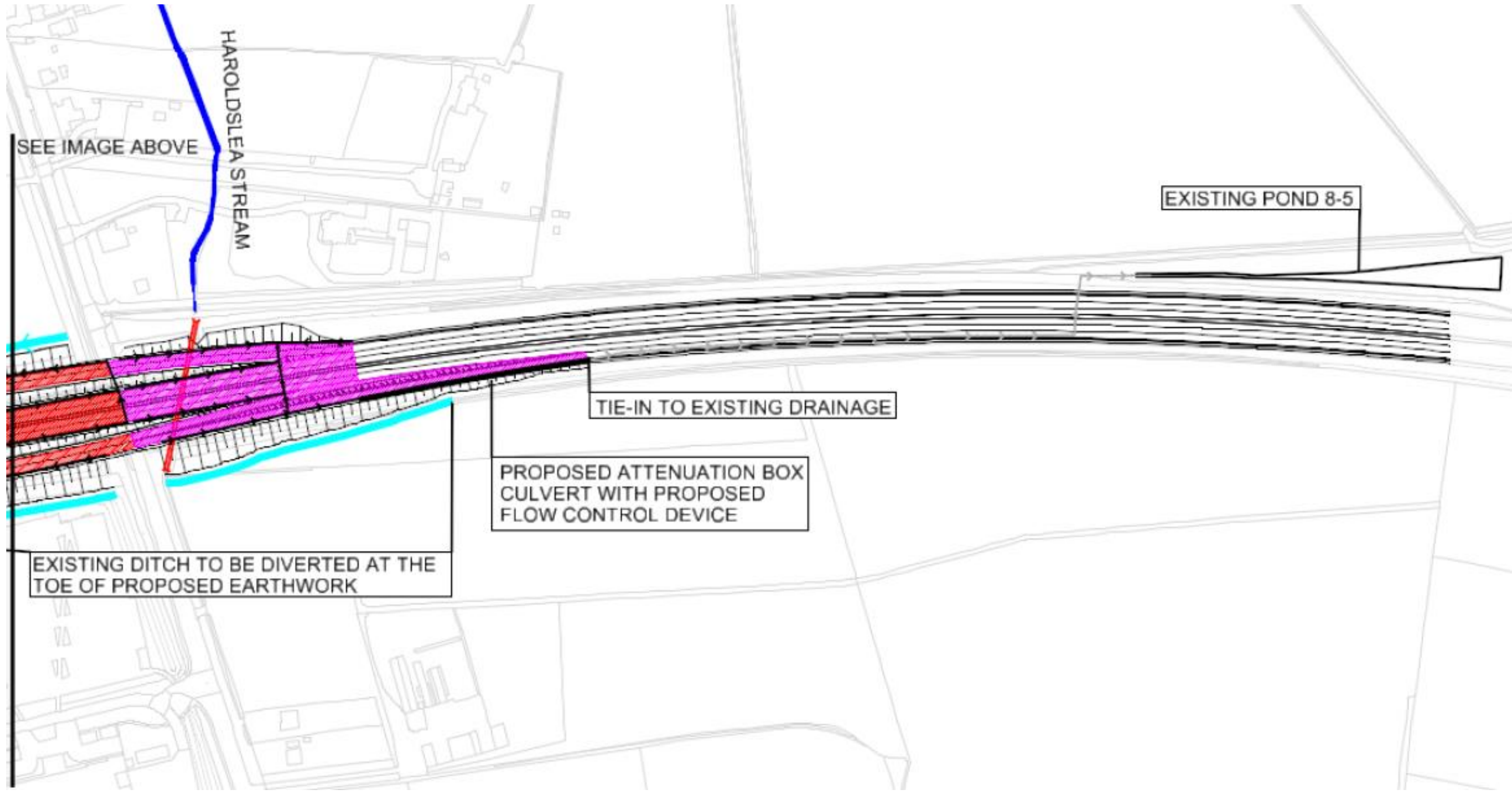


Figure 11-5: Indicative North Terminal Roundabout Drainage Layout

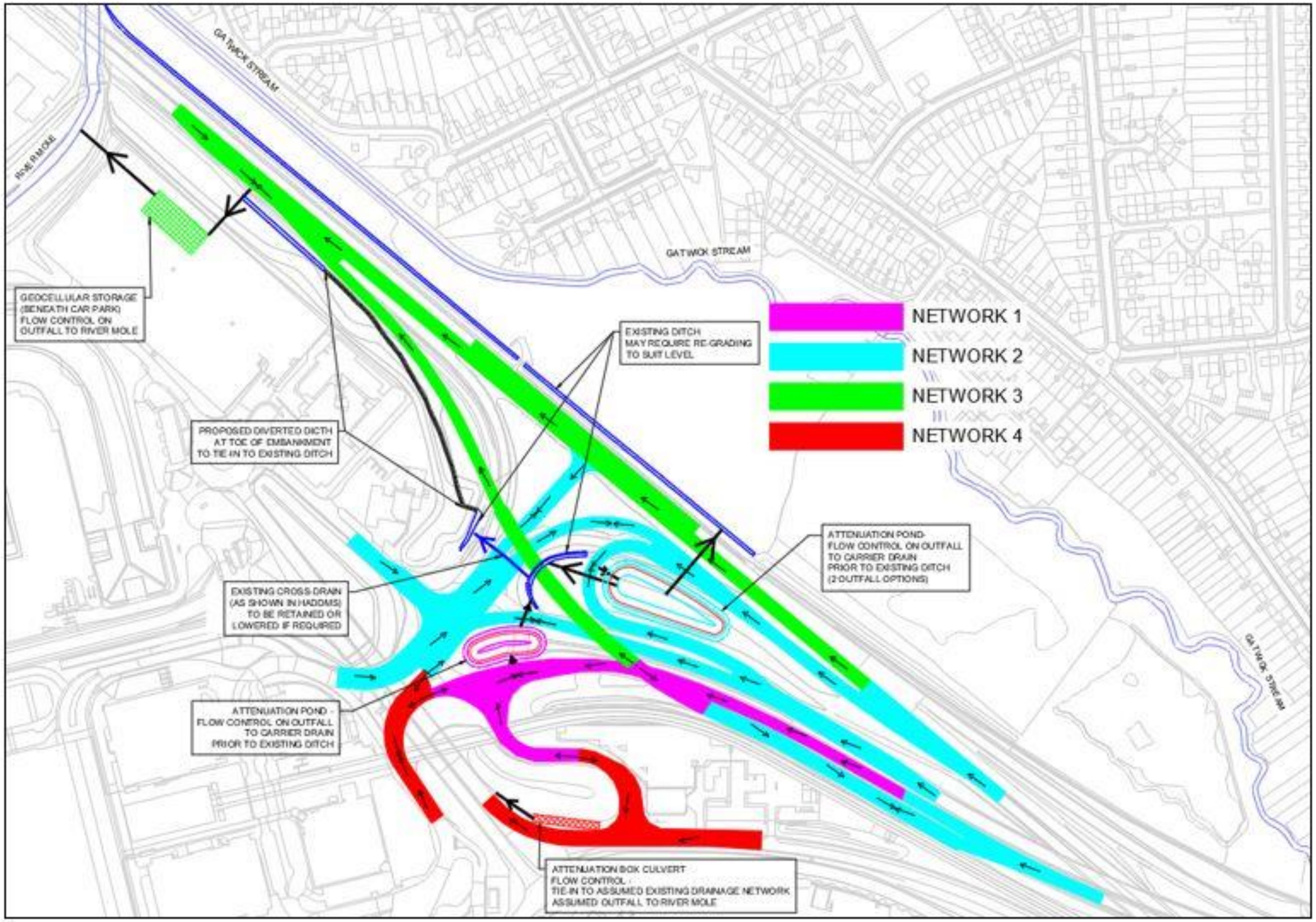
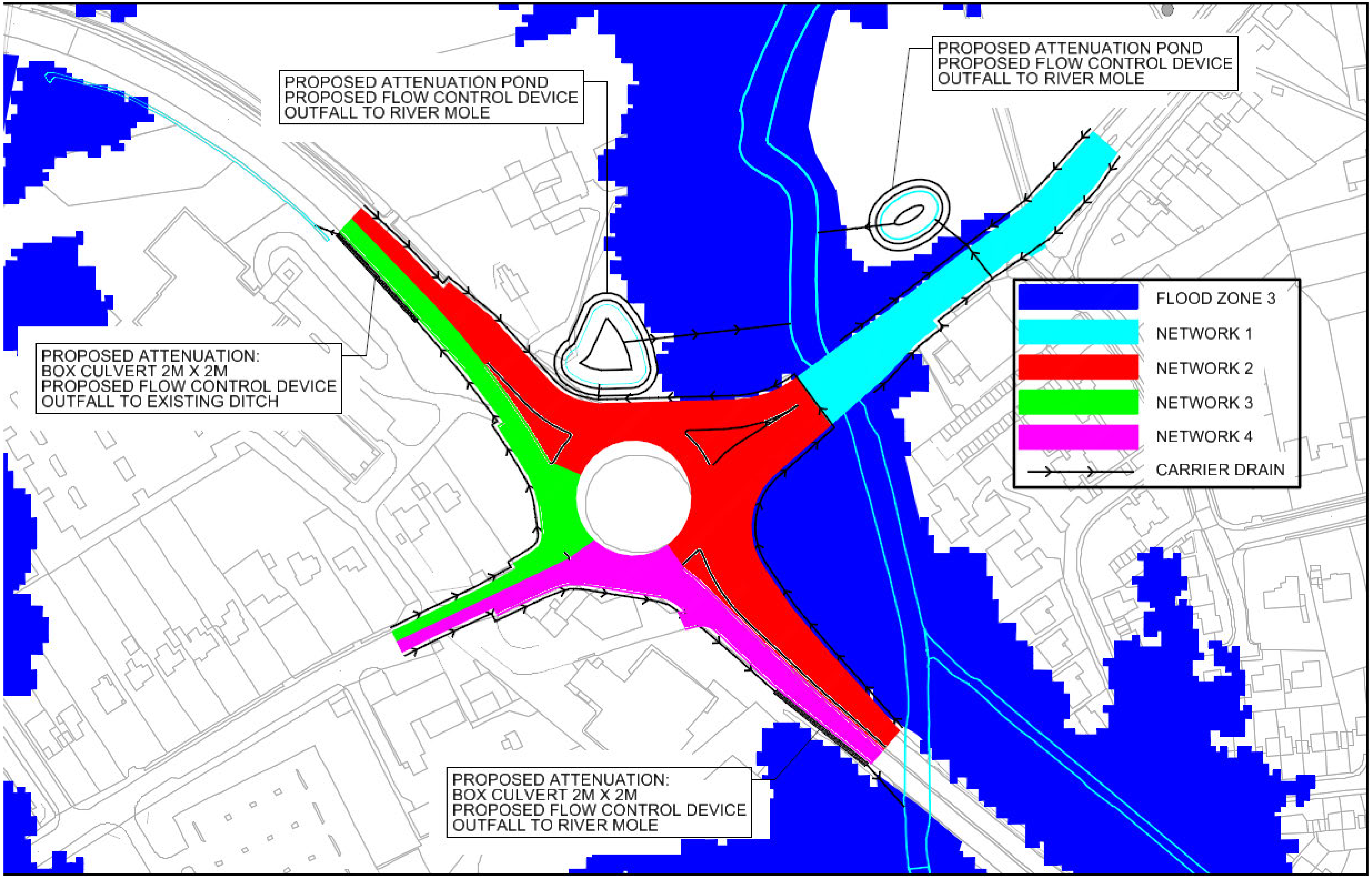
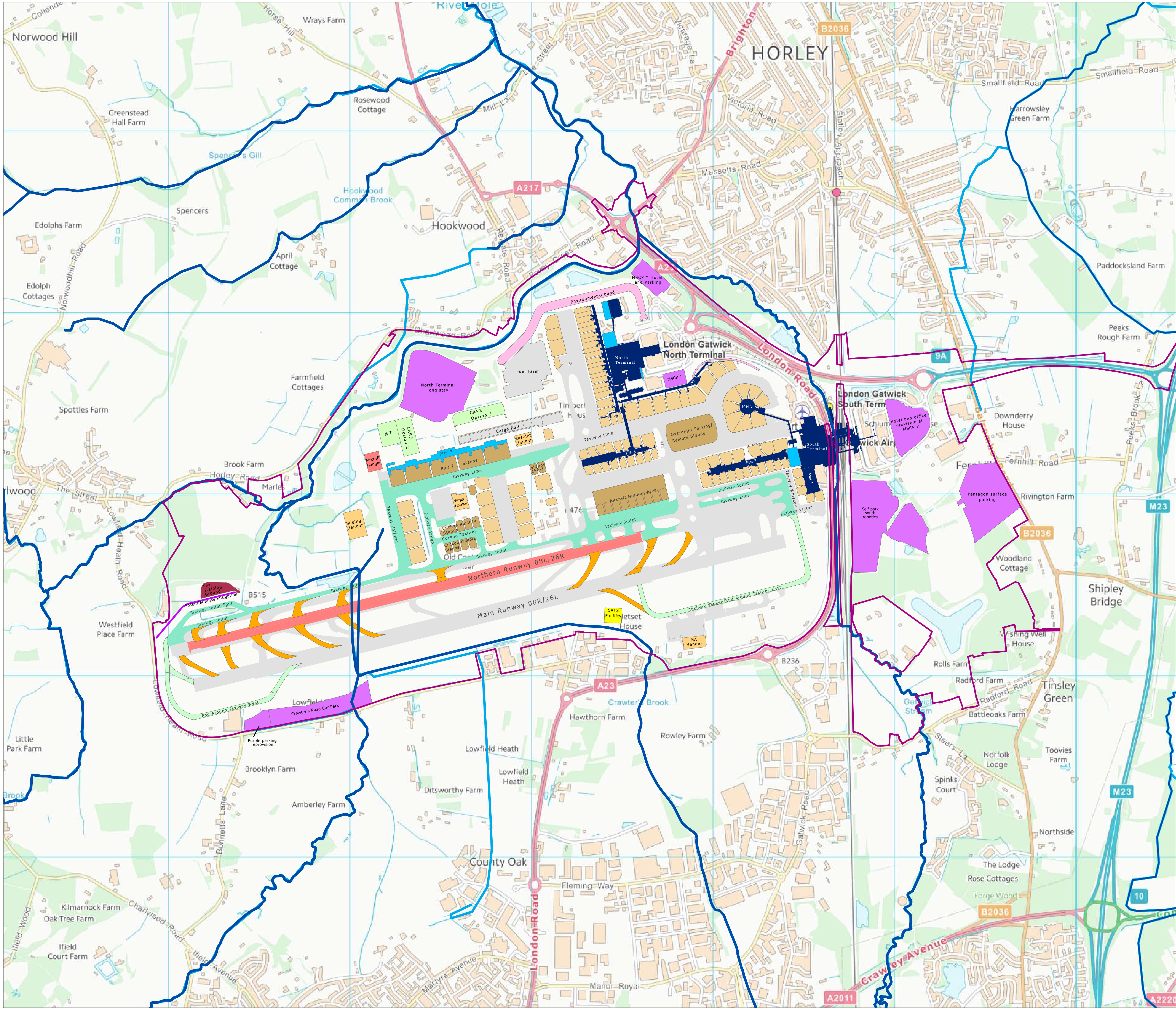


Figure 11-6: Indicative Longbridge Roundabout Drainage Layout





YOUR LONDON AIRPORT
Gatwick

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Existing/Consented Elements

- Terminal
- Existing stands
- Existing runway or taxiway
- Other existing airport infrastructure
- Environmental Mitigation
- Hangar

Project elements

- Exit taxiways
- Central Area Recycling Enclosure (CARE) and Motor Transport (MT) maintenance facilities
- End Around Taxiways
- Stands
- Aircraft Holding Area
- Terminal works
- Northern Runway 08L/26R
- Potential noise mitigation
- Taxiway
- Relocation of Fire Training Ground
- Hangar
- Satellite Airport Fire Service Facility provision south of main runway

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Project Elements

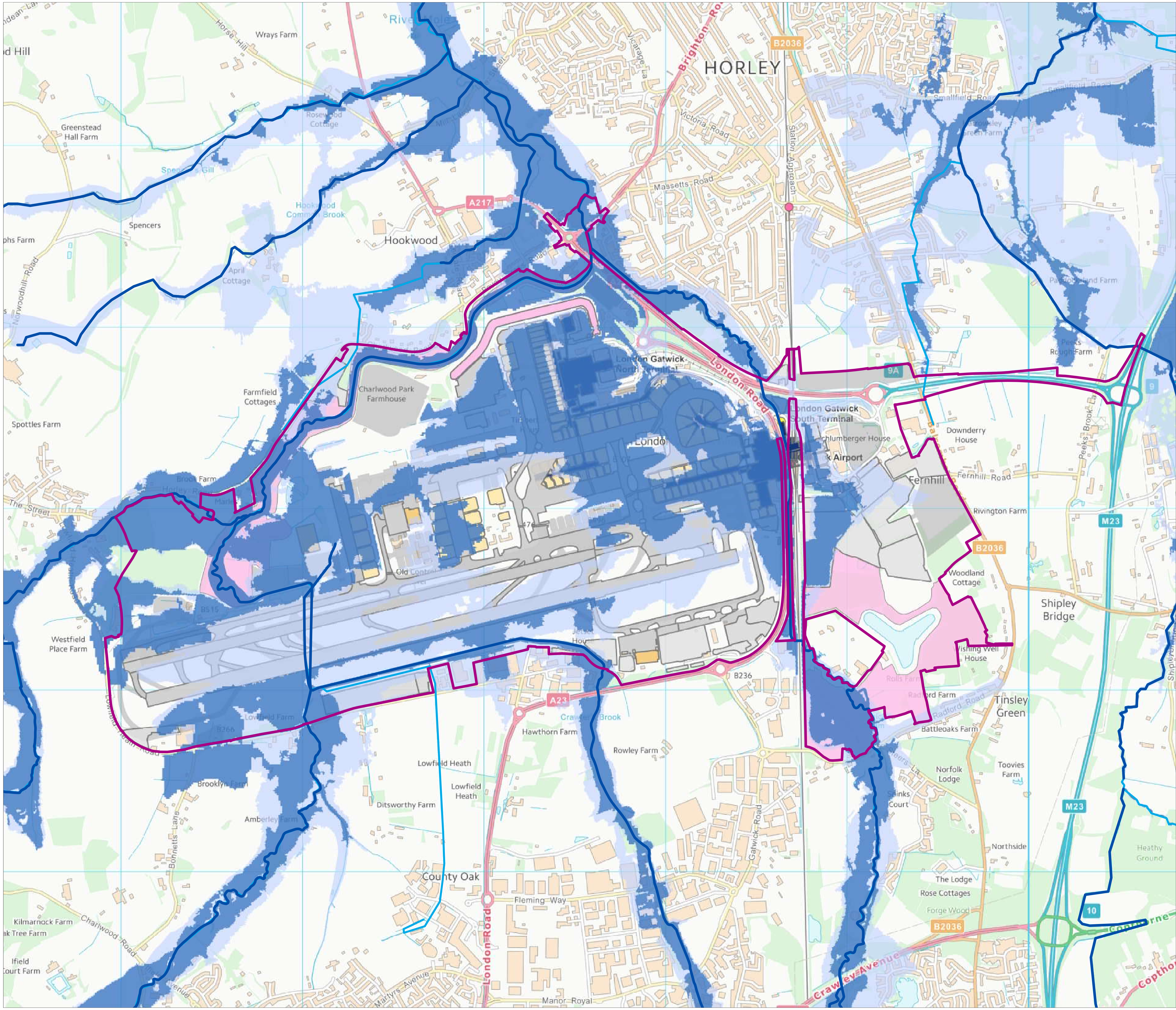
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 2.2.1	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 250 500 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\Project Elements.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- Flood Zone 3
- Flood Zone 2

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report
Appendix 11.9.1

DRAWING TITLE
Environment Agency Published Flood Zones

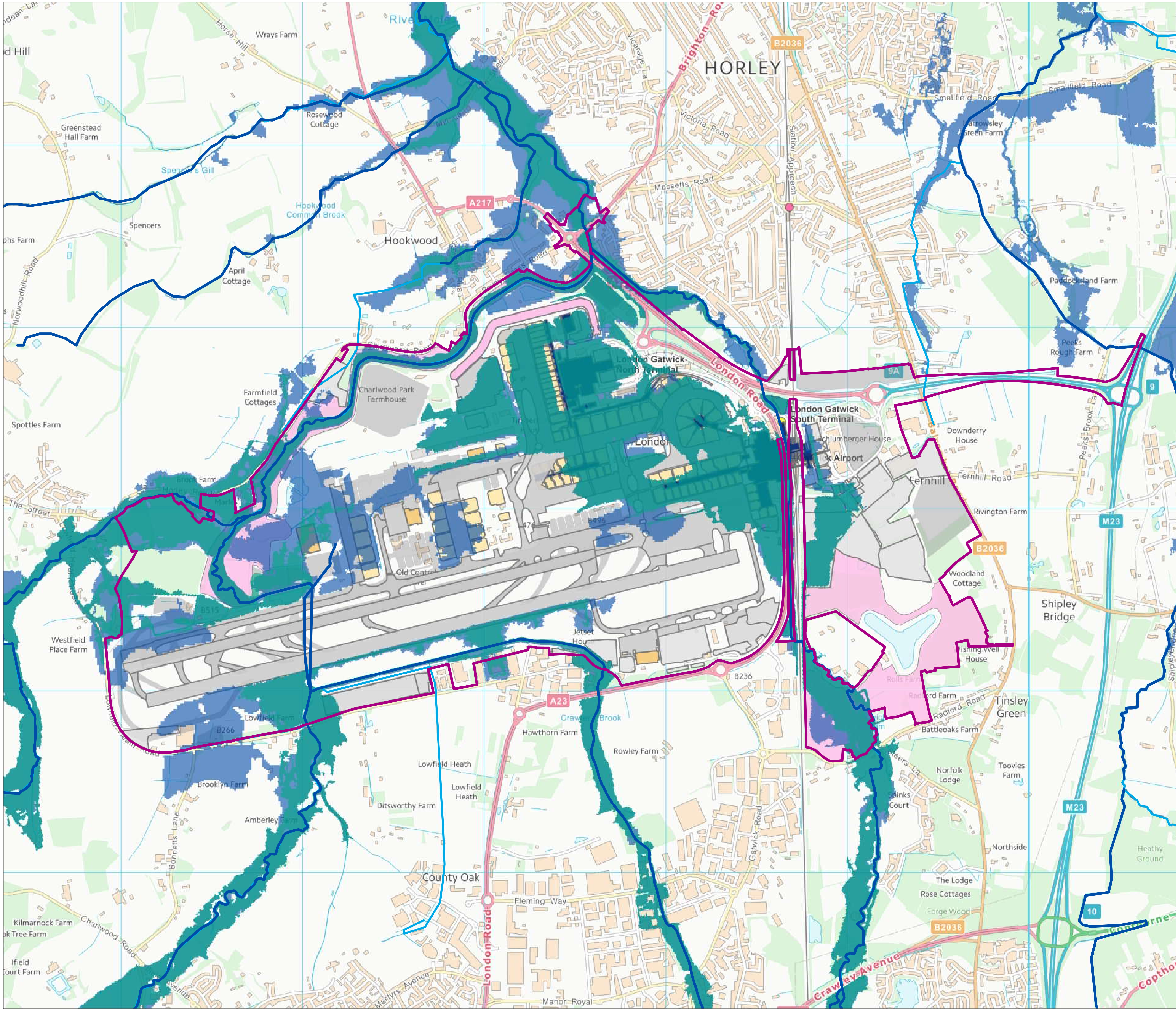
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.2.1	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- Upper Mole Model 1% AEP event
- Flood Zone 3

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Upper Mole Model 1% (1 in 100) AEP Event Extents and EA Flood Zone 3 Extents

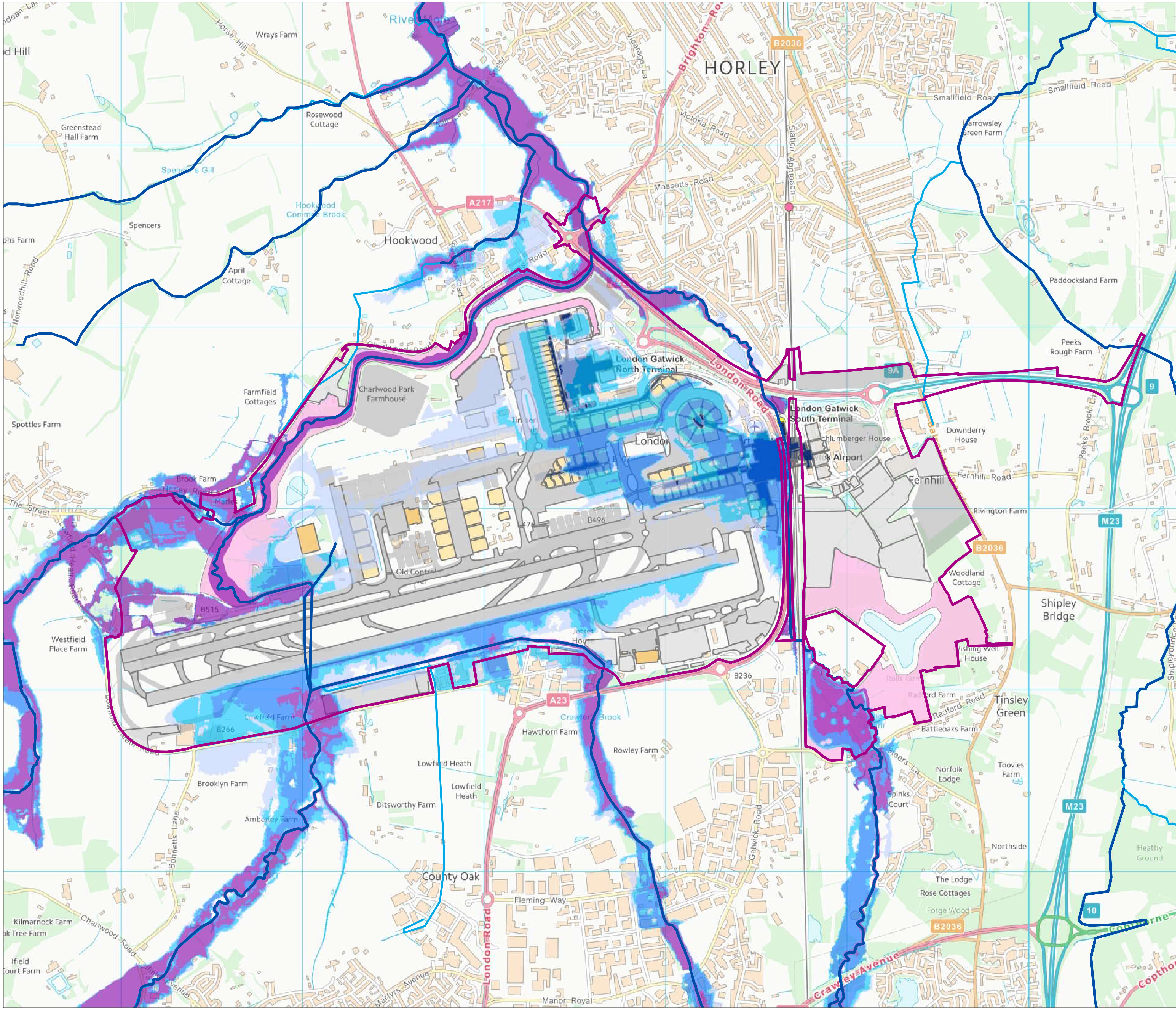
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.2.2	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- Upper Mole Model 5% AEP event
- Upper Mole Model 1% AEP event
- Upper Mole Model 1% + 35%CC AEP event
- Upper Mole Model 1% + 70%CC AEP event

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Gatwick Surface Water Model 1%+20%CC, 1% + 40%CC Extents (Baseline Scenario) for the 30 mins duration

DATE

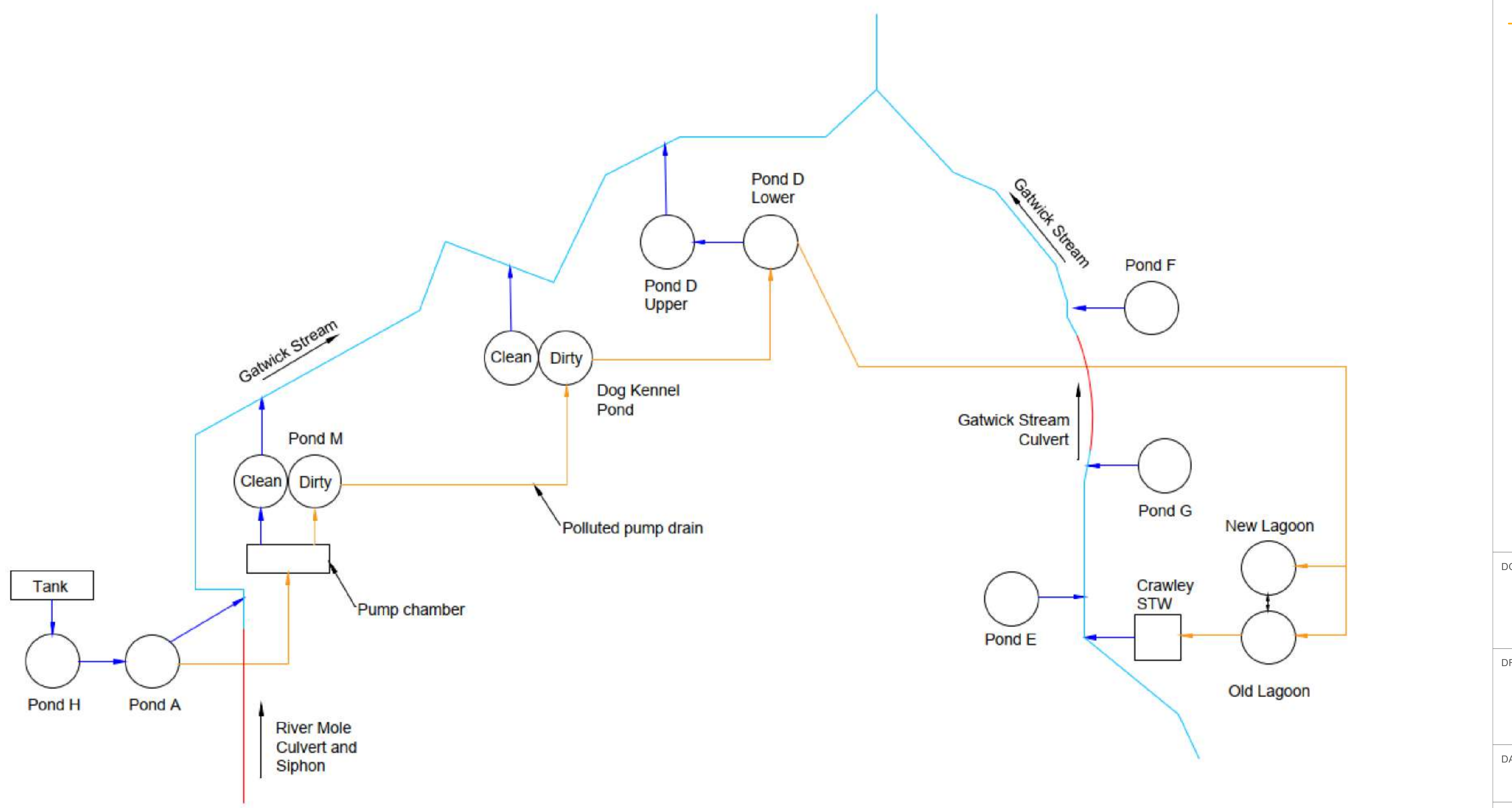
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.3.3	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

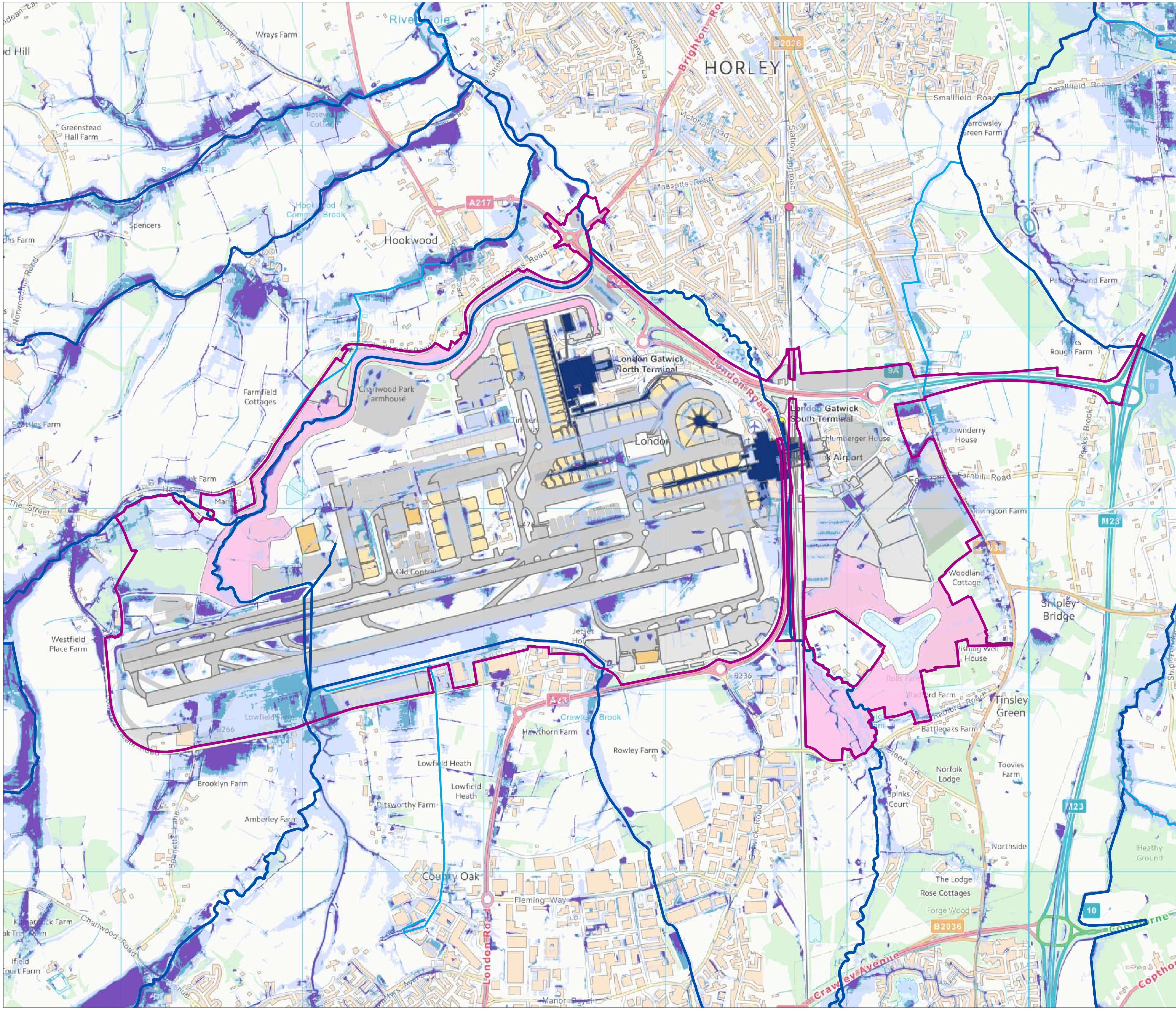
DOCUMENT
Preliminary Environmental Information Report
Appendix 11.9.1

DRAWING TITLE
Drainage Schematic

DATE
September 2021

DRAWING NO.	REVISION
FIGURE 5.3.1	For PEIR Issue
DRAWN BY	PM / CHECKED BY
CW	MS

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\Drainage Scheme.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- EA RoFSW 3.3% (1 in 30) Flood Extent (High Risk)
- EA RoFSW 1% (1 in 100) Flood Extent (Medium Risk)
- EA RoFSW 0.1% (1 in 1000) Flood Extent (Low Risk)

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Risk of Flooding from Surface Water Flooding Extents

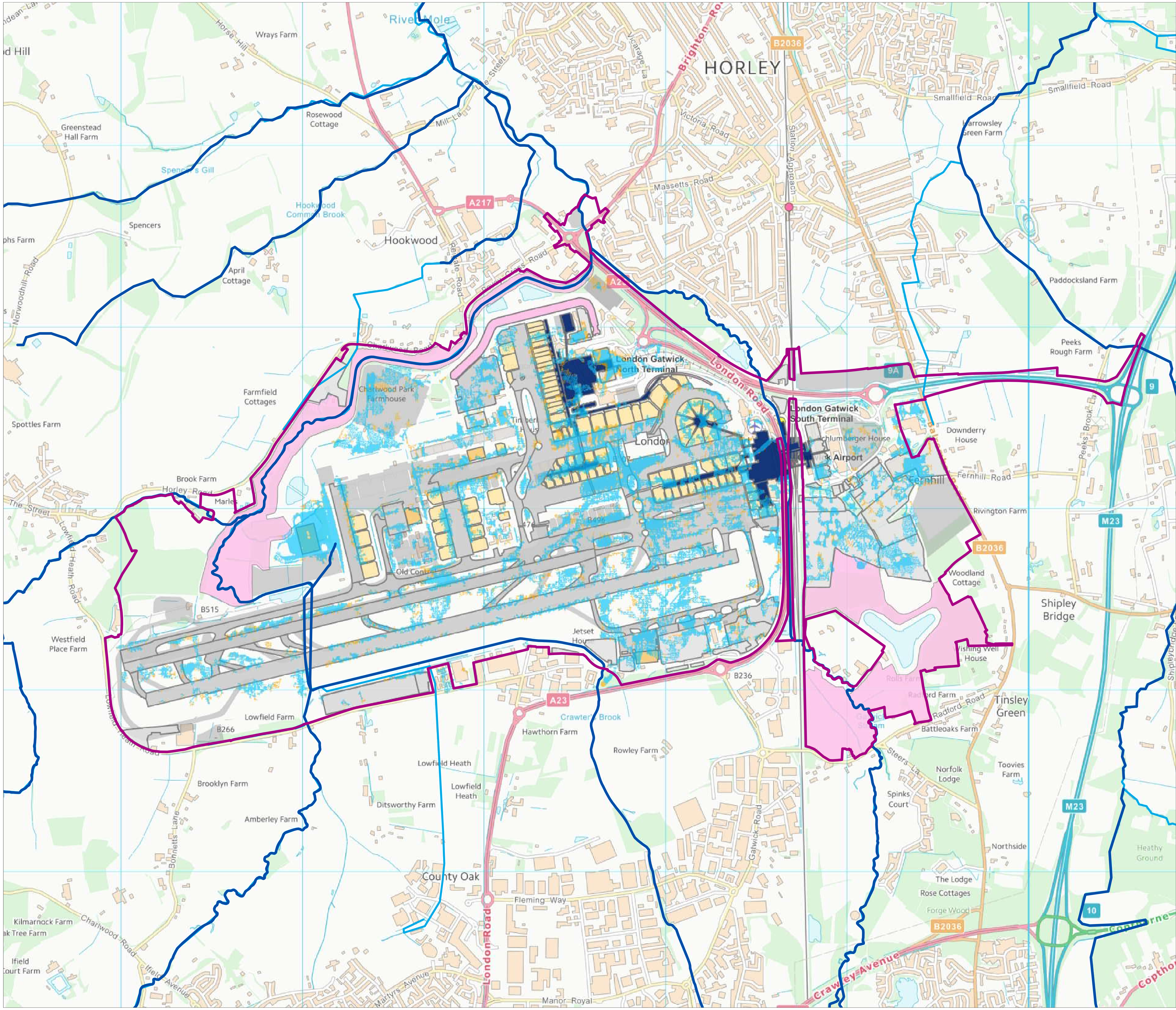
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.3.2	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- 1% (1 in 100) AEP event + 20% climate change (30-mins)
- 1% (1 in 100) AEP event + 40% climate change (30-mins)

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Gatwick Surface Water Model 1%+20%CC, 1% + 40%CC Extents (Baseline Scenario) for the 30 mins duration

DATE

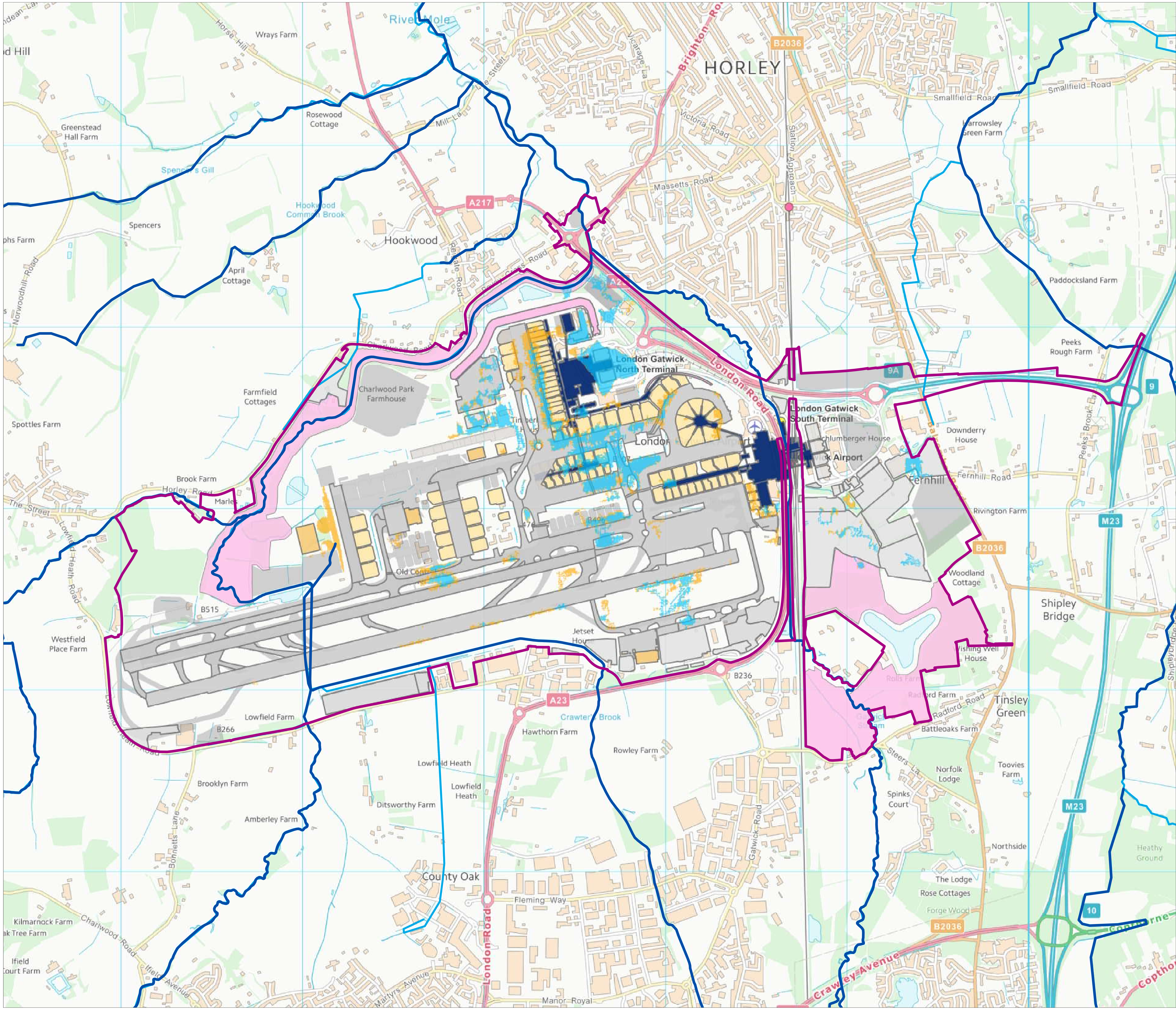
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.3.3	For PEIR Issue
	DRAWN BY: CW	PM / CHECKED BY: MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- 1% (1 in 100) AEP event + 20% climate change (1440-mins)
- 1% (1 in 100) AEP event + 40% climate change (1440-mins)

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Gatwick Surface Water Model 1%+20%CC, 1% + 40%CC Extents (Baseline Scenario) for the 1440 mins duration

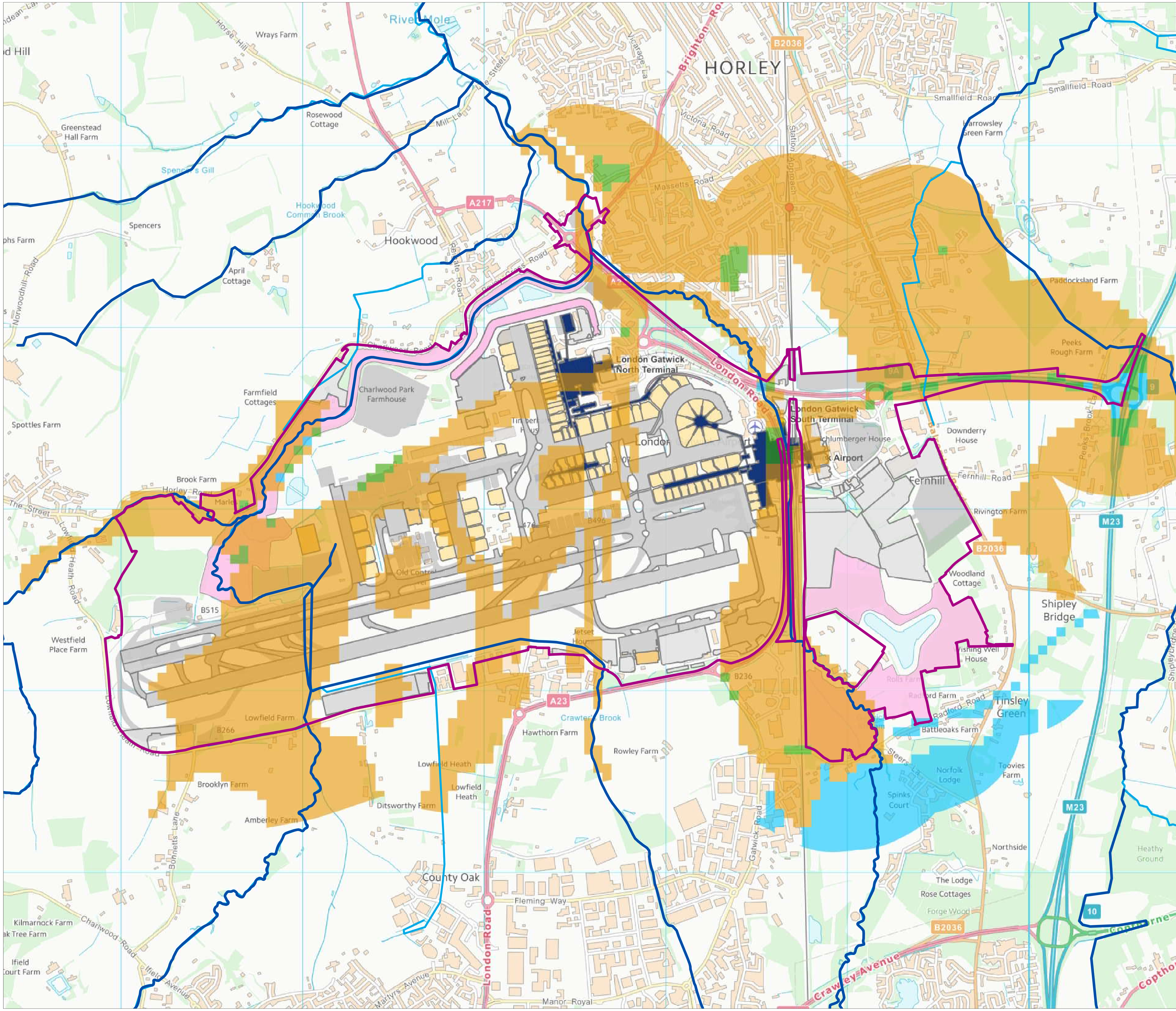
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.3.4	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Areas Susceptible to Groundwater Flooding

- Limited potential for groundwater flooding to occur
- Potential for groundwater flooding of property situated below ground level
- Potential for groundwater flooding to occur at surface

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Areas Susceptible to Groundwater Flooding

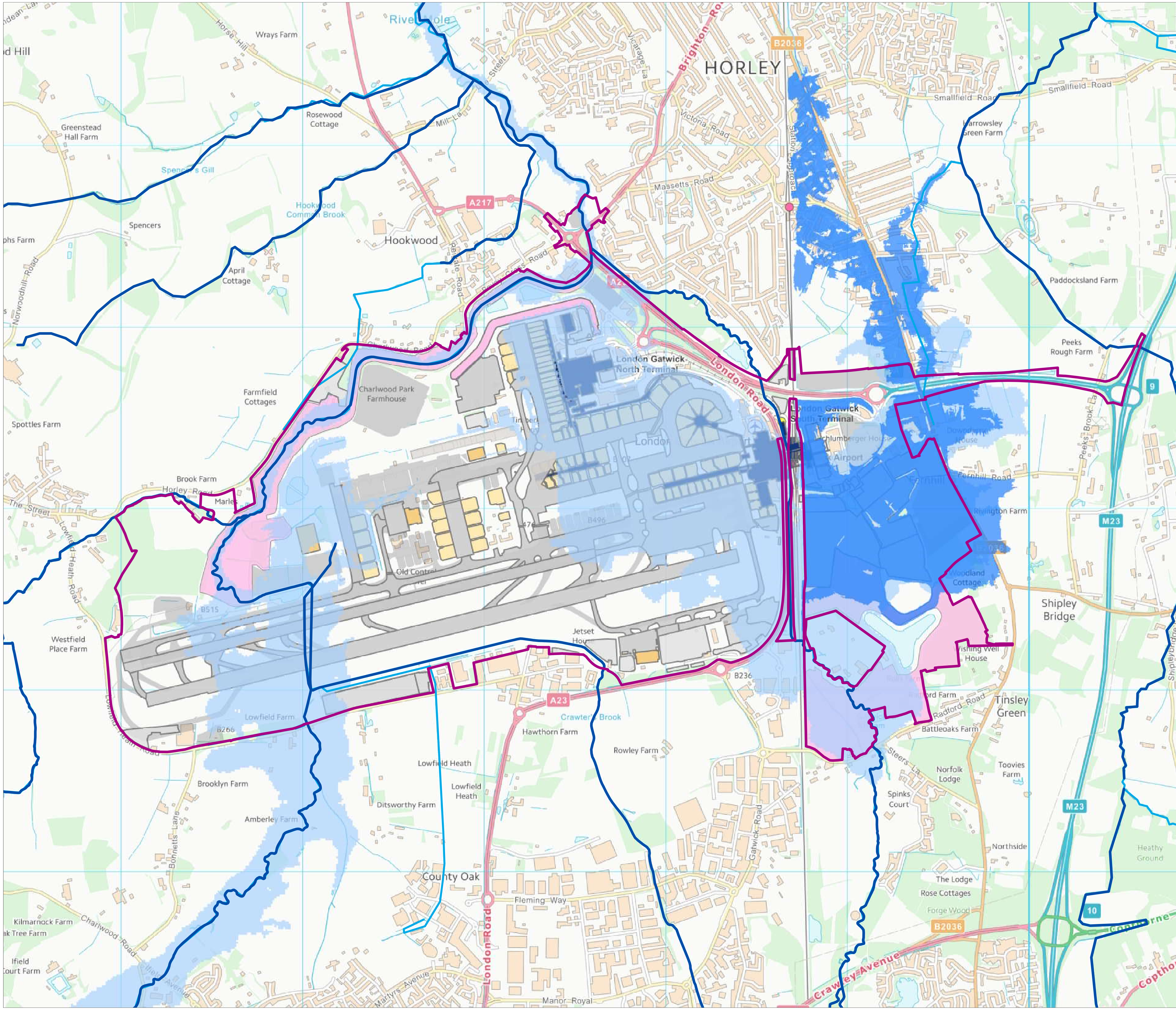
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.4.1	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- Area at Risk of Flooding from Reservoirs
- GAL Breach Flood Extents

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Historic Flooding

DATE

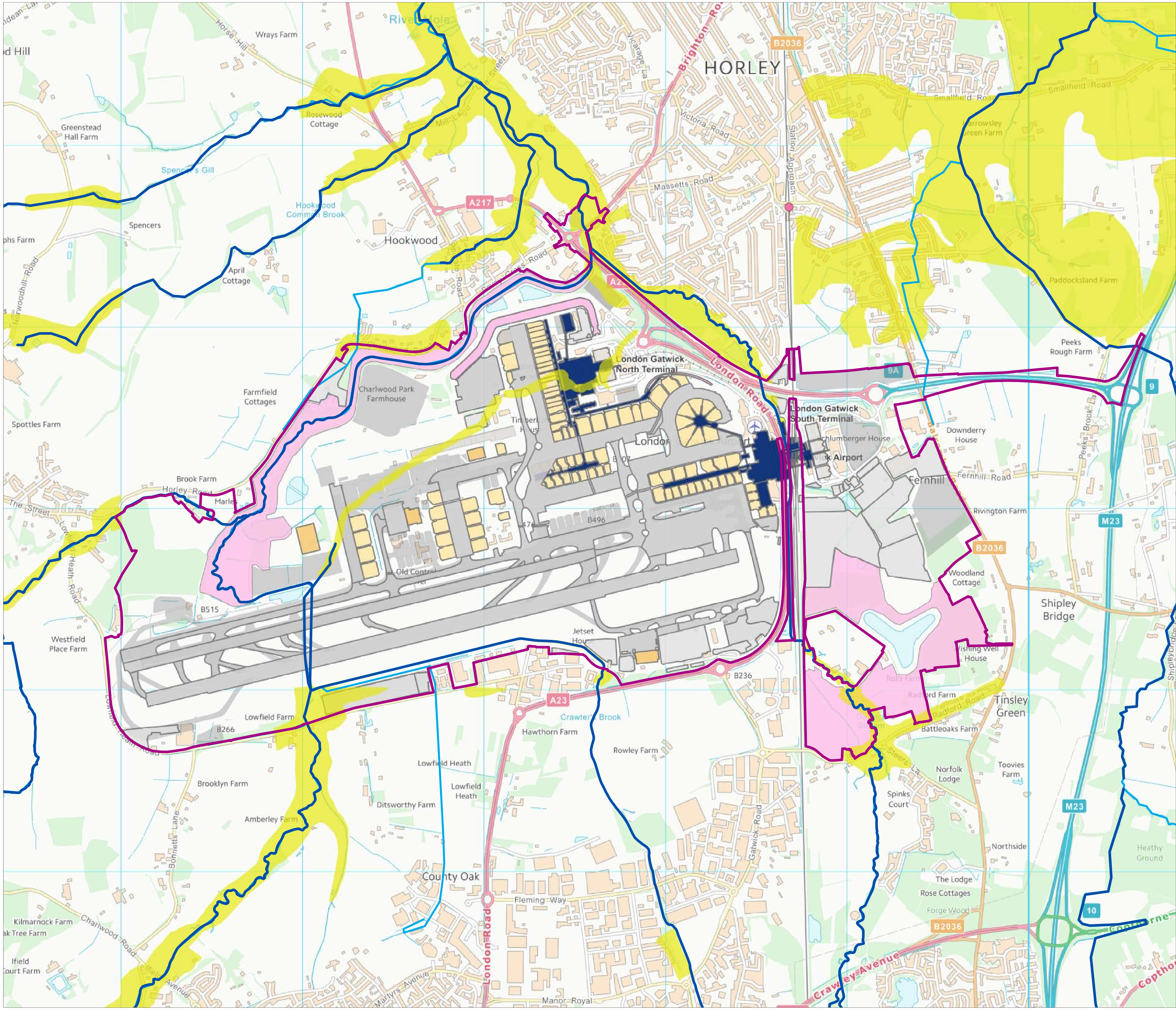
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.5.1	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- EA Historic Flood Map

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Historic Flooding

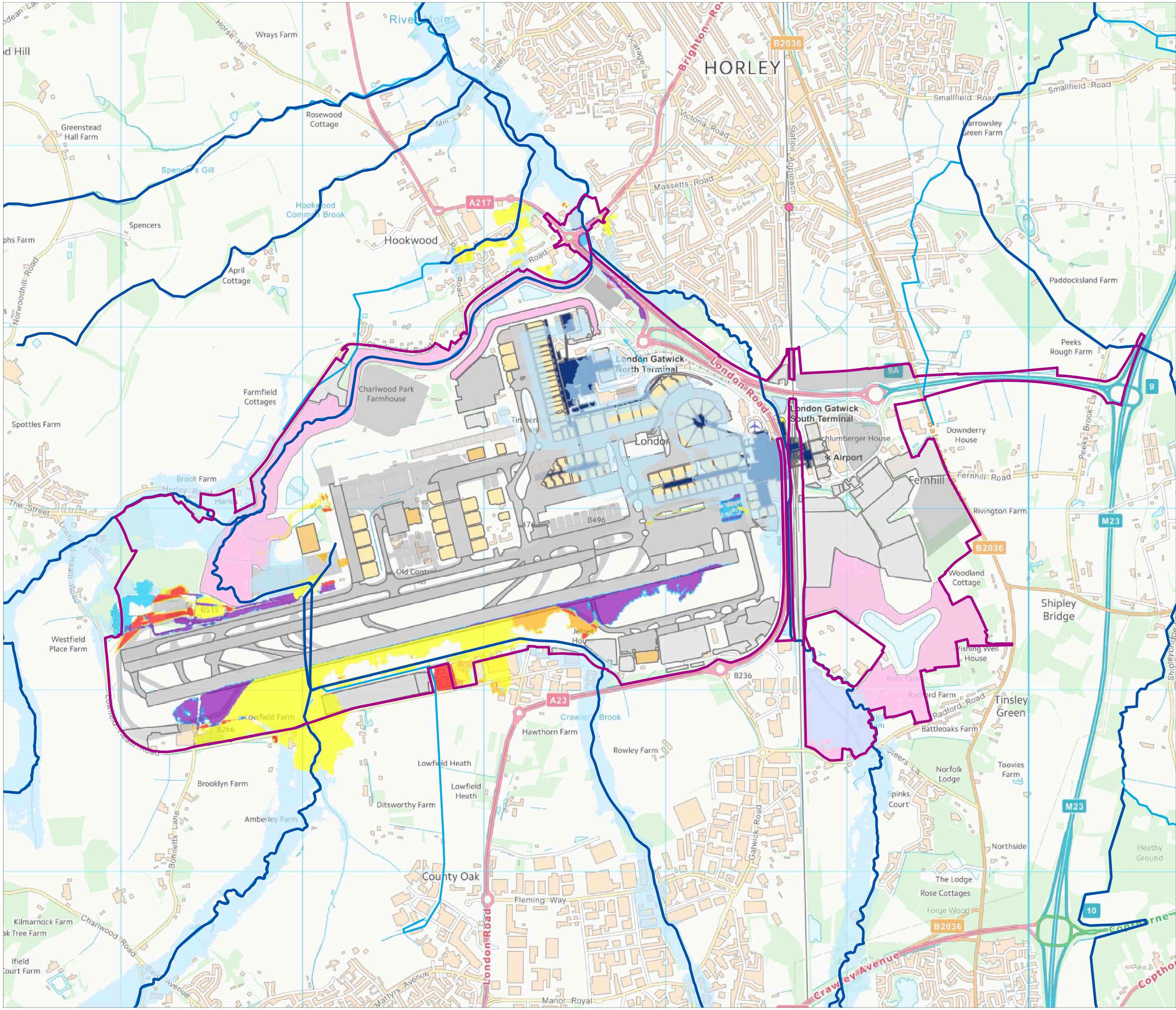
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 5.8.1	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALTCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Depth difference 1% (1 in 100) AEP event + 35% CC

Depth (m)

- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Upper Mole Hydraulic Model 1% + 35%CC AEP Event Depth Difference to Baseline (With-Project,No-Mitigation Scenario)

DATE

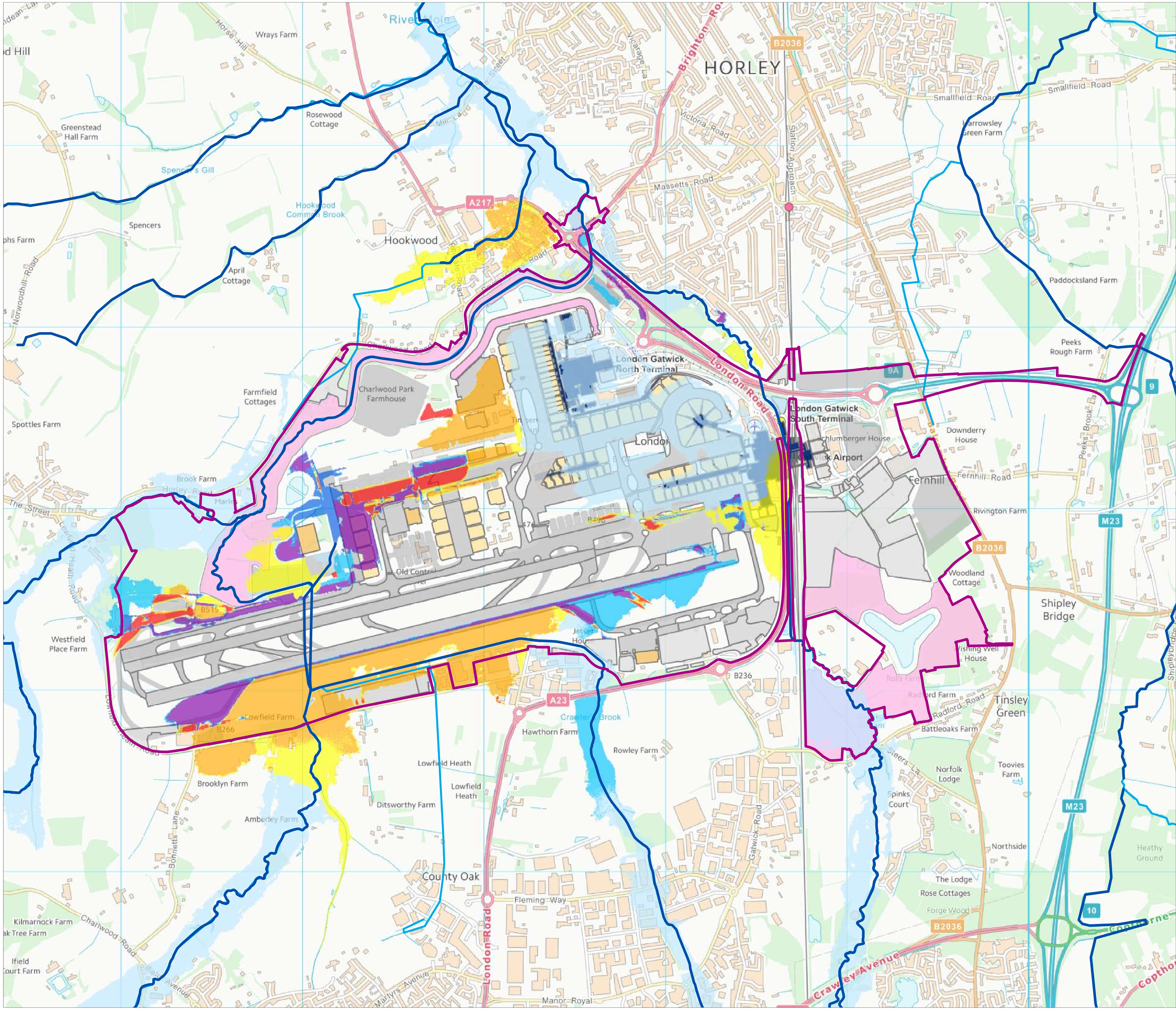
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 6.2.1	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Depth difference 1% (1 in 100) AEP event +70% CC

Depth (m)

- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Upper Mole Hydraulic Model 1% + 70%CC AEP Event Depth Difference to Baseline (With-Project,No-Mitigation Scenario)

DATE

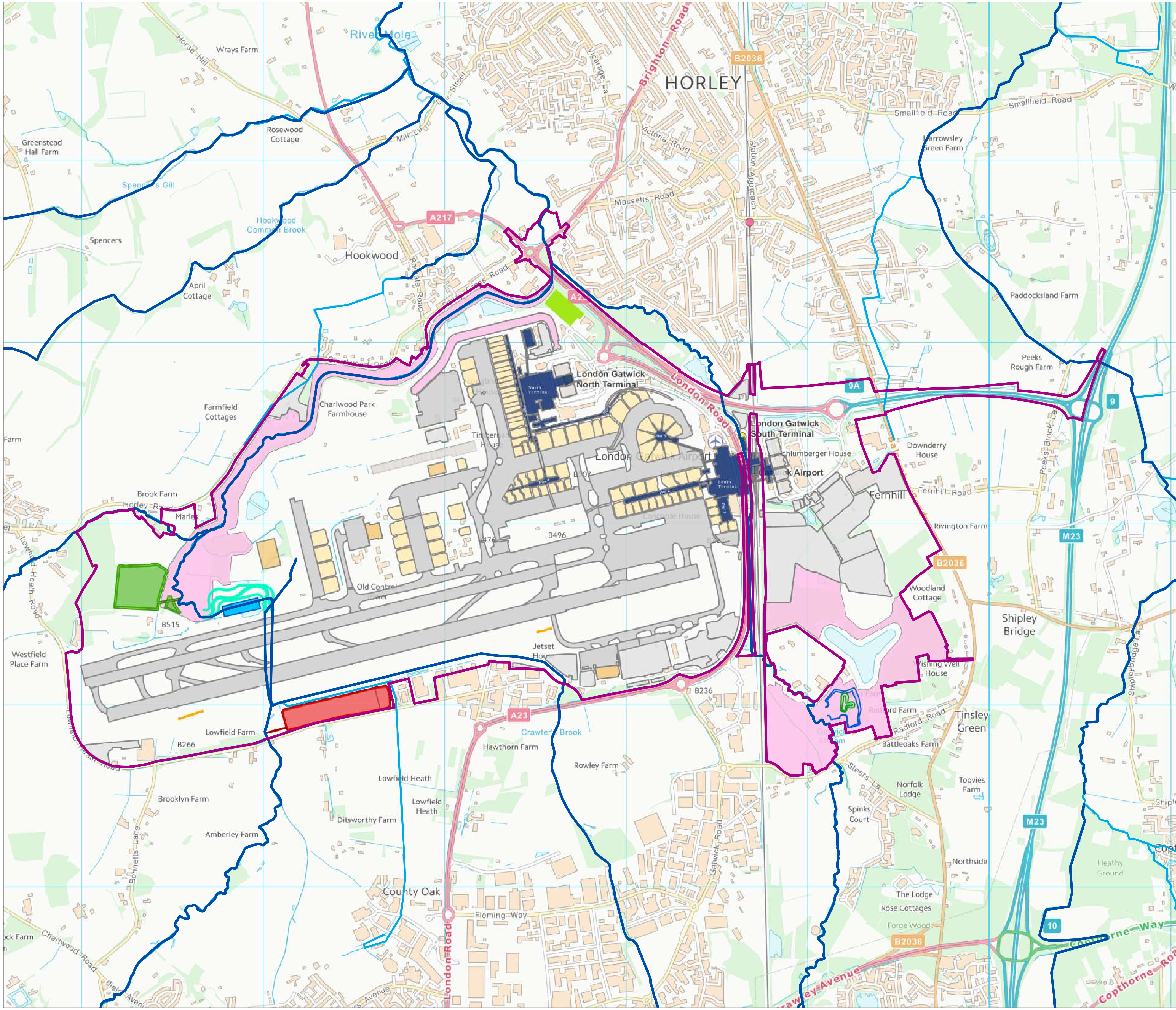
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 6.2.2	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Flood Mitigation Measures

- Gatwick Stream FCA
- Car Park X
- Car Park Y Underground Storage
- Museum Field
- Pond A Relocation
- River Mole Diversion
- Airfield Syphons

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

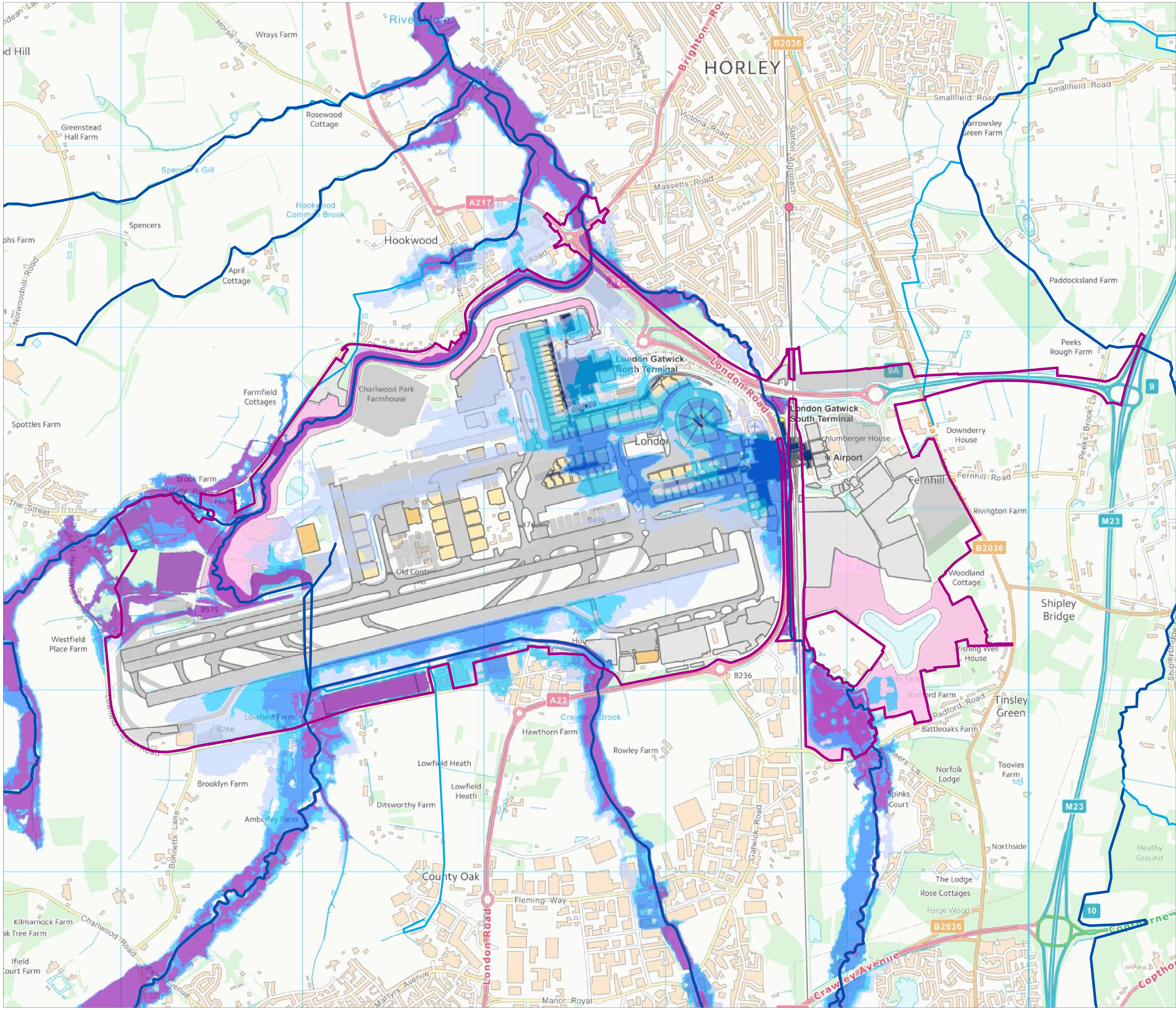
DRAWING TITLE
Proposed Flood Mitigation Measures

DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.2.1	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000
0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\Mitigation Measures.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- Upper Mole Model 5% AEP event
- Upper Mole Model 1% AEP event
- Upper Mole Model 1% + 35%CC AEP event
- Upper Mole Model 1% + 70%CC AEP event

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report
Appendix 11.9.1

DRAWING TITLE

Upper Mole Model 5%, 1%, 1%+35%CC, 1%+70%CC AEP Event Extents (With-Project, With-Mitigation)

DATE

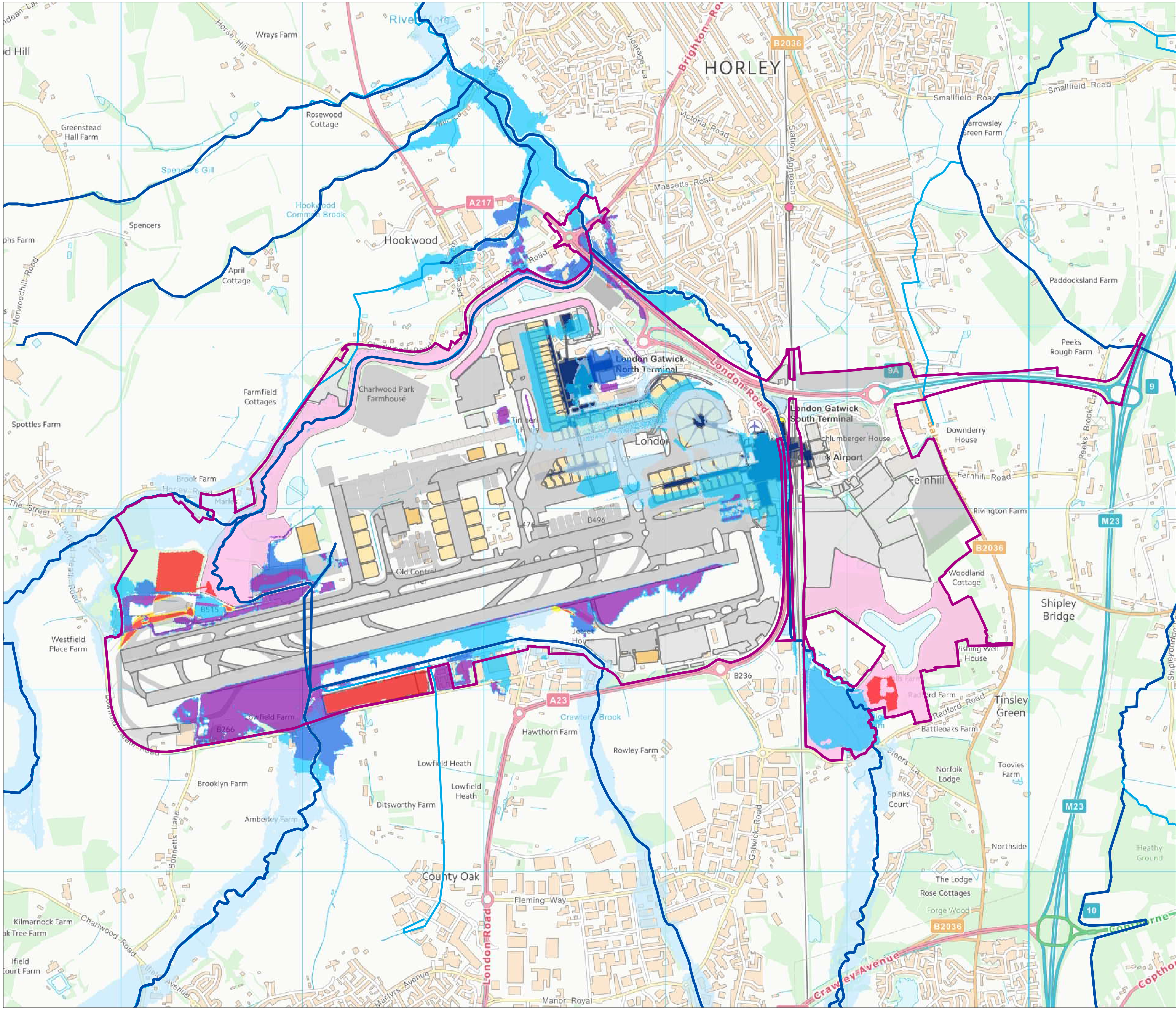
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.2.2	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY
- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Depth difference 1% (1 in 100) AEP event + 35% CC
- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements
- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements
- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Upper Mole Hydraulic Model 1% + 35%CC AEP Event Depth Difference to Baseline (With-Project,With-Mitigation Scenario)

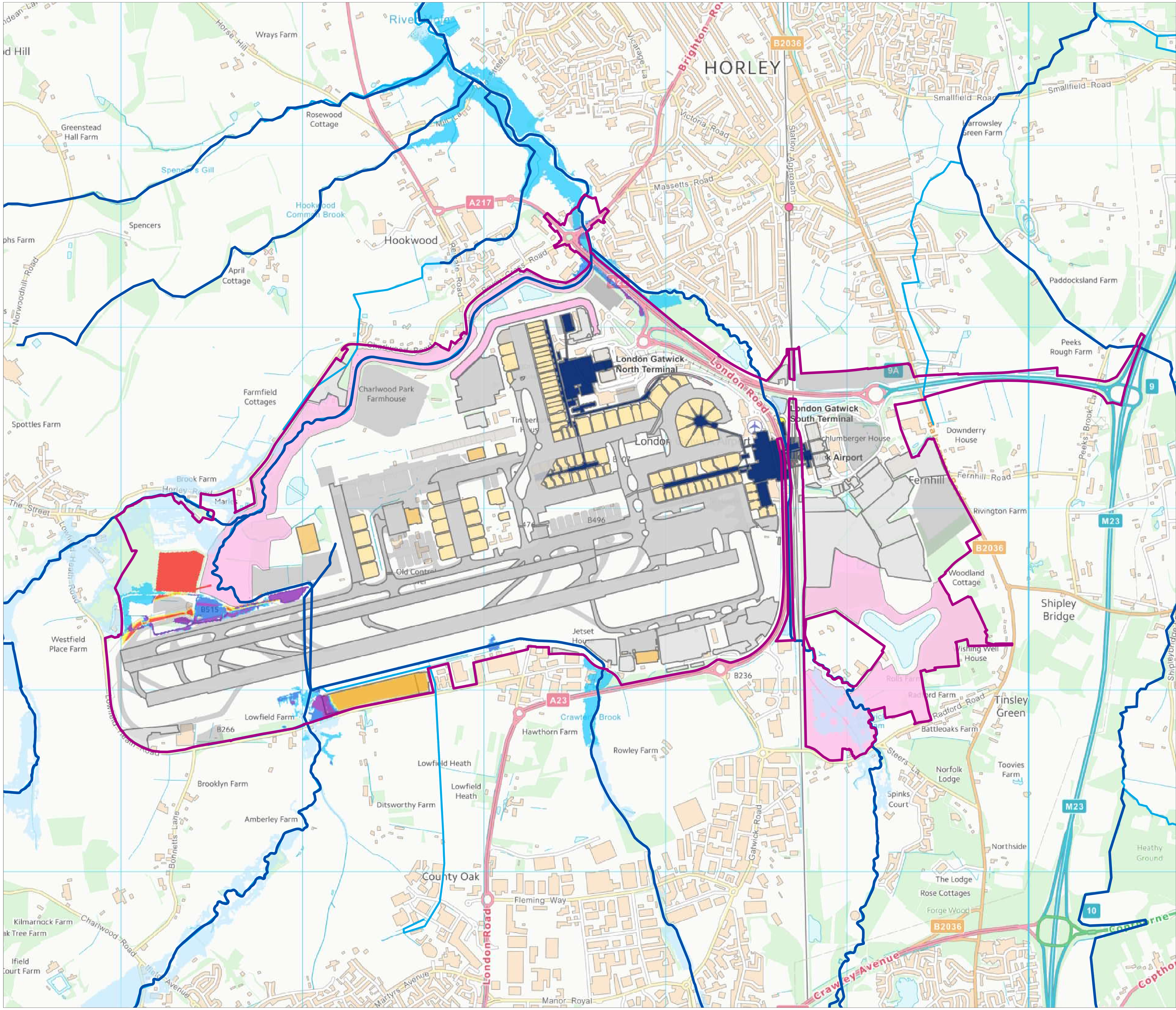
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.2.3	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

5% (1 in 20) AEP event Depth Difference

Depth (m)

- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Upper Mole Hydraulic Model 5% AEP Event Depth Difference to Baseline (With-Project, With-Mitigation Scenario)

DATE

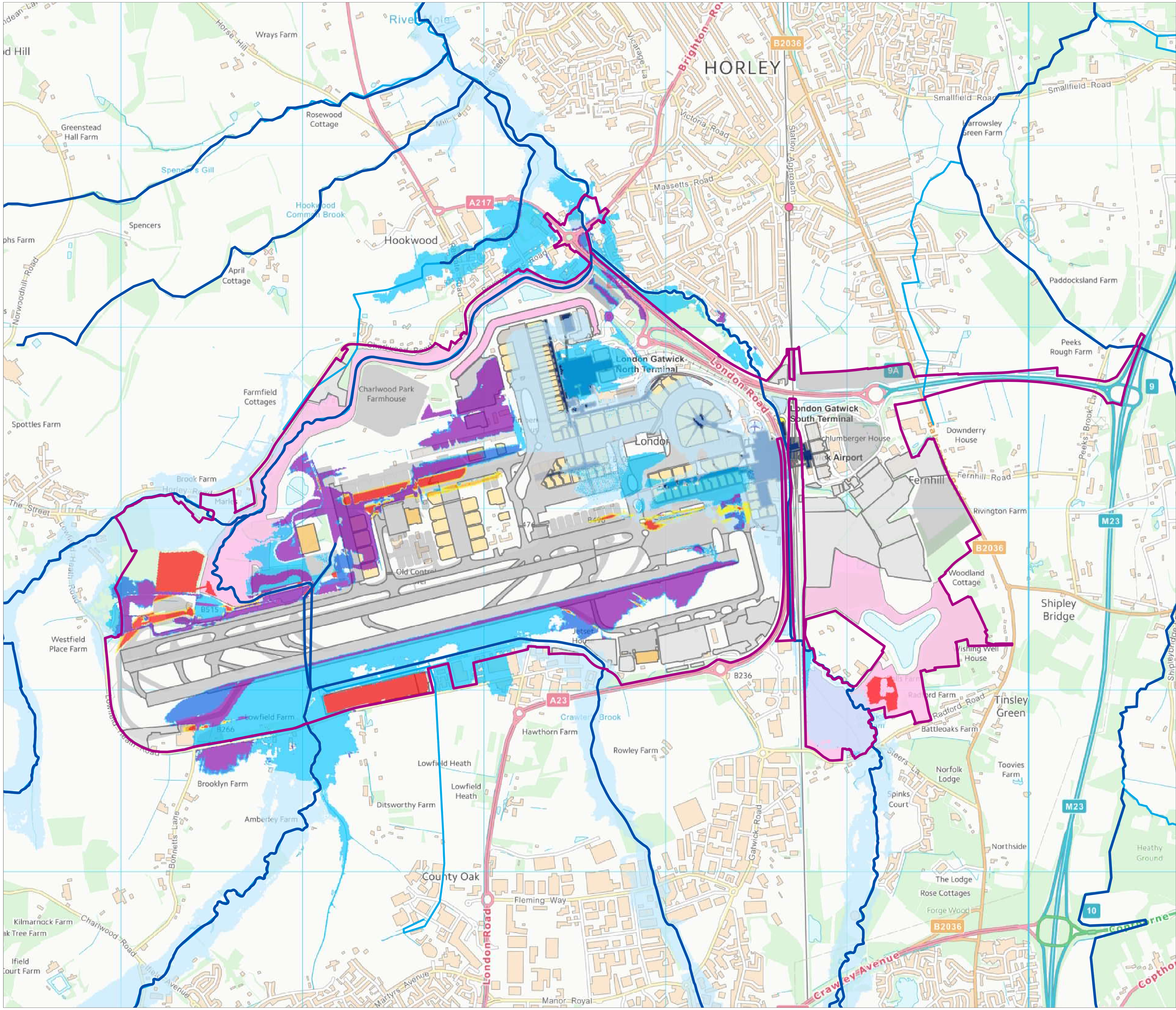
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.2.4	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

Project Site Boundary (PEIR)

Main Rivers

Ordinary Watercourses

Depth difference 1% (1 in 100) AEP event + 70% CC

Depth (m)

- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Upper Mole Hydraulic Model 1% + 70%CC AEP Event Depth Difference to Baseline (With-Project,With-Mitigation Scenario)

DATE

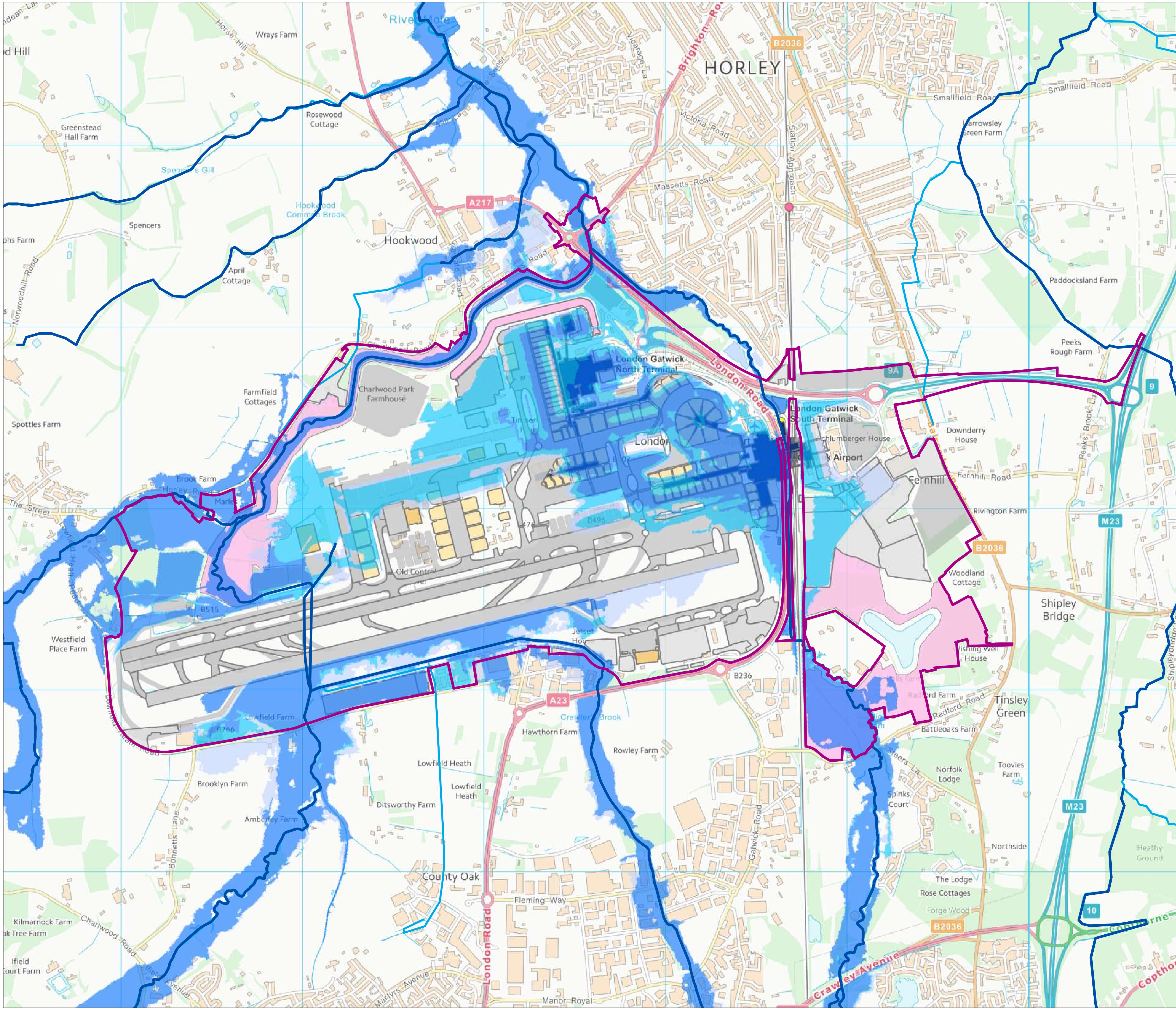
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.2.5	For PEIR Issue
	DRAWN BY: CW	PM / CHECKED BY: MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses
- Upper Mole Model 1% + 35%CC AEP event
- Upper Mole Model 1% + 35%CC AEP event (Undefended)
- Upper Mole Model 1% + 70%CC AEP event (Undefended)

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

Proposed Elements

- Proposed Elements

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Upper Mole Hydraulic Model 1% + 35%CC (With-Project,With-Mitigation Scenario) and 1%+35%CC and 1%+70%CC (With-Project, No-Mitigation Scenario) AEP Event Extents

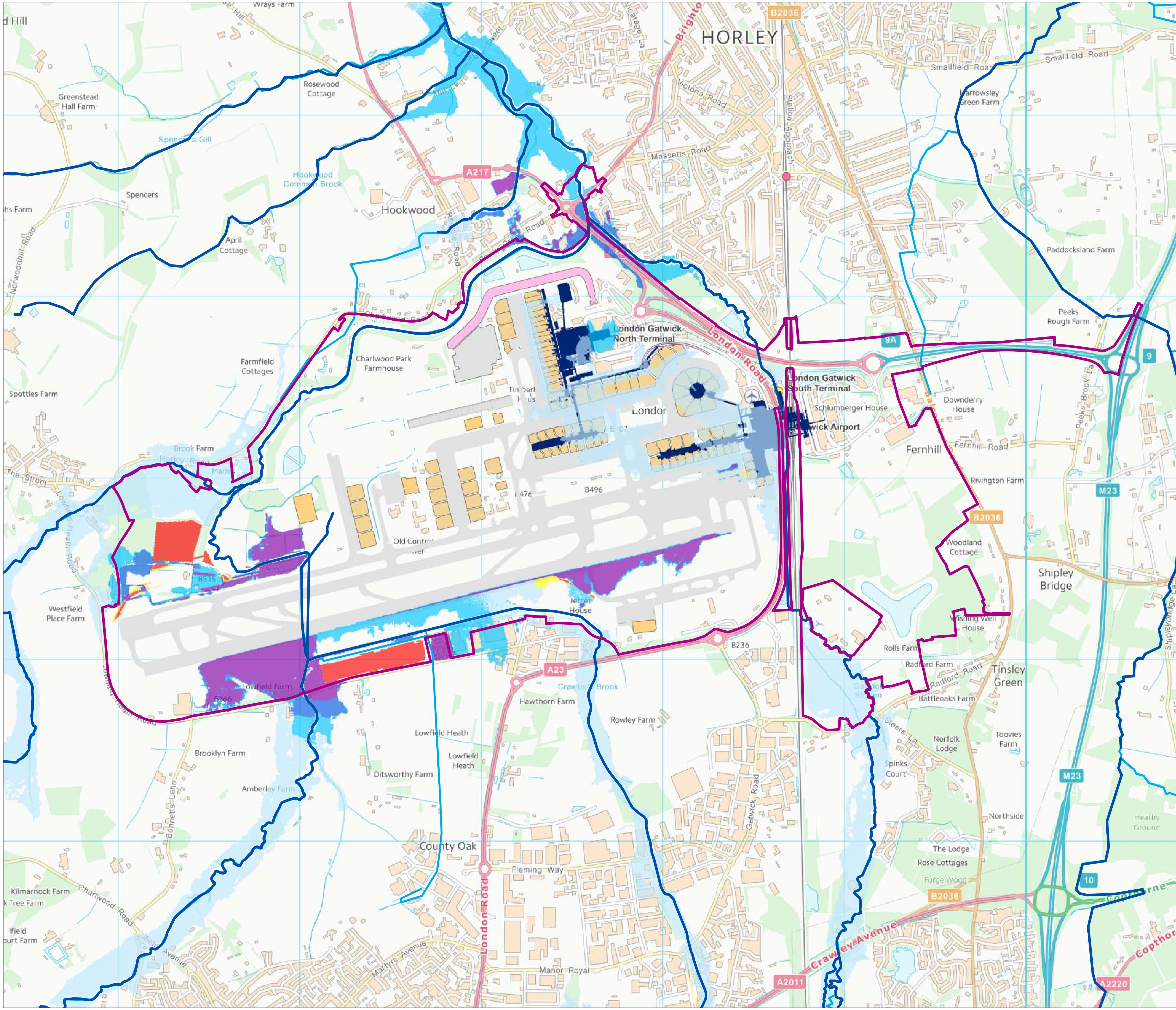
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.2.6	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA Figures V5.mxd



YOUR LONDON AIRPORT
Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Phase 1 and 2 (1% + 25%CC AEP Event Depth Difference to Baseline)

Depth (m)

- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE
Phase 1 and 2 (2024-2028) 1% + 25%CC AEP Event Depth Difference to Baseline

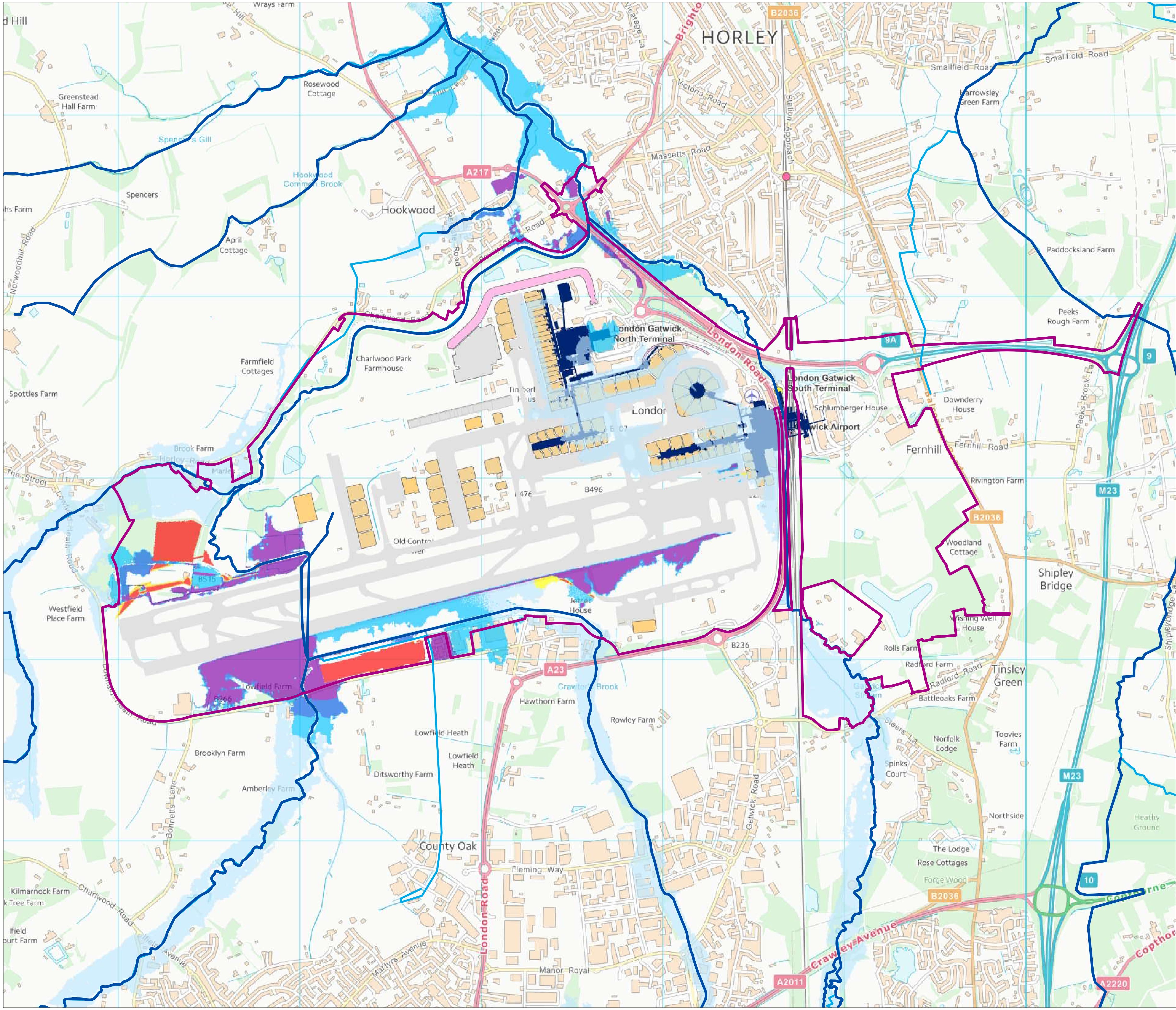
DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.4.1	For PEIR Issue
	DRAWN BY: CW	PM / CHECKED BY: MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA_Figures_Construction.mxd



YOUR LONDON AIRPORT Gatwick

KEY

- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Phase 3 (1% + 25%CC AEP Event Depth Difference to Baseline)

Depth (m)

- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements

- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

DOCUMENT

Preliminary Environmental Information Report Appendix 11.9.1

DRAWING TITLE

Phase 3 (2028-2032) 1% + 25%CC AEP Event Depth Difference to Baseline

DATE

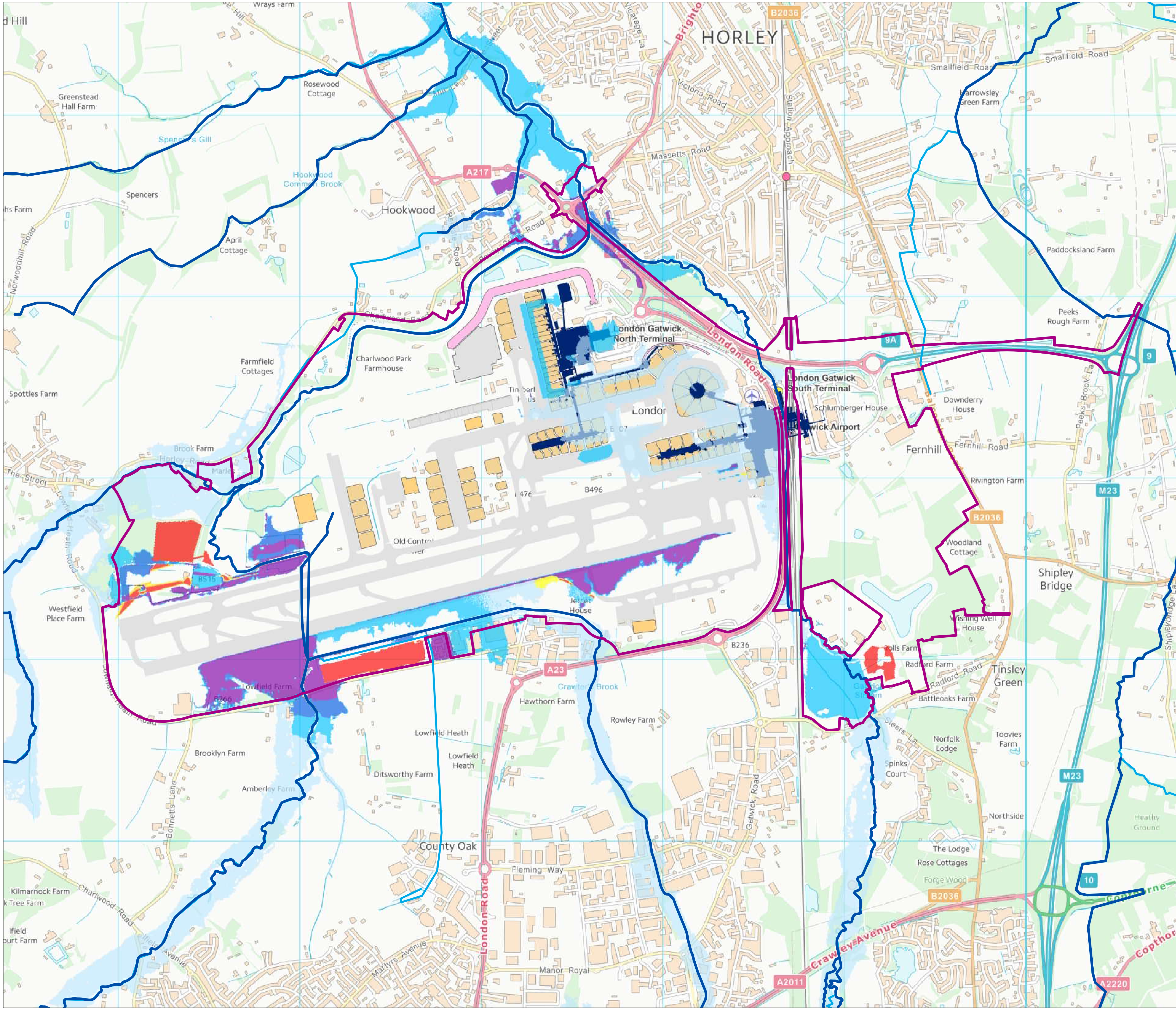
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.4.2	For PEIR Issue
	DRAWN BY	PM / CHECKED BY
	CW	MS

SCALE @ A3 1:20,000

0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA_Figures_Construction.mxd



YOUR LONDON AIRPORT
Gatwick

KEY
- Project Site Boundary (PEIR)
- Main Rivers
- Ordinary Watercourses

Phase 4 (1% + 25%CC AEP Event Depth Difference to Baseline)

Depth (m)
- -10 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01 Negligible
- 0.01 to 0.05
- 0.05 to 0.1
- >=0.1

Existing Elements
- Terminal
- Existing runway or taxiway
- Environmental Mitigation
- Existing stands
- Other existing airport infrastructure
- Hangar

DOCUMENT
Preliminary Environmental Information Report Appendix 11.9.1

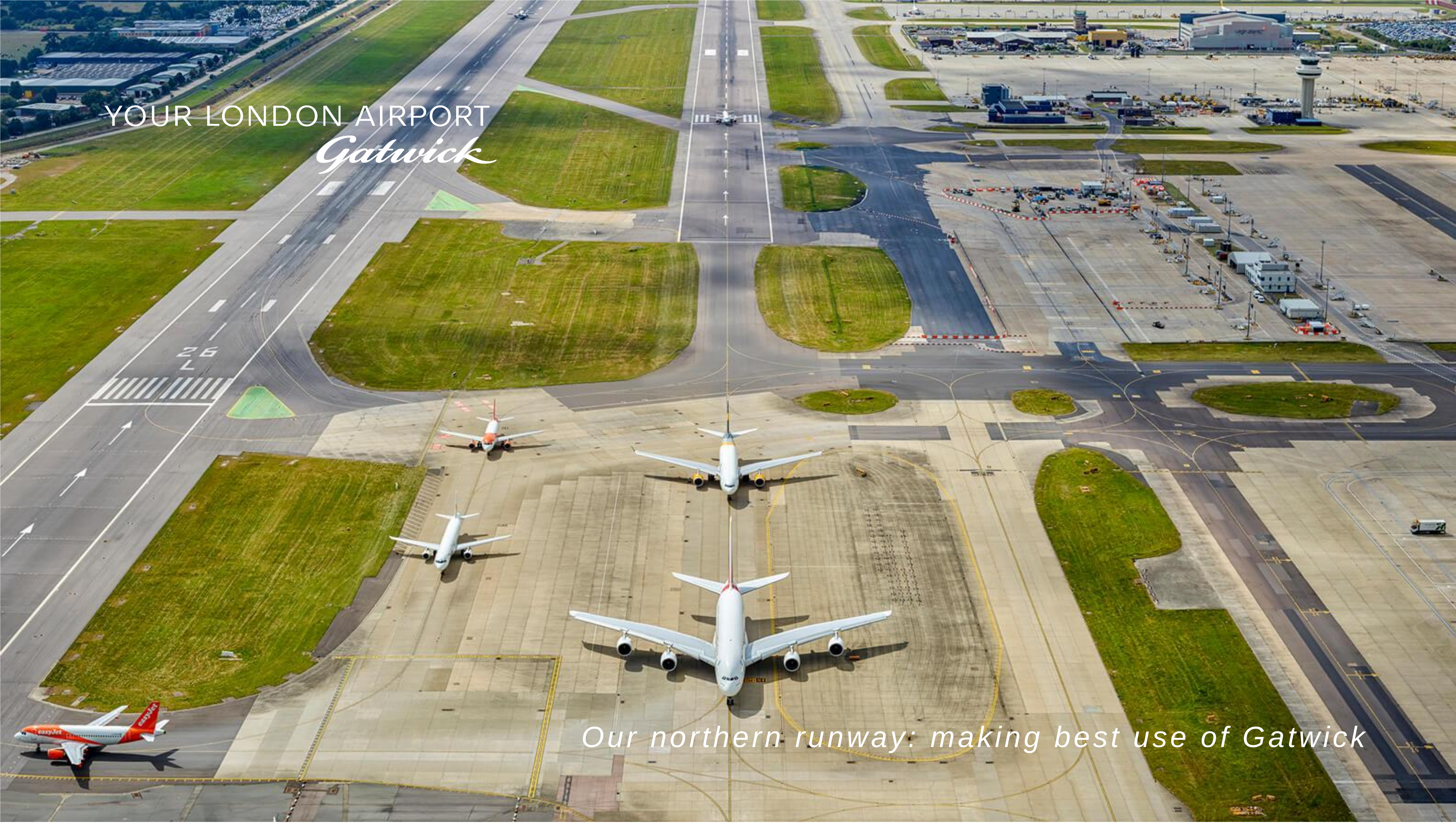
DRAWING TITLE
Phase 4 (2032-2038) 1% + 25%CC AEP Event Depth Difference to Baseline

DATE
September 2021

ORIENTATION	DRAWING NO.	REVISION
N	FIGURE 7.4.3	For PEIR Issue
	DRAWN BY: CW	PM / CHECKED BY: MS

SCALE @ A3 1:20,000
0 125 250 500 750 1,000 m

\\Uk-lon-fas02\projects\SSBU\GADD001A-Gatwick-EMR\@Projects\GALCTC25-Northern-Runway-Water\500 GIS\Figures\MXDs\FRA_Figures_Construction.mxd



Preliminary Environmental Information Report
Appendix 11.9.2: Water Environment Regulations Compliance Assessment

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This document forms Appendix 11.9.2 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description.

1.1.2 This document provides the Preliminary Water Environment (Water Framework Directive (WFD)) Regulations 2017 (WER) compliance Assessment for the Project.

1.2 Purpose of this Report

1.2.1 Compliance with the provisions of the WER legislation needs to be taken into account in the planning of all new activities in the water environment. The Environment Agency (EA), as competent authority in England must exercise its relevant functions so as to secure compliance with the Regulations (including determining any authorisation for an Environmental Permit or a licence to abstract or impound water), and so as best to secure the achievement of the following environmental objectives:

- measures should be put in place to prevent deterioration of the surface water status or groundwater status of a body of water (subject to the application of Regulations 18 and 19), and
- measures should otherwise support the achievement of the environmental objectives set for a body of water (subject to the application of Regulations 16 to 19).

1.2.2 Regulations 16 to 19 set out the conditions relevant to extended deadlines for environmental objectives (Reg16), setting less stringent environmental objectives (Reg17), natural causes of change (Reg18) and modifications to physical characteristics of water bodies (Reg19).

1.3 Background

1.3.1 All water bodies should meet good ecological status (GES) (or good ecological potential (GEP) if an artificial or heavily modified water body) by a set timeframe. Overall ecological status (or potential) is made up of a number of biological, hydromorphological and chemical quality characteristics called elements. The overall status is determined by the lowest element status.

1.3.2 Any activity which has the potential to have an impact on ecology will need consideration in terms of whether it could cause deterioration in the ecological status or potential of a water body. It is, therefore, necessary to consider the possible changes associated with the proposed options for the Scheme.

1.3.3 Where there are sites protected under transposed and adopted regulations, WER aims for compliance with any relevant standards or objectives for these sites. including the Urban Waste Water Treatment (England and Wales) Regulations 1994, the Nitrate Pollution Prevention Regulations 2017 or the Conservation of Habitats and Species Regulations 2019

1.3.4 For those water bodies that are not already in 'good' condition, specific mitigation measures have been set for each River Basin District (RBD) to achieve the environmental objectives of the WER. These measures are to mitigate impacts that have been or are being caused by human activity and to enhance and restore the quality of the existing environment. These mitigation measures will be delivered through the River Basin Management Plan (RBMP) which also identifies the different organisations responsible for their delivery.

1.4 Project Description

Key Components of the Project

1.4.1 The Project proposes alterations to the existing northern runway which, along with lifting the current restrictions on its use, would enable dual runway operations. Together with the alterations to the northern runway, the Project would include the development of a range of infrastructure and facilities to allow increased airport passenger and aircraft operations and to allow Gatwick Airport to make best use of its existing runways.

1.4.2 The Project would include alterations to the existing northern runway and corresponding enhancements to the taxiway system and parking stands to accommodate an increase in aircraft movements.

1.4.3 The Project includes the following key components, which are described in further detail in Chapter 5: Project Description of the PEIR:

- amendments to the existing northern runway including repositioning its centreline 12 metres further north to enable dual runway operations;
- reconfiguration of taxiways;
- pier and stand alterations (including a proposed new pier);
- reconfiguration of other airfield facilities;
- extensions to the existing airport terminals (north and south);
- provision of additional hotel and office space;
- provision of reconfigured car parking, including new car parks;
- surface access (including highway) improvements;
- reconfiguration of existing utilities, including surface water, foul drainage and power; and
- landscape/ecological planting and environmental mitigation.

2 Water Environment Regulations Assessment stages

2.1.1 The following discrete stages need to be followed to complete the assessment of the proposed development for its compliance with the Regulations:

- **Data collection:** identification of relevant water bodies potentially affected by the proposed development
- **Scoping:** identifies the receptors and water body elements that are potentially at risk from the proposed development and need impact assessment
- **Impact Assessment:** considers the potential impacts of the proposed development, identifies ways to avoid or minimise impacts, and indicates if the proposed development may cause deterioration or jeopardise the water body achieving GES or GEP.

3 Scoping

3.1 Waterbody Screening

3.1.1 Table 3.1.1 is a baseline summary of the surface water, and groundwater water bodies within the study area that have been screened into the assessment based on proximity to the Project and hydrological connectivity. Data have been extracted from Environment Agency Catchment Data Explorer (2019).

3.1.2 The WER waterbodies and watercourses of the Project are shown in Figure 3.1.1.

Table 3.1.1: General Water Features and Baseline (Rivers and Groundwater Bodies)

Water Body Code	Name of water body in RBMP	Hydro-morphological Designation	Current Status/ Potential (2019)	Objective/ Status Potential-	Linked Protected Areas
Surface Water Bodies within the Study Area					
GB106039017481	Mole upstream of Horley	Heavily Modified	Moderate	Good 2015	No data to show
GB106039017500	Tilgate Brook and Gatwick Stream	Heavily Modified	Moderate	Moderate 2015	River Mole UKENRI58 Urban Wastewater Treatment Regulations
GB106039017520	Burstow Stream	River – not designated artificial or heavily modified	Bad	Poor 2027	Medway at Weir Wood NVZ S488 and Eden Brook East of Lingfield NVZ S487 Nitrates Regulations
GB106039017621	Mole (Horley to Hersham)	River – not designated artificial or heavily modified	Moderate	Moderate 2015	Wandle (Croydon to Wandsworth) and the R. Gravney NVZ S464, Hogsmill NVZ S450 and Law Brook S679 Nitrates Regulations. River Mole Urban Wastewater Treatment Regulations. Mole Gap to Reigate Escarpment Habitats Regulations
Groundwater Bodies within the Study Area					
GB40602G602400	Copthorne Tunbridge Wells Sands	N/A	Good	Good 2015	Drinking Water Protected Area
Upstream water bodies (upstream of those in the study area)					
GB106039017450	Stanford Brook	River – not designated artificial or heavily modified	Moderate	Good 2027	River Arun (u/s Pallingham) NVZ S523 Nitrates Regulations
Downstream water bodies					

Water Body Code	Name of water body in RBMP	Hydro-morphological Designation	Current Status/ Potential (2019)	Objective/ Status Potential-	Linked Protected Areas
GB106039017622	Mole Hersham to River Thames confluence at East Molesey	River – heavily modified	Moderate	Moderate 2015	No data to show

3.1.3 Table 3.1.2 includes a summary of relevant biological and hydromorphological elements for the water bodies within the study area. This information is carried forward in the assessment tables presented in Section 2 (Step 2).

Table 3.1.2: Biological and Supporting Elements for Water Bodies

Element	Current Status 2019	Overall status objective	Reasons for not achieving good status and reasons for deterioration
Surface Water Bodies			
Mole Upstream of Horley (includes Man's Brook, Withy Brook and Crawter's Brook)			
Ecological	Moderate	Good (2015)	No data available on Catchment Data Explorer
Biological quality element	Good	Good (2015)	
Hydromorphological Supporting Elements	Supports Good	Supports Good (2015)	
Physico-chemical quality elements	Moderate	Not assessed (2015)	
Specific pollutants	High	Not assessed (2015)	
Chemical	Fail	Good (2015)	
Tilgate Brook and Gatwick Stream at Crawley (includes Gatwick Stream)			
Ecological	Moderate	Moderate (2015)	▪ Physical modification, Flood protection - structures, Local and Central Government, Fish ▪ Point source, Sewage discharge (continuous), Water Industry, Fish ▪ Point source, Sewage discharge (continuous), Water Industry, Invertebrates ▪ Diffuse source, Urbanisation - urban development, Urban and transport, Invertebrates ▪ Diffuse source, Urbanisation - urban development, Urban and transport, Phosphate ▪ Diffuse source, Transport Drainage, Urban and transport, Invertebrates ▪ Diffuse source, Transport Drainage, Urban and transport, Fish ▪ Physical modification, Other (not in list, must add details in comments), Recreation, Mitigation Measures Assessment ▪ Physical modification, Other (not in list, must add details in comments), Urban and transport, Mitigation Measures Assessment ▪ Physical modification, Other (not in list, must add details in comments), Local and Central Government, Mitigation Measures Assessment ▪ Invasive non-native species, North American signal crayfish, No sector responsible, Fish ▪ Physical modification, Barriers - ecological discontinuity, Urban and transport, Fish ▪ Physical modification, Urbanisation - transport, Urban and transport, Fish ▪ Point source, Sewage discharge (continuous), Water Industry, Phosphate ▪ Physical modification, Urbanisation - transport, Urban and transport, Invertebrates ▪ Invasive non-native species, North American signal crayfish, No sector responsible, Invertebrates
Biological quality element	Bad	Moderate (2027)	
Hydromorphological Supporting Elements	Supports Good	Supports Good (2015)	
Physico-chemical quality elements	Good	Moderate (2015)	
Specific pollutants	High	High (2015)	
Chemical	Fail	Good (2015)	

Element	Current Status 2019	Overall status objective	Reasons for not achieving good status and reasons for deterioration
Burstow Stream (includes Burstow Stream and Burstow Stream Tributary)			
Ecological	Bad	Poor (2027)	▪ Physical modification, Barriers - ecological discontinuity, Domestic General Public, Fish ▪ Physical modification, Land drainage - operational management, Agriculture and rural land management, Fish ▪ Physical modification, Barriers - ecological discontinuity, Urban and transport, Fish ▪ Flow, Low Flow (not drought), No sector responsible, Invertebrates ▪ Physical modification, Urbanisation - urban development, Urban and transport, Fish ▪ Diffuse source, Riparian/in-river activities (inc. bankside erosion), Agriculture and rural land management, Invertebrates ▪ Point source, Sewage discharge (continuous), Water Industry, Fish ▪ Flow, Low Flow (not drought), No sector responsible, Fish ▪ Point source, Sewage discharge (continuous), Water Industry, Invertebrates ▪ Physical modification, Land drainage - operational management, Agriculture and rural land management, Invertebrates ▪ Physical modification, Barriers - ecological discontinuity, Other, Fish ▪ Physical modification, Land drainage - operational management, Agriculture and rural land management, Fish ▪ Physical modification, Reservoir / Impoundment - non flow related, Other, Invertebrates ▪ Flow, Low Flow (not drought), No sector responsible, Phosphate ▪ Point source, Sewage discharge (continuous), Water Industry, Phosphate ▪ Point source, Sewage discharge (intermittent), Water Industry, Phosphate ▪ Point source, Sewage discharge (intermittent), Water Industry, Macrophytes and Phytobenthos Combined ▪ Flow, Low Flow (not drought), No sector responsible, Macrophytes and Phytobenthos Combined ▪ Point source, Sewage discharge (continuous), Water Industry, Macrophytes and Phytobenthos Combined ▪ Invasive non-native species, North American signal crayfish, No sector responsible, Invertebrates
Biological quality element	Bad	Poor (2027)	
Hydromorphological Supporting Elements	Supports Good	Supports Good (2015)	
Physico-chemical quality elements	Moderate	Moderate (2015)	
Specific pollutants	High	Not assessed (2015)	
Chemical	Fail	Good (2015)	
Mole (Horley to Hersham) (includes River Mole and Withy Brook)			
Ecological	Moderate	Moderate (2015)	▪ Diffuse source, Poor nutrient management, Agriculture and rural land management, Phosphate ▪ Point source, Sewage discharge (continuous), Water Industry, Phosphate ▪ Point source, Sewage discharge (intermittent), Water Industry, Macrophytes and Phytobenthos Combined ▪ Diffuse source, Poor nutrient management, Agriculture and rural land management, Macrophytes and Phytobenthos Combined ▪ Point source, Sewage discharge (intermittent), Water Industry, Phosphate ▪ Point source, Sewage discharge (continuous), Water Industry, Invertebrates ▪ Point source, Sewage discharge (intermittent), Water Industry, Invertebrates ▪ Point source, Sewage discharge (continuous), Water Industry, Macrophytes and Phytobenthos Combined
Biological quality element	Moderate	Moderate (2015)	
Hydromorphological Supporting Elements	Supports Good	Supports Good (2015)	
Physico-chemical quality elements	Moderate	Moderate (2015)	
Specific pollutants	High	High (2015)	
Chemical	Fail	Good (2015)	

Element	Current Status 2019	Overall status objective	Reasons for not achieving good status and reasons for deterioration
			▪ Diffuse source, Poor Livestock Management, Agriculture and rural land management, Macrophytes and Phytobenthos Combined ▪ Diffuse source, Poor soil management, Agriculture and rural land management, Macrophytes and Phytobenthos Combined ▪ Point source, Private Sewage Treatment, Domestic General Public, Macrophytes and Phytobenthos Combined ▪ Diffuse source, Poor soil management, Agriculture and rural land management, Phosphate ▪ Diffuse source, Poor Livestock Management, Agriculture and rural land management, Phosphate ▪ Invasive non-native species, North American signal crayfish, No sector responsible, Invertebrates ▪ Point source, Private Sewage Treatment, Domestic General Public, Phosphate
Groundwater Bodies within the Study Area			
Copthorne Tunbridge Wells Sands			
Quantitative	Good	Good (2015)	N/A
Quantitative – saline intrusion	Good	Good (2015)	N/A
Quantitive water balance	Good	Good (2015)	N/A
Quantitative – GWDTE	Good	Good (2015)	N/A
Quantitative – dependent surface water body	Good	Good (2015)	N/A
Chemical	Good	Good (2015)	N/A
Chemical– saline intrusion	Good	Good (2015)	N/A
Chemical – water balance	Good	Good (2015)	N/A
Chemical – GWDTE	Good	Good (2015)	N/A
Chemical– dependent surface water body	Good	Good (2015)	N/A

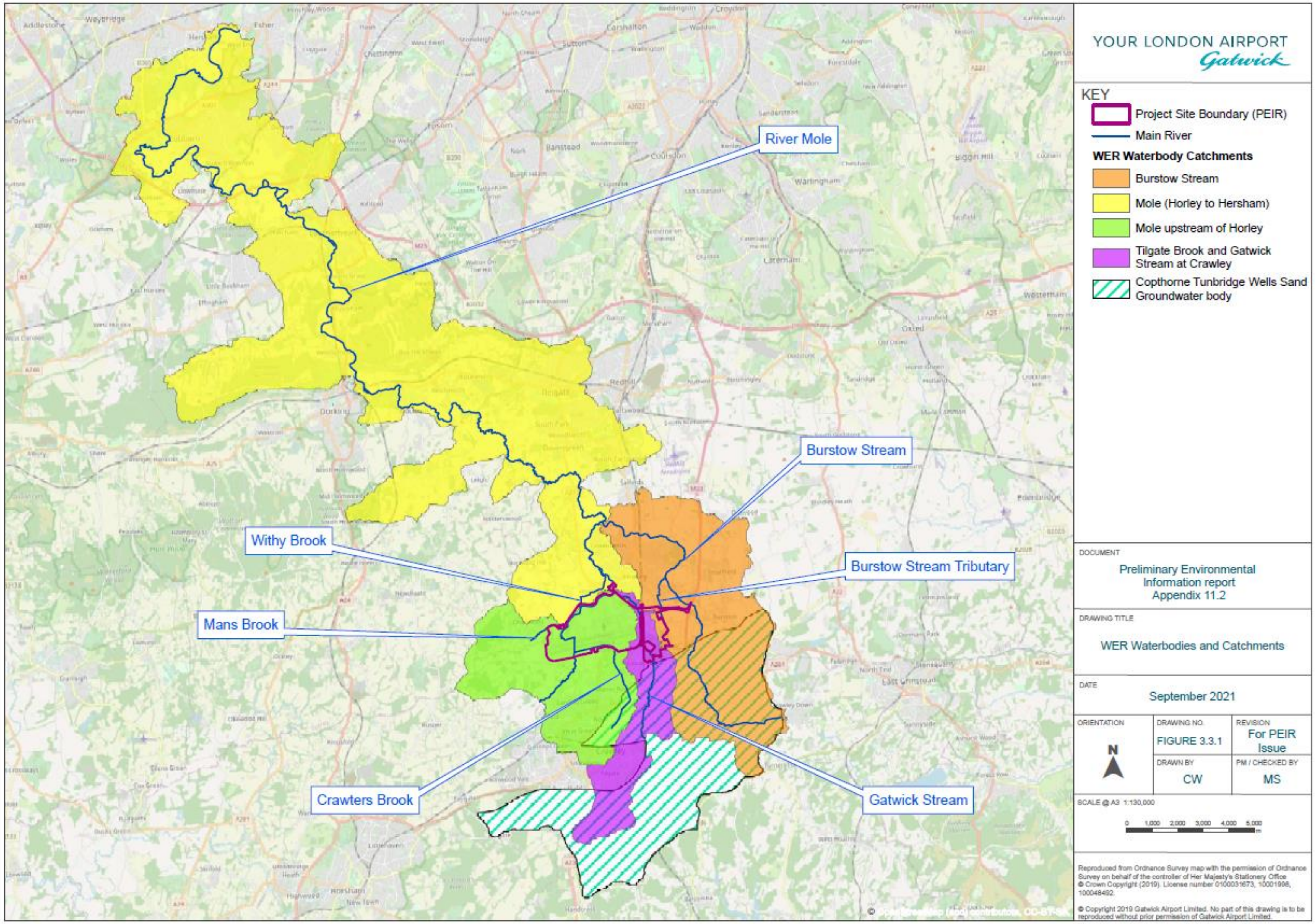


Figure 3.1.1: WER Waterbodies

3.2 Screening of Project Components

3.2.1 The elements of the Project are detailed in Section 5.2.3 of the Project Description (PEIR Chapter 5).

3.2.2 The following scheme components would need to be assessed:

- Increase in impermeable area
- Outfalls
- Earthworks
- Culverting
- Works within the floodplain

3.3 Scoping of Water Body Elements

3.3.1 Table 3.3.1 summarises the quality elements scoped into further assessment for surface water bodies, due to the possibility of the Project to impact on them. Table 3.3.2 summarises the quality elements scoped into further assessment for groundwater bodies, due to the possibility of the Project to impact on them.

Table 3.3.1: Surface water body elements for further consideration

Element	Scoped in or out
Fish	In
Benthic invertebrates	In
Macrophytes and phytobenthos combined	In
Thermal conditions	In
Oxygenation conditions	In
Acidification status	Out (no external environmental parameters to promote acidification)
Nutrient conditions	In
Connection to groundwater	In
Quantity and Dynamics of Flow	In
River Continuity	In
River depth and width variation	In
Structure and substrate of the river bed	In
Riparian zone	In
Chemical elements and Specific pollutants	In
Invasive Non-Native Species (INNS)	In
Protected areas	In

Table 3.3.2: Ground water body elements for further consideration

Element	Scoped in or out
Groundwater dependent terrestrial ecosystems	Out (no Groundwater dependent terrestrial ecosystems)
Saline intrusion	Out (no saline source)
Water balance	Out (no scheme interaction with water balance)
Surface water	In
Qualitative Elements	
Drinking Water Protected Area	In
Groundwater dependent terrestrial ecosystems	Out (no Groundwater dependent terrestrial ecosystems)
Saline intrusion	Out (no saline source)
Surface water	In
General quality	Out (no scheme interaction with water quality)

4 Impact Assessment

4.1 Assessment

4.1.1 The impact assessment is undertaken in Table 4.1.1 for surface water during construction and in 4.1.2 for surface water during operation and 4.1.3 for groundwater during construction and operation. The impact is for before mitigation. The table includes the possible ways to mitigate the impact to reduce the impact to negligible.

Table 4.1.1: Comparison of project against status objectives and elements for surface water bodies during construction

Key to Impact							
Negative		Negligible		Positive		No change	

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
Amendments to the existing northern runway including repositioning its centreline 12 metres further north to enable dual runway operations	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish fauna	Construction impacts to water quality and therefore macrophytes, invertebrates and phytobenthos (if present in the water body). Potential increase in runoff; potential increase in suspended sediments and fines due to runway works and disturbance to substrate downstream of site, however limited potential for fine sediment to enter the River Mole (Mole upstream of Horley water body) on site as it flows under the runway. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. Code of Construction Practice (CoCP), application of relevant guidance, and Environmental Action Plan (EAP) to provide mitigation. Require survey data to account for species quantity and quality to fully account for implications to biological elements.
	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Structure of the riparian zone	Change to substrate in riparian zone – most likely to be made ground so no impact on riverine sediments. Potential contaminated ground under runway, however. Construction impacts on the hydrological regime, including quantity and dynamics of flow due to changes in substrate – discharge to gravity to River Mole only. However, there will be no significant impact at water body scale or to other water bodies outside of airport boundary and no discernible pathway to these as receptors. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation for de-icer pollutant risk.
	Chemical and physico-chemical elements supporting the biological elements: Oxygenation conditions Nutrient conditions	Water quality: Pollution is likely to be dust, increased suspended sediment concentrations from runoff and from plant machinery. Pollutants are more than likely to be intercepted via the drainage system and discharged away from the surface water bodies. If they are washed into the River Mole, impacts are likely to be temporary and localised. There is no direct entry as the river flows under the runway. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation for de-icer pollutant risk.
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Potential contaminated ground under the runways which could release contaminants into the River Mole. Wash out into the River Mole could release sediment and soil, presenting a temporary but localised risk to overall water quality conditions. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation for de-icer pollutant risk.
Reconfiguration of taxiways	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish fauna	Construction impacts to water quality and therefore macrophytes, invertebrates and phytobenthos (if present in the water body). Potential increase in runoff; potential increase in suspended sediments and fines due to runway works and disturbance to substrate downstream of site, however limited potential for fine sediment to enter the River Mole (Mole upstream of Horley water body) on site as it flows under the runway. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. Code of Construction Practice (CoCP), application of relevant guidance, and Environmental Action Plan (EAP) to provide mitigation. Require survey data to account for species quantity and quality to fully account for implications to biological elements.
	Hydromorphological elements supporting the biological elements	Change to substrate in riparian zone – most likely to be made ground so no impact on riverine sediments. Potential contaminated ground under runway, however.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
	Hydrological regime Quantity and dynamics of water flow Structure of the riparian zone	Construction impacts on the hydrological regime, including quantity and dynamics of flow due to changes in substrate – discharge to gravity to River Mole only. However, there will be no significant impact at water body scale or to other water bodies outside of airport boundary and no discernible pathway to these as receptors. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation for de-icer pollutant risk.
	Chemical and physico-chemical elements supporting the biological elements: Oxygenation conditions Nutrient conditions	Water quality: Pollution is likely to be dust, increased suspended sediment concentrations from runoff and from plant machinery. Pollutants are more than likely to be intercepted via the drainage system and discharged away from the surface water bodies. If they are washed into the River Mole, impacts are likely to be temporary and localised. There is no direct entry as the river flows under the runway. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation for de-icer pollutant risk.
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Potential contaminated ground under the runways which could release contaminants into the River Mole. Wash out into the River Mole could release sediment and soil, presenting a temporary but localised risk to overall water quality conditions. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation for de-icer pollutant risk.
Pier and stand alterations (including a proposed new pier)	Biological elements: Invertebrates Fish	Construction impacts to water quality: Potential increase in runoff; potential increase in suspended sediments and fines due to works and disturbance to substrate, and potential for fines to enter the River Mole via drainage at high flows. Fines likely to settle in the margins and subsequently be colonised by macrophytes during lower flows and be re-suspended during higher flows. This could disturb benthic invertebrates and fish temporarily. However, distance of the works from River Mole and its situation under the runway would make this unlikely.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation. Require survey data to account for species quantity and quality to fully account for implications to biological elements. Require more information (to be done as part of ES) for corroboration of this.
	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Structure of the riparian zone	Construction impacts to the hydrological regime due to changes in substrate would be negligible as the discharge would be under gravity to the River Mole only. Overall, there would be no significant impact at water body scale or to other water bodies outside of airport boundary and no discernible pathway to these as receptors. Change to substrate in riparian zone – the substrate is most likely to be made ground but the riparian zone is already developed, so no overall change from present conditions. Potential contaminated ground on site, however which may need to be remediated. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Potential contaminated ground which could release contaminants into the watercourse (River Mole) during construction. Wash out into the Mole could release sediment and soil, presenting a temporary but localised risk to overall water quality conditions. However, distance of works from the River Mole would make this unlikely.	CoCP, application of relevant guidance, and EAP to provide mitigation.
Reconfiguration of other airfield facilities	Biological elements: Macrophytes and phytobenthos	Construction impacts to biological elements due to water quality: Potential increase in runoff; potential increase in suspended sediments and fines due to works and disturbance to	CoCP, application of relevant guidance, and EAP to provide mitigation.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
	Benthic invertebrate fauna	substrate, and potential for fines to enter the River Mole via drainage. Fines likely to settle in margins and subsequently be colonised by macrophytes during lower flows and be re-suspended during higher flows. This could disturb benthic invertebrates and fish temporarily. However, distance of works from the River Mole would make the impact of this negligible.	Require survey data to account for species quantity and quality.
	Hydromorphological elements supporting the biological elements Structure of the riparian zone	Change to substrate in riparian zone – most likely to be made ground but riparian zone is already developed, so no overall change from present conditions. Potential contaminated ground on site, however which may need to be remediated. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Construction impacts to water quality: Potential increase in runoff; potential increase in suspended sediments and fines due to runway works and disturbance to substrate, and potential for fines to enter the River Mole. However, distance of works from River Mole would make this unlikely.	CoCP, application of relevant guidance, and EAP to provide mitigation.
Provision of reconfigured car parking, including new car parks	Hydromorphological elements supporting the biological elements Structure of the riparian zone	Potential disturbance/loss of riparian zones under footprint of internal routes. As this is unlikely to be large swathes of floodplain, impact is likely to be negligible, and therefore not causing deterioration to the status of the relevant water bodies within the Project's boundary.	N/A
Surface access (including highway) improvements. including: South Terminal roundabout works. Earthworks would support the approach to the bridge and reinforced earth-walls or retaining walls would be required between the Brighton-London mainline railway and slip roads North Terminal roundabout Replace the existing roundabout with a signalised junction arrangement	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish fauna	Working within or close to the channel (including Gatwick Stream, Burstow Stream) could release large volumes of sediment and soil, presenting a temporary but localised risk to species within the channel during works. Risks could include smothering, loss of habitat and burial. Potential loss or relocation of some species under footprint of retaining walls and earthworks. Disturbance to fish species within the river at this point, which could include temporary interruption to any migration (if occurring), potential for disturbance or loss of species over a localised and temporary event. Disturbance could be due to noise of construction, movement of substrate within or adjacent to channel or installation of structures within or adjacent to the channel. Overall impact likely to be negligible. Sediment could be remobilised during works with potential for smothering downstream channel bed features or in-channel habitat (localised and temporary sediment remobilisation so impact limited). Installation of cofferdam should mitigate this. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation. Impact to species quality and quantity to be determined at the ES stage following results from fish surveys and other ecological surveys. Avoid spawning periods for working in the river.
Longbridge roundabout – expanded northwards and eastwards into flood zone, extended crossing of Mole on Barcombe Road	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Structure and substrate of the river bed Structure of the riparian zone	Removal/change to subsurface drainage systems as a result of earth works will loosen substrate in localised area, temporarily affecting porosity, cohesion, pore water and integrity of surface therefore potentially affecting the structure of the riparian zone. An increase in the length of the concrete lined channel further reduces the potential for naturalisation in Burstow Stream. Loss of riparian zone and structure under footprint of any newly created areas as part of the Project. Potential increase in loose non-cohesive material as works being excavated, and potential disturbance to substrate adjacent to the road works and the Burstow stream works.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
		However, this is short-term, temporary and localised. Overall, this is unlikely to cause a change in water body status.	
		Potential change to structure of channel substrate due to construction in the Burstow Stream. Changes in variability of flow will lead to increased sediment variability. Aggregation of fines (potential for) in slacker areas of water.	
		Potential disturbance/loss of riparian zones under footprint of internal routes. As this is unlikely to be large swathes of floodplain, the impact is likely to be negligible, and therefore not causing deterioration to the status of the relevant water bodies within the Project's boundary. Substrate most likely to be made ground but riparian zone is already developed, so no overall change from present conditions. Potential contaminated ground on site.	Limit journeys with plant on ground to avoid tracking repetitively on softer verges; provision of matting; utilisation of pollution prevention guidelines. CoCP, application of relevant guidance, and EAP to provide mitigation.
	Chemical and physico-chemical elements supporting the biological elements Oxygenation conditions Nutrient conditions	As these water bodies are connected via drainage capture and ditches, there could be a potential temporary increase in localised suspended sediment concentrations and therefore deterioration in water quality but not substantially greater than present background conditions. Fines likely to settle in margins and be re-suspended during higher flows. There will be no overall change in water body status.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
	Specific pollutants Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Working within or close to the channel (including Gatwick Stream, Burstow Stream and balancing ponds close to M23) could release large volumes of sediment and soil, presenting a temporary but localised risk to species within the channel during works. As these water bodies are connected via drainage capture and ditches, there could be a potential temporary increase in localised suspended sediment concentrations but not substantially greater than present background conditions. Fines likely to settle in margins and be re-suspended during higher flows. There will be no overall change in water body status	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
Reconfiguration of existing utilities, including surface water, foul drainage and power. Including: Works to realign existing surface water drainage infrastructure along Taxiway Yankee, providing a connection to Pond D Creation of an additional runoff treatment and storage area (including runoff from deicing areas) to complement the existing	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish	No change to Pond D as a result of works. Potential improvement to River Mole water quality as drainage is improved.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Working within or close to Pond D could release large volumes of sediment and soil, presenting a temporary but localised risk to species within the channel during works. Pond D is not a surface water body.	
		Underground works likely to involve excavation and piling. Disturbance to any species located in soils (if any). Fines likely to settle in margins and subsequently be colonised by macrophytes during lower flows and be re-suspended during higher flows if they are entrained across the surface to the Mole. This could disturb benthic invertebrates and fish temporarily. However, distance of works from River Mole would make this unlikely. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
		Potential contaminated ground under the original Pond A, which could release contaminants into the watercourse (River Mole) during construction. Wash out into the River Mole could release sediment and soil, presenting a temporary but localised risk to overall water quality conditions. However, distance of works from River Mole would make this unlikely.	CoCP, application of relevant guidance, and EAP to provide mitigation.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
capacity provided by Pond D. Relocation of Pond A	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Morphological conditions River depth and width variation Structure and substrate of the river bed Structure of the riparian zone	Potential disturbance/loss of riparian zones under footprint of drainage routes. Impact is only likely to be negligible, and therefore not causing deterioration to the status of the relevant water bodies within the project's boundary (River Mole).	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
		Disturbance to riparian zone due to nature of works below surface. Change to substrate in riparian zone – most likely to be made ground but riparian zone is already developed, so no overall change from present conditions. Potential contaminated ground on site. Overall impact likely to be negligible. Disturbance to substrate due to excavation during construction. Construction impacts due to changes in substrate – discharge to gravity to River Mole only. However, there will be no significant impact at water body scale or to other water bodies outside of airport boundary and no discernible pathway to these as receptors. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
		Loss of substrate under footprint of any newly created areas as part of the Project. Potential increase in loose non-cohesive material as works being excavated, and potential disturbance to substrate. However, this is short-term, temporary and localised. Due to the proximity of water bodies, this is unlikely to cause a change in water body status and is likely to increase levels of biodiversity and green spaces. Relocation of Pond A provides extra floodplain capacity. Impacts to Pond A likely to be more site-specific due to connection to drainage system. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
	Chemical and physico-chemical elements supporting the biological elements Oxygenation conditions Nutrient conditions	Risk of discharging waste materials from the works into the water bodies due to proximity of the River Mole can cause deterioration to quality elements. Any impact is likely to be localised and temporary and depends on flood routes, so potential minor impact. Impact to Pond A likely to be greater due to connection of drainage. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Construction impacts to water quality: Potential increase in runoff; potential increase in suspended sediments and fines due to runway works and disturbance to substrate, and potential for fines to enter the River Mole. However, distance of works from River Mole would make this unlikely.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Risk of discharging waste materials from the works into the water bodies depends on the likely flood routes, and containment of pollutants during works; therefore, the impacts to nutrient conditions during construction is largely controlled by this. Any impact is likely to be localised and temporary and depends on flood routes, so potential minor impact. Impacts to Pond A likely to be more site-specific due to connection to drainage system. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
Landscape/ecological planting and environmental mitigation. Including: Lowering of ground levels in Museum Field	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish fauna	Potential direct effects on biological quality elements due to change in habitat structure within the River Mole (upstream of Horley) Loss of habitat under footprint of embankment and in area where floodplain is lowered so loss of benthic invertebrates and macrophytes/phytobenthos. Invertebrates: Potential negative effect on macrophytes and invertebrates because of water quality during construction and release of fines as substrate is lowered.	Habitat enhancement within flood storage area through integration of scrapes and other wetland habitat features. CoCP, application of relevant guidance, and EAP to provide mitigation. Any low points within the flood storage area should be connected to the River Mole by swales to encourage any fish

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
Provision of a new flood compensation area (FCA) to the east of Museum Field Diversion of the River Mole and Museum Field FCA / east of Museum Field FCA with re-meandering Lowering of the existing ground levels in car park X by 2.5 metres; installation of flapped culvert Provision of a new flood storage area to the east of Gatwick Stream, south of Crawley Sewage Treatment Works		Ecology and riparian habitat: Permanent loss of aquatic habitat under footprint of spillway but potential increase in areas where floodplain lowered due to removal of channel bank and lowering of floodplain to facilitate this structure.	that move with rising flood water to return to the river as flood waters recede. Further design information required to understand how fish will get over the spillway.
		Construction of the two-stage channel as part of river diversion: Potential change in habitat structure within the Mole (upstream of Horley). Potential effect on macrophytes and invertebrates because of water quality during construction and release of fines as substrate is lowered. Overall impact likely to be negligible.	Impoundment should not occur outside of flood events. Design culverts to have rough bed/baffles to maintain water depth at low flows to allow fish passage. CoCP, application of relevant guidance, and EAP to provide mitigation.
		Flap culvert installation: Invertebrates and macrophytes: Disturbance during construction and displacement of species during construction. No impact to water body overall.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Potential fish disturbance during construction works. Potential limited loss of habitat due to the siltation resulting from the works within the banks. However, this will be temporary. Potential disturbance to fish due to noise during construction. However, this will be temporary and localised. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Morphological conditions River depth and width variation Structure and substrate of the river bed Structure of the riparian zone	Loss of riparian zone in areas under the spillway, and where floodplain substrate lowered. Hydromorphology and habitat development: Limiting the maximum flow downstream of the Museum Field flood storage area could reduce sediment transport in the channel downstream. This could theoretically see a reduction in reworking of the channel bed and an increase in the extent and duration of smothering of the river bed by fine sediment supplied from upstream. This could then in turn cause the channel bed to become more compact and stable and this will reduce the habitat suitability of the channel bed. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Structure and substrate of the river bed and riparian zone: The impacts could include reduced or increased sediment supply downstream of the structure; destabilisation of bed and banks downstream of culvert;	Design flow control structure to reduce water levels behind the embankment slowly (if the water level receded rapidly fish are more likely to be stranded). CoCP, application of relevant guidance, and EAP to provide mitigation.
	Chemical and physico-chemical elements supporting the biological elements Thermal conditions Oxygenation conditions Nutrient conditions	Thermal conditions: Flood water held in the storage basin would be held temporarily and is likely to have a negligible impact on water temperature of the water body. Oxygenation conditions. Flood water held in the storage basin artificially would be temporary and is likely to have a negligible impact on dissolved oxygen levels of the water body.	N/A
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Water quality: Pollution by other substances identified as being discharged in significant quantities into the body of water. There is a temporary potential pollution risk if working in or adjacent to channel particularly where floodplain is being lowered to make way for this element of the Project. Overall impact likely to be negligible.	All works to be undertaken in accordance with relevant Pollution Prevention Guidelines. Riparian planting could be used as buffer strips to reduce diffuse pollution.
Construction compounds	Biological elements: Macrophytes and phytobenthos	Disturbance to species within substrate and potential smothering of species and disturbance of habitat due to plant movements. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
	Invertebrates		
	Hydromorphological elements supporting the biological elements Structure of the riparian zone	Risk of discharging waste materials from the works into the watercourses. Works could release large volumes of sediment and soil, presenting a temporary but localised risk particularly where plant movement is frequent. Potential indirect impacts from construction stage of the development can be managed and no likely significant effects are anticipated on the water environment depending on whether there is a pathway to the receptor. Overall impact likely to be negligible. Potential loss of riparian zone under footprint of any newly created areas as part of the Project. Overall impact likely to be negligible. Potential increase in loose non-cohesive material as works being excavated, and potential disturbance to substrate. However, this is short-term, temporary and localised. Overall, this is unlikely to cause a change in water body status. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
	Chemical and physico-chemical elements supporting the biological elements Oxygenation conditions Nutrient conditions	Risk of discharging waste materials from the works into the watercourses. Works could release large volumes of sediment and soil, presenting a temporary but localised risk particularly where plant movement is frequent. Potential indirect impacts from construction stage of the development can be managed and no likely significant effects are anticipated on the water environment depending on whether there is a pathway to the receptor. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Risk of discharging waste materials from the works into the watercourses. Works could release large volumes of sediment and soil, presenting a temporary but localised risk particularly where plant movement is frequent. Potential indirect impacts from construction stage of the development can be managed and no likely significant effects are anticipated on the water environment depending on whether there is a pathway to the receptor. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
Non-Native Invasive Species	All quality elements	Risk of spread of invasive species. Reportable on sighting. The presence of American signal crayfish has been confirmed in Gatwick Stream. New Zealand mud snail was identified at both the River Mole and Gatwick Stream. Need to be removed if possible.	Invasives are reportable to DEFRA. Best practice guidelines should be used to prevent spread of species.
Connection to European sites	River Mole UWWT. Nitrates Regulations: Medway at Weir Wood NVZ S488, Eden Brook East of Lingfield NVZ S487, Wandle (Croydon to Wandsworth) and the R. Gravney NVZ S464, Hogsmill NVZ S450, Law Brook S679. Mole Gap to Reigate Escarpment Habitats Regulations.	No effect.	N/A

Table 4.1.2: Comparison of project against status objectives and elements for surface water bodies during operation

Key to Impact							
Negative		Negligible		Positive		No change	

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
Amendments to runway, holding area and reconfiguration of taxiways – including de-icer and drainage	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish fauna	Increase in impermeable area. Potential increase in discharge to gravity into the River Mole. However, no impact to All biological elements as discharge would only occur when water levels are high in the River Mole to meet pollution prevention elements of discharge consent from Pond D. Increased discharge would not be enough to change species numbers, quality and the habitat that they colonise downstream. Overall impact likely to be negligible.	N/A
		De-icer is not discharged to the Mole so no impact as a result of operation. Pond D is the key drainage pond receiving the majority of runoff from Gatwick including that transferred from the 'dirty' side of the Dog Kennel Pond. Runoff from the Pond D catchment drains to Pond D (lower) and is then raised by three Archimedes Screws. If the water quality meets the required standard, or if there is no capacity in the downstream storage lagoons, runoff enters Pond D (upper) via a series of separator channels and discharges to the River Mole. Discharge to the River Mole is at a consented rate, controlled by a series of hydrobrakes and pumps. The actual rate of discharge is determined by the volume of flow in the River Mole. Higher flow rates in the River Mole permit a higher discharge rate from Pond D (upper).	N/A. Will need further information at the Environmental Statement (ES) stage to further support this.
	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Structure of the riparian zone	Resurfacing and removal of redundant hardstanding – potential change in impermeable areas. Increased discharge (attenuated to greenfield discharge) would not impact on hydrological regime sufficiently to cause deterioration in status. Overall impact likely to be negligible.	N/A
	Chemical and physico-chemical elements supporting the biological elements: Oxygenation conditions Nutrient conditions	De-icer has a very large biological oxygen demand (BOD), which would be discharged into Pond D but not into the River Mole. Pollution storage lagoons are impacted by current and future conditions, mainly as a result of pollution from de-icer and the discharge of pollutants from aircraft during takeoff, landing and taxiing. No change to River Mole as pollutants treated in Pond D or additional treatment in a storage tank beneath car park Y or via pollution lagoons.	N/A
Pier and stand alterations (including a proposed new pier)	Biological elements: Invertebrates Fish	Project results in an increase in impermeable surface area. However, no impact to ALL biological elements as discharge increase due to changes in impermeable area would only occur when water levels are high in the Mole – due to the nature of the discharge of water under gravity.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation. Require survey data to account for species quantity and quality to fully account for implications to biological elements.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
			Require more information (to be done as part of ES) for corroboration of this.
	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Structure of the riparian zone	Potential change in impermeable areas. Increased discharge would not impact on hydrological regime sufficiently to cause deterioration in status. Overall impact likely to be negligible.	N/A
Reconfiguration of existing airport facilities, including fire training	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna	Fire training drainage - if polluted – would be diverted to a reed bed and then to foul drainage; if not polluted, it would be diverted to Pond A. In future operation, there would be no change to this.	CoCP, application of relevant guidance, and EAP to provide mitigation. Require survey data to account for species quantity and quality.
	Hydromorphological elements supporting the biological elements Structure of the riparian zone	potential change in impermeable areas. Increased discharge would not impact on hydrological regime sufficiently to cause deterioration in status. Overall impact likely to be negligible.	N/A
Extensions to the existing airport terminals (north and south); provision of additional hotel and office space	Hydromorphological elements supporting the biological elements Structure of the riparian zone	Substrate most likely to be made ground but riparian zone is already developed, so no overall change from present conditions during operation. Potential contaminated ground on site. Overall impact likely to be negligible.	N/A
Provision of reconfigured car parking, including new car parks	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna	All: if surface runoff increased due to increased impermeability, there is a likely increased risk of pollutants such as dust, traffic pollutants etc. being conveyed into any adjacent water body (e.g. River Mole, Gatwick Stream). Any impact is likely to be localised and temporary (usually after rain) and depends on flood routes and attenuation, so potential minor impact but insignificant at the water body scale.	CoCP, application of relevant guidance, EAP to provide mitigation.
	Hydromorphological elements supporting the biological elements Structure of the riparian zone	Substrate most likely to be made ground but riparian zone is already developed, so no overall change from present conditions.	
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	If surface runoff is increased due to increased impermeability, there is a likely increased risk of pollutants such as dust, traffic pollutants etc. being conveyed into any adjacent water body (e.g. The River Mole, Gatwick Stream). Any impact is likely to be localised and temporary (usually after rain) and depends on flood routes, and attenuation so potential minor impact but insignificant at the water body scale. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
Surface access (including highway) improvements. Including: South Terminal roundabout works. Earthworks would support the approach to the bridge and reinforced earth-walls or retaining walls would	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish fauna	All - Drainage has the potential to provide a contamination pathway to a river from road dust and contaminants if not intercepted by better road drainage under current conditions, where it is discharged into toe drains. With an improved drainage strategy, there is likelihood of betterment to all water bodies connected to the Mole, Burstow and Gatwick Streams. Overall impact likely to be negligible.	Drainage strategy to prevent contaminant loads discharging into the water bodies.
	Hydromorphological elements supporting the biological elements Hydrological regime	Where land take would be required, the riparian zone would be lost under the footprint of the works. Overall impact likely to be negligible.	N/A

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
be required between the Brighton-London mainline railway and slip roads Longbridge roundabout – expanded northwards and eastwards into flood zone, extended crossing of Mole on Barcombe Road	Quantity and dynamics of water flow Structure and substrate of the river bed Structure of the riparian zone		
	Chemical and physico-chemical elements supporting the biological elements Oxygenation conditions Nutrient conditions	Potential improvement on water quality within the watercourse if surface water which normally flows into river from flooding runoff carries pollutants and silts, e.g. by running off road surfaces. Improvement dependent on drainage design. Drainage has the potential to provide a contamination pathway to the water bodies (Burstow Stream, River Mole) from road dust and contaminants if not intercepted by the road drainage under current conditions - where it is discharged into toe drains. With an improved drainage strategy, there is the likelihood of betterment in water quality to all water bodies connected to the Mole, Burstow and Gatwick Streams.	Drainage strategy in place to provide betterment.
	Specific pollutants Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Drainage: Potential to provide a contamination pathway to river from road dust and contaminants if not intercepted by road drainage under current conditions, where it is discharged into toe drains. With an improved drainage strategy, likelihood of betterment to all water bodies connected to the River Mole, Burstow Stream and Gatwick Stream.	N/A
		Internal access routes: No change from present conditions.	N/A
Reconfiguration of existing utilities, including surface water, foul drainage and power. Including: Works to realign existing surface water drainage infrastructure along Taxiway Yankee, providing a connection to Pond D Creation of an additional runoff treatment and storage area (including runoff from deicing areas) to complement the existing capacity provided by Pond D. Relocation of Pond A	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna	No change to Pond D. Potential improvement to River Mole water quality as drainage is improved.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Relocation of Pond A could increase levels of biodiversity and green spaces. Relocation of pond A provides extra floodplain capacity.	
	Hydromorphological elements supporting the biological elements Structure of the riparian zone	Potential disturbance/loss of riparian zones under footprint of drainage routes. Impact is only likely to be negligible, and therefore not causing deterioration to the status of the relevant water bodies within the project's boundary (River Mole).	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
		Potential change in impermeable areas. Increased discharge would not impact on hydrological regime sufficiently to cause deterioration in status.	N/A
		Improvement due to less runoff in places where it has previously caused a problem. Decreased runoff discharged to water bodies.	N/A
		Loss of substrate under footprint of any newly created areas as part of the Project. Potential increase in loose non-cohesive material as works being excavated, and potential disturbance to substrate. However, this is short-term, temporary and localised. Due to the proximity of water bodies, this is unlikely to cause a change in water body status and is likely to increase levels of biodiversity and green spaces. Relocation of Pond A provides extra floodplain capacity. Impacts to Pond A likely to be more site-specific due to connection to drainage system. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
	Nutrient conditions	No change to Pond D. Potential improvement to River Mole water quality as pollutants are not discharged directly into the water body.	N/A

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
	Specific pollutants: Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	If surface runoff is increased due to increased impermeability, there is a likely increased risk of pollutants such as dust, traffic pollutants etc. being conveyed into any adjacent water body (e.g. the River Mole). Any impact is likely to be localised and temporary (usually after rain) and depends on flood routes, so potential minor impact but insignificant at the water body scale. Overall impact likely to be negligible.	N/A
Landscape/ecological planting and environmental mitigation Lowering of ground levels in Museum Field Provision of a new flood compensation area (FCA) to the east of Museum Field Diversion of the River Mole and Museum Field FCA / east of Museum Field FCA with re-meandering Lowering of the existing ground levels in car park X by 2.5 metres; installation of flapped culvert Provision of a new flood storage area to the east of Gatwick Stream, south of Crawley Sewage Treatment Works	Biological elements: Macrophytes and phytobenthos Benthic invertebrate fauna Fish fauna	Potential direct effects on biological quality elements due to change in habitat structure within the River Mole (upstream of Horley) Potential fish stranding during operation, and therefore potential fish kills. Loss of habitat under footprint of embankment and in area where floodplain is lowered so loss of benthic invertebrates and macrophytes/phytobenthos.	Habitat enhancement within flood storage area through integration of scrapes and other wetland habitat features. CoCP, application of relevant guidance, and EAP to provide mitigation. Further design information required to understand how fish will get over the spillway.
		Potential direct effects on biological quality elements due to change in habitat structure within the River Mole (upstream of Horley) Potential fish stranding during operation, and therefore potential fish kills. Loss of habitat under footprint of embankment and in area where floodplain is lowered so loss of benthic invertebrates and macrophytes/phytobenthos. Ecology and riparian habitat: Permanent loss of aquatic habitat under footprint of spillway but potential increase in areas where floodplain lowered due to removal of channel bank and lowering of floodplain to facilitate this structure.	Habitat enhancement within flood storage area through potential integration of scrapes and other wetland habitat features. Any low points within the flood storage area should be connected to the River Mole by swales to encourage any fish that move with rising flood water to return to the river as flood waters recede. Further design information required to understand how fish will get over the spillway.
		Ecology: invertebrates. Potential effect on macrophytes and invertebrates because of water quality, Dissolved Oxygen and artificial holding of water within the FCA. Loss of habitat under footprint of embankment and in area where floodplain is lowered so loss of benthic invertebrates and macrophytes/phytobenthos. Ecology and riparian habitat: Permanent loss of aquatic habitat under footprint of spillway but potential increase in areas where floodplain lowered due to removal of channel bank and lowering of floodplain to facilitate this structure.	Design culverts to be as short as possible to avoid tunnelling effect and light-dark barrier at threshold. Design culverts to have rough bed / baffles to maintain water depth at low flows to allow fish passage. Fish refuges on floodplain. For example, low points within the FCA could be connected to the watercourse by swales to encourage any fish that move with rising flood water to return to the river as flood waters recede. Design flow control structure to reduce water levels behind the embankment slowly (if the water level receded rapidly fish are more likely to be stranded). Any low points within the flood storage area should be connected by swales to encourage any fish that move with rising flood water to return to the river as flood waters recede. Loss of aquatic habitat for fish should be mitigated by in-channel habitat elsewhere. CoCP, application of relevant guidance, and EAP to provide mitigation. Need species data and ecology survey results.
		Potential direct effects on biological quality elements due to change in habitat structure within the River Mole (upstream of Horley). Loss of habitat under footprint of embankment and in area where floodplain is lowered so loss of benthic invertebrates and macrophytes/phytobenthos. Permanent loss of aquatic habitat under footprint of spillway but potential increase in areas where floodplain lowered due to removal of channel bank and lowering of floodplain to facilitate this structure. Potential fish stranding during operation, and therefore potential fish kills.	

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
		Potential improvement in habitat for all species due to two stage channel and variability in channel form. Improved heterogeneity in channel form improves water quality and therefore has the potential to improve the quantity and quality of species within the channel.	Impact to species quality and quantity to be determined at the ES stage following results from fish surveys and other ecological surveys.
		Facilitates fish passage and prevents kills due to fish being stranded out of river (potentially).	N/A
		Fish: Potential direct effects on biological quality elements due to change in habitat structure. Impacts can include potential impediment to fish passage (if any fish in the water body); potential fish stranding during FSA operation; potential fish kills during operation. Flap valve should reduce this. Loss of area for macrophytes and phytobenthos under footprint of works.	Design flow control structure to reduce water levels behind the embankment slowly (If the water level receded rapidly fish are more likely to be stranded). Consider habitat creation within the flood storage area e.g. multi-stage channel, scrapes etc. CoCP, application of relevant guidance, and EAP to provide mitigation.
	Hydromorphological elements supporting the biological elements Hydrological regime Quantity and dynamics of water flow Morphological conditions River depth and width variation Structure and substrate of the river bed Structure of the riparian zone	Loss of riparian zone in areas under the spillway, and where floodplain substrate lowered. Hydromorphology and habitat development: Limiting the maximum flow downstream of the Museum Field flood storage area could reduce sediment transport in the channel downstream. This could theoretically see a reduction in reworking of the channel bed and an increase in the extent and duration of smothering of the river bed by fine sediment supplied from upstream. This could then in turn cause the channel bed to become more compact and stable and this will reduce the habitat suitability of the channel bed. Additionally, there could be a destabilisation in the bed and banks downstream of the works. This will depend on how often the Museum Field flood storage area is in operation.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Increased turbidity and scour potential during operation. Impacts are short-lived, temporary and localised. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Loss of riparian zone under the spillway, and where floodplain substrate lowered. Hydromorphology and habitat development: Limiting the maximum flow downstream of the field could reduce sediment transport in the channel downstream. This could theoretically see a reduction in reworking of the channel bed and an increase in the extent and duration of smothering of the river bed by fine sediment supplied from upstream. This could then in turn cause the channel bed to become more compact and stable and this will reduce the habitat suitability of the channel bed. Additionally, there could be a destabilisaiton in the bed and banks downstream of the works. This will depend on how often the Museum Field flood storage area is in operation. Overall impact likely to be negligible.	The riparian zone within the flood storage area could be improved with fencing, buffer strips and/or planting and tree management and installation of woody debris (all subject to landowner agreement).
		Increased turbidity and scour potential during operation. Impacts are short-lived, temporary and localised. Overall impact likely to be negligible.	Installation of scour protection measures or stilling basin downstream of the spillway. CoCP, application of relevant guidance, and EAP to provide mitigation.
		Riparian zone: hydromorphology and ecology. Potential for gullying as water drains back into the watercourse from the floodplain and outflanking at spillway edges. Potential for bank destabilisation due to excess wetting leading to potential for sediments to be transported from floodplain to channel as the FCA drains.	Scour protection and toe protection along bankside installation of erosion control methods.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
		Hydromorphology and habitat development: Limiting the maximum flow downstream of the FCA could reduce sediment transport in the channel downstream. This could theoretically see a reduction in reworking of the channel bed and an increase in the extent and duration of smothering of the river bed by fine sediment supplied from upstream. This could then in turn cause the channel bed to become more compact and stable and this will reduce the habitat suitability of the channel bed should this be reinstated. This depends on how often the FCA is in operation. Overall impact likely to be negligible. Morphology: The reduction of flow velocities is likely to lead to altered morphology both upstream and downstream of the two-stage channel structure. This could lead to reduced or increased sediment supply downstream of the structure; destabilisation of bed and banks downstream of culvert where unlined, which could be designed out; potential siltation downstream of culvert if flow velocities are reduced, as well as impacting upon invertebrate populations; and higher rates of siltation/blockages above the culvert than anticipated, affecting the operation of the culvert. River depth and width: The opportunity to vary channel form could improve channel width and depth. However, there is unlikely to be much variation if culverted, so variability needs to be added to detailed design. Overall impact likely to be negligible. Structure and substrate: The opportunity to vary channel form through the development of a meandering two-stage channel could provide an additional benefit of improving the structure of the channel bed and the substrate also. At present, the sediments are silty which promotes poor water quality. Overall impact likely to be negligible. Flow: The development of a sinuous channel promotes variable channel flow and improved heterogeneity in all channel characteristics. This is an opportunity for betterment. It improves water quality and potentially improves oxygen levels. Overall impact likely to be negligible.	Habitat enhancement within flood storage area through integration of scrapes and other wetland habitat features. Increase 'bed' roughness of culvert to provide opportunity for deposition of materials. Diverse and multi-stage channel profiles in the realigned watercourse to maximise the transport of coarse sediment through the impounded section, reduce the impact of flow impoundment on coarse sediment transport and minimise the accumulation of such material. Minimise length of culverted channel. Use natural gravel substrate to provide small-scale variations in water depth. Use baffles to retain sediment, create resting areas for fish and invertebrates and improve flow diversity. CoCP, application of relevant guidance, and EAP to provide mitigation.
		Potential disturbance/loss of riparian zones under footprint. Impact is likely to be negligible, and therefore not causing deterioration to the status of the relevant water bodies within the Project's boundary.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		Hydrological regime: Discharge likely to be more controlled, and intermittent compared to previous without flap. Overall, no deterioration in water body elements. Around outfall outlet: Temporary effect to substrate due to works in progress; no change in morphology within the river. Smaller rates of discharge via flapped outfall could lead to differential rates of repeated sediment deposition and erosion at outfall.	N/A
		Structure and substrate of the river bed and riparian zone: The impacts could include reduced or increased sediment supply downstream of the structure; destabilisation of bed and banks downstream of culvert; potential siltation downstream of culvert if flow velocities are reduced, reducing the availability of clean spawning gravels for fish (if present, as well as impacting upon invertebrate populations (food of fish); higher rates of siltation/blockages above the culvert than anticipated, affecting the operation of the culvert.	Design flow control structure to reduce water levels behind the embankment slowly (if the water level receded rapidly fish are more likely to be stranded). CoCP, application of relevant guidance, and EAP to provide mitigation.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
		Hydrological regime, flow of water: Limiting the maximum flow downstream of the FSA could have an impact on sediment transport in the channel downstream. This could theoretically see a reduction in reworking of the channel bed and an increase in the extent and duration of smothering of the river bed by fine sediment supplied from upstream. This could then in turn cause the channel bed to become more compact and stable and this will reduce the habitat suitability of the channel bed. This is a consequence of the Project. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation. Need species surveys to be undertaken to confirm potential risk.
	Chemical and physico-chemical elements supporting the biological elements Thermal conditions Oxygenation conditions Nutrient conditions	Thermal conditions: Flood water held in the storage basin would be held temporarily and is likely to have a negligible impact on water temperature of the water body. Oxygenation conditions. Flood water held in the storage basin artificially would be temporary and is likely to have a negligible impact on dissolved oxygen levels of the water body.	N/A
		Thermal conditions: Flood water held in the storage basin would be held temporarily and is likely to have a negligible impact on water temperature of the water body.	
		Oxygenation conditions: Flood water held in the storage basin would be temporary and is likely to have a negligible impact on dissolved oxygen levels of the water body.	
		Oxygenation conditions in the diversion could be improved due to variability in channel form and improvement to channel flow.	Positive impact. Mitigation not required.
		Thermal conditions: Flood water would be held temporarily and is likely to have a negligible impact on water temperature of the water body as a result of the car park.	N/A
		Oxygenation conditions: Flood water held in the car park area would be temporary and is likely to have a negligible impact on dissolved oxygen levels of the water body as a result of the car park.	
		Thermal conditions: Flood water held in the FSA would be held temporarily and is likely to have a negligible impact on water temperature of the water body.	
		Oxygenation conditions: Flood water held in the FSA would be temporary and is likely to have a negligible impact on dissolved oxygen levels of the water body.	
	All quality elements	Potential to cause temporary species displacement but overall this is neutral because of the benefits to the floodplain that this will bring.	Positive impact. Mitigation not required.
Connection to European sites	River Mole UWWT. Nitrates Regulations: Medway at Weir Wood NVZ S488, Eden Brook East of Lingfield NVZ S487, Wandle (Croydon to Wandsworth) and the R. Gravney NVZ S464, Hogsmill NVZ S450, Law Brook S679. Mole Gap to Reigate Escarpment Habitats Regulations.	No effect.	N/A

Table 4.1.3: Comparison of Project against Status Objectives and Elements for groundwater bodies

Key to Impact							
Negative		Negligible		Positive		No change	

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
Amendments to the existing northern runway including repositioning its centreline 12 metres further north to enable dual runway operations	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	During construction and operation: No significant change to the groundwater body because works are surficial. The geology in the vicinity of the airfield does not include a primary aquifer or a groundwater body; the depth of the groundwater body is unknown but considered to be much deeper than penetration by machinery. Alterations to the surface of the runway are shallow and therefore unlikely to form a pathway to the groundwater receptor.	N/A
Pier and stand alterations (including a proposed new pier	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	During construction and operation: No significant change to the groundwater body because works are surficial. Piling would not be deep enough to create a pathway to the groundwater body. The geology here is not a primary aquifer or a groundwater body; the depth of the groundwater body is unknown. Alterations to the surface of the runway are shallow and therefore will not form a pathway to the groundwater receptor.	N/A
Reconfiguration of other airfield facilities, including fire training	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	During construction and operation: No significant change to the groundwater body because works are surficial. Piling would not be deep enough to create a pathway to the groundwater body. The geology here is not a primary aquifer or a groundwater body; the depth of the groundwater body is unknown. Alterations to the surface of the runway are shallow and therefore would be not form a pathway to the groundwater receptor. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
extensions to the existing airport terminals (north and south). Provision of additional hotel and office space	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	During construction and operation: No significant change to the groundwater body because works are surficial. Piling would not be deep enough to create a pathway to the groundwater body. The geology here is not a primary aquifer or a groundwater body; the depth of the groundwater body is unknown. Alterations to the surface of the runway are shallow and therefore will not form a pathway to the groundwater receptor. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
Provision of reconfigured car parking, including new car parks	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	During construction and operation: No significant change to the groundwater body because works are surficial. Piling would not be deep enough to create a pathway to the groundwater body. Local geology does not include a primary aquifer or a groundwater body; the depth to groundwater table is unknown. Alterations to the surface of the runway are shallow and therefore will not form a pathway to the groundwater receptor. Will need further data to support this.	N/A
Surface access (including highway) improvements. Including: South Terminal roundabout works. Earthworks would	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	During construction and operation of the carriageways: Groundwater quality: negligible potential for pollution pathway to receptor during piling (if piling is the preferred method over spread footings). No impact to both quality and quantity. Works unlikely to impact on quantity and quality of the water body. Pollution unlikely to enter bedrock; further, quality and quantity of groundwater within water body not going to be affected by surficial works as proposed in	N/A

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
support the approach to the bridge and reinforced earth-walls or retaining walls would be required between the Brighton-London mainline railway and slip roads Longbridge roundabout – expanded northwards and eastwards into flood zone, extended crossing of Mole on Barcombe Road		this Project. Where the road is widened through embankment steepening, no piling would be used, so no anticipated impact. On the roundabout, close to Balcombe Road, sheet piling is being considered, but again no impact likely due to the shallow nature of the works compared to the depth of the groundwater body below the surface. Close to the attenuation pond, a retaining wall would be put in place using piling. Again, no impact likely due to the shallow nature of the works compared to the depth of the groundwater body below the surface.	
	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	Piling: No impact likely due to the shallow nature of the works compared to the depth of the groundwater body below the surface. No survey data are available for the depth of the groundwater body, but the works are likely to be shallow in comparison.	N/A
Reconfiguration of existing utilities, including surface water, foul drainage and power. Including: Works to realign existing surface water drainage infrastructure along Taxiway Yankee, providing a connection to Pond D Creation of an additional runoff treatment and storage area (including runoff from deicing areas) to complement the existing capacity provided by Pond D. Relocation of Pond A	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	Groundwater: works are superficial so unlikely to disturb groundwater body as a receptor. Groundwater is not a surface water body in this area. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
		During construction and operation: No significant change to the groundwater body because works are surficial. The geology here is not a primary aquifer or a groundwater body; the depth of the groundwater body is unknown. Alterations to the surface of the runway are shallow and therefore will not form a pathway to the groundwater receptor.	N/A
	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	Construction impacts: Potential impacts to groundwater body if underground storage interrupts groundwater flow in aquifer. Depth of groundwater body unknown. It is not a ground water body. Overall impact likely to be negligible.	Any potential impact should be mitigated by drainage design, drainage capture and attenuation. CoCP, application of relevant guidance, and EAP to provide mitigation.
		During construction and operation: No significant change to the groundwater body because works are surficial. Piling would not be deep enough to create a pathway to the groundwater body. The geology here is not a primary aquifer or a groundwater body; the depth of the groundwater body is unknown. Alterations to the surface of the runway are shallow and therefore will not form a pathway to the groundwater receptor. Overall impact likely to be negligible.	CoCP, application of relevant guidance, and EAP to provide mitigation.
Landscape/ecological planting and environmental mitigation Lowering of ground levels in Museum Field Provision of a new flood compensation area (FCA) to the east of Museum Field Diversion of the River Mole and Museum Field FCA /	Quantitative Dependent Surface Water Body Status Chemical Dependent Surface Water Body Status	During construction and operation of flap valve: No significant change to the groundwater body because works are surficial. The geology here is not a primary aquifer or a groundwater body; the depth of the groundwater body is unknown.	CoCP, application of relevant guidance, and EAP to provide mitigation.

Project element	Element likely to be impacted	Description of impact	Possible ways to mitigate impact
east of Museum Field FCA with re-meandering Lowering of the existing ground levels in car park X by 2.5 metres; installation of flapped culvert Provision of a new flood storage area to the east of Gatwick Stream, south of Crawley Sewage Treatment Works		Pilling is proposed to a depth of approximately 8m. The Copthorne Tunbridge Wells Sands ground water body is approximately 5m deep at this location. Therefore, there is potential for and impact on connection to groundwater.	All works to be undertaken in accordance with relevant Pollution Prevention Guidelines.

5 Conclusions

5.1.1 The assessment of the works for the Project has identified some adverse impacts affecting the surface water bodies.

5.1.2 It has been concluded that potential impacts of the Project, including considerations for mitigation measures outlined, have the potential to cause deterioration in status of individual quality elements and the overall status of water bodies. It is not anticipated that the Proposed Project would compromise the implementation of the Urban Waste Water Treatment (England and Wales) Regulations 1994, the Nitrate Pollution Prevention Regulations 2017 or the Conservation of Habitats and Species Regulations 2019.

5.1.3 The preliminary assessment has concluded that it is anticipated that the Project could lead to deterioration in the current status or prevent the WER water bodies from achieving Good Status/Potential in the future and is therefore considered likely to be not currently compliant with the WER legislation. Consequently, a detailed WER compliance assessment is required to assess impacts of the Project and provide further detail on the mitigation (as listed in Section 4) for impacts anticipated to contribute towards deterioration. The detailed WER will be undertaken to support the Environmental Statement.

6 References

Environment Agency (2019) Catchment Data Explorer. [Online] Available at: https://environment.data.gov.uk/catchment-planning/

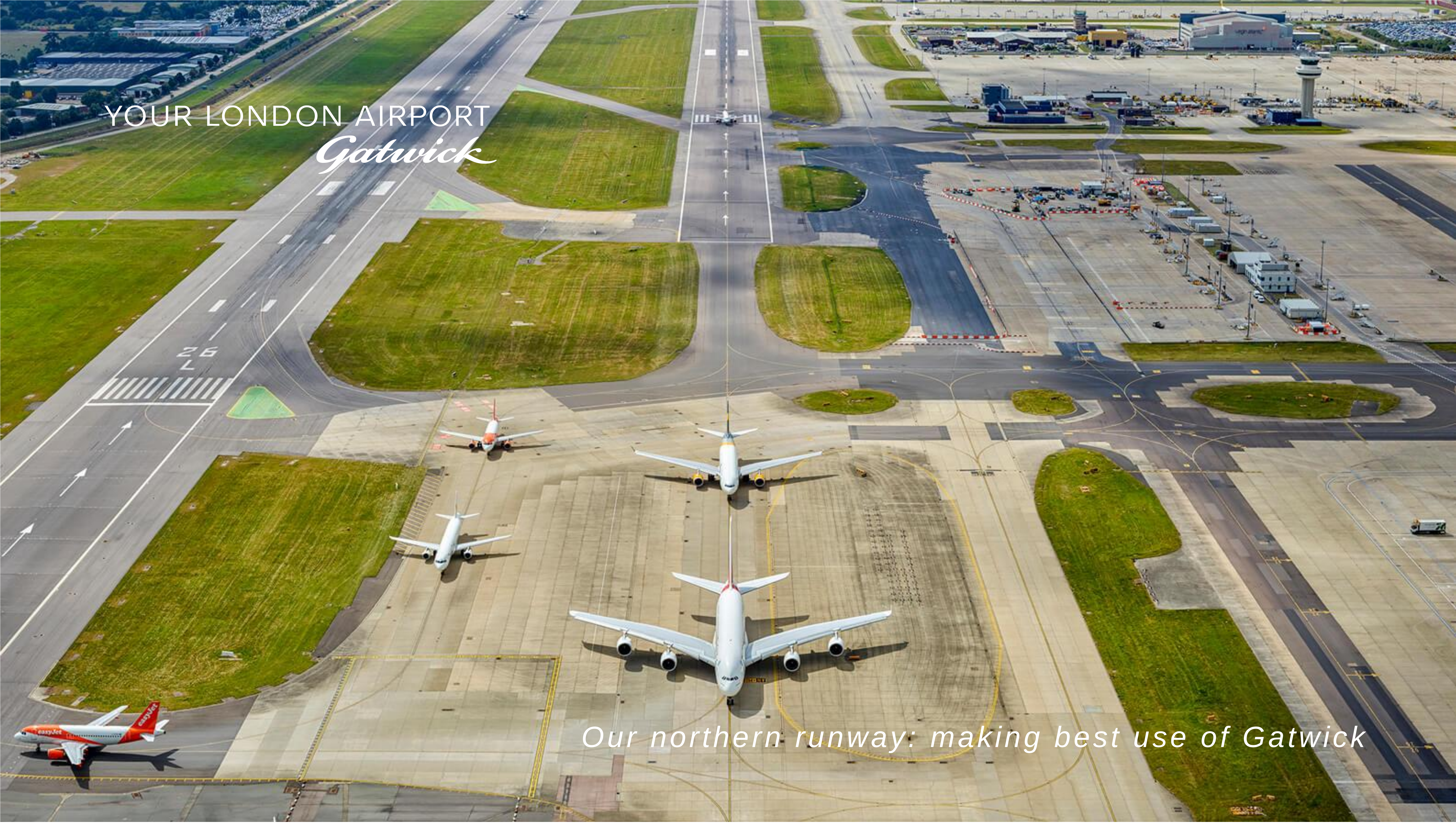
7 Glossary

7.1 Glossary of terms

Term	Description
Biological element	A collective term for a particular characteristic group of animals or plants present in an aquatic ecosystem (for example phytoplankton; benthic invertebrates; phytobenthos; macrophytes; macroalgae; phytobenthos; angiosperms; fish).
Biological quality element	A characteristic or property of a biological element that is specifically listed in Annex V of the Water Environment Regulations for the definition of the ecological status of a water body (for example composition of invertebrates; abundance of angiosperms; age structure of fish).
BOD	Biological oxygen demand
Catchment	The area from which precipitation contributes to the flow from a borehole spring, river or lake. For rivers and lakes this includes tributaries and the areas they drain. In river basin management this can refer to the larger management catchments and the smaller operational catchments.
Chemical status	The classification status for the surface water body against the environmental standards for chemicals that are priority substances and priority hazardous substances. Chemical status is recorded as good or fail. A status of good means that concentrations of priority substances and priority hazardous substances do not exceed the environmental quality standards in the Environmental Quality Standards Directive. The chemical status classification for the water body, and the confidence in this (high or low), is determined by the worst test result. Chemical status and ecological status together define the overall surface water status of a water body. For groundwater see "Groundwater chemical status".
Classification	Method for distinguishing the environmental condition or 'status' of water bodies and putting them into one category or another.
CoCP	Code of Construction Practice
Diffuse sources (of pollution)	Diffuse sources are primarily associated with run-off and other discharges related to different land uses such as agriculture and forestry, from septic tanks associated with rural dwellings and from the land spreading of industrial, municipal and agricultural wastes.
EA	Environment Agency
EAP	Environmental Action Plan
Ecological status	Ecological status is an expression of the structure and functioning of aquatic ecosystems associated with surface waters. Such waters are classified as being of good ecological status when they meet the requirements of the regulations.
EIA	Environmental Impact Assessment
ES	Environmental Statement
FCA	Flood Compensation Area
GAL	Gatwick Airport Limited
GES	Good ecological status is a general term meaning the status achieved by a surface water body when both the ecological status and its chemical status are at least good or, for groundwater, and when both its quantitative status and chemical status are at least good.
GEP	Good ecological potential
Good groundwater status	Good groundwater status is that achieved by a groundwater body when both its quantitative status and chemical status are good.
Good surface water chemical status	Good surface water chemical status means that concentrations of pollutants in the water body do not exceed the environmental limit values specified in the regulations.
Heavily Modified Water Body	Article 2 (9) defines a heavily modified water body as a 'body of surface water which as a result of physical alterations by human activity is substantially changed in character, as designated by the Member State in accordance with the provisions of Annex II (of the Water Framework Directive).'
Hydromorphology	Describes the hydrological and geomorphological processes and attributes of surface water bodies. For example for rivers, hydromorphology describes the form and function of the channel as well as its connectivity (up and downstream and with

Term	Description
	groundwater) and flow regime, which defines its ability to allow migration of aquatic organisms and maintain natural continuity of sediment transport through the fluvial system. The Water Environment Regulations require surface waters to be managed in such a way as to safeguard their hydrology and geomorphology so that ecology is protected.
ITTS	Inter-Terminal Transit System
Macrophyte	Larger plants, typically including flowering plants, mosses and larger algae but not including single-celled phytoplankton or diatoms.
Morphology	Describes the physical form and condition of a water body, for example the width, depth and perimeter of a river channel, the structure and condition of the riverbed and bank.
MRF	Material recovery facility
MT	Motor transport
Nitrate Vulnerable Zones	A Nitrate Vulnerable Zone is designated where land drains and contributes to the nitrate found in "polluted" waters
Nitrates Regulations	A basic measure under the WER, the Nitrates regulations aims to protect water quality by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices.
NNIS	Non-native invasive species. Many species of plants and animals have been introduced to this country. Several of these non-native species are invasive and have been causing serious problems to the aquatic and riverine ecology and environment. Problems include detrimental effects on native species, deoxygenation of water causing fish mortalities, blocking of rivers and drainage channels, predation and competition with native species, and in some cases pose health risks to the public or livestock.

Term	Description
No deterioration (in water body status)	Where none of the quality elements used in the classification of water body status deteriorates to the extent that the overall status of the water body is reduced. This is referred to as 'preventing deterioration' throughout the consultation.
Not designated artificial or heavily modified	A description of a water body that has not been designated as artificial or heavily modified. In other words it is substantially natural in character.
PEIR	Preliminary Environmental Information Report
Point sources (of pollution)	Point sources are primarily discharges from municipal wastewater treatment plants associated with population centres or effluent discharges from industry.
Protected areas	Areas that have been designated as requiring special protection under EU legislation for the protection of their surface water and groundwater or for the protection of habitats and species directly depending on water.
River basin	River basin means the area of land from which all surface water run-off flows, through a sequence of streams, rivers and lakes into the sea at a single river mouth, estuary or delta.
RBMP	River Basin Management Plan
ST	Surface Transport
WER	Water Environment Regulations



Preliminary Environmental Information Report
Appendix 11.9.3: Geomorphology Assessment

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This document forms Appendix 11.9.3 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description of the PEIR.

1.1.2 This document provides the detail of the geomorphology assessment for the Project, including the baseline study and impact assessment.

2 Study area

2.1.1 There are four watercourses that have the potential to be directly or indirectly impacted by the Project and these have been defined as the fluvial geomorphological receptors. A study area has been defined that covers the catchments of the receptors and a smaller site study area has been defined based on the channels that will be directly impacted by the Project. The watercourses all sit within the Mole management catchment of the Thames River Basin District. The watercourses identified as receptors include:

- River Mole;
- Gatwick Stream;
- Crawter's Brook;
- Burstow Stream; and
- Burstow Stream Tributary.

2.1.2 These watercourses are identified in Figure 11.4.1 of the PEIR.

2.1.3 Design changes (including a reduction in the extent of flood mitigation measures) between the scoping and PEIR stages of reporting mean that the following watercourses will now be scoped out of the PEIR, given that they are no longer considered to be impacted by the Project:

- Withy Brook; and
- Man's Brook.

2.1.4 Design changes include the removal of Withy Brook flood compensation area.

2.1.5 Other watercourses scoped out of this assessment include Hookwood Common Brook and Spencer's Gill (tributaries of the River Mole), Dolby Brook (tributary of Man's Brook), and Crawter's Brook Tributary (tributary of Crawter's Brook).

3 Methodology for baseline studies

3.1 Desktop Study

3.1.1 The baseline study included a fluvial geomorphology assessment undertaken at a catchment scale. The catchment extents of each watercourse have been used as the extent of a desk-based review of conditions (PEIR Chapter 11, Figure 11.2.1). This provides an overview of the catchments and how they currently function, and summary information on historical changes. This information then feeds into the more detailed baseline. The following are the key data sources used for this desk study:

- Environment Agency Catchment Data Explorer (Environment Agency, 2018);
- Thames River Basin District Management Plan (Department for Environment, Food and Rural Affairs (Defra), 2015);
- Ordnance Survey (OS) mapping;
- Geology maps (British Geological Survey, 2019);
- Historical maps (National Library of Scotland, 2019); and,
- Hydrological information (Centre of Ecology and Hydrology, 2019).

3.2 Site Specific Surveys

3.2.1 A geomorphological walkover survey was undertaken of the site study area within the Project Site Boundary to develop a more detailed baseline of channel characteristics on the watercourses which are potentially impacted by the Project (PEIR Chapter 11, Figure 11.4.1). The survey took place in September 2019 and water levels were above average following a prolonged period of heavy rainfall. As a result, the beds and part of the banks were not visible. However, some information on the banks, physical processes and existing pressures was recorded, and photographs were taken on site to supplement this. Therefore, sufficient information was obtained to fully assess effects of relevance to this study.

3.2.2 No geomorphological walkover has been undertaken on Burstow Stream at this stage. Prior to the latest design (March 2021), Burstow Stream was scoped out of the assessment based on the reduced extent of the highways works. Burstow Stream has been scoped into this assessment, and a further site visit to collect detailed baseline information will be undertaken and reported in the Environmental Statement (ES).

3.3 Methodology for Impact Assessment

3.3.1 The potential geomorphological impacts of the Project and flood risk mitigation components were identified for each watercourse. The baseline assessment was taken to be indicative of the current morphological condition of the watercourses. Descriptions of the potential effects of construction and operational activities were outlined using expert judgment of fluvial geomorphological processes. The Water Environment (Water Framework Directive) (England and Wales) Regulations (WER) 2017 water body status was used to infer sensitivity to Project impacts where relevant (Table 3.3.1). For water bodies not designated under the Directive, sensitivity is assigned based on diversity of morphological features and processes, state of natural equilibrium, and extent of artificial modification or anthropogenic influence. A qualitative assessment of the magnitude of the impacts was established using expert judgement with reference to GIS information, baseline conditions (including existing morphological pressures) and the proposed design with embedded mitigation. The magnitude of the impact was determined in a matrix which combines the duration and scale of the impact into a qualitative descriptor (Table 3.3.2 and Table 3.3.3). The significance of the effect was then determined in a matrix which combines sensitivity and magnitude into a qualitative descriptor (PEIR Chapter 11, Table 11.4.6.). Where a range of significance levels are presented in the matrix, the final assessment for each effect is based upon expert judgement.

Table 3.3.1 Sensitivity criteria for receptors

Sensitivity	Criteria
Very High	Watercourse having a 'High' (or potential to achieve 'High') WER status. Non WER classified watercourses may be applicable if they demonstrate qualities such as: a channel in stable equilibrium and exhibiting a range of natural morphological features (such as pools, riffles and bars); diversity in morphological processes reflects unconstrained natural function; free from artificial modification or anthropogenic influence.
High	Watercourse having a 'Good' (or potential to achieve 'Good') WER status. Non WER classified watercourses may be applicable if they demonstrate qualities such as: a channel achieving near-stable equilibrium and exhibiting a range of natural morphological features (such as pools, riffles and bars); diversity in morphological processes reflects relatively unconstrained natural function, with minor artificial modification or anthropogenic influence.
Medium	Watercourse having a less than 'Good' (or potential to achieve 'Good') WER status. Non WER classified watercourses may be applicable if they include channels currently showing signs of historical or existing modification and artificial constraints, and/or attempting to recover to a natural equilibrium and exhibiting a limited range of natural morphological features (such as pools, riffles and bars).
Low	Minor local watercourses not having WER status. A channel currently showing signs of extensive historical or existing modification and artificial constraints. There is no evidence of diverse fluvial processes and morphology and active recovery to a natural equilibrium.
Negligible	Minor ephemeral drains and channels

Table 3.3.2 Magnitude of impact criteria

Duration of impact	Scale of impact (km)					
	<0.1	0.1- 0.5	0.5 to < 1.5	1.5 to < 5	5 to < 10	> 10
	Negligible	**Very Small**	**Small**	**Medium**	**Large**	**Very Large**
Short term:1 to 12 months	Negligible	Negligible	Low	Low	Medium	Medium
Medium term: 1 to 5 years	Negligible	Low	Low	Medium	Medium	High
Long term: Over 5 years	Negligible	Low	Medium	Medium	High	High

Table 3.3.3 Magnitude of impact criteria definitions

Magnitude of Impact	Criteria
High	Works will impact the geomorphology at a waterbody scale.
Medium	Works will impact the geomorphology at a multi-reach scale.
Low	Works will impact the geomorphology at a reach scale.
Negligible	Works will impact the geomorphology at a local scale.
No change	Works will have no impact on geomorphology.

4 Current Baseline

4.1 Catchment Overview

4.1.1 The River Mole originates south of Crawley in West Sussex and flows through Surrey for approximately 80 km before reaching the Thames at Molesey. The catchment of the River Mole has an area of 512 km^2, and forms five per cent of the Thames catchment area (Environment Agency, 2018). The watercourses scoped into this assessment are in sub-catchments of the River Mole, including the Mole (upstream of Horley), Gatwick Stream, and Burstow Stream.

4.1.2 The catchment terrain of the watercourses is dominated by the Low Weald topography of the Wealden Basin, and underlain by Wealden Group clay. Surface geology mainly comprises alluvium and river terrace sands and gravels (BGS, 2019).

4.1.3 The River Mole sub-catchment area upstream of Horley is approximately 30 km^2, and includes urban areas of Crawley and Three Bridges, and Gatwick (Environment Agency, 2018). The Mole forms at the confluence of the tributaries of Ifield Brook and Baldhorns Brook, north of Crawley, where it flows north-eastwards through mainly rural land, receiving runoff from field drains. This section of the watercourse has a naturally meandering planform and wide channel of approximately 5 metre width.

4.1.4 At the southern perimeter of Gatwick, the River Mole is joined by Crawter's Brook. Crawter's Brook is a narrow stream of approximately 2 m width which rises in Tilgate Forest in the south and flows northwards through Crawley via a network of culverts and open channels towards the southern perimeter of the airport. The watercourse is realigned westwards along a straightened channel to meet the Mole. The River Mole then runs via a culvert and siphon under the existing main and northern runways. North of the runways, the River Mole re-emerges from the culvert and siphon and is joined by Man's Brook, a small 2-4-metre-wide stream which rises at Tilgate and flows through agricultural land to the east. The River Mole has been realigned around the northern perimeter of the airport, confined in a low valley between the airport infrastructure and urban residential areas. The River Mole is culverted under the A23, at which point it meets the confluence with Gatwick Stream.

4.1.5 Gatwick Stream is a tributary of the River Mole. It rises in Worth Forest below Clays Lake in West Sussex and flows northwards through Tilgate Forest, through Maidenbower, Three Bridges and Tinsley Green to the confluence with the River Mole. Tilgate Brook is a tributary of Gatwick Stream, approximately 300 metres in length. Crawley Sewage Treatment Works (STW), operated by Thames Water, is located to the east of the Gatwick Stream, downstream of Crawley. Gatwick Stream is approximately 8 km in length, with a catchment area of 14 km^2 (Environment Agency, 2018). The river planform is sinuous as it flows through Tinsley Green: a mixture of wooded area and parkland. The width of the channel typically measures 4-5 metres along this section.

4.1.6 Downstream of the STW, the watercourse passes through a culvert under the Brighton-London mainline railway and flows northwards along an engineered straightened course adjacent to the A23. The watercourse is narrower at this point with an approximate width of 3 metres. The watercourse is culverted under the South Terminal building and under Airport Way, where it re-emerges into Riverside Garden Park, to the north of the A23, as a 900-metre-long section of natural meandering channel. Downstream, the watercourse is straightened as it flows between the A23 and residential areas, before joining the River Mole to the east of Longbridge Roundabout.

4.1.7 Burstow Stream is a tributary of the River Mole. It rises at Crawley Down in Sussex, flowing through predominantly rural areas and the urban area of Copthorne, joining the River Mole at Horley. Burstow Stream is approximately 2 km away from the airport, however, a small section which flows under the M23 motorway and a tributary is within the study area. Burstow Stream Tributary is a tributary of the Burstow Stream. It is a small channel fed by several drains from agricultural land and road drains. The stream is typically less than 2 metres in width. Current OS mapping indicates the stream originates south of Horley as a drain along Balcombe Road and is culverted under the M23 motorway. The stream flows mostly in an open channel through the residential area east of Horley.

4.2 Historical Change Analysis

4.2.1 To identify historical geomorphological and land use changes, a series of digitised pre-WWII 1:10,560 scale OS maps and post-WWII 1:25,000 scale OS maps have been used in GIS, available through the National Library of Scotland (National Library of Scotland, 2019). The results are presented Table 4.2.1.

4.2.2 Historical OS mapping pre-1913 shows the land use within the study area was predominately rural, including agricultural land around the River Mole, Crawter's Brook and Burstow Stream tributary. Gatwick Stream flowed through a mixture of wooded area and parkland.

4.2.3 Since the 1930s, all receptors have been significantly modified, which predominately relate to the expansion of the airport and creation of associated transport links. The most significant changes include the realignment of the River Mole for construction of the North Terminal during the 1980s (Table 4.2.1, locations 11-12), various modifications to the course of Crawter's Brook since the 1950s (Table 4.2.1, locations 5-6, 14) and straightening of Gatwick Stream in the 1930s (Table 4.2.1, location 3).

Table 4.2.1: Historical Analysis of Watercourses in Study Area

Location	Date	Comment
1	Pre-1900	The River Mole was originally split into two channels to power the (now disused) Horley Mill since about the 13th century. The channel was again modified to form one channel in the following century post 1959 after the mill's closure.
2	1935	The confluence between the River Mole and Gatwick Stream was severed by construction of the A23. The River Mole was straightened downstream in alignment with the A23.
3		Gatwick Stream was straightened to allow for the construction of the A23.
4	1945-1955	Unnamed tributary of the River Mole is removed following airport expansion.
5	1945-1960	Crawter's Brook was realigned to join the River Mole further upstream for construction of the runway.
6		A channel alongside the runway was constructed to connect the River Mole and Crawter's Brook, north of the runway.

Location	Date	Comment
7		The River Mole was culverted under the runway.
8	1970s	Burstow Stream culverted for construction of the M23.
9	1980s	The remaining channel of Crawter's Brook, north of the runway, was removed for construction of the North Terminal. The connecting channel to the River Mole adjacent to the runway was also removed.
10		Man's Brook was shortened to join the new channel of the River Mole further upstream to make way for the North Terminal
11		The River Mole was realigned half a kilometre northwest from its original position for construction of the North Terminal
12		The River Mole was realigned along an existing stream (Westfield Farm), encircling ancient woodland (Brockley Wood)
13	1960-2000	The confluence between Burstow Stream and its tributary was modified.
14		Crawter's Brook straightened again at far west of airside perimeter.
15	Post-2000	The Mole biodiversity area was created upstream of Man's Brook, which included naturalisation of the watercourse and ecological improvements.
16		Gatwick Stream flood attenuation and grasslands scheme helping to prevent flooding in areas downstream. The main channel was enhanced with natural river features such as pool, fast flowing areas and native wetland. Control gates were added to enable excess water to collect in the low-lying grassland.

4.3 Site Channel Characteristics

4.3.1 The site visit was undertaken after a short period of exceptionally wet weather. Water levels were higher than typical by approximately 0.5 metres on the River Mole and Gatwick Stream; therefore, the riverbed and bedforms were not clearly visible during the survey. Table 4.3.1 to Table 4.3.4 include a detailed description of channel characteristics and photos of the watercourses surveyed. Channel dimensions provided were measured using cross-sectional data on Flood Modeller, unless otherwise stated. It is intended to repeat the site visit to update this assessment and inform the ES.

Crawter's Brook – Gatwick Airside to Confluence with the River Mole

Table 4.3.1: Crawter's Brook Site Characteristics

Representative image	Description
 Photo 1: Mid-channel vegetated bars  Photo 2: Damaged gabion mattresses  Photo 3: Bank erosion downstream of gabions	The valley is broad and formed in Wealden Clay and localised areas of river terrace superficial deposits. The floodplain is constrained on either side by the airport Perimeter Road South and fence and grassy strip to the south on the left bank, and the airport main runway to the north on the right bank. The floodplain is also constrained to the north adjacent to the bank top by a low (<0.5 m) narrow (approximately 1 metre) grassy embankment along its length. The channel itself is covered by netting crossing from the bank top. The channel baseflow width is typically approximately 4 metres and bank top channel width is approximately 12 metres. Bank height varies from 3-4 metres, and depth is <1 metre. This section of Crawter's Brook has been heavily modified and straightened for its entire length. It is a trapezoidal channel with relatively steep uniform banks and uniform flow types. The channel banks consist of clay and made ground, including concrete rubble and brick but are largely undefended and stable. Bedforms visible include mid-channel vegetated bars dispersed through the upstream length of the channel (Photo 1), formed of reeds and long grasses, and one instance of large woody debris in the channel. The bed and bedform materials were not visible during the site survey. Channel form and flows become increasingly uniform downstream, with sediment having dropped out further upstream to form the vegetated bars. Left and right bank characteristics are similar in that the riparian vegetation consists of mostly continuous coarse grasses and sparse small shrubs in the upstream extent. Some woody debris from shrubs is within the channel, resulting in localised changes in flow patterns. Vegetation is patchy in places where the channel banks are defended by concrete lining and geotextiles, particularly at Old Brighton Road South bridge. Both vegetation density and the number of vegetated bars decreases downstream. Slightly beyond the Old Brighton Road South road bridge (adjacent to Perimeter Road South) on the outside bend of the channel, a section of gabion mattresses on the right bank is significantly damaged, with cobbles having come loose from the cages, likely as result of high discharge events (Photo 3). This area appears to have experienced erosion in the past. Downstream of these defences on the right bank, localised active erosion continues to occur, where clay and made ground rubble has crumbled away from the bank side (Photo 3). In these areas, the bank has become over-steepened resulting in the destabilisation of the bank formed of unconsolidated materials. Observations indicate that animal burrowing may be resulting in erosion of bank top material under the netting. Erosion on the right bank occurs for 300 metres downstream. Existing pressures include five outfalls on the left bank, three bridges including concrete abutments and sloping masonry on adjacent banks, deteriorated geotextiles, vertical concrete walls at the confluence with the River Mole before being culverted under the runway, two slipways with gates, and one concrete drain structure with vertical concrete walls.

The Mole – Runway crossing to Confluence with Gatwick Stream

Table 4.3.2: River Mole Site Characteristics

Representative image	Description
 Photo 1: Mid-channel vegetated bar  Photo 2: Embankment view from right bank  Photo 3: Concrete lined outfall structure set into the right bank	The valley is broad and formed in Wealden Clay and alluvium superficial deposits. The valley is marginally steeper to the west of the Mole where limestone bands in the Wealden Clay have formed low hills. The River Mole has been re-routed and modified following airport expansion, and it is now situated west of its original natural course. Embankments have been built up along much of the channel length to form an 'artificial valley' which channels the water between the surrounding infrastructure. The floodplain is constrained left (west) of the channel by an artificial pond (Pond A) as the River Mole exits the runway culvert, and downstream of Man's Brook by Horley/Charlwood Road, Povey Cross Road and the settlement of Hookwood. The floodplain on the right of the channel is constrained by airport infrastructure, including hangars, the long stay car park, and two artificial ponds (Pond D and Pond M). Deciduous woodland is planted on the valley sides along the edge of the floodplain. The floodplain is up to 150 metres wide upstream of Man's Brook and narrows to 40-70 metres width downstream. On exiting the culvert, the River Mole flows around a sharp >90º bend into a 300-metre straightened section of channel with embankments on either side. Downstream, the River Mole has been re-naturalised to create a biodiversity area, where the river has been engineered with a sinuous planform and wider floodplain with public access along the left bank of the river. Downstream of Man's Brook, the river planform decreases in sinuosity, and is straightened as it flows around the perimeter of the long stay car park to the confluence with Gatwick Stream. Channel bankfull width is typically between 4-7 metres and the bank heights are typically approximately 1 metre. The channel banks are gently graded and formed in clay. Bedforms include large mid-channel vegetated bars dispersed throughout the length of the channel, formed of reeds and long grasses, and numerous instances of large woody debris in the channel, resulting in non-uniform flow types (Photo 1). The bed and bedform materials were not clearly visible during the site survey due to high water levels and turbidity. Left and right bank characteristics are similar in that the riparian vegetation includes mostly continuous coarse grasses on the sloping embankments, and scattered shrubs and small deciduous trees along the channel sides (Photo 2). Long grasses and reeds dominate the upstream banks and floodplain. Tree density increases downstream, particularly on the right bank. Given the high-water levels, there was no observable erosion of the banks. Water was frequently over-topping the banks and footpath on the floodplain. Existing pressures include an outfall on the right bank near the A23 road crossing, two bridges including concrete abutments and sloping masonry on the right bank of the sharp bend after the runway culvert. Pond D also releases water from a concrete lined outfall structure on the right bank (Photo 3).

Gatwick Stream – Tinsley Bridge to Confluence with the Mole

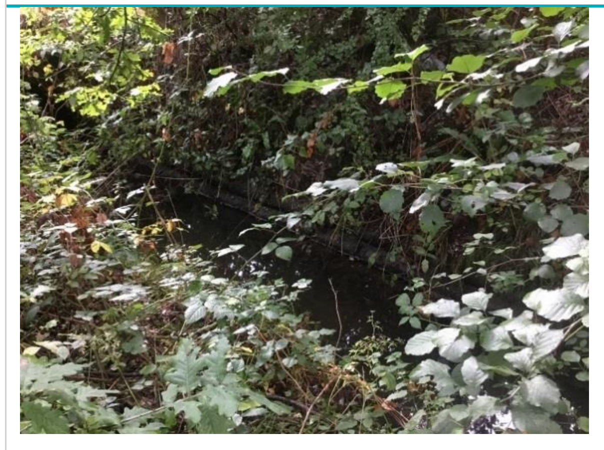
Table 4.3.3: Gatwick Stream Site Characteristics

Representative image	Description
 Photo 1: Netting over the Gatwick Stream  Photo 2: Erosion of vertical right bank and scattered vegetation  Photo 3: Gabion mattresses and erosion of bank	The valley is broad and formed in Wealden Clay and Upper Tunbridge Sands bedrock and alluvium superficial deposits. The floodplain of Gatwick Stream can be considered in three sections. From Tinsley Bridge to the Brighton-London mainline railway the river has been almost entirely realigned as part of the Upper Mole flood attenuation scheme. The channel is constrained by embankments on both sides, and control gates allow the low-lying grasslands to the left of the channel to collect excess water during extreme flood events. The channel itself is covered by netting crossing from the bank top (Photo 1). The eastern floodplain is also constrained by Crawley STW. Between the railway and Riverside Garden Park, the floodplain is entirely constrained and disconnected by the A23, pathway and railway which are parallel to the watercourse. Gatwick Stream is also culverted beneath the railway crossing, Gatwick Airport South Terminal, and the A23 crossing. Through Riverside Garden Park to the confluence with the Mole, the floodplain is mostly constrained on the right (north) of the watercourse by residential properties, whilst the left side is mostly unconstrained. The channel bankfull width is between 4-6 metres and bank top channel width varies between 9-11 metres. Depth is typically <1 metre and bank height varies from 1-3 metres. Between Tinsley Bridge and the railway, the channel has a sinuous planform with relatively steep banks and varied flow types. The channel is actively meandering. The channel banks consist of clay and sandy soil. Bedforms include vegetated mid-channel bars dispersed along its length, formed of reeds and long grasses, and numerous instances of woody debris in the channel giving rise to areas of faster flow and pools. The bed and bedform materials were not clearly visible during the site survey due to high water levels and turbidity. Riparian vegetation mainly comprised of continuous deciduous trees and Himalayan Balsam upstream of the realigned section, and coarse grasses and small shrubs downstream. The vegetation was stripped from near-vertical sections of the right bank that are actively eroding (Photo 2). Vegetated bars are also encouraging erosion of both banks by pushing the flow towards the banks. There is one outfall on the right bank and the river is culverted downstream near Crawley Sewage Treatment Works (STW). From the culverted section under the railway to Riverside Garden Park, the river is straight with relatively steep, root-bound clay banks and mainly uniform flow types. Between the railway culvert and Pond E, the channel is concrete lined. Immediately downstream of the concrete lining, the bed level drops where the river has scoured the natural bed and banks. Gabion mattresses protect both banks along this section (Photo 3). The bed and bedform materials were not clearly visible during the site survey due to high water levels and turbidity, however, cobbles were noted downstream of the gabion mattresses. Riparian vegetation included a dense mixture of shrubs and deciduous trees lining both banks. Woody debris was visible in the channel, varying the flow patterns locally. There was no other evidence of bank erosion. The river is canalised by vertical concrete walls and concrete lining before flowing through the South Terminal culvert. The channel briefly re-emerges through a short naturalised wooded section, with one outfall and pipe crossing, before flowing under the A23. Through Riverside Garden Park, the channel is sinuous with moderately steep root-bound clay banks and varied flow types. The banks and bed are concrete lined as the river exits the A23 culvert, flowing over a weir structure. Along the right bank the banks appear over-steepened in sections with evidence of erosion (Photo 4). Several small sections of the right bank are protected by brick walls as they abut gardens of residential properties. The bed and bedform materials were not clearly visible during the site survey due to high water levels and turbidity. Riparian vegetation includes continuous mature deciduous woodland and shrubs. Woody debris was visible in the channel, varying the flow patterns locally. The channel is straightened for 370 metres before meeting the confluence with the River Mole.

Representative image	Description
 Photo 4: Over-steepened banks along straightened section	

Burstow Stream Tributary – M23 Road Bridge Crossing

Table 4.3.4: Burstow Stream Tributary Site Characteristics

Representative image	Description
 Photo 1: Concrete lined channel from culvert  Photo 2: Pipe crossing close to culvert	The valley is broad and formed in Wealden Clay bedrock and widespread river terrace superficial deposits. The floodplain is constrained and dissected by the M23 road crossing, formed of a high embankment which crosses the path of the stream perpendicularly, and the Balcombe Road and residential properties which abut the left side of the channel. Observations on site indicate that the channel has a bank top channel width between 1-2 metres, and bank height is <1 metre. This section of Burstow Stream tributary has been heavily modified to accommodate the road embankment into which it is culverted. The channel banks are relatively steep suggesting the channel has been deepened in the past. During the site visit, discharge was low, and water was not flowing, suggesting that the channel is dry for most of the year. There were no notable bedforms and the bed material was mostly covered by thick deposits of leaf litter. Downstream beyond the culvert there were gravels and silts within the bed substrate amongst the leaf litter. Both left and right bank characteristics show the banks are formed of root-bound clay further upstream and downstream of the culvert. Riparian vegetation consisted of a high density of continuous shrubs and deciduous trees on the bank top, which cause the stream to be overgrown and shaded. The channel is concrete lined for several metres from the culvert both upstream and downstream (Photo 1). Existing pressures include the culvert under the M23 embankment and a pipe crossing close to south side of culvert (Photo 2). No survey has currently been undertaken for Burstow Stream, however this information will be collected for the ES.

5 Future baseline

5.1 Initial Construction Phase: 2024-2029

5.1.1 It is anticipated that climate change would not have a significant impact on the geomorphology before 2029 when compared to the baseline assessment. Therefore, no climate change effects have been considered for the initial construction phase. There will be some evolution of the watercourses due to natural adjustment.

5.2 First Full Year of Opening: 2029

5.2.1 It is anticipated that airport growth and any effects from climate change would not have a significant effect on geomorphology when compared to the baseline assessment. Therefore, changes to the baseline are not expected for the first year of opening (2029), with exception for continued evolution of the watercourses due to natural adjustment.

5.3 Interim Assessment Year: 2032

5.3.1 It is anticipated that airport growth and any effects from climate change would not have a significant effect on geomorphology when compared to the baseline assessment. Therefore, changes to the baseline are not expected for the interim assessment year (2032), with exception for continued evolution of the watercourses due to natural adjustment.

5.4 Design Year: 2038

Evolution due to Climate Change

5.4.1 Over a medium to long-term time period, climate change could potentially alter the hydrological regime of the watercourses. Increased frequency/severity of droughts and floods could potentially lead to the watercourses adjusting to different patterns of erosion and deposition. However, it is likely that the adjustment would remain localised and of relatively low magnitude given the modified channel types.

Evolution due to Natural Adjustment.

5.4.2 The River Mole and Gatwick Stream are currently exhibiting some evidence of channel adjustment. These channels have been assessed as having a low to moderate energy, with limited competence to actively move the course of the planform. It is anticipated that if left undisturbed, the watercourses would continue to adjust slowly laterally and potentially through incision within the defined wider corridor so that over time the baseline will change. The remaining watercourses in the study area exhibited less evidence of adjustment, with lower energies, and are considered unlikely to adjust significantly so channel adjustment is not expected.

Evolution due to Meeting Policy Objectives

5.4.3 The Thames River Basin Management Plan (RBMP) provides details of the anticipated ecological status (which is partly dependent on stream morphology) for the WER water bodies within the study area by 2027 (Defra, 2015). It is anticipated that WER water body status and the quality elements (including hydromorphology) would improve with implementation of local measures specified by the Thames RBMP. It is therefore anticipated that some of the lower quality (poor and moderate) WER water bodies will begin to move towards good status/potential by the design year.

5.4.4 The Thames RBMP outlines future local measures in the River Mole catchment, these are listed in full in Appendix 11.9.2: WER Assessment. Of note are the following which could lead to improvement in individual quality elements: tackling non-native species, removal of fish barriers, and restoration of more natural morphology where man-made modifications exist (Defra, 2015).

6 Mitigation

6.1 Initial Construction Phase: 2024-2029

6.1.1 Construction impacts would be mitigated through best practice measures outlined in the Code of Construction Practice (CoCP). The implementation of these measures would lessen the magnitude of the impact, for example by reducing the amount of fine sediment washed into the channel downstream of the works. This will reduce the length of the channel adversely impacted and the duration of impact.

6.1.2 Diversion of the River Mole would begin in 2024 and would require excavation and earthworks along a 400-metre length of the existing channel. Best practice measures implemented through the CoCP and the offline construction of the diversion channel would reduce the release of fine sediments to the channel and downstream and reduce the likelihood of any unexpected large-scale change. The length of the channel adversely impacted, and duration of the impact would be reduced. The works will deliver an overall improvement to the geomorphology of the watercourse through re-meandering and naturalisation of the channel.

6.1.3 Construction of the Museum Field FCA and the East of Museum Field FCA would begin in 2024 and would involve lowering the existing ground level by up to 3.5 metres and 1.8 metres, respectively. The floodplain compensation areas would connect to the watercourse by lowering the stream bank of the River Mole. Construction impacts should be mitigated through best practice measures outlined in the CoCP. For example, this would include reducing the amount of fine sediment washed downstream in the River Mole.

6.1.4 Construction impacts associated to lowering of car park X to provide a compensatory floodplain storage area and extension to the River Mole culvert and siphon will also be mitigated through best practice measures outlined in the CoCP.

6.2 First Full Year of Opening: 2029

6.2.1 During the first full year of opening, impacts to the geomorphology would be caused through construction of the South Terminal and North Terminal surface access arrangements which would begin in 2029. This would involve extension of Burstow Stream tributary culvert. It would also involve development in the floodplain, and new and modified outfalls connecting to highway drainage attenuation basins on Burstow Stream Tributary and Burstow Stream. Ongoing adjustment of the geomorphology is expected to continue as the watercourses adapts and adjust to construction works associated with various watercourses. Best practice measures to mitigate the construction impacts would continue to control the impacts.

6.3 Interim Assessment Year: 2032

6.3.1 Impacts to the geomorphology of the channels during this time would be caused through construction of the Longbridge Roundabout surface access arrangements which would begin in 2031. This would involve widening the existing overbridge at the River Mole by 5-6 metres, development in the floodplain to accommodate widening and modifications to the A23 and two outfalls connecting to highway drainage attenuation basins. Best practice measures to mitigate the construction impacts would continue to control the impacts, for example minimising riparian vegetation clearance to maintain bank stability.

6.4 Design Year: 2038

6.4.1 During the design year, impacts to the geomorphology of the channels would be caused through construction of the Gatwick Stream flood compensation area which would begin in 2036, and through operational activities. The works to create the Gatwick Stream flood compensation area would involve lowering the existing ground level by up to 5 metres. The floodplain compensation area would connect to the watercourse by lowering the stream bank. Construction impacts should be mitigated through best practice measures outlined in the CoCP. For example, the amount of fine sediments washed downstream would be reduced. This would reduce the length of the channel adversely impacted and the duration of impact.

6.4.2 Operational activities have the potential to impact on the geomorphology of the watercourses. These impacts are associated with the flood risk mitigation which includes channel diversion, creation of flood storage areas and extension of culverts. Impacts are also associated with the change to road layouts, as part of the Project works, which involve the extension of culverts. The impact of these elements can be reduced through the implementation of the following design recommendations that have been incorporated in principal at this stage and should be developed as the design develops:

- Flood compensation areas:
  - Varied bank form where banks are being lowered/altered to improve natural variance of flow in the channel.
  - Ecological planting to restore natural vegetation to the floodplain.
  - Soft/bio engineering would be used in preference to concrete where natural banks require protection at the connecting spillways to the new flood compensation areas, e.g. pre-seeded coir matting. Provides opportunity to re-plant riparian vegetation and stabilise the bank.
- Channel diversion:
  - Timing of works to allow diversion channel to vegetate over before flow is initiated to reduce likelihood large-scale change and release of fine sediments downstream.
  - Varied cross sections to mimic natural process, bed and bank forms.
  - Addition of suitable substrate.
  - Suitable river type for the bed gradient of the realignment to maintain sediment transport capability.
  - Creation of a more natural planform to improve floodplain coupling and flow regime.
  - Multiple stage channel to ensure natural and varied flow conditions (not only the 1:100-year flow).
  - Movement of sediment downstream if deposition occurs along diversion (maintenance).
- Culvert extension:
  - Depress invert to maintain sediment transport capability.
  - Keep natural bed gradient.
  - Designed with splayed wing walls to reduce the light and dark barrier.
  - Inclusion of baffles or low flow channel to retain sediment in the culvert and create suitable depth of flow under a range of conditions.

6.4.3 Other geomorphological impacts related to access arrangements can be offset by improvements and environmental enhancement in other areas of the catchment. Such embedded mitigation includes landscaping and ecological planting on the newly created floodplain compensation areas.

6.5 Monitoring

6.5.1 Regular monitoring of any change to the channel bed and banks could be undertaken, particularly in the vicinity of the River Mole channel diversion, following completion of the Project. This could be undertaken using fixed point photography. If negative change occurs, appropriate mitigation should be implemented. It is anticipated that monitoring will be included as a requirement in the DCO.

7 Impact Assessment

7.1 Assessment of Effects

7.1.1 The effects of the Project on the water environment along with a methodology as to how the effects have been assessed are presented within Chapter 11: Water Environment, Section 11.4. A summary of the effects on geomorphological elements during the construction and operational phases of the development are summarised below. These effects have been assessed with the mitigation outlined in Section 6 in place.

7.2 Initial Construction Phase: 2024-2029

7.2.1 This section considers the potential effects of the activities that are likely to be carried out during initial construction phase of the Project. The construction activities are outlined in the PEIR Chapter 5: Project Description. Each receptor has been assessed for the impacts in Table 7.2.1.

Table 7.2.1: Initial Construction Phase Impacts for Geomorphology

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
General construction activities relating to the Project have potential impacts on all watercourses. These may include: ▪ Increase to suspended sediment loads due to channel disturbance from working in the channel, and runoff from construction areas. Impacts sediment transport and bed substrate downstream. This would have a localised impact on the geomorphology of the channel due to the CoCP mitigation that will be put in place, that reduces the release of fine sediment into the channel, for example through use of a silt barrier or filter fence. ▪ Localised increase in potential for erosion of bed and banks due to excavation and earthworks, and removal of riparian vegetation. The CoCP mitigation would also reduce the potential for erosion by use of temporary bank and bed protection and re-establishment of riparian vegetation, where necessary. ▪ Localised loss of and damage to riparian vegetation due to vegetation clearance. The CoCP mitigation reduces the impact by re-establishment of riparian vegetation and minimising area impacted. ▪ Localised disruption of quantity and dynamics of flow and sediment supply, due to changes in bed and bank form during construction. The CoCP mitigation reduces the impact by minimising the area impacted and protecting bed and banks where necessary.	River Mole	Medium-term	High	Negligible Adverse	Minor Adverse
	Gatwick Stream	Medium-term	High	Negligible Adverse	Minor Adverse
	Crawter's Brook	Medium-term	High	Negligible Adverse	Minor Adverse
	Burstow Stream Tributary	Medium-term	Low	Negligible Adverse	Negligible Adverse
	Burstow Stream	Medium-term	Medium	Negligible Adverse	Minor Adverse
Construction of the River Mole diversion may require excavation and earthworks along a 400-metre length of existing channel. These activities may impact the existing watercourse by: ▪ Localised destabilisation of banks due to bank top loading and ground vibration. The CoCP mitigation follows best practice measures which would minimise works on the bank top and reduce the potential for instability using temporary bank and bed protection, where necessary. ▪ Localised damage to bank face due to modification and removal of bank material. The impacts are localised as the works only require a small section of bank for connecting the channel to the diversion channel.	River Mole	Medium-term	High	Low Adverse	Minor Adverse

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
▪ Local to reach scale loss of natural bed forms and materials due to infilled original channel. The CoCP mitigation would involve addition of suitable substrate to the diversion channel to create the natural bed conditions for the given river type. ▪ Local destabilisation of banks due to vegetation clearance, as vegetation binds the bank material and draws water. The CoCP mitigation reduces the duration and scale of the impact by re-establishment of riparian vegetation following works and by minimising the area impacted. ▪ Change in the quantity and dynamics of flow and sediment supply, due to changes in bed and bank form, channel planform, cross-section and gradients, as the channel adjusts. Best practice measures implemented through the CoCP and the offline construction of the diversion channel would reduce the release of fine sediments to the channel and downstream and reduce the likelihood of any unexpected large-scale change. The length of the channel adversely impacted, and duration of the impact would be reduced with offline construction of the channel diversion and implementation of best practice measures through the CoCP. Although natural bed and bank forms in the existing channel would be lost, the works would deliver an overall improvement to the geomorphology of the watercourse through re-meandering and naturalisation of the diversion channel. Therefore, the overall significance is Minor Adverse.					
Construction of the culvert extension and re-provisioning of the siphon north of runway would have the permanent effect of loss of existing bed and bank form and material, and riparian vegetation. This can result in localised disruption of quantity and dynamics of flow and sediment supply. The CoCP mitigation reduces the impact by re-establishment of riparian vegetation and minimising area impacted. The area potentially impacted is also relatively small, and part of the existing culvert would be replaced. There is the potential increase to suspended sediment loads due to channel disturbance from working in the channel. This would have a localised impact on the geomorphology of the channel due to the CoCP mitigation that will be put in place to reduce these effects.	River Mole	Medium-term	High	Negligible Adverse	Minor Adverse
The construction of the Museum Field flood compensation area (FCA) would involve lowering the existing ground level on the floodplain by up to approximately 3.5 metres below ground level. The FCA would connect to the River Mole via a spillway which would involve lowering the watercourse bank. These activities may impact the watercourse by: ▪ Localised damage to bank face due to modification and removal of bank material. The impacts would be localised as the works would only require a small section of bank for the spillway connection. The CoCP mitigation would also reduce the impact by minimising the area impacted and replacing natural bank material, where possible. ▪ Localised loss of natural bed forms and materials due to excavation works. The impacts would be localised as the works only require a small section of bed for the spillway connection. The CoCP mitigation would also reduce the impact by minimising the area impacted and replacing natural bed material, where possible. ▪ Destabilisation of banks due to vegetation clearance, as vegetation binds the bank material and draws water. The impacts would be localised as the works only require a small section of bank for the spillway connection. The CoCP mitigation also reduces the duration and scale of the impact by re-establishment of riparian vegetation following works and by minimising the area impacted. ▪ Localised disruption of quantity and dynamics of flow and sediment supply, and release of fine sediments into the channel. This would occur due to changes in bed and bank form, channel planform, cross-section and gradients as the channel adjusts. The impacts would be localised as the works only require a small section of bank and bed for the spillway connection. This would have a temporary and localised impact on the	River Mole	Medium-term	High	Low Adverse	Minor Adverse

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
geomorphology of the channel due to the CoCP mitigation that would be put in place, which would reduce the release of fine sediment into the channel, e.g. through use of silt barriers or filter fences during construction. The impacts would be localised and mostly temporary with the provision of best practice measures adopted through the CoCP, therefore the overall significance would be Minor Adverse.					
The construction of a new flood compensation area is proposed between the River Mole diversion and Museum Field, also known as East of Museum Field, FCA 3. This would require lowering of the ground levels on the floodplain by up to approximately 1.8 metres below ground level. The area is expected to be returned to grassland following completion of the excavation works. These activities would have the effect of increased sediment loading within the River Mole during construction. The impact would be localised as the FCA is set back from the watercourse and implementation CoCP mitigation would reduce the release of fine sediments entering the channel. The spillway from Museum Field is anticipated to pass through FCA 3, connecting to the River Mole. Impacts on the watercourse are localised around the construction of the spillway, which are part of the Museum Field FCA.	River Mole	Medium-term	High	Negligible Adverse	Minor Adverse
The works to provide a compensatory floodplain storage area in car park X, south of Crawter's Brook, would involve lowering of the car park ground level by a depth of up to 2.5 metres. The flood compensation area would connect to the River Mole downstream via an outfall structure, which may take the form of a flapped culvert. The construction of the outfall headwall would impact the watercourse by: ▪ localised damage to bank face due to modification and removal of bank material as the works only require a small area of the bank for the outfall. ▪ temporary release of fine sediments into the watercourse and sediment pollution. This would have a localised impact on the geomorphology of the channel due to the CoCP mitigation that would be put in place, which reduces the release of fine sediment into the channel.	River Mole	Medium-term	High	Negligible Adverse	Minor Adverse
Ground lowering and increase of the depth of water in the floodplain in car park X would have the effect of increased sediment loading within Crawter's Brook during construction. The impact would be localised as the car park is set back from the watercourse and implementation CoCP mitigation would reduce the release of find sediments entering the channel.	Crawter's Brook	Short-term	High	Negligible Adverse	Minor Adverse

7.3 First Full Year of Opening: 2029

7.3.1 This section considers the potential effects of the activities that are likely to be carried out during first full year of opening of the Project. The activities are outlined in the PEIR Chapter 5: Project Description. The receptor has been assessed for the impacts in Table 7.3.1.

Table 7.3.1: First Full Year of Opening Impacts for Geomorphology

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
Construction of new surface access arrangements (South Terminal) would involve the M23 road widening and culvert extension on Burstow Stream Tributary, and an attenuation pond adjacent to Balcombe Road with flow control on the outfall drain to Burstow Stream Tributary downstream of the culvert. These activities may impact the watercourse by localised disruption of quantity and dynamics of flow and sediment supply. This would occur due to changes in bank and bed form, channel cross-section and gradient, temporary release of fine sediments into the watercourse and sediment pollution runoff from construction areas. The impacts would be localised as the works	Burstow Stream Tributary	Short-term	Low	Negligible Adverse	Minor Adverse

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
only require a small section of bank for culvert extension and concrete headwall for the outfall, and there is existing concrete lining along the upstream and downstream of the culvert. The impacts would be mostly temporary with the provision of best practice measures adopted through the CoCP.					
Construction of new surface access arrangements (South Terminal) would involve widening of the M23 spur, and modification and improvements to the existing attenuation pond, and the drains and outfalls which connect to Burstow Stream. These activities may impact the watercourse by localised disruption of quantity and dynamics of flow and sediment supply. This would occur due to changes in bank form and temporary release of fine sediments into the watercourse and sediment pollution runoff from construction areas. The impacts would be localised as the works only require a small section of bank for the outfall, and modifications on the floodplain are setback from the watercourse. The impacts would be mostly temporary with the provision of best practice measures adopted through the CoCP.	Burstow Stream	Short-term	Medium	Negligible Adverse	Minor Adverse
Construction of new surface access arrangements (North Terminal) would be setback from the watercourse, however there is the potential for sediment pollution due to runoff from construction areas. Outfalls will be constructed on the River Mole and Gatwick Stream connecting to a highway drainage attenuation tank and pond, respectively. The construction of the outfall headwalls would impact the watercourse by localised disruption of quantity and dynamics of flow and sediment supply. This would occur due to: ▪ localised damage to bank face due to modification and removal of bank material and riparian vegetation as the works only require a small area of the bank for the outfall ▪ temporary release of fine sediments into the watercourse and sediment pollution runoff from construction areas This would have a localised impact on the geomorphology of the channel due to the CoCP mitigation that would be put in place, that reduces the release of fine sediment into the channel.	Gatwick Stream, River Mole	Short-term	High	Negligible Adverse	Minor Adverse
Construction of new surface access arrangements at Longbridge Roundabout would include widening the existing overbridge at the River Mole by 5-6 metres, development in the floodplain to accommodate widening and modifications to the A23, and two concrete headwalls for the new outfalls connecting the highway drainage attenuation basins. The construction of the outfall headwall would impact the watercourse by localised disruption of quantity and dynamics of flow and sediment supply. This would occur due to: ▪ localised damage to bank face due to modification and removal of bank material and riparian vegetation as the works only require a small area of the bank for the outfall ▪ temporary release of fine sediments into the watercourse and sediment pollution runoff from construction areas This would have a localised impact on the geomorphology of the channel due to the CoCP mitigation that would be put in place. The effects would be minor adverse which is not significant.	River Mole	Short-term	High	Negligible Adverse	Minor Adverse
Change to the geomorphology of the watercourse is expected to continue as the watercourses adapt and adjust to associated construction works. Best practice measures to mitigate the construction impacts through the CoCP would continue to control the impacts, as described in Section 7.2.	River Mole, Gatwick Stream, Crawter's Brook, Burstow Stream Tributary, Burstow Stream	Medium-term	High to Low	Negligible Adverse	Minor Adverse - Gatwick Stream, River Mole and Crawter's Brook, Burstow Stream Negligible – Burstow Stream Tributary

7.4 Interim Assessment Year: 2032

7.4.1 This section considers the potential effects of the activities that are likely to be carried out during the interim assessment year of the project. The activities are outlined in the PEIR Chapter 5: Project Description. The receptor has been assessed for the impacts in Table 7.4.1.

Table 7.4.1: Interim Assessment Year Impacts for Geomorphology

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
The construction of the east of Gatwick Stream FCA would involve lowering the existing ground level by up to 5 metres and lowering of the stream bank to connect the watercourse to the FCA. These construction activities may impact the watercourse by: ▪ Localised damage to bank face due to modification and removal of bank material. The impacts are localised as the works only require a small section of bank for the spillway connection. The CoCP mitigation will also reduce the impact by minimising the area impacted and replacing natural bank material, where possible. ▪ Localised loss of natural bed forms and materials due to excavation works. The impacts would be localised as the works only require a small section of bed for the spillway connection. The CoCP mitigation would also reduce the impact by minimising the area impacted and replacing natural bed material, where possible. ▪ Destabilisation of banks due to vegetation clearance, as vegetation binds the bank material and draws water. The impacts are localised as the works only require a small section of bank for the spillway connection. The CoCP mitigation would also reduce the duration and scale of the impact by re-establishment of riparian vegetation following works and by minimising the area impacted. ▪ Localised disruption of quantity and dynamics of flow and sediment supply, and release of fine sediments into the channel. This would occur due to changes in bed and bank form, channel planform, cross-section and gradients, as the channel adjusts. The impacts would be localised as the works only require a small section of bank and bed for the spillway connection. This would have a temporary and localised impact on the geomorphology of the channel due to the CoCP mitigation that will be put in place, which reduces the release of fine sediment into the channel, eg through use of silt barriers or filter fences during construction. The impacts would be localised and mostly temporary with the provision of best practice measures adopted through the CoCP, therefore the overall significance is Minor Adverse.	Gatwick Stream	Medium-term	High	Low Adverse	Minor Adverse
Change to the geomorphology of the watercourse is expected to continue as the watercourses adapt and adjust to associated construction works. Best practice measures to mitigate the construction impacts through the CoCP would continue to control the impacts, as described in Section 7.2.	River Mole, Gatwick Stream, Crawter's Brook, Burstow Stream, Burstow Stream Tributary	Medium-term	High to Low	Negligible Adverse	Minor Adverse - Gatwick Stream, River Mole and Crawter's Brook, Burstow Stream Negligible – Burstow Stream Tributary

7.5 Design Year: 2038

7.5.1 This section mainly considers the potential effects of the operational activities and are considered long-term impacts. Often it is difficult to quantify the magnitude of long term impacts due to the timescales over which they may occur and the resilience of the environment to adapt to future changes, therefore expert judgement is used to undertake the assessment. Each receptor has been assessed for the impacts in Table 7.5.1.

Table 7.5.1: Design Year Impacts for Geomorphology

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
Gatwick Stream flood compensation area and connecting spillway					
Creation of the flood storage area and connecting spillway would improve floodplain-channel coupling during flood conditions. Lowering the banks for connecting the spillway to the flood storage area has the effect of localised loss of existing bank form. However, the impact would be reduced with mitigation designed to vary bank form where banks are being lowered/altered, which would maintain or improve natural variance of flow in the channel. Ground lowering and planting of grassland in flood storage areas has the effect of loss of natural floodplain vegetation. These alterations to the baseline could encourage erosion of the banks and bed along the connecting spillway during flood events. The scale impacts would be reduced with mitigation including ecological planting to restore natural vegetation to the floodplain and use of soft/bio engineered bank protection if banks need to be protected. The length of bank impacted is relatively small and the flood storage area is set back from the watercourse. Furthermore, enough time would have passed since the construction phase for the river to naturally adjust and for vegetation to establish on the banks to aid bank stability. Therefore, the significance of the impact is Minor Adverse.	Gatwick Stream	Long-term	High	Low Adverse	Minor Adverse
Diversion of the Mole north of runway in two-stage channel					
Reinstatement of a more naturalised planform and morphology of the section of the River Mole has the long-term effect of improving the flow regime and channel diversity along the section of the diversion and downstream. Floodplain improvements and re-meandering improves floodplain-coupling. Planting of natural floodplain vegetation has the effect of improving riparian habitats and improving bank stability, downstream sediment dynamics and flow regime. The impacts would improve the geomorphology of the watercourse at a multi-reach scale, as many of the impacts would affect the watercourse downstream, e.g. sediment dynamics and flow regime. The effect would also be long-term and therefore significance of the impact is considered Moderate Beneficial.	River Mole	Long-term	High	Medium Beneficial	Moderate Beneficial
There is potential for reduction in water velocity along the river diversion, which may cause deposition at this location, and sediment starvation and erosion downstream. These changes would arise due to the changes in cross-sectional form and channel gradient. Detailed design work on the diversion channel mitigates these effects. This mitigation would include creating a suitable river type for the bed gradient of the realignment to maintain sediment transport capability; and, a multiple stage channel to ensure natural and varied flow conditions; creation of varied cross-sections to mimic natural process, bed and bank forms; and, addition of suitable substrate. The impact is local to reach scale, however with appropriate design of the diversion channel, the scale of the impact would be reduced. Natural channel adjustment would also be expected during the operational phase. Therefore, the overall significance of the impact is Minor Adverse.	River Mole	Long-term	High	Low Adverse	Minor Adverse

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
Culvert extension and re-provisioning of siphon north of runway					
Extension of the culvert and concrete channel lining would have the permanent effect of loss of existing bed and bank form and material, and riparian vegetation. The homogeneity of the new channel cross-section creates the potential for loss of natural variance in velocities and secondary flows cells, leading to changes in velocity and geomorphological processes. The area potentially impacted is relatively small, and part of the existing culvert would be replaced. Provision of the River Mole diversion channel and other culvert design features (Section 6.4) would act to mitigate these effects.	River Mole	Long-term	High	Negligible Adverse	Minor Adverse
Flood compensation area in Museum Field and connecting spillway					
Creation of the flood compensation area and connecting spillway would improve floodplain-channel coupling during flood conditions. Lowering the banks for connecting the spillway to the flood compensation area has the effect of localised loss of existing bank form. However, the impact would be reduced with mitigation designed to vary bank form where banks are being lowered/altered, which would maintain or improve natural variance of flow in the channel. Ground lowering and planting of grassland in the flood storage area has the effect of loss of natural floodplain vegetation. These alterations to the baseline could encourage erosion of the banks and bed along the connecting spillway during flood events. The scale of impacts would be reduced with mitigation including ecological planting to restore natural vegetation to the floodplain and use of soft/bio engineered bank protection if banks need to be protected. The length of bank impacted would be relatively small and not entirely natural, and the flood storage area is set back from the watercourse. Furthermore, enough time would have passed since the construction phase for the river to naturally adjust and for vegetation to establish on the banks to aid bank stability. Therefore, the significance of the impact is Minor Adverse.	River Mole	Long-term	High	Low Adverse	Minor Adverse
Creation of the flood compensation area at FCA 3, East of Museum Field, would improve floodplain-channel coupling during flood conditions. Ground lowering in the flood storage area has the effect of loss of natural floodplain vegetation, which could encourage erosion of the FCA and spillway bed during flood conditions, inputting eroded sediment into the watercourse. The scale of impacts would be reduced with mitigation including ecological planting to restore natural vegetation to the floodplain. Furthermore, enough time would have passed since the construction phase for vegetation to establish. Therefore, the significance of the impact is Negligible Adverse.	River Mole	Long--term	High	Negligible Adverse	Minor Adverse
Flood attenuation and ground lowering in Car Park X					
Ground lowering and increase to depth of water in the floodplain in Car Park X has the effect of reduction in area of floodplain-channel coupling. The area impacted is relatively small and set back from the watercourse.	Crawter's Brook	Long-term	High	Negligible Adverse	Minor Adverse
Construction of the outfall headwall from the compensatory floodplain storage area has the effect of loss of existing banks and localised changes to sediment transfer and flow patterns in the channel. The length of channel impacted is relatively small.	River Mole	Long-term	High	Negligible Adverse	Minor Adverse
New surface access arrangements					
New surface access arrangements (North Terminal) Permanent change to the baseline would include loss of floodplain and natural vegetation due to encroachment of highway footprint onto existing natural floodplain. The footprint is set back from the watercourse.	Gatwick Stream, River Mole	Long-term	High	Negligible Adverse	Minor Adverse

Description of Impact	Receptor	Duration	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect
Construction of the outfall headwall from the highway drainage attenuation tank and pond has the effect of loss of natural banks and localised changes to sediment transfer and flow patterns in the channel. Flow control on the outfall drain and filtering of pollutants would reduce the impact on flow and sediment transfer. The length of channel impacted is relatively small.					
New surface access arrangements (South Terminal) Permanent change to the baseline would include loss of natural bed and bank form, and riparian vegetation due to the M23 road widening and culvert extension. Homogeneity of the channel cross-section has the potential for loss of natural variance in velocities and secondary flow cells, leading to changes in velocity and geomorphological processes. There is existing concrete lining along the upstream and downstream of the culvert on Burstow Stream Tributary and only a relatively small area is potentially impacted on both watercourses. Permanent loss of natural banks and localised changes to sediment transfer and flow patterns in the channel would occur due to creation of a new concrete outfall headwall connecting the highway drainage attenuation pond adjacent to Balcombe Road. Flow control on the outfall drain and filtering of pollutants would reduce the impact on flow and sediment transfer. The length of channel impacted is relatively small.	Burstow Stream Tributary	Long-term	Low	Negligible Adverse	Negligible Adverse
New surface access arrangements (South Terminal) Permanent loss of existing banks and localised changes to sediment transfer and flow patterns in the channel would occur due to modifications and improvements the existing attenuation pond, drains and outfall connecting to the Burstow Stream. Flow control on the outfall drain and filtering of pollutants would reduce the impact on flow and sediment transfer. Permanent change to the baseline would also include loss of floodplain and natural vegetation due to encroachment of highways footprint onto existing natural floodplain. The length of channel impacted is relatively small as existing structures will be modified and/or improved. The works on the floodplain are setback from the watercourse.	Burstow Stream	Long-term	Medium	Negligible Adverse	Minor Adverse
New surface access arrangements (Longbridge Roundabout) Permanent change to the baseline would include loss of floodplain and natural vegetation due to encroachment of highway footprint onto existing natural floodplain. Permanent change to the baseline would also include loss of natural bed and bank form, localised changes to sediment transfer and flow patterns, and loss natural riparian vegetation, due to the widening and modifications on the existing overbridge and two concrete outfall headwalls connecting the highway drainage attenuation basins. Flow control on the outfall drain and filtering of pollutants would reduce the impact on flow and sediment transfer. The length of channel impacted is relatively small.	River Mole	Long-term	High	Negligible Adverse	Minor Adverse

8 Summary

8.1.1 This assessment evaluates the potential impacts of the Project and the embedded flood mitigation measures on the geomorphology of watercourses in the study area, during the construction and operational phases of the Project. The assessment found that during the initial construction phase of the Project, there would be minor adverse impacts on the River Mole associated to construction of the channel diversion and creation of flood compensation areas which are part of the embedded flood mitigation. The effects would be temporary, however, and the channel diversion works would deliver an overall improvement to the geomorphology of the watercourse, supporting WER objectives during operation. There would be negligible to minor adverse impacts during construction works, including creation of the compensatory floodplain storage area in car park X and extension of the River Mole syphon and culvert. These impacts assume the provision of mitigation and best practice measures through the CoCP. During the first full year of operation, there would be a negligible to minor adverse impact on the watercourses as they adapt and adjust to associated construction works. There would be minor adverse impacts through the construction of the new surface access arrangements at the South Terminal and North Terminal, with the provision of mitigation and best practice measures through the CoCP. During the interim assessment year of the Project, there would be minor adverse impacts on the Gatwick Stream associated to construction of the Gatwick Stream flood compensation area, with the provision of mitigation and best practice measures through the CoCP. During the design year, there would be minor to negligible adverse impacts associated to operational activities on the watercourses. These relate to the River Mole channel diversion, flood compensation areas and culvert extensions. There would be a moderate beneficial impact on the River Mole with the implementation of the mitigation proposed and further detailed design work. Other remaining impacts on the watercourses associated to the Project, such as new access arrangements, would be offset by improvements and environmental enhancement in other areas of the catchment, as part of the embedded mitigation.

9 References

British Geological Survey, 2019. *Geology of Britain Viewer.* [Online]
Available at:
[redacted]
[Accessed 1 August 2019].

Centre for Ecology & Hydrology, 2019. *Data.* [Online]
Available at: [redacted]
[Accessed 1 August 2019].

DEFRA, 2015. *Thames River Basin District River Basin Management Plan.* [Online]
Available at: http://gov.uk/government/publications/thames-river-basin-district-river-basin-management-plan
[Accessed 1 August 2019].

Environment Agency, 2009. *River Basin Management Plan glossary,* London: Environment Agency.

Environment Agency, 2021. *Catchment Data Explorer.* [Online]
Available at: https://environment.data.gov.uk › catchment-planning
[Accessed 1 April 2021].

GAL, 2019. *Scoping Report,* London: GAL.

National Library of Scotland, 2019. *Map Images.* [Online]
Available at: [redacted]
[Accessed 1 August 2019].

Osterkamp, W. R., 2008. Annotated Definitions of Selected Geomorphic Terms and Related Terms of Hydrology, Sedimentology, Soil Science and Ecology. *Open File Report, USGS,* p. 49.

10 Glossary

10.1 List of Acronyms

Table 10.1.1: List of Acronyms

Term	Definition
CoCP	Code of Construction Practice
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
FCA	Flood compensation area
GAL	Gatwick Airport Limited
OS	Ordnance Survey
PEIR	Preliminary Environmental Information Report
RBMP	River Basin Management Plan
STW	Sewage Treatment Works
WER	Water Environment (Water Framework Directive) (England and Wales) Regulations (WER) 2017
WFD	Water Framework Directive

10.2 Glossary of terms

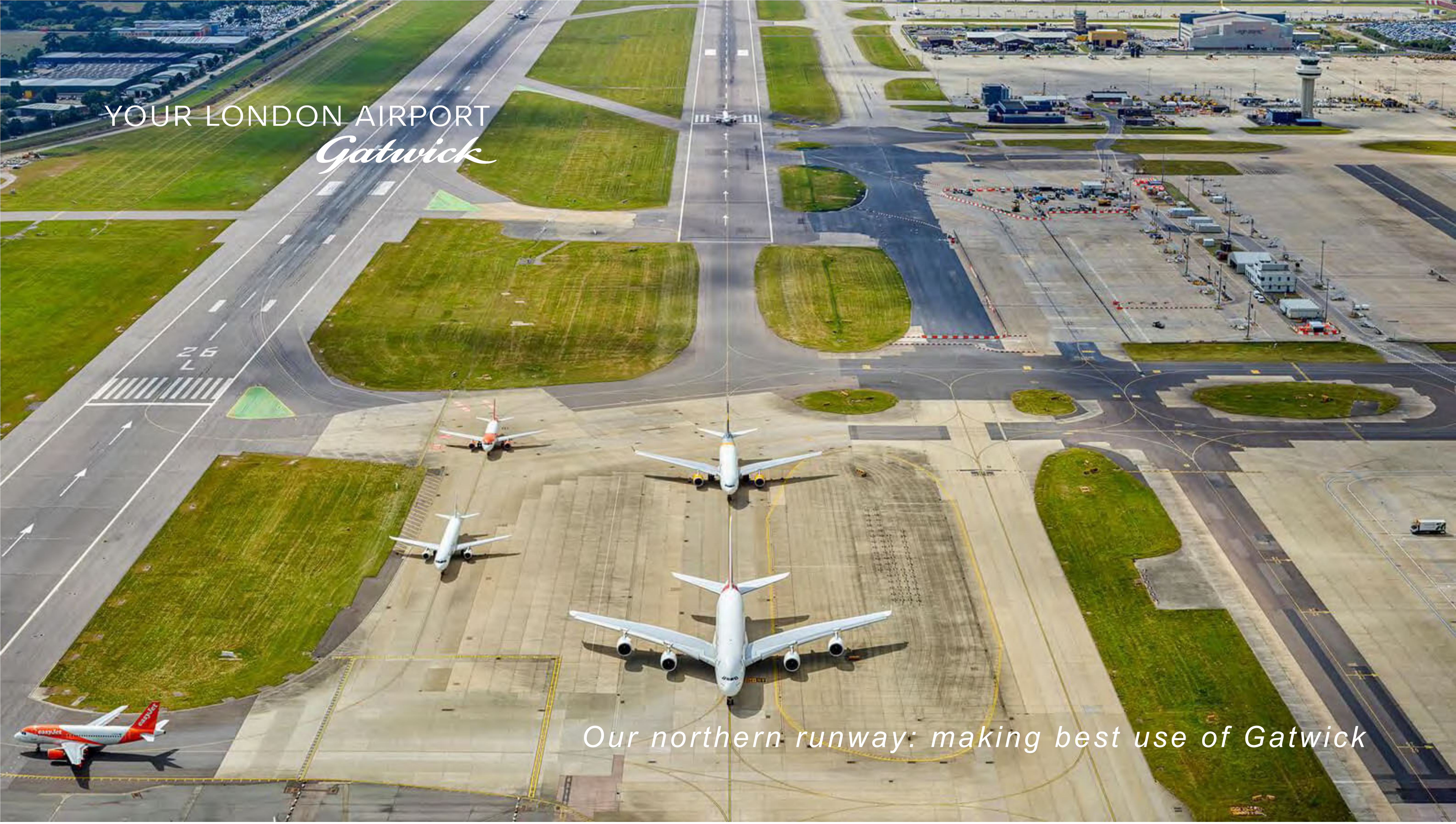
Table 10.2.1: Glossary (adapted from Osterkamp, 2008; Environment Agency, 2009)

Term	Description
Adjustment	The tendency of stream channels to change in size and shape in response to the changing effects of water, sediment, dissolved solids, and organic matter that alter them or pass through them.
Bank	A sloping margin of a natural, stream-formed, alluvial channel that confines discharge during non-flood flow. Designation of a right or left bank is done when looking in the downstream direction.
Bank material	The sediment of which the mostly sloping sides, or banks, of a stream channel are formed; like bed material, it is mostly

Term	Description
	indicative of the suspended-load transported by streams during non-flood periods.
Bars	In-channel sediment of relatively coarse bed material, typically coarse sand through cobbles in size, that is generally deposited during the recession of a high flow and is mostly exposed during periods of low flow. Bars may become vegetated when stable.
Bed	Bottom surface of a watercourse upon which water and sediment moves during periods of discharge.
Bed material	Sediment of which the mostly horizontal bed of a stream channel is formed; it is mostly indicative of the bed-load sizes transported by the stream
Catchment	The area from which precipitation contributes to the flow in a borehole spring, river or lake. This includes tributaries and the areas they drain.
Channel	A natural, or constructed, passageway or depression of perceptible linear extent containing continuously or periodically flowing water and sediment, or a connecting link between two bodies of water.
Channel erosion	Detachment and transport, possibly followed quickly by re-deposition, of channel bed or bank material by concentrated flow in areas of open-channel flow.
Conveyance	A measure of the amount of water that can pass through a stream-channel section without spilling onto higher surfaces as flood flow.
Deposition	Accumulation into beds or irregular masses of loose sediment or other rock material by any natural agent.
Discharge	The movement downstream per unit length of channel of a volume of water; water discharge is given in volume per unit time, typically cubic meters per second ($m^3 s^{-1}$).
Disturbance	Any short-term alteration, natural or imposed, of the land surface that results in a change of

Term	Description
	geomorphic, hydrologic, or biological processes from a state of approximate equilibrium to one of relative instability.
Good status	WFD status achieved by a surface water body when both the ecological status and its chemical status are at least good.
Gradient	The rate of elevation change between two specified sites of horizontal distance measured along the thalweg of the channel; it is generally expressed as a non-dimensional number ($m\ m^{-1}$).
Hydromorphology	Describes the hydrological and geomorphological processes and attributes of surface water bodies.
Morphology	Describes the physical form and condition of a surface water body, for example the width, depth and perimeter of a river channel, the structure and condition of the riverbed and bank.
Pressures	Human activities such as abstraction, effluent discharges or engineering works that have the potential to have adverse effects on the water environment.
Restoration	Applied to stream corridors that have been altered through human activity, is the attempt to recreate the adjusted physical and biological conditions that were present prior to the alteration.
Riparian vegetation	Vegetation in part of the fluvial landscape inundated or saturated by flood flows; the area consists of all surfaces of active fluvial landforms up through the floodplain.
River Basin Management Plan	For each River Basin District, the Water Environment (Water Framework Directive) (England and Wales) Regulations (WER) 2017 requires a River Basin Management Plan to be published. These are plans that set out the environmental objectives for all the water bodies within the River Basin District and how they will be achieved. The plans will be based upon a detailed analysis

Term	Description
	of the pressures on the water bodies and an assessment of their impacts. The plans are reviewed and updated every six years.
Status	The physical, chemical, biological, or ecological quality of a waterbody.
Suspended sediment	Sediment moved in suspension in water and is maintained in suspension by the upward component of turbulent currents or by colloidal suspension.



Preliminary Environmental Information Report
Appendix 11.9.4: Water Supply Assessment

September 2021

1 Baseline Forecast

1.1 General

1.1.1 This document forms Appendix 11.9.4 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description.

1.1.2 This document provides the Water Supply Assessment for the Project.

1.2 Existing Consumption

1.2.1 The following data considers consumption at existing buildings and predictions for changes in demand based on previous studies.

Data Source

1.2.2 In order to complete the calculation of forecasted demands any existing demand forecast information must be verified and amended as necessary. All information used to understand existing and forecast future demands has been taken from a previous study commissioned by GAL, titled 'London Gatwick Water Masterplan 2020 & 2028 Forecast - Full Backing Report' (2018) which has been included as Annex 4.

1.2.3 To confirm and update baseline consumption, the forecasted demands were compared to annual recorded data and the variance calculated. The predicted curve is then re-aligned to actual consumption figures and as the baseline forecast only extends to 2028 the curve was also then extrapolated out to 2039, which is the design horizon for the Project.

Forecasted passenger numbers

1.2.4 From the internal review in 2018, passenger forecasts for both the 2020 and 2028 scenarios (without the Project) are used to help in calculating passenger consumption and forecasting demand. The review projected both best and worst case consumption scenarios for both 2020 and 2028, for the purposes of the Project the 'worst-case' (highest demand) predictions have been included in Table 1.2.1.

Table 1.2.1: Predicted passengers for 2020 and 2028.

Component	2020	2028
Predicted passengers (millions)	48.4	62.8

1.3 Forecasted water consumption

1.3.1 The previous demand study details the forecasted total water consumption for Gatwick for 2017 which was compared with actual metered consumption data, received on 04/09/2019. Table 1.3.1 and Diagram 1.3.1 detail the comparison of the predicted and actual consumption values.

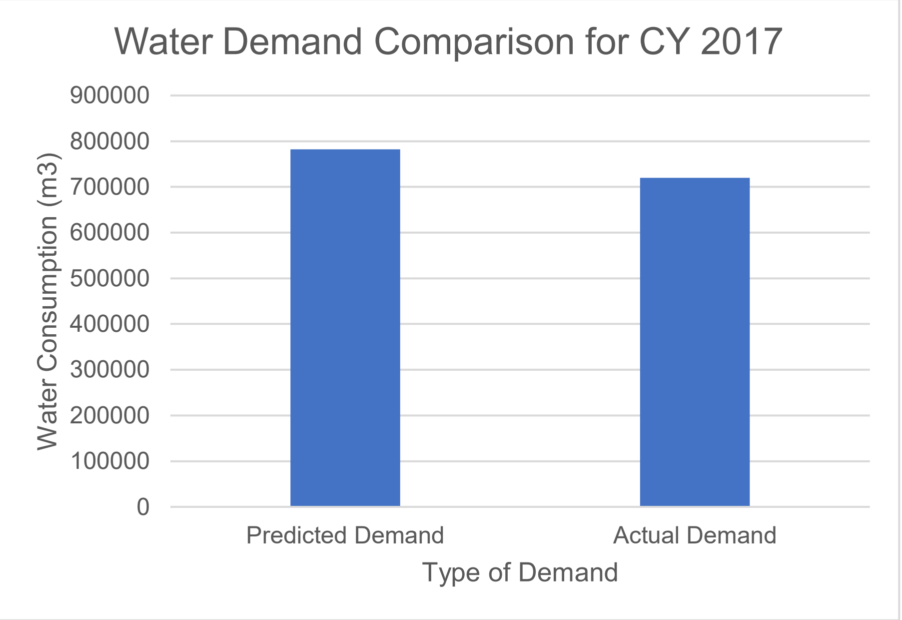
Table 1.3.1: Predicted and Actual demand results for 2017.

Month	Predicted Demand* (m^3/yr)	Actual Demand** (m^3/yr)	Percentage Error
Jan – Jun	362,652	358,034	-1.3%
Jul - Dec	419,290	361,960	-15.8%
Total water consumption	781,942	719,994	-8.6%

*Predicted demand results based from information provided in Water Masterplan 2020 & 2028 Forecast - Full backing report.

**Actual demand data obtained from GAL.

Diagram 1.3.1: Total demand comparison for predicted and actual 2017 data (m^3/year)



1.3.2 There was an over estimation of 61,948 m^3 of water consumption which equated to an 8.604% variance from the predicted to the actual demand for 2017. This percentage variance has been used as a factor to adjust the values for the previously forecasted water consumption years of 2020 and 2028 (see Table 1.3.2 below).

Table 1.3.2: Comparison of Predicted demands and Adjusted predicted demands

Forecasted Year	Third Party Predicted Demand (m^3/yr)	Adjusted Third Party Predictions (m^3/yr)
2020	764,446	703,884
2028	786,052	723,778

1.4 Water Efficiency Measures

1.4.1 The previous study recommended the use of the water efficiency measures summarised in Table 1.4.1. GAL responses indicate that a number of these recommendations have already been implemented on site at Gatwick, as indicated.

Table 1.4.1: List of possible water efficiencies and responses received from GAL.

Water efficiency method	Adoption by GAL
Installation of Automatic Reading Meters	Approximately 14 sub-meters are installed to date. It is planned to gradually increase this over coming years.
Mains pressure reduction to reduce leakage	Pressure reduction has been designed in at mains system level. No pressure reduction has been introduced at campus network level. Majority of networks are combined domestic / fire systems serving hydrants and so no pressure reduction plans are in place for these.
Installation of controllers on basin taps and urinals in offices, workshops and older buildings at Gatwick	Majority of public and staff toilet facilities have flow controllers and taps are generally low flow.
Re-used water for fire-fighting	Currently no system in place for this.
Re-used water for aircraft washing	Currently no system in place for this. Potable water is currently used for aircraft de-icing and vehicle wash down due to the machinery requiring good water quality.
Rainwater harvesting at existing buildings with large roof areas	Technical standards make this a prerequisite for designers to assess for inclusion in all new buildings. To date just one small building has had a system installed and due to a design issue, it has had to be taken out of service. Pier 6 Extension has a rainwater system ‘designed in’ and this is the expectation for all large extension and new build facilities in the future.
Grey water reuse	Technical standards make this a prerequisite for designers to assess for inclusion in all new buildings, however, to date no new build facilities have included this technology. This would not be ruled out to be applied in the future, but a trial location/system needs to be identified to prove the system technology.
	There is a grey water facility airside (water recycled from storm water ponds) that has fallen into disrepair. There are plans to refurbish it in the next 2 years and try to encourage its use for low quality water uses such as irrigation, cleaning, jetting etc. If this is successful there seems a possibility that GAL should/could consider a landside facility. Hotels generate massive opportunity for grey water, which should be investigated.
Automatic reading meters installed at main sewage pump stations and gravity outfall sewer leaving Gatwick (to help identify levels of building water wastage)	Technical standards make this a prerequisite for designers to assess for inclusion in all new buildings, however, to date no new build facilities have included this technology. This would not be ruled out to be applied in the future, but a trial location/system needs to be identified to prove the system technology.
Cooling tower water consumption	There are some old meters and flow measurement, however no reliable Automated Meter Read (AMR) and to date no further work is planned. We would not rule this out in the future.

1.5 Updated Baseline Consumption: Existing Facilities

1.5.1 Table 1.5.1 summarises the baseline forecast of water demand for existing facilities only, updated against actual demand data in 2017 from Section 1.3. This data is based on the annual average flow for 2017 for consistency due to the original baseline consumption using the annual average flow data to obtain their predictions for 2017, 2020 and 2028 in the ‘Water Masterplan 2020 & 2028 Forecast – Full backing report’ included in Annex 4.

1.5.2 The peak flow has also been considered for a peak flow updated baseline consumption as a worst-case scenario based on the peak flow months in 2017 and is detailed in Annex 1.

Table 1.5.1: Comparison of the Average and Peak Flow updated baseline consumption for each forecasted year.

Year Start	Average Flow - Updated Forecasted Baseline Consumption (m^3/yr)	Peak Flow - Updated Forecasted Baseline Consumption (m^3/yr)
2017	719,944	878,332
2018	706,070	861,405
2019	704,977	860,072
2020	703,884	858,738
2021	706,371	861,772
2022	708,858	864,806
2023	711,344	867,840
2024	713,831	870,874
2025	716,318	873,908
2026	718,805	876,941
2027	721,291	879,975
2028	723,778	883,009
2029	726,268	886,047
2030	728,759	889,086
2031	731,251	892,127
2032	733,745	895,169
2033	736,240	898,212
2034	738,735	901,257
2035	741,232	904,303
2036	743,730	907,351
2037	746,229	907,351
2038	748,729	913,449

2 Construction Consumption

2.1 Construction Consumption Criteria

2.1.1 During the construction phase of the project, it is anticipated that there will be extra water demand required, for the contractor and the equipment that may be used such as for dust suppression or equipment cleaning. The construction phase of the programme is to last for 15 years starting in 2023 with pre-construction enabling works and the main works running from 2024 to completion in 2038.

Table 2.1.1: Construction Timing (extract from Chapter 5: Project Description of this PEIR Table 5.5.1)

Element of the Project	Key Parameter for Assessment
Phasing	
Commencement of main construction phase	2024-2029
Year of opening	2029
Completion of construction works	2038

Table 2.1.2: Chronological timeline of construction components of the Project and impact on water supply

Component of the Project	Anticipated Phasing	Influence on water supply during construction?	Influence on water supply after commissioning?
Pre-construction activities (including surveys for any unexploded ordnance and any necessary pre-construction surveys)	2023	No	No
Early works (set up of compounds, fencing, early clearance and diversion works)	2024	Yes	No
Alterations to the existing northern runway	2024 - 2027	No	No
Works to existing taxiways and construction of new taxiways	2029 – 2031	Yes	No
Amendments to stand arrangements	2024 – 2031	Yes	No
Pier 7	2030 – 2034	Yes	Yes
Reconfiguration of existing airfield facilities (Phase 1)	2024 – 2029	Yes	Yes
Further improvements to airfield facilities	2029 – 2034	Yes	No
Extensions to North and South Terminals	2024 – 2030	Yes	Yes
Hotel and commercial facilities	2024 – 2032	Yes	Yes
Car parking	2024 – 2035	Yes	No
Surface access improvements	2029 – 2032	Yes	No
Surface water drainage and management of foul water	2024 – 2038	Yes	No

2.2 Construction Component Consumption

2.2.1 Robust estimates for potential water requirements during the construction phase have been made based on previous experience. Based on information provided, estimated total required water is detailed below.

Table 2.2.1: Construction phase in order of start date and the forecasted water demand during the years of construction.

Component	Year Start	Year End	Duration (years)	Forecasted Water demand (m^3/yr)	Forecasted Total Water Demand (m^3/yr)
Early works (set up of compounds, fencing, early clearance and diversion works)	2024	N/A	1	3,916	3,916
Car Parking	2024	2035	11	6,198	68,178
Amendments to stand arrangements	2024	2031	8	1,065	8,520
Alterations to the existing northern runway	2024	2029	5	2,445	12,227
Reconfiguration of existing airfield facilities (Phase 1)	2024	2029	5	1,321	6,607
Extension to North and South terminals	2024	2030	6	4,116	24,696
Surface access improvements	2029	2032	3	9,955	29,866
Further improvements to airfield facilities	2029	2034	5	11,478	57,389
Surface water drainage and management of foul water	2024	2038	14	3,133	43,865
Hotel and Commercial Facilities	2024	2032	8	9,972	49,862
Pier 7	2030	2034	4	3,177	12,707

2.3 Total Construction Consumption per year

2.3.1 This consumption was then aligned against the programme and the annual required consumption during construction phase was calculated.

Table 2.3.1: Total water consumption from all construction per year during the construction phase of the Project

Year Start	Construction Demand (m^3/yr)
2024	28,426
2025	24,510
2026	24,510
2027	24,510
2028	24,510
2029	49,223
2030	48,634
2031	44,518
2032	43,453
2033	27,266
2034	27,266
2035	9,331
2036	3,133
2037	3,133
2038	3,133

3 Forecasted Demand for Future Facilities

3.1 Forecasted Consumption

3.1.1 From the programme of works for the Project, elements most likely to require potable water demand following completion were extracted from the programme and water consumption estimated based on information available. Table 3.1.1 lists the elements considered for water demand calculations.

Table 3.1.1: Extract from Chapter 5: Project Description of the PEIR showing the facilities that will have an impact on water supply in the future

Element of the Project	Key Parameter for Assessment
Development consent application area	838 hectares
Works within existing GAL land ownership	760 hectares
Permanent land take (third party)	73 hectares
Temporary land take (third party)	4 hectares
Pier 7	
Pier 7 footprint	10.1 hectares
Pier 7 maximum height	18 metres
Terminal Extension	
Terminal extension footprint: North Terminal IDL	6,300 m^2
Terminal extension footprint: North Terminal baggage reclaim	650 m^2
Terminal extension footprint: North Terminal baggage hall	6,552 m^2
Maximum height of terminal extension: North Terminal IDL	32.5 metres
Maximum height of terminal extension: North Terminal baggage reclaim	7 metres
Maximum height of terminal extension: North Terminal baggage hall	12.5 metres
Terminal extension footprint: South Terminal IDL	3,780 m^2
Maximum height of terminal extension: South Terminal	30.5 metres
Hotel and Commercial Facilities	
South Terminal Hotel	400 bedrooms
South Terminal Hotel: Maximum building height	27 metres
North Terminal Hotel	400 bedrooms
North Terminal Hotel: Maximum building height	27 metres
Hotel (car rental location)	200 bedrooms
Hotel (car rental location): Maximum building height	16.3 metres
Office blocks – new footprint	1,024 (x3) m^2
Office blocks – new floorspace	9,000 m^2
Maximum height of office blocks	27 metres
South Terminal roundabout expansion: footprint	[TBC]
South Terminal roundabout expansion: height	10 metres

3.1.2 Based on the current timeline for completion of works there would be three components of the Project that would have a permanent impact on water supply after construction.

- 2024 onwards – **Extensions to the North and South Terminal**
- 2024 onwards – **Extensions to the North and South Terminal + Hotels and Commercial Facilities**
- 2030 onwards – **Extensions to the North and South Terminal + Hotels and Commercial Facilities + Pier 7**

Pier 7

3.1.3 A new Pier 7 is proposed to the north west of Pier 6. This pier would occupy an area of approximately 10.1 hectares and would contain commercial facilities. Construction is programmed to be completed in 2034.

3.1.4 Assuming Pier 7 would have a water demand of 100 m^3/ha per day from Table 1.6 in Twort's Water Supply 6th Edition (Johnson Ratnayaka Brandt, 2009), the calculation for annual water demand would be as follows:

100 m^3/ha x 10.1ha = 1,010 m^3 per day

1,010m^3 x 365 days = **368,650 m^3 per year**

Extension to the North and South Terminal

3.1.5 Planned extensions to the North and South Terminals are due to be completed in 2030.

3.1.6 Assuming the use of the North and South Terminal extensions would result in a water demand of 100 m^3/ha per day from Table 1.6 in Twort's Water Supply 6th Edition (Johnson Ratnayaka Brandt, 2009) , the calculations for annual water demand is presented in Table 3.1.2.

Table 3.1.2: Breakdown of terminals and their impact on forecasted water demand

Terminal	Component	Extra Capacity	Water demand (m^3/day)	Water demand (m^3/year)
North Terminal	Extension to the International Departure Lounge (IDL), providing mix of retail, catering and general circulation space	6,300 m^2 = 0.63ha	63	22,995

Terminal	Component	Extra Capacity	Water demand (m^3/day)	Water demand (m^3/year)
	Extension to the baggage hall	6,552 m^2= 0.65ha	65	23,725
	Extension to baggage reclaim	650 m^2 = 0.065ha	6.5	2,373
Total Water Demand (m3/yr) per year for North Terminal				**49,093**
South Terminal	Extension to the IDL, providing a mix of retail, catering and general circulation space.	3,780 m^2 = 0.37ha	37	13,505
Total Water Demand (m3/yr) per year for South Terminal				**13,505**
Total Water Demand (m3/yr) per year for both terminals				**62,598**

Hotel and Commercial Facilities predicted demand

3.1.7 The following are proposed for hotels to be constructed from 2024 to 2032:

- a new South Terminal (up to 400 bedrooms);
- a new North Terminal (up to 400 bedrooms); and
- a new hotel at the current car rental location (200 bedrooms).

3.1.8 The following commercial facilities are proposed to be constructed from 2024 – 2029.

- 3 new office blocks for internal airport uses, 27m high with approx. 9,000 m^2 of floor space.

3.1.9 According to Twort's Water Supply 6th Edition (Johnson Ratnayaka Brandt, 2009), Table 1.6, the consumption allowance for hotels is 250 – 400l/day per bed. For this assessment the worst-case scenario of 400l/day per bed (0.4 m^3/day) will be used. The consumption allowance for offices is 50-75 l/day per employee.

3.1.10 According to the Health and Safety Executive (HSE), the minimum work space in the office should be 11 m^3 per employee therefore allowing 5 m^2 (assuming height of 2.5 metres) per employee. Assuming office space of 9,000 m^2, the assumption is that the maximum number of employees is 1,800 (9,000 / 5 m^2) and using the worst-case scenario of 75 l/day per employee (0.075 m3/day).

3.1.11 Although the Hilton and BLOC hotels are not part of the Project, they will impact water demand on the Gatwick site and therefore have been retained to give a complete estimate of future water requirements.

Table 3.1.3: Breakdown of hotels and commercial facilities and their impact on forecasted water demand

Component	Extra Capacity	Water demand (m^3/day)	Water demand (m^3/year)
South Terminal Hotel	400 bedrooms	(400 x 0.4) = 160	58,400
North Terminal Hotel	400 bedrooms	(400 x 0.4) = 160	58,400
Hotel	200 bedrooms	(200 x 0.4) = 80	29,200
BLOC hotel extension	200 bedrooms	(200 x 0.4) = 80	29,200
Hilton hotel reconfiguration	50 bedrooms	(50 x 0.4) = 20	7,300
3 new office blocks	9,000 m^2	(0.075 x 1,800) = 135	(260 x 135) = 35,100
Total Water Demand (m3) per year			**217,600**

*Assuming offices only open on weekdays (52 weeks x 5 days = 260 days per year).

3.1.12 Assuming construction for the hotel and office facilities finishes in 2032, this would be an increase in demand of 217,288 m^3/yr from 2032 onwards.

3.1.13 As a cross-check, demand was also calculated based on forecast increase in passengers (pax) against current calculated pax per customer. Based on the information provided in project description, the Project could enable an increase of 13 million passengers per annum (mppa) by 2038 and based on the previously forecasted consumption as detailed in Water Masterplan 2020 & 2028 forecast document worst-case consumption is 15.9 l/PAX. Therefore, this will result in a potential water consumption increase of (13,000,000 x 15.9)/1000 = 206,700 m^3 by 2038. This is less than 5% variance on the calculated value, giving confidence in the consumption value to be applied.

3.2 Total Future Facilities' Demand

3.2.1 Based on the calculated consumption as detailed in the previous section and the programmed completion dates, the following annual consumption values have been calculated. See Annex 3 for full details of the Total Components' Demand.

Table 3.2.1: Total demand for all future project facilities without water efficiencies implemented.

Year Start	Total Components' Demand (m^3/yr)
2029	0
2030	217,600
2031	217,600
2032	217,600
2033	280,198
2034	280,198
Consumption per annum 2035 onwards	648,848

3.3 Introducing Water Efficiencies

3.3.1 There are a few water efficiency methods that can be utilised for as part of the Project. An example of these are presented in Table 3.3.1.

Table 3.3.1: Water Efficiencies that can potentially be implemented into the new facilities.

Water Efficiency Method	Potential Facilities for savings	Potential reduction savings (%)
Installation of Automatic Reading Meters	Airfield Facilities Pier 7 North and South Terminal Hotels Offices	AMI/AMR does not actually save water but allows for more accurate recording of consumption data.
Mains pressure reduction to reduce leakage	Pier 7 North and South Terminal	TBC – Can be estimated through hydraulic modelling
Grey water re-use	Hotels and Facilities	Requires further investigation.
Installation of controllers on basin	Hotels and Facilities Pier 7	60 %* of relevant consumption.

Water Efficiency Method	Potential Facilities for savings	Potential reduction savings (%)
taps and urinals in offices, workshops	Extensions to North and South Terminal	It is not possible at this stage to calculate demand requirements for toilet facilities. More information is required.
Re-use water for firefighting (rainwater harvesting)	Airfield facilities	Previous on-site evidence suggests possible 20 % savings, however further investigations. It is not possible at this stage to calculate demand requirements for toilet facilities. More information is required.
Rainwater harvesting	Pier 7 Extensions to North and South Terminal Hotels Offices	25 % 25 % 36 % 46 %
Re-use water for aircraft washing	Airfield Facilities	Previous on-site evidence suggests 20 % savings however further investigations. It is not possible at this stage to calculate demand requirements for toilet facilities. More information required.

*Similar studies have recorded 60% savings for washroom facilities consumption from applying water efficiencies.

Pier 7

Table 3.3.2: Breakdown of water consumption savings for Pier 7

Component	Water demand before water efficiencies (m^3/yr)	Water savings from 25% reduction from rainwater harvesting (m^3/yr)	Water savings from water efficient fittings in toilet facilities (m^3/yr)	Total Water Demand after water efficiency savings (m^3/yr)
Pier 7	368,650	92,163	TBC	**276,487**

Extension to the North and South Terminal savings

Table 3.3.3: Breakdown of water consumption savings for both terminals

Component	Water demand before water efficiencies (m^3/yr)	Water savings from 25% reduction from rainwater harvesting (m^3/yr)	Water savings from water efficient fittings in toilet facilities (m^3/yr)	Total Water Demand after water efficiency savings (m^3/yr)
North Terminal	49,093	12,273	TBC	**36,820**
South Terminal	13,505	3,376	TBC	**10,129**
Total for both terminals	**N/A**	**N/A**	**N/A**	**46,949**

Hotels and Commercial Facilities savings

3.3.2 Based on information from WRAP – Achieving water efficiency on projects – information sheet report, figures for water efficiency savings for hotels and offices can be applied to the forecasted water demand. For example, using current available technologies water savings of 25-50% can be seen for showers, 40% savings with urinals, and 33-50% on taps.

Table 3.3.4: Total water demand per year of new hotel facilities after water efficiency savings of 47.3%* was applied (*see Annex 3 for full calculation details)

Component	Water demand (m^3/yr) before including water efficiency savings	Water savings from water efficiencies (m^3/yr)	Water demand (m^3/yr) with water efficiency savings
South Terminal Hotel	58,400	27,623	**30,777**
North Terminal Hotel	58,400	27,623	**30,767**
Hotel	29,200	13,812	**15,388**
BLOC hotel extension	29,200	13,812	**15,388**
Hilton hotel reconfiguration	7,300	3,453	**3,847**
Total Water Demand	**182,500**	**86,323**	**96,178**

Table 3.3.5: Total water demand per year of the new office facilities after water efficiency savings of 80.5%* was applied (*See Annex 3 for full calculation details)

Component	Water demand (m^3/yr) before water efficiency savings	Water demand (m^3/yr) with water efficiency savings
3 Office Blocks	35,100	**6,845**
Total Water Demand	**35,100**	**6,845**

Total Water Savings per year

Table 3.3.6: Breakdown of the Total Water Savings for each forecasted year

Forecasted Year	Pier 7 water savings (m^3/yr)	Extensions to the North and South Terminal water savings (m^3/yr)	Hotels and Commercial Facilities water savings (m^3/yr)	Total Water Savings (m^3/yr)
2029	N/A	N/A	N/A	**N/A**
2030	N/A	46,949	N/A	46,949
2031	N/A	46,949	N/A	46,949
2032	N/A	46,949	N/A	**46,949**
2033	N/A	46,949	103,023	**149,972**
2034	N/A	46,949	103,023	**149,972**
Consumption per annum 2035 onwards	276,487	46,949	103,023	**426,459**

4 Total Forecast Demand

4.1.1 This section presents the breakdown of all water consumption for all the forecasted years to the completion of the project in 2038.

4.2 The Worst-Case Scenario Demand

4.2.1 The worst-case scenario is with no water efficiencies implemented for future developments.

4.2.2 The worst-case scenario demand includes:

- the (average flow) updated baseline consumption;
- total construction demand (years impacted, 2024 – 2038); and
- the Project facilities' demand (post-construction) (years impacted, 2030 onwards)

Table 4.2.1: Total Water Consumption for the Worse-Case scenario

Year Start	Total (m^3/yr)
2019	704,977
2020	703,884
2021	706,371
2022	708,858
2023	711,344
2024	1,058,643
2025	1,057,214
2026	1,059,701
2027	1,062,187
2028	1,064,674
2029	1,091,877
2030	1,363,331
2031	1,361,707
2032	1,363,136
2033	1,132,156
2034	1,134,651
2035	1,119,213
2036	1,115,513
2037	1,118,012
2038	1,120,512

4.3 The Best-Case Scenario Demand

4.3.1 The best case scenario includes all possible water efficiencies implemented with future developments. The best-case scenario demand includes:

- the (average flow) updated baseline consumption;
- total construction demand (years impacted, 2024 – 2034)
- the Project facilities' demand (post-construction) (years impacted, 2030 onwards)
- all water efficiencies that can be implemented for the Project's facilities based on the information provided, however these savings can potentially be increased in the future if more information can be provided on water consumption facilities such as restrooms for example.

Table 4.3.1: Total of Water Consumption for the Best-Case Scenario

Year Start	Worst-Case Scenario (m3/yr)	Total water savings (m3/yr)	Best-Case Scenario Demand (m3/yr)
2019	704,977	N/A	**704,977**
2020	703,884	N/A	**703,884**
2021	706,371	N/A	**706,371**
2022	708,858	N/A	**708,858**
2023	711,344	N/A	**711,344**
2024	1,058,643	N/A	**1,058,643**
2025	1,057,214	N/A	**1,057,214**
2026	1,059,701	N/A	**1,059,701**
2027	1,062,187	N/A	**1,062,167**
2028	1,064,674	N/A	**1,064,674**
2029	1,091,877	N/A	**1,091,877**
2030	1,363,331	46,949	1,316,382
2031	1,361,707	46,949	1,314,758
2032	1,363,136	46,949	1,316,187
2033	1,132,156	149,972	982,184
2034	1,134,651	149,972	984,679
2035	1,119,213	426,459	692,754
2036	1,115,513	426,459	689,054
2037	1,118,012	426,459	691,553
2038	1,120,512	426,459	694,053

4.4 Design Year 2038 Total

4.4.1 The forecasted number of passengers for 2038 with the Project is 75 mppa, a 13 mppa increase from the original future baseline.

4.4.2 Due to there being no detailed breakdown of the proportion of the increase in forecasted passengers related individually to the completion of the North and South Terminal extensions (expected in 2029) and the Pier 7 (expected in 2034), total water consumption can only be calculated for the Design Year of 2038 using the 2038 forecasted passenger numbers.

4.4.3 Due to there being no additional information provided on washroom facilities required for Pier 7 and the North and South Terminal extensions, the additional passengers' consumption (m^3/pax) has been used in the table below to assume the water consumption for these washroom facilities.

Table 4.4.1: Breakdown of the Total Water Consumption for the Design Year of 2038.

Component	Average Flow Water Consumption (m^3/yr)	Peak Flow Water Consumption (m^3/yr)
Updated Baseline Consumption	748,729	913,449
Construction Demand	3,133	3,133
Extensions to the North and South Terminal	62,598	62,598
Hotels and Commercial Facilities	217,600	217,600
Pier 7	368,650	368,650
Total	**1,400,710**	**1,565,430**

5 References

Gatwick Airport Ltd (2018) 'London Gatwick Water Masterplan 2020 & 2028 Forecast - Full Backing Report'.

Johnson Ratnayaka Brandt (2009) Twort's Water Supply 6th Edition.

WRAP (n.d.) Information Sheet: Achieving water efficiency on projects. [Online] Available at: [redacted]

6 Glossary

6.1 Glossary of Terms

Term	Description
AMR	Automated Meter Reader
GAL	Gatwick Airport Ltd
HSE	Health and Safety Executive
mppa	Million passengers per annum
PEIR	Preliminary Environmental Information Report
SESW	Sutton and East Surrey Water
WRAP	Waste and Resources Action Programme

Annex 1

Updated Baseline Consumption

A1.1 An update of current and future baseline water consumption figures was completed using actual data for 2017 and 2018, and growth information for 2020 and 2028 as indicated in Table A1.1 and Graph A1.1 to inform the environmental impact assessment for the baseline, interim and Project coemption years .

Table A1.1: Updated Baseline Consumption Projections

Year	Original Baseline Consumption (m³/yr)	(Average Flow) Updated Baseline Consumption (m³/yr)	(Peak Flow) Updated Baseline Consumption[7] (m³/yr)
2017	781,942[1]	719,944[2]	878,332
2018		706,070[2]	861,405
2019		704,977[4]	860,072
2020	764,466[1]	703,884[3]	858,738
2021		706,371[5]	861,772
2022		708,858[5]	864,806
2023		711,344[5]	867,840
2024		713,831[5]	870,874
2025		716,318[5]	873,908
2026		718,805[5]	876,941
2027		721,291[5]	879,975
2028	786,052[1]	723,778[3]	883,009
2029		726,268[6]	886,047
2030		728,759[6]	889,086
2031		731,251[6]	892,127
2032		733,745[6]	895,169
2033		736,240[6]	898,212
2034		738,735[6]	901,257
2035		741,232[6]	904,303
2036		743,730[6]	907,351
2037		746,229[6]	910,400
2038		748,729[6]	913,449

[1]Forecasted water consumption from the '*Water Masterplan 2020 & 2028 Forecast – Full backing report*'

[2]Actual data obtained from 'GAL Water Consumption Balance 280819_MB'.

[3]Data obtained from using the percentage error calculated (-8.604%) from the annual predicted data to the annual actual data in 2017 and applying it to the original baseline consumption.

[4]Data obtained from the average of 2018 and 2020 in the average flow updated baseline consumption.

[5]Data obtained from the difference of 2028 and 2020 in the average flow updated baseline consumption column then increased in increments of that difference over 8 years between 2020 to 2028.

(Year 2028) 723,778 – (Year 2020) 703,884 = **19,894 m³**.

19,894 m³ / 8 years = **2,487 m³**.

[6]Data was obtained from calculating the percentage change of each year from the previous year of the average flow updated baseline from 2021 to 2028 which started at a 0.353% increase in 2021 and with the percentage increase dropping by 0.001% every consecutive year.

[7]Applied a factor of 1.22 to the average flow updated baseline consumption to obtain the values in the peak flow column.

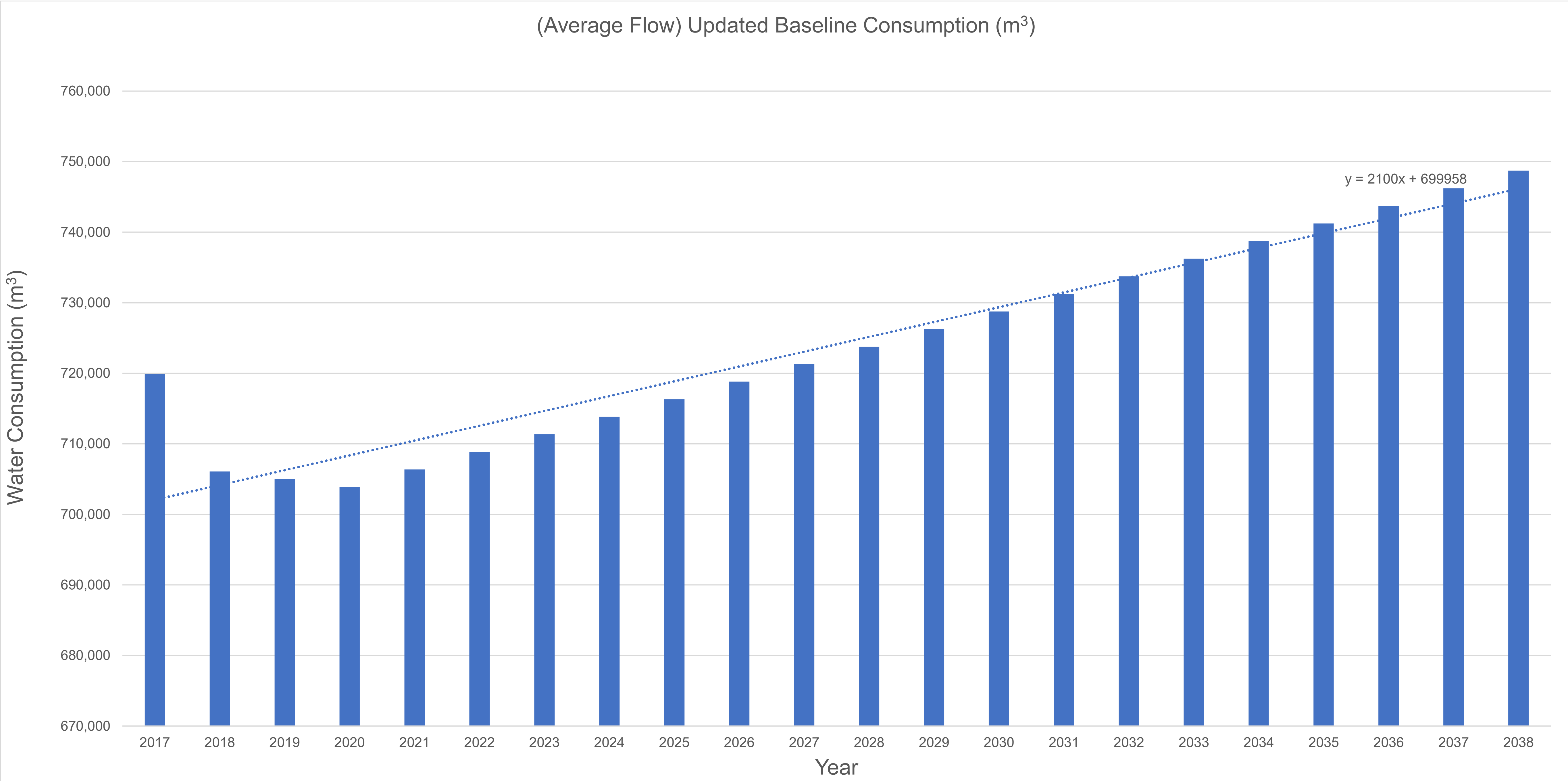
Table A1.2: Calculation for Peak Flow Consumption for 2017.

Component	Peak Month	Peak Flow Consumption (m³/month)	Peak Flow Consumption (m³/yr)
South Terminal (all meters)	August	35,654	427,848
North Terminal Povey Cross	June	37,750	453,000
Total	**-**	**-**	**880,848**

Table A1.3: Calculation for Peak Flow Factor

Component	Average Flow	Peak Flow	Percentage Change from average flow to peak flow.
2017 Consumption	719,994	880,848	22.3%
Peak Flow Factor	-	-	1.22

Graph A1.1: (Average Flow) Updated Baseline Consumption Projections



Annex 2

Construction Demand Details

Table A2.1: Chronological order of construction activities and water consumption by year

Year Start	Construction Activities in Project Genesis (m^3/yr)												
	Early works	Works to existing taxiways	Car Parking	Amendments to Stand Arrangements	Alterations to the existing northern runway	Reconfiguration of existing airfield facilities (Phase 1)	Extensions to North and South Terminals	Surface Access Improvements	Further improvements to airfield facilities	Surface water drainage and management of foul water	Hotel and Commercial Facilities	Pier 7	Total Construction Water Demand (m^3/yr)
2024 – 25	3,916	-	6,198	1,065	2,445	1,321	4,116	-	-	3,133	6,232	-	28,426
2025 – 26	-	-	6,198	1,065	2,445	1,321	4,116	-	-	3,133	6,232	-	24,510
2026 – 27	-	-	6,198	1,065	2,445	1,321	4,116	-	-	3,133	6,232	-	24,510
2027 – 28	-	-	6,198	1,065	2,445	1,321	4,116	-	-	3,133	6,232	-	24,510
2028 – 29	-	-	6,198	1,065	2,445	1,321	4,116	-	-	3,133	6,232	-	24,510
2029 – 30	-	3,280	6,198	1,065	-	-	4,116	9,955	11,478	3,133	6,232	-	49,223
2030 – 31	-	3,280	6,198	1,065	-	-	-	9,955	11,478	3,133	6,232	3,177	48,634
2031 – 32	-	3,280	6,198		-	-	-	9,955	11,478	3,133	6,232	3,177	44,518
2032 – 33	-	3,280	6,198		-	-	-	-	11,478	3,133	-	3,177	43,453
2033 – 34	-	3,280	6,198		-	-	-	-	11,478	3,133	-	3,177	27,266
2034 – 35	-	-	6,198	-	-	-	-	-	-	3,133	-	-	27,266
2035 – 36	-	-	,	-	-	-	-	-	-	3,133	-	-	9,331
2036 – 37	-	-	-	-	-	-	-	-	-	3,133	-	-	3,133
2037 – 38	-	-	-	-	-	-	-	-	-	3,133	-	-	3,133

Construction Demand Parameters

A2.1 Table A2.2 summarises the parameters selected for each construction phase. The water source is assumed to be Mains supply/standpipe for all choices.

A2.2 The duration of all activities in Table A2.2 are assumed to be the entire contract timeline. The programme has been assumed to run for the years listed in Chapter 5: Project Description on the PEIR, for example construction of Pier 7 runs from 2030 to 2034 therefore it is four years. In the calculator this is chosen as 01/01/2030 to 31/12/2034.

Table A2.2: Design Parameters for Construction Demand Calculator

Component	B - Dust Suppression	C – Site Welfare Facilities	D – General Cleaning
Early works, including establishment of compounds, fencing, early clearance and diversion works and re-provision of essential replacement services	B.1 – Damping and Misting Method – Misting Cannon (reduced power) x 1 Duration - 1 hours/day, 1 days/month	C.1 – Canteen C.2 – Toilet Facilities Urinal (with water management system) x 6 Toilets (Dual Flush Toilet 4 litres) x 6 C.3 – Showers x 2 C.4 Hand Washing Method – Tap aerator (Twist/Lever Top) Basins x 4	D.1 Boot Washing Method – Pressure Wash Station Duration – 0.2 hours/day, 4 days/month D.2 Plant and Equipment Cleaning Method – Pressure washer (Electric Pump 150 bar) Duration - 1 hour/day, 2 days/month
Works to existing taxiways and construction of new taxiways	B.1 – Damping and Misting Method – Misting Cannon (reduced power) x 1 Duration - 1 hours/day, 3 days/month B.3 - Road Sweeping Method – Truck Mounted Road Sweeper (Typical flow rate) Duration – 2 hours/day, 4 days/month		
Car Parking	B.1 – Damping and Misting Method – Misting Cannon (reduced power) x 1 Duration - 1 hours/day, 4 days/month		
Amendments to stand arrangements	N/A		D.2 Plant and Equipment Cleaning Method – Pressure washer (Electric Pump 150 bar) Duration - 1 hour/day, 2 days/month
Alterations to the existing northern runway	B.1 – Damping and Misting Method – Misting Cannon (reduced power) x 1 Duration - 1 hours/day, 4 days/month		
Reconfiguration of existing airfield facilities (Phase 1)			D.1 Boot Washing Method – Pressure Wash Station Duration – 0.2 hours/day, 4 days/month D.2 Plant and Equipment Cleaning Method – Pressure washer (Electric Pump 150 bar) Duration - 1 hour/day, 2 days/month
Extension to North and South terminals			
Surface access improvements			D.2 Plant and Equipment Cleaning Method – Pressure washer (Electric Pump 150 bar) Duration - 1 hour/day, 2 days/month
Further improvements to airfield facilities	B.1 – Damping and Misting Method – Misting Cannon (reduced power) x 1 Duration - 1 hours/day, 1 days/month		D.1 Boot Washing Method – Pressure Wash Station Duration – 0.2 hours/day, 4 days/month D.2 Plant and Equipment Cleaning Method – Pressure washer (Electric Pump 150 bar) Duration - 1 hour/day, 2 days/month
Surface water drainage and management of foul water	B.1 – Damping and Misting Method – Misting Cannon (reduced power) x 1		

Component	B - Dust Suppression	C – Site Welfare Facilities	D – General Cleaning
	Duration - 1 hours/day, 2 days/month		
Hotels and Commercial Facilities	B.1 – Damping and Misting		
Pier 7	Method – Misting Cannon (reduced power) x 1 Duration - 1 hours/day, 4 days/month		

Annex 3

Forecasted Demand for Future Facilities

Table A3.1: Breakdown of the individual facilities and total demand.

Year Start	Pier 7 and Stand Amendments (m^3/yr)	Extensions to the North and South Terminal (m^3/yr)	Hotel and Commercial Facilities (m^3/yr)	Total Components' Demand (m^3/yr)
2029	-	-	-	-
2030	-	62,598	-	62,598
2031	-	62,598	-	62,598
2032	-	62,598	-	62,598
2033	-	62,598	217,600	280,198
2034	-	62,598	217,600	280,198
2035	368,650	62,598	217,600	648,848
2036	368,650	62,598	217,600	648,848
2037	368,650	62,598	217,600	648,848
2038	368,650	62,598	217,600	648,848

A3.1 Based on The Waste and Resources Action Programme (WRAP) – Achieving water efficiency on projects 'Water efficiency within buildings.' water efficiencies have been categorised as:

- **Standard practice** – 'consumption typical of buildings fitted with current baseline practice fittings and appliances';
- **Enhanced practice** – 'consumption typical of buildings where a majority of fittings and appliances would be classified as efficient (on average)'; and
- **Leading-edge practice** – 'consumption typical of buildings where a majority of fittings and appliances would be classified as highly efficient, and where additional measures are taken to minimise and substitute demand for potable water'.

A3.2 Standard practice was used to consider the worst-case scenario with no water efficiencies in place and leading-edge practice was used to consider the best-case scenario with the recommended water efficiencies.

Table A3.2: Extract from WRAP – Achieving water efficiency on projects, fig. A1.7.

Building type	Standard practice	Enhanced practice	Leading-edge practice
Hotels (room only, excluding staff use, pool, laundry and restaurant) (litres/room/day)	110	98 – Assumes 6/4 l dual flush WCs and low flow basin taps, offsetting a full-sized bath and high flow rate shower.	58 – Assumes 4.5/2.5 l dual flush WCs, with 75 per cent of flush demand met by rainwater harvesting; 10 l/min shower.

A3.3 Calculating from the standard practice of 110 (litres/room/day) to the leading-edge practice of 58 (litres/room/day) a percentage calculation was made to estimate the savings hotels can produce based on optimising technology for toilets, basins and showers and utilising rainwater harvesting.

- **Percentage saving** = 110 - 58 = 52 l/room/day
  = (52 / 110) x 100% = 47.27…%
  = **47.3%**

Table A3. 3: Extract from WRAP – Achieving water efficiency on projects, fig. A1.7.

Building type	Standard practice	Enhanced practice	Leading-edge practice
New offices (excluding canteen) (litres/person/day)	41	27 – Assumes taps and shower have flow rates below efficient practice, but dishwasher has baseline consumption.	8 – Assumes highly efficient fittings, with 75 per cent of flush demand met by rainwater harvesting.

A3.4 Calculating from the standard practice of 41 (litres/room/day) to the leading-edge practice of 8 (litres/room/day) a percentage calculation was made to estimate the savings offices can produce based on optimising technology for taps and showers and utilising rainwater harvesting.

- **Percentage saving** = 41 - 8 = 33 l/room/day
  = (33 / 41) x 100% = 80.487... %
  = **80.5%**

Annex 4

Water Masterplan 2020 & 2028 Forecast - Full backing Report, 2018

-

JACOBS

London Gatwick - Water Masterplanning

Gatwick Airport Ltd

Water Masterplan 2020 & 2028 Forecast - Full backing report

| Final

04 January 2018

London Gatwick - Water Masterplanning

Project No:	GADD009A
Document Title:	Water Masterplan 2020 & 2028 Forecast - Full backing report
Revision:	Final
Date:	17 November 2017
Client Name:	Gatwick Airport Ltd
Client No:	N/A
Project Manager:	Lucy Chapman
Author:	Mark Goldberg, James Cullinane, Jamie Shotter
File Name:	GADD009A_Water Masterplan 2020 & 2028 Forecast - Full backing report

Jacobs U.K. Limited

Simpson House
6 Cherry Orchard Road
Croydon CR9 6BE
United Kingdom
[redacted]

Document history and status

Revision	Date	Description	By	Review	Approved
1	18/8/17	For client review	MG, JC, JS	MS	LC
2	27/10/17	Final report	MG, JC, JS	MS	LC
3	04/01/2017	Final report	MG, JC, JS	MS	LC

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide Gatwick Airport Limited (GAL) ('The Client') with a description of GAL's water management today and how this has changed in recent years with reference to the volumes reported in the 2012 master plan. This shall be conducted in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. As otherwise stated in the report, unless specifically stated Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete, then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time, or times, outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

Through the data collection exercise a number of gaps in data availability have been identified. Wherever possible, assumptions have been made to permit a meaningful assessment of the management of water. The limitations of the assessment are included in a detailed methodology summary in Appendix B.

Executive Summary

Gatwick Airport Ltd (GAL) has undertaken passenger forecasts to understand the future airport development for two growth scenarios. The focus of interest for GAL is their Decade of Change (DoC) water target end point (2020) and the single-runway airport's development in the assessment year (2028). A forecast has been produced for each of these years. The outputs from these forecasts will be used to develop the water use, water quality and flood risk and surface water management input to the masterplan.

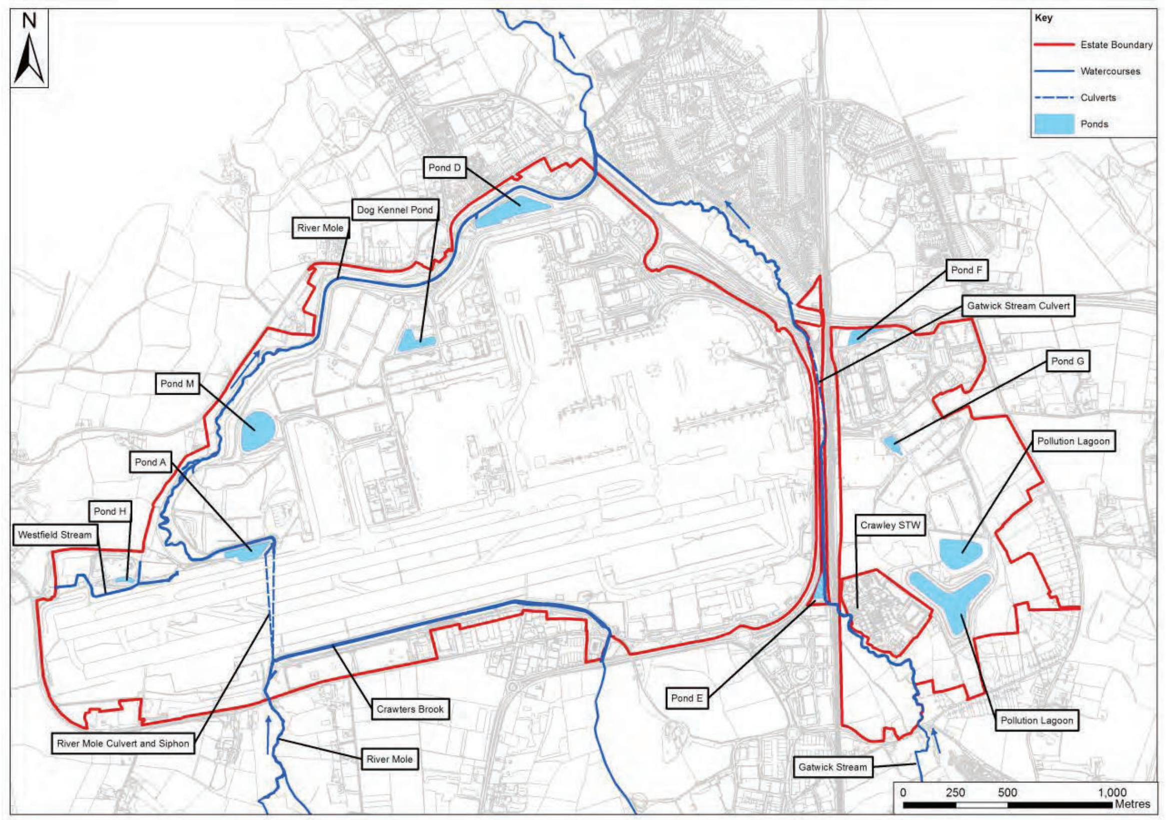
Airports and Water

Airports have a potentially significant impact upon all stages of the water cycle. Gatwick used 676 Megalitres of water in 2015 or 17 litres per passenger, not just for services for passengers but also airplane operations such as de-icing. Consequently, a similar volume of wastewater requires treatment before being discharged back to watercourses. There is the potential for Gatwick to generate large volumes of rainfall runoff from impermeable areas including runways, taxiways and buildings, which if unmanaged could increase flood risk to those downstream, consequently the airport has an extensive drainage system to manage this risk.

GAL collaborates with a number of organisations through the supply and disposal of water at the airport. Water is supplied by Sutton and East Surrey (SES) Water and is disposed of either to the Thames Water (TW) Crawley Sewage Treatment Works (STW) or TW Horley STW for foul or to local watercourses for rainfall runoff. If the latter is of insufficient quality, it is also drained to the STW for further treatment. The EA consent discharges to the local watercourses (Gatwick has 11); the quality standards to be met by Gatwick vary by consent. If the runoff does not meet the required standard it is retained within the system for further treatment. New development at Gatwick would be expected to limit surface water runoff to greenfield rates to reduce flood risk.

The key elements of water management at Gatwick are identified in Figure 1-1.

Figure 1-1 : Key Water Management Features



Water Usage

The historic data has been taken from the Gatwick water fiscal meters. The water supply to Gatwick is provided by Sutton and East Surrey (SES) Water and within the Gatwick estate is composed of four supply areas; North Terminal and the airfield area served by 1 fiscal meter at Povey Cross, South Terminal served by 4 fiscal meters, East of Rail (EOR) served by 1 fiscal meter, and other areas served by 24 fiscal meters. In 2016 the Povey Cross Meter Area (which includes the North Terminal) accounted for 52% of the water consumption, South Terminal 25%, EoR 20% and other 3%.

Figure 1-2 : GAL Water Supply Areas

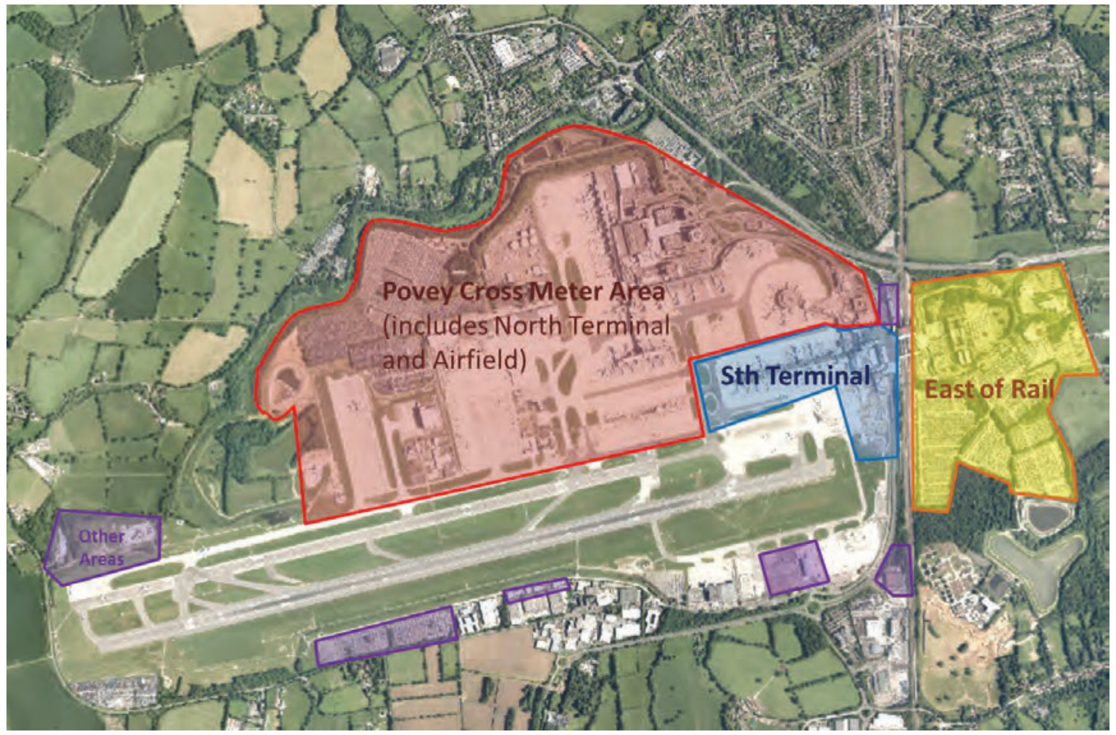
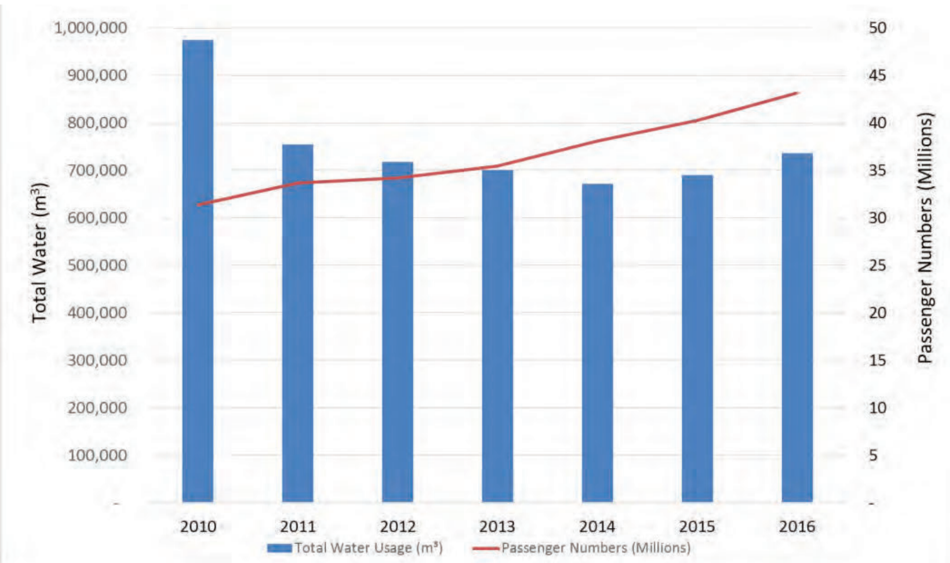


Figure 1-3 : Gatwick Water Consumption and Passenger Numbers



Water Masterplan 2020 & 2028 Forecast - Full backing report

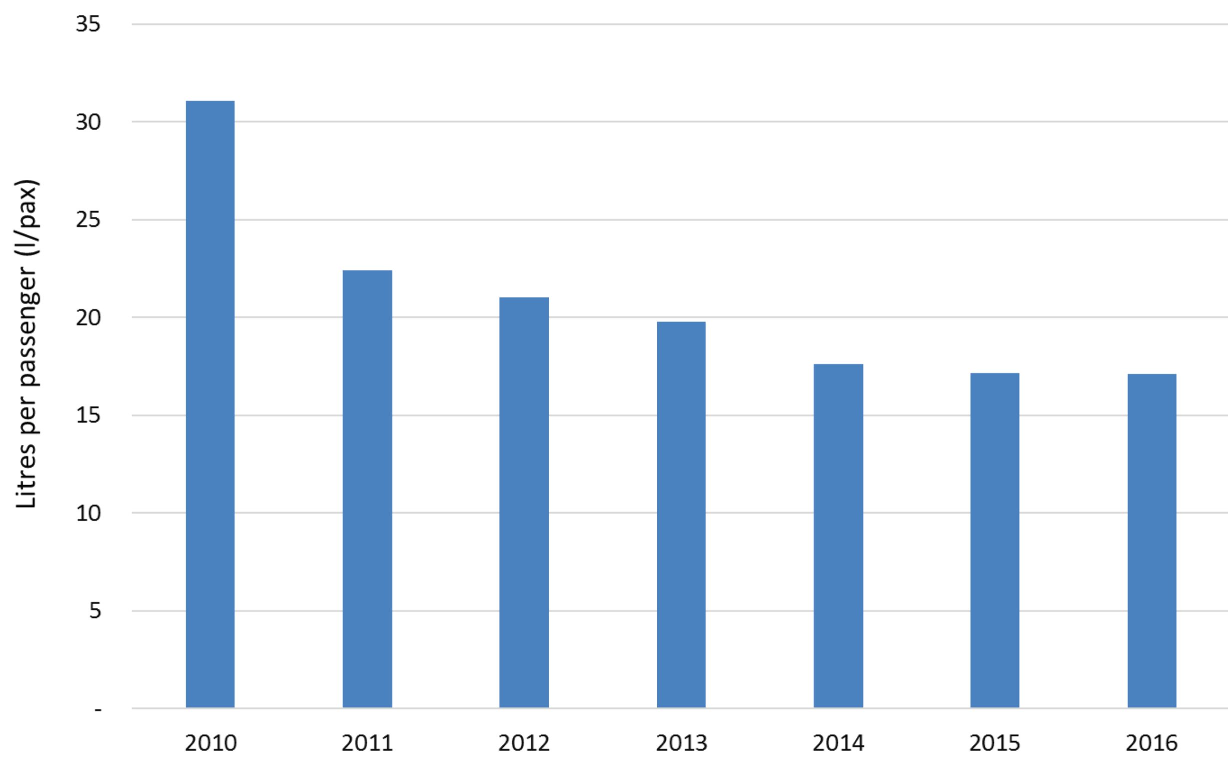
JACOBS

Water consumption decreased sharply from 2010 to 2014. This was due to leakage management, and water efficiency programmes, such as continued use of water efficient toilet facilities. Additionally, key assets reductions such as the part closure of Pier 5 for refurbishment and Pier 1 demolition.

Consumption increased from 2014 to 2016, potentially due to the reopening of Pier 5 and construction of Pier 1 and Bloc Hotel. This could also be due to leakage reduction programmes finding it more challenging to identify new leaks, compared to earlier easier success.

Over the same period from 2010 to 2016 passenger numbers have increased from 31.3 million to 43.1 million. As passenger numbers have been increasing the consumption per passenger has decreased from 31.1 litres/pax (2010) to 17.1 litres/pax (2016); see Figure 1-4.

Figure 1-4 : Gatwick Water Consumption per Passenger



Forecasts for water consumption in 2020 and 2028 have been based on medium trends in water consumption from 2012 to 2016, and taking into account asset changes expected to be implemented prior to 2020 with further changes anticipated by 2028.

The forecast water consumption in 2020 is estimated to be 764,000 m³ which is higher than any of the previous years, apart from 2010. This is a 20% reduction on the consumption in 2010, and compares to the target launched in the Decade of Change Report in 2010 of a 20% reduction, but which has now been stretched to 25% to spur further water efficiencies as the airport grows. The 2020 forecast suggests that this target will not be met.

Consumption in 2020 will be similar to that of 2011, but with a reduced unit consumption of 16 l/pax, compared to more than 22 l/pax in 2011. Calculation figures and results are summarised in Table 1.

Table 1 : 2020 Water Consumption Forecast

2020 Water Forecast	
	Meters Cubed
Business as usual consumption	730,144
Asset Changes	34,302
Total 2020 Consumption	764,446
Scenario 1 (litres / PAX)	15.8
Scenario 2 (litres / PAX)	15.9
2010	
Total Consumption	974,067
Consumption per PAX (lites per PAX)	31.1
DOC Original target - 20%	
Target 2020 Consumption	779,254
Target reduction against 2010 baseline	20%
DOC Stretch target - 25%	
Target 2020 Consumption	730,550
Target reduction against 2010 baseline	25%
Predicted reduction against 2010 baseline	-5%
Reduction in consumption per PAX	49%

The forecast water consumption in 2028 is estimated to be 786,000 m^3, but with a further unit consumption of less than 14 l/pax. The provision of the 2028 forecast is subject to the realisation of the asset changes detailed in this report. The main sensitivity lies with the Boeing Hangar and its consumption per floor area being similar to that of the Virgin Hangar. Calculation figures and results are summarised in Table 2.

Table 2 : 2028 Water Consumption Forecast

2028 Water Forecast	
	Meters Cubed
Business as usual consumption	741,987
Asset Changes	44,065
Total 2028 Consumption	786,052
Passanger Nos Scenario 1 (million)	53
Scenario 1 (litres / PAX)	14.7
Scenario 2 Passanger Nos (million)	55.3
Scenario 2 (litres / PAX)	14.2
Consumption change against 2020	2.8%
Consumption per PAX change against 2020 Scenario 1	-7%
Consumption per PAX change against 2020	-11%

Water Efficiency Measures

There is significant scope for improvement in water efficiencies at Gatwick.

The first priority is to reduce the currently high levels of unaccounted for water by improving metering at GAL and installing automatic reading meters at key facilities to monitor the water consumption pattern throughout the day and night. Leakage and water losses in facilities are estimated to be significant and warrant attention.

An enhanced leakage control and reduction programme is recommended to find leaks more effectively and implement repairs. Additionally consideration is to be given to mains pressure reduction during periods of low demand, but ensuring pressure can be restored quickly and adequately when demands suddenly increase for firefighting emergencies.

In buildings and facilities improvements have already been realised through the use of controllers on basin taps and urinals in the main terminal buildings. Similar controls should be rolled out to offices, workshops and older buildings at Gatwick.

Consideration will also be given to water reuse through rainwater harvesting at existing buildings with large roof areas, and for new buildings and facilities grey water reuse and/or rainwater harvesting to be incorporated where evaluated to be feasible.

Consideration should also be given to the monitoring of foul wastewater flows in the main sewage pump stations and main gravity outfall sewer leaving Gatwick for Thames Water sewage works. Automatic reading meters similar to those used on the main water supply are recommended for installation. When installed these will help identify levels of building water wastage and infiltration present and where savings can be made.

Water Quality

Biological Oxygen Demand (BOD) has been identified as a key performance indicator of water quality at Gatwick. GAL therefore use the number of BOD exceedances of an adopted 10mg/l threshold at the discharge point from Pond D as a reportable indicator of water quality. The main contributor to a number of events when BOD is greater than 10mg/l has been identified as de-icers both for aircraft and pavement use. Limited capacity for storing and treating runoff from the airfield on site over the winter period means that, by the end of the season, GAL could have to discharge potentially high BOD excess runoff to local watercourses. Jacobs has used Chemical Oxygen Demand (COD) loading as an indicator of potential future BOD exceedances within surface waters.

Due to the predicted increase in Air Traffic Movements (ATMs) at Gatwick de-icer usage has been predicted to increase from the current 1,080,000 litres/yr to around 1,190,000 litres/yr in Scenario 1 (airport growth model C55-53) or 1,240,000 litres/yr in Scenario 2 (airport growth model C60-C55) by 2028.

Pavement de-icer usage is also likely to increase to 2028 due to new developments at the airport increasing the amount of hardstanding requiring de-icing. The increase will be of around 15,000 l/yr from a current average of 1,270,000litres/yr to a predicted 1,280,000 litres/yr. This could lead to increased COD loading and consequently an increased potential for BOD exceedances. Four options were considered to project future COD loading to the surface water drainage system, it is understood that Option 2 is being considered and Option 3 is being implemented where practical.:

- Option 1: “Do Nothing” baseline – does not include the positive future impacts of current management strategies;
- Option 2: Aircraft de-icer recovery increase (from 20% to 40%);
- Option 3: The continued use of less polluting potassium acetate-based de-icers instead of glycol-based de-icers (e.g. ECO2) wherever possible; and
- Option 4: Both Option 2, aircraft de-icer recovery and Option 3, use of potassium-based de-icers wherever possible.

If no mitigation strategies are implemented, the COD load to surface water is projected to increase by 5-7% before 2028, due to increased de-icer usage for aircraft and pavements. However, the ongoing adoption of potassium acetate based de-icer wherever possible together with an increase in the recovery of pavement de-icer are adopted (Option 4), COD loading could decrease by around 44% to 46%.

A high-level options assessment has been undertaken of future surface water quality management at Gatwick. The assessment reviews options for water quality management including reduction in usage, reducing pollution impacts through product changes, increased water storage and treatment options for glycol in order to identify opportunities for improvement. Recent consideration of a different aircraft de-icer recovery technique through use of two as opposed to one de-icer recovery vehicle have noted that there may be potential benefits in reviewing the feasibility of treatment/separation of de-icer saturated recovery water immediately following recovery, rather than allowing recovered de-icer to mix with less contaminated runway runoff. Other opportunities may exist as a result of the necessity to negotiate a new effluent discharge agreement with Thames Water, which may make other forms of water treatment on-site more viable.

Flood Risk and Surface Water Management

The primary sources of flood risk to Gatwick are fluvial (river) and surface water (from exceedance of the drainage network capacity). Based on hydraulic modelling Gatwick Airport is considered to be at risk of fluvial flooding on average between the 1 in 20 annual chance (5% AEP) and the 1 in 50 annual chance (2% AEP) events. The airport is served by an extensive surface water drainage network which would be overwhelmed by extreme rainfall events, which is predicted to flood on average for the 1 in 10 annual chance (10% AEP) event. The location at highest risk of surface water flooding is the North Terminal.

As part of the Gatwick Masterplan, over the next decade there are plans for a number of proposed developments across the airport to ensure Gatwick has sufficient capacity, to grow and to become the airport of choice for London. This Phase 2 Masterplan report assesses at a high level the potential fluvial and surface water flood risk to these proposed developments, how they may impact on existing levels of flood risk, identifies potential mitigation measures to ameliorate their impact and provides suggestions for how Gatwick should strategically manage flood risk over the next decade and beyond.

An assessment has been undertaken of the fluvial and surface water flood risk to the proposed development locations. It should be noted that this assessment is limited by the storm event results that are available from the hydraulic modelling undertaken for GAL previously. Fluvial storm event results were available for the 1 in 5 annual chance (20% AEP), 1 in 20 annual chance (5% AEP), 1 in 50 annual chance (2% AEP), 1 in 75 annual chance (1.33% AEP), 1 in 100 annual chance (1% AEP) and the 1 in 100 (1% AEP) plus 20% for climate change event. Surface water storm event results were available for the 1 in 10 annual chance (10% AEP), 1 in 100 annual chance (1% AEP) and 1 in 100 (1% AEP) plus 20% for climate change event. The assessment is an approximation; the modelling of additional storm events would increase the accuracy of the assessment. National planning policy requires that all new development remain safe for users throughout its operational life. Therefore, assuming a 100 year design life, all new development as a minimum would be expected to be flood resilient up to and including the 1 in 100 annual chance (1% AEP) event plus an allowance for climate change.

For fluvial flood risk most of the proposed developments are at low risk of flooding and are located in areas that would not necessitate the provision of mitigation measures. The domestic/CTA baggage reclaim and Boeing Hangar developments are at greatest risk of flooding. It is understood that the Boeing Hangar development has been granted planning permission.

For surface water the majority of the developments are in locations at significant risk of surface water flooding. In accordance with national planning policy the development proposals would need to demonstrate that they would be safe for their lifetime.

The assessment of changes to impermeable area is a net change, taking into account the current surface type. An increase in impermeable area would result in an associated increase in runoff to the surface water drainage network, potentially increasing flood risk downstream if unmitigated. Development proposals at Gatwick would need to consider the impact of increased runoff on the available storage in the attenuation ponds.

A number of measures have been identified that could be implemented by Gatwick over the life of the masterplan to manage flood risk at the airport:

- Flood defences to protect the airport from flooding from the Gatwick Stream and River Mole;
- The identification of measures to make critical infrastructure resilient to flood events to minimise disruption;
- Incorporation of surface water attenuation storage for all new development;
- Confirm the capacity of the surface water drainage network and identify critical sewers;
- A review of the operation of the surface water drainage network, to rationalise the system;
- Consideration of the use of SuDS measures, safeguarding notwithstanding, such as green roofs to reduce runoff from new development; and
- Consideration of sacrificial storage of flood water above ground in non-critical areas of the airport.
- Collaborating with the Environment Agency to progress flood mitigation schemes; and
- Investigation options to increase the pumping output at Pond D to increase capacity in the upstream surface water drainage network across the airport.

In addition a number of best practice measures from other airports and industries have been identified for consideration and potentially incorporation into new development.

GAL should give consideration to the development of a site wide flood mitigation strategy to direct the reduction in flood risk over the next ten years and beyond.

Contents

Figures

Tables

1. Introduction

Gatwick Airport Limited (GAL) has identified a requirement for a forecast to help understand the water aspects related to the development of the airport. It is anticipated that this forecast will be used to help prepare a new publically available masterplan for the airport although a timetable has not yet been fixed. The forecast reflects the development needs of the existing single-runway airport (including key asset changes) based on information provided by GAL listed in Appendix A.

GAL has undertaken passenger forecasts to understand the future airport development for two growth scenarios. The focus of interest for GAL is their Decade of Change (DoC) water target end point (2020) and the single-runway airport's development in the assessment year (2028). A forecast has been produced for each of these years. The outputs from these forecasts will be used to develop the water use, water quality and flood risk and surface water management input to the masterplan.

The forecast material delivered under this commission will be used in its entirety for internal planning purposes but may be summarised if included in a future, public masterplan document. The material includes text, data and graphics which describe GAL's current and future water use and strategies to reduce water demand, water quality and strategies to improve it and flood risk and surface water management and strategies to mitigate and improve it.

This report supports the overall Gatwick Airport Masterplan in relation to water performance. It provides a forecast for consumption, quality and flood risk levels in 2020 and 2028. The forecasts are derived by evaluating historical trends and predicted impact of changes. The narrative and graphical presentation is presented at airport level (suited to masterplan summary use). The Executive Summary offers a high-level commentary on the water forecast and their associated methodology. The main text of this report provides text and data which describes GAL's historic trends, the forecast model methodology, verification of the forecasts using 2017 data and considerations and challenges.

Broadly the approach taken was:

- Data collection, including information from GAL, external sources and interviews with key GAL staff;
- Forecasts of future water use, efficient, water quality and flood risk to 2028;
- Data analysis and interpretation to identify the key issues facing the management of water at Gatwick over the next ten years to 2028 and suggested measures for mitigation.

1.1 Scope

This report provides the evidence for the assessment of future water management impacts associated with projected passenger throughput air transport movements and new infrastructure development in the assessment year, 2028 to include:

- The estimation of water consumption, wastewater volumes based on development proposals (see Section 2 and Section 4);
- The estimation of water consumption in 2020 with reference to GAL's Decade of Change (see Section 2.5);
- The presentation of a strategy for enhancing the water quality of local watercourses (see Section 5);
- The estimation of future flood risk based on climate change and airport development proposals (see Section 6) and;

- The presentation of a strategy for the management of storm water runoff and other flooding events in order to meet GAL's targets for flood protection and Committee for Climate Change recommendations (see Section 6.5); and

- Impact of compliance with local and national planning policies in the assessment year and longer term (see Appendix H).

1.2 Passenger Forecast

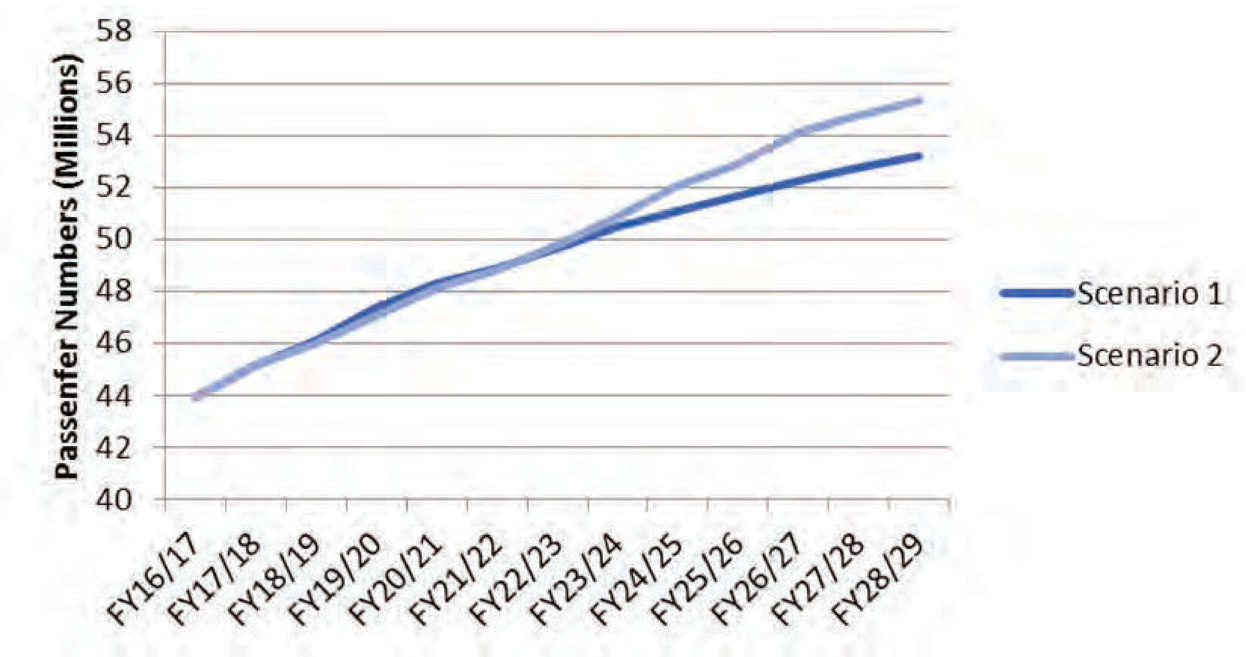
GAL has undertaken passenger forecasts to understand the future airport development for two growth scenarios. This is taken from the "Primary forecasts both scenarios" spreadsheets. Scenario 1 is taken from ICF Masterplan Outputs C55-53 (09.06.17) and Scenario 2 taken from ICF Masterplan Outputs C60-55 (09.06.17).

- Scenario 1: Passenger numbers are predicted to increase by 21% from FY16/17 to FY28/29 (1.8% of FY16/17 per year).

- Scenario 2: Passenger numbers are predicted to increase by 26% from FY16/17 to FY28/29 (2.2% of FY16/17 per year); and

- Both scenarios represent a reduced rate of growth compared to recent historic growth, when passenger numbers increased by 38% from 2010 to 2016 (6.3% per year). Airport passenger number growth is strongly linked to passenger demand and wider economic factors (e.g. GDP), but the reduced rates of growth considered in part reflect capacity constraints both from the airport approaching runway capacity for air traffic movements with a single runway and limitations linked to terminal capacity.

Figure 1-1 : Passenger Forecast Scenarios



2. Water Usage

2.1 Introduction

Phase 1 of the masterplan assessed the historic trends of GAL's water use. In order to establish a sound basis for the forecasting process, historic data has been revisited to identify trends and key drivers for water consumption. The subsequent sections draw on the historic data and trends to generate the forecasts.

2.2 Historic Trends

Historic data was obtained from the Gatwick water fiscal meters. Water is supplied to Gatwick by Sutton and East Surrey (SES) Water company and within the Gatwick estate is composed of four supply areas; North Terminal (also known as Povey Cross) served by 1 fiscal meter, South Terminal served by 4 fiscal meters, East of Rail (EoR) served by 1 fiscal meter, and 'other' areas served by 22 fiscal meters. In 2016 the Povey Cross Meter Area serving North terminal and the airfield accounted for 52% of the water consumption, South Terminal 25%, EOR 20% and 'other' 3%.

Figure 2-1 indicates the total water consumption at Gatwick, alongside passenger numbers. As can be seen:

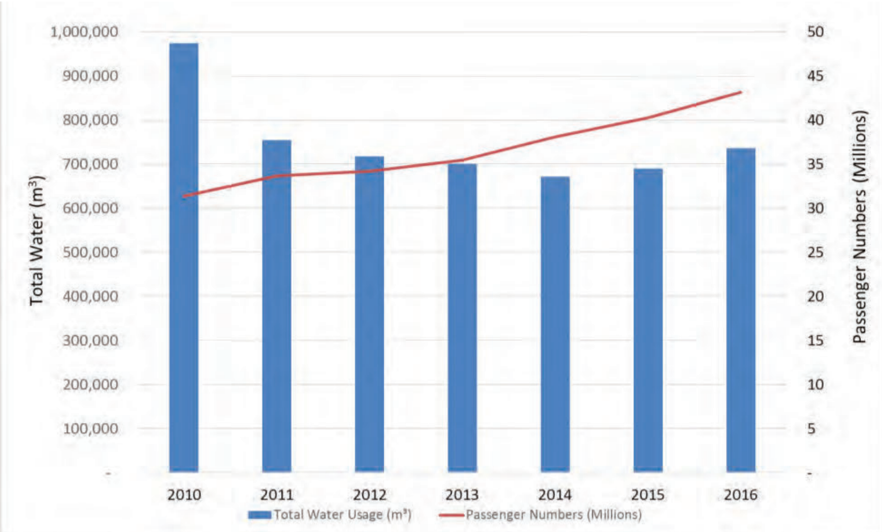
- Consumption decreased sharply from 2010 (956,539m^3) to 2011 (754,599m^3). This is potentially due to a leak reduction programme Gatwick implemented, as referred to in Project Acorn[1];

- Consumption continued to decrease from 2011 to 2014 (663,061m^3). As discussed in Phase 1, this is most likely due to further leakage management, and continued use of water efficient urinals. The Pier 5 partial closure for refurbishment and Pier 1 demolition, may have had a marginal effect on reduction in consumption, but water consumption is generally driven by passenger numbers and water use efficiency.

- Consumption has increased from 2014 to 2016 (731,047m3). This is potentially due to the reopening of Pier 5 and construction of Pier 1 and Bloc Hotel. This could also be due to leakage reduction programmes finding it more challenging to identify new leaks, compared to earlier successes. Also, there is a noticeable trend increase in the water nightline for EoR, and a significant leak found and isolated in the area, discussed further in Section 3. Over the same period passenger numbers have increased from 31.3 million to 43.1 million.

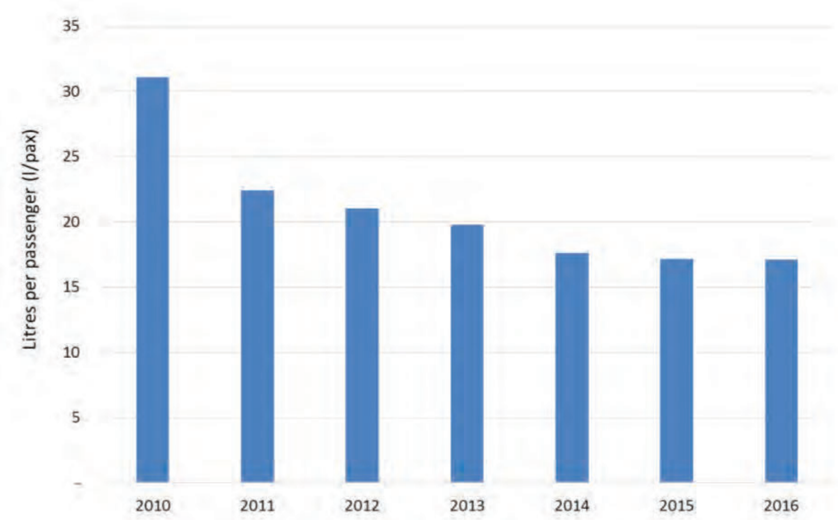
[1] The Project Acorn study was undertaken to understand the likely impact of planned capital and other projects at Gatwick Airport on the current typical consumption of energy and water.

Figure 2-1 : Gatwick Water Consumption



As passenger numbers have been increasing the relative consumption per passenger has decreased from 30.6 litres/pax (2010) to 17.0 litres/pax (2016). This is shown in Figure 2.2.

Figure 2-2 : Gatwick Water Consumption per Passenger



2.2.1 Monthly Profiles

In order to understand the dependencies of consumption, monthly water consumption profiles have been produced, along with the passenger profile for Gatwick.

Figure 2-3 indicates the monthly passenger profile for Gatwick. The number of passengers at Gatwick has increased by 38% from 2010 to 2016. This has translated to a relatively even incremental year on year increase and the monthly profile has remained similar for each year but more importantly, passenger numbers are also increasing in the typically quieter shoulder months when water use per passenger is normally at its highest. Generally the lowest passenger numbers occur in January and highest in August. For 2016 the difference in monthly passenger numbers from the lowest point in January to the peak in August was 2.3 million (or a 92% increase from the lowest to the peak month).

Water Masterplan 2020 & 2028 Forecast - Full backing report
JACOBS

Figure 2-3 : Gatwick Passenger Monthly Profile from Jan 2010 to Jun 2017

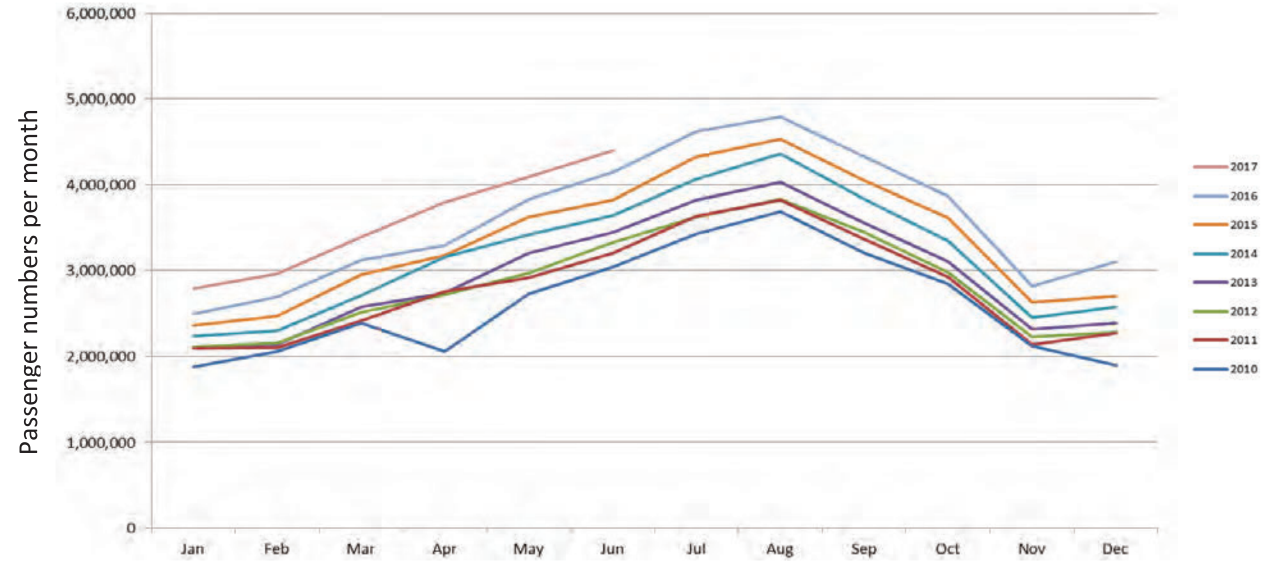


Figure 2-4 : Gatwick Monthly Water Consumption (m^3/month)

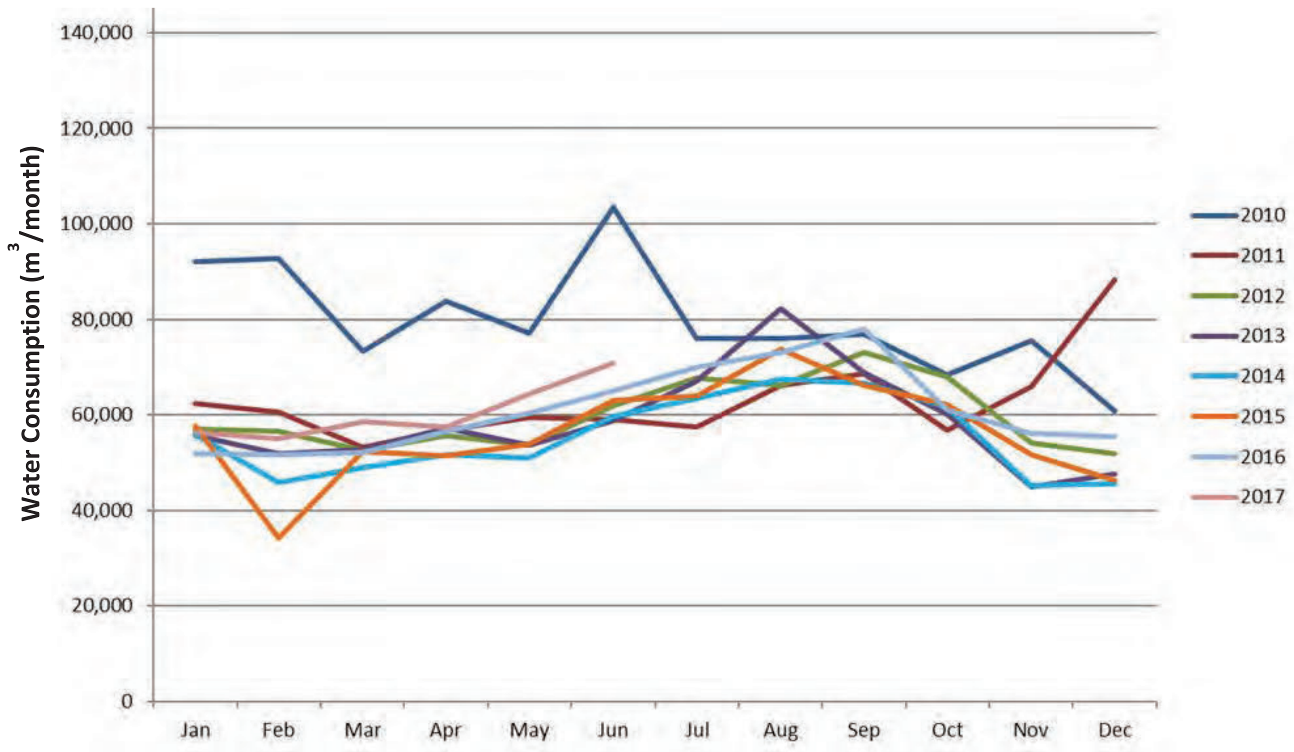


Figure 2-4 indicates the monthly profile of Gatwick's water consumption. The following can be noted:

- In general the annual profile is similar to that for passengers; however some years have their maximum consumption peak in September rather than August, and some fiscal meters are only read bi-annually;

- Water consumption does not increase at the same rate as passenger numbers, from January to August 2016 monthly water consumption increased by 34% (compared to a 92% increase in passengers);
- 2010 consumption does not appear reflective of a normal year, potentially due to the subsequent leak reduction programme;
- 2011 November consumption is high due to increased consumption at Povey Cross and 2011 December consumption is distorted due to the previous 18 months consumption at South Terminal chilling station being allocated to one month in December.

2.2.2 Historic Asset Changes

Gatwick assets have undergone several alterations over recent years, potentially influencing water use. The following asset changes have taken place within the period:

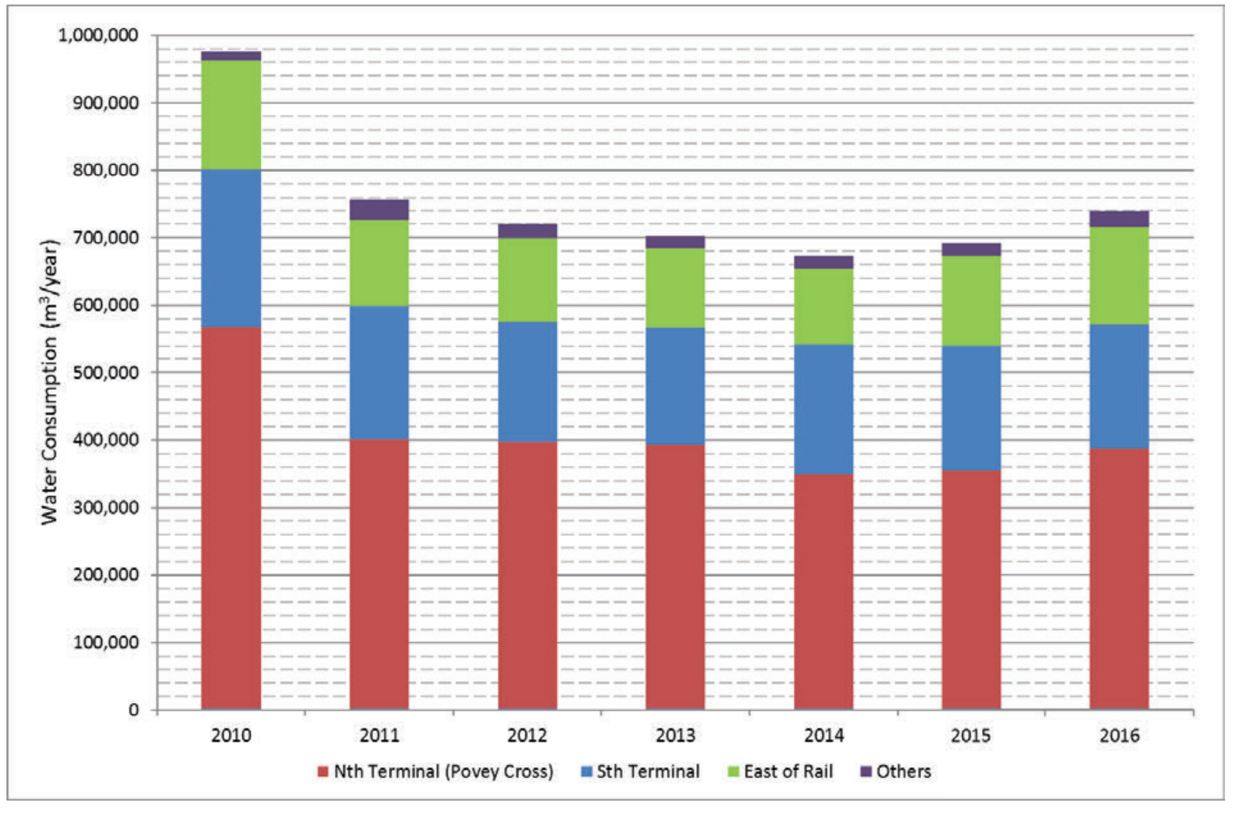
- **2010** - Ian Stewart centre closes, First Point opens;
- **2011** – Longbridge House and Southgate building 211 close, North Terminal extension and NT MSCP6 opens;
- **2012** – Southgate building Bay A9 closes, Norfolk refurbishment takes place, Viewpoint and Premier Inn open;
- **2013** – Hangar 1 and Pier 1 close, Pier 5 part closure / refurbishment commences Atlantic house extension, Hilton hotel and ST boiler house open;
- **2014** – Bloc Hotel, Airfield operations building and Ashdown house open;
- **2015** – NT MSCP temporary closes, ST IDL refurbished, Pier 5 reopens (Sept); and
- **2016** – Pier 1 reopens (April).

Due to the lack of historic sub-metering data it is not possible to fully analyse the impact of these changes. The impacts would depend on the water consumption of the building. Asset changes can cause leaks in a system if demolished assets are not properly isolated. Improved sub-metering and consumption analysis combined with active leak reduction programmes are required to keep a consistent level of consumption.

2.2.3 Main Fiscal Meters

A high level analysis has been undertaken of the annual consumption of the primary fiscal meters in order to further understand the trends and impact of any asset changes. North Terminal, South Terminal and EoR areas, supplied by AMR meters (Automatic Meter Reads), consume more than 95% of the water supplied to Gatwick, see Figure 2-5, and consequently have been classified as the primary meters.

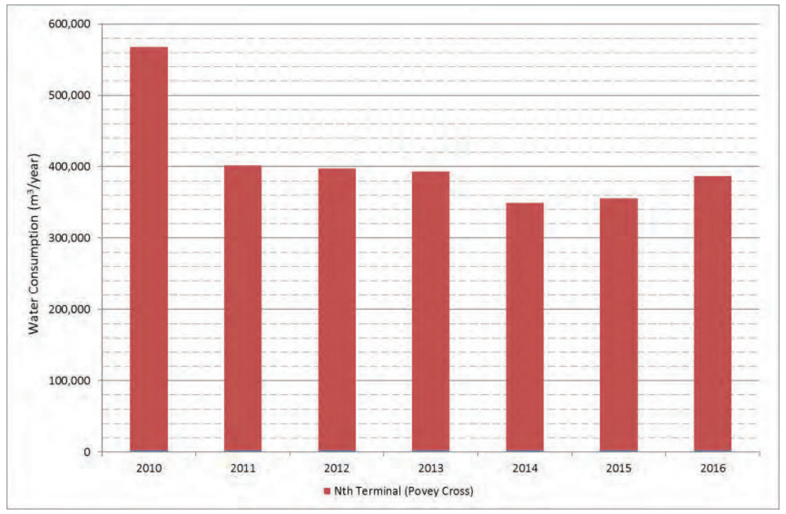
Figure 2-5 : Gatwick annual Water Consumption by areas – 2010 to 2016



Povey Cross Meter Area (North Terminal and airfield) Network

Figure 2-6 indicates the annual consumption of the Povey Cross Network fiscal meter. The consumption at Povey cross decreased from 2010 to 2011, potentially due to the leak reduction programme. Consumption remained relatively consistent from 2011 to 2013. Consumption then decreased in 2014, influenced by the repair of a large leak at NT MSCP5 in October 2013. The subsequent increase is potentially related to increases in passenger numbers, leakage and construction activities, such as the MSCP5 repairs

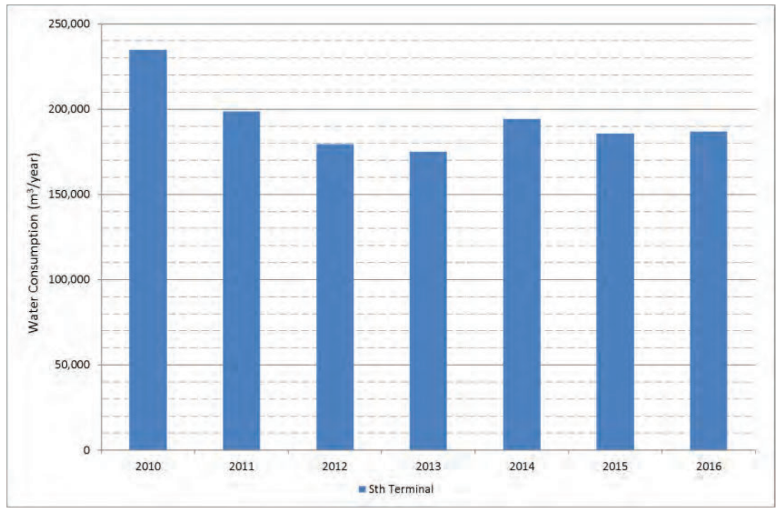
Figure 2-6 Povey Cross (North Terminal and Airfield) Consumption



South Terminal Network

Figure 2-7 shows the annual consumption of the four main south terminal fiscal meters, indicating that consumption has generally decreased from 2010 to 2014 in line with the overall Gatwick consumption. Consumption increased in 2014, potentially due to the construction and opening of Bloc Hotel 1, in March 2014. Consumption decreased in 2015, the same year the South Terminal International Departure Lounge was refurbished. But it cannot be fully ascertained if there is a link between the two. Consumption then increased in 2016 and this is likely to be attributed to the Pier 1 reopening in April 2016.

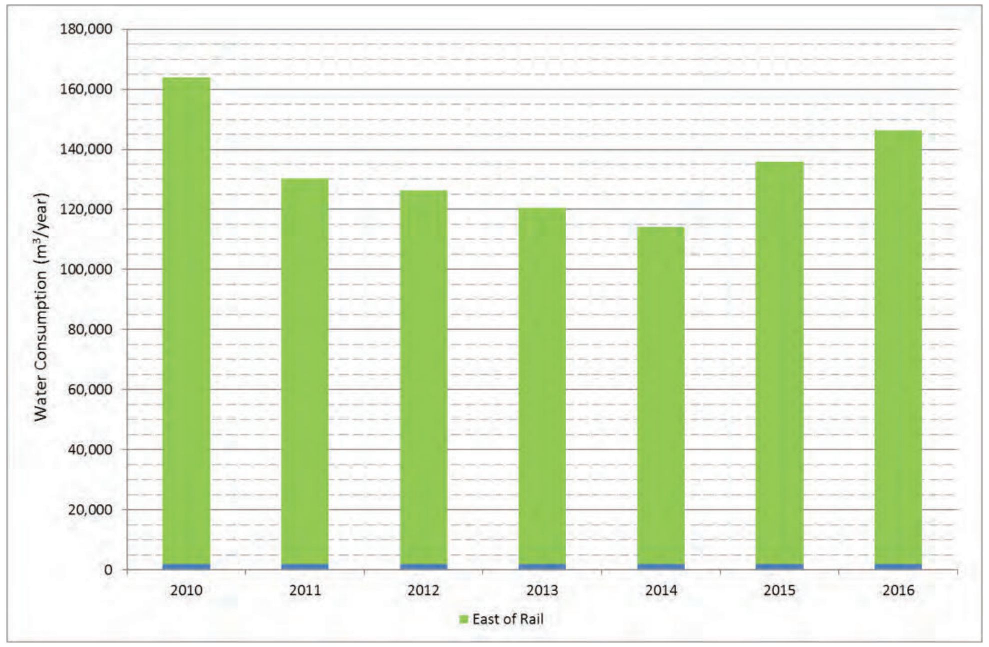
Figure 2-7 South Terminal Consumption



East of Rail (EoR)

Figure 2-8 indicates the annual consumption of the EoR fiscal meter. As can be seen consumption has generally decreased from 2010 to 2014 in line with the overall Gatwick consumption, but then increased from 2014 to 2016. This is believed to be due to an increase in leakage, based on observation of the diurnal flow graph for the period 2014 to 2017 – see Appendix C, section C.5. Section 3 provides further details on leakage and developments.

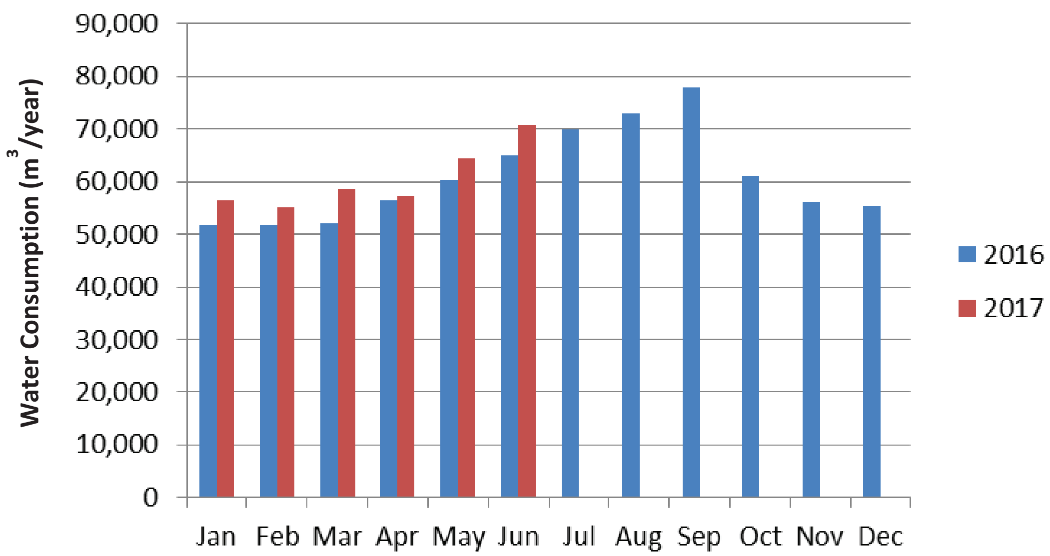
Figure 2-8 EoR Consumption



2.3 2017 Consumption

In 2017, it can be seen that water consumption for January to June is 7.5% above the same period in 2016. This suggests there will be an increase in total annual consumption. Figure 2-9 depicts the monthly water consumption profile for 2016 and 2017 to date. This increase is in line with passenger number increases and potentially due to Pier 1 reopening in April 2016, and the increase in leakage on the EoR network. Reduction occurred at the end of June, when a large leak on the Povey Cross Network was found and then isolated on 26 June, followed by repair in August 2017

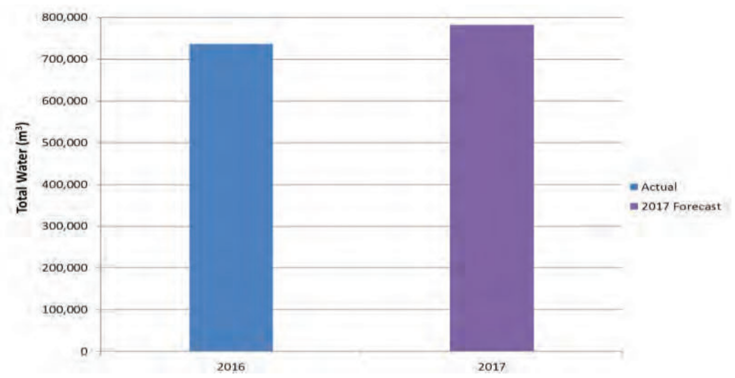
Figure 2-9 Monthly Water Consumption for 2016 & 2017 - year to date



- Water consumption from January to June in 2016 was 337,488m³ which accounted for 46% of the total annual consumption.
- Average water consumption from January to June (for 2011 to 2016) was 330,219m³, on average accounting for 47% of the total annual consumption (2010 was discounted due to the reasons discussed in the previous section. due to the suspected high level of leakage present at the time), and
- Water consumption from January to June in 2017 was 362,652m³.

Using the average percentage for January to June of the total annual water consumption and the consumption to date for 2017, a simple annual consumption forecast has been derived for 2017, as indicated in **Figure 2-10**. Forecast water consumption for 2017 is 781,942m³.[2]

Figure 2-10 2016 and Forecast 2017 Annual Consumption



2.4 Forecasting Methodology

It has been agreed with GAL that the water forecast will be provided on a calendar year (CY) basis rather than financial year (FY). FY20/21 passenger data has been used for CY 2020 and FY28/29 passenger data for CY 2028.

The following conclusions are drawn from preceding sections which inform the forecasting methodology:

- 2017 is showing increased consumption compared to 2016, for the period January to June of the year. To ensure any forecast trends reflect the airport at full operation a forecast annual total for the full year January to December 2017 has been included for forecasting purposes;
- Increasing passenger numbers generally contribute to increasing consumption. But where high levels of unaccounted for water exist, as they do at GAL as discussed in Section 3, the increasing effect is less marked;
- Leak reduction and water efficiency programmes can decrease water consumption in the face of increasing passenger numbers, as has occurred between 2010 and 2014;
- The closure of Pier 1 and Pier 5 have potentially lowered the consumption in 2014 and 2015 and the reopening of them and construction of the Bloc Hotel has potentially contributed to the increase in consumption in 2016 and 2017;
- Leaks on the EoR and Povey Cross networks have contributed to the increased water consumption in 2017.

[2] Consumption since June suggests that this figure is likely to be slightly high, as only an annual consumption of 740-750,000m3 is now expected.

2.4.1 Future Asset Changes

As discussed in Section 2.2 asset changes are potentially having an impact on water consumption. GAL has several asset changes that are expected to be implemented prior to 2020 with further changes anticipated by 2028. These will have an impact on water consumption. Table 2.1 lists the future asset changes with associated water consumption implications. The majority of these projects are as identified by the Capital Investment Programme (CIP) however certain projects have been identified in conjunction with the GAL engineering team.

The Asset changes have been categorised as being pre 2020 or post 2020 for purposes of identifying which are applicable to which forecast. These asset changes have then been added to the BAU trend forecast to provide a total forecast consumption.

Table 2.1 : Future Asset Changes

Title	Pre or Post 2020	Additional Area (m²)	Water Consumption (m³)
Boeing Hangar	Pre 2020	17,393	11,302
Bloc Hotel 2	Pre 2020	4,320	23,000
Pier 6 extension	Post 2020	15,000	9,763
Pier 6: Rain/Greywater savings		-10%	-976
Total		36,713	43,088

Boeing Hangar

A new Boeing hangar will be in operation before 2020. An estimate of the water consumption for the Boeing Hangar was derived based on the new building footprint and the water consumption figure per unit of floor area for the existing Virgin hanger as the most representative figure for the new development.

Bloc Hotel 2

A new Bloc Hotel is expected to be constructed by 2020, which GAL has confirmed will double the size of the hotel. This was assumed to have similar water consumption to Bloc Hotel 1 per floor area.

Pier 6 Extension

An extension to Pier 6 is expected to be constructed by 2028. An estimate of the consumption for the Pier 6 extension was derived from the existing water use of Pier 6 based on the floor area and consumption. Additionally an allowance has been made for water savings on the new Pier 6 extension. Whereas savings in residential settings can be in the order of 50% of total water consumption, savings in airports will be less since only washing water can be re-used, and this will be limited to restaurants, offices and toilets. The potential for savings on a pier extension are even less, with only hand wash water being available, plus the rainwater component. Accordingly, a preliminary estimate of 10% savings has been allowed for in Table 2.1 above.

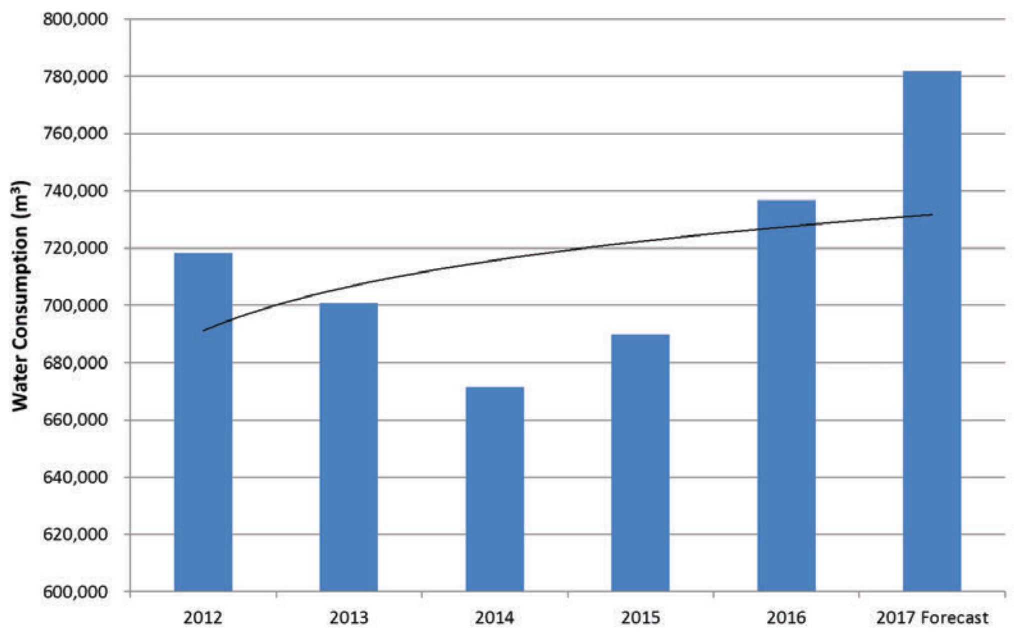
2.4.2 Business as Usual (BAU) Trend Development

In order to capture the overall consumption BAU trends occurring at GAL a top down approach (where the trends in total consumption at GAL are analysed) has been adopted. This is in preference to a bottom up approach, where trends would be analysed at the building or category level, as it is felt that this approach may not capture all changes occurring at the airport, and has an increased margin of error due to the use of multiple trend lines.

To establish a BAU trend, an associated trend line using the historic annual consumption was analysed over the following periods (reference to 2017 is based on the forecast 2017 consumption identified in Section 2.3):

- Short term (2014 to 2017) – Due to the increasing trend in consumption in recent years, potentially due to assets reopening and a leak on the EoR network, this trend projects a continued rate of increasing consumption which is not expected to be reflective of the airports future consumption.
- Medium term (2012 to 2017) – Due to the decreases in consumption made in the earlier years of this period, potentially as assets were out of use, and the increases seen in the later years, potentially as those assets reopened, the trendline for this data period is felt to be most reflective of Gatwick consumption moving forward. The trendline shows an increase overall in consumption which could potentially be caused by leak issues and passenger increases; and
- Long term (2010 to 2017) – Due to the substantial changes from 2010 to 2011 this data set did not best reflect the expected future trends in airport consumption.

Figure 2-11: Medium Term Consumption Trend



Example long term and medium term graphs are given in Appendix C.

A series of MS excel derived trend lines (Linear, Polynomial (Poly), Exponential (Exp), Logarithmic (Log) and Power (Pow)) were applied to these data sets. Power trend-lines were found to align best with the annual consumption and the expected consumption levels moving forward. Results for the different trend lines are contained in Appendix C.

2.5 2020 Forecast

Table 2.2 gives the results for the 2020 forecast. This includes the BAU trendline results, as discussed in Section 2.5.2, and the asset changes discussed in Section 2.5.1. These have been combined to produce an overall forecast for 2020.

Water Masterplan 2020 & 2028 Forecast - Full backing report

JACOBS

Table 2.2 : 2020 Forecast

2020 Water Forecast	
	Meters Cubed
Business as usual consumption	730,144
Asset Changes	34,302
Total 2020 Consumption	764,446
Scenario 1 (litres / PAX)	15.8
Scenario 2 (litres / PAX)	15.9
2010	
Total Consumption	974,067
Consumption per PAX (lites per PAX)	31.1
DOC Original target - 20%	
Target 2020 Consumption	779,254
Target reduction against 2010 baseline	20%
DOC Stretch target - 25%	
Target 2020 Consumption	730,550
Target reduction against 2010 baseline	25%
Predicted reduction against 2010 baseline	-5%
Reduction in consumption per PAX	49%

- BAU 2020 water consumption (730,144m^3) is similar to 2016 (736,772m^3), but is less than the 2017 forecast (776,744m^3);
- Overall 2020 water consumption (with asset changes) is **764,446m^3** which is higher than any of the previous years, apart from 2010; and
- Scenario 1 and 2 have similar passenger numbers for 2020 (48.3 million and 48.1 million respectively) so consumption per passenger is similar, both having a total consumption per PAX of 15.9 litres.

2.5.1 Decade of Change

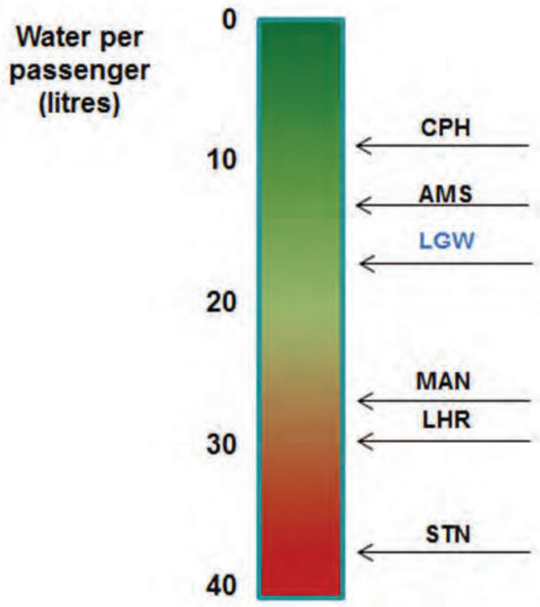
In 2010, GAL launched its Decade of Change (DoC) which set out GAL's sustainability targets with the view of achieving these by 2020. In relation to water the DoC report sets out an ambition that by 2020 GAL will reduce water usage by 20% (against a 2010 baseline). The intention now is to stretch this target to 25% to spur further water efficiencies as the airport grows.

The forecast 2020 water consumption predicts an 20% reduction against the 2010 figure and therefore suggests that the target will be met. The additional 5% reduction to meet the stretch target may be possible through water efficiency measures as detailed in Section 3, although this is not borne out by current information available.

Consumption in 2020 will be similar to that of 2011, despite a substantial increase in passenger numbers over this period. This is partially as passenger numbers do not appear to have a strong impact on water consumption, as established in Section 2.2, and also potentially due to water efficiency improvements helping to mitigate any impact of increased passenger numbers. Using relative (rather than absolute) metrics, a reduction of 47% in gross unit consumption per passenger has been achieved in this period (30.6 litres/PAX to 15.9

litres/PAX). Compared to other UK airports (Manchester, Stansted and Heathrow), GAL performs well, but not as good as some European airport e.g. Copenhagen and Amsterdam – see Figure below (extracted from Jacobs 2016 Report, *Airport Infrastructure Exemplar Sustainability Route Map).*

Unit Water Consumption compared to other UK and European Airports



The 2012 Masterplan expected the number of passengers for 2020 to be 39.1 Million. This was exceeded in 2015 with expected passenger numbers in 2020 now 48.3 Million for Scenario 1 and 48.1 Million for Scenario 2. If passenger numbers in 2020 had only reached 39.1 million (and assuming the water consumption was broadly similar to that forecast now) that would have equated to a consumption per passenger of 20.1 litres/PAX and only a 34% reduction in consumption per PAX since 2010.

2.6 2028 Forecast

The medium term trend lines used in the 2020 forecast have been extended to 2028. The additional asset changes, as included in Section 2.5.1, have then been applied to the BAU consumption profile.

Table 2.3 gives the results of the 2028 forecast:

- BAU 2028 water consumption is predicted to be **741,987m³**. An increase of 11,843 m³ against the BAU figure of 2020;
- Overall water consumption (with asset changes) is **786,052m³**. An increase of 21,606 m³ against the 2020 predicted figure;
- Scenario 1 has fewer passengers for 2028 than scenario 2 (53.3 Million and 55.3 Million respectively). For Scenario 1 total consumption per PAX is 14.7 litres and for Scenario 2 is 14.2 litres.

The provision of the 2028 forecast is subject to the realisation of any of the asset changes detailed earlier in this report. The main sensitivity lies with the Boing Hangar and its consumption per floor area being similar to that of the Virgin Hangar.

Table 2.3 : 2028 Forecast

2028 Water Forecast	
	Meters Cubed
Business as usual consumption	741,987
Asset Changes	44,065
Total 2028 Consumption	786,052
Passanger Nos Scenario 1 (million)	53
Scenario 1 (litres / PAX)	14.7
Scenario 2 Passanger Nos (million)	55.3
Scenario 2 (litres / PAX)	14.2
Consumption change against 2020	2.8%
Consumption per PAX change against 2020 Scenario 1	-7%
Consumption per PAX change against 2020	-11%

Figure 2-12 indicates the forecast consumption, BAU. As can be seen from the graph the consumption decreases from 2017 to 2020, returning to a similar level as 2016. It then increases slightly to 2028.

Figure 2-12 Forecast Consumption BAU

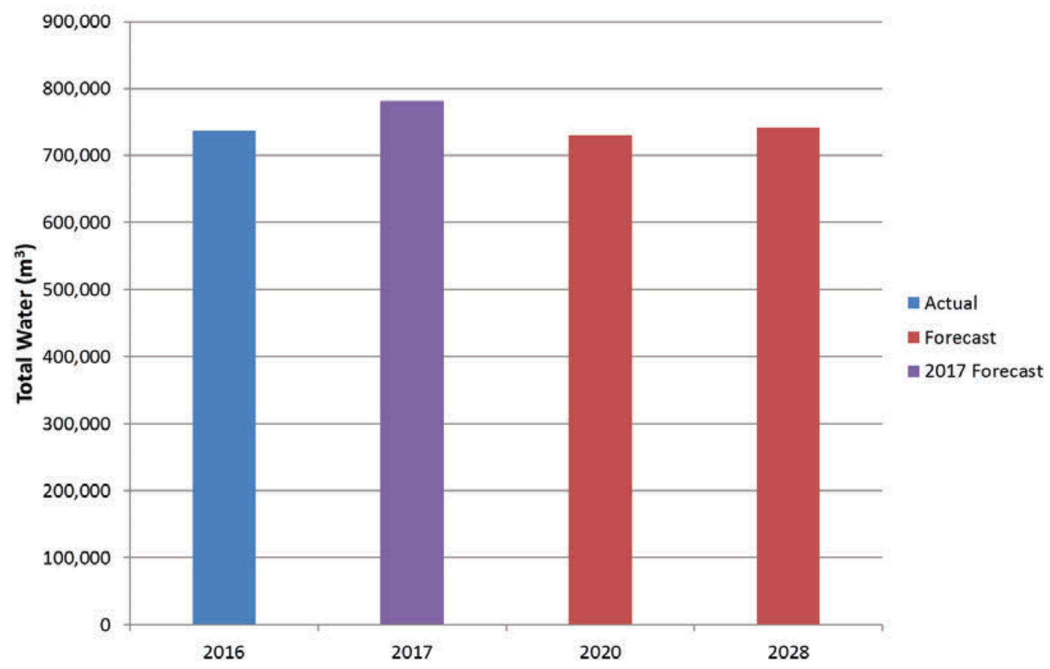
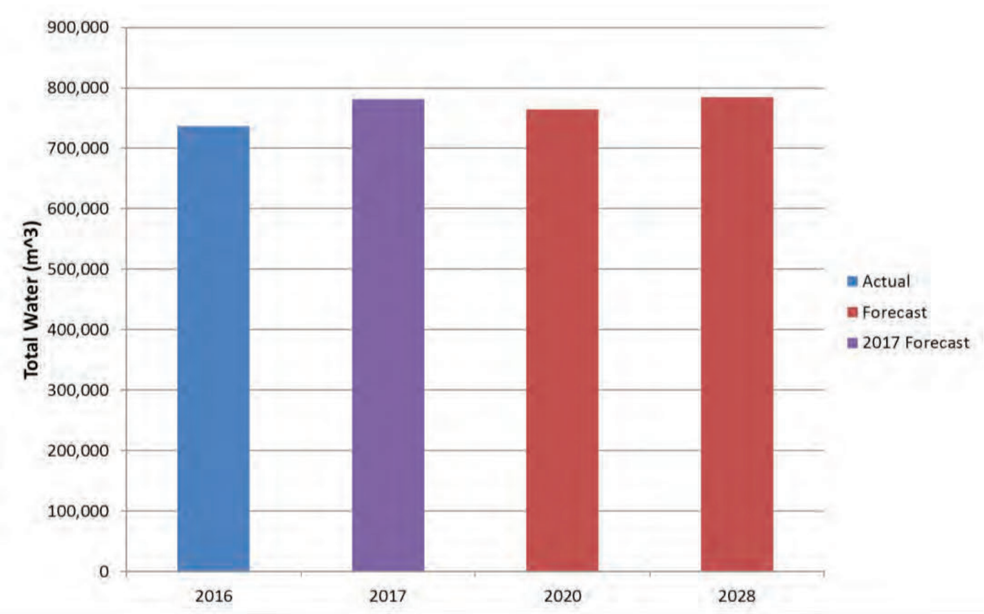


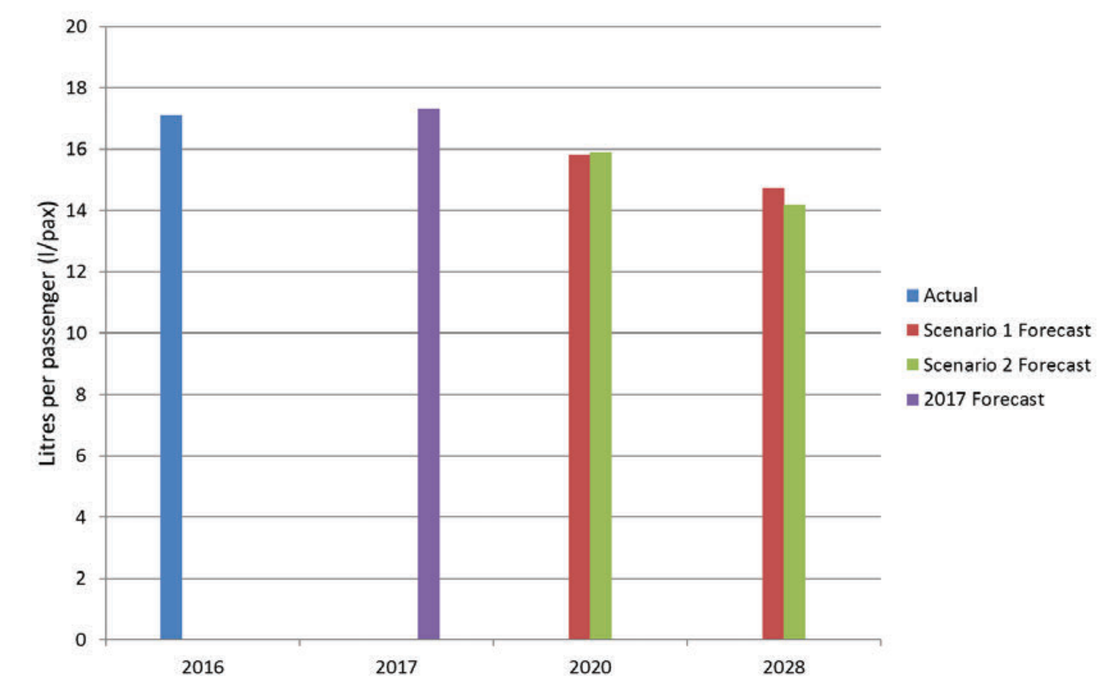
Figure 2-13 indicates the forecast consumption with asset changes. As can be seen from the graph the consumption increases from 2017 to 2028 due to the proposed asset changes.

Figure 2-13: Forecast consumption with asset changes



As passenger numbers are increasing at a greater rate than consumption it is forecast that there will be a decrease in consumption per PAX (with asset changes) of 7% for Scenario 1 compared to 2020 and 11% for Scenario 2 compared to 2020; see Figure 2-14. It is forecast that consumption would be approximately 15 litres /PAX for both scenarios.

Figure 2-14: Gatwick Consumption per PAX Forecast



2.7 Conclusions

The following conclusions can be drawn from the forecast:

- A 6.3% increase in water consumption is expected to be seen from 2016 to 2017 potentially due to leakage and Pier 1 reopening;
- Trend lines predict increasing consumption from 2017 to 2028;
- Total annual consumption in 2020 is forecast to exceed 2017 due to the construction of the Boeing Hangar and Bloc Hotel 2;
- 2020 total consumption is forecast to be 20% lower than the 2010 baseline and will meet the DoC target of 20% (or the stretch target of 25%); however consumption per PAX is forecast to decrease by 48% compared to a 2010 baseline;
- 2028 total consumption is forecast to be marginally more than 2020 due to the increasing BAU trend and construction of the Pier 6 extension;
- Consumption per PAX is forecast to decrease due to increasing passenger numbers with evidence to support a potential consumption per PAX of 15 litres by 2028. This is generally better than other UK airports, but not as good as certain European airports. Through the GAL Airport Infrastructure Exemplar Sustainability Route Map, the exemplar water management performance is benchmarked as water consumption of 10 litres / passenger (total); and
- A forecast verification has been conducted in Section 3.5 and collaborates these results.

2.7.1 Caveats

The following caveats apply to the forecast:

- The forecast is based on historic trends. A deviation or step change from these will impact the forecast.
- The BAU forecast trend is based upon a forecast annual consumption for 2017. If actual consumption differs significantly from this short term forecast, the trends may be impacted. As such a review of this forecast could be considered post 2017 when the actual data is received.
- Asset changes are as detailed in Section 2.5.1, and are as provided by GAL. Changes to these and the timing of these would impact the forecast. Key sensitivities would be items such as Boeing Hangar having a similar consumption per floor area as the Virgin Hangar.
- It is assumed the leak on the EoR network will be fixed and therefore is only a temporary increase in consumption; and
- The Net Unit water consumption approach to forecasting in Section 3.5 assumes a Fixed Unaccounted for Water (UFW) consumption and Fixed 8.1l/pax for net unit water consumption.

2.7.2 Recommendations

Recommendations for additional measures aimed at further reduction of water use are as follows:

- Analysis of the North Terminal water usage sub-meters indicates that unaccounted water is approximately 41%. The South Terminal sub-meter coverage is significantly less than the provision for the North Terminal therefore that area was not analysed. Improved analysis of water efficiency can be achieved by installing further sub-meters in both areas. This will assist in the identification of leakage and areas of unexpectedly high consumption;
- Installation of additional sub-meters to facilitate the identification of areas of leakage and poor water efficiency;

- Investigation into further water efficiency measures, particularly in the areas of the airport where none have yet been implemented; and
- Enhanced leakage management techniques, discussed in Section 3.

3. Water Efficiency Measures

3.1 Introduction

There are a variety of methods of improving water efficiency at Gatwick Airport. In summary the following issues and opportunities have been identified and will be discussed in this section:

- Unaccounted for Water (UFW),
- “Nightline” flow analysis,
- Leakage,
- Facility water wastage (i.e. uncontrolled urinals and taps left running),
- Re-used water for fire-fighting,
- Re-used water for aircraft washing,
- Grey water re-use,
- Rainwater harvesting.

UFW has to be first priority in any water efficiency programme, as it is high at Gatwick, in the order of 374,000m^3/year and representing more than 50% of total supply of 731,047m^3/year. Improved understanding of usage would aid the identification of water efficiency measures.

3.2 Terminology and application to Gatwick

Terms used in the breakdown and analysis of UFW and Leakage are:

Unaccounted for Water (UFW) is defined as the difference between the water supplied to a network and the water used at customer facilities. At GAL it is the sum of the fiscal meters into water supply, less the sum of all the facility sub-meters. There is the complication at GAL in that of the estimated 161 facility sub-meters, 47 are not working, missing or not read. Nonetheless the UFW is calculated on the difference between the total of the fiscal supply meters and the 114 sub-meters that are read.

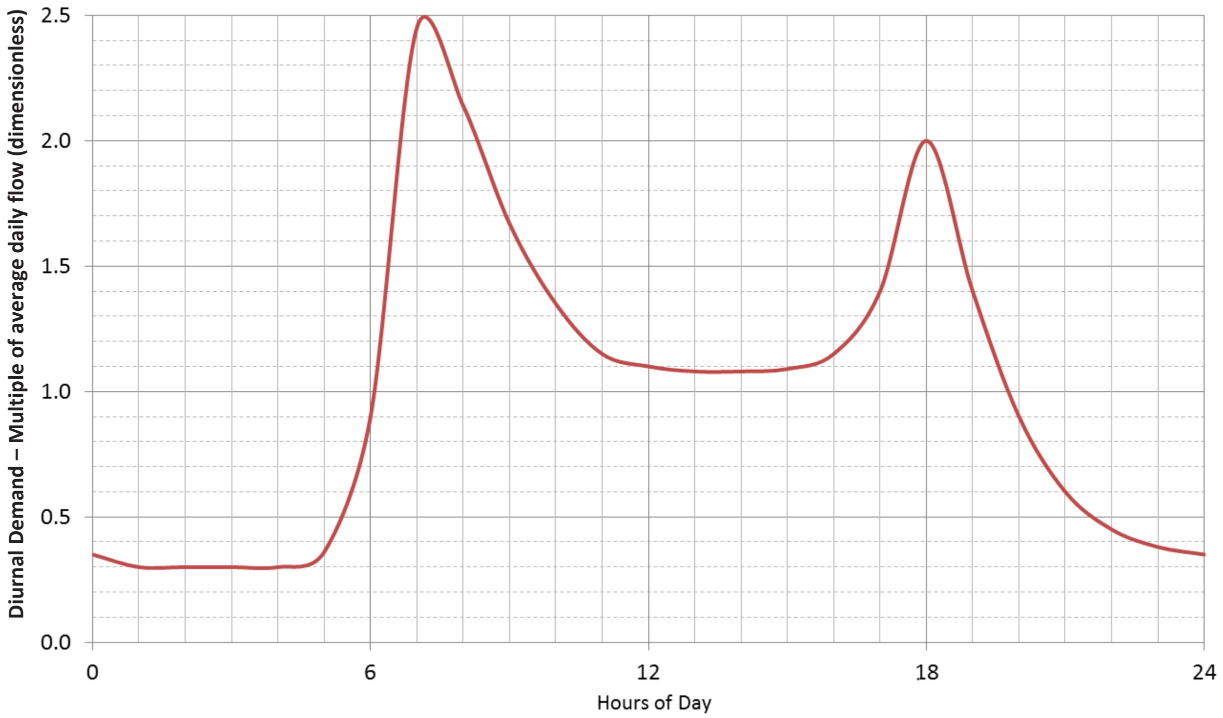
The “nightline” is the observed straight line often seen on graphs of diurnal water demand plotted over a 24 hours day. Typically between 1am and 5am for domestic supply, but at Gatwick varies between 1am to 3am in summer, and 1am to 5am in winter – an example is included in Figure 3-1.

Leakage is different to UFW and is defined as water lost from pipes underground. There are two components – mains leakage downstream of main supply meters and “customer side” or facility leakage downstream of facility sub-meters from leaks in underground or above ground pipework.

Facility water wastage is generally defined as water wasted downstream of facility sub-meters, typically inside buildings and typically consists of uncontrolled urinal flushing, taps left running, continuous overflows for water tanks etc.

A District Meter Area is a section of network pipes where all inflows and outflows are metered and any unmetered cross-connections to adjoining areas are closed. It is understood from discussions with GAL that the water supply areas for North Terminal, South Terminal and EoR represent DMAs and do not have open interconnecting boundaries. However as will be shown later in Section 3.4.2, there is reason to suspect that this may not be the case.

Figure 3-1 : Typical Domestic Example (not Gatwick) of 24 hour diurnal water demand showing “nightline” in early hours of morning



A summary of these aspects applicable to Gatwick are provided in Table 3.1.

Table 3.1 : Typical components of UFW and “Nightlines”

Water Loss	UFW	“Nightline”
Unmetered Consumption	YES	YES
Metered consumption (night-time allowance)	N/A	YES
Meter errors / not working	YES	N/A
Open boundaries between DMAs	YES	YES
Leakage - from pipes	YES	YES
Water wastage – i.e. urinals, running taps and tank overflows	N/A	YES

3.3 Analysis of “Nightline” from the ARM (Automatic Reading) meters

The 6 No. ARM meters cover about 95% of the water supplied to Gatwick, and consequently the analysis of the nightline for the three areas (North and South Terminals and EoR) is a good indicator of unaccounted for water and leakage (see Figure 2-5, page 7)

The diurnal water consumption for these three areas are given in Appendix C, sections C3, C4 and C5 and provide an illustration of the nightlines observed at Gatwick in July 2017, during the last 3 months and covering a 3 years period since readings started in 2014.

Observation results for the nightlines (for the 6No. ARM Meters only, but which cover more than 95% of GAL’s consumption) are summarised in Table 3.2, which includes the UFW results, and given more fully by areas in Appendix C.6.

Table 3.2 : Unaccounted For Water and “Nightline” Analysis

GAL TOTAL	Apr14-Mar15	Apr15-Mar16	Apr16-Mar17	Current
	2014	2015	2016	Jul-17
Total SES Fiscal Meters: GROSS Supply	663,307	676,626	731,227	
Total Sub-meters: NET Consumption	338,189	333,976	356,914	
Unaccounted For Water (m^3/year) (UFW)	325,118	342,650	374,313	
Unaccounted For Water (m^3/hour) [(1)]	37.09	39.09	42.70	
Unaccounted For Water (%)	49%	50.6%	51.2%	
Estimate Average Annual Nightline (m3/h)	missing data in ST area		42.6	42.0
Passenger numbers	38,653,099	40,788,058	43,958,160	
GROSS Water Consumption (l/pax)	17.2	16.6	16.6	
NET Water Consumption (l/pax)	8.7	8.2	8.1	

161	Total No. of Sub-meters
47	No. of Sub-meters NOT WORKING
29%	% of Sub-meters NOT WORKING

Note [(1)] *Unaccounted for water for 2014 estimated assuming 2.0m3/hr lower than in 2015 - this is based on the changes observed in nightlines from 2014 to 2015.*

3.4 Unaccounted for Water (UFW) and improved metering

3.4.1 Calculation of UFW

The UFW has been determined using monthly readings of the sub-meters supplying facilities at Gatwick, and deducting from the sum of the fiscal supply meters to the three main areas. There are 161 sub-meters as follows:

- North Terminal – 94 sub-meters (of which 26 are not working or not read);
- South Terminal – 43 sub-meters (of which 16 are not working or not read); and
- East of Rail – 24 sub-meters (of which 5 are not working or not read),

A monthly plot of UFW from April 2015 to March 2017 is given in Figure 3-2 and a composite summary, together with nightline results, is recorded in Table 3.2.

3.4.2 Analysis of UFW and Nightline flow

There is some noticeable difference between UFW and nightlines in the three individual areas, but there is good concurrence when comparing the total overall figures of 42.6m^3/hr UFW and total nightline of approximately 42.0m^3/hr:

- Povey Cross (North Terminal/Airfield) - UFW 19.71 m^3/hr < Nightline 28 m^3/hr,
- South Terminal - UFW 16.58 m^3/hr > Nightline 5.6 m^3/hr,
- East of Rail - UFW 3.76 m^3/hr < Nightline 9 m^3/hr,
- There are a variety of reasons as to why the UFW and nightline can be different, namely;
  - High number of night time users, such as hotels in the EoR area, making the nightline higher than monthly UFW;
  - Meter errors in South Terminal as UFW are higher than nightline flows, and
  - And, open boundaries between DMAs or areas – experience shows this is very common within the water industry, even where operators believe they have closed boundaries, which can be readily verified, as explained in Appendix E.

Figure 3-2 : Gatwick Monthly water consumption and UFW: April 2015 to March 2017

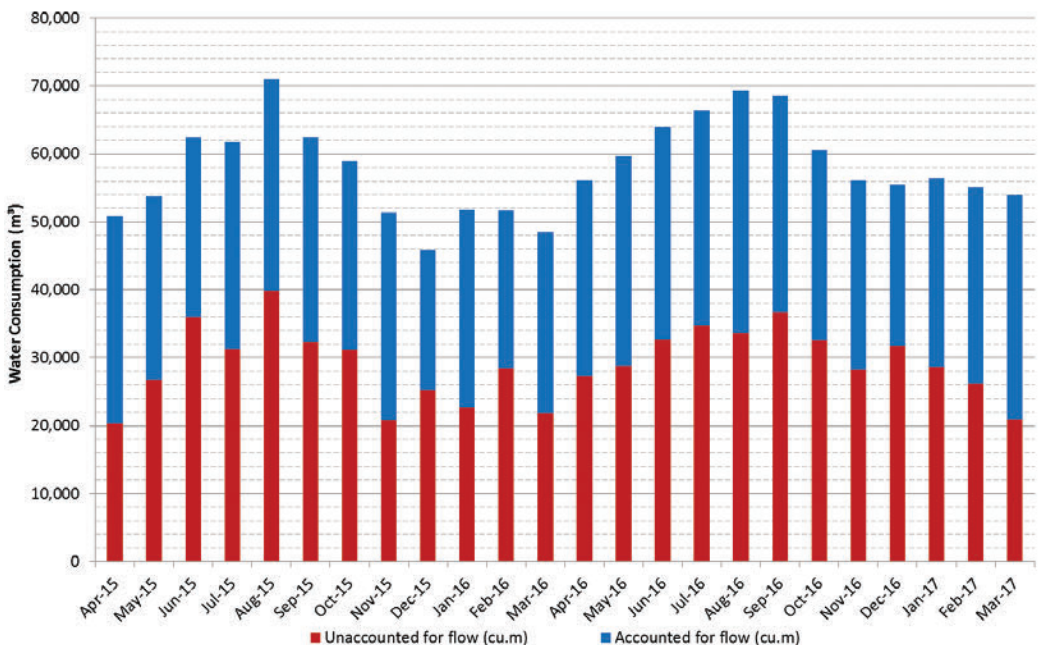


Figure 3-2 indicates the seasonal variation in UFW, low in winter and high in summer. If leakage was the dominant factor we would expect to see UFW following more or less a flat-line across the year. The variation suggests that meters not working/not read and water wastage inside buildings are a significant factor.

From for minimum month UFW it can be deduced, with some caution, that leakage and facility water wastage inside buildings might be in the order of 20,000m³/month (240,000m³/year) or 28m³/hr. The remainder of the total UFW (from Table 3.2) of 374,133 – estimated leakage of 240,000m³/year, say 130,000m³/year (in round figures) is probably attributed to UFW from meters not working or not read.

The nightline for 2016 is estimated at 42.6m³/hr. As the nightline is measured between 1am and 3am, typically 2am, then it is expected that in the airport only night staff will be on duty and that normal workings at the airport are not taking place. The numbers of staff involved are not known, but are thought to comprise the Police, Fire station staff and Security Staff – a figure of 1000 is assumed. Other night users are expected to be the ST Boiler house, chilling station and hotels supplied from Gatwick water supply system. An estimate of the anticipated night time user are given in Table 3.3.

Table 3.3 : Estimate of night time water consumption

Night Time Water Consumption	Average 2016		Estimated nightline	
	m³/yr	m³/hr	%	m³/hr
Premier Inn	32,886	3.75	50%	1.88
Sofitel Hotel	48,786	5.57	50%	2.78
Hampton Hilton Hotel	12,112	1.38	50%	0.69
Bloc Hotel	11,380	1.30	50%	0.65
Yotel	179	0.02	50%	0.01
ST Boiler House	673	0.08	100%	0.08
ST Chilling Station	13,736	1.57	100%	1.57
Hilton Hotel	68,562	7.83	50%	3.91
Airport Staff 1000	pax, at	0.6	l/pax/hr	0.60
			Total Estimate	12.17

Note that the assumption of 0.6 litres/person/hour is the normal water industry allowance for night time consumption. This then leaves the remainder of the total nightline (Table 3.2) of 42.6 – night time consumption (Table 3.3) of 12.2 = 30.4 m³/hr, or 266,000m³/year, which is then the combined leakage and water wastage in buildings. This concurs well with the estimate taken the monthly UFW of 28 m³/hr.

Based on limited information, it is estimated that leakage and wastage is in the order of 28 m³/hr and that unaccounted for metering is in the order of 14m³/hr. it is not possible to break the figures down any further. When the 47 No. meters, currently not working or not read, are resolved to give a more accurate figure of UFW, then the leakage and water wastage figures can be separated out from the Nightline flows. Additionally it is recommend to install ARM Meters of the boiler house, chilling station and hotels. It is strongly suspected that leakage rather, than building water wastage, will prove to be the major factor. In formula terms these can be expressed as;

- *Leakage = (accurate) UFW – permitted unmetered consumption,*
- *Leakage = Nightline – Total night-time usage,*
- *Water wastage in buildings = Total night-time usage – Legitimate night-time usage.*

3.4.3 Improved metering

A comprehensive list and hierarchy of the facility sub-meters was provided in the Appendices of the Phase 1 Report, a summary is given in Table 3.4.

Table 3.4 : Gatwick Facility Sub-Meters

Supply Area	SES Fiscal Meter	SES Meter reading frequency	GAL Sub-Meters	GAL 2nd level sub-meters
North Terminal and Airfield Area	Povey Cross OUT23DM - 189689	Automatic Reading (ARM) to SES-Gatwick website	15 No. direct – 4 not used	None
			Bulk Meter 2	None: direct to 230 Stands batching plant
			Bulk Meter 3	5 No. total: 3 working, 1 with no meter and 1 not in use
			Bulk Meter 4	7 No. total: 4 working, 2 with no meter and 1 not working
			Bulk Meter 5	7 No. total: 5 working, 1 with no meter and 1 not working
			Bulk Meter 5A	3 No. total: 2 working,1 not working
			Bulk Meter 6	42 No. total: 30 working and 12 with no meters
			Bulk Meter 7 – not used	None – supply point not in use
			"Bulk Meter 8" – no meter, just a meter area	5 No. total: 3 working, 2 with no meters
			Bulk Meter 9	None – direct to Snow Base Area
			Total of 94 No. GAL sub-meters (26 out of use or not working)	
South Terminal	ST Arrivals - 189319	Automatic Reading (ARM) to SES-Gatwick website	29 No. – 14 not in use	None
	ST Departures 1 and 2 – 189313 and 189314		11 No. – 1 with no meter, and 1 unfound,	None
	ST Concorde House - 189325		3 No.	None

Supply Area	SES Fiscal Meter	SES Meter reading frequency	GAL Sub-Meters	GAL 2nd level sub-meters
			Total of 43 No. GAL sub-meters (16 out of use or not working)	
East of Railway	East of Railway - 189323	Automatic Reading (ARM)	21No. direct	None
			Bulk Meter 1	2No. – Taxi Feeder Park and ST Car Hire
			Total of 24 No. GAL sub-meters (5 out of use or not working)	
Other Areas	24No. SES Meters	23 – biannual 1 - monthly	None – all direct supplied	None

Of the total of 161 facility sub-meters, 47 are not in use or not working, and thereby not read or accounted for.

An inspection survey of all facilities where meters are not read, or located or not working should be undertaken with a view to closing off these loopholes and ensuring working readable meters are in place.

3.5 Leakage – Control and Reduction Measures

Leakage management to detect, find and fix leaks is traditionally done by sounding techniques (e.g. using listening sticks / dopplers) on metal pipes. This is still practiced, but the principle of detecting and analysing acoustic noise from leaks in pipes can be enhanced using state of the art technology. Also techniques are used to verify permanent sub-division of water supply areas and sub-divide and isolate water supply areas on a temporary basis for testing.

A description of the appropriate techniques to be applied to Gatwick are given in Appendix E and summarised in the following sub-sections.

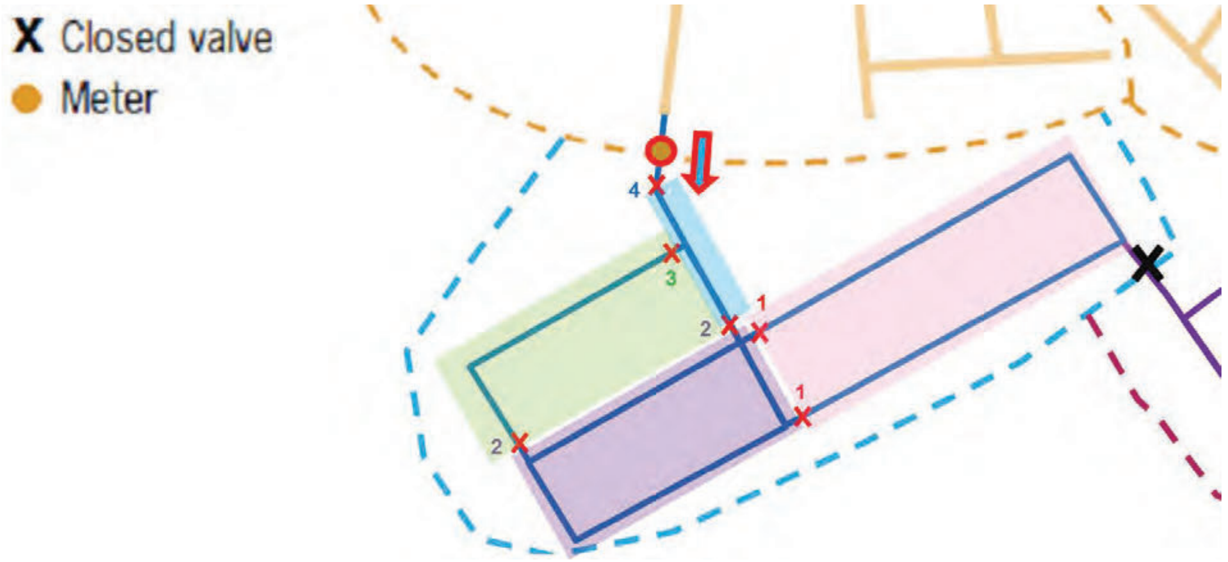
3.5.1 Verification of District Meter Areas (DMAs) water supply boundaries

As mentioned in Section 3.4.2 above, open boundaries between DMAs will invalidate attempts to monitor water consumption within set boundaries. Where this is suspected, pressure tests are undertaken, typically during a 2 to 3 hour period at night, to determine if all the valves known and unknown are closed on boundary – see Appendix E.1.

3.5.2 "Step Testing" within DMAs

This involves sub-dividing a DMA water supply area, again during the silent hours of the night. The main supply meters are monitored, whilst prearranged sub-divisions within the DMA are closed sequentially. "Steps" in the nightline flow are then observed – see Figure 3-3. The results when analysed will indicate leakage levels in each sub-divided area for further investigation. For more details – see Appendix E.2.

Figure 3-3 : Example of a DMA undergoing a "Step Test" - in 4 steps, closing valve sets 1, 2, 3 and 4 sequentially on the 4 areas



3.5.3 Leak noise correlation

Traditional sounding techniques with listening sticks are effective in identifying the presence of leakage, but cannot easily pinpoint a leak in an underground pipe. Current technology using leak noise correlators can do this making connections on two positions of a pipe, which must be metallic. Analysis by the machine displayed on a laptop can pin point the leak position – see Appendix E.3.

3.5.4 Acoustic noise loggers

Alternatively in busy areas where access during silent night-time hours is not possible, an array of acoustic noise loggers can be deployed en-masse across a DMA or entire network. The noise loggers, which also correlate the leaks, are left in position for a period of typically 1 to 2 weeks, and then analysed to determine leaks and leak positions. Verification with a ground microphone or leak noise correlator is recommended before excavating for the leak – see Appendix E.4.

3.5.5 Pressure management

Pressure reduction on network offers quick fix solution to reduction of leakage across DMAs, which can be applied before or after carrying out leak detection surveys. The pressure at GAL as measured for North Terminal (see Appendix C.3) varies between 5 and 6 bar – 5 bar at peak times of day and 6bar at night. There is therefore clearly scope to reduce pressure during night time, and even day time on a "need to have" basis.

Typically a Pressure Reducing Valve (PRV) is installed and a controller connected to regulate the downstream pressure setting, rather than keeping the downstream at a fixed pressure. The controller will ensure that the minimum required pressure is always available to consumers and will open up automatically when high flows are required in emergencies, such as fire-fighting.

Protection measures are also introduced so that the fail-safe positions for PRVs are acceptable for the water supply operations.

Buildings which have pressure requirements for sprinklers can be provided with their own booster pump systems, rather than pressurise an underground network of pipes to unnecessarily high pressures, and exacerbating leakage.

Pressure management is extremely effective in saving on leakage, but it has to be continuously monitored and, where economic to do so, backed up with "find and fix" leakage techniques. For more details – see Appendix E.5.

3.6 Facility Water Wastage – improved efficiency in water use appliances

Water wastage inside buildings typically consists of continuous flows from uncontrolled urinals, taps stuck open and left running and tank overflows from faulty float valves. With good maintenance wastage from faulty equipment is rare, however the water wastage by uncontrolled automatically flushing urinals can be very high and is typically a major contributor to out of hours water usage in large institutions.

The airport main terminal buildings with public access all have “state of the art” passive infra-red (PIR) detectors for urinal flushing, basin tap and WC flushing in compliance with latest GAL Standards for toilets, *20000-XX-Q-XXX-STD-000066 Toilets Technical Standard*, issued 2012 and revised 2016. A pilot 2016 public toilet refurbishment project, using latest GAL standards, has produced approximately a 30% saving in water use.

But older buildings and offices around the Gatwick airport and airfield side may not have this and may still use traditional control settings of the flushing cisterns operating once every 20 minutes. Old and abandoned buildings should also be checked and water switched off in the same way that electricity is isolated from unused buildings for safety reasons.

An inspection survey of all buildings outside the main public access terminals should be inspected and where there are urinals in place, without proper controls, then these should be introduced.

In addition to the design laid out in the GAL Toilets Technical Standard, using PIR activated urinal flushes, there are other options, where retrofitting to existing appliances. These typically include:

- Installing control devices on water pipes on existing urinals, without sensors, that only permit flushing when urinals have been used:
  - activated by PIR movement detectors,
  - or by pressure drop valves, and
  - or door opening actuated devices.
- Alternatively waterless urinals can be introduced into any existing building, but will require plumbing alterations and introduce a weekly maintenance regime. Waterless urinals are generally not recommended in high usage facilities due to their maintenance requirements and risk regarding hygiene; and
- Removal of urinals altogether and fitting WC s only, as with ladies toilets.

3.7 Other water efficiency measures

In addition to managing metering, leakage and water wastage in buildings there are other water efficiencies that can be practiced at Gatwick. But it needs to be considered that the priority should deal with the leakage and wastage, which is estimated to be equivalent to 370,000m^3/year, and represents more than 50% of the total water supplied to Gatwick.

3.7.1 Fire fighting

The main areas where recycled water is used in place of potable water is for the airfield fire ring main, which is filled with pressurised ‘dirty’ water from Ponds D and E. This is effectively “Rainwater Harvesting”, and is reported as such by other airports.

Generally firefighting is undertaken using fire tenders filled with potable water in their tanks and water from the ‘dirty’ side of the surface water drainage system as a secondary resource should fire tenders exhaust on-board supplies.

The dirty pond water is not preferred by fire-fighters, as it can damage their pumps and clean water is needed for making foam.

Apart from possible future use of rainwater harvesting there appears to be limited opportunity to improve on water efficiencies in fire-fighting.

3.7.2 Aircraft washing

Potable water is currently used for aircraft de-icing and vehicle wash down. There is limited scope in these areas to use recycled water because good quality water is required for mixing de-icing sprays for aircraft, and similarly clean water is required for washing down.

A portion of the water used for de-icing is recovered and recycled. In 2015 of 684 m^3 of water used for de-icing, 128 m^3 was recovered, approximately 20%.

But keeping things in perspective, the 128m^3 saved represents only 0.02% of the 676,240m^3 of water used in 2015, compared to UFW which for 2015 was 342,273m^3 or 50%.

3.7.3 Grey water re-use

Grey water re-use involves the practice of taking “sullage” water, wastewater from sinks, basin, showers, baths etc, i.e. wastewater containing non-faecal matter.

It has the potential to save on water use, by reusing this element of water for other purposes, such as toilet flushing, irrigation of plants or even washing cars. However for safety and hygiene reasons, the water requires treatment, which is typically a small scale treatment plant with operational requirements and risks. Studies by CIRIA in Guidance *C539 “Rainwater and greywater use in buildings” 2001,* found that in trials none were economic and payback periods were in the order of 15 to 20 years.

This does not mean that grey water is not feasible, but there are sufficient risks and challenges to not retrofit this to existing buildings. For new buildings, it can always be a consideration, where the opportunity exists to design the water and sanitary pipework, storage tanks and treatment plant accordingly. Regulations regarding identification of pipes and the water hygiene risks are also issues to be taken into account.

There is currently no known use of grey water at Gatwick, and comparisons with Heathrow suggest it is not in use there either. Manchester is reportedly trialling rainwater and grey water in its road sweepers, but few other cases are known.

Because of the requirement to treat the water, it is not recommended to attempt to retrofit grey water re-uses to existing facilities, but could be considered in new buildings.

3.7.4 Rainwater harvesting

Rainwater harvesting involves collecting water from roofs or paved areas for re-use.

Rainwater harvesting is used at the Airfield Operations Building and previously used at the NT Sanitation block, but is not otherwise widely used across the airport. Plans are under way to refurbish the rainwater harvesting system in the NT sanitation block. The harvested rainwater is proposed to be used for construction, irrigation, filling tankers and paved surface sweepers The system is also connected to the dirty water fire water system.

The prospects of introducing rainwater harvesting have been discussed in meetings between Jacobs and GAL staff, and there is broad agreement that these measures work well in new buildings, where it is part of the design and operational philosophy, but the practical constraints of retrofitting this into existing buildings are difficult to implement.

Examples of rainwater harvesting at comparative airports:

a) Heathrow has implemented rainwater harvesting at Terminal 5, assumed to come from the large terminal building roof area. The 2015 sustainability report gives the following figures;

Water use (m^3/year)	2009	2010	2011	2012
Total Water used at Heathrow (from ~85% mains, 15% boreholes)	2,486,774	2,227,668	2,265,944	2,220,772
Terminal 5 roof rainwater Harvesting (%)	27,597	31,183	4,367	0

Water use (m³/year)	2009	2010	2011	2012
	(1.1%)	(1.4%)	(0.2%)	(0%)

Source: Heathrow 2012 Sustainability Performance Summary

However the utilisation is low at marginally over 1% of the total water used at Heathrow, and the use of rainwater harvesting appears to have reduced in 2011 and 2012 for reasons unknown.

b) At Changi airport, Singapore, the rainwater runoff from runaway are used for rainwater harvesting. Saving a reported 30% of water usage. The water is used for fire-fighting and toilet flushing. [3]

c) Frankfurt airport, the largest in Germany, reuses 100,000m³/year of rainwater. The water is used for toilet flushing, irrigation of plants and cleaning of the air conditioning systems. [4]

d) East Midlands airport in the UK uses rainwater harvesting for toilet flushing and claims this has helped reduced the passenger unit water consumption by 19%.[5]

Rainwater harvesting does have great potential for saving water, but it is recommend ensuring that the end use does not require any treatment other than minor screening. Roofs are clearly preferred over paved areas, as the water is generally cleaner, but it depends on the end use.

3.8 Conclusions and Recommendations

There is potential to make improvement in water efficiency at Gatwick.

With unaccounted for water, leakage and building water wastage amounting to 50% of supply, it is recommended to focus on these areas first, with rainwater harvesting being considered for large existing buildings and all new buildings.

In summary the recommended actions are:

- Inspect and survey all facilities where meters are not working, or not being read and replace as required and add to reading schedule. Consider the re-introduction of ARM meters for facility sub-meters;
- Monitor nightlines after improved metering and compare against UFW to help quantify the extent of leakage from building water wastage;
- Conduct an inspection survey of toilets in older buildings to check on urinal controls, and other potential sources for water wastage, outside taps, roof tank overflows, isolate unused buildings, etc.;
- Carry out enhanced leakage surveys, consider feasibility and benefits of:
    - Step-testing areas,
    - Widespread use of an array of acoustic noise loggers,
    - Use of leak noise correlators to find and repair leaks,
    - Pressure reduction in mains network, using modulate Pressure Reducing Valves (PRVs), with protection measures and contingencies for emergency water demands; and
- Consider Rainwater Harvesting for large buildings and all new buildings.

[3] [redacted]
[4] Climate Culture Communications Lab, [redacted]
[5] Manchester Airport Sustainability Group,, [redacted]

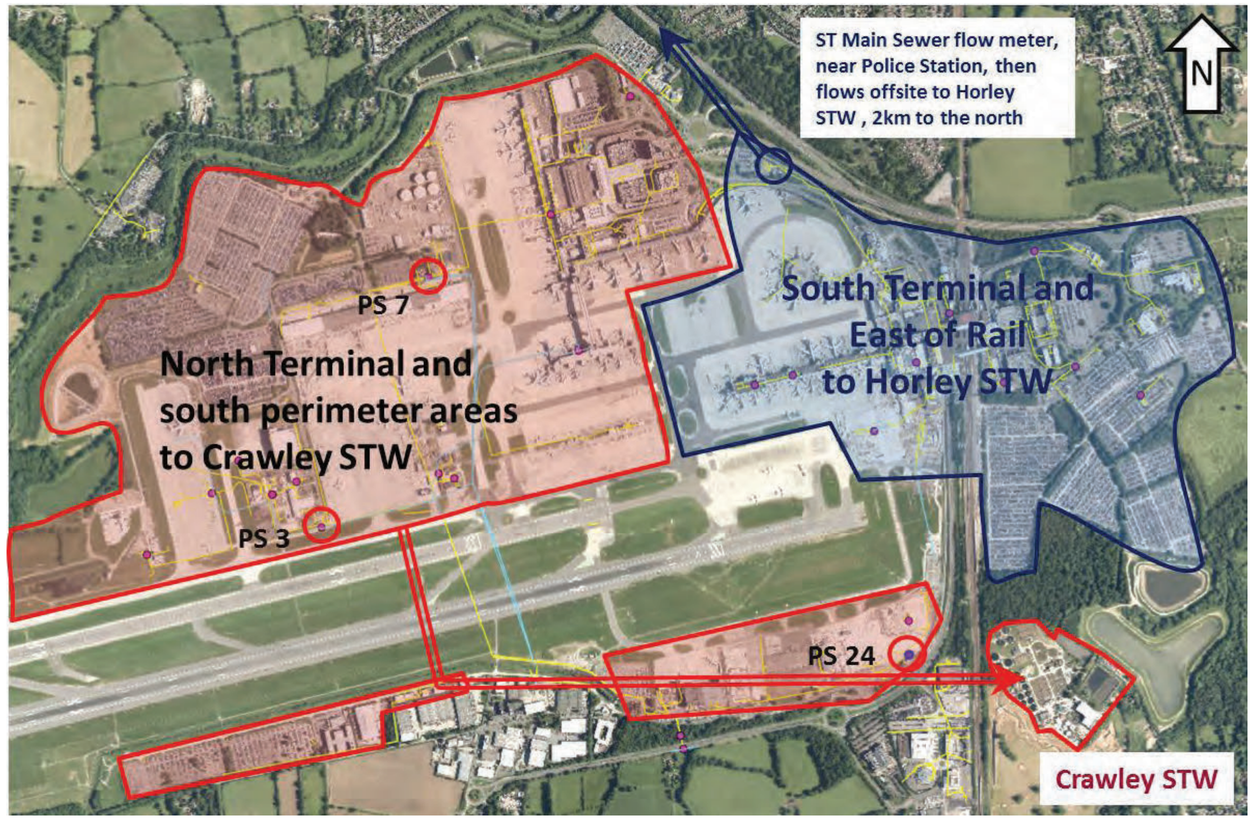
4. Foul Wastewater

4.1 Foul sewer catchment areas

The wastewater flow from Gatwick is divided into two areas:

- North Terminal and building along the southern perimeter discharging to Thames Water Crawley Sewage Treatment works (STW),
- South Terminal (ST) and East of Rail (EoR) all collect in a main gravity sewer, believed to be 400mm pipe size, which then discharges off site near the Police Station and then is conveyed to Thames Water Horley STW.

Figure 4-1: Plan Layout of Sewer Network Areas



4.2 Measured sewer flow rates

The flow rates discharging to Crawley STW are measured from flow meters at the terminal pump stations, PS 3, PS 7 and PS 24. Flow meter readings from the main sewer near the Police station discharging to Horley STW are not available, consequently an estimate of the flows from South Terminal and EoR to Horley STW cannot be determined.

Flow data available from the 3 No. terminal pump stations in the North Terminal area are provided in Table 4.1.

Table 4.1 : Gatwick Foul Sewer Flow measurements 2010 to 2016

Year	Flow to Crawley STW (m³/yr)				Flow to Horley STW (m³/yr)	Total (m³/yr)	Water Usage (m³/yr)	Wastewater as a % of Water Usage
	PS3	PS7-1	PS7-2	PS24	Gravity Pipe			
2010	16,511	117,596	407,467	Not available	Flowmeter readings not available	**541,574**	956,471	**57%**
2011	59,931	89,390	304,789	30,476		**484,586**	754,599	**64%**
2012	59,090	100,352	336,146	40,800		**536,388**	718,326	**75%**
2013	58,798	133,569	225,391	37,916		**455,674**	700,902	**65%**
2014	72,067	183,547	217,434	48,351		**521,400**	663,061	**79%**
2015	67,385	176,576	212,613	38,139		**494,713**	676,249	**73%**
2016 (m3/yr)	53,621	299,247	98,832	34,857		**486,558**	731,047	**67%**
2016 (l/sec)	**1.70**	**9.48**	**3.13**	**1.10**		**15.42**	**23.17**	

Pump Station Capacities and Thames Water Peak Flow Discharge Consents

Item	PS3	PS7-1	PS7-2	PS24	Horley STW
Pump Capacity (l/sec)	30	27	20	11	n/a
Peak Consent (l/sec)	**30**	**54**		n/a	**65**

flow rates from meter reading sheets

4.3 Foul sewer flow forecasts for 2020 and 2028

If the sewer catchment areas matched the water supply areas in Figure 4.1, then an attempt could be made to compare sewer flows for North Terminal against water consumption, and estimate the South Terminal and EoR sewer flow pro-rata from its water consumption but due to the mismatch in areas this will not be possible.

Wastewater flow data is incomplete, therefore the forecast of wastewater flow can only be based on the water usage forecast with an assumed relationship factor. In the UK, where irrigation is minimal, and in the absence of any better information the relationship is assumed to be a 100% match, water to sewer flows.

Total wastewater flow from Gatwick in the forecast has been estimated based on the water use forecasts provided in Sections 2.5 and 2.6 above.

- Foul wastewater volume in 2020 is forecast to be 785,981 m³
- Foul wastewater volume in 2028 is forecast to be 807,587 m³

The relationship assumed is highly speculative due to the incomplete nature of the historical foul wastewater flow data.

Forecasting wastewater volume with any accuracy has not been possible because a large proportion of the wastewater leaving the site not being recorded.

4.4 Recommendations

It is recommended that the flow meter in the main sewer from the South Terminal and East or Rail, believed to be 400mm size, is repaired or replaced. During the course of the project, a question was raised by GAL regarding the cost of installing a new flow meter in the main sewer near the Police station.

Accordingly enquiries with specialist companies have been made and we can report that the cost for installing a suitable flow and monitoring device with controller and datalogger, including installation and training at approximately £5,400 excl. VAT.

The flow and depth monitoring device is relatively small and would be installed unobtrusively on the sewer invert, normally in the channel in a manhole.

This can not only provide weekly cumulative flow readings, as are recorded at present but also a complete set of diurnal flow recordings, as well as daily or weekly readings, similar to the ARM meters installed by SES on the water meters.

Further it is recommended that GAL consider a project to not only install a new flow meter in the Police Station main sewer, but also to connect all flowmeters to dataloggers at the main sewage pump stations PS 3, PS 7, PS 24 and any other location of particular interest. In terms of meter compatibility, it may be necessary to replace any meters not found to be suitable for digital connections.

Once this is done GAL will be able to interrogate sewer flows, diurnally as well as weekly, this will provide a powerful tool in determining the sewer nightflows. The sewer nightflows between say 1am and 3am can be expected to consist of:

a) Legitimate sewer use;

   i. GAL staff on duty – normal allowance as for water use is 0.6l/pax/hour, which for say 1000 person is only 0.6m³/hour,

   ii. Hotels (as water night-time usage in Table 3.3),

   iii. Boiler house and chilling station etc.

b) Infiltration.

c) Water wastage - i.e. uncontrolled urinals and taps left running.

Experience shows that the latter two - infiltration and water wastage - are the dominant factors in sewer nightflows.

5. Water Quality

Gatwick discharges runoff to watercourses around the airport, including Gatwick Stream, Crawter's Brook and the River Mole. The runoff is managed via a number of ponds, with 'dirty' water (that does not meet GAL's minimum standards for discharge) conveyed and treated at either Pond D or the pollution lagoons at Crawley STW prior to final discharge off-site.

In its 2015 Decade of Change performance report, GAL set its own minimum surface water quality guidance limits to be met before being discharged. However, in some circumstances, unavoidable discharge occurs that does not meet these thresholds. These discharges are recorded and reported within the water section of GAL's annual Decade of Change performance report.

The highest numbers of exceedances are of GAL's Biological Oxygen Demand (BOD) threshold; the Phase 1 stage of this project identified that these occur following a period of peak de-icer use and a lack of storage capacity at the end of the season, usually February-April. Therefore this section will assess the potential impact of de-icer use on receiving surface waters of GAL's current management strategies, focussing on two scenarios up to 2028, as outlined in Section 5.1 of this report.

5.1 Forecasting Methodology Summary

The primary indicator of water pollution at the airport is the BOD of the water. This is the amount of oxygen required by bacteria while stabilising decomposable organic matter under aerobic conditions. This can depend on the type of microbes, the temperature or the oxygen content of the water, and is thus very specific to the sample. A more comparable measure of the amount of oxygen required to fully oxidise all of the oxidizable pollutants in the water is measured using the Chemical Oxygen Demand (COD), expressed in mg/l. This can be used to determine a COD load; i.e. the absolute amount of oxygen required to fully oxidise a product, expressed as a weight of oxygen. COD cannot be directly equated to BOD, but does give an indication of the likely relative BOD.

The predicted increase in Air Traffic Movements (ATMs) will potentially result in an increase in de-icer usage. Therefore it is assumed that the number of BOD exceedances will increase as ATMs and use of de-icer increase. Note that GAL has current management strategies in place, as stated within the 2015 and 2016 Decade of Change performance reports to reduce the pollution loading of de-icer to surface waters, via increasing the direct recovery of aircraft de-icer and the use of less polluting pavement de-icing salts.

In order to provide a "do nothing" baseline for forecasts, an average has been developed for the period 2010/11 to 2015/16; the period before the management strategies as laid out in the 2015 and 2016 DoC reports were implemented. The dataset provided by GAL that this average is calculated from is not complete: aircraft de-icer figures run from 2010-2016, however full pavement de-icer data runs from 2004-2013.

Scenarios have been developed to forecast the future water quality implications of de-icer use from the established average use based on historic data: a "do nothing" baseline (Option 1) has been developed assuming that the current management strategies are not implemented, but the airport is subject to increased usage over time (and thus increased de-icer application). The potential impact of GAL's current management strategies on surface water quality have been assessed by developing two extrapolations of COD load up to 2028, assuming both current management strategies are implemented separately. These are referred to as Options 2 & 3. Finally, a "management" prediction has been developed, based on full implementation of the management strategies proposed in the 2015 and 2016 DoC reports. This is referred to as Option 4.

The assessment year runs from 1 May to 30 April to retain the winter de-icing period in a single assessment year. Calculations to develop these indicative options have been provided in Appendix G.

5.2 Water Quality in 2028

5.2.1 Air traffic movements

Information provided by Gatwick indicates that annual ATMs are predicted to rise by 10-14% to 2027/28 which is likely to result in a proportionate rise in the application of aircraft de-icer, and an increase in COD load discharged to the drainage system. This is based on Gatwick's ICF Masterplan two Growth Scenarios - Scenario 1 (C55-C53 09.06.17) predicting a 10% ATM growth and Scenario 2 (C60-C55 09.06.17) predicting a 14% ATM growth. The predicted increase in ATMs for both scenarios are presented in Figure 5-1.

Figure 5-1 : Predicted Air Traffic Movements 2016-2028

Note: This graph is based on the ICF Masterplan Outputs C55-53 (09.06.17) Scenario1 and C60-C55 (09.06.17) Scenario 2.

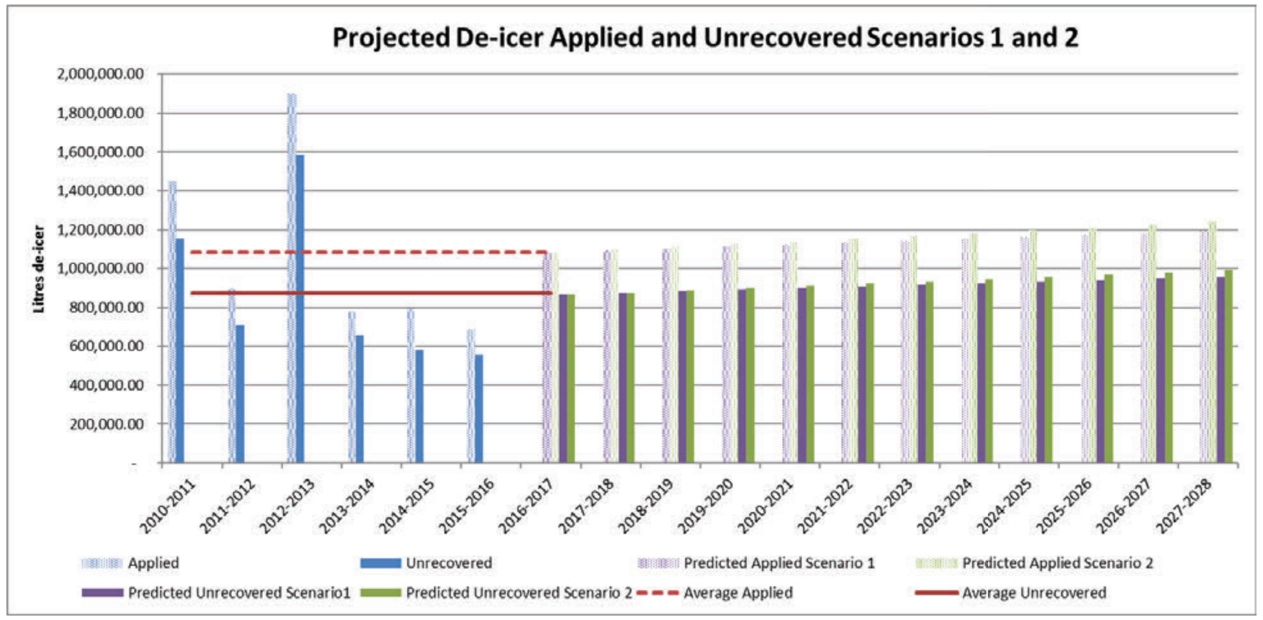
5.2.2 Changes in pavement de-icer application

Annual increase of ATMs has been linearly extrapolated to de-icer usage. Consequently a 10-14% increase in ATMs will equate to a similar increase in aircraft de-icer application. By 2028 based on current average use, aircraft de-icer consumption will increase from approximately 1,080,000 litres/yr to approximately 1,190,000 litres/yr in Scenario 1 and 1,240,000 litres/yr in Scenario 2. The increase in aircraft de-icer use applied for both scenarios has been presented in **Figure 5-2.**

5.2.3 Changes in aircraft de-icer recovery

A proportion of aircraft de-icer is recovered directly after application, reducing the volume entering the surface water drainage system. Over recent years (2010/11 to 2015/16) de-icer recovery has remained fairly stable, at around 20%. The unrecoverable de-icer is channelled into the drainage system. An average volume of unrecovered de-icer has been calculated and presented in Figure 5-2 with the data extrapolated over the period up to 2027/28 for Scenarios 1 and 2.

Figure 5-2 : Aircraft de-icer runoff and predicted runoff to 2028



Note: The increase in the predicted applied de-icer is based on the C55-53 and C60-C55 Scenarios as per Figure 5-1. *See Jacobs' Phase 1 report for a fuller commentary on previous years' de-icer usage trends. The current average recovery rate of 20% has been extrapolated to future years.*

An assumed COD load of 1.46 kg O_2/litre aircraft de-icer is predicted to result in an increase of between approximately 120,000 to 175,000 kg O_2/yr over the ten-year period to 2028.

The key variable is temperature which has a significant effect on de-icer use as indicated in Phase 1 stage of this project. For example, de-icer use in 2012/13 was double that in adjacent years due to the cold winter. Thus, the variation in the 'baseline' years of 2010/11-2015/16 is greater than the trend. However, our projection takes into account the data from a number of years which is averaged, which should reduce the uncertainty from years of greatest variance from the average.

5.2.4 Pavement de-icer

The second significant use of de-icer at Gatwick is that applied to areas of hardstanding, including the runway, taxiways or vehicle and pedestrian areas. According to data provided by GAL; on average between 2010/11 and 2015/16 approximately 1,270,000 litres is used for pavement de-icing per annum.

There are a number of new developments proposed before 2028 which are estimated to result in an increase of approximately 53ha of impermeable area by 2028. See Section 6.6 for a breakdown of this figure which provides an explanation of which developments are included. This would increase the volume of runoff that would enter the drainage system and would result in further BOD exceedances related to high flows. It has also been assumed this would increase pavement de-icer use by a corresponding 1%. This assessment has focused on the increase of the amount of de-icer applied, and does not take into account the possibility of high flows caused by the increase of hardstanding area, covered in Section 6

As there are a number of different de-icer products used at Gatwick, the application of each has been multiplied by the manufacturers' reported CODs where provided by GAL, in order to weight the different types of de-icer by its impact on surface water quality. With reference to Table 5.1, glycol-based de-icers have a higher COD load, and are the heaviest used; on average around 1,000,000 litres/yr of glycol-based de-icers are applied, compared to around 270,000 litres/yr of acetate-based de-icer applied.

Table 5.1 : Comparison of pavement de-icers

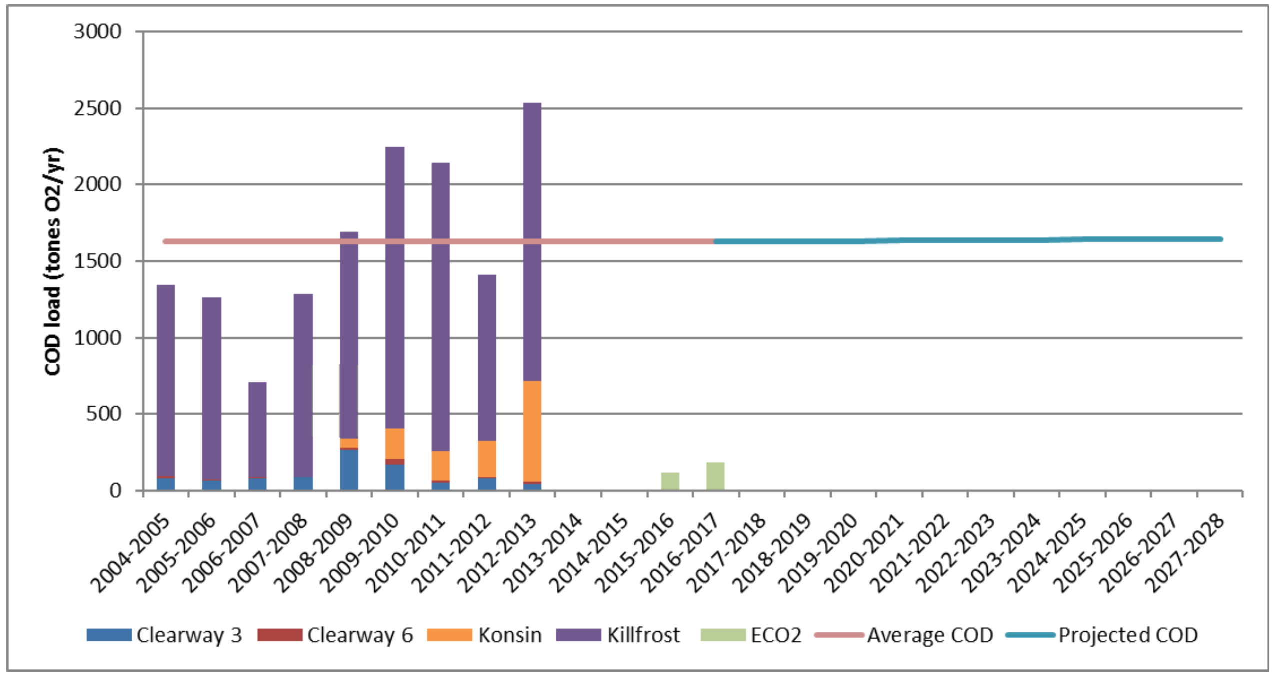
	Clearway 3	Clearway 6	Konsin	Killfrost	ECO2
Active chemical	Potassium acetate-based	Sodium acetate-based	Ethylene glycol-based	Propylene glycol-based	Potassium acetate-based
Quoted undiluted COD load	320 mg O_2 / g	561mg O_2/g	1290 mg O_2/g	1390 mg O_2/g	Assumed Clearway 3 as a potassium-acetate de-icer
Quoted densities	1.3 g/cm³	800 kg/m³	1.1 g/cm³	1.1 g/ml	1.3 g/cm³
Calculated COD load	416,000 mg O_2/l de-icer	448,000 mg O_2/l de-icer	1,419,000 mg O_2/l de-icer	1,529,000 mg O_2/l de-icer	416,000* mg O_2/l de-icer

Note: ECO2 technical datasheet not provided, so figure stated here is the same as Clearway 3 as an equivalent potassium acetate-based de-icer.

Assuming that the same proportion of hardstanding surface area is de-iced as existing, the increase in the application of pavement de-icers would result in an increase of COD load of pavement de-icer from 1,606 tonne O_2/yr to 1,682 tonnes O_2/yr, equating to an increase of around 1%.

It has been assumed that none of the pavement de-icer is recovered after application; all pavement de-icer applied enters the surface water drainage system.

Figure 5-3 : COD load from predicted pavement de-icer increases until 2028



Notes:

- *No data for de-icer applications during the winters of 2013/14 or 2014/15 have been received.*
- *Data has been provided for 2015/16 and 2016/17, but has not been used to establish the average.*
- *Average COD based on total COD from different de-icers for each year averaged between 2004/05 and 2012/13.*
- *Note the high COD load in the abnormally cold winter of 2012/13.*
- *No data was received for the abnormally wet winter of 2013/14.*

- *The average COD has been taken forward to 2015/16, then an upwards projection has been developed from the winter of 2016/17.*

5.2.5 Current management strategies

Potential positive impacts on water quality are likely to result from strategies already in place. The change in contractor for aircraft de-icer recovery which according to GAL has recently taken place is estimated to increase aircraft de-icer recovery from around 20% to approximately 40%, which could result in a corresponding decrease in the COD load to the surface water drainage system. The replacement wherever possible of glycol-based pavement de-icers with a high COD load with ECO2, a potassium acetate based pavement de-icer with approximately a third of the COD load, could also reduce the COD load. Note that the use of ECO2 has already been partly implemented wherever possible for non-airfield use as shown in the 2015/16 and 2016/17 data, which was issued to Jacobs on the 5th December 2017.

When calculating the decrease in COD load from the change of pavement de-icer brand to a potassium acetate based product it is assumed that the same volume of de-icer will be applied but the COD load will decrease, resulting in approximately a 70% decrease of COD load from pavement de-icing to around 1,600 tonnes O_2/yr to around 520 tonnes O_2/yr over the 10 year period.

5.2.6 Potential options for reducing COD loading

Without action and based on extrapolation of the 2010/11 to 2015/16 data the COD loading will increase by between 2,882 tonnes (Scenario 1, C55-53) and 3,071 tonnes annually (Scenario 2 C60-55). However, there are two water quality management strategies already in place that could positively impact on the COD load, as described in Section 5.1. The options presented in Figure 5-4 and Figure 5-5 that have been considered as baselines up to 2028 are:

- Option 1: “Baseline” – does not include the positive future impacts of current management strategies;
- Option 2: Aircraft de-icer recovery increase (from 20% to 40%) assuming the addition of a second de-icer recovery vehicle;
- Option 3: Continued use of ECO2 instead of glycol-based de-icers wherever possible (100% replacement has been assumed for the purposes of this assessment); and
- Option 4: Both aircraft de-icer recovery and use of ECO2.

These options have been developed for both growth Scenarios in Figure 5-4 and Figure 5-5.

Figure 5-4 : Total predicted COD load to 2028 – C55-53 Scenario 1

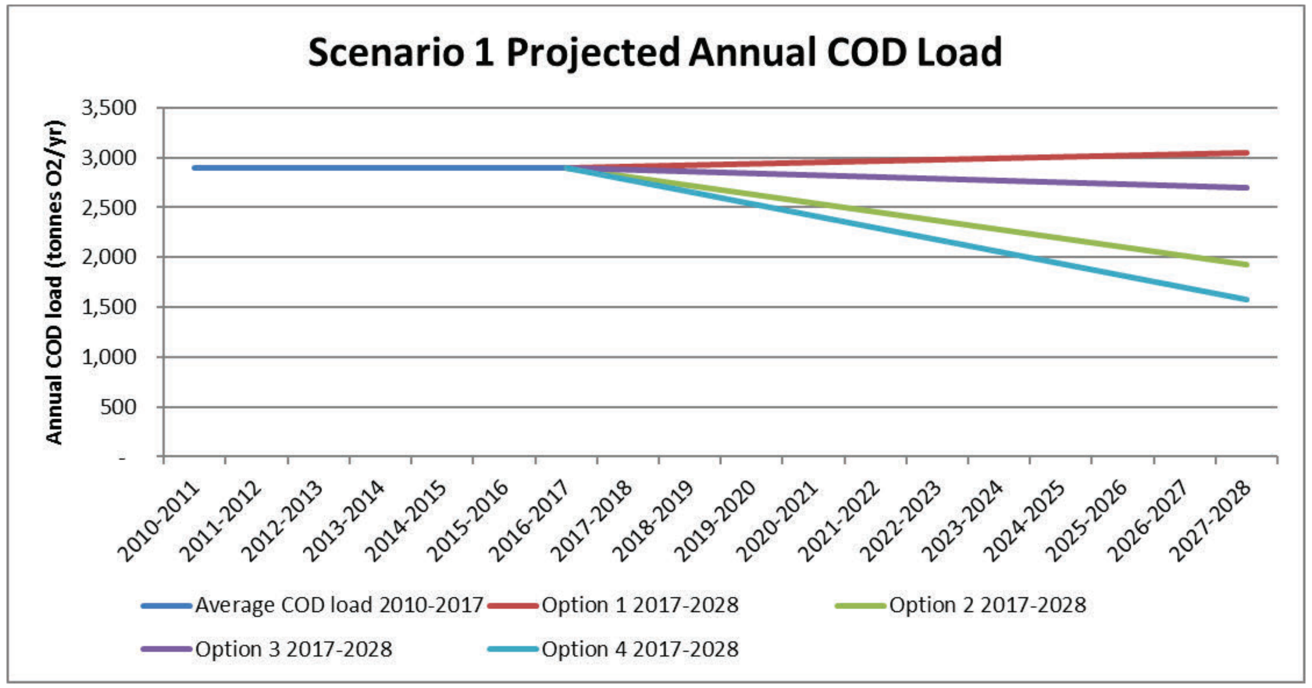
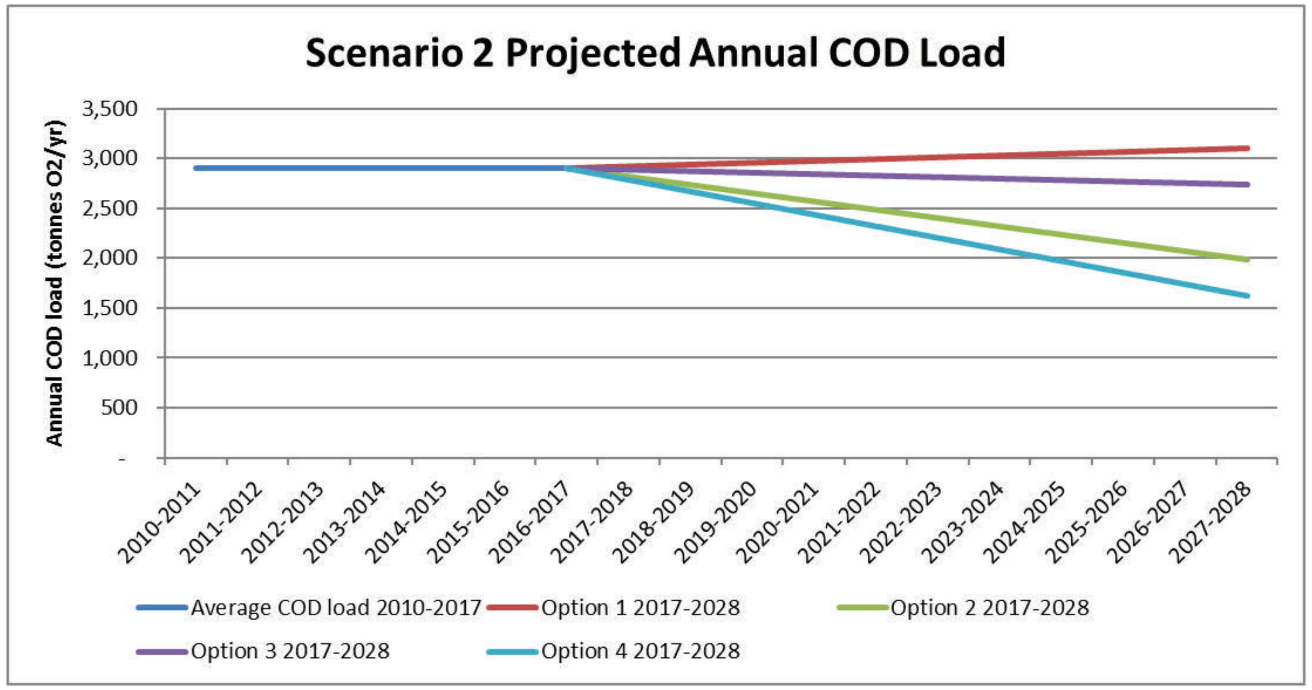


Figure 5-5 : Total predicted COD load to 2028 – C60-C55 Scenario 2



The two forecast scenarios produce a similar result as their variance in COD load is relatively small compared to the total for the airport.

Option 1 (current management strategies are not implemented) is the worst case. In isolation, Option 2 (improved recovery of aircraft de-icers) does not produce a significant reduction in overall COD load over the timescale of the study due to the increase in ATMs. Option 3 (ECO2 is used more widely as a pavement de-icer in place of glycol-based de-icers) results in a more significant decrease in COD of approximately 32%-34% (subject to the growth scenario). However, ECO2 has a smaller operating temperature range than glycol-based de-icers and it is unlikely that glycol can be entirely replaced and there would be occasions, such as during colder weather, where glycol application will be required. The greatest absolute decrease occurs when existing management measures are maintained (Option 4 -both methods used); equating to a 44%-64% decrease on current COD loads subject to the growth scenario considered. These results are presented in Table 5.2 and Table 5.3.

Table 5.2 : Future COD load for Growth Scenario 1 (C55-C53)

2028 COD load, tonnes O2/yr (percentage of current average) (Scenario 1 C55-C53)	Increase in hardstanding	Change of de-icer
Increase in aircraft numbers	3,041 (5% increase) Option 1 (worst case)	1,982 (68% decrease) Option 3
Increase in recovery rate	2,954 (7% decrease) Option 2	1,891 (46% decrease) Option 4 (best case)

Table 5.3 : Future COD load for Growth Scenario 2 (C60-C55)

2028 COD load, tonnes O2/yr (percentage of current average) (Scenario 2 C60-C55)	Increase in hardstanding	Change of de-icer
Increase in aircraft numbers	3,097 (7% increase) Option 1 (worst case)	1,982 (32% decrease) Option 3
Increase in recovery rate	3,006 (6% decrease) Option 2	1,891 (44% decrease) Option 4 (best case)

5.3 Potential Water Quality Management Improvement Measures

Initial options for further reduction of COD load have been developed and assessed by Jacobs and assessed on its likely cost, implementation timescale, land take, environmental impact, potential benefits and potential issues. Further details of the assessment are included in Appendix H.

5.3.1 Reduce de-icer usage

This option involves applying less de-icer to hardstanding either through reduction in overall use or application to selective areas to reduce the volume washed off during precipitation events, and consequently a lower COD load in the surface water drainage network. Changing the current procurement mechanism for de-icer application may encourage increased efficiency, i.e. not paying by volume applied. It may be possible for GAL to directly change the use of pavement de-icer by reviewing the hardstanding de-icing policy to reduce application volumes.

Applying less de-icer would have a cost saving in terms of reduced treatment, and environmental benefits from the reduced COD load, but it would also reduce costs as less de-icer will need to be purchased.

Water Masterplan 2020 & 2028 Forecast - Full backing report

JACOBS

5.3.2 Less polluting de-icer usage

The de-icer used for aircraft is currently glycol-based. A switch to an acetate-based de-icer when possible would reduce the COD load entering the surface water drainage system. However, acetate-based de-icers tend to operate at a higher temperature range than glycol-based de-icers, consequently acetate-based de-icers would be favoured under warmer conditions. While such innovation may be led by the airlines or the Civil Aviation Authority, GAL are in a position to influence its implementation as a member of a pan-airport group sharing industry de-icing innovations.

5.3.3 Increase upstream water storage on-site

This option involves creating extra water storage ponds on-site to avoid discharging water with higher levels of BOD to Crawley STW, or to local watercourses. There are two additional benefits with this option: it will have a positive impact on flood risk, as increased storage results in a reduced peak flow and selective storage of locally recovered water, for example from dedicated de-icing stands followed by treatment including near de-icer application areas could also provide water quality benefits.

After 2019 GAL's water treatment agreement with Thames Water ends and treatment costs will revert to standard business rates, which could increase the cost of sewage treatment off-site.

5.3.4 Higher aircraft de-icer recovery on site

Higher de-icer recovery will reduce the amount entering the surface water drainage system, thus reducing the COD load and the requirement to treat runoff.

Recovery from de-icing stands is already being considered by GAL, with initial estimates suggesting that recovery rates may increase from 20% to 25%. However, with dedicated drainage from de-icing areas, runoff would be collected, not just that which has pooled during de-icing. This could lead to de-icer recovery rates increasing significantly. It is understood that GAL are selectively trialling the use of remote de-icing (push and hold) stands where de-icing salts are applied in a specific area of the airport with recovery via a mobile vehicle after each wave of aircraft. The GAL 2016 DoC performance report states that this has been partly successful due to the viscosity of the water/de-icer mix but no specific data on overall recovery is available.

There is also a known phenomenon where excess de-icer 'shears' off the wings during take-off. Extra de-icer could be collected from dedicated drainage systems at these areas on the runway, increasing recovery rates, and reducing COD load on the system. Further data should be collected and assessed to establish how much of this 'sheared-off' de-icer is dropped on the runway, and how much can be recovered.

5.3.5 Increase water treatment on site

Increased treatment on-site could reduce the volume and chemical contamination of runoff being conveyed to Crawley STW. This could save GAL money as their trade waste agreement is due to expire in 2018/2019 and costs are likely to increase as a result.

However, intensive water treatment is relatively expensive per unit volume and potentially less intensive solutions such as reed bed/aeration systems could be considered in collaboration with smaller volume higher intensity treatment such as desalination-type processes. The latter may be suited to part-time operation during the winter and spring and as such does not need to maintain a biomass, so could be subject to longer term shut-downs. Feasible location of facilities need to be carefully considered and high intensity options would almost certainly need to be on airport near the point of deposition to maximise their benefit.

For a full assessment of possible water treatment options, see the Jacobs report (Treatment Feasibility Assessment is GAD7013E-GAL-DOC-00000004).

5.3.6 Increased treatment off-site

Off-site treatment could either be via transport polluted runoff off-site for treatment by tanker or a piped network conveyed to Crawley STW. This is the most expensive option, as treatment costs are high.

Transporting off-site by tanker is expensive as there are transportation and treatment costs. However, GAL currently tanker recovered de-icer off-site for treatment.

5.3.7 Conclusions

Due to the increase in ATMs, continuing with current management measures could result in the overall COD load from de-icer would increase by 5-7% by 2028 (depending on the growth scenario). The contamination from runoff is mainly due to the use of de-icing salts, so is concentrated in winter, and varies considerably due to ‘cold’ or ‘warm’ winters. Current strategies for managing the high COD of surface water discharges are being trialled, and could have a positive impact on surface water quality if implemented fully, potentially reducing current COD loads by up to 46% by 2028.

5.3.8 Recommendations

It is recommended that consideration of a selection of options are taken forward for quantitative assessment of cost, lead-in times and land take, and this should be balanced against the impact on water quality for consideration by GAL.

6. Flood Risk and Surface Water Management

6.1 Introduction

The Phase 1 Water Masterplan Report (Jacobs, 2017) assessed the flood risk to Gatwick Airport from all sources including fluvial, surface water, pluvial, groundwater, reservoirs, foul drainage systems and the failure of flood defences. The assessment established that the primary sources of flood risk to Gatwick are fluvial (river) and surface water (from exceedance of the drainage network capacity).

Fluvial flood risk to the airport emanates from the watercourses which surround it: primarily the River Mole and the Gatwick Stream. Based on hydraulic modelling Gatwick is considered to be at risk of fluvial flooding events that are predicted to occur on average between the 1 in 20 annual chance (5% Annual Exceedance Probability AEP) and the 1 in 50 annual chance (2% AEP) events. The airport is served by an extensive surface water drainage network which would be overwhelmed by extreme rainfall events, which is predicted to flood on average once every ten years (or a 10% chance of occurrence in any one year). The location at highest risk of surface water flooding is the North Terminal. Further details of the risk of flooding from all sources and the nature and operation of the drainage network are included in the Phase 1 Water Masterplanning Report.

6.2 Objectives

Over the next decade there are plans for a number of proposed developments across the airport to ensure Gatwick has sufficient capacity, to grow and to become the airport of choice for London. This Phase 2 Masterplan report assesses at a high level the potential fluvial and surface water flood risk to these proposed developments, how they may impact on existing levels of flood risk, identifies potential mitigation measures to ameliorate their impact and provides suggestions for how Gatwick should strategically manage flood risk over the next decade and beyond.

6.3 Methodology

The following methodology was adopted in order to assess the fluvial and surface water flood risk to and from the proposed development over the next decade:

- The fluvial and surface water flood extents adopted to assess flood risk to the developments were taken from the fluvial and surface water hydraulic modelling work undertaken by CH2M for Gatwick since 2010 which is the basis of the assessment of flood risk. These flood extents are available for a number of return period events (see Section 6.4), further details on how they were developed are included in the Phase 1 Water Masterplan report;

- The layout and nature of the proposed developments were outlined in a presentation titled “*Gatwick Airport Master Plan Production Workshop*” presented by GAL on the 4 May 2017. The presentation contains a series of layouts of development drawings and boundary lines for the proposed developments;

- The proposed development footprints were compared to the predicted fluvial and surface water flood extents to determine if they would be in areas at risk of flooding; and

- The change in impermeable area as a result of the developments was estimated to determine the potential impact on runoff volumes and consequently how they would impact upon the existing surface water drainage network and flood risk.

6.4 Predicted Flood Risk

The fluvial and surface water flood extents used for the assessment of flood risk originated from the fluvial and surface water hydraulic modelling work undertaken by CH2M for GAL previously, full details are provided in the Phase 1 Water Masterplan report. The hydraulic models simulate fluvial and surface water flooding for the existing Airport. The fluvial model includes the Upper Mole Flood Alleviation Scheme (including the Clay’s Lake scheme currently under construction), the Gatwick Stream Flood Alleviation Scheme and the Crawter’s Brook Attenuation

Areas. Fluvial flood extents were available for the 1 in 5 annual chance (20% AEP), 1 in 20 annual chance (5% AEP), 1 in 50 annual chance (2% AEP), 1 in 75 annual chance (1.33% AEP), 1 in 100 annual chance (1% AEP) and the 1 in 100 (1% AEP) plus 20% for climate change event.

The surface water model is a sub-catchment based model where individual catchments are assigned to individual carrier drains as opposed to a direct rainfall-runoff model consequently the model does not simulate overland surface water flow paths before they enter the drainage systems. The model simulates flooding arising from the surface water drainage system once it reaches capacity and simulates overland flow if the collected surface water runoff exits the surface water drainage system. As the Masterplan and proposed developments progress it is recommended that a direct rainfall-runoff model is developed to simulate overland surface water flow paths before surface water runoff enters the surface water drainage system to optimise the proposed developments with regard to surface water flood risk. Surface water flood extents were available for the 1 in 10 annual chance (10% AEP), 1 in 100 annual chance (1% AEP) and 1 in 100 (1% AEP) plus an allowance of +20% for climate change event.

While these models have been relied upon as the best available data to assess the flood risk implications of the proposed developments, it should be noted that recent reviews undertaken by GAL of the models have identified the following amendments that are required to increase the accuracy of the prediction of flood risk:

- In August 2016 GAL commissioned Jacobs to undertake a flood resilience review of the hydraulic modelling undertaken by CH2M for which a report was produced titled “Gatwick Resilience Review” (Jacobs, 2016 - Report No. GADD001A_1) which documents Phase 1 of the hydraulic model reviews. This report presents actions for GAL and CH2M to address. The main actions relate to the verification and calibration of the fluvial model, a discrepancy between the fluvial and surface water models and the level of model documentation. At the time of our assessment CH2M were acting on the Jacobs fluvial model review findings and producing the revised fluvial flood extents. To our knowledge the surface water modelling comments are not being addressed presently. As such revised models were not available to use for this fluvial and surface water flood risk assessment. However, the existing outputs from the CH2M fluvial and surface water modelling is regarded as the most accurate representation of the current flood risk to Gatwick Airport and have therefore been adopted as the best estimate of flood risk to the proposed developments presently available;

- The Upper Mole Flood Alleviation Scheme has been included in the fluvial model developed by CH2M with Clay’s Lake Flood Alleviation Scheme also included although it has yet to be fully constructed on site. Once constructed it is recommended that the Clay’s Lake representation in the fluvial model is checked against final “As-Built” drawings to ensure the potential fluvial flood risk is accurately represented; and

- The climate change uplift factor of +20% adopted in the CH2M hydraulic models has subsequently been superseded by updated guidance from the Environment Agency (EA). The Masterplan assessment year of 2028 falls within the 2015 to 2039 time interval specified by the updated guidance. Consequently an uplift factor of 15 or 25% should be applied subject to the nature of the development and which flood zone within which it is located. As a result, the existing +20% predicted flood extents provide an acceptable median figure to apply an assessment of risk for the purposes of the Masterplan, although flood extents for the new guidance should be developed by GAL.

It is recommended that as the Masterplan and associated proposed developments progress the prediction of fluvial and surface water flood risk should be re-visited once these amendments have been implemented.

6.4.1 Fluvial Flood Risk

It is predicted that the current standard of protection at Gatwick Airport against fluvial flooding is between the 1 in 20 annual chance (5% AEP) and 1 in 50 annual chance (2% AEP) events. The cause of the flood risk being the restricted capacity of the culvert on the Gatwick Stream adjacent to the South Terminal, which is exceeded and

causes increased upstream flood levels and hence places the South Terminal at risk of flooding. Appendix C of the Phase 1 Water Masterplan report indicates the maximum fluvial flood extents for these events.

6.4.2 Surface Water Flood Risk

It is predicted that the current standard of protection at Gatwick Airport against surface water flooding is approximately 1 in 10 annual chance (10% AEP) event (see Appendix C of the Phase 1 Water Masterplanning report). This relates to the capacity of the pumps at Pond D, which when overwhelmed result in water backing up placing the North Terminal at risk of flooding as occurred in 2013. GAL has identified critical infrastructure for which flood resilience reviews are underway.as part of the Phase 2 Flood Resilience Review Project. A number of these assets are estimated at risk of flooding from fluvial and/or surface water sources (i.e. water levels above ground level) and possible resilience measures are being recommended for these.

6.5 Climate Change

National recommendations for the consideration of climate change for new development and for nationally significant infrastructure are subject to change as new information becomes available. The EA updated its guidance on the climate change uplift factors to be incorporated for new development in February 2016. The scientific evidence that underpins the guidance: the United Kingdom Climate Change Projections (UKCP09) is due to be updated in 2018, which could lead to further revisions in the uplift factors to be incorporated for new development.

Both the fluvial and surface water hydraulic modelling undertaken by CH2M incorporated the predicted impact of climate change by applying an uplift factor of +20% to the 1 in 100 annual chance (1% AEP) event. **However, it should be noted that this was completed before the latest guidance was published in 2016 which new development would be expected to comply with and would potentially require them to incorporate a higher allowance for the predicted impact of climate change than included in this modelling (subject to proposed design life).**

The climate change uplift is included to provide an estimate of potential flood risk to Gatwick Airport for the 1 in 100 annual chance (1% AEP) event in the future, in the case of this Masterplan study, up to the year 2028. The risk of flooding is likely to increase due to the predicted impact of climate change.

6.6 Risk of Flooding to Proposed Development

The risk of fluvial and surface water flooding has been assessed for all development proposals provided by GAL, as summarised in Table 6-1. In addition the table indicates the estimated change in impermeable area as a result of each development proposal. Additional detail on the development proposals and the predicted impact to and from the proposed developments regarding flood risk is included in Appendix F in the form of a detailed summary table and a series of fluvial/surface water flood risk maps for each proposed development location.

Table 6-1: Risk of Flooding to Proposed Development and Impermeable Area Changes

Ref	Description	Surface Water Drainage Catchment	Flood Risk		Increase in Impermeable Area (m^2)
			Fluvial	Surface Water	
1	Pier 6 Extension	Pond D	1 in 100	1 in 100	0
2	Re-aligned Quebec Taxiway	Pond D	1 in 100+20%	1 in 10	5,333
3	A380 Relocation to Pier 5	Pond D	>1 in 100+20%	1 in 10	0
4	Remote Parking Stands	Pond M, Pond D & Dog Kennel Pond	>1 in 100+20%	1 in 10	15,710

5	Push & Hold Stands	Pond D	>1 in 100+20%	1 in 10	5,968
6	Lima Taxiway	Pond D	>1 in 100+20%	1 in 10	3,045
7	Domestic/CTA Baggage Reclaim	Pond D	1 in 50	1 in 10	0
8	Long Stay Car Parking	Pond G	Outside model extent	Outside model extent	0
9	Multi-Storey Car Park 4	Pond F	>1 in 100+20%	Outside model extent	2,018
10	Multi-Storey Car Park 7	Pond D	>1 in 100+20%	1 in 10	0
11	Boeing Hangar	River Mole and / or Man's Brook	1 in 75	1 in 10	17,393
12	South Terminal Car Rental Re-location	Uncertain	>1 in 100+20%	Outside model extent	285
13	Gatwick Airport Rail Station	Uncertain	1 in 100	1 in 100	3,229
TOTAL					52,981

Climate change would be expected to increase the frequency of storms of equivalent severity, e.g. hypothetically an event with a current 1 in 50 annual chance (2% AEP) could in the future be expected to occur with greater frequency, e.g. have a 1 in 30 annual chance (3.33% AEP) of occurring. As a result new development needs to consider the predicted impact of climate change on peak river flows and rainfall.

Table 6-1 indicates the most frequent modelled storm events that the development location is predicted to experience flooding from, for both fluvial and surface water events. It should be noted that this assessment is limited by the storm event results that are available from the hydraulic modelling undertaken for GAL previously. The assessment is an approximation; the modelling of additional storm events would increase the accuracy of the assessment. However, with specific regard to a suitable design standard of protection for safe, continued operation of Gatwick Airport during a flood over its lifetime, it is recommended that the minimum design standard is the 1 in 200 annual chance (0.5% AEP) event for Critical National Infrastructure. Refer to Section 4.9.3 for a more detailed discussion on the standard of protection regarding flooding for Critical National Infrastructure like Gatwick Airport.

Table 6-1 indicates that for fluvial flood risk most of the proposed developments are at low risk of flooding and are located in areas that would not necessitate the provision of mitigation measures. The domestic/CTA baggage reclaim and Boeing Hangar developments are at greatest risk of flooding. It is understood that the Boeing Hangar development has been granted planning permission.

For surface water the majority of the developments are in locations at significant risk of surface water flooding. In accordance with national planning policy the development proposals would need to demonstrate that they would be safe for their lifetime.

The assessment of changes to impermeable area is a net change, taking into account the current ground surface type. An increase in impermeable area would result in an associated increase in runoff to the surface water drainage network, potentially increasing flood risk downstream if unmitigated. The development proposals at Gatwick would need to consider the impact on increased surface water runoff to the available storage in the attenuation ponds. The development proposals will require the inclusion of additional storage to attenuate the

surface water discharge to the existing surface water drainage system. This would reduce the hydraulic load on the existing drainage system and hence reduce flood frequency elsewhere at Gatwick Airport.

6.7 Management of Future Flood Risk

As stated in Section 6.4 climate change will increase the risk of fluvial and pluvial flooding to Gatwick. A review of fluvial and pluvial hydraulic modelling undertaken on behalf of GAL by CH2M indicates that for the 1% (1 in 100) AEP fluvial flood risk event the area of the airport at risk will increase to include the North Terminal, an area to the south-east of Pond M and areas to the south of the runway. Surface water modelling indicates that for the 1% (1 in 100) AEP event the increase in risk will include more extensive flooding at North terminal and an area to the east of the Dog Kennel Pond. Areas already at risk of flooding are likely to experience an increase in predicted flood depths across the airport.

Outlined in Section 6.7 are a variety of potential high level flood mitigation measures coming out of this Masterplan to study that could be employed to minimise the potential fluvial and surface water flood risk identified for each of the proposed developments in Section 6.6. These measures could be applied during the next decade; within the timescale of this Masterplan or beyond.

National and Local planning policy includes a presumption on the use of more sustainable methods of surface water management using green infrastructure (e.g. infiltration of runoff, swales, grassed attenuation ponds, etc.) which fall under the description of Sustainable Drainage Systems (SuDS). The objective of SuDS techniques is to minimise the impacts from a proposed development on the quantity and quality of the surface water runoff and to maximise the amenity and biodiversity opportunities. The traditional method of draining surface water runoff from urban areas (e.g. cities, airports, etc.) has been through underground piped systems. These traditional systems are designed to prevent flooding locally by conveying the water away from the site efficiently. However, there is a risk of increasing flooding to downstream receptors if appropriate flood risk mitigation is not incorporated. The philosophy of SuDS is to replicate, as closely as possible, the natural drainage from a site before development. In the UK the SuDS manual (CIRIA C753, 2015) details techniques that should be considered for SuDS. It is recognised that there are constraints to using SuDS at an airfield (e.g. open water channels convey water in an airfield may attract birds presenting bird strike risk, etc.). Nonetheless these sustainable water management methods should be evaluated as to how they can be implemented at Gatwick.

Considering GAL's ambition to become the UKs most sustainable airport a high-level study has been undertaken to identify global best practice and innovation regarding flood risk management that could contribute to the sustainable management of water and flood risk at Gatwick Airport to 2028 and beyond, the findings are summarised in Table 6-2. The findings are primarily related to the innovative practices of other large airports around the world but some examples have been provided from other industries.

6.8 Flood Risk Mitigation Measures

Previous flood protection and resilience studies have been undertaken which have recommended measures to reduce fluvial and surface water flood risk to the airport, which are summarised in the subsequent sections.

6.8.1 Fluvial Flood Risk Mitigation

Fluvial flood risk mitigation measures that could be employed at Gatwick Airport regarding the proposed developments include:

- The introduction of a flood defence along the alignment of the Gatwick Stream that currently presents a flood risk to the Airport, this could be formed by a new hard flood defence wall or localised bank raising along the Gatwick Stream. Both options would retain the flow in channel during a major storm event up to the chosen design return period of the flood defence. The scheme may require the provision of floodplain compensation to replace the existing floodplain that would be removed by the scheme to prevent it increasing risk to third parties. This would seem to offer substantial improvement to the fluvial flood protection to Gatwick Airport. Jacobs have submitted a proposal titled "*Gatwick Stream Flood Wall (05/07/2017)*" to GAL to undertake optioneering for such a flood defence along the Gatwick Stream. This does not imply that a "Gatwick Stream Flood Wall" is definitively the solution at this stage. Rather, the proposal represents a good starting point, from which options may be considered and developed taking account of a range of constraints and specific engineering, environmental, stakeholder and economic factors. Proposed developments that would benefit from such a measure include the Pier 6 Extension, Quebec Taxiway Realignment, A380 Stand Relocation to Pier 5, Push and Hold Stands and Domestic/Common Travel Area Baggage Reclaim facility. Existing infrastructure such as the South Terminal Building, A23 underpass and South Terminal Tunnel, Pier 1 Baggage Hall, taxiways, aircraft stands, existing pier buildings, etc. would also benefit;

- There are significant flood extents predicted from the River Mole for the 1 in 75 annual chance (1.33% AEP) to the 1 in 100 annual chance (1% AEP) plus climate change events that cross the proposed Boeing Hangar site and onto Taxiway Uniform. Given the concentration of proposed large scale development in this area it would appear valid to investigate the provision of a hard flood defence along the River Mole in this location similar to that being considered on the Gatwick Stream. Proposed developments that could benefit from such a measure include the Boeing Hangar, Remote Parking Stands and Taxiway Lima Extension. Existing infrastructure such as Taxiway Uniform and its associated stands would also benefit. The Planning Statement for the development[6] states that it does not give rise to changes in flood risk downstream and is considered acceptable development within Flood Zone 3 classified as 'Less Vulnerable' in accordance with paragraph 066 of the National Planning Practice Guidance;

- Flood defences can always be overwhelmed when the severity of a flood event exceeds that which it was designed to withstand. Gatwick has been undertaking an exercise to identify infrastructure critical to its operation to ultimately ensure that it is resilient to such a scenario. Measures could involve additional protection works local to the asset, or resilience to ensure that there are backup services in place for operations to continue unaffected, or that the duration of outage is limited to minimise disruption. While all critical infrastructure could benefit from such measures, proposed development that would benefit from such measures are the Pier 6 building extension, Pier 5 building extension, Domestic/Common Travel Area Baggage Reclaim facility and the Boeing Hangar;

- In the event that fluvial mitigation measures are overwhelmed in exceptional circumstances, demountable flood defences could be deployed at the new development locations to protect critical infrastructure. The equipment would need to be purchased in advance which may also require enabling works and GAL staff should be trained appropriately in their deployment. However, detailed investigations will be required to look at such mitigation measures to identify and eliminate potential underground flow bypass routes to ensure demountable flood defences will be effective; and

- Regarding the proposed Gatwick Airport Rail Station extension it is noted that a section of the existing Gatwick Stream culvert will be beneath the development. It is recommended that the structural integrity of the culvert is assessed to determine if it would withstand the additional loading, and remain operational for the design life of the proposed rail station extension. The proposed rail station development could be an opportunity to assess the viability of increasing the capacity of the existing culvert, to reduce the risk of blockage and its constriction of flows.

6.8.2 Surface Water Flood Risk Mitigation

Surface water flood risk mitigation measures that could be employed at Gatwick Airport regarding the proposed developments include:

- National and local planning policy requires that new development does not have a deleterious impact upon flood risk. Therefore for all of the proposed developments the proposed surface water drainage systems would need to incorporate attenuation storage (e.g. underground attenuation tank, oversized carrier drains, ponds etc.) to facilitate the restriction of the discharge rates to the existing site conditions

[6] Boeing Aircraft Hangar Gatwick Airport North West Development Zone Planning Statement, Vantage Chartered Town Planning, February 2017

Water Masterplan 2020 & 2028 Forecast - Full backing report

JACOBS

as a minimum requirement and not increase peak flows offsite, which is likely to require the provision of additional storage;

- There is notable surface water flooding predicted for the 1 in 10 annual chance (10% AEP) event at a number of the proposed development locations. This could potentially indicate the existing drainage system is close to capacity at certain locations in the downstream drainage system. Gatwick should therefore give consideration to increasing the drainage network capacity via additional storage at suitable locations, which given the available space would primarily be below ground;

- The use of green roofs on proposed new buildings (e.g. Pier 6 Extension, Pier 5 building extension, Domestic/Common Travel Area Baggage Reclaim facility, etc.) would potentially reduce the hydraulic loading on the airport surface water drainage system by reducing peak flows from the new development. Soil layers would reduce the rate of runoff to the wider surface water drainage system while a proportion of the intercepted runoff would be lost to the atmosphere through evapotranspiration, reducing the volume entering the surface water drainage system. Safeguarding is an important factor to consider when proposing such elements into a development at Gatwick. Consequently such development proposals would need to be agreed with the Gatwick safeguarding team;

- Provision of a large diameter low level surface water sewer to intercept the various drainage systems at the airport. This would be an expensive option and a major construction project but would improve hydraulic performance and collection of surface water runoff and would provide long-term benefits to Gatwick;

- For high intensity, short duration storm events, e.g. 1 in 100 annual chance (1% AEP), 30 minute duration, it is likely that surface water drainage collection areas would be overwhelmed due to the high rate and runoff volumes. To account for such a rare occurrence proposed development critical infrastructure should be made resilient to such surface water flooding. Resilience measures could include raising building thresholds above flood levels, raising electrical equipment above flood levels, etc.);

- For locations such as car parks, pedestrian footpaths, etc. that are not subject to de-icer use or other potentially harmful contaminants there is a possibility to install pervious paving. In suitable ground conditions they would permit infiltration of rainfall to ground thereby reducing runoff to the surface water drainage system. Where ground conditions are not appropriate for infiltration pavement sub-base layers could be surrounded with impermeable liner to provide attenuation storage prior to discharge to the surface water drainage system;

- A number of the proposed development footprints are crossed by existing surface water drainage systems (see Appendix F). In such cases the hydraulic capacity and structural integrity of these existing drainage systems will need to be assessed such that they cope with climate change, withstand the loading from the proposed developments and achieve the proposed design life;

- It is noted that the footprint of the proposed Multi-Storey Car Park (MSCP) 7 development is crossed by a large (approximately 3m) diameter surface water sewer which conveys runoff from a large part of the airport to Pond D. Pond D is the most critical surface water drainage pond in the network and it would be advisable to avoid having such a critical asset beneath MSCP 7. Consideration should therefore be given to re-routing the sewer around the footprint of the new development, although this would require a detailed assessment of feasibility. If this is not possible then the hydraulic capacity and structural integrity of the sewer should be assessed to confirm, that it can withstand the additional loading. The development could have an impact on the ability of GAL to maintain the sewer, which is critical to draining much of the airport;

- With regards to the proposed Boeing Hangar development to mitigate the encroachment of the potential surface water flooding from Taxiway Union a flood bund could be installed to provide a barrier to the flooding encroaching on the site.

A summary table is included in Appendix J which details the fluvial and surface water flood risk initial high level mitigation measures applicable to each of the proposed developments.

6.8.3 Global Best Practice and Innovation

Table 6-2 summarises the findings from a high-level desk study into global best practice and innovation with regards to fluvial and surface water flood risk management primarily from airports and urban areas. The primary innovations are the incorporation of green drainage infrastructure to provide more sustainable drainage solutions; including green roofs, bio-retention areas, permeable pavements, wetland installation, rainwater harvesting, etc. The utilisation of such sustainable drainage methods aids the reduction of runoff rates and volumes, provides runoff treatment (e.g. settle out suspended sediments, etc.), addresses climate change with a holistic approach and enhances biodiversity.

Table 6-2: Innovative Flood Management Measures

Sustainable Flood Management/Innovation	Description	Source / Application Location
Rainwater Harvesting	This source describes the potential for the use of rainwater harvesting at Schiphol Airport. Roof surfaces at Schiphol Airport would be used to collect rainwater which can then be stored and used for non-potable water uses at the airport (e.g. plane washing, toilet flushing, etc.). This would also reduce direct runoff to the surface water drainage system (Kuller, M., Dolman, N., Vreeburg, J.H.G. & Spiller., M., 2016).	Airport – Amsterdam Airport Schiphol (EU)
Green Drainage Infrastructure & Rainwater Harvesting (Water Vision Schiphol 2030)	The "Water Vision Schiphol 2030" study (Royal HaskoningDHV, 2014) is an exploration and adaptation strategy to create a strong and resilient Amsterdam Airport Schiphol. Actions in studies underway from flood risk/water use standpoint include: (i) Maximising the installation of green infrastructure and sustainable drainage systems to manage surface water runoff; (ii) Growing vegetation and developing water storage facilities which are favourable from an ecosystems and biodiversity perspective but are not attractive to birds; Rainwater harvesting for decrease use of potable water in toilet flushing and fire-fighting (and reducing direct runoff to the surface water drainage system).	Airport – Amsterdam Airport Schiphol (EU)
Sustainable Drainage – Infiltration Methods	At Munich Airport the rainfall runoff from buildings, roads, flight operation areas and other paved surfaces that collects over large areas or in drainage channels is permitted to soak into the ground onsite, preferably using soakage facilities near the surface such as pits or trenches. The surface water is filtered through the infiltration process, ensuring protection of groundwater (Munich Airport, 2017).	Airport – Munich (EU)
Large Surface Water Interceptor Sewer	This source describes the Copenhagen Airport "Water Motorway" which is a potential 2 to 3 kilometre long deep sewer under the airport which would lead water away from the wider drainage network to a pumping station on the coast by the Oresund Sound (Ministry of the Environment and Food of Denmark, 2014).	Airport – Copenhagen (EU)
Sustainable Drainage – Infiltration Methods	In 2016 Luton Airport installed a new surface water treatment system, the first of its kind in the UK. The system combines SuDS measures and attenuation tanks with vortex separation to remove substances such as suspended particulate matter in addition to oils and de-icing chemicals adhered to suspended particulate matter from the water to mitigate pollution. The remaining surface water is then directed into one of three receptors: Luton Hoo Lake, the River Lea and an underlying Chalk Aquifer (i.e. groundwater recharge – sustainable water disposal) (Brockett, J., 2016).	Airport – London Luton (EU)
Green Drainage Infrastructure (e.g. Biofiltration planters, car park biofiltration units, etc.)	This source explores the use of green infrastructure for drainage at Hartsfield Jackson Atlanta International. A goal of the airport is to adopt the City of Atlanta's policy to use green infrastructure and runoff reduction practices that require the first 1.0" (≈25mm) of rainfall to be managed on-site. Proposed projects include the use of biofiltration planters, biofiltration on car parking units and implementing tree wells for existing parking areas (i.e. reduce paved area) (Emanuel, B. & Sattler, P., 2015).	Airport - Hartsfield Jackson Atlanta International (USA)
Green Drainage Infrastructure (e.g. green roofs, permeable pavements, etc.)	At Chicago O' Hare Airport they have undertaken a project in the South Cargo area to use more green infrastructure methods for surface water drainage. This includes five green roofs and three permeable pavement car parks (i.e. infiltration) to contribute to the volume control and treatment of the surface water runoff. The vegetated green roofs are especially effective in Chicago at limiting runoff because of the local rainfall characteristics (i.e. vegetated green roofs evapotranspirate and absorb up to 25mm of rainfall. Given local rainfall characteristics 90%-95% of precipitation falling on the green roofs never reaches the drainage system (Antonoglu, E., 2017).	Airport - Chicago O'Hare International (USA)
Sustainable Drainage – Infiltration Methods	Los Angeles International airport is proposing a $40 million project to treat pollution in millions of gallons of surface water runoff (i.e. presently large volumes of contaminated surface water discharge to Santa Monica Bay). A large volume of the runoff could be discharged to an underground storage facility and subsequently pumped to infiltration galleries. The soil will filter the runoff naturally and the treated water will discharge to the aquifer recharging groundwater reserves, and reducing the need for a surface water drainage network (Morin, M., 2015).	Airport - Los Angeles International (USA)
Green Drainage Infrastructure (e.g. permeable pavements, etc.)	As part of San Francisco International Airports Sustainability Plan (Esmaili, H., 2013) they propose the use of permeable pavements where soil conditions are appropriate for car parks, footpaths, etc. Permeable pavements would reduce the rate of runoff (i.e. percolate through the pavement and into soil to recharge groundwater).	Airport - San Francisco International (USA)
Green Drainage Infrastructure (e.g. Bio-retention areas, etc.)	Chattanooga Airport is helping the local community revitalize their land. The airport purchased two abandoned car parks within the airport's Runway Protection Zone. Collaborating with Chattanooga city, the land was used to tackle surface water flooding locally. The project demonstrated how to prevent surface water entering the city's sewer system using green infrastructure. The project improved the soil, levelled the land to mimic natural water patterns, created bio-retention areas to hold surface water and recreated vegetation cover whilst extending the airport's Runway Protection Zone. The project received the 2013 Governor's Environmental Stewardship Award for sustainable performance (Chattanooga Airport, 2017).	Airport - Chattanooga Airport (USA)
Green Drainage Infrastructure (e.g. swales, attenuation	The aim of the Llanelli RainScape project (Welsh Water, 2017) is to reduce the amount and rate of runoff to the Llanelli sewer system reducing flood risk. The innovative surface water management techniques, developed in partnership with Carmarthenshire County Council, include installing attractive planted areas and green space	Urban Area – Llanelli (UK)

ponds, permeable pavements, etc.)	that will absorb water (e.g. during a rain event a swale can collect the water, let it gradually seep into a below ground storage unit, before releasing it to the surface water drainage network. A series of other projects including other forms of green drainage infrastructure (e.g. attenuation ponds, etc.) are proposed throughout Llanelli to reduce runoff rates.	
"Blue" Urban Corridors	A Croydon Council report titled "Developing Urban Blue Corridors - Scoping Study" (URS Corporation, 2011) describes the concept of urban blue corridors. Urban Blue Corridors encompass the idea that both new and existing development within the urban environment is planned around watercourses, overland flow paths and surface water ponding areas creating a network of urban corridors designed to facilitate natural hydrological processes whilst minimising urban flooding, enhancing biodiversity and helping to adapt to climate change. 'Urban Blue Corridors' is the collective name (and linking mechanism) for interconnecting features including, but not limited to, overland flow paths, ponding areas, rivers and canals, wetlands, flood storage areas, historic river channels, floodplains, etc.	Urban Area – London Borough of Croydon (UK)
"Blue – Green" Drainage Solutions	Nature Based Solutions (NBS) – green infrastructure installations such as green roofs, tree wells and swales can yield multiple urban benefits. These include reduction of water and air pollution, mitigation of flood risk and heat islands, as well as provision of areas for recreation and urban agriculture. The Blue Green Solutions Guide (Bozovic, R., Maksimovic, C., Mijic, M., Smith, K.M., Suter, I. & van Reeuwijk, M., 2017) presents the innovative, systematic framework created by Imperial College London researchers, with the support of Climate KIC (the EU's main climate innovation initiative), to harness the power of NBS to deliver attractive cities and developments that are resilient (including surface water flood risk), sustainable and cost-efficient.	Urban Areas – Research Guidance from Imperial College London (UK)
Natural Fluvial Flood Management – Slowing the Flow at Pickering	This study based at Pickering (North Yorkshire) looks at how changes in land use and land management can help to reduce fluvial flood risk (i.e. can be investigated for River Mole, Gatwick Stream, etc.). The overall aim of the project was to demonstrate how the integrated application of a range of land management practices can help reduce fluvial flood risk at the catchment scale, as well as provide wider multiple benefits for local communities. Mitigation measures assessed include the planting of riparian woodland to reduce runoff from land, provision of woody dams to attenuate flow volumes, planting woodland to improve infiltration of water to the soil, etc. (Forest Research, 2017).	Urban Area – Natural Fluvial Flood Management Research

6.9 Flood Risk Management Strategy

The review of the development proposals for Gatwick and global best practice has identified a number of features that Gatwick should give consideration to including in their management of flood risk over the next decade and beyond.

6.9.1 Flood Risk Management Strategy

GAL should develop a strategy that covers all aspects of flood risk management at Gatwick. The strategy would provide a framework for new development and the mitigation of flooding to the existing airport. The new

developments present opportunities to consider them as a whole, measures at one development may be able to mitigate for the impacts of another thereby reducing the cost and future maintenance requirements at the airport.

In particular it is recommended that an airport-wide surface water drainage strategy is developed. This is to facilitate the effective management and disposal of surface water to minimise surface water flood risk to Gatwick Airport as opposed to addressing surface water management on a piecemeal basis as and when new developments are required. An airport-wide surface water drainage strategy should look to the future at potential developments and plan ahead with regards to attenuation storage and discharge arrangements (e.g. minimising pumping). The potential use of infiltration methods across the airport should also be investigated as a means of surface water disposal. Surface water disposal via infiltration is the preferred method by the Environment Agency (EA) as it reduces direct surface water runoff to the main surface water drainage system and recharges groundwater. As an example, a large project requiring significant capital investment such as a potential second runway is a prime opportunity to think strategically about surface water management. A large diameter low level surface water relief sewer could be investigated to intercept the majority of surface water drainage at the airport. Such a low level surface water relief sewer could provide additional attenuation storage capacity and minimise the requirement for local pumping from individual developments (i.e. a low level sewer would enable development to drain by gravity with pumping utilised within the low level sewer to discharge to nearby treatment facilities and/or local watercourses). Equally a large diameter low level surface water relief sewer could also be investigated for the existing single runway Gatwick Airport to intercept the existing surface water drainage systems.

6.9.2 Strategic Approach

Reviewing where the new development is proposed may reduce the mitigation required. For example it may be possible to provide all the mitigation for the proposed developments in the Pond D catchment at one location thereby reducing the scale and extent of mitigation works.

6.9.3 Standard of Protection

The existing standard of flood protection provided at the airport varies. Under national planning policy future development needs to be safe for users for its lifetime, including the consideration of climate change. In 2011, the UK Cabinet Office produced a report: "Keeping the Country Running: Natural Hazards and Infrastructure" which provided guidance to improve the resilience of critical infrastructure and essential services. This document noted that there is no national standard for the resilience of infrastructure in the UK. The report also refers to recommendations from the Pitt Review (2007) which highlighted concerns about the existing level of resilience of critical infrastructure to disruption as a result of flooding, which is considered to be the greatest natural hazard to the UK. The Pitt Review concluded that: "*for the purposes of building resilience in the critical infrastructure, a minimum standard of 1 in 200 (0.5%) annual probability would be a proportionate starting point [for all forms of flooding]*".

The Cabinet Office report (2011) also states:

"The flood resilience standard, as suggested in the Pitt Review, provides a useful aspiration and guide to longer term planning and investment beyond regulatory price reviews and investment cycles. But the standard should be viewed in terms of the broader approach to resilience consisting of the components of resistance, redundancy, reliability, response and recovery. Thus a more useful benchmark is that "as a minimum essential services provided by Critical National Infrastructure (CNI) in the UK should not be disrupted by a flood event with an annual likelihood of 1 in 200 (0.5%)". Infrastructure owners and, where relevant, regulators should consider the cost/benefits of individual projects when determining which projects to fund and whether they can achieve this resilience standard for flooding. Actual levels of resilience for CNI should be monitored through the Sector Resilience Plans".

Therefore, with specific regard to a suitable design standard for safe, continued operation of Gatwick Airport during a flood, it is recommended that the minimum design standard is the 1 in 200 annual chance (0.5% AEP) event for critical infrastructure.

6.9.4 Drainage Network Review

GAL should undertake a review of the surface water drainage network to identify potential efficiencies and redundancy. For example at present water is potentially pumped numerous times before leaving the airport, minimising pumping would reduce energy consumption.

Alongside potential benefits to water quality, treating de-icer use at source could reduce the pollutant load to the drainage ponds. The provision of SuDS measures throughout the airport and integrated into new development would also increase the quality of the runoff entering the drainage ponds, thereby increasing the volumes that could be discharged from the airport directly without additional treatment and reducing pumping requirements.

As part of this review GAL should also identify areas of the airport that could be designated to sacrificially store flood waters on the ground surface. These would be less critical areas that could temporarily store flood waters, returning the water to the drainage system when downstream levels recede. Opportunities could include car parking areas during winter when passenger numbers are lower.

6.9.5 Critical Infrastructure Resilience

GAL are currently progressing a review of critical infrastructure, this should be progressed to undertake works to make the airport resilient to a suitable standard of flood protection.

6.9.6 Unused Impermeable Area

GAL should undertake a review of their existing impermeable areas to determine if any could be removed and returned (for example) to grassland which would reduce runoff to the surface water drainage system. This would benefit the system by reducing the rate and volume of runoff.

6.10 Conclusions

The Phase 1 Water Masterplan report identified fluvial (river) and surface water (from exceedance of the surface water drainage system capacity) as the primary sources of flood risk to Gatwick Airport. This Phase 2 Masterplan report has therefore assessed the fluvial and surface water flood risk to the proposed developments associated with the Gatwick Masterplan and identified measures that could be adopted by GAL to manage future flood risk at the airport.

Regarding fluvial flood risk the flood extents from the Gatwick Stream impacts on the following proposed developments:

- Pier 6 Extension – the proposed Pier 6 Extension development is impacted by the 1 in 100 annual chance (1% AEP) and the 1 in 100 annual chance (1% AEP) event plus 20% climate change uplift fluvial flood extents;

- Quebec Taxiway Realignment – the proposed Quebec Taxiway Realignment development is impacted by the 1 in 100 annual chance (1% AEP) event plus 20% climate change uplift fluvial flood extents;

- A380 Stand Relocation to Pier 5 – the proposed A380 Stand Relocation to Pier 5 development is impacted by the 1 in 100 annual chance (1% AEP) event plus 20% climate change uplift fluvial flood extents; and

- Domestic/Common Travel Area Baggage Reclaim facility – the proposed Domestic/Common Travel Area Baggage Reclaim development is impacted by the 1 in 50 annual chance (2% AEP), 1 in 75 annual chance (1.33% AEP), 1 in 100 annual chance (1% AEP) and the 1 in 100 annual chance (1% AEP) event plus 20% climate change uplift fluvial flood extents.

The proposed Push and Hold Stands, Long Stay Car Parking facility, Multi-Storey Car Park 4, Multi-Storey Car Park 7, South Terminal Car Rental facility and the Gatwick Airport Rail Station Extension are outside the fluvial flood extents from the Gatwick Stream up to and including the 1 in 100 annual chance (1% AEP) plus 20% climate change uplift event.

The fluvial flood extents from the River Mole for the 1 in 75 annual chance (1.33% AEP), 1 in 100 annual chance (1% AEP) and the 1 in 100 annual chance (1% AEP) plus 20% climate change uplift impact on the Boeing Hangar development. The proposed Remote Parking Stands and Taxiway Lima developments are located marginally outside the fluvial flood extents from the River Mole up to and including the 1 in 100 year annual chance (1% AEP) plus 20% climate change uplift. However, the potential fluvial flooding from the River Mole on Taxiway Union could impact accessibility to the proposed Remote Parking Stands and proposed Taxiway Lima depending on the flood depths.

The majority of the proposed developments are at risk of surface water flooding due to their proximity to the extensive surface water drainage system serving Gatwick Airport the capacity of which is exceeded for the 1 in 10 annual chance (10% AEP) event. It is evident that the surface water drainage systems serving the existing car parking facilities in the vicinity of the proposed Multi-Storey Car Parks 4 and 7, Long Stay Car Parking, South Terminal Car Rental, Remote Parking Stands and Taxiway Lima developments have not been hydraulically modelled. Therefore, the existing surface water flood risk cannot be fully evaluated. Surface water drainage models should be developed for the existing car parking facilities at these locations.

A range of potential mitigation measures have been identified that could address the fluvial and surface water flood risk at Gatwick Airport both within the masterplan timescale of 2028 and beyond. Briefly the flood mitigation measures include the introduction of a hard flood defence along the Gatwick Stream, incorporating flood resilience measures (i.e. building threshold raising, etc.) into proposed developments, employing green drainage infrastructure (e.g. swales, attenuation ponds, green roofs, etc.) to reduce runoff rates and volumes, etc.

6.10.1 Recommendations

In light of the fluvial and surface water flood risk assessment undertaken as part of this Phase 2 Masterplan report the following is recommended to mitigate future flood risk at Gatwick both within the next decade and beyond:

- The current EA climate change guidance is incorporated into both the fluvial and surface water hydraulic models and simulations undertaken to confirm predicted future flood risk;

- The assessment of flood risk to and from the proposed Gatwick Masterplan developments is revisited once the hydraulic models are amended of Jacobs findings documented in the report titled “Gatwick Resilience Review” (Jacobs, 2016 - Report No. GADD001A_1) and incorporated the current EA climate change guidance;

- Surface water drainage models are built for any existing car parking facilities within the vicinity of the proposed developments to enable the full evaluation of surface water flood risk and determination of allowable discharge rates;

- The existing Gatwick Airport surface water drainage model held by CH2M should be updated with the relevant comments from the flood resilience review undertaken by Jacobs titled “Gatwick Resilience Review” (Jacobs, 2016 - Report No. GADD001A_1) which documents Phase 1 of the hydraulic model reviews;

- GAL should continue to collaborate with the EA and Lead Local Flood Authority (LLFA) to identify and progress flood mitigation measures that would benefit the airport and local communities. For example, works in Ifield, the Withy Brook and the River Mole. Such measures could include increases to the discharge capacity of Pond D and in turn reduce the risk of surface water flooding to the airport;

- The viability of collected surface water runoff disposal via infiltration methods should be examined as part of the Flood Risk Assessment (FRA) and surface water drainage strategies required for each development. Disposal of clean surface water via infiltration methods is preferred by the Environment Agency (EA) as it mirrors natural drainage process: delaying discharge to nearby watercourse by encouraging infiltration through the ground formation and recharges local groundwater. The constraints to delivery of such measures could be assessed within the timescale of this Masterplan;

- The provision of flood defences along the River Mole immediately downstream of the culvert under the runway should be investigated. Flood defences like those mentioned for the Gatwick Stream could reduce the risk of fluvial flooding to the proposed Boeing Hangar, Remote Parking Stands and Taxiway Lima developments. It could also reduce the fluvial flood risk to the existing Taxiway Union;
- A number of the proposed development footprints are crossed by existing underground surface water drainage systems. As part of each proposed development work package the hydraulic capacity and structural integrity of the existing surface water drainage at the affected locations will need assessment. This is to ensure its adequacy over the design life of the proposed developments planned as part of the Gatwick Masterplan;
- GAL should review and update their flood resilience technical standards to meet current national Standard of Protection guidance; and
- A portion of the existing Gatwick Stream culvert will be covered by the proposed Gatwick Airport Rail Station Extension. The structural integrity of the Gatwick Stream should be assessed to understand its ability to withstand the construction loading and its ability to last the design life of the proposed Rail Station Extension. This could also be an opportunity to assess the viability of replacing and upsizing the Gatwick Stream culvert to improve flood risk upstream.
- An airport-wide flood risk management strategy should be developed. This is to facilitate the effective management of flood risk from all sources (i.e. fluvial, surface water, groundwater, reservoir failure, etc.) to minimise flood risk to Gatwick Airport as opposed to addressing flood risk management on a piecemeal basis as and when new developments are required and to identify opportunities to reduce pumping within the surface water drainage system. For example, an airport-wide surface water drainage strategy should look at future potential developments and plan ahead for the use of infiltration measures or attenuation storage and discharge arrangements (e.g. minimising pumping) as appropriate for the geology.

7. Future Local and National Planning Policy

A summary of how compliance standards may change in the near term is included in Appendix H. In brief emerging national policy documents such as the call for evidence for the future of aviation strategy and the emerging Aviation National Policy Statement are not expected to lead to a change in standards. Recommendations are made for the emerging masterplan based on existing policy approaches.

Crawley Borough Council adopted their Local Plan to 2030 in December 2015 and subsequently adopted a Planning and Climate Change Supplementary Planning Document (SPD) in October 2016. Their Local Development Scheme (LDS) for the period 2015-2018 refers to an update of the Gatwick Airport SPD in 2017, but there is no evidence of progress with this. The draft of the next LDS is expected in September 2017 and GAL should monitor this. Mole Valley and Tandridge District Council have not progressed to new Local Plans and these will need to be monitored. Reigate and Banstead and Mid Sussex have emerging Local Plans which do not appear to raise new issues.

It is understood that BREEAM standards are likely to be updated in Spring 2018 and work on new climate change projections may also emerge in 2018 – see Section 6.5, which may change the planning requirements for future management of water at Gatwick

8. Conclusion

8.1 Water Use Forecasts

Historic data from 2012-16 has been analysed to generate a trend for water consumption which has been applied to the GAL growth forecasts to estimate future water demands in 2020 and 2028 at Gatwick.

The forecast water consumption in 2020 is estimated to be 764,446m^3, which is higher than any of the previous years, apart from 2010. This is a 20% reduction of the consumption in 2010 and compares to the target launched in the Decade of Change Report in 2010 of a 20% reduction, but which has now been stretched to 25% to spur further water efficiencies as the airport grows. The 2020 forecast suggests that this target will not be met.

The business as usual (without proposed infrastructure changes) water use forecast in 2028 is estimated to be 741,987m^3, an increase of 11,843 m^3 against the BAU figure of 2020.

The forecast water consumption in 2028 is estimated to be 786,052 m^3, but with a further unit consumption of less than 14 l/pax based on the proposed asset changes at Gatwick. The consideration of the Boeing hanger is a significant sensitivity; its impact has been based on assumed figures from the operation of the Virgin hanger.

8.2 Water Efficiency

There is potential to make improvements in water efficiency at Gatwick.

With unaccounted for water, leakage and building water wastage amounting to 50% of supply, it is recommended to focus on these areas first, with rainwater harvesting being considered for large existing buildings and all new buildings.

In summary the recommended actions are:

- Inspect and survey all facilities where meters are not working, or not being read and replace as required and add to reading schedule. Consider the re-introduction of ARM meters for facility sub-meters;
- Monitor nightlines after improved metering and compare against UFW to help separate the quantify the extent of leakage from building water wastage;
- Conduct an inspection survey of toilets in older buildings to check on urinal controls, and other potential sources for water wastage, outside taps, roof tank overflows, isolate unused buildings, etc.;
- Carry out enhanced leakage surveys, consider feasibility and benefits of:
  - Step-testing areas,
  - Widespread use of an array of acoustic noise loggers,
  - Use of leak noise correlators to find and repair leaks,
  - Pressure reduction in mains network, using modulate Pressure Reducing Valves (PRVs), with protection measures and contingencies for emergency water demands; and
- Consider Rainwater Harvesting for large buildings and all new buildings.

8.3 Foul wastewater

It is recommended that the flow meter in the main sewer from the South Terminal and East or Rail, believed to be 400mm size, is repaired or replaced. Further it is recommended that GAL consider a project to not only install a new flow meter in the Police Station main sewer, but also to connect all flowmeters to dataloggers at the main sewage pump stations PS 3, PS 7, PS 24 and any other location of particular interest.

Subsequently GAL will be able to interrogate sewer flows, diurnally as well as weekly, this will provide a powerful tool in determining the sewer nightflows.

8.4 Water Quality

Due to the predicted increase in ATMs at Gatwick de-icer usage has been predicted to increase from the current 1,080,000 litres/yr to around 1,190,000 litres/yr in Scenario 1 (airport growth model C55-53) or 1,240,000 litres/yr in Scenario 2 (airport growth model C60-C55) by 2028.

Pavement de-icer usage is also likely to increase to 2028 due to new developments at the airport increasing the amount of hardstanding requiring de-icing. The increase will be of around 15,000 litres/yr from a current average of 1,270,000 litres/yr to a predicted 1,280,000 litres/yr. This could lead to increased COD loading and consequently an increased potential for BOD exceedances. Four options were considered to project future COD loading to the surface water drainage system, it is understood they are presently in their early stages of implementation, but Jacobs has projected that COD load could reduce by 44-46% by 2028.

It is recommended that consideration of a selection of options are taken forward for quantitative assessment of cost, lead-in times and land take, and this should be balanced against the impact on water quality for consideration by GAL.

8.5 Flood Risk and Surface Water Management

The primary sources of flood risk to Gatwick are fluvial (river) and surface water (from exceedance of the drainage network capacity). Based on hydraulic modelling Gatwick Airport is considered to be at risk of fluvial flooding on average between the 1 in 20 annual chance (5% AEP) and the 1 in 50 annual chance (2% AEP) events. The airport is served by an extensive surface water drainage network which would be overwhelmed by extreme rainfall events, which is predicted to flood on average for the 1 in 10 annual chance (10% AEP) event. The location at highest risk of surface water flooding is the North Terminal.

Flood risk from both fluvial (river) and surface water sources is predicted to increase within the next ten years as a result of climate change if no mitigation measures are implemented. Such an impact would increase beyond the life of this masterplan.

A number of the proposed developments at Gatwick would be at risk of fluvial flooding from the 1 in 100 annual chance (1% AEP) event:

- Pier 6 Extension;
- Quebec Taxiway Realignment;
- A380 Stand Relocation to Pier 5; and
- Domestic/Common Travel Area Baggage Reclaim facility.

The majority of the proposed developments are at risk of surface water flooding.

A range of potential mitigation measures have been identified from other airports and industries.

It is recommended that GAL develop an airport-wide flood risk management strategy in order to coherently direct the management of flood risk from all sources and minimise flood risk to Gatwick Airport as opposed to addressing flood risk management on a piecemeal basis as and when new developments are required. Such an approach would also identify opportunities to reduce pumping within the surface water drainage system.

Appendix A. Data Sources

A.1 Water Consumption and Waste Water

Water Data

In addition to the data provided during Phase 1, GAL also provided:

- Water meter data to end of June 2017 for all SES fiscal meters and GAL sub-meters,
- Water meter diurnal flow readings and charts for SES 6No. ARM fiscal meter up to 25th July 2017
- Wastewater meter data for PS3 and PS7 for 2010 to 2016.
- Wastewater meter data for PS24 for 2011 to 2016.

Passenger Numbers

Decades of Change 2015 Performance Summary Report.

Traffic by Terminal May 2017.

Forecast Passenger Numbers

Primary forecasts both scenarios. Scenario 1 is taken from ICF Masterplan Outputs C55-53 (09.06.17) and Scenario 2 taken from ICF Masterplan Outputs C60-55 (09.06.17).

Future Asset Changes

Meeting with Gatwick staff on 5/7/17 – Clare Belsey, Doug Waters, Martin Bilton, Stephen Fuller & David Livesley.

2017 CIP Projects.

A.2 Flood Risk and Surface Water Management

The data utilised for the assessment of flood risk was primarily obtained during Phase 1, via a site visit and a number of meetings with personnel from GAL and CH2M. The key data and documentation provided by GAL which has been used is as follows:

- PowerPoint presentation titled *"Gatwick Airport Master Plan Production Workshop"* delivered by GAL on the 4 May 2017 which at a high level describes the proposed developments likely to pursued as part of the Gatwick Masterplan – Obtained Phase 2;
- Planning application drawings for the proposed Boeing Hangar development which are also available on the Crawley Borough Council website at the webpage below. Drawing No's: 777-D5A-00-XX-DR-A-010-0002 and 777D5A-00-XX-DR-A-010-003 - Obtained Phase 2;

  http://www.crawley.gov.uk/pw/Planning_and_Development/Planning_Permission___Applications/Planning_Applications_Search/index.htm?accept=Search&pRecordID=41441&pApplicationNo=0116&pAD=yes&pAppNo=CR/2017/0116/FUL
- A report drafted by Gatwick Airport Station Development (GASD) team titled "Gatwick Airport Station Development - Single Option Concept Report" (Gatwick Airport Ltd, 2016 - Report No. 142637-COT-REP-EAR-000001) which describes the concept design for the proposed Gatwick Airport Rail Station Extension – Obtained Phase 2;

- Layout drawings illustrating the location of various structures and taxilane/stand identification across Gatwick Airport (i.e. GAL Drawing No's: GALGDTMM-000030Z00001 and GALGDTMM-000031Z00001) – Obtained Phase 2;
- Fluvial and surface water flood risk information from the EA website at https://flood-warning-information.service.gov.uk/long-term-flood-risk/risk?address=10091951274 - Obtained Phase 2;
- Data included on the Gatwick SAFE GIS system (viewed June/July 2017) – Phase 2;
- Surface water and fluvial modelling outputs (i.e. flood extents) from the CH2MILL hydraulic models – Obtained Phase 1;
- CH2M draft model build and calibration report, Upper Mole Flood Modelling Study (CH2M, 2015) – Obtained Phase 1;
- Layout drawings and GIS data (i.e. shapefiles, base mapping, etc.) illustrating the airport layout, the location of existing infrastructure, pond locations, surface water drainage system layout, etc. Obtained Phase 1;
- Report documenting the Christmas 2013 flood events at Gatwick Airport titled "Disruption at Gatwick Airport Christmas Eve 2013" (McMillan, 2014) by David McMillan – Phase 1; and
- Report drafted by Jacobs titled "Gatwick Airport – Flood Resilience Review" (Jacobs, 2016) which details a high-level review of the CH2M hydraulic models undertaken by Jacobs in order to understand the existing flood risk posed to Gatwick Airport, understand the infrastructure at risk of flooding, with particular attention to infrastructure critical to airport operations and comment on the surface water and fluvial flood risk, and proposed measures to address the flood risk.

A.3 Water Quality:

In addition to the data provided at Phase 1, GAL provided a record of the types and volume of pavement de-icer annual usage from 2004-2013 (spreadsheet entitled Use Comparison 2013).

Jacobs also downloaded technical datasheets for the different types of de-icer used to establish COD loads.

Appendix B. Assumptions

B.1 General

- It is assumed the data provided by GAL is complete, correct and reflective of full airport operation.

2017 Forecast Annual Consumption

- It is assumed that the average monthly breakdown percentage for 2011 to 2016 is reflective of what can be expected for 2017.

Trend Lines

- The forecast is based on historic trends. A deviation or step change from these will impact the forecast; and
- The predicted trend is based upon a forecast annual consumption for 2017. If actual consumption differs from predicted, the trends may vary. As such a review of this forecast could be considered post 2017 when actual data is available.

Future Asset Changes

- Asset changes are limited to those listed in Section 2.5.1;
- It is assumed the listed asset changes are additional to business as usual operations;
- Floor areas of new build assets are as those provided in the 2017 CIP project slides;
- The asset changes will take place either pre 2020 or post 2020 as provided;
- Boeing Hangar. Consumption per m^2 is assumed to be similar to the existing Virgin Hangar, taken from FY16/17;
- Pier 6 Extension. Consumption per m^2 is assumed to be similar to the existing Pier 6, taken from FY16/17; and
- Bloc Hotel 2. Consumption is assumed to be similar to the existing Bloc Hotel 1, taken from FY16/17.

B.2 Forecast Water Consumption per Passenger

- The consumptions per passenger given are for the forecast passenger numbers. A change in the passenger numbers may result in a change in the consumption per passenger.

B.3 Waste Water Flow Forecast

- Historical data is incomplete therefore a total wastewater flow is unknown;
- A metered area of the wastewater collection system could not be matched with a metered area of the water supply system therefore a relationship between water usage and wastewater could not be established;
- Total wastewater flow has been assumed to be equal to the total water usage flow and this relationship is assumed to be constant in the forecast;

- The wastewater flow from the North Terminal is known from data from flowmeters at the three pumping stations (PS3, PS7 and PS24) that transfer sewage to Crawley Sewage Treatment Works. However a large proportion of the flow to Horley Sewage Treatment Works from the remainder of Gatwick is not recorded (the Police Station flowmeter). Table 8 shows the relationship between the metered wastewater flow and the total water usage flow;
- The wastewater collection system for North Terminal does not match directly the water supply system for North Terminal therefore a ratio of water usage to wastewater cannot be established by that method;
- In a perfectly isolated water/wastewater system “water-in” equals ”water-out”, however, it is normal to have gains and losses to and from the systems;
- Typical losses include:

  - leakage from pipe joints and cracked pipes

  - water exported by users at the point of delivery
- Typical gains include:

  - infiltration to the wastewater system,

  - water imported by users from off-site,

  - surface water drains connected to the wastewater system.
- The forecast total wastewater flow in the forecast has been estimated by assuming that the ratio between the total water usage to total wastewater flow to the sewage treatment works is 1:1, i.e. wastewater flow is assumed to be equal to the water usage. However this ratio has a very wide band of uncertainty which would be narrowed considerably by the collection of data from the Police Station flowmeter.

B.4 Flood Risk and Surface Water Management:

With regards to the existing surface water drainage system, in Phase 1 of the Gatwick Masterplan Jacobs reviewed the data provided and discussed various aspects with GAL and CH2M. Refer to the report titled “Jacobs Flood Resilience Review” (Jacobs, 2016 - Report No. GADD001A_1) which documents the findings. Phase 1 identified a number of discrepancies in the information provided regarding the existing surface water drainage system which are summarised in Section A4.2 of the Phase 1 report and also pertain to Phase 2. Further assumptions and limitations associated with Phase 2 are as follows:

- Jacobs undertook a review of the CH2M fluvial hydraulic models the findings of which are documented in the report titled “Jacobs Flood Resilience Review” (Jacobs, 2016 - Report No. GADD001A_1). It is understood that CH2M are presently addressing Jacobs findings regarding the fluvial model. Therefore, revised fluvial flood extents are not yet available. This flood risk assessment has been undertaken with the flood extents generated from the hydraulic models prior to Jacobs findings as it is the best flood risk data set available at present;
- The EA climate change guidance was updated in February 2016. Therefore, the +20% adopted in the CH2M fluvial and surface water hydraulic models is superseded and should be amended to match with EA current climate change guidance which will alter the hydraulic model outputs;
- The proposed development footprints are based on those included in the PowerPoint presentation titled “Gatwick Airport Master Plan Production Workshop” delivered by GAL on the 4 May 2017. This information on the proposed development layouts, proposed location on the airfield, etc. has been used

to generate development footprints to facilitate this flood risk assessment. This information from GAL on the proposed development is assumed to be correct and representative of the Masterplan;

- It was evident from this assessment of flood risk that the surface water drainage systems for the existing car parking facilities east of the airfield were not modelled (i.e. no flood extents available). Therefore, the existing surface water flood risk could not be assessed. It is recommended that hydraulic modelling of these car parking facilities is undertaken to inform the flood risk;

B.5 Water Quality

In general, the information provided has been relied upon and presumed accurate. The following assumptions have been made:

Baseline

- The 'worst case' do-nothing baseline has assumed steady recovery rates at historical averages (recovery rate of 20%).
- Climate change has not been factored in, including change in average winter temperature or average rainfall.
- Annual variation in de-icer application has not been factored in to calculations; the predicted COD load can change by a factor of 2-3 depending on winter conditions.

Aircraft de-icer

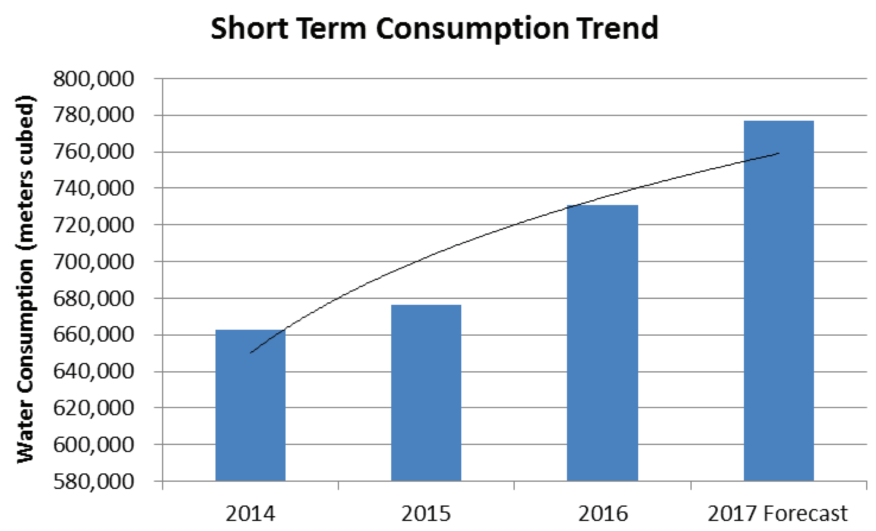
- Aircraft de-icer application is linearly correlated to ATMs.
- Aircraft de-icer used at Gatwick has an average COD of 1.46 kg O2/l. This has been taken from other glycol-based de-icers in use within the industry.
- Improvements in the rate of de-icer recovery will be a rapid change over the first 4-5 years, followed by a steady maximum recovery rate of 40%.

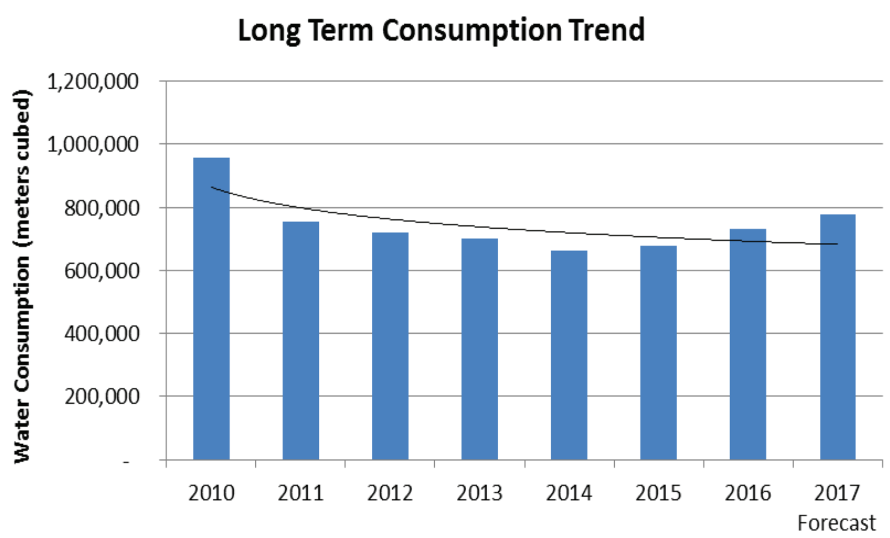
Pavement de-icer

- No change in the percentage of hardstanding de-iced.
- No change in the relative volumes of glycol-based pavement de-icers used.
- The hardstanding increase will happen steadily before 2028.
- It has been assumed that glycol de-icers will be 100% replaced by acetate de-icers, and that this replacement will occur by 2020.
- ECO2 has a COD load of 320 mg O2/l; this has been taken from similar acetate-based de-icers.

Appendix C. Additional Graphs and Tables on Water Consumption Trends

C.1 Trend line graphs

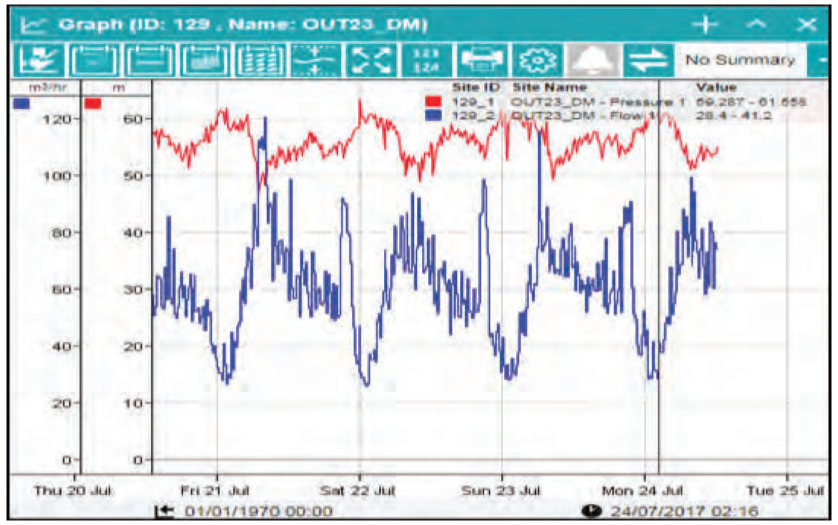


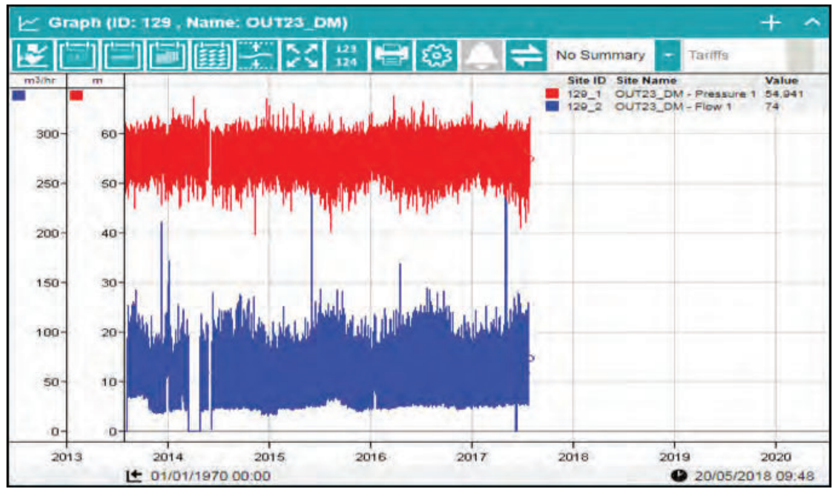


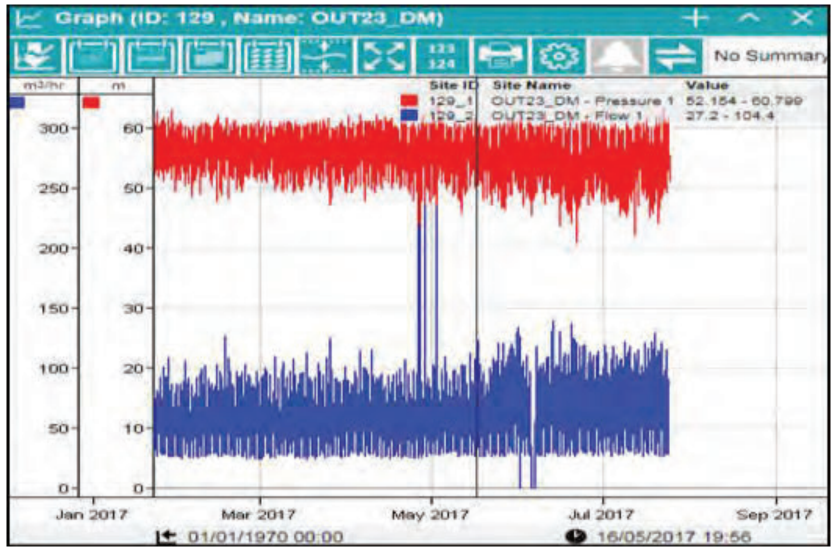
C.2 Medium Term Trendline Results

Trendline	2017	2020	2028
Linear	739,312	773,212	863,612
Polynomial	780,178	1,108,252	3,061,732
Exponential	737,694	772,343	872,907
Power	722,692	730,144	741,987
Linear	724,302	32,024	744,137

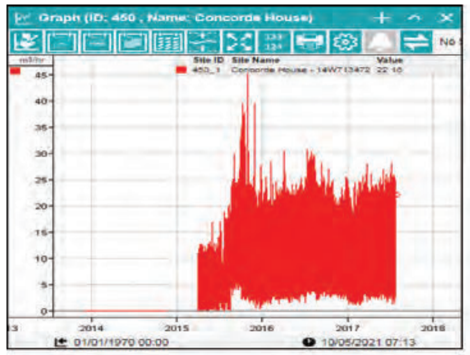
C.3 North Terminal (Povey Cross ARM Meter) Diurnal Water Consumption

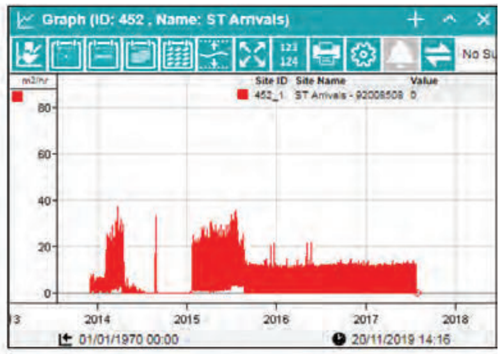


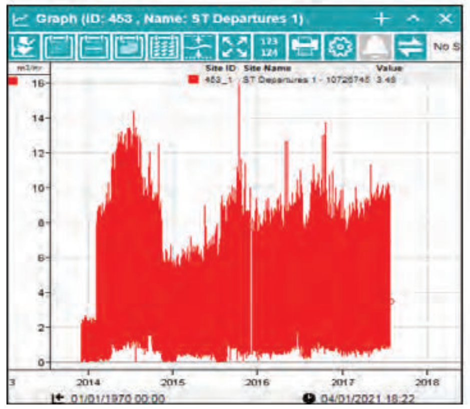


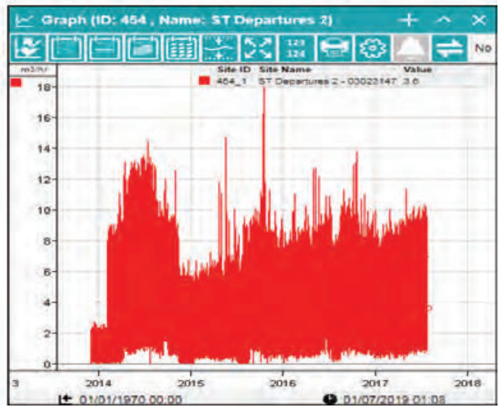


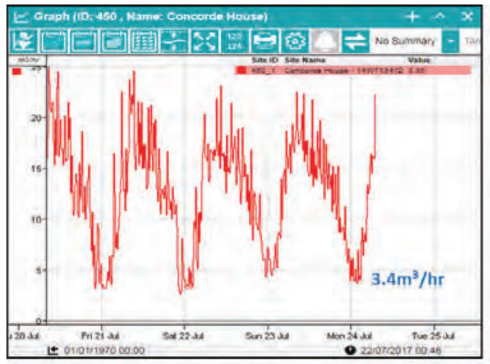
C.4 South Terminal (4No. ARM Meter) Diurnal Water Consumption

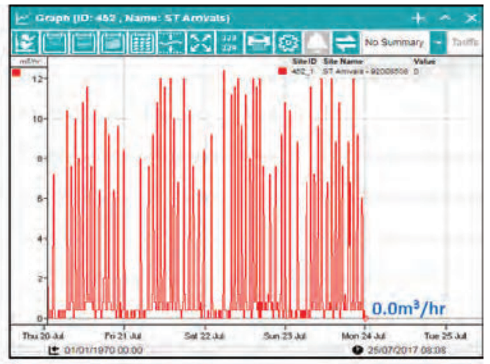


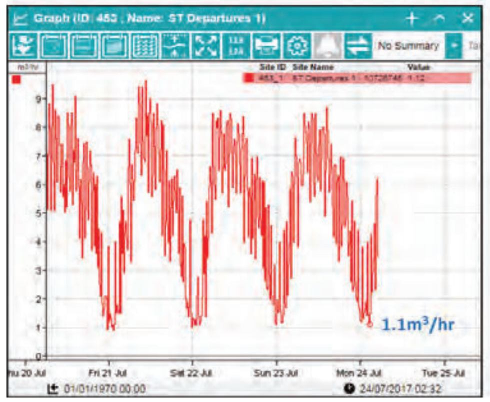


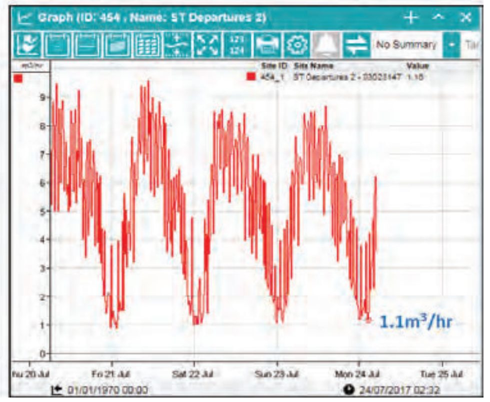




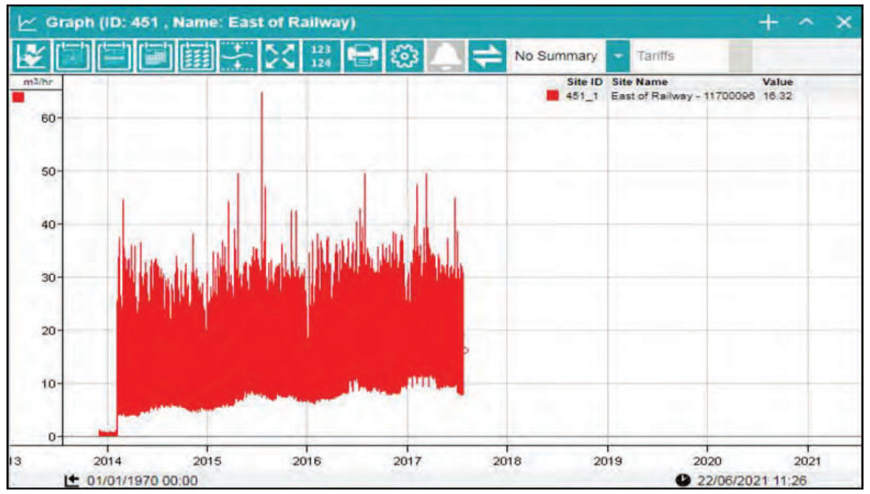


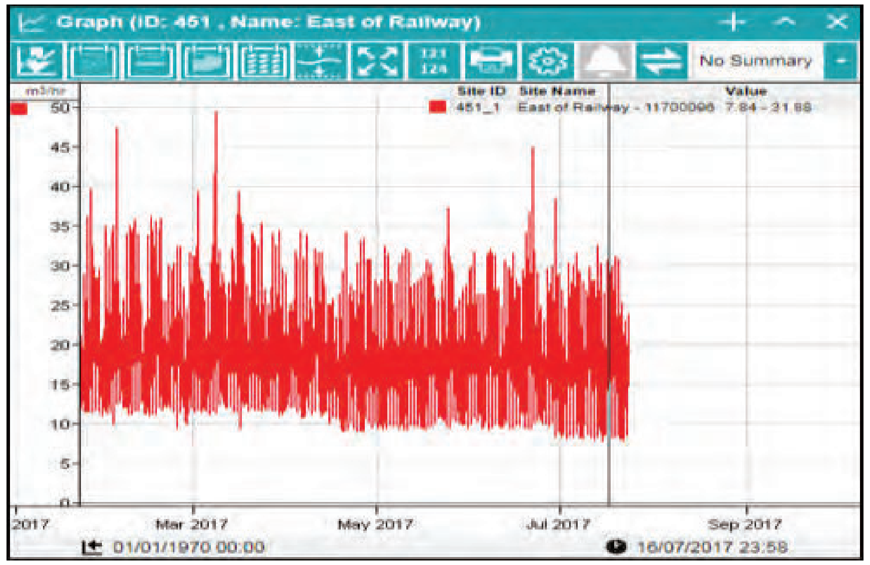


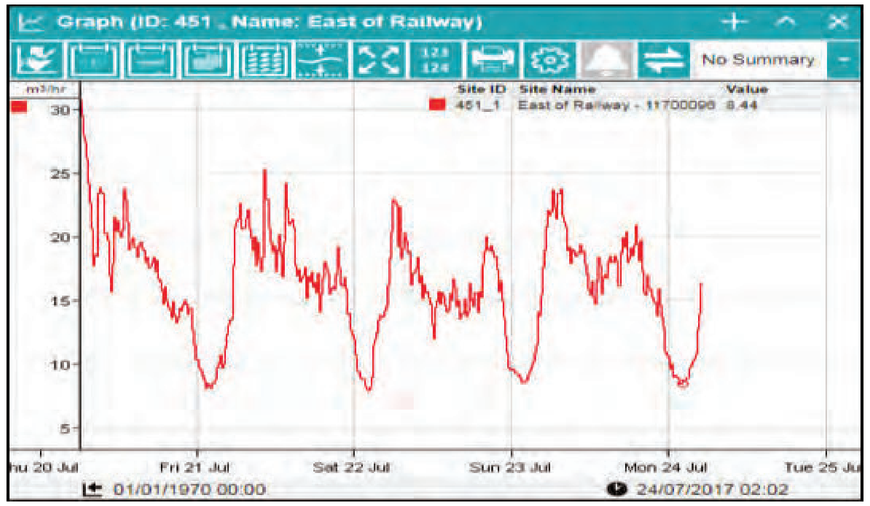




C.5 East of Rail (ARM Meter) Diurnal Water Consumption







C.6 Unaccounted for Water and "Nightline" Analysis by DMA areas

Water Masterplan 2020 & 2028 Forecast - Full backing report

JACOBS

	Apr14-Mar15 2014	Apr15-Mar16 2015	Apr16-Mar17 2016	Current Jul-17	
EAST OF RAIL					
SES Fiscal ARM Meter: Supply	110,683	131,212	143,115		
Total Sub-meters: Consumers		104,708	110,116		24 Total No. of Sub-meters
Unaccounted For Water (m^3/year)		26,504	32,999		5 No. of Sub-meters NOT WORKING
Unaccounted For Water (m^3/hour)		3.02	3.76		21% % of Sub-meters NOT WORKING
Unaccounted For Water (%)		20.2%	23.1%		
Estimate Average Annual Nightline (m3/h)	5.0	7.0	9.0	8.4	
SOUTH TERMINAL					
4No. SES Fiscal ARM Meters: Supply	189,859	179,949	183,384		
Total Sub-meters: Consumers		33,713	38,026		43 Total No. of Sub-meters
Unaccounted For Water (m^3/year)		146,236	145,358		16 No. of Sub-meters NOT WORKING
Unaccounted For Water (m^3/hour)		16.68	16.58		37% % of Sub-meters NOT WORKING
Unaccounted For Water (%)		81.3%	79.3%		
Estimate Average Annual Nightline (m3/h)	*missing data - See Fig 3.2*		5.6	5.6	
NORTH TERMINAL (Povey Cross)					
SES Fiscal ARM Meter: Supply	343,053	346,457	381,530		
Total Sub-meters: Consumers		195,555	208,772		94 Total No. of Sub-meters
Unaccounted For Water (m^3/year)		150,902	172,758		26 No. of Sub-meters NOT WORKING
Unaccounted For Water (m^3/hour)		17.21	19.71		28% % of Sub-meters NOT WORKING
Unaccounted For Water (%)		43.6%	45.3%		
Estimate Average Annual Nightline (m3/h)	28.0	28.0	28.0	28.0	
Total SES Fiscal Bi-annual meters (24 No.): Supply	19,712	19,008	23,198		0 Total No. of Sub-meters

GAL TOTAL	Apr14-Mar15 2014	Apr15-Mar16 2015	Apr16-Mar17 2016	Current Jul-17	
Total SES Fiscal Meters: GROSS Supply	663,307	676,626	731,227		
Total Sub-meters: NET Consumption	338,189	333,976	356,914		161 Total No. of Sub-meters
Unaccounted For Water (m^3/year) (UFW)	325,118	342,650	374,313		47 No. of Sub-meters NOT WORKING
Unaccounted For Water (m^3/hour) (1)	37.09	39.09	42.70		29% % of Sub-meters NOT WORKING
Unaccounted For Water (%)	49%	50.6%	51.2%		
Estimate Average Annual Nightline (m3/h)	*missing data in ST area*		42.6	42.0	
Passenger numbers	38,653,099	40,788,058	43,958,160		
GROSS Water Consumption (l/pax)	17.2	16.6	16.6		
NET Water Consumption (l/pax)	8.7	8.2	8.1		

Note (1) Unaccounted for water for 2014 estimated assuming 2.0m3/hr lower than in 2015 - this is based on the changes observed in nightlines from 2014 to 2015.

C.6.1 North Terminal (from Povey Cross Meter):

- Highest nightline over all areas, is approximately 28.0 m^3/hr from 21st to 24th July 2017.
- In 2014 and 2015 some variation in the nightline were observed, between 20 and 30m^3/hr, and with loss of recordings in March and April 2014.
- But the overall trend over the last 3 years shows the nightline relatively flat-lined at about 28m^3/hr, and therefore the leakage in this area has been high.

C.6.2 South Terminal (from 4No. ARM Meters):

- Current nightline for period 21st to 24th July 2017 from the 4 meters is:
  - Concorde House = 3.4m^3/hr,
  - ST Arrivals = 0.0m^3/hr,
  - ST Departures 1 = 1.1m^3/hr,

- ST Departures 2 = 1.1m^3/hr,
- Total = 5.6 m^3/hr.

o Trends over the last 3 years are variable showing –

- Concorde House - missing data for all of 2014.
- ST Arrivals – gaps in data from mid-2014 to January 2015.
- ST Departures 1 and 2 show variations between 0 and 2m^3.hr in 2014 and 2015, but overall at much the same level as current.
- The similarities between the two graph plots of ST Departures meters 1 and 2 is because the two meters are located in parallel pipes at the same location.

C.6.3 East of Rail:

o Current nightline 21st to 24th July 2017 is approx. 8.4m^3/hr,

o Trend since ARM meter recordings started show a steady increase from 4m^3/hr in January 2004 to 10m^3/hr in January 2017,

o In January 2017 the nightline increased to 12m^3/hr, but then reduced to 10m^3/hr on or about 18th April then reduced again to approx. 8m^3/hr on 28th June. The latter reduction concurs with a leak being found and isolated at the end of June by GAL,

o The rising trend is of concern and suggests that leakage has been increasing over the last 3 years.

Appendix D. Verification of 2020 and 2028 Water Consumption Forecasts

The high level of Unaccounted For Water (UFW) observed on the water supply system suggests that another approach to forecasting future water consumption can be made to the forecasting given earlier in Sections 2.5 and 2.6.

As described above this essentially consists of splitting the water consumption into its two main components:

- Net water consumption – Gross water consumption **less** UFW;
- UFW – Difference between main fiscal supply meters and facility sub-meters.

It is uncertain if all the facilities are adequately metered at this stage, estimates are based on the best available data, summarised at the bottom of Table 3.2.

To verify forecasts using net water consumption, it is assumed that in future the unit net water consumption remains at 8.1l/pax and that UFW continues unchanged at 42.68m^3/hour as at present. The results of these forecasts, based on passenger forecast numbers for scenarios 1 and 2 in passenger forecasts is given in Figure 8-1 and Figure 8-2.

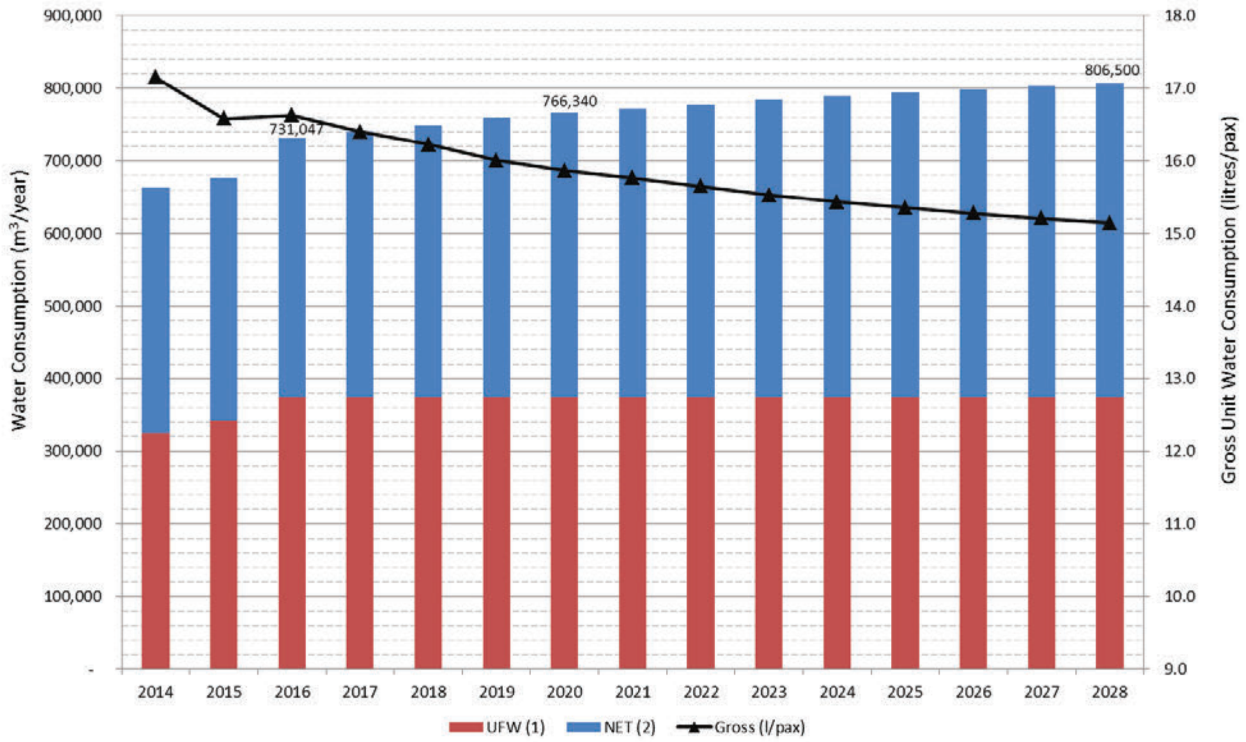


Figure 8-1 : Scenario 1 (C55) – forecast Water consumption – based on a Fixed UFW and Fixed unit net water consumption of 8.1l/pax.

The results compare well with the medium term trend lines, coupled with known asset changes – see Sections 2.5 and 2.6.

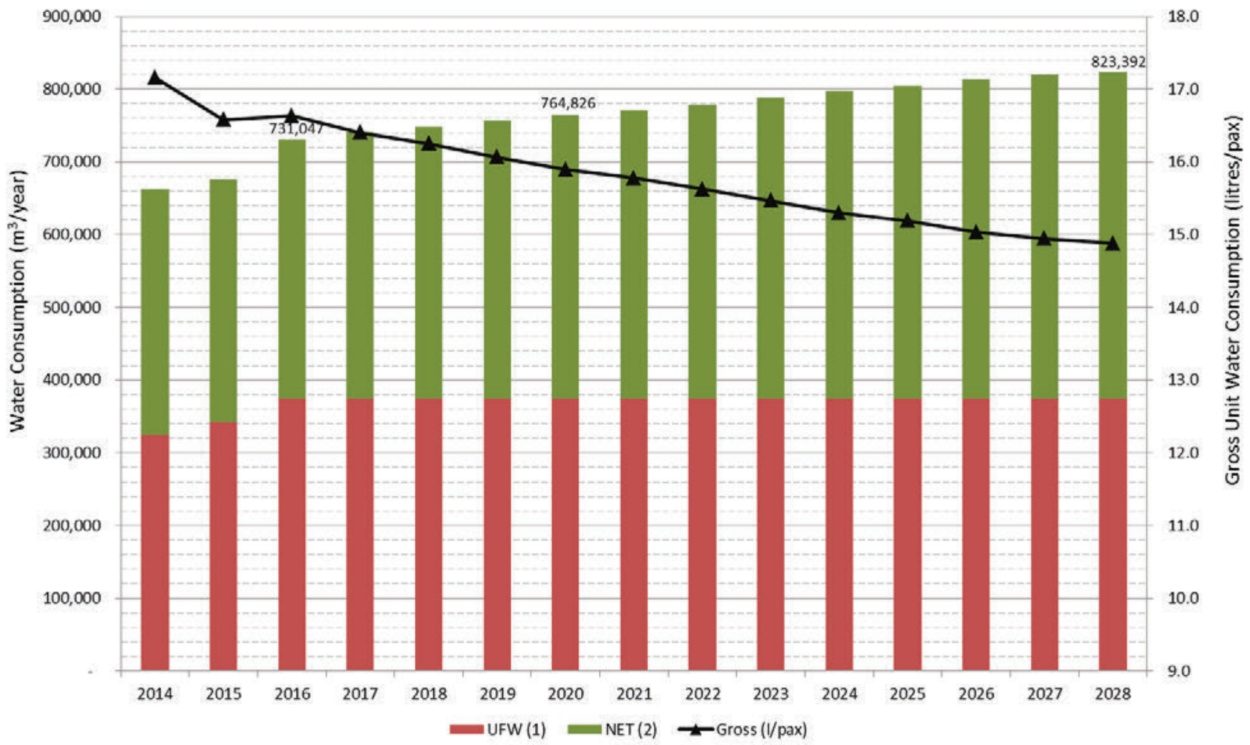


Figure 8-2 : Scenario 2 (C60) – forecast Water consumption – based on a Fixed UFW and Fixed NET UNIT water consumption of 8.1l/pax.

Table D.1 : Comparison of Forecast Water consumption by different methods :

Forecast Year	Scenario	Medium Term Trending with Asset Changes		Fixed UFW and Fixed Net UNIT water consumption of 8.1l/pax	
		Gross Water Consumption (m^3/yr)	Gross UNIT Water Consumption (l/pax)	Gross Water Consumption (m^3/yr)	Gross UNIT Water Consumption (l/pax)
2020	1	785,981	16.3	766,340	15.9
	2		16.3	764,826	15.9
2028	1	807,587	15.2	806,500	15.1
	2		14.6	823,392	14.9

As can be seen from the above table, although there is a minor difference in the forecast figures for 2020, the two methods concur well for 2028. Note both methods effectively assume that UFW effectively remains the same going forward.

There is clearly scope for improvement, since the estimate given in Section 0 based on current estimates, 240,000m³/yr is attributed to leakage and wastage, whilst 130,000 m³/yr is attributed to unaccounted for metering. The latter can be resolved and will not significantly change the water consumption, but the leakage and wastage can be reduced. If for example the leakage and wastage can be halved in the next 10 years, then the gross consumption will reduce by 120,000m³/yr, and result in consumption in the broad range of 687,000 to 704,000m³/yr. If achieved this will result in a reduction in water consumption and the gross unit consumption figure to below 13l/pax.

Appendix E. Leakage – Control and Reduction Techniques

Leakage management to detect, find and fix leaks is traditionally done by sounding techniques (e.g. using listening sticks / dopplers) on metal pipes. This is still practiced, but the principle of detecting and analysing acoustic noise from leaks in pipes can be enhanced using state of the art technology. Also techniques are used to verify permanent sub-division of water supply area and sub-divide and isolate water supply areas on a temporary basis.

E.1 Verification of District Meter Areas (DMAs) water supply boundaries

Open boundaries between DMAs will invalidate attempts to monitor water consumption within set boundaries. Where this is suspected, all known valves on boundaries should be checked that they are closed. Then verification is undertaken by undertaking a "pressure-zero test" on the DMA. The main supply valves are slowly closed at night, and pressure is monitored at high frequency (once or twice per minute) at locations (typically fire hydrants) along both sides of the boundaries. It is also important to know in advance the direction of closure of valves, if there are irregularities these can also be checked during a night-time operation. During the operation hydrants can be checked for loss of pressure, but the post operation analysis of the pressure monitors is more succinct in confirming if the boundary was open or closed, during the pressure zero test, as the pressure-time graph will show this clearly – see Figure 8-3.

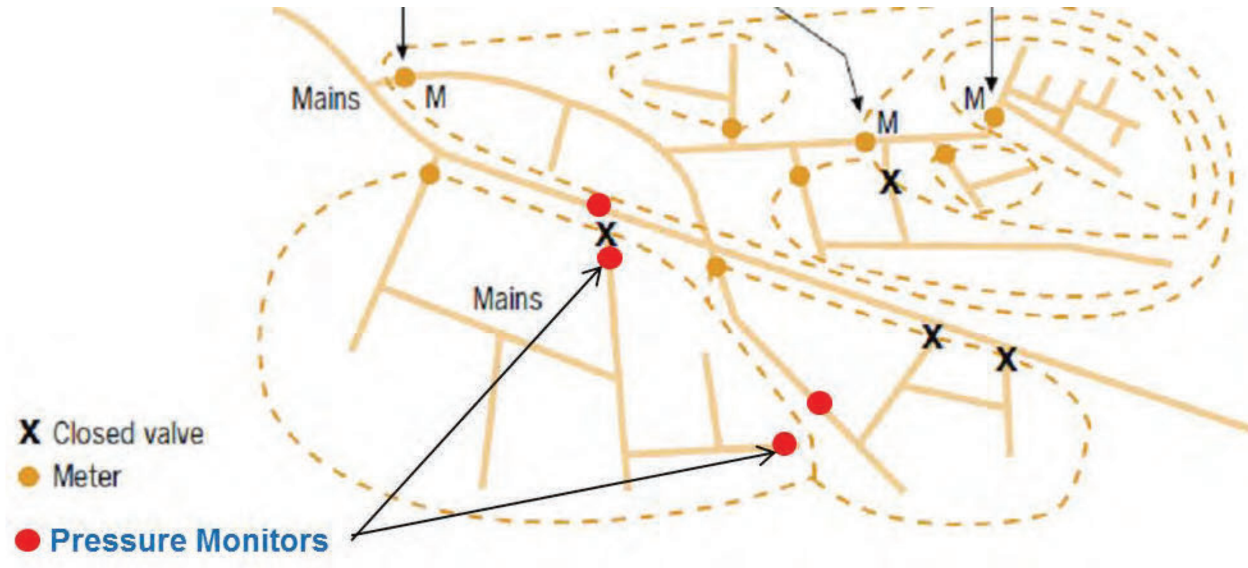


Figure 8-3 : Example "Pressure-Zero Test" to validate DMA boundaries *(Source: background figure; Farley 2001, with additional annotation by Jacobs)*:

These techniques can be done in the space of 2 or 3 hours during silent night hours, and can be done at Gatwick if required.

E.2 "Step Testing" within DMAs

"Step testing" involves sub-dividing a DMA water supply area, again during silent hours in the night. The main supply meters are monitored but the frequency of monitoring is increased from 15 minutes to 15 or 30 seconds. The prearranged sub-divisions within the DMA are then closed sequentially, starting from those furthest from supply meters, and the "step" in the nightline is then observed – see Figure 8-4.

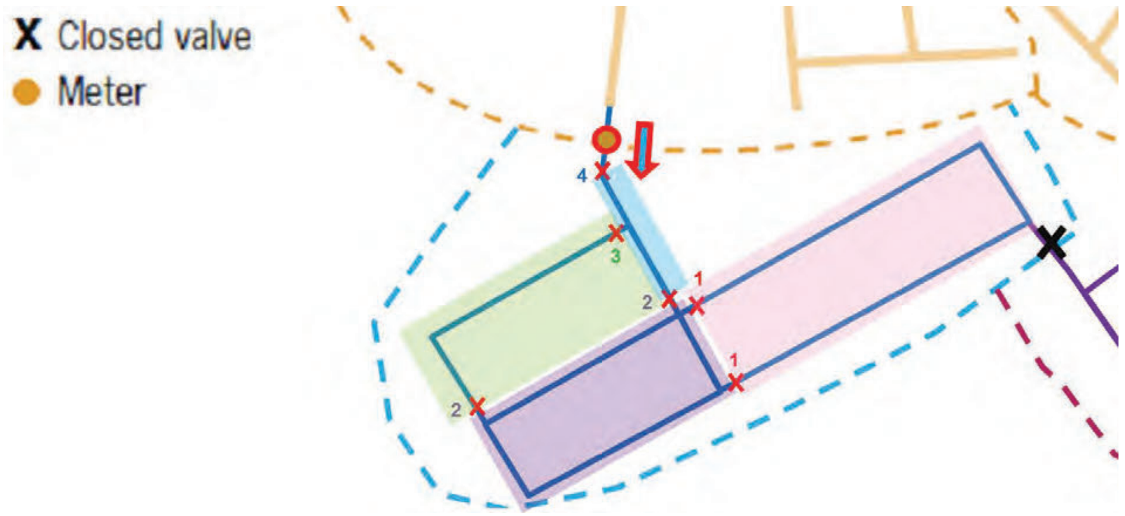


Figure 8-4 : Example plan layout of a DMA undergoing a "Step Test" - in 4 steps, closing valve sets 1, 2, 3 and 4 on 4 areas

There needs to be sufficient time (20 to 30 mins) allowed for the flow to stablise and to obtain meaningful readings before moving onto isolate next sub-division. At the end of the test the sub-divisions are reopened sequentially again, although often at a quicker pace. The results when analysed will indicate leakage levels in each sub-divided area for further investigation – see Figure 8-5. From the example DMA illustrated in Figure 8-4 and Figure 8-5. It can be seen that sub-area 2 has the largest "step" drop in water consumption when shut-off and thereby indicates the highest leakage.

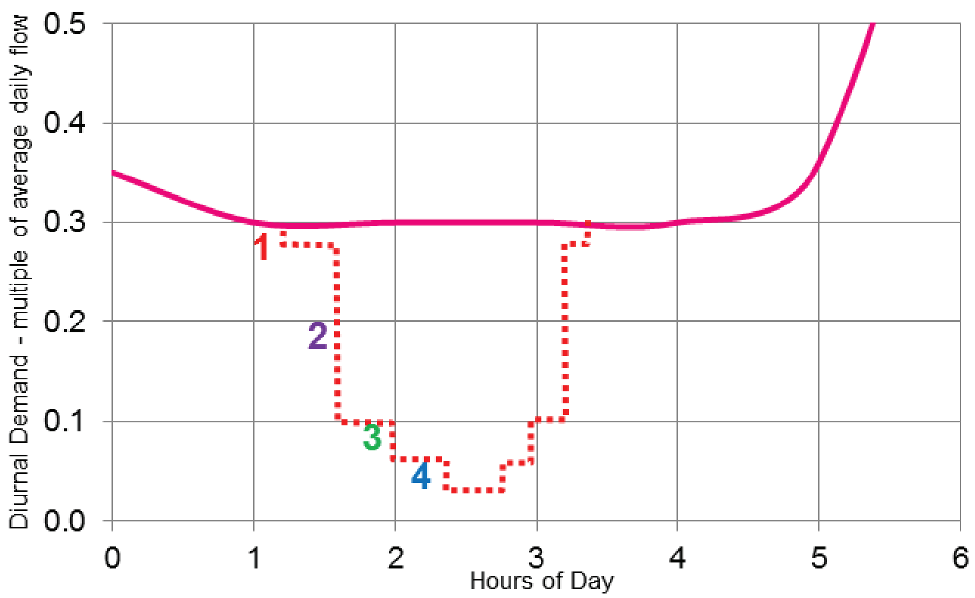


Figure 8-5 : Example results for a "Step Test"

E.3 Leak noise correlation

Traditional sounding techniques with listening sticks are effective in identifying the presence of leakage, but cannot easily pinpoint a leak in an underground pipe. Current technology using leak noise correlators can do this making connections on two ends of a pipe, on something metal, usually a valve cap or stem. Analysis by the machine displayed on a laptop can pin point the leak position – see Figure 8-6.

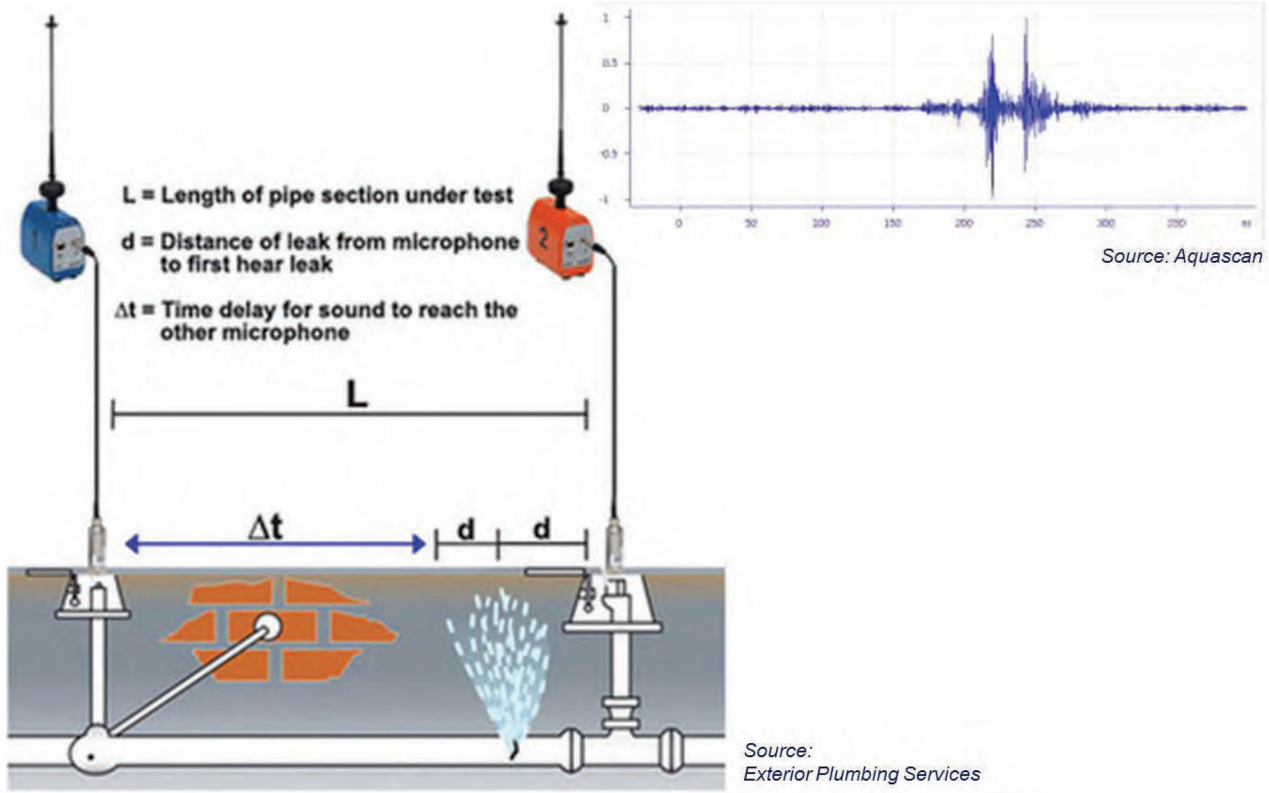


Figure 8-6 : Use of leak noise correlators

Note that it is important to fix leaking valves first, before connecting leak noise correlators. The technique can be used on plastic pipes, using hydrophones, inserted through hydrants up to 300m spacing. But it is best used on small diameter metallic pipes in networks and is less effective on large diameter trunk mains.

In traffic busy areas it is best done at night to minimise background noises.

E.4 Acoustic noise loggers

Alternatively in busy areas where access during silent night-time hours is not possible, an array of acoustic noise loggers can be deployed en masse across a DMA or entire network. They can be used on metallic or plastic pipes, and reportedly better on trunk mains than using manual leak noise correlators. The noise loggers, which also correlate the leaks, are left in position for a period of typically 1 to 2 weeks, and then analysed to determine leaks and leak positions. These can also be used on trunk mains. Verification with a ground microphone or leak noise correlator is recommended before excavating for the leak – see Figure 8-7 ci-dessous.

Figure 8-7 : Acoustic noise loggers/correlators (*Source: Primayer*)

E.5 Pressure management

Pressure reduction on network offers quick fix solution to reduction of leakage across DMAs, which could be applied before or after carrying out leak detection surveys.

It has been found through tested experience that the relationship between reduction of leakage and reduction of average area pressures is governed by the following relationship;

$$\frac{L_1}{L_0} = \left(\frac{P_1}{P_0}\right)^{n1}$$

where P_0 and L_0 are initial values of pressure and leakage and P_1 and L_1 are the reduced values. The indicy, *n1* is not 0.5 (square root) as might be expected for a fixed hole, but because leak holes expand with pressure, the indicy, *n1* has been found from widespread international observation to be 1.15. But for planning purposes, and in making conservative predictions on savings, *n1* =1 is normally used.

The pressure at GAL as measured for North Terminal varies between 5 and 6bar – 5bar at peak times of day and 6bar at night. There is therefore clearly scope to reduce pressure during night time, and even day time on a "need to have" basis.

Typically a PRV is installed and a controller connected to regulate the downstream pressure setting, rather than keeping the downstream fixed. The controller can be:

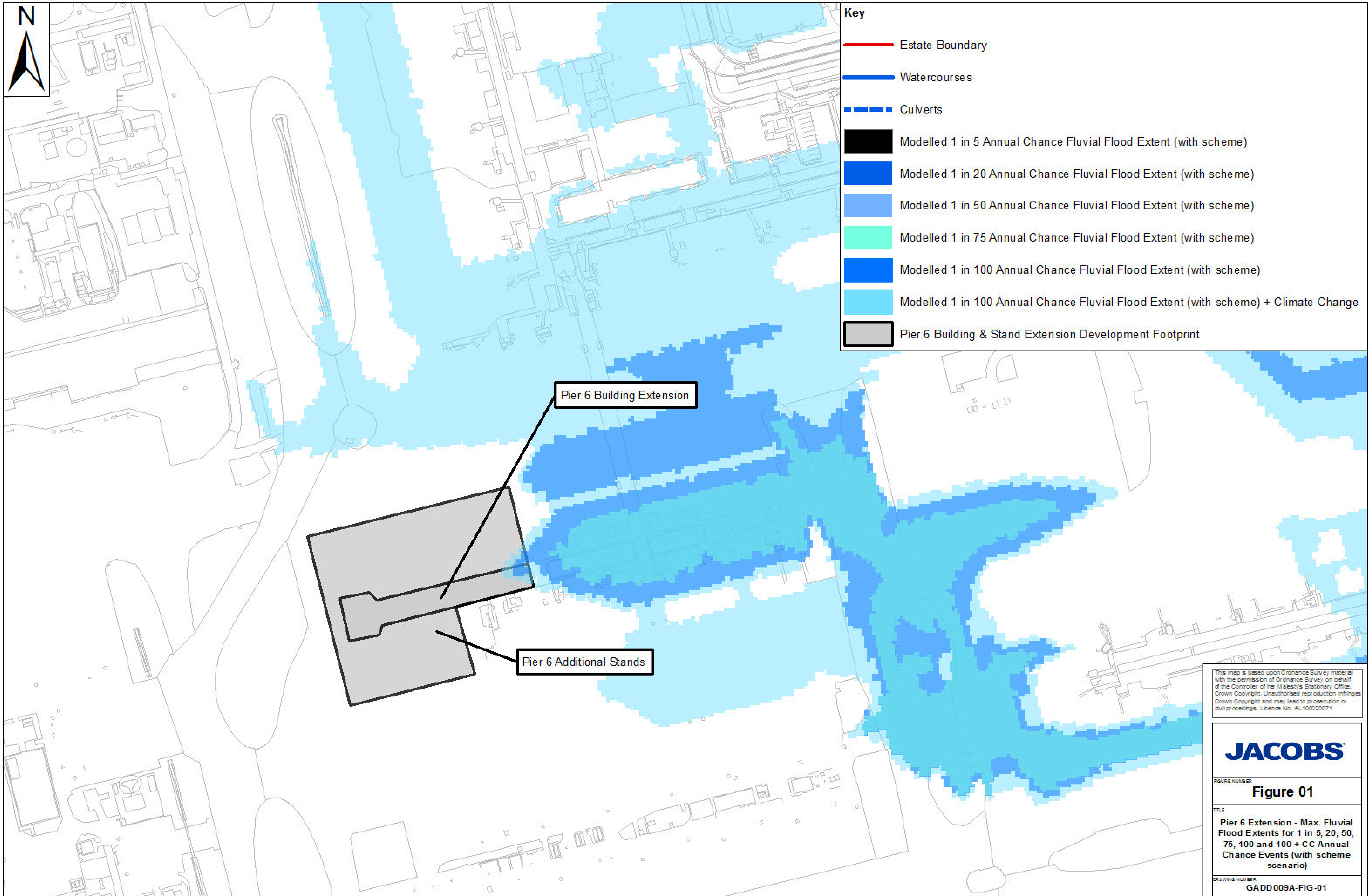
- flow modulated - PRV closes and reduces pressure during periods of low flow, such as at night, but open up increasing pressure during periods of high flow demand, such as fire hydrants being opened in an emergency;
- modulated by critical node/s in network ("closed loop") – key pressure monitors are installed at key points in the network, for which a target minimum pressure is set. The critical nodes transmit (typically by GSM) their respective pressures to the PRV, which then adjusts up or down, to meet the target pressures at the critical nodes.

Protection measures are also introduced so that the fail-safe positions for PRVs are acceptable for the water supply operations.

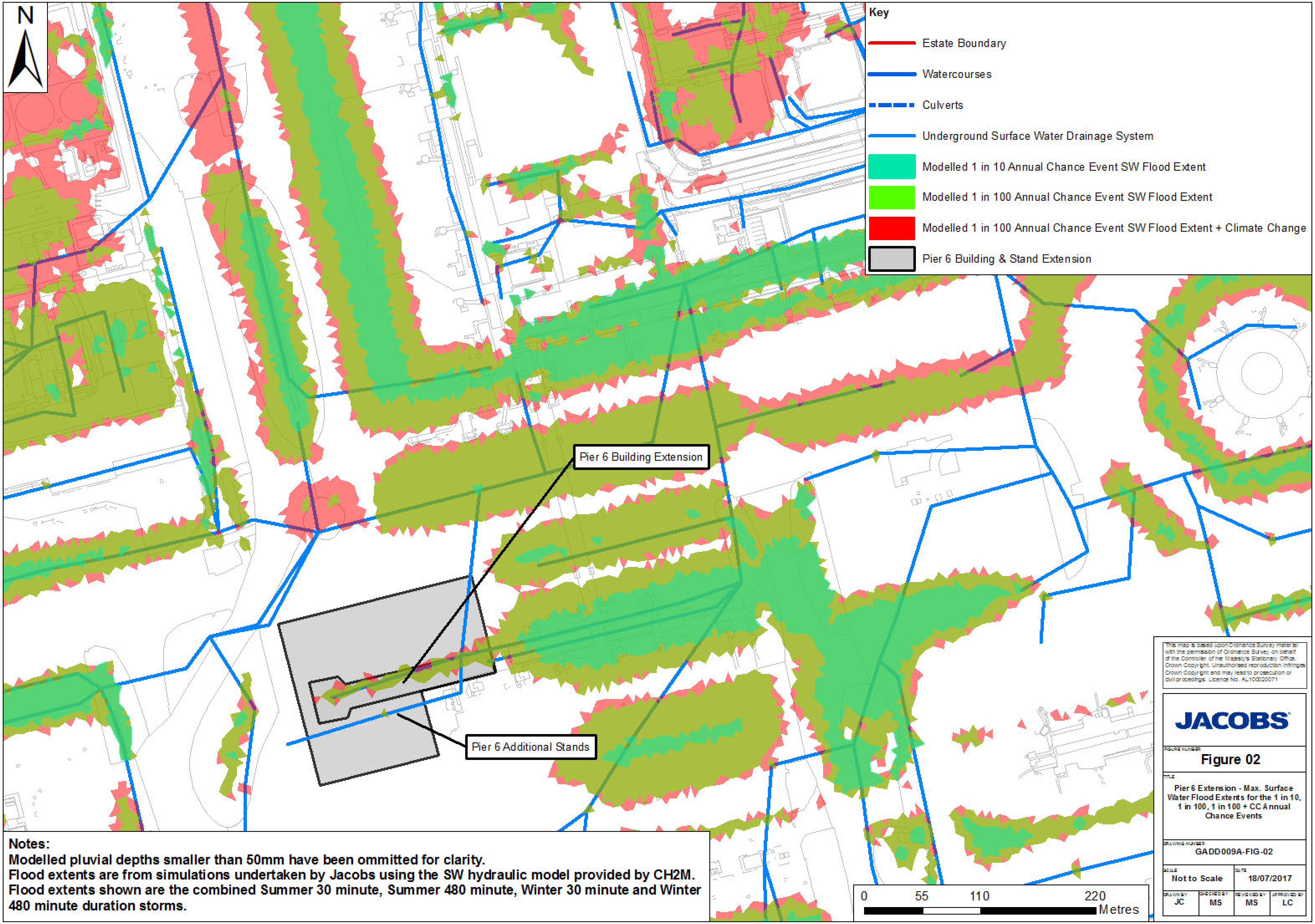
Buildings which have pressure requirements for sprinklers can be provided with their own booster pump systems, rather than pressurise an underground network of pipes to unnecessarily high pressures, and exacerbating leakage.

Pressure management is extremely effective in saving on leakage, but it has to be continuously monitored and, where economic to do so, backed up with "find and fix" leakage techniques.

Appendix F. Flood Risk Figures



Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

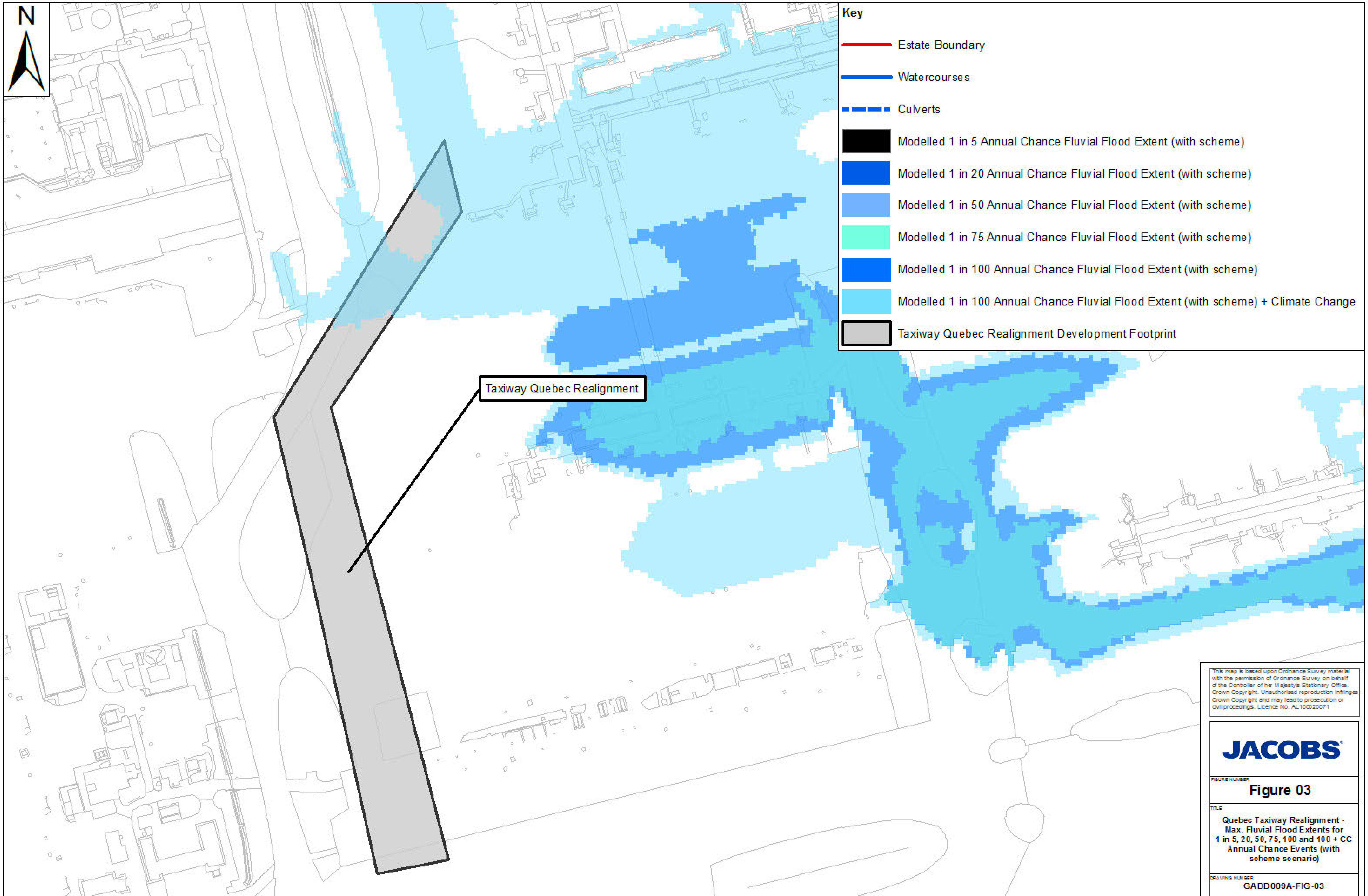
JACOBS

FIGURE NUMBER: Figure 02

TITLE: Pier 6 Extension - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100, 1 in 100 + CC Annual Chance Events

DRAWING NUMBER: GADD009A-FIG-02

SCALE	DATE		
Not to Scale	18/07/2017		
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

JACOBS

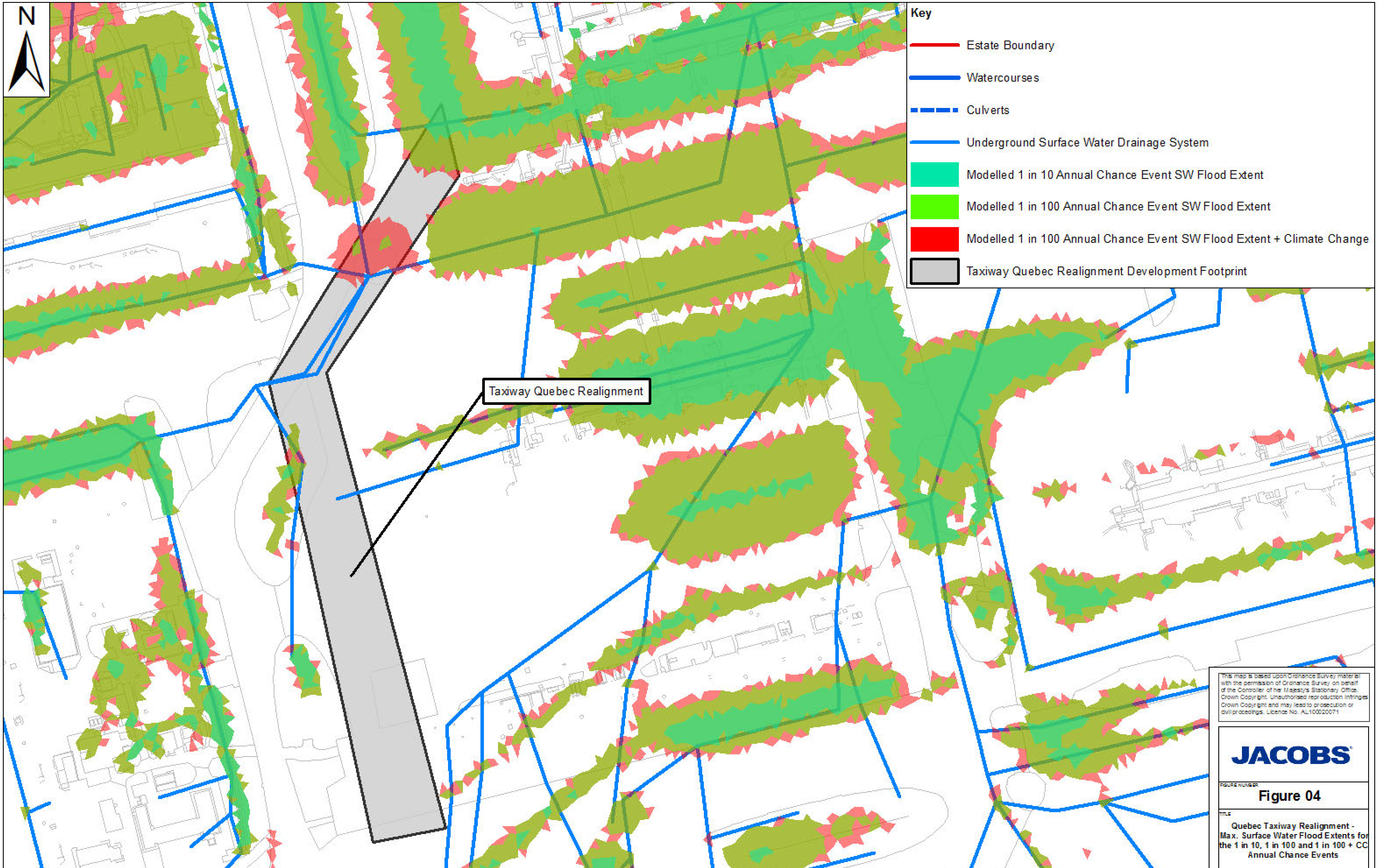
FIGURE NUMBER
Figure 03

TITLE
Quebec Taxiway Realignment - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)

DRAWING NUMBER
GADD009A-FIG-03

SCALE	DATE
Not to Scale	17/07/2017

DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



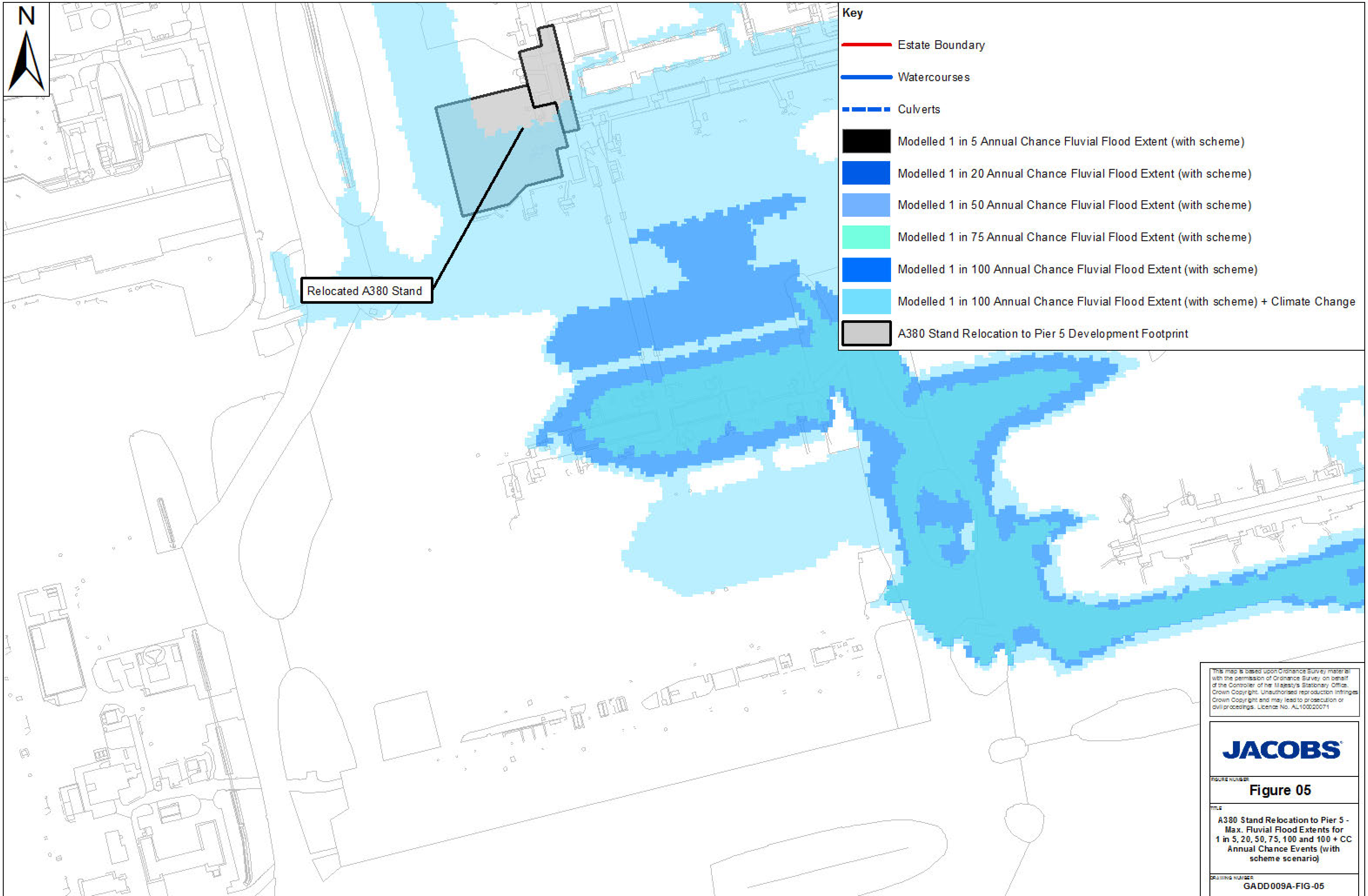
Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

JACOBS

FIGURE NUMBER
Figure 04

TITLE
Quebec Taxiway Realignment - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER			
GADD009A-FIG-04			
SCALE: Not to Scale		DATE: 18/07/2017	
DRAWN BY: JC	CHECKED BY: MS	REVIEWED BY: MS	APPROVED BY: LC



Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

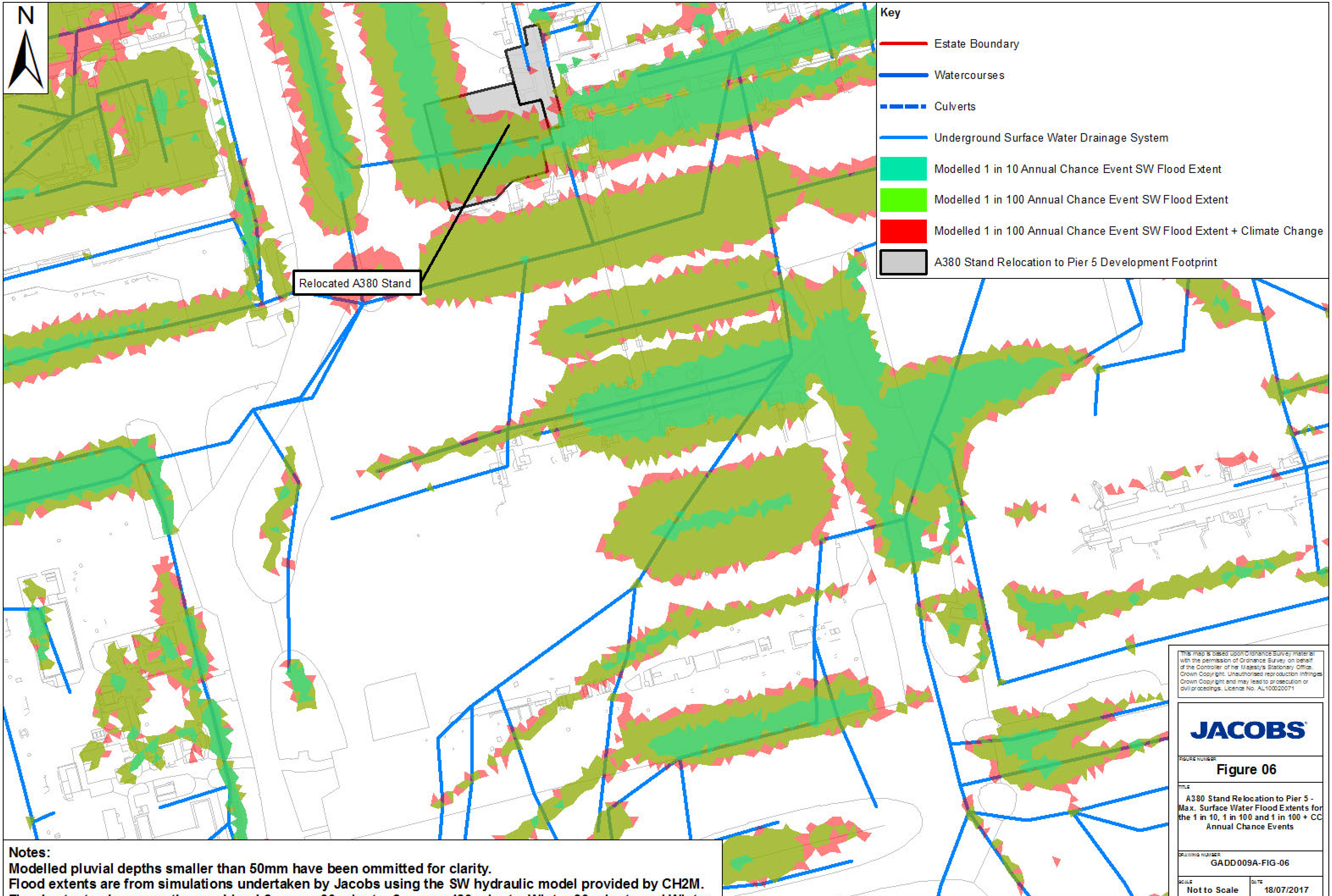
JACOBS

FIGURE NUMBER
Figure 05

TITLE
A380 Stand Relocation to Pier 5 - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)

DRAWING NUMBER
GADD009A-FIG-05

SCALE		DATE	
Not to Scale		17/07/2017	
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



JACOBS

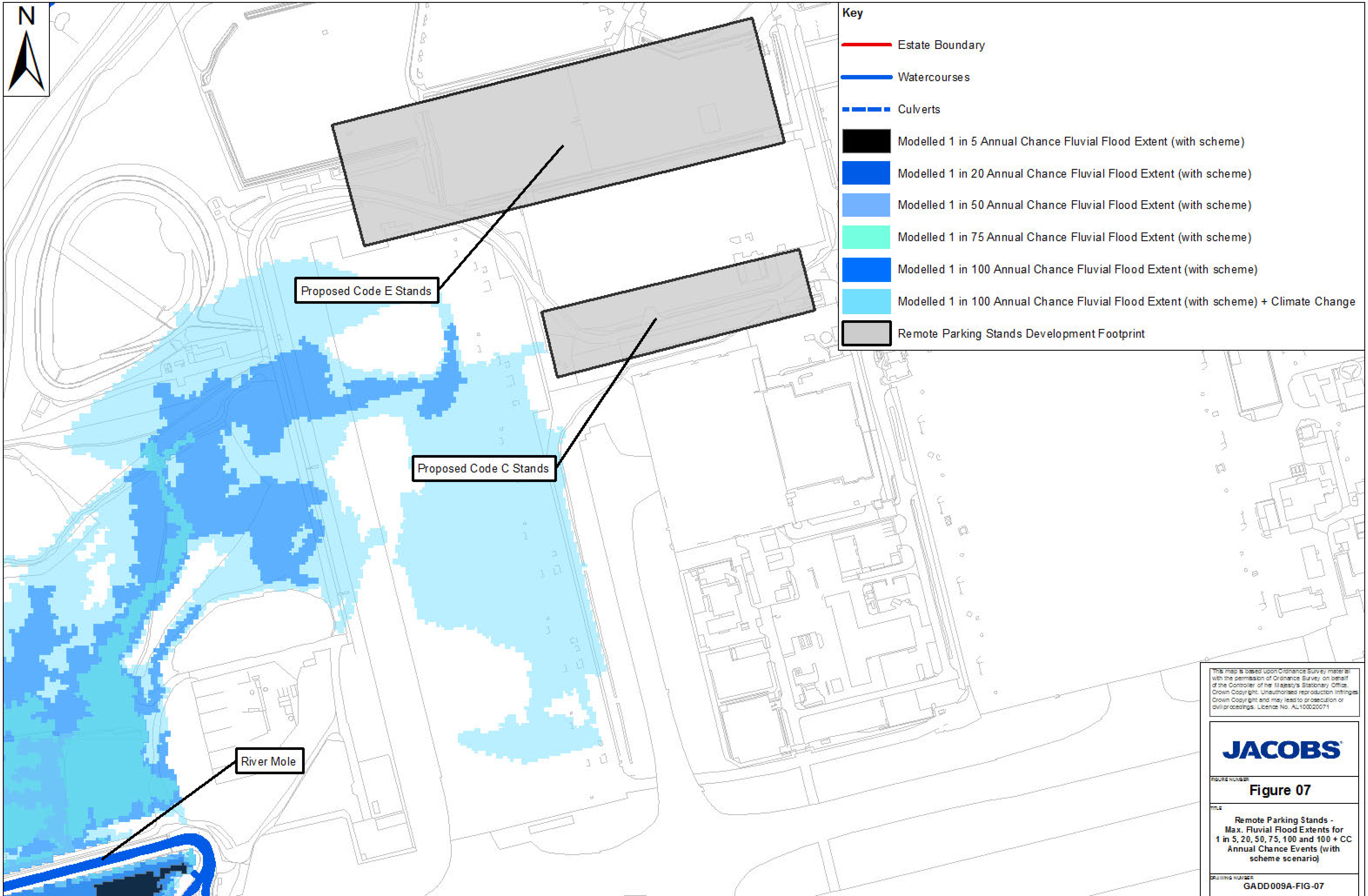
FIGURE NUMBER: **Figure 06**

TITLE: A380 Stand Relocation to Pier 5 - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER: GADD009A-FIG-06

SCALE	DATE		
Not to Scale	18/07/2017		
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC

Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.



Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

JACOBS

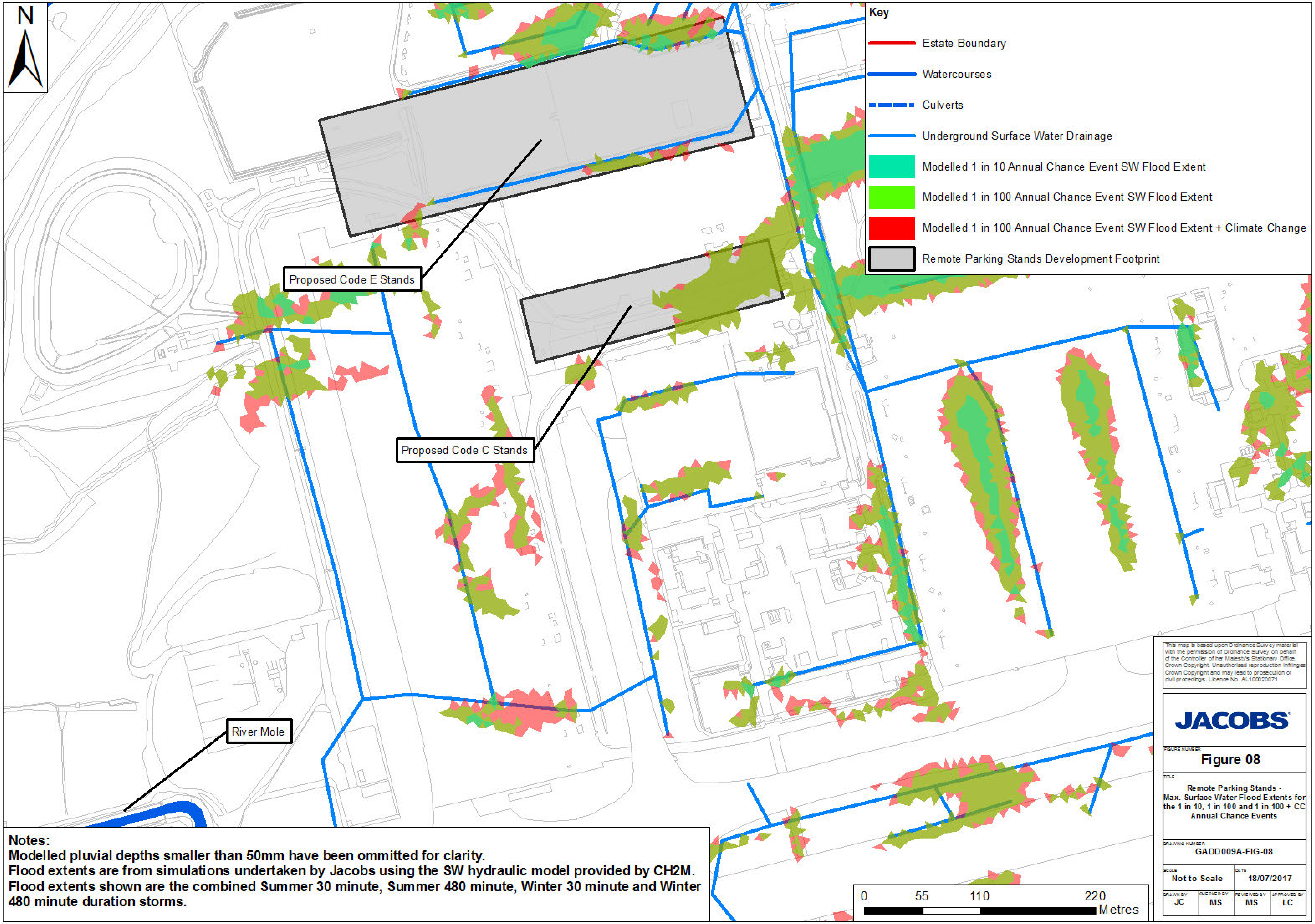
FIGURE NUMBER
Figure 07

TITLE
Remote Parking Stands - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)

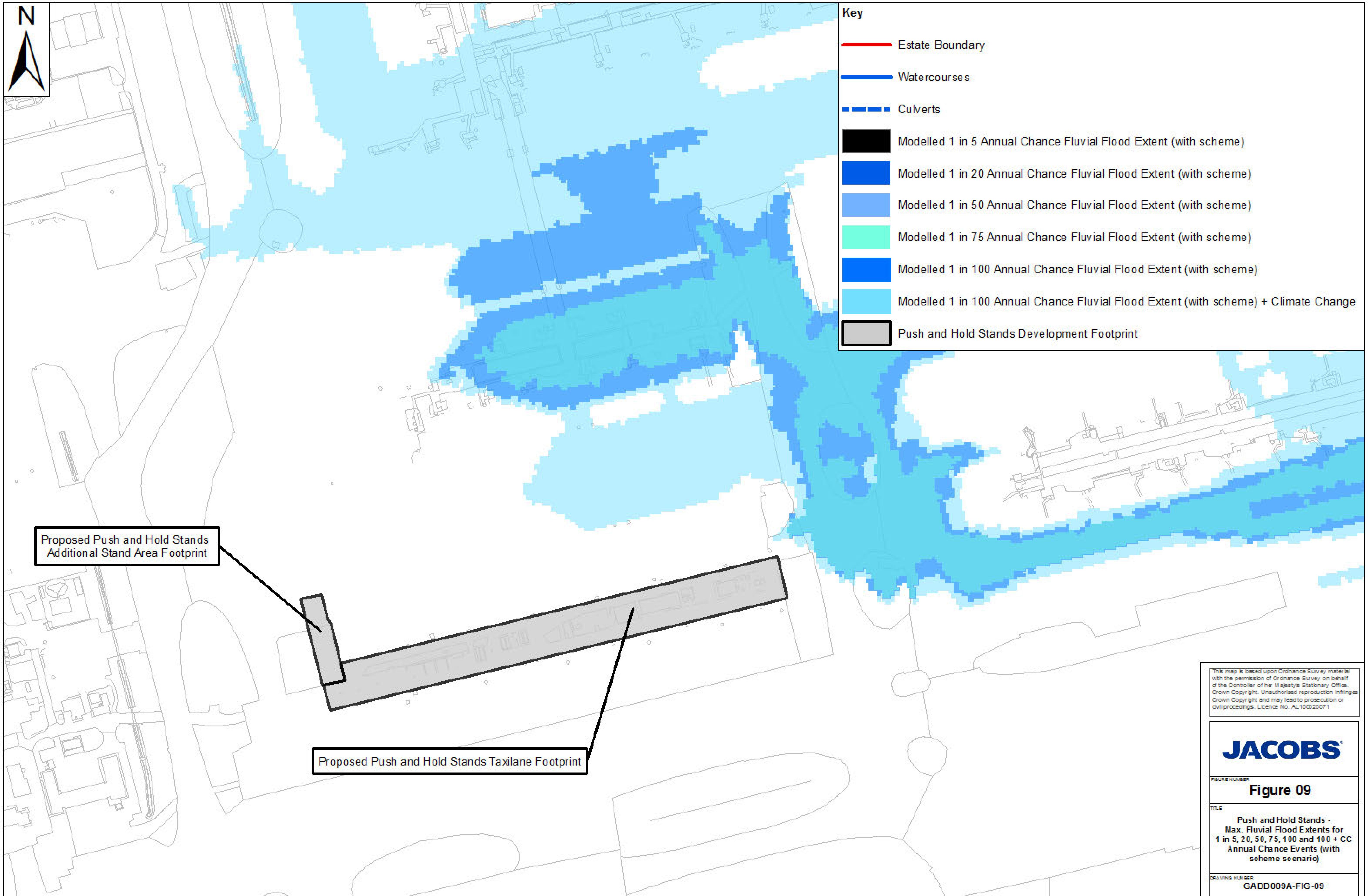
DRAWING NUMBER
GADD009A-FIG-07

SCALE	DATE
Not to Scale	17/07/2017

DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

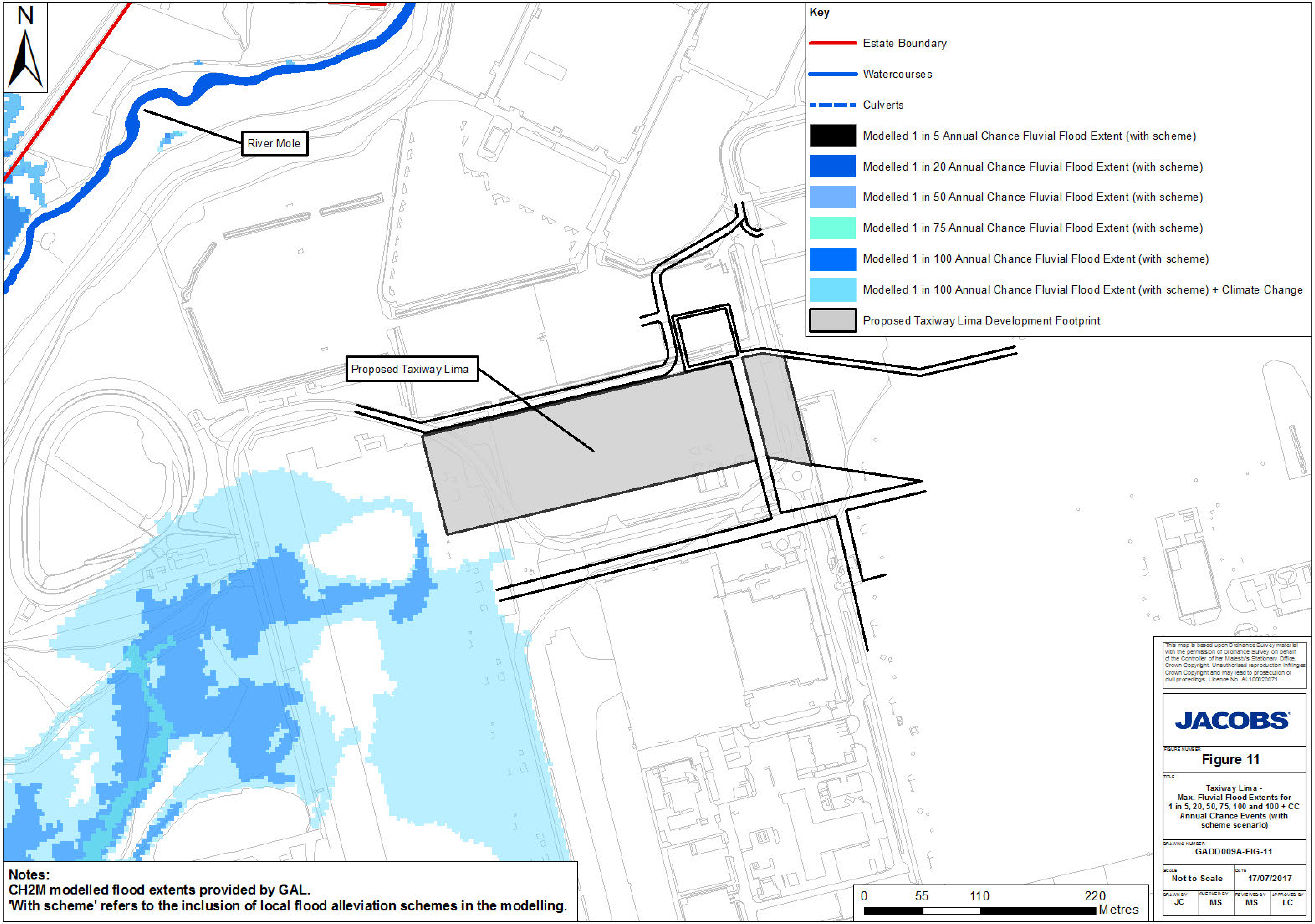


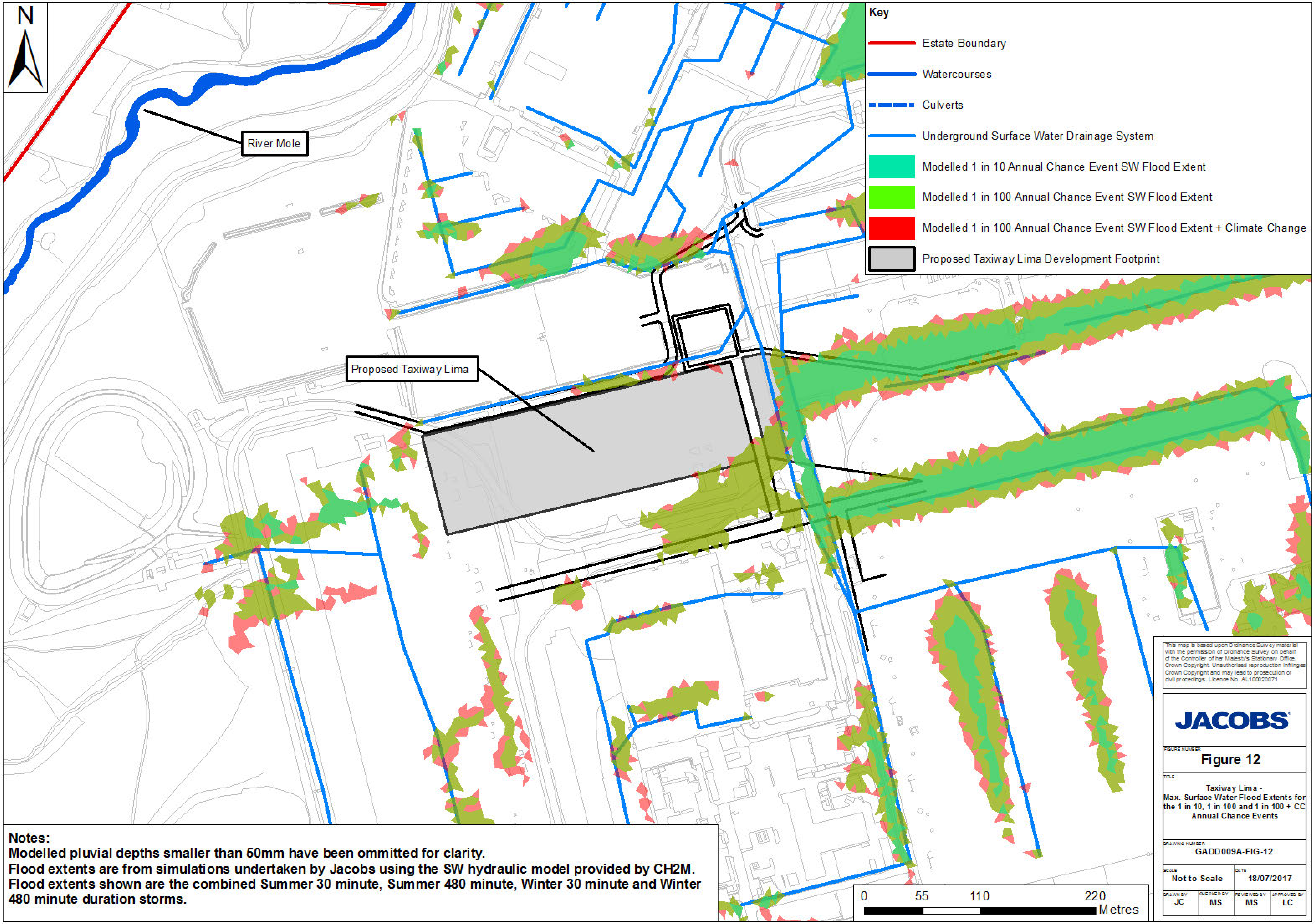
Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter

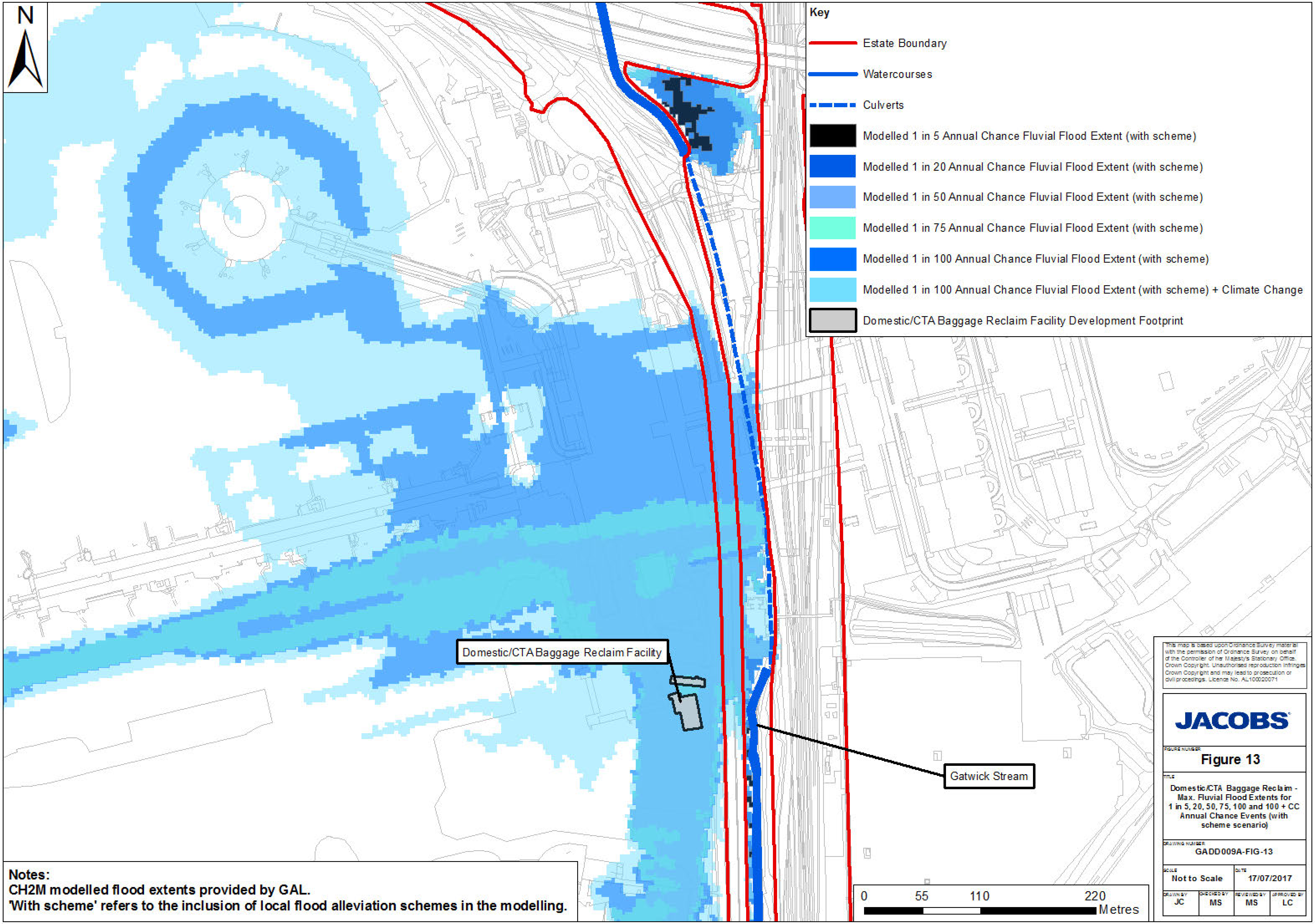
JACOBS

FIGURE NUMBER	**Figure 10**
TITLE	**Push and Hold Stands - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events**
DRAWING NUMBER	GADD009A-FIG-10
SCALE	Not to Scale
DATE	18/07/2017
DRAWN BY	JC
CHECKED BY	MS
REVIEWED BY	MS
APPROVED BY	LC


N
River Mole
Proposed Taxiway Lima
Key
Estate Boundary
Watercourses
Culverts
Modelled 1 in 5 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 20 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 50 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 75 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 100 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 100 Annual Chance Fluvial Flood Extent (with scheme) + Climate Change
Proposed Taxiway Lima Development Footprint
Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.
0 55 110 220
Metres
JACOBS
Figure 11
Taxiway Lima -
Max. Fluvial Flood Extents for
1 in 5, 20, 50, 75, 100 and 100 + CC
Annual Chance Events (with
scheme scenario)
GADD009A-FIG-11
Not to Scale
17/07/2017
JC
MS
MS
LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.



Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

JACOBS

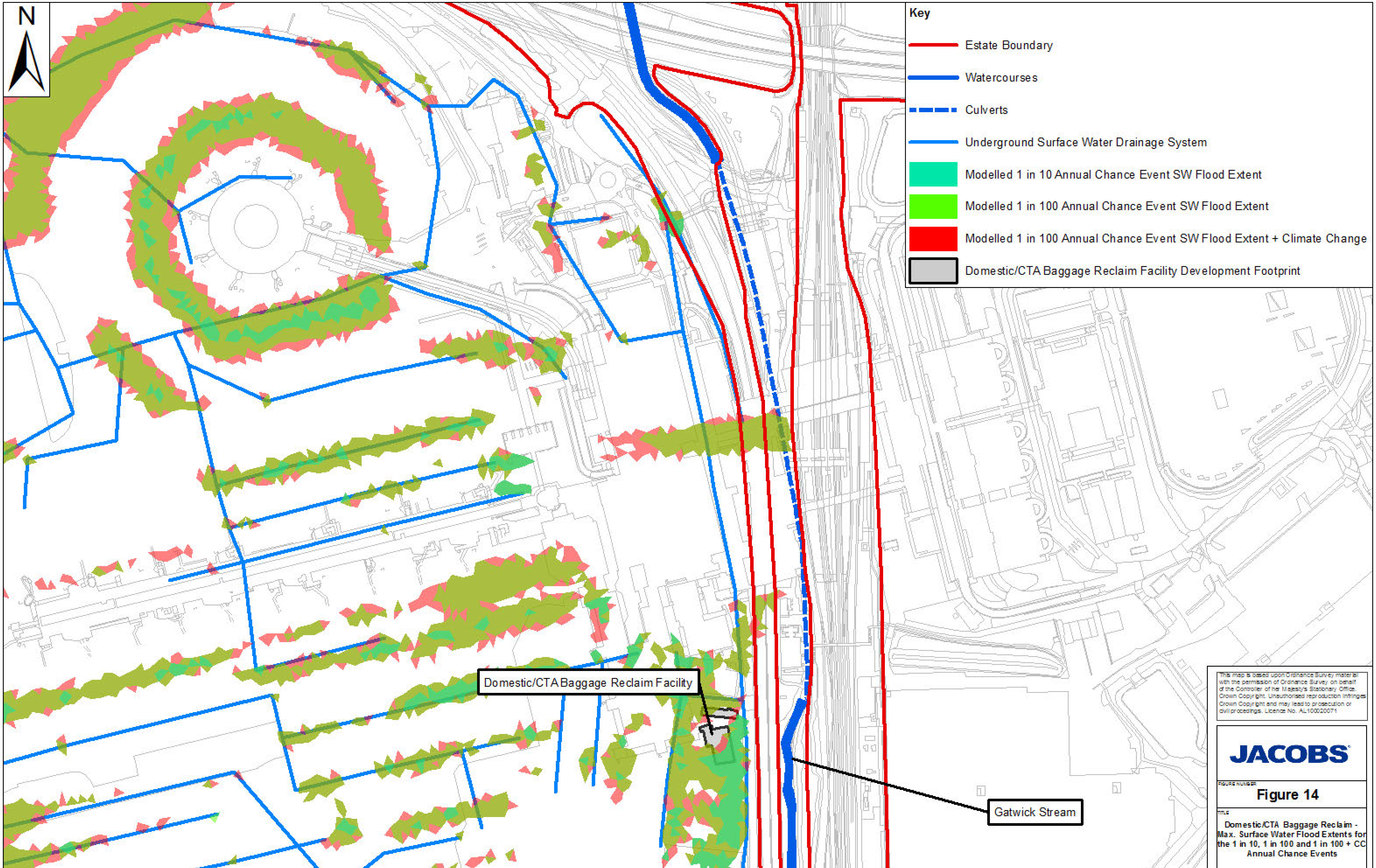
FIGURE NUMBER: **Figure 13**

TITLE: Domestic/CTA Baggage Reclaim - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)

DRAWING NUMBER: GADD009A-FIG-13

SCALE	DATE
Not to Scale	17/07/2017

DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

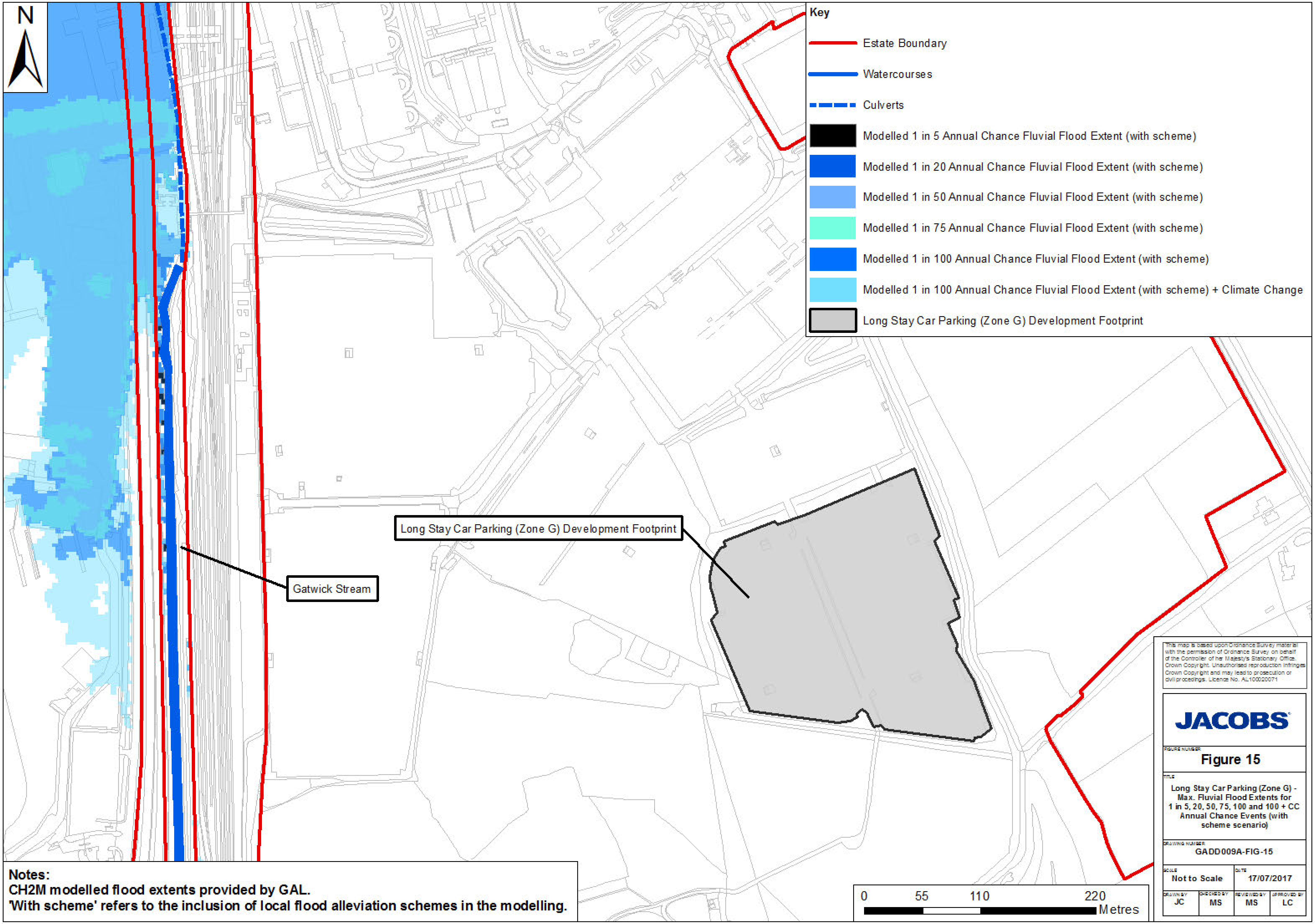
JACOBS

FIGURE NUMBER
Figure 14

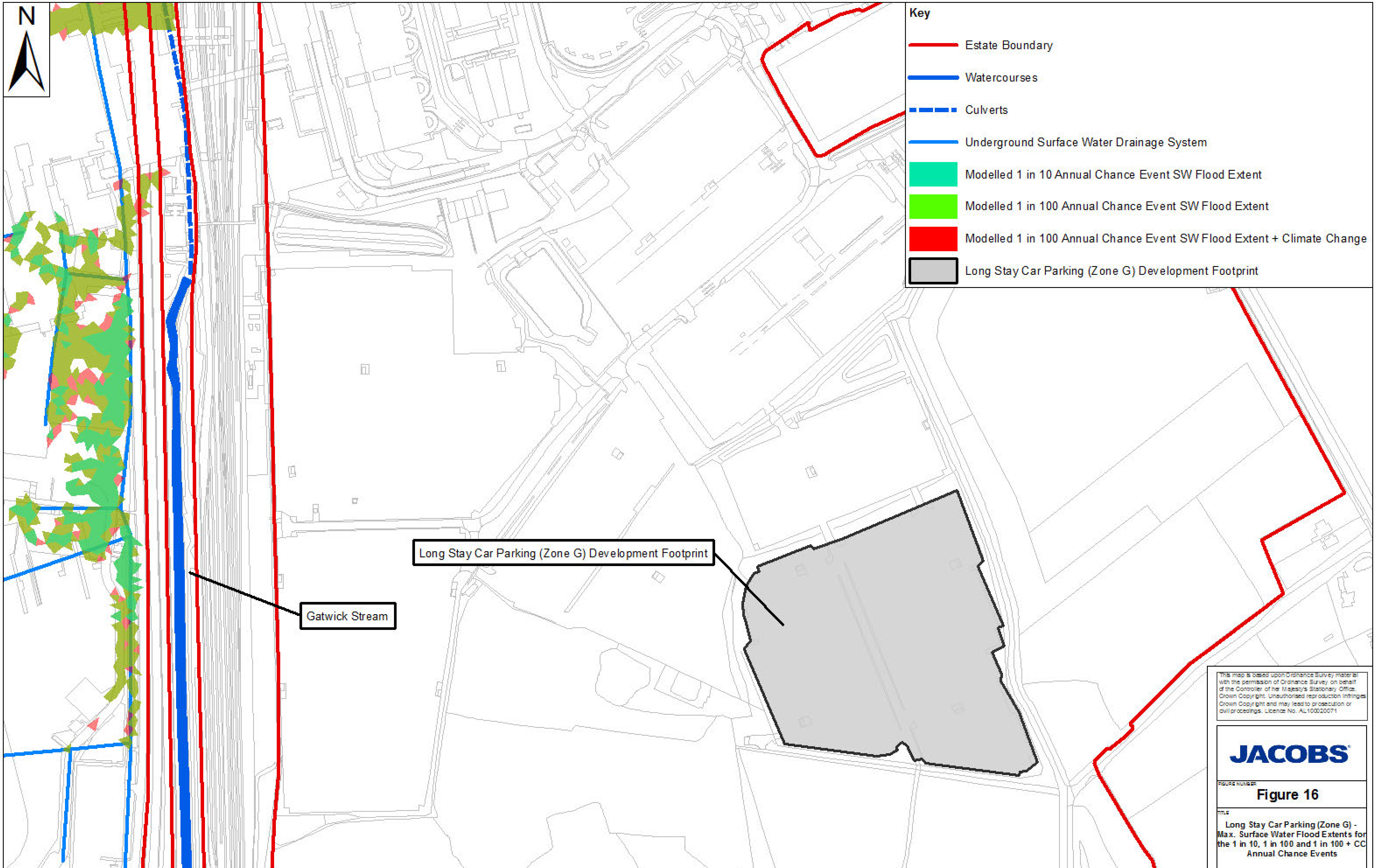
TITLE
Domestic/CTA Baggage Reclaim - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER
GADD009A-FIG-14

SCALE		DATE	
Not to Scale		18/07/2017	
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



N
Key
Estate Boundary
Watercourses
Culverts
Modelled 1 in 5 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 20 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 50 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 75 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 100 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 100 Annual Chance Fluvial Flood Extent (with scheme) + Climate Change
Long Stay Car Parking (Zone G) Development Footprint
Long Stay Car Parking (Zone G) Development Footprint
Gatwick Stream
Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.
0
55
110
220
Metres
This map is based upon Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office. Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings. Licence No. AL100020071
JACOBS
FIGURE NUMBER
Figure 15
TITLE
Long Stay Car Parking (Zone G) - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)
DRAWING NUMBER
GADD009A-FIG-15
SCALE
Not to Scale
DATE
17/07/2017
DRAWN BY
JC
CHECKED BY
MS
REVIEWED BY
MS
APPROVED BY
LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

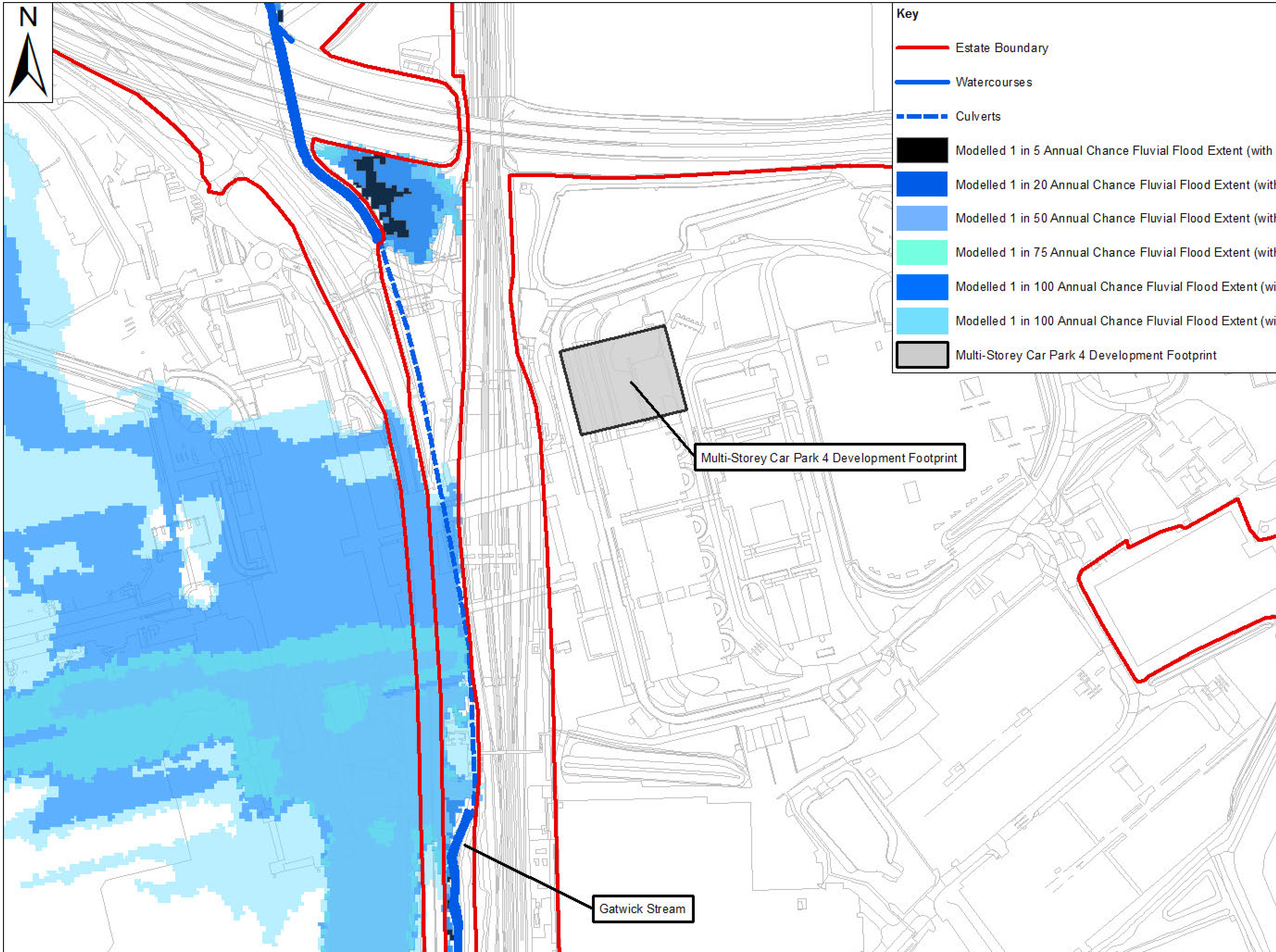
JACOBS

FIGURE NUMBER
Figure 16

TITLE
Long Stay Car Parking (Zone G) - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER
GADD009A-FIG-16

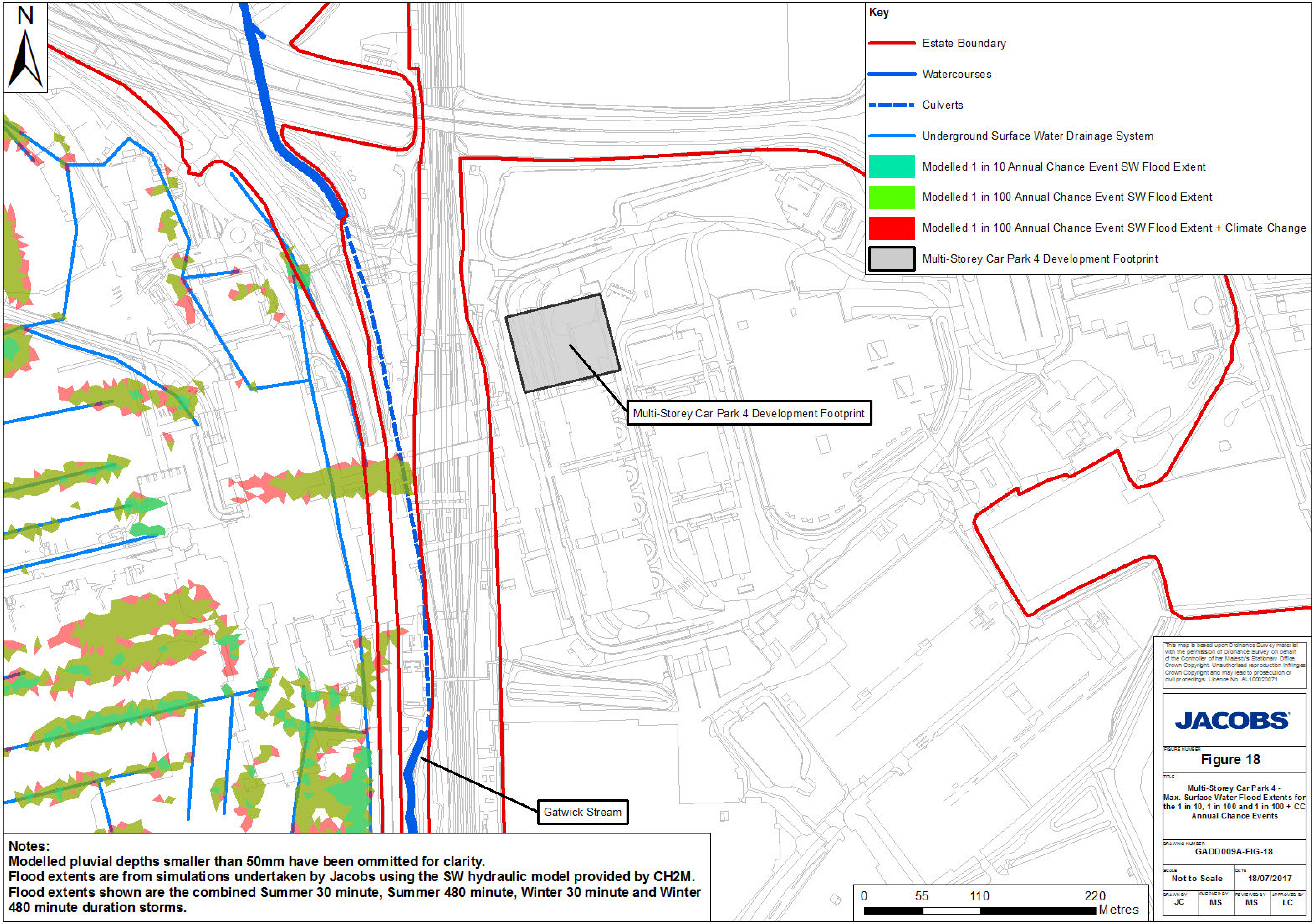
SCALE	DATE		
Not to Scale	18/07/2017		
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



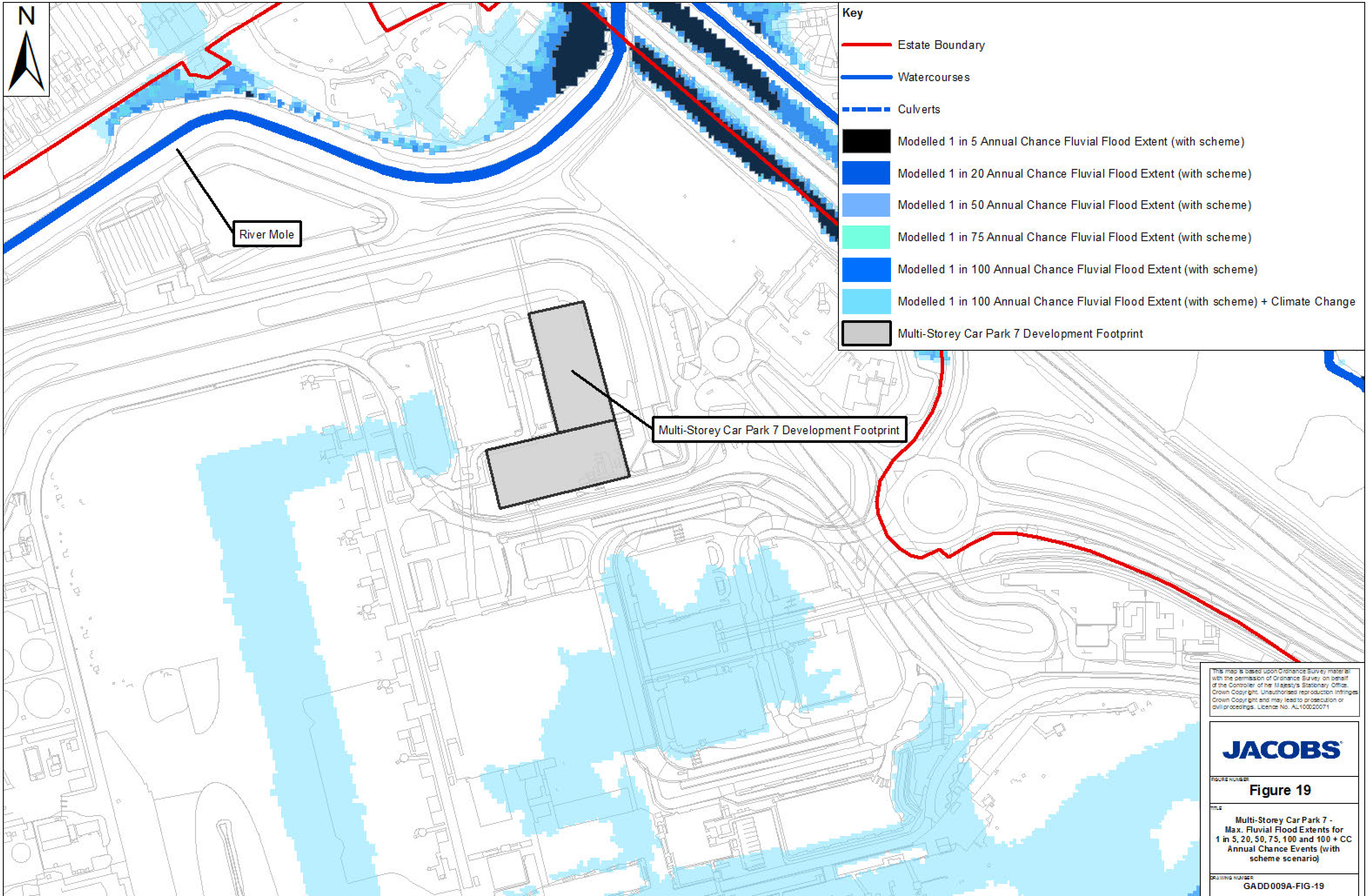
Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

JACOBS

FIGURE NUMBER	**Figure 17**		
TITLE	**Multi-Storey Car Park 4 - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)**		
DRAWING NUMBER	GADD009A-FIG-17		
SCALE: Not to Scale		DATE: 17/07/2017	
DRAWN BY: JC	CHECKED BY: MS	REVIEWED BY: MS	APPROVED BY: LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.



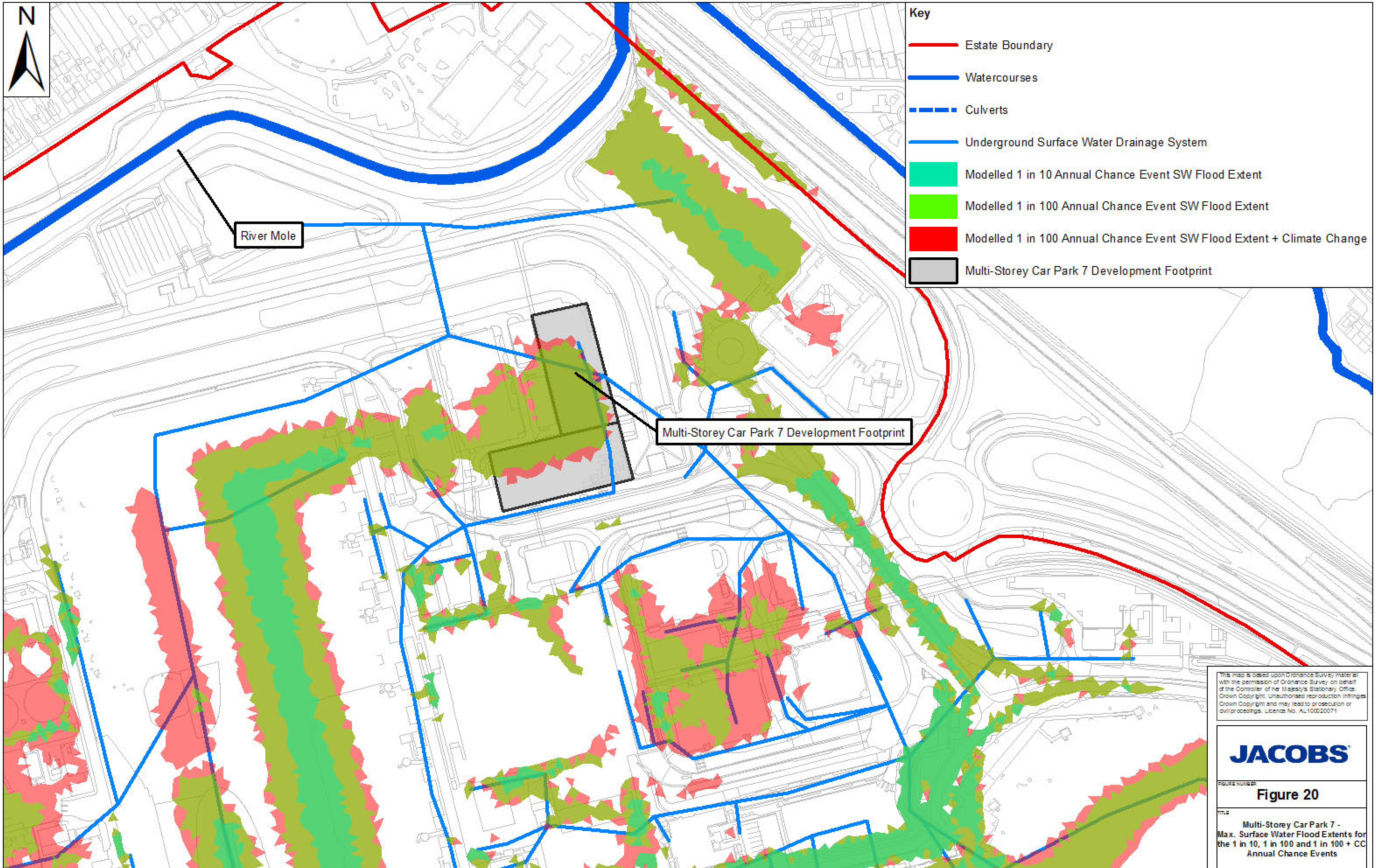
Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

JACOBS

FIGURE NUMBER
Figure 19

TITLE
Multi-Storey Car Park 7 - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)

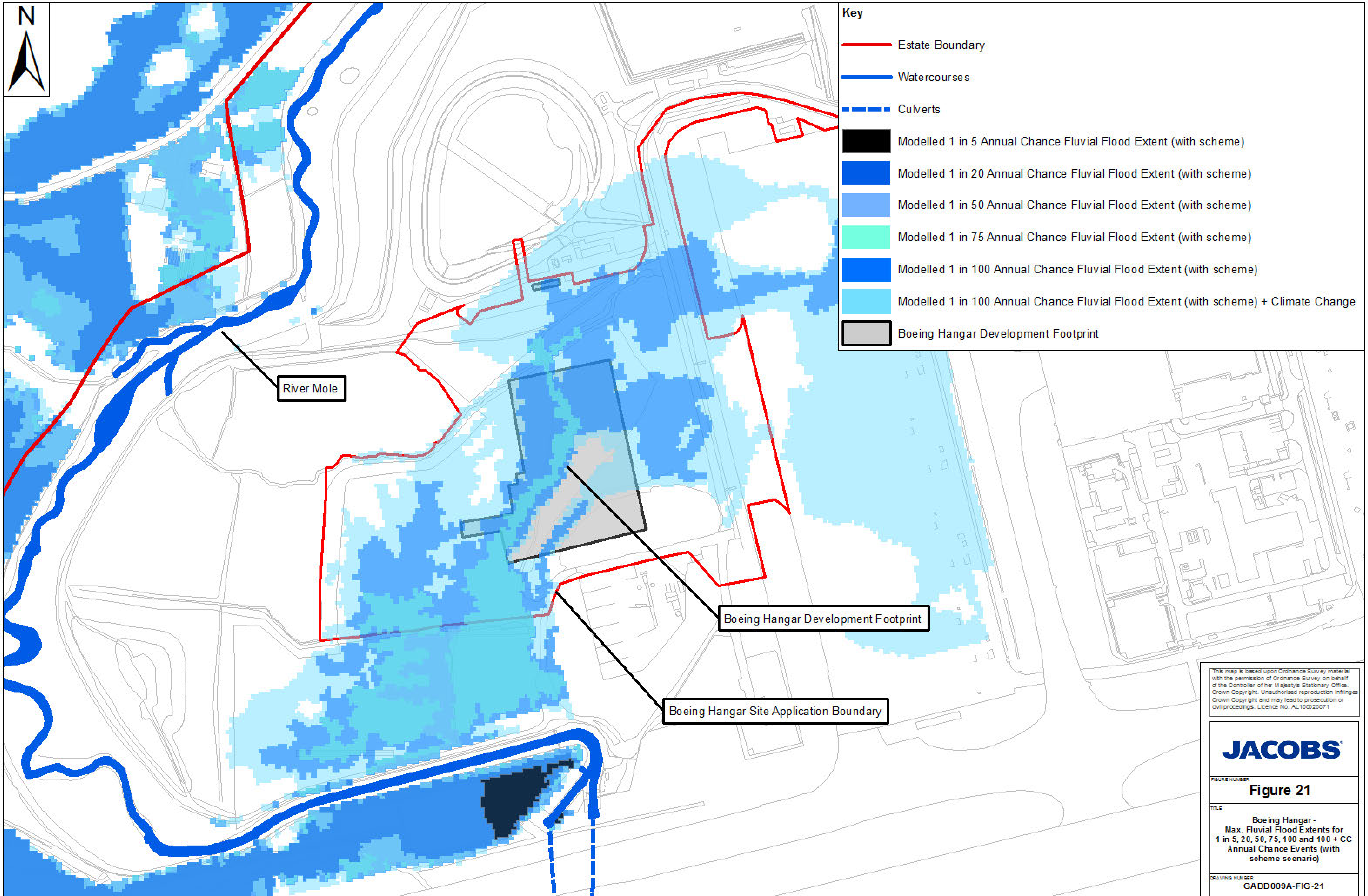
DRAWING NUMBER			
GADD009A-FIG-19			
SCALE: Not to Scale		DATE: 17/07/2017	
DRAWN BY: JC	CHECKED BY: MS	REVIEWED BY: MS	APPROVED BY: LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

JACOBS

FIGURE NUMBER	Figure 20
TITLE	Multi-Storey Car Park 7 - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events
DRAWING NUMBER	GADD009A-FIG-20
SCALE	Not to Scale
DATE	18/07/2017
DRAWN BY	JC
CHECKED BY	MS
REVIEWED BY	MS
APPROVED BY	LC



Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

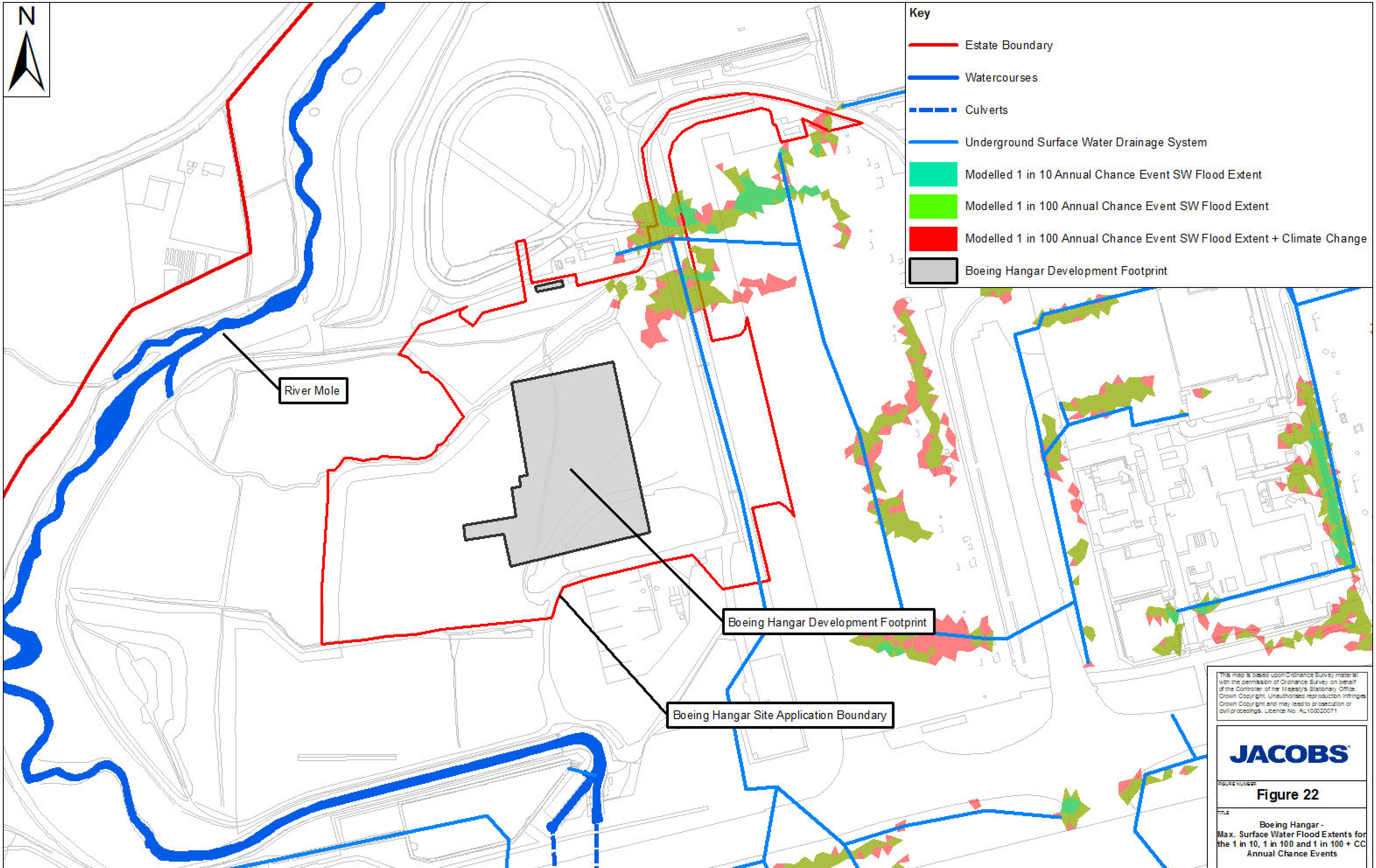
JACOBS

FIGURE NUMBER
Figure 21

TITLE
Boeing Hangar - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)

DRAWING NUMBER
GADD009A-FIG-21

SCALE	DATE		
Not to Scale	17/07/2017		
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

JACOBS

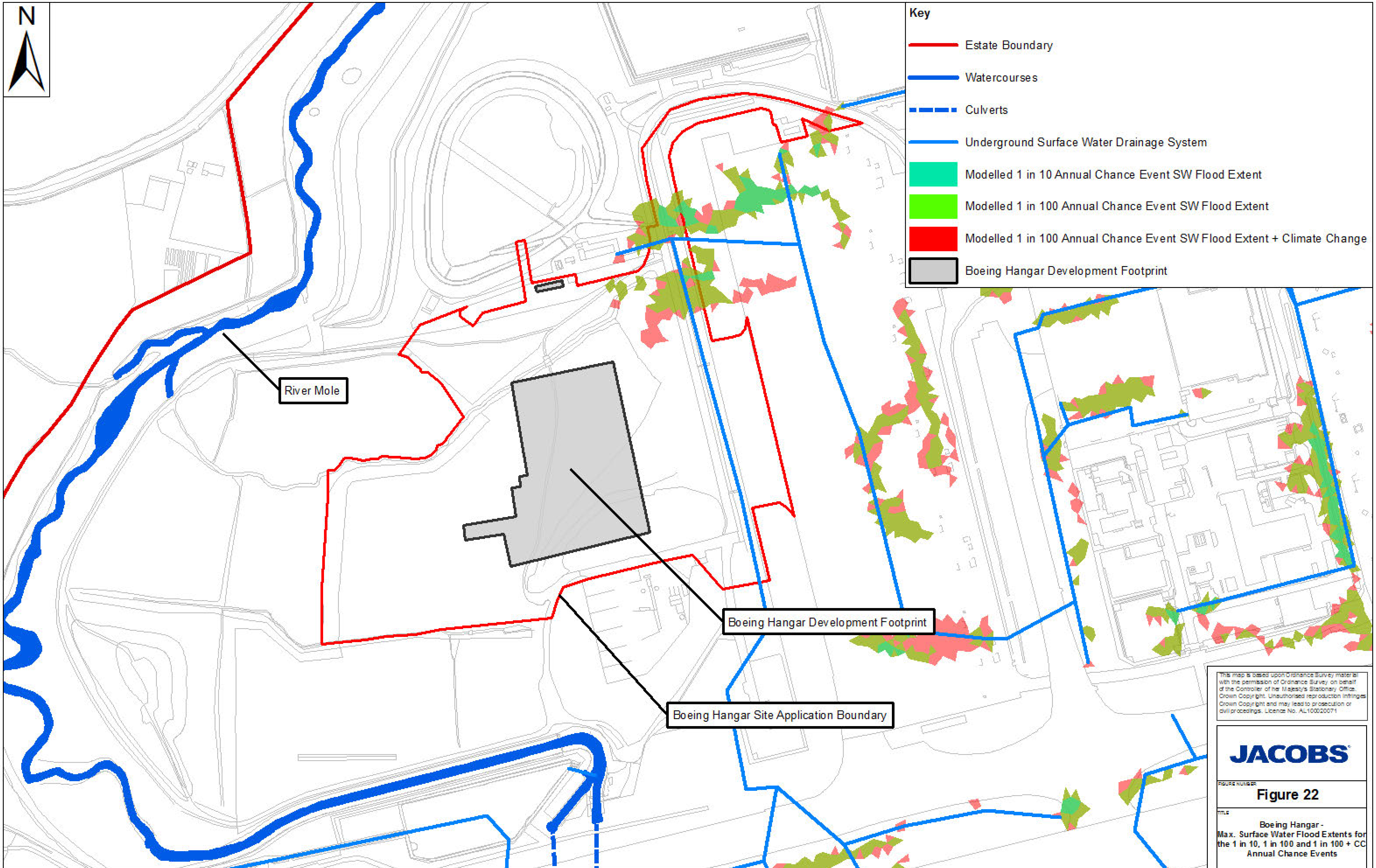
FIGURE NUMBER
Figure 22

TITLE
Boeing Hangar - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER
GADD009A-FIG-22

SCALE	DATE
Not to Scale	18/07/2017

DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

JACOBS

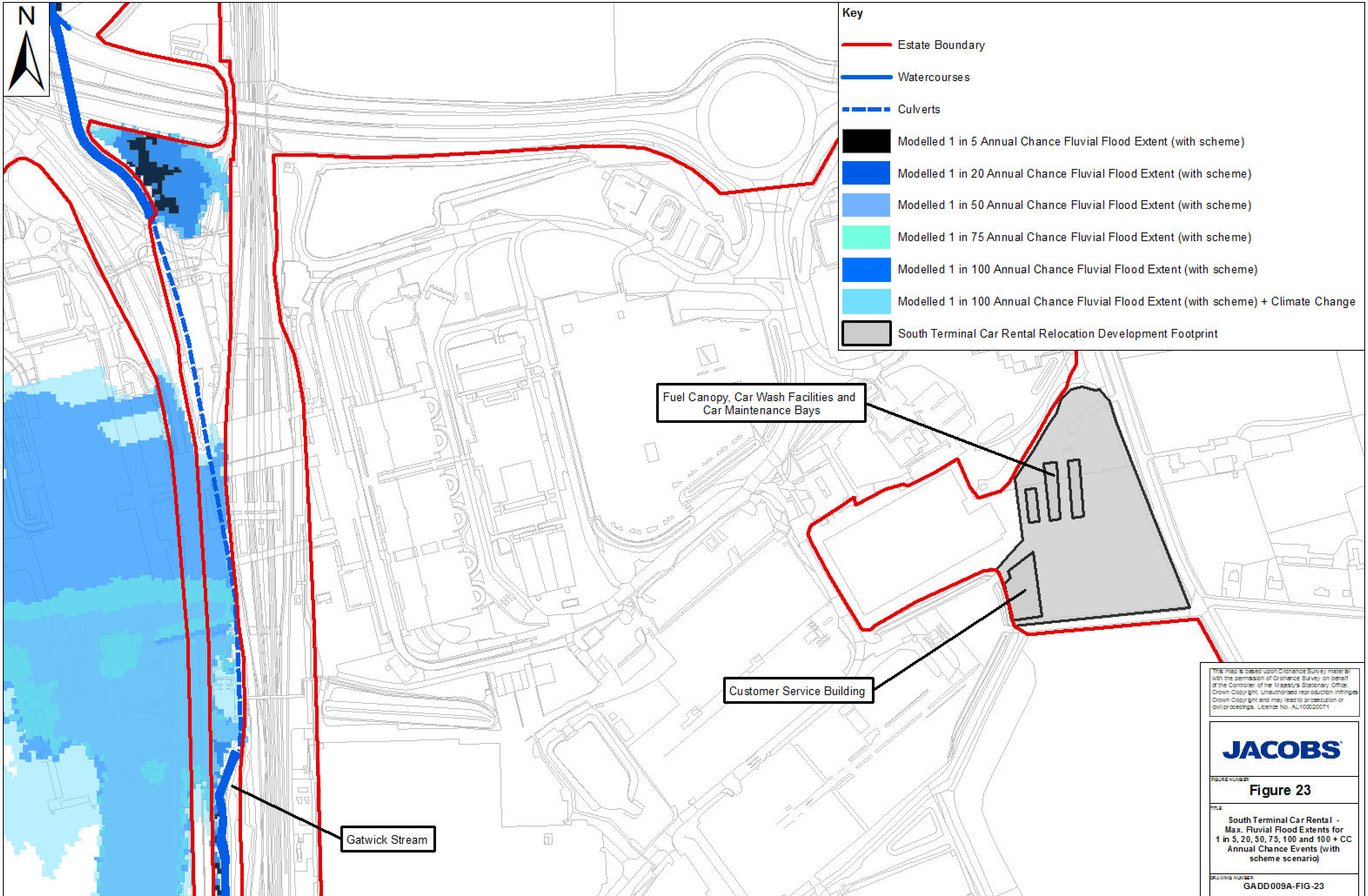
FIGURE NUMBER
Figure 22

TITLE
Boeing Hangar - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER
GADD009A-FIG-22

SCALE	DATE
Not to Scale	18/07/2017

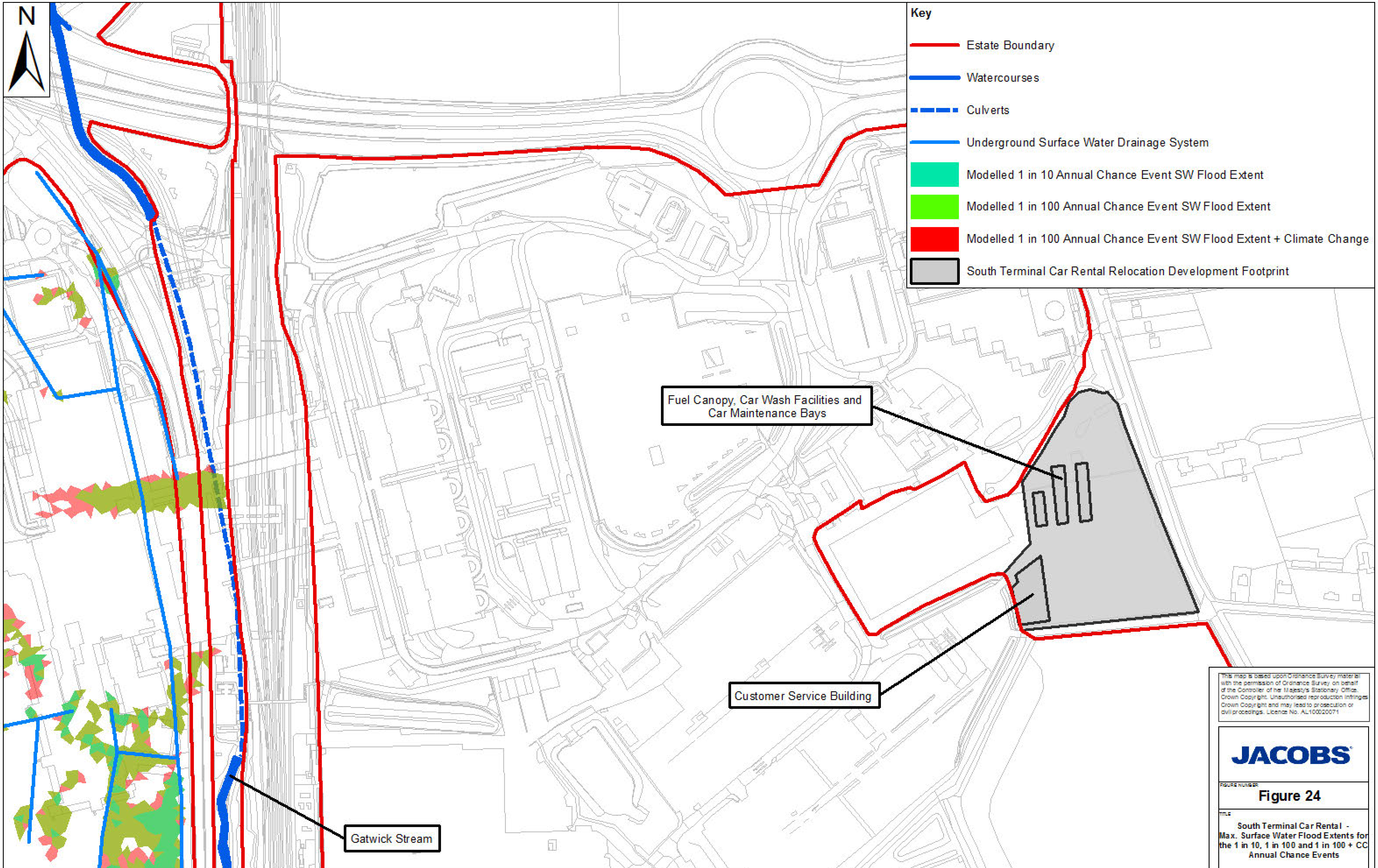
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC



Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.

JACOBS

FIGURE NUMBER			
Figure 23			
TITLE: **South Terminal Car Rental - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)**			
DRAWING NUMBER: **GADD009A-FIG-23**			
SCALE: **Not to Scale**		DATE: **17/07/2017**	
DRAWN BY: **JC**	CHECKED BY: **MS**	REVIEWED BY: **MS**	APPROVED BY: **LC**



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

JACOBS

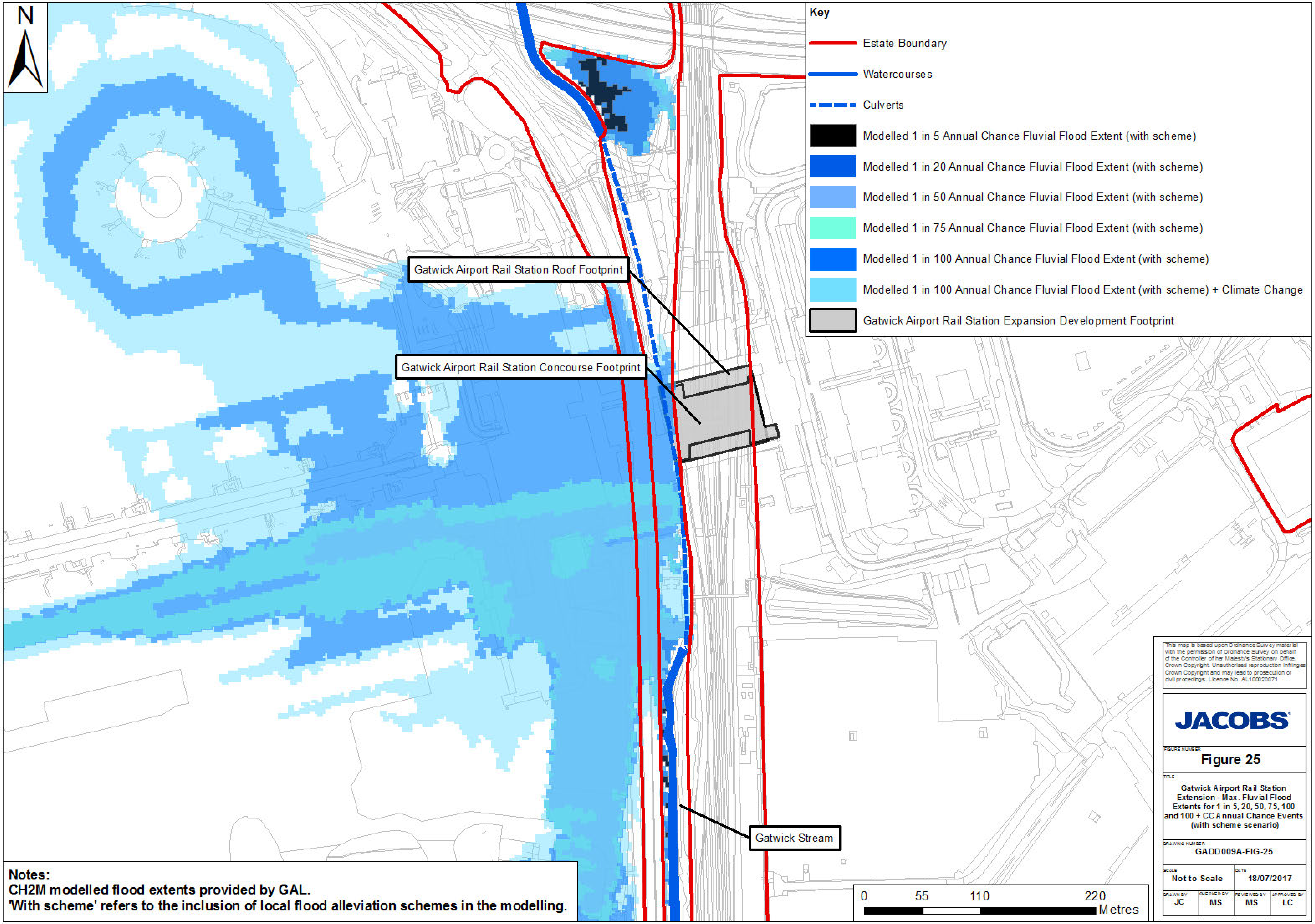
FIGURE NUMBER
Figure 24

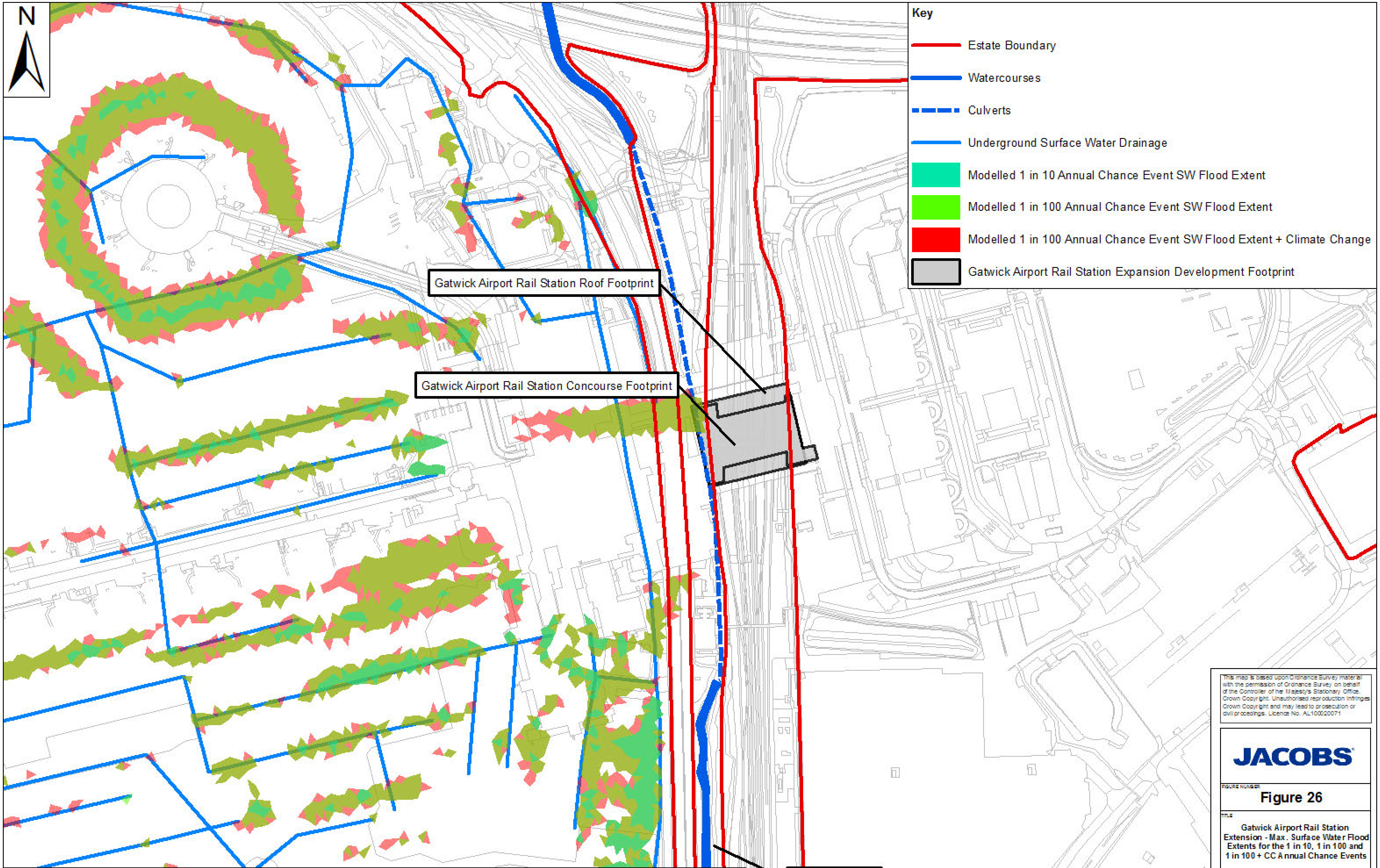
TITLE
South Terminal Car Rental - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER
GADD009A-FIG-24

SCALE	DATE
Not to Scale	18/07/2017

DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC


N
Key
Estate Boundary
Watercourses
Culverts
Modelled 1 in 5 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 20 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 50 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 75 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 100 Annual Chance Fluvial Flood Extent (with scheme)
Modelled 1 in 100 Annual Chance Fluvial Flood Extent (with scheme) + Climate Change
Gatwick Airport Rail Station Expansion Development Footprint
Gatwick Airport Rail Station Roof Footprint
Gatwick Airport Rail Station Concourse Footprint
Gatwick Stream
0
55
110
220
Metres
Notes:
CH2M modelled flood extents provided by GAL.
'With scheme' refers to the inclusion of local flood alleviation schemes in the modelling.
This map is based upon Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of her Majesty's Stationary Office. Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings. Licence No. AL100020071
FIGURE NUMBER
Figure 25
TITLE
Gatwick Airport Rail Station Extension - Max. Fluvial Flood Extents for 1 in 5, 20, 50, 75, 100 and 100 + CC Annual Chance Events (with scheme scenario)
DRAWING NUMBER
GADD009A-FIG-25
SCALE
Not to Scale
DATE
18/07/2017
DRAWN BY
JC
CHECKED BY
MS
REVIEWED BY
MS
APPROVED BY
LC



Notes:
Modelled pluvial depths smaller than 50mm have been ommitted for clarity.
Flood extents are from simulations undertaken by Jacobs using the SW hydraulic model provided by CH2M.
Flood extents shown are the combined Summer 30 minute, Summer 480 minute, Winter 30 minute and Winter 480 minute duration storms.

JACOBS

FIGURE NUMBER
Figure 26

TITLE
Gatwick Airport Rail Station Extension - Max. Surface Water Flood Extents for the 1 in 10, 1 in 100 and 1 in 100 + CC Annual Chance Events

DRAWING NUMBER
GADD009A-FIG-26

SCALE		DATE	
Not to Scale		18/07/2017	
DRAWN BY	CHECKED BY	REVIEWED BY	APPROVED BY
JC	MS	MS	LC

Appendix G. Calculation of Future Water Quality

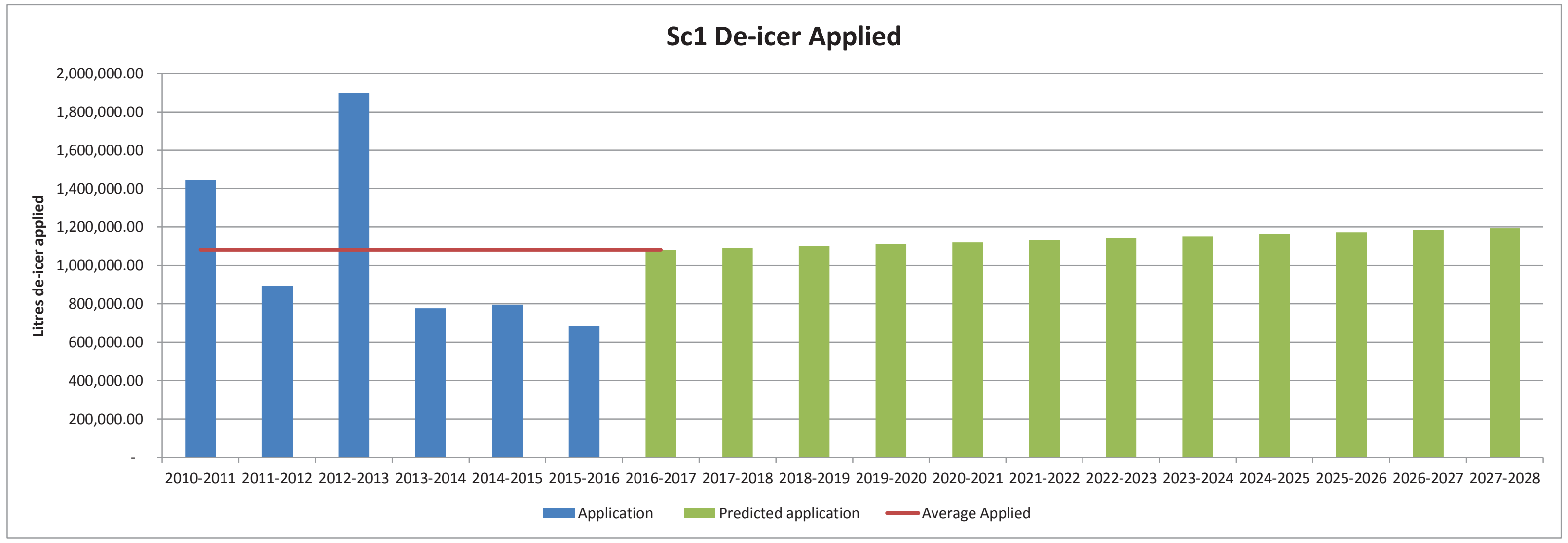
Scenario 1 C55-53 ATMs (k)		Base FY16/17	Bottom up FY17/18	Bottom up FY18/19	Bottom up FY19/20	Bottom up FY20/21	Bottom up FY21/22	Bottom up FY22/23	Bottom up FY23/24	Bottom up FY24/25	Bottom up FY25/26	Bottom up FY26/27	Bottom up FY27/28	Bottom up FY28/29
	Domestic	32	33	33	33	33	33	31	31	31	31	31	31	31
	Short Haul	222	222	223	225	225	228	231	233	234	235	236	237	239
	Long Haul	24	28	29	30	32	32	33	34	35	36	36	37	37
	Total	**279**	**282**	**285**	**288**	**290**	**293**	**295**	**297**	**299**	**301**	**303**	**305**	**306**
	Increase per year		1.012563	1.008614	1.012868	1.006804	1.008313	1.006276	1.009394	1.005945	1.006399	1.006004	1.005547	1.005496
	Increase in		9.8%											

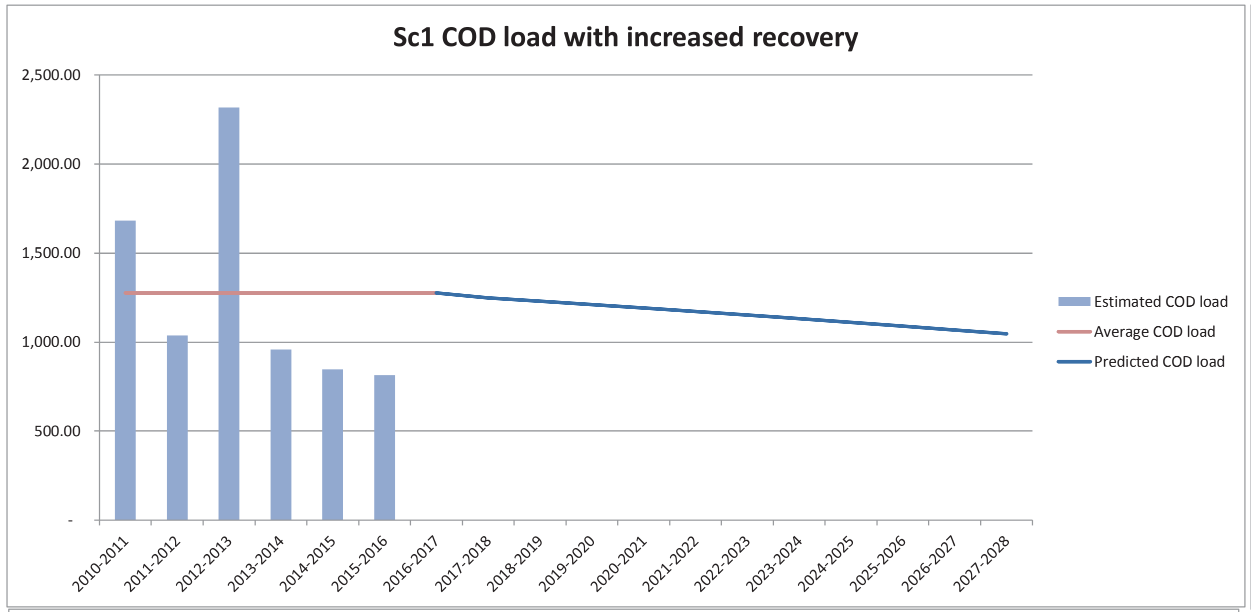
Scenario 2 C60-55 ATMs (k)		Base FY16/17	Bottom up FY17/18	Bottom up FY18/19	Bottom up FY19/20	Bottom up FY20/21	Bottom up FY21/22	Bottom up FY22/23	Bottom up FY23/24	Bottom up FY24/25	Bottom up FY25/26	Bottom up FY26/27	Bottom up FY27/28	Bottom up FY28/29
	Domestic	32.4	33.1	33.1	33.2	33.2	33.2	31.2	31.2	31.3	31.3	31.3	31.3	31.3
	Short Haul	222.2	221.7	222.2	223.3	224.2	225.2	227.2	230.4	233.6	235.4	238.7	241.3	242.5
	Long Haul	24.3	27.5	28.5	30.1	32.3	33.8	35.9	37.3	38.7	40.1	42.2	42.9	43.5
	Total	**278.9**	**282.4**	**283.9**	**286.6**	**289.7**	**292.1**	**294.3**	**299.0**	**303.6**	**306.7**	**312.2**	**315.5**	**317.3**
	Increase per year		1.012563	1.005478	1.009659	1.010597	1.008478	1.007262	1.016067	1.015527	1.010275	1.017864	1.010494	1.005698
	Increase in		13.8%											

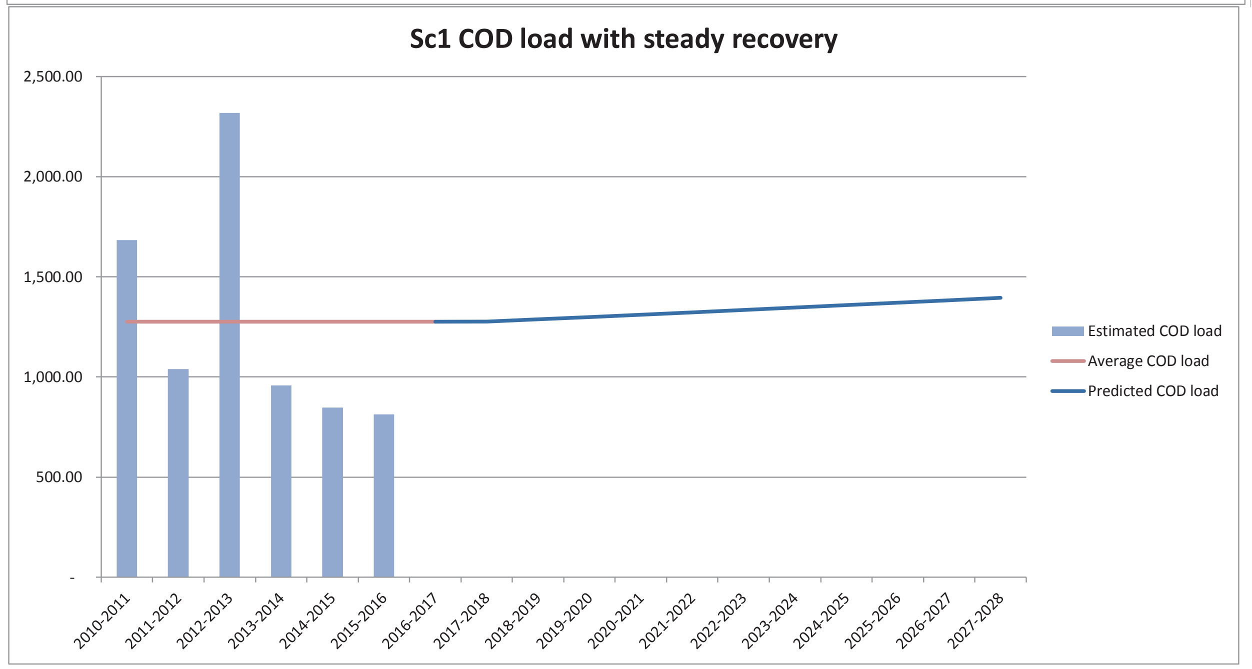
		Without Improvement			With Improvement			
Title	New floor area (m2)	Additional Consumption - Gas (kWh)	Additional Consumption - Elec (kWh)	Total (kWh)	Improvement factor	Additional Consumption - Gas (kWh)	Additional Consumption - Elec (kWh)	Total (kWh)
ESOS / Energy efficiency savings		-2,000	-12,500	-14,500	0%	-2,000	-12,500	-14,500
Boeing Hanger	17,393		4,429,192	4,429,192	25%		3,321,894	3,321,894
Pier 6 extension	15,000	1,173,986	5,162,290	6,336,276	25%	880,489	3,871,718	4,752,207
Pier 6 - A380 Stand	885	69,265	304,575	373,840	25%	51,949	228,431	280,380
CTA/ Domestic facility	470	250,016	278,023	528,039	25%	187,512	208,517	396,029
Railway Station expansion	5,158	Unknown	Unknown	Unknown	25%	Unknown	Unknown	Unknown
MSCP 7	84,735		5,908,001	5,908,001	25%		4,431,001	4,431,001
MSCP 4	27,300		975,751	975,751	25%		731,813	731,813
Long stay decking phase 1	40,180		87,957	87,957	25%		65,967	65,967
Remote aircraft parking - Additions	11 stands		1,021,604	1,021,604	0%		1,021,604	1,021,604
Push & Hold / De-icing stands								
Lima taxiway								
Total	**191,121**	**1,491,267**	**18,154,894**	**19,646,161**		**1,117,951**	**13,868,446**	**14,986,397**

Sc1
C55-53

Aircraft De-icer	Application	Recovery	Unrecovered	Average Applied	Average Unrecovered	Estimated Baseline	Assumin 1.46 kg o2/l Estimated COD load	tonnes o2 /yr Average COD load	Aircraft numbers Per year increase	Recovery Rate	Based on average applied Predicted application	Based on average applied - steady recovery rates Predicted unrecovered	Based on average applied - increased recovery rates Predicted unrecovered	Based on baseline applied Predicted application	Assuming steady recovery rates (tonnes O2/yr) Predicted COD load based on average applied	Future COD load based on baseline applied	Including increase in recovery rates Predicted COD load based on average applied	Future COD load based on baseline applied	
2010-2011	1,447,190.00	295,000.00	1,152,190.00	1,083,022.67	873,755.33	600,000.00	1,682.20	1,275.68		0.20									
2011-2012	894,494.00	183,500.00	710,994.00	1,083,022.67	873,755.33	600,000.00	1,038.05	1,275.68		0.21									
2012-2013	1,898,563.00	311,404.00	1,587,159.00	1,083,022.67	873,755.33	600,000.00	2,317.25	1,275.68		0.16									
2013-2014	776,811.00	120,600.00	656,211.00	1,083,022.67	873,755.33	600,000.00	958.07	1,275.68		0.16									
2014-2015	796,667.00	217,100.00	579,567.00	1,083,022.67	873,755.33	600,000.00	846.17	1,275.68		0.27									
2015-2016	684,411.00	128,000.00	556,411.00	1,083,022.67	873,755.33	600,000.00	812.36	1,275.68	1.00	0.19									
2016-2017				1,083,022.67	873,755.33	600,000.00		1,275.68	1.00	0.20	1,083,022.67	866,418.13	866,418.13	600,000.00	1,275.68	700.80	1,275.68	876.00	
2017-2018									1.01	0.22	1,092,706.89	874,165.51	854,298.12	605,365.11	1,276.28	707.07	1,247.28	867.76	
2018-2019									1.01	0.24	1,102,477.71	881,982.17	841,892.07	610,778.19	1,287.69	713.39	1,229.16	859.31	
2019-2020									1.01	0.25	1,112,335.91	889,868.72	829,195.86	616,239.68	1,299.21	719.77	1,210.63	850.63	
2020-2021									1.01	0.27	1,122,282.25	897,825.80	816,205.27	621,750.00	1,310.83	726.20	1,191.66	841.74	
2021-2022									1.01	0.29	1,132,317.53	905,854.02	802,916.06	627,309.60	1,322.55	732.70	1,172.26	832.61	
2022-2023									1.01	0.31	1,142,442.54	913,954.03	789,323.94	632,918.91	1,334.37	739.25	1,152.41	823.25	
2023-2024									1.01	0.33	1,152,658.09	922,126.47	775,424.53	638,578.38	1,346.30	745.86	1,132.12	813.66	
2024-2025									1.01	0.35	1,162,964.99	930,371.99	761,213.45	644,288.45	1,358.34	752.53	1,111.37	803.84	
2025-2026									1.01	0.36	1,173,364.05	938,691.24	746,686.21	650,049.58	1,370.49	759.26	1,090.16	793.77	
2026-2027									1.01	0.38	1,183,856.09	947,084.87	731,838.31	655,862.22	1,382.74	766.05	1,068.48	783.46	
2027-2028									1.01	0.40	1,194,441.96	955,553.56	716,665.17	661,726.85	1,395.11	772.90	1,046.33	772.90	
INCREASE											111,419.29	89,135.43		61,726.85	119.43	72.10	- 229.35	- 103.10	
															9%	10%	-18%	-12%	% change

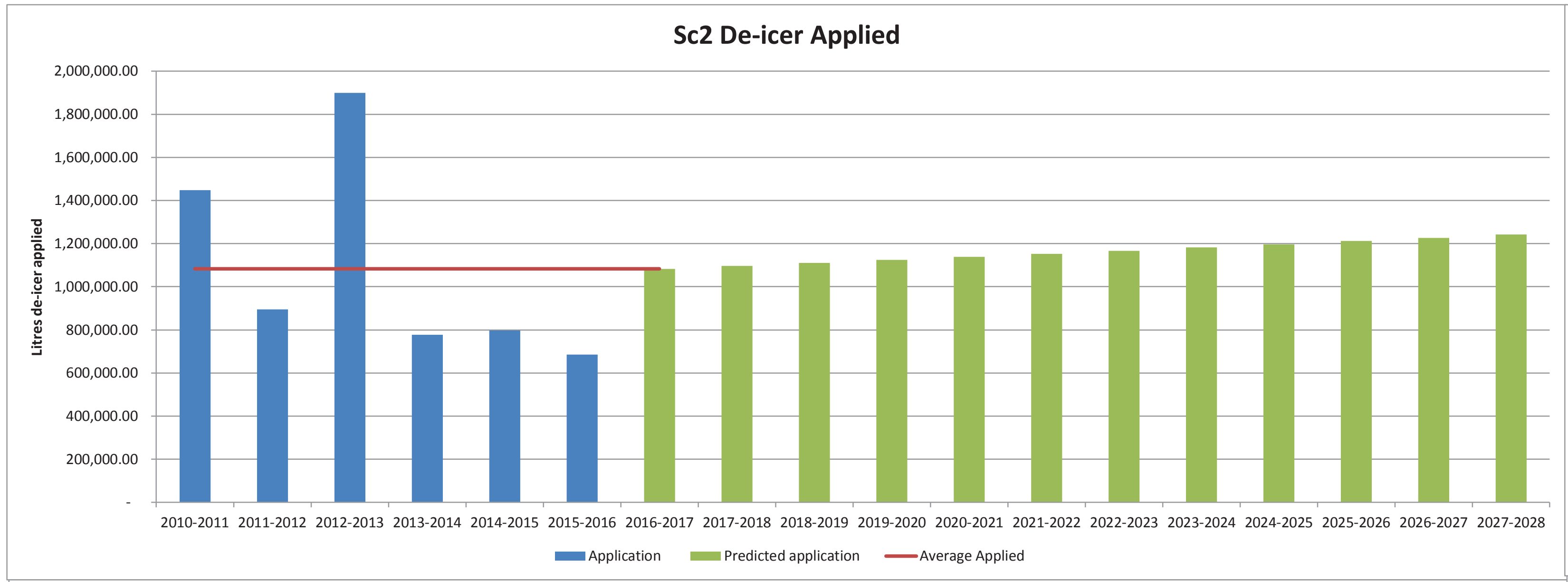

Sc1 De-icer Applied
Litres de-icer applied
2,000,000.00
1,800,000.00
1,600,000.00
1,400,000.00
1,200,000.00
1,000,000.00
800,000.00
600,000.00
400,000.00
200,000.00
-
2010-2011 2011-2012 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2018-2019 2019-2020 2020-2021 2021-2022 2022-2023 2023-2024 2024-2025 2025-2026 2026-2027 2027-2028
Application
Predicted application
Average Applied

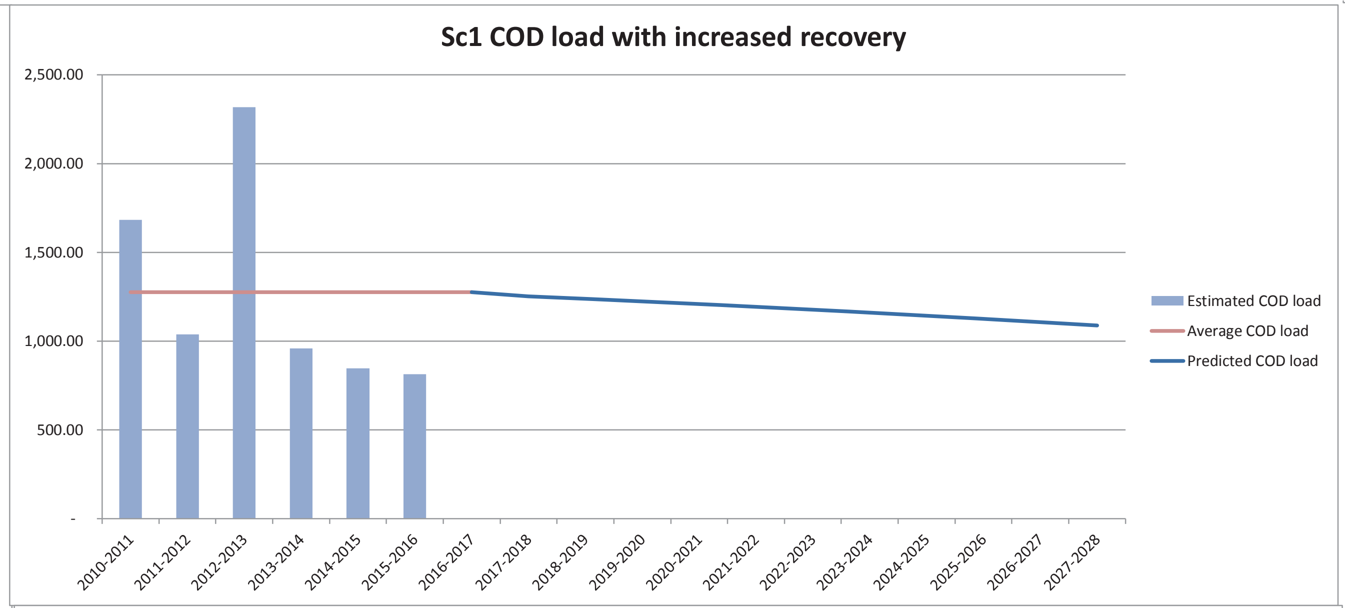

Sc1 COD load with increased recovery
2,500.00
2,000.00
1,500.00
1,000.00
500.00
-
2010-2011 2011-2012 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2018-2019 2019-2020 2020-2021 2021-2022 2022-2023 2023-2024 2024-2025 2025-2026 2026-2027 2027-2028
Estimated COD load
Average COD load
Predicted COD load

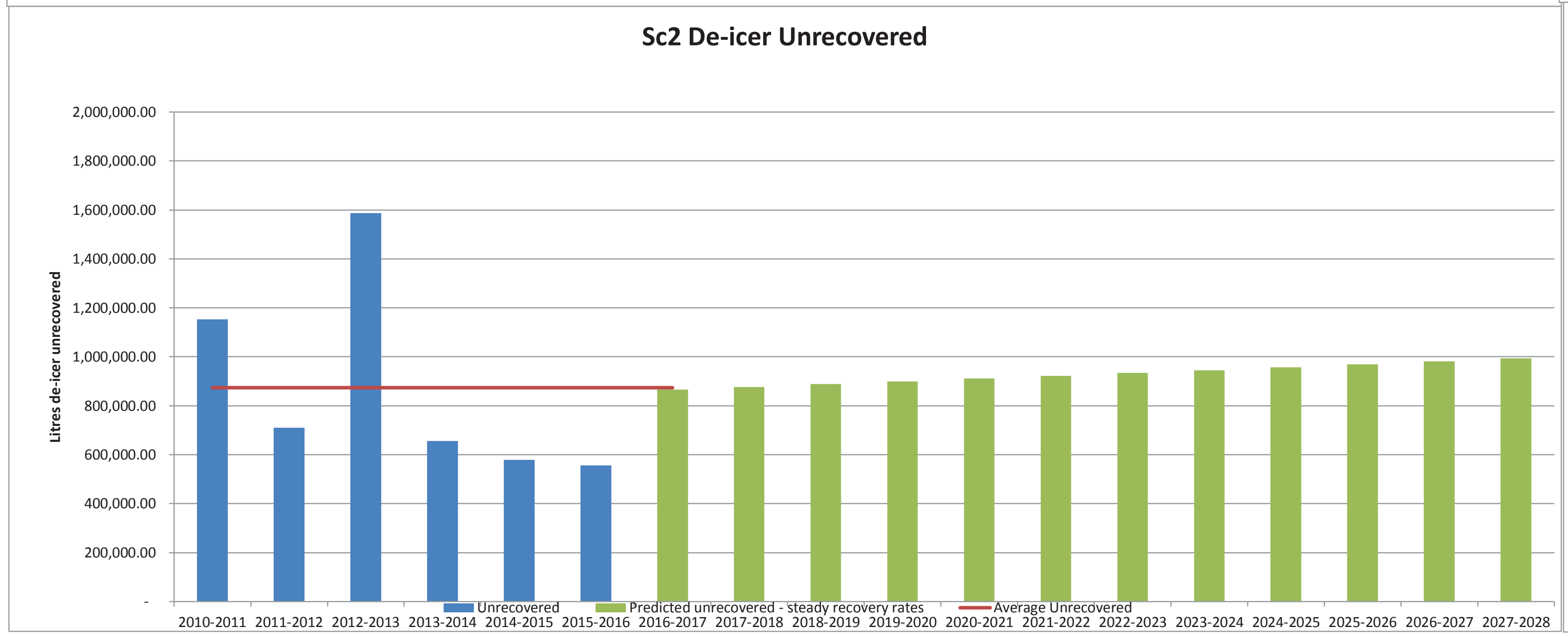

Sc1 COD load with steady recovery
2,500.00
2,000.00
1,500.00
1,000.00
500.00
-
2010-2011 2011-2012 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2018-2019 2019-2020 2020-2021 2021-2022 2022-2023 2023-2024 2024-2025 2025-2026 2026-2027 2027-2028
Estimated COD load
Average COD load
Predicted COD load

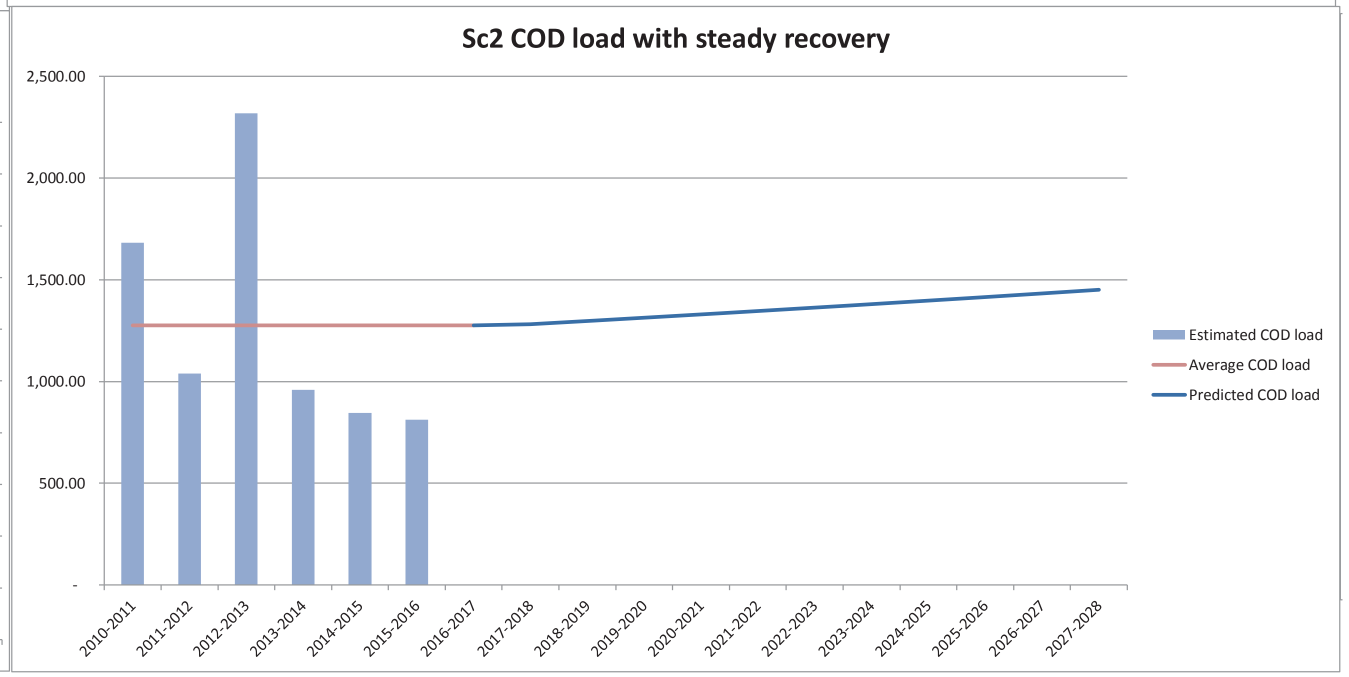
Sc2
C60-55

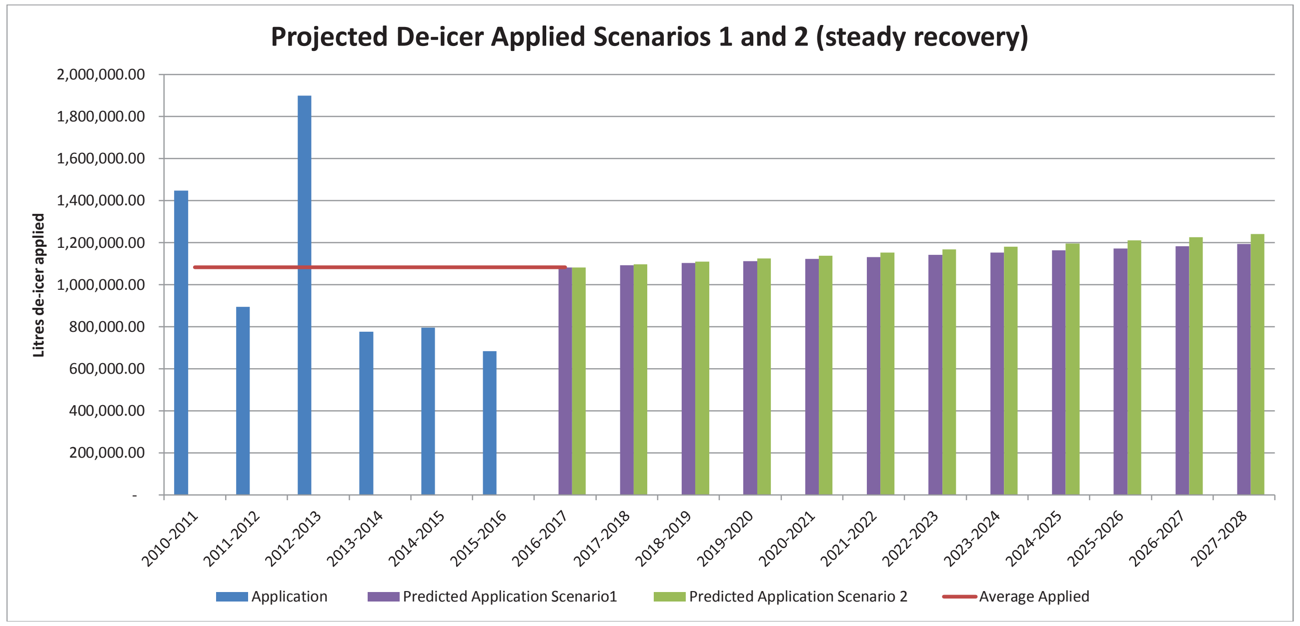
Aircraft De-icer	Application	Recovery	Unrecovered	Average Applied	Average Unrecovered	Estimated Baseline	Assuming 1.46 kg o2/l Estimated COD load	tonne O2/yr Average COD load	From Aircraft numbers Per year increase	Recovery Rate	Based on average applied Predicted application	Based on average applied unrecovered - steady recovery	Based on average applied unrecovered - increasing recovery	Based on baseline applied Predicted application	ASSUMING A COD LOAD OF 1.460 kg o2/l Assuming steady recovery rates: Predicted COD load based on average applied	ASSUMING A COD LOAD OF 1.460 kg o2/l Assuming steady recovery rates: Future COD load based on baseline applied	ASSUMING A COD LOAD OF 1.460 kg o2/l Also including increase in recovery rates: Predicted COD load based on average applied	ASSUMING A COD LOAD OF 1.460 kg o2/l Also including increase in recovery rates: Future COD load based on baseline applied	
2010-2011	1,447,190.00	295,000.00	1,152,190.00	1,083,022.67	873,755.33	600,000.00	1,682.20	1,275.68		0.20									
2011-2012	894,494.00	183,500.00	710,994.00	1,083,022.67	873,755.33	600,000.00	1,038.05	1,275.68		0.21									
2012-2013	1,898,563.00	311,404.00	1,587,159.00	1,083,022.67	873,755.33	600,000.00	2,317.25	1,275.68		0.16									
2013-2014	776,811.00	120,600.00	656,211.00	1,083,022.67	873,755.33	600,000.00	958.07	1,275.68		0.16									
2014-2015	796,667.00	217,100.00	579,567.00	1,083,022.67	873,755.33	600,000.00	846.17	1,275.68		0.27									
2015-2016	684,411.00	128,000.00	556,411.00	1,083,022.67	873,755.33	600,000.00	812.36	1,275.68	1.00	0.19									
2016-2017				1,083,022.67	873,755.33	600,000.00		1,275.68	1.00	0.20	1,083,022.67	866,418.13	866,418.13	600,000.00	1,275.68	700.80	1,275.68	876.00	
2017-2018									1.01	0.22	1,096,598.85	877,279.08	857,340.92	607,521.27	1,280.83	709.58	1,251.72	870.85	
2018-2019									1.01	0.24	1,110,345.22	888,276.18	847,899.99	615,136.83	1,296.88	718.48	1,237.93	865.44	
2019-2020									1.01	0.25	1,124,263.91	899,411.13	838,087.64	622,847.85	1,313.14	727.49	1,223.61	859.76	
2020-2021									1.01	0.27	1,138,357.07	910,685.66	827,896.05	630,655.54	1,329.60	736.61	1,208.73	853.79	
2021-2022									1.01	0.29	1,152,626.90	922,101.52	817,317.26	638,561.09	1,346.27	745.84	1,193.28	847.54	
2022-2023									1.01	0.31	1,167,075.60	933,660.48	806,343.15	646,565.75	1,363.14	755.19	1,177.26	841.01	
2023-2024									1.01	0.33	1,181,705.43	945,364.35	794,965.47	654,670.75	1,380.23	764.66	1,160.65	834.17	
2024-2025									1.01	0.35	1,196,518.65	957,214.92	783,175.84	662,877.35	1,397.53	774.24	1,143.44	827.03	
2025-2026									1.01	0.36	1,211,517.56	969,214.05	770,965.72	671,186.82	1,415.05	783.95	1,125.61	819.58	
2026-2027									1.01	0.38	1,226,704.49	981,363.59	758,326.41	679,600.45	1,432.79	793.77	1,107.16	811.81	
2027-2028									1.01	0.40	1,242,081.79	993,665.43	745,249.08	688,119.55	1,450.75	803.72	1,088.06	803.72	
INCREASE											159,059	127,247	- 121,169	88,120	175	103	- 188	- 72	tonnes O2
															14%	15%	-15%	-8%	% change


Sc2 De-icer Applied
Litres de-icer applied
Application
Predicted application
Average Applied

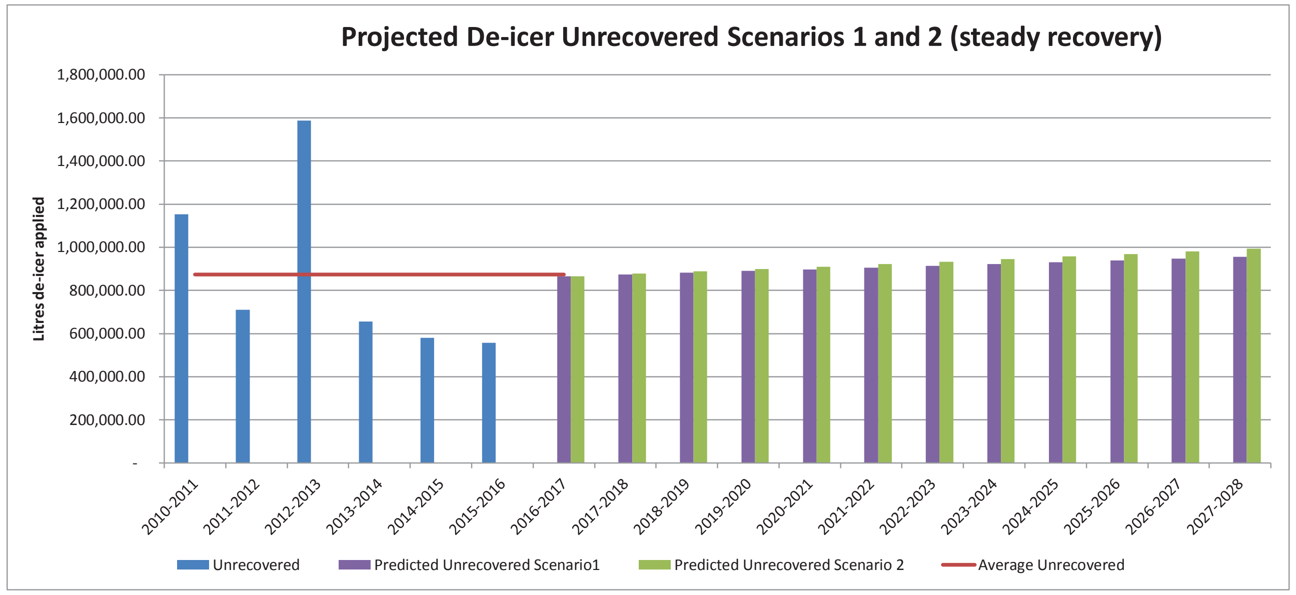

Sc1 COD load with increased recovery
Estimated COD load
Average COD load
Predicted COD load

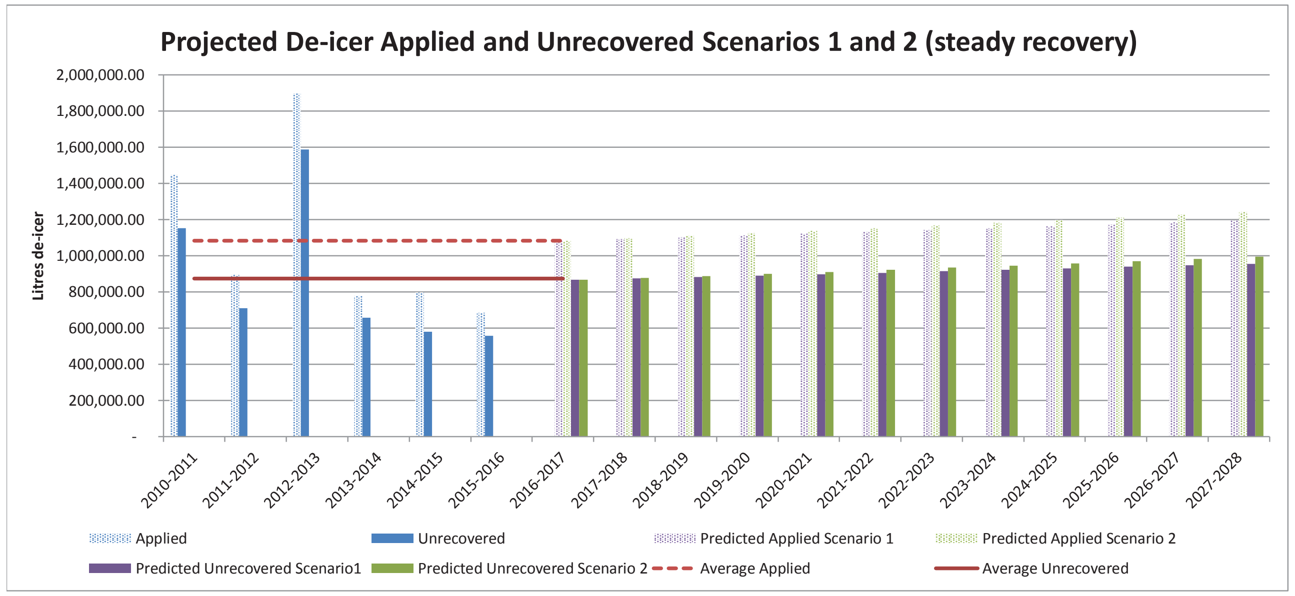

Sc2 De-icer Unrecovered
Litres de-icer unrecovered
Unrecovered
Predicted unrecovered - steady recovery rates
Average Unrecovered


Sc2 COD load with steady recovery
Estimated COD load
Average COD load
Predicted COD load



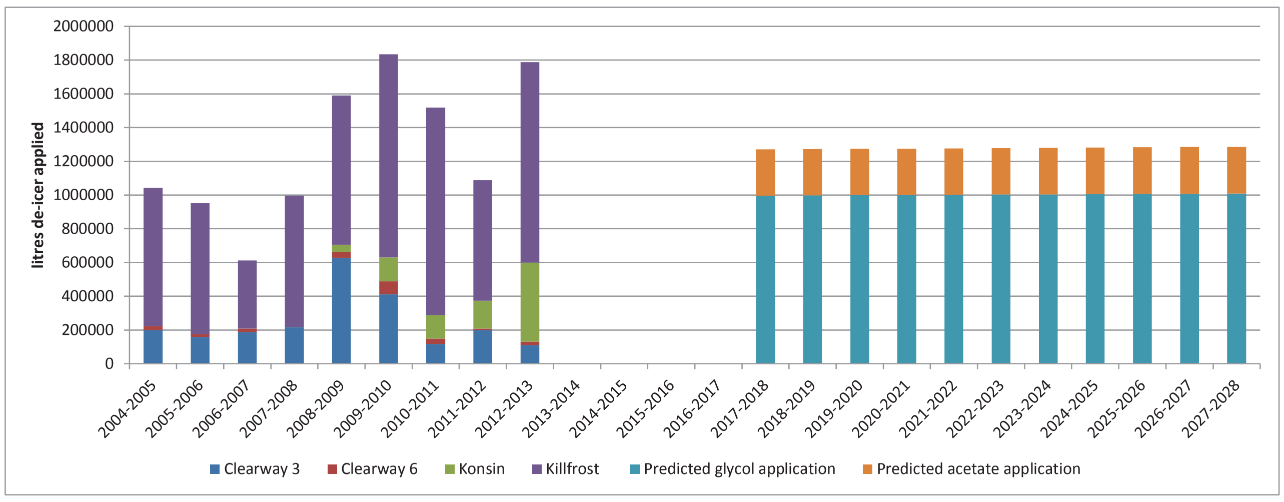
Projected De-icer Applied Scenarios 1 and 2 (steady recovery)
Litres de-icer applied
2,000,000.00
1,800,000.00
1,600,000.00
1,400,000.00
1,200,000.00
1,000,000.00
800,000.00
600,000.00
400,000.00
200,000.00
-
2010-2011
2011-2012
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019
2019-2020
2020-2021
2021-2022
2022-2023
2023-2024
2024-2025
2025-2026
2026-2027
2027-2028
Application
Predicted Application Scenario1
Predicted Application Scenario 2
Average Applied


Projected De-icer Unrecovered Scenarios 1 and 2 (steady recovery)
Litres de-icer applied
Unrecovered
Predicted Unrecovered Scenario1
Predicted Unrecovered Scenario 2
Average Unrecovered

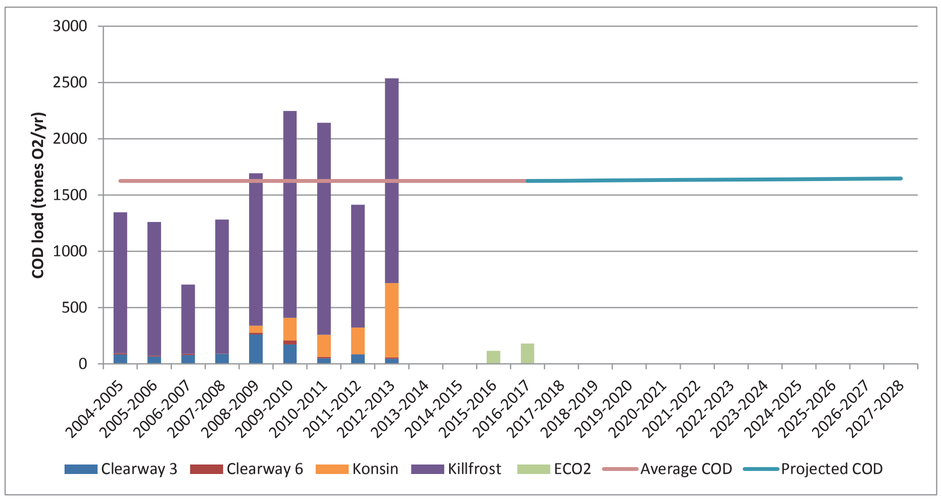

Projected De-icer Applied and Unrecovered Scenarios 1 and 2 (steady recovery)
Litres de-icer
Applied
Unrecovered
Predicted Applied Scenario 1
Predicted Applied Scenario 2
Predicted Unrecovered Scenario1
Predicted Unrecovered Scenario 2
Average Applied
Average Unrecovered

Current Hai	410	ha
Future Incre	5.4	ha
% increase	1%	

	K-acetate-based	Na-acetate-based	Ethylene glycol-based	Propylene glycol-based	K-acetate-based	Average Application		
	Actual application (l/yr)				Actual			
	Clearway 3	Clearway 6	Konsin	Killfrost	ECO2	Average Total	Average glycol based	Average acetate based
2004-2005	200000	23000	0	820000	0	1269222	995444	273777.7778
2005-2006	158000	17000	0	776000	0	1269222	995444	273777.7778
2006-2007	186000	23000	0	404000	0	1269222	995444	273777.7778
2007-2008	215000	2000	0	780000	0	1269222	995444	273777.7778
2008-2009	629000	33000	44000	885000	0	1269222	995444	273777.7778
2009-2010	411000	78000	142000	1203000	0	1269222	995444	273777.7778
2010-2011	116000	33000	138000	1232000	0	1269222	995444	273777.7778
2011-2012	200000	8000	166000	713000	0	1269222	995444	273777.7778
2012-2013	109000	23000	467000	1189000	0	1269222	995444	273777.7778
2013-2014						1269222	995444	273777.7778
2014-2015						1269222	995444	273777.7778
2015-2016	0	0	0	0	280282	1269222	995444	273777.7778
2016-2017	0	0	506	0	433678	1269222	995444	273777.7778
2017-2018								
2018-2019								
2019-2020								
2020-2021								
2021-2022								
2022-2023								
2023-2024								
2024-2025								
2025-2026								
2026-2027								
2027-2028								
INCREASE								
% change								



			COD	320 mg O2 / g	561mg O2/g	1290 mg O2/g	1390 mg O2/g	Assume 320		
			density	1.3g/cm3	800kg/m3	1.1g/cm3	1.1g/mL	1.40g/cm3		
			COD(kg O2/L)	0.416	0.4488	1.419	1.529	0.416		
Application increase assuming no change in de-icer, but				Approx COD (tonne O2/yr)						
Hardstanding increase per year	Predicted glycol application	Predicted acetate application		Clearway 3	Clearway 6	Konsin	Killfrost	Safegrip ECO2	Average	Total
				83.2	10	0	1253.78		1625	1347
				65.728	8	0	1186.504		1625	1260
				77.376	10	0	617.716		1625	705
				89.44	1	0	1192.62		1625	1283
				261.664	15	62.436	1353.165		1625	1692
				170.976	35	201.498	1839.387		1625	2247
				48.256	15	195.822	1883.728		1625	2143
				83.2	4	235.554	1090.177		1625	1413
				45.344	10	662.673	1817.981		1625	2536
									1625	
									1625	
				0	0	0	0	117	1625	117
				0	0	0.718014	0	180	1625	181
1.001197339	996636.3291	274106								
1.001197339	997829.6409	274434								
1.001197339	999024.3815	274762								
1.001197339	1000220.553	275091								
1.001197339	1001418.156	275421								
1.001197339	1002617.193	275751								
1.001197339	1003817.666	276081								
1.001197339	1005019.576	276411								
1.001197339	1006222.926	276742								
1.001197339	1007427.716	277074								
1.001197339	1008633.949	277405								
	11997.61959	**3300**								
	1%	1%								



Current COD load (tonnes O2/yr)	
Aircraft de-icer COD load	1,276
Pavement de-icer COD load	1,625
Total de-icer COD load	2,901

Scenario1 C55-53

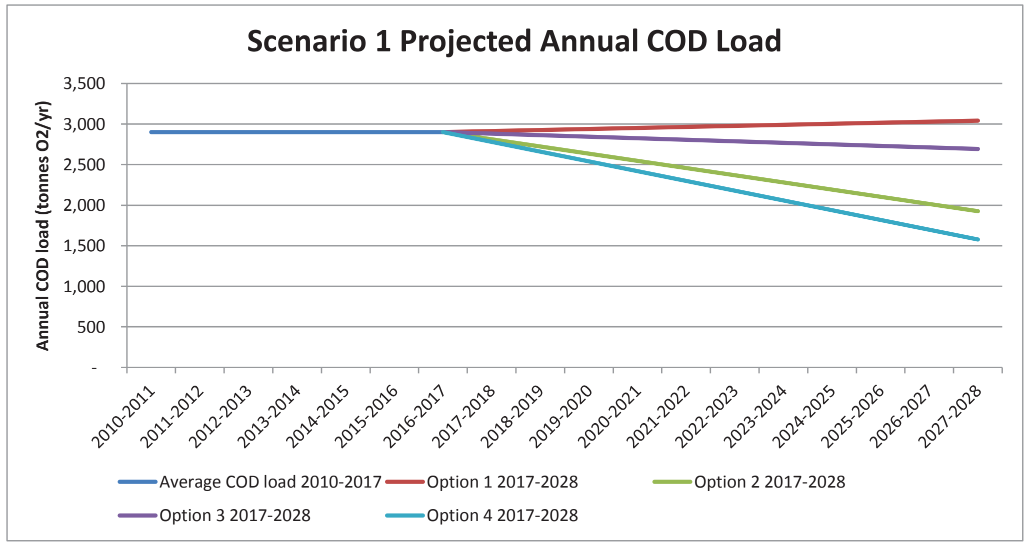
Future COD load (tonnes O2/yr)	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc1 (baseline)	3,042	1,926
Increase in recovery rate	2,693	1,577

% change from current	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc1 (baseline)	105%	66%
Increase in recovery rate	93%	54%

Future COD load (tonnes O2/yr)	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc1 (baseline)	- 141	975
Increase in recovery rate	208	1,324

decrease	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc1 (baseline)	-5%	34%
Increase in recovery rate	7%	46%

Scenario 1 (tonnes O2/yr)	Average COD lc	Option 1 2017-:	Option 2 201	Option 3 2017-2028	Option 4 2017-2028
2010-2011	2,901				
2011-2012					
2012-2013					
2013-2014					
2014-2015					
2015-2016					
2016-2017	2,901	2,901	2,901	2,901	2,901
2017-2018					
2018-2019					
2019-2020					
2020-2021					
2021-2022					
2022-2023					
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028		3,042	1,926	2,693	1,577



Scenario 1 COD load assuming no change in de-icer and increase in				Scenario 2 COD load assuming glycol to ECO2 de-icer change, but no hardstanding change					Scenario 3 COD load assuming glycol to ECO2 de-icer change and			
Predicted glycol COD	Predicted acetate COD	Hardstanding increase per year	Predicted total COD	Predicted glycol COD	Predicted acetate COD	Predicted ECO2 COD	ECO2 % glycol replacement per year	Predicted total COD	Predicted glycol COD	Predicted acetate COD	Predicted ECO2 COD	Predicted total COD
1510	115	1.001197339	1625	1510	115	0	0	1625	1510	115		1625
1512	115	1.001197339	1627	1057	115	124	0.3	1296	1059	115	124	1298
1514	115	1.001197339	1629	423	115	248	0.6	786	424	115	249	788
1516	115	1.001197339	1631	21	115	393	0.95	529	21	115	394	530
1518	115	1.001197339	1633	0	115	414	1	529	0	115	415	530
1519	115	1.001197339	1635	0	115	414	1	529	0	115	415	530
1521	116	1.001197339	1637	0	115	414	1	529	0	116	415	530
1523	116	1.001197339	1639	0	115	414	1	529	0	116	415	530
1525	116	1.001197339	1641	0	115	414	1	529	0	116	415	530
1527	116	1.001197339	1643	0	115	414	1	529	0	116	415	531
1529	116	1.001197339	1645	0	115	414	1	529	0	116	415	531
1530	116	1.001197339	1647	0	115	414	1	529	0	116	415	531
	22					**-1096**				**-1094**		**tonnes O2**
			1%					-67%				-67%

Appendix H. Qualitative Appraisal of Water Quality Management Measures

Current COD load (tonnes O2/yr)	
Aircraft de-icer COD load	1,276
Pavement de-icer COD load	1,625
Total de-icer COD load	2,901

Scenario2 C60-55

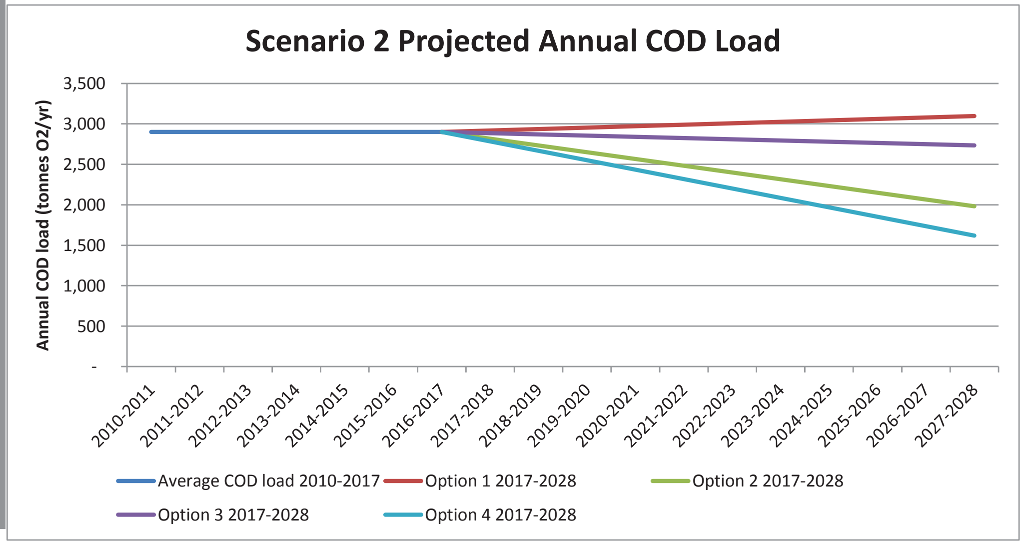
Future COD load (tonnes O2/yr)	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc2 (baseline)	3,097	1,982
Increase in recovery rate	2,735	1,619

% change from current	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc2 (baseline)	107%	74%
Increase in recovery rate	94%	60%

Future COD load (tonnes O2/yr)	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc2 (baseline)	- 197	919
Increase in recovery rate	166	1,282

decrease	Increase in hardstanding (baseline)	Change of de-icer
Increase in aircraft numbers Sc1 (baseline)	-7%	32%
Increase in recovery rate	6%	44%

Scenario 2 (tonnes O2/yr)	Average COD lo	Option 1 2	Option 2 2	Option 3 2017-2028	Option 4 2017-2028
2010-2011	2,901				
2011-2012					
2012-2013					
2013-2014					
2014-2015					
2015-2016					
2016-2017	2,901	2,901	2,901	2,901	2,901
2017-2018					
2018-2019					
2019-2020					
2020-2021					
2021-2022					
2022-2023					
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028		3,097	1,982	2,735	1,619



GAL - Water Quality Management Strategy - De-Icing Fluids Management Strategy

The aim is to produce a high level option review for enhancing the quality of local watercourses.
The timescale 2017 to 2028
Current Situation - Key Points
Average use of de-icer to aircraft - approx 1,083,000 litres per year with 209,000 litres per year recovery (approx. 20% and steady)
Average use of de-icer to pavement - average from 2007/08 to 2013/14 is approx. 1.4m litres per year and no recovery.
Current water quality issues - BOD >10mg/l in stream numbers over years. Since 2010 an average of 28 days/yr (170 total and 77 max in one year) have had discharges above 10mg/l/
Growth in ATMs - between 10%-14% depending on growth scenario
Growth in hardstanding area - 5.4Ha of paving airside (1% increase). Note, this is "new" hardstanding on greenfield

Options Table - potential strategies to further reduce COD load to surface water drainage system and nearby surface water courses

Scenario	More Explanation	Cost	Timescales	Land Take	Environmental Impact	Potential Benefits	Potential Issues	Comments	Recommendations
Do Nothing	Continue as present with no further mitigation.	No infrastructure costs, but increased cost of treatment in Crawley STW. Trade waste agreement expires 2018/2019. Currently costs £100-150k/yr. Future costs may be up to £400-500k/yr.	N/A	None.	Significant Negative - Due to 10% increase of ATMs, Approx. 10% more hard surfacing. This will have a negative impact on volume of BOD discharged and likelihood of exceedance of voluntary and permitted BOD/COD limits	None - due to 2019 cost hike for water disposal.	Large increase in cost from 2019. Increasing likelihood of compliance limit exceedances which may lead to fines and possible prosecution resulting in financial costs, potential clean-up requirement/mitigation being imposed and reputational damage.	Negative reputational effects. New trade waste agreement may be different.	Look into likely cost profiles for glycol disposal going forward to 2028.
Less De-Icer Usage	Apply de-icer at a specific area of apron to airplanes or certain areas of taxiway.	Initial cost of infrastructure/equipment for de-icer application in specific areas. Increased de-icing cost with different systems? However, saving in de-icer usage.	Likely 6 months to 1 year due to any existing contractual commitments and equipment purchase.	Possible small land take if new equipment / stands for application required.	Minor /Significant positive reduction of COD/BOD and less treatment required.	Reduction in pollution due to decreased usage. Potential to recover more de-icer if applied to specific areas making it easier to recover.	Could lead to longer turnaround if application to planes is due to more taxiing or potential queuing of aircraft to receive de-icing at specific locations. Airlines likely to have their own de-icing procedures and possibly products. Application to specific taxiways could result in Health and Safety and operational efficiency risks, particularly in the event of sudden severe weather.	Significantly less de-icer usage unlikely - already using less de-icer than previous years. Greater recovery more likely to be possible.	Clarify current pavement de-icing regime with GAL. Review potential modifications to technique and regime (where it's applied)? Where does this drain to? Could this have implications for limiting the amount of water to be treated?
Less Polluting De-Icer Usage	Since 2015, Gatwick has changed to de-icer products with lower pollution potential (reduction in COD and BOD).	Potential greater cost of new products. Konsin - £1.10/l, Eco2 - £1.29/l. Existing stocks of some de icers e.g. Clearway 6.	Use up existing stocks, new contracts; ongoing.	None or small.	Significant Positive - 3-4x decrease in COD load with different de-icer formulation (from about 1,600mg/l to 350mg/l).	Significant decrease in treatment level/type/volume required to discharge de-icer. The benefit will increase after 2019 due to increased water treatment charges.	Current de-icer purchasing agreement. Layout of water storage may need some consideration.	This could result in a 3 to 4x decrease in COD load depending on the product used. Early results from 2015/2016 show that significant reduciton in COD loading has been achieved. For info COD:BOD ratio (5-day) - 2:1.	Find out more details on the products currently being used together with plans for future usage of each.
More Water Storage Onsite	Construction of a further pollution or water storage lagoon to reduce BOD loading of discharge to stream to less than 10mg/l more frequently.	High cost - broadly proportional to the size of pond required. Note costs may be offset anyway by requirement for further water storage.	2-4 yrs. Considerable planning, design, construction and testing required to implement solution.	Variable but quite significant, say 2-5 Ha? Constrained by operations. Constrained by topography. Possibly in SW of site? Near FTG?	Minor Positive - Both in terms of water quality. Additional minor positive in terms of flooding as more storage leading to greater control on discharge, providing less 'peaky' flow. Holding and segregating 'polluted' runoff so discharge of more water when less polluted. Then more intensive treatment?	Flood storage and additional water efficiency benefits. More storage leading to greater control on discharge, providing less 'peaky' flow. Holding and segregating 'polluted' runoff so discharge of more water when less polluted. Opportunity to use 'clean' water for fire fighting.	Relatively costly. System needs to be gravity fed? New pipes crossing runway or taxiway would be difficult to implement?	Possible firefighting storage location to remove that water load from pond D, thus increasing storage of polluted waters. May also work in combination with treatment or other solutions.	Discuss feasible on-site locations with GAL and then evaluate the feasibility further.
More de-icer recovery Onsite	More active recovery of de-icer. Either of plane run-off or from sweeper fluid. Potentially using a second sweeper vehicle.	Low to moderate cost. May need new sweepers, interceptors or recovery equipment. Balance against potential reduction in Southern Water treatment plant bill.	6 months to 2 years depending on solution.	Relatively low - Possibly more land if logistics requires more standing time?	Potentially significant positive impact. But note no reduction in usage and technical/practical limitations in additional recovery.	Possible cross-benefits with water storage and attenuation.	Could lead to longer turnaround if application to planes is due to more taxiing or potential queuing of aircraft to receive de-icing at specific locations. Airlines likely to have their own de-icing procedures and possibly products.	Greater recovery possible. New contractor currently in place who apparently is recovering 23% of de-icer as opposed to previous average 20% of de-icer.	Review latest figures on de-icer recovery. Look into the feasibility of greater recovery of de-icer from sweeper fluid?
More treatment Onsite	Use a water pre-treatment system onsite to mitigate effects of de-icer. The solution considered was an aerated reed bed.	Moderate to high. This is dependant upon intensity of treatment required and effluent volume. Higher energy = higher costs (both capital and operational).	Potential licensing as well as planning and development cycle - 3-5yrs?	Trade-off between energy, land take and treatment efficiency - higher energy = more intense treatment = less land take. Reed bed treatment has relatively large footprint. There are likely to be constraints on location and possibly may not be undertaken onsite.	Minor/Significant Positive - This is dependant on whether discharge is direct to river or to Treatment Works.	More control on effluent discharge. Significant saving in water disposal costs, particularly after 2019.	Technical issues 'Feeding' of reed bed prior to winter period to increase rate of treatment in cold weather. May need on-site specialist or service agreement?	Pre-treatment of run-off before pond D to increase amount of water flowing from pond D to stream, rather than into lower D. Downstream reed-bed option would need consideration of additional land purchase by Gatwick.	Review the proposals for currently dealing with water treatment and integrate these into this options appraisal. Review the feasibility of a "near source" treatment system which could recover/separate de-icer, possibly with re-use such as membrane filtration/reverse osmosis?
More Treatment Offsite	Addition of pre-treatment for Discharge from pollution lagoon to Crawley STW.	Current agreement expires 2018/2019. Currently 100-150k/yr with 40% discount. Future costs may be up to 400-500k/yr based on current position. Costs offset partly against above although additional treatment would likely be higher, as would likely include an element of operational costs as well as capital costs. Lastly land purchase costs.	Estimated 4-7 yrs to include negotiations with Southern Water, planning and construction. May be other based upon AMP cycle.	Offsite so no land-take as pumped off-site - possible gravity-fed space at STW (i.e. downstream of lagoons).	None assuming that the water treated is the foul effluent only and no impact on discharge to stream.	No impacts to GAL in terms of land usage. If addition to Southern Water then operation will be their responsibility. If GAL, then they will have greater control on the treatment process and more able to make adjustments.	Potential cost of purchasing land. Requirements for specialists in GAL if GAL run treatment plant. If STW run treatment plant then GAL will only have an indirect control on costs via contract agreements.	Potentially a number of options to consider here. GAL or Southern Water to run system. Suitable area of land needs to be identified.	As above.

Appendix I. Compliance with Planning Policy

Table I1: Emerging/Draft National Planning Policy

	Document Reference (Policy Number, Paragraph Number)	Policy Summary (See hyperlink for further elaboration on Policy requirements)	Recommendations for the development of the Masterplan
THE HORIZON: THE FUTURE OF UK AVIATION – A CALL FOR EVIDENCE ON A NEW STRATEGY (JULY 2017)			
	The Horizon: The Future of UK Aviation - A call for Evidence on a New Strategy Paragraph 2.2: Proposed Aims and Objectives.	This emerging strategy is not a planning policy document as such and does not have any specific policy or objective for, flood or water quality. However overall the aim of this strategy is "*to achieve a safe, secure and sustainable aviation sector that meets the needs of consumers and of a global, outward-looking Britain*". The strategy will have the following six objectives: *• help the aviation industry work for its customers;* *• ensure a safe and secure way to travel;* *• build a global and connected Britain;* *• encourage competitive markets;* *• support growth while tackling environmental impacts; and* *• develop innovation, technology and skills.*	Future development at Gatwick would comply with national and local policy. The Masterplan should take into account the high level aims and objectives identified within this strategy.
	Chapter 7: Support Growth While Tackling Environmental Impacts, Paragraph 7.2: Context.	The strategy identifies that *"Government and industry have a vital role in ensuring that the aviation sector grows in a sustainable way"*. This includes taking in to account environmental impacts and the mitigation proposed associated with airport expansion.	
DRAFT AIRPORTS NATIONAL POLICY STATEMENT (NPS): NEW RUNWAY CAPACITY AND INFRASTRCTURE AT AIRPORTS IN THE SOUTH EAST OF ENGLAND (FEBRUARY 2017)			
Water use and wastewater management	Draft Airports National Policy Statement Chapter 5: Specific Impacts and Requirements, Paragraph 5.126-5.136	This strategy provides the primary basis for decision making on development consent applications for additional airport capacity for the Heathrow Northwest Runway but is also "important and relevant" for any	The Masterplan should have regard to assessment for waste management under its specific section on the management of water, how it is managed today and in the medium and long term. It is not thought that

	Document Reference (Policy Number, Paragraph Number)	Policy Summary (See hyperlink for further elaboration on Policy requirements)	Recommendations for the development of the Masterplan
		applications for terminal capacity in London and the Southeast. **Resource and Waste Management** It is identified that as part of the assessment for waste management "*the applicant should set out the arrangements that are proposed for managing any waste produced in the application for development consent. The arrangements described should include information on the proposed waste recovery and disposal system for all waste generated by the development. The applicant should seek to minimise the volume of waste sent for disposal unless it can be demonstrated that the alternative is the best overall environmental, social and economic outcome when considered over the whole lifetime of the project*". As part of the mitigation for waste management it is identified within this strategy that *"The applicant should set out a comprehensive suite of mitigations to eliminate or significantly reduce the risk of adverse impacts associated with resource and waste management"*.	the document introduces any new policy approaches in the field of water use and waste water management as it is derived from existing policy statements.
Flood risk and surface water management	Paragraphs 5.137 – 5.160	**Flood Risk** The strategy identified that there is the potential for airport expansion to result in increased risk from climate change effects, particularly to increased surface water runoff rate and pressure on potable water supply. There may also be effects on groundwater. The strategy states that "*The applicant should provide a flood risk assessment. This should identify and assess the risks of all forms of flooding to and from the preferred scheme, and demonstrate how these flood risks will be managed, taking climate change into account*".	In terms of flood risk the Masterplan should take into account that development would be expected to comply with the Sequential and Exception Tests which will be demonstrated via planning applications. While this would aim to ensure development was within the areas of lowest flood risk, airport operations, and the location of existing facilities may require such developments to be located in areas of higher risk. In such circumstances the application will demonstrate that it is safe for users over its lifetime and will not

	Document Reference (Policy Number, Paragraph Number)	Policy Summary (See hyperlink for further elaboration on Policy requirements)	Recommendations for the development of the Masterplan
		The strategy goes on to state that *"Where the preferred scheme may be affected by, or may add to, flood risk, the applicant is advised to seek early pre-application discussions with the Environment Agency, and, where relevant, other flood risk management bodies such as lead local flood authorities, Internal Drainage Boards, sewerage undertakers, highways authorities and reservoir owners and operators.* For local flood risk (surface water, groundwater and ordinary watercourse flooding), "*local flood risk management strategies and surface water management plans provide useful sources of information for consideration in a flood risk assessment".* Furthermore, as stated within the strategy "*when assessing the potential impacts of climate change on airports which can be wider than flooding impacts, such as implications from heat and water availability and the potential adaptation strategies for them, the applicant should take into account the latest UK Climate Change Risk Assessment, the latest set of UK Climate Projections, and other relevant sources of climate change evidence".*	exacerbate flood risk to other parties.
Water Quality		**<u>Water Quality and Resources</u>** Airport infrastructure projects can have adverse effects on the water environment, including groundwater, inland surface water and transitional waters. It is therefore considered that as part of any application for the expansion of an airport *"the applicant should make sufficiently early contact with the relevant regulators, including the Environment Agency, for abstraction*	The Masterplan should demonstrate how, as part of the development application, it would impact upon current water quality and (if required) the mitigation proposed to ensure no deleterious impact on then current water quality.

	Document Reference (Policy Number, Paragraph Number)	Policy Summary (See hyperlink for further elaboration on Policy requirements)	Recommendations for the development of the Masterplan
		licensing and environmental permitting, and with the water supply company likely to supply the water. Where the proposed development is subject to an environmental impact assessment and the development is likely to have significant adverse effects on the water environment, the applicant should ascertain the existing status of, and carry out an assessment of, the impacts of the proposed project on water quality, water resources and physical characteristics as part of the environmental statement". Furthermore "*The applicant should assess the effects on the surrounding water and wastewater treatment network in cooperation with the relevant water and sewerage undertaker(s). It should also address any future water infrastructure requirements of the preferred scheme, including for supplies and sewerage treatment, and the effects on the surrounding water and wastewater treatment network. This assessment would be based on the additional wastewater flows which would need to be treated at sewage treatment works and should be developed through liaison with the relevant water and sewerage undertaker(s)".*	

Emerging Plans within Crawley Borough Council

There are currently no emerging plans or planning guidance for Crawley Borough Council. The new Local Plan, Crawley 2030 was adopted in December 2015 and therefore the policies and objectives are still currently relevant. Relevant Supplementary Planning Guidance is up to date. We note that the Council are currently consulting on Affordable Housing SPD, but do not consider this to be relevant. The Local Development Scheme (LDS) for the period 2015-2018 does refer to a Planning and Climate Change SPD (which was adopted in October 2016) and an update of the Gatwick Airport SPD beginning in 2017, but there is no evidence of any steps having been taken on this and we understand a new Local Development Scheme will begin in September 2017. GAL will need to monitor progress with this LDS, or engage with the Council to help shape their plans.

Emerging Local Plans in Surrounding Areas

The emerging Local Plans in the surrounding districts as identified in Table 2 are also relevant to the wider assessment of future development particular as they are referred to on pages 2 and 3 of the S.106 agreement[7]. Surrey County Council, West Sussex County Council and Horsham District Council do not currently have any emerging plans relevant to the assessment of this masterplan topic area. There are no emerging Strategic Flood Risk Assessments (SFRA) associated with the development of the emerging plans.

Table I2: Emerging/Recently Adopted Local Plans in Surrounding Areas

District Council	Plan/Policy/Guidance	Summary of Plan/Policy/Guidance	Recommendations for the development of the Masterplan
East Sussex County Council	County Councils only have a statutory function for Waste and Minerals Planning. These plans are not directly relevant to the consideration of water resources although they would need considering as part a wider master planning exercise.	N/A	The Masterplan should take into consideration of recently adopted Replacement Waste Local Plan (2017) Replacement Waste Local Plan No updates on Strategic Flood Risk Management Assessments.
Mole Valley District Council	The Future Mole Valley Local Plan.	No document available.	There is currently no document available. However, the Masterplan should take into consideration the development of the Future Mole Valley Local Plan and the timeline for its adoption. It is identified in the Local Development Scheme (2016) that the new local plan is set for adoption in Autumn 2018. No updates on Strategic Flood Risk Management Assessments.
Reigate and Banstead District Council	The Development Management Plan – Part 2 of the Local Plan.	Section 4: Climate Change Resilience and Flooding Policy SC9: *"Direct development away from areas at risk of flooding, and ensure all developments are safe from flood risk and do not increase flood risk elsewhere or result in a reduction in water quality".* The draft Development Management Plan identifies proposed policy CCF2 which states "*Sites within flood zones 2 and 3, sites within flood zone 1 which are greater than 1 hectare in area and sites with critical drainage problems will be required to:*	The Masterplan should take into consideration the development of Part 2 to the Local Plan Policies SC9 and CCF2. Development Management Plan - Part 2 of Local Plan No updates on Strategic Flood Risk Management Assessments.

[7] S.106 agreement agreed between Gatwick Airport Limited, West Sussex County Council and Crawley Borough Council dated 15th December, 2015 doc ref GAT/7/BS

District Council	Plan/Policy/Guidance	Summary of Plan/Policy/Guidance	Recommendations for the development of the Masterplan
		A) Satisfy sequential test and where necessary the exceptions test; and *B) Demonstrate through a site-specific flood risk assessment (appropriate to the scale of development) and flood risk management plan.* *In addition to complying with other relevant DMP policies all development proposals in areas of flood risk will be expected to:* *A) Be designed so that the most vulnerable uses are located in areas of lowest flood risk within the site.* *B) Incorporate appropriate flood plain compensation, surface water attenuation, flood storage and flood resilient design features, which would not increase flood risk elsewhere or reduce the quality of attenuated surface water prior to it entering the watercourse downstream.* *C) Make an appropriate allowance for the effects of climate change representative of the nature and scale of development proposals and the national sensitivity ranges for rainfall intensity and peak river flows.* *D) Provide for safe access and egress in the event of flooding.* *E) Be designed to ensure the safe management and mitigation of residual risk.* *F) Maintain the free passage of surface water along the natural flow paths where possible.* *G) Incorporate a sustainable drainage system – including appropriate arrangements for its ongoing maintenance for the lifetime of the development - unless it*	

District Council	Plan/Policy/Guidance	Summary of Plan/Policy/Guidance	Recommendations for the development of the Masterplan
		can be demonstrated to be inappropriate. For all major development (including that outside flood risk areas), sustainable urban drainage systems should be provided unless demonstrated to be inappropriate.	
Tandridge District Council	Emerging Tandridge Local Plan - Consultation on sites.	No document available.	There is currently no document available. However, the Masterplan should take into consideration the development of the Emerging Tandridge Local Plan when published. The submission of a draft local plan is scheduled for 2018 within the Local Development Scheme document (June 2017). The proposed date for adoption is scheduled for 2019 in accordance with the Local Development Scheme document. Emerging Tandridge Local Plan
Mid Sussex District Council	Mid Sussex District Plan 2014-2031- Pre Submissions document.	Within the emerging local district plan it is identified that "*the Gatwick airport has ambitious plans for growth and development, utilising the existing runway and terminals, to support up to 45 million passengers by 2021. The Council within mid Sussex District will work with partners across the Gatwick Diamond area, through the Gatwick Diamond Initiative, to encourage sustainable economic growth to support this expansion. This will include supporting Gatwick as an economic and transport hub, and seeking to improve access to and from the airport by a range of modes of transport.*"	The Masterplan should take into consideration the development of the Mid Sussex District Plan when adopted (2017, according to the Local Development Scheme). It is understood that this plan is currently at examination. Pre-Submissions Draft Mid Sussex District Plan 2014-2031 No updates on 2015 Strategic Flood Risk Management Assessments.

Water Masterplan 2020 & 2028 Forecast - Full backing report

JACOBS

Other Emerging and/or changing legislation

BREEAM

The Masterplan should be aware of the updates to BREEAM's standards. As a key part of the update process, all technical issues will be reviewed to ensure they continue to deliver value and are up to date with recent developments within the industry, best practice standards, regulation & policy. There is currently no document available to identify the proposed changes. These are likely to be launched in Spring 2018.

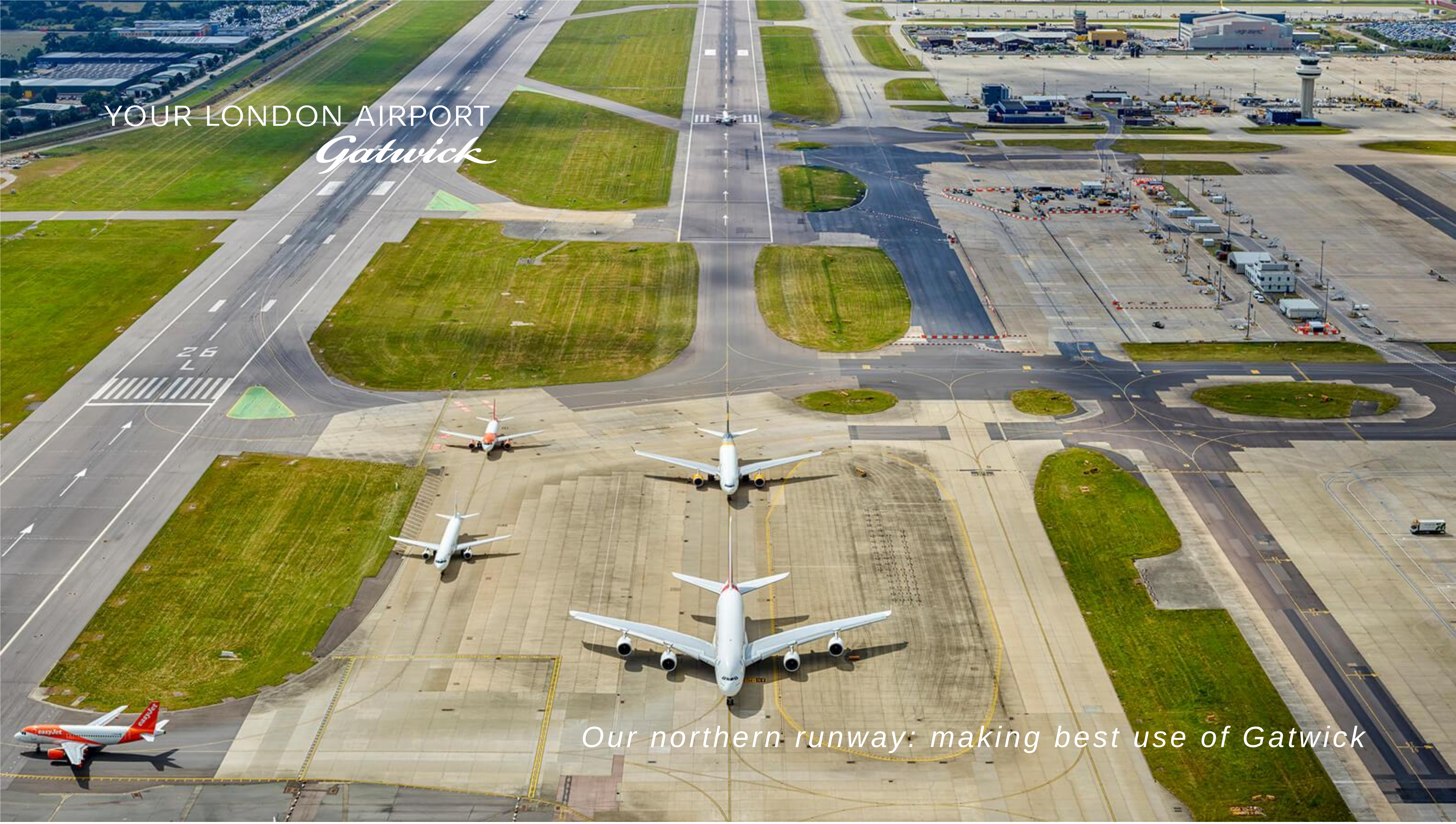
Climate Change Predictions

The Masterplan should be aware of the expected updates to climate change predictions following the Paris Climate Change Agreement in December 2015. The UKCP (UK Climate Predictions) 18 project is to build upon the UKCP09 project which will further help decision-makers assess the full range of risks from the changing climate and advise how we can adapt. The upgrades to climate change predictions will focus on future climate scenarios such as temperature and precipitation over land and are therefore considered relevant to the Masterplan. Planning requirements have previously been driven by the requirements of the Environment Agency who last update their guidance in 2016, the publication of UKCP18 may result in a further update.

Appendix J. Potential Flood Risk Mitigation Measures

Proposed Development Number	Proposed Development	Development Works	Surface Water Drainage Catchment	Fluvial Flood Risk – Storm Return Period 5yr	20yr	50yr	75yr	100yr	100yr+20% CC	Surface Water Flood Risk – Storm Return Period 10yr	100yr	100yr+20% CC	Potential Flooding Description – Fluvial	Potential Flooding Description – Surface Water	Existing Permeable Areas Loss (m^2)	Potential Flood Mitigation Options – Fluvial	Potential Flood Mitigation Options – Surface Water	Recommendations
1	Pier 6 Extension	Pier 6 is located south-west of the North Terminal building. The objective of the Pier 6 project is to increase the level of pier service in the North Terminal as well as providing a consolidated operations zone for Gatwick's largest carrier, easyJet. The Pier 6 project will deliver 7 new full Code C stands immediately west of the current pier. It will also make modifications to Stand 103, allowing the stand to accommodate up to an A320 aircraft, giving a total of 17 pier served stands (a net gain of 6 stands). The extension is currently expected to be be complete in Spring 2022. In order to make way for the Pier 6 extension the current A380 stand (Stand 110 at Pier 6) will be relocated to Pier 5 (described in further detail further along in this table). Modifications will be made to the Quebec taxiway to facilitate the A380's reaching it's new stand. The Pier 6 building western extension will be 3 storeys with a total footprint of approx. 15,000m^2 (building outline footprint of approx. 5000m^2). The extension is assumed to require a new substation. The 7 new stands will require approx. 20,000m^2 of concrete. However, the existing site is already paved so there will be no net increase in paved area. The Quebec taxiway will require 6,000m^2 of additional/replacement concrete. Stand 103 substation generators will be relocated to allow the stand to be brought into service.	Pond D	N	N	N	N	Y	Y	N	Y	Y	The majority of the existing Pier 6 building is located within the 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change fluvial flood extents from the Gatwick Stream.The 1 in 75 annual chance fluvial flood extent does however fall short of the proposed Pier 6 building extension by approx.30 metres to the east. With regards to the 1 in 100 annual chance and 1 in 100 annual chance plus climate change events the fluvial flood extents encroach on the eastern end of the proposed Pier 6 building extension. The flood extent within the proposed building footprint is quite small but nonetheless the proposed Pier 6 building footprint would likely displace this fluvial flooding into the adjacent Pier 6 stands if not mitigated for.	The existing Pier 6 building is almost fully located within the 1 in 10 annual chance surface water flood extent. It appears that the surface water flooding is from the existing slot drains located adjacent to the northern and southern faces of the Pier 6 building which likely drain the existing Pier 6 stands of surface water.The Pier 6 building extension is located outside the the 1 in 10 annual surface water flood extent. The proposed Pier 6 building extension is subject to encroachment of potential surface water flood extents from the 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events. This appears to be originating from an existing slot drain (Google aerial imagery) serving the existing stands. The proposed Pier 6 building footprint is located over this slot drain and so the slot drain would likely be removed and repositioned as part of the propsoed development. It is unlikley the flood risk from such a large storm event could be completely designed out (i.e. slot drainage slots only have a certain capacity to accept runoff). However, any potential flooding could be accounted for in the design of the proposed Pier 6 building/stands to minimise operational impacts.	Development area already fully paved. No net gain in paved area.	(1) Introduce a hard flood defence (e.g. flood wall) along the left-hand bank of the Gatwick Stream to retain the flow in channel and prevent flooding of the airfield.This would be an expensive option but would offer the best fluvial flood protection to the airfield. (2) Employ bank raising along the Gatwick Stream to contain the water in channel and prevent it flooding the airfield. If the options to provide a flood wall or bank raising along the Gatwick Stream are not pursued then the following less expensive mitigation options could be considered: (3) For the existing Pier 6 building its resilience to fluvial flooding could be assessed and if any low floor level thresholds, critical assets (e.g. electrical equipment) are idenitifed these coud be raised above fluvial flood water levels to increase flood resilience. Demountable flood defences could also be employed where appropriate (e.g. doorways) in the event of a flood event to limit flood inundation of the building interior. An assessment to identify potential underground flowpaths (e.g. cable trenches, etc.) would need to be undertaken to assess the viability of demountable flood defences. (4) Although there is limited encroachment of fluvial flood extents to the proposed Pier 6 building footprint the proposed structure could nonetheless be designed with added resilience to fluvial flooding (e.g. increased floor level thresholds, placement of critical assets above fluvial flood water levels, etc.)	**Existing Pier 6 Building & Stands Surface Water Drainage:** (1) The surface flooding could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally at Pier 6. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally at Pier 6; (2) For large return period and short duration storm events (i.e. high rainfall intensity) there will be an increased risk of surface water flooding as the surface water drainage system collection area at the ground surface has a fixed capacity to accept rainfall runoff. To mitigate inundation of the Pier 6 building with surface water building floor thresholds could be raised, move critical assets above floodwater levels and employ demountable defences where approriate (e.g. doorways, etc.); (3) For large return period and long duration events (i.e. lower rainfall intensity but sustained rainfall) if the existing surface water drainage system has insufficient attenuation to contain large volumes of surface water runoff (i.e. resulting in surcharging the drainage system and flooding the airfield) then an option may be to retrofit the drainage system and employ increased attenuation storage on the drainage system (e.g. offline underground attenuation storage tank) thereby reducing the risk of surface water surcharging the drainage system and flooding the airfield ground surface. **Proposed Pier 6 Building Extension & Stands Surface Water Drainage:** (4) Where practicable an exercise could be undertaken to identify areas that can be installed as permeable as opposed to being paved within the proposed Pier 6 development. This will reduce the volume of surface water runoff draining to the proposed drainage system thereby reducing the surface water flood risk and the extent of any potential surface water flooding; (5) For large return period and short duration storm events (i.e. high rainfall intensity) there will be an increased risk of surface water flooding as the surface water drainage system collection area at the ground surface will have a fixed capacity to accept rainfall runoff. Surface water modelling of the proposed drainage system should be undertaken to assess the movement of the surface water that evades the drainage system at the ground surface such that design measures can be employed. For example the ground can be profiled to fall certain directions away from less critical areas to eventually drain into the drainage system, etc); (6) For large return period and long duration storm events (i.e. lower rainfall intensity but sustained rainfall) attenuation storage can	(1) Once outline/detailed design is commenced on the proposed Pier 6 building extension and associated stands a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and proivde effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) Potentially a project could be undertaken to identify redundant pavement across the airfield to reduce the hydraulic loading on the drainage system which could improve drainage locally at Pier 6; (4) The footprint of the proposed Pier 6 development is crossed by existing surface water sewers. Consideration should therefore be given to re-routing these sewers around the footprint of the new development, although this would require a detailed assessment of feasibility. If this is not possible then the hydraulic capacity and structural integrity of the sewers should be assessed to confirm, that they can withstand the additional loading, but the development could have an impact on the ability of GAL to maintain these sewers.
2	Re-aligned Quebec Taxiway	There is limited information available on the proposed Taxiway Quebec realignment at present. There is only a single reference on the Pier 6 Extension presentation slides which states that a realignment of Quebec Taxiway is proposed and shows reduced grassed areas relative to Google aerial imagery for the location.	Pond D	N	N	N	N	N	Y	Y	Y	Y	The proposed QuebecTaxiway realignment corridor is not impacted by fluvial flood extents for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, and 1 in 100 annual chance events from the Gatwick Stream. However, the fluvial flood extents for the 1 in 100 annual chance plus climate change storm event encroach on a small portion of the the Quebec Taxiway corridor just south-west of the proposed tie-in point with the proposed relocated A380 stand at Pier 5 (i.e. existing Stands 254 and 255 at the southern end of Pier 5).	The surface water flood extents for the 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events encroach on a small portion of the proposed Quebec Taxiway realignment corridor. The prime area affected is at the tie-in location to the proposed A380 stand on Pier 5 (i.e. existing Stands 254 and 255 at the southern end of Pier 5).	5333	(1) Introduce a hard flood defence (e.g. flood wall) along the left-hand bank of the Gatwick Stream to retain the flow in channel and prevent flooding of the airfield.This would be an expensive option but would offer the best fluvial flood protection to the airfield; (2) Instead of a hard flood defence employ bank raising along the Gatwick Stream to contain the water in channel and prevent it flooding the airfield. This would offer a similar level of protection as the hard flood defence in Point (1). If the options to provide a flood wall or bank raising along the Gatwick Stream are not pursued then the following less expensive mitigation options could be considered: (3) Although there is limited encroachment of the 1 in 100 annual chance plus climate change fluvial flood extents to the proposed Pier 5 building addition footprint the proposed structure could nonetheless be designed with added resilience to fluvial flooding (e.g. increased floor level thresholds, placement of critical assets above fluvial flood water levels, etc.); (4) Demountable flood defences could also be stored on site and employed where appropriate (e.g. doorways) in the event of a flood event to limit flood inundation of the building interior. This would be a last resort mitigation measure in the event of a major flood event. An assessment to identify potential underground flowpaths (e.g. cable	**Existing Quebec Taxiway Surface Water Drainage:** (1) The surface flooding could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally on Quebec Taxiway. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally on the affected Quebec Taxiway; (2) For large return period and long duration events (i.e. lower rainfall intensity but sustained rainfall) if the exisitng surface water drainage system has insufficient attenuation to contain large volumes of surface water runoff (i.e. resulting in surcharging the drainage system and flooding the airfield) then an option may be to retrofit the drainage system and employ increased attenuation storage on the drainage system (e.g. offline underground attenuation storage tank or oversized carrier drains/slot drains) thereby reducing the risk of surface water surcharging the drainage system and flooding the airfield ground surface.	(1) Once outline/detailed design is commenced on the proposed Quebec Taxiway a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and proivde effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) Given that existing permeable area will be lost as part of this proposed development potentially a project could be undertaken to identify redundant pavement across the airfield to balance the permeable/paved area split and to reduce the hydraulic loading on the drainage system which could improve drainage locally; (4) The footprint of the proposed Quebec Taxiway development is crossed by existing surface water sewers. Consideration should therefore be given to re-routing these sewers around the footprint of the new development, although this would require a detailed assessment of feasibility. If this is not possible then the hydraulic capacity and structural integrity of the sewers should be assessed to confirm, that they can withstand the additional loading.
3	A380 Relocation to Pier 5	Pier 5 is located directly west of the North Terminal Building. Due to the proposed expansion of the Pier 6 stands west and associated extension of the Pier 6 building the A380 stand (Stand 110 on Pier 6) will be relocated to Pier 5. The location is the approximate area covered by exisitng Stands 554 and 555 on the southern end of Pier 5. The new stands are to serve all Code E and Code F models currently available and on order. The number of Code C stands should not be reduced from the existing provision (currently 6 Code C stands between Stands 551 and 559).	Pond D	N	N	N	N	N	Y	Y	Y	Y	The re-located A380 stand and the additon to the Pier 5 building to accommodate the re-located A380 stand are not impacted by fluvial flood extents for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance and 1 in 100 annual chance events from the Gatwick Stream. Fluvial flood extents for the 1 in 100 annual chance event plus 20% climate change uplift factor for the Gatwick Stream do encroach on the majority of the proposed re-located A380 stand and the southern portion of the Pier 5 building addition.	Surface water flood extents for the 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift encroach on the proposed re-located A380 stand boundary and the southern end of the addition to the Pier 5 building. The surface water flood extent for the 1 in 10 annual chance storm event takes up just under a quarter (by eye) of the proposed A380 stand footprint and is concentrated around the alignment of the existing surface water slot drains serving Stands 554 and 555. The surface water flood extents for the 1 in 100 annual chance and the 1 in 100 annual chance plus climate change uplift events are much more extensive, encroaching on the majority of the proposed A380 stand footprint. This is likely due to the fact that the existing slot drainage throats are slender openings with a limited capacity to collect runoff. The 1 in 100 annual chance and 1 and 100 annual chance plus climate change uplift events are very large rainfall events and hence large surface water flood extents result.	Development area already fully paved. No net gain in paved area.	(1) Introduce a hard flood defence (e.g. flood wall) along the left-hand bank of the Gatwick Stream to retain the flow in channel and prevent flooding of the airfield.This would be an expensive option but would offer the best fluvial flood protection to the airfield; (2) Instead of a hard flood defence (e.g. flood wall)employ bank raising along the Gatwick Stream to contain the water in channel and prevent it flooding the airfield. This would offer a similar level of protection as the hard flood defence in Point (1). If the options to provide a flood wall or bank raising along the Gatwick Stream are not pursued then the following less expensive mitigation options could be considered: (3) Outside the measures quoted in points (1) and (2) above it is quite limited as to what can be done in the middle of an airport taxiway to mitigate fluvial flooding. However, an exercise could be undertaken to assess the feasability of profiling the taxiway pavement such that any potential fluvial flood water for the 1 in 100 annual chance plus climate change uplift event can be directed to a less critical location on the airfield. There are nearby grassed areas located adjacent to Quebec Taxiway which could be used a sacraficial flood storage locations	**Existing Stands 554 & 555 (i.e. proposed A380 Stand) & Pier 5 Additional Building Surface Water Drainage:** (1) The surface flooding could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally at the proposed A380 Stand location. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally at the A380 Stand location; (2) For large return period and short duration storm events (i.e. high rainfall intensity) there will be an increased risk of surface water flooding as the surface water drainage system collection area at the ground surface has a fixed capacity to accept rainfall runoff. To mitigate inundation of the Pier 5 building addition with surface water building floor thresholds could be raised, move critical assets above floodwater levels, etc. Surface water ponding on the stands could also be mitigated through the provision of attenuation storage in the drainage system to contain additional flood water; (3) For large return period and long duration events (i.e. lower rainfall intensity but sustained rainfall) if the exisitng surface water drainage system has insufficient attenuation to contain large volumes of surface water runoff (i.e. resulting in surcharging the drainage system and flooding the airfield) then an option may be to retrofit the drainage system and employ increased attenuation storage on the drainage system (e.g. offline underground attenuation storage tank) thereby reducing the risk of surface water surcharging the drainage system and flooding the airfield ground surface; (4) Demountable flood defences could also be stored on site and employed where appropriate on the Pier 5 additional building (e.g. doorways) in the event of a flood event to limit flood inundation of the building interior. This would be a last resort mitigation	(1) Once outline/detailed design is commenced on the proposed A380 Stand re-location a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and proivde effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) Given that existing permeable area will be lost as part of this proposed development potentially a project could be undertaken to identify redundant pavement across the airfield to balance the permeable/paved area split and to reduce the hydraulic loading on the drainage system which could improve drainage locally; (4) The footprint of the proposed A380 Stand Re-location development is crossed by existing surface water sewers. Consideration should therefore be given to re-routing these sewers around the footprint of the new development, although this would require a detailed assessment of feasibility. If this is not possible then the hydraulic capacity and structural integrity of the sewers should be assessed to confirm, that they can withstand the additional loading, but the development could have an impact on the ability of GAL to maintain these sewers.
4	Remote Parking Stands	The GAL presentation titled "Gatwick Airport Master Plan Production Workshop" (presented 4th May 2017) presents two options (i.e. Option 1 and 2) for the remote parking stands. GAL have stated to take Option 2 forward for this Masterplan flood risk assessment. The selection of Option 1 or 2 depends on the timing of the proposed Lima Taxiway (discussed further below) and timing of requirement. GAL have taken high level assumptions that 6 proposed Code C stands will be required to the south side of the proposed Lima Taxiway. Approx 15,000m^2 of concrete will be required. The Code C stands development will result in the loss of existing permeable areas and replacement with the aforementioned concrete paving. GAL have taken high level assumptions that 5 proposed Code E stands will be required to the north side of the proposed Lima Taxiway. Approx 25,000m^2 of concrete will be required. The Code E stands development location is currently a car parking facility which is primarily paved. However, there will be a loss of small pockets of existing permeable areas and replacement with the aforementioned concrete paving. Assumed that new substations are required to support the proposed Code C and Code E stands.	Pond M/Pond D - Code C Stands (Primarily Pond M but a portion development boundary straddling Pond D catchment) Dog Kennel Pond - Code E Stands	N	N	N	N	N	N	Y	Y	Y	Proposed Code C Stands (south of proposed Lima Taxiway): The proposed Code C stands are not impacted by fluvial flood extents for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change events from the River Mole. However, fluvial flood extents for the 1 in 100 year plus climate change event get within 5m immediately west of Code C stands development. Proposed Code E Stands (north of proposed Lima Taxiway): The proposed Code E stands are not impacted by fluvial flood extents for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change events from the River Mole. However, fluvial flood extents for the 1 in 100 annual chance plus climate change event get within 25m immediately south-west of Code E stands development.	(i) Proposed Code C Stands (south of proposed Lima Taxiway): There appears to be no encroachment of surface water flood extents for the 1 in 10 annual chance event on the proposed Code C stands development footprint. The flood extents (which appear to originate from the existing stand surface water drainage on Lima Taxiway) are approx. 40 metres west of the proposed development footprint. Flood extents do encroach on the proposed Code C stands development footprint from the east for the 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events. These flood extents appear to originate from the existing slot drain systems serving the aircraft stands on Lima Taxiway to the east. No surface water flooding is shown from the existing car park surface water drainage system within the development boundary. It is likely that this car park surface water drainge system may not have been modelled. It is recommended that the existing surface water drainage system is modelled for the aforementioned design events to gain a representative picture of surface water flooding to the Code C stands development footprint. (ii) Proposed Code E Stands (north of proposed Lima Taxiway): Flood extents encroach on the proposed Code E stands footprint in the north-east corner and along the southern boundary for the 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events. These flood extents appear to originate from the surface water drainage systems serving the existing car parks located immediately north and within the development footprint. However, no surface water flooding is shown from the majority of the existing car park surface water drainage system within the development boundary. It is likely that this car park surface water drainge system may not have been modelled completely. It is recommended that the existing car park surface water drainage system is modelled for the aforementioned design events to gain a representative picture of surface water flooding to the Code E	Code C Stands = 6510 Code E Stands = 12120 **Note:** Polygon area of 25,000m^2 quoted in the GAL presentation titled "Gatwick Airport Master Plan Production Workshop" does not match area of the polygon illustrated in the presentation of approx. 45,615 m^2. The existing grassed area in the 45,615 m^2 polyon is 12,210m^2 but is not necessarily the area that could be lost.	Based on the CH2M fluvial modelling there are no flood extents present on the proposed Remote Parking Stands (Code C and Code E) and so no mitigation is recommeded within the development footprint itself. However, the nearby taxiway, namely Taxiway Sierra to the south is inundated with flood water from the 1 in 100 annual chance event and the 1 in 100 annual chance plus climate change event which could restrict accessability (depending on flood depths) to the proposed Taxiway Lima and therefore the proposed Code C and Code E stands during a major storm event. Given that it's open airfield at this location the options available are limited to the following: (1) Introduce a hard flood defence (e.g. flood walls) along the banks of the River Mole just downstream of the existing culvert under the runway to retain the flow in channel and prevent flooding of the airfield. This would prevent the flood extents encroaching on the aforementioned taxiway. This would be an expensive option but would offer the best fluvial flood protection to the airfield; (2) Employ bank raising along the River Mole to contain the water in channel and prevent it flooding the airfield. This would prevent the flood extents encroaching on Taxiway Sierra. This would offer similar protection to the aforementioned flood wall option; (3) An alternative to the aforementioned flood wall and bank raising options is to provide flood bunds just south of the proposed Boeing Hangar site application boundary (see Boeing Hangar entry further along in this table) and along the western boundary of the aggregate grading facility to the north-east of River Mole. This would contain the floodwaters in a reduced floplain and avoid encroachment of the fluvial flood waters onto Taxiway Sierra.	(1) The surface flooding from Taxiway Lima encroaching on the proposed Code C stands could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally at Taxiway Lima. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally at Taxiway Lima and preventing flood extents encroaching on the proposed Code C Stands development footprint. This also applies similarly to the proposed Code E stands for which surface water flood extents encroach from the adjacent car park faciltiy to the north; (2) For large return period and short duration storm events (i.e. high rainfall intensity) there will be an increased risk of surface water flooding as the surface water drainage system collection area at the ground surface has a fixed capacity to accept rainfall runoff. Surface water ponding on the stands could be mitigated through the provision of attenuation storage in the drainage system to contain additional flood water; (3) For large return period and long duration storm events (i.e. lower rainfall intensity but sustained rainfall) attenuation storage can be provided within the proposed drainage systems for the Code C and Code E stands to mitigate water surcharging the drainage system and encroching on the proposed stands. The attenuation provision can be an underground attenuation tank or oversized carrier drains/slot drains with a flow control device to limit the dischagre rate.	(1) Once outline/detailed design is commenced on the proposed Remote Parking Stands development a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and provide effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) Existing car parks are located within the proposed Code C and Code E stands development footprints. It does not appear that the existing car park surface water drainage systems have been modelled by CH2M. It is recommended that the existing car park surface water drainage system is modelled to understand the existing surface water flood risk and to determine the allowable discharge rates for the proposed developments (i.e. there are pockets of permeable area within the development boundary); (4) Given that existing permeable area will be lost as part of this proposed development potentially a project could be undertaken to identify redundant pavement across the airfield to balance the permeable/paved area split and to reduce the hydraulic loading on the airport drainage system which could improve drainage locally.; (5) With regards to the new substations required to support the proposed Code C and Code E stands a study must be undertaken to ensure these are located in an area of no flood risk. If this is not feasible then mitigation measures should be put in place to ensure flood resilience (e,g, raising critical equipment above floodwater levels, ensuring accessability to substations even during a flood event, etc.).
5	Push & Hold Stands	Push and Hold Stands will be for aircraft that are ready to push back but for whom there is not an immediately available runway slot to tie up stands and resources. Push and hold stands offer the opportunity to improve on-time performance, and maintain capacity. Departing aircraft can push back from stand, taxi to a hold point, close to the runway, and be ready to respond when a slot becomes available. According to GAL the current 130/140 stands are ideally located for push and hold operations. They are en-route to the runway from Piers 3, 4, 5, and 6 and are very close to the runway. The current 130/140 stands are located immedaitely south of Pier 6 and its associated stands. According to GAL the push and hold stands will be delivered in three phases – the first phase, for Summer 2019 will comprise 3 additional new stands at the western end. The existing stands are assumed to remain as is. However, the existing roadway, buildings and grassed areas in between the two sets of stands will require removal and replacement with a taxilane. The aforementioned grassed areas will be replaced with approx 1500m^2 of concrete. The total space will be approx. 86,000m^2. Approximately half of the stands will be equipped for de-icing operations in winter, with appropriate drainage and contaminant recovery systems.	Pond D	N	N	N	N	N	N	Y	Y	Y	The proposed Push and Hold stands are not impacted by fluvial flood extents for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change events from the Gatwick Stream. However, fluvial flood extents for the 1 in 100 annual chance plus climate change storm event get within 15m immediately north-east of the Push and Hold stands proposed taxilane development.	Existing 130/140 Stands to remain in operation as part of Push & Hold Stands development: The existing 130 and 140 stands are subject to the encroachment of surface water flood extents for the 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events. The 140 stands in particular are subject to significant surface water flood extents for the aforementioned flood events with a large portion of the stand area (eastern half) inundated with surface water from the "back-of-stand" slot drain. Push & Hold Stands - Proposed Taxilane: The 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift flood extents from an existing slot drain serving the 130/140 stands crosses diagonally through the proposed footprint of the Push and Hold Stands taxilane. A small flood extent for the 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift also encroaches on the proposed taxilane boundary from the existing surface water slot drain serving the 140 Stands located south of the proposed taxilane footprint. Push & Hold Stands - Proposed Additional Stand Area: The proposed additional stand area footprint is located immediately outside the 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift flood extents from an existing slot drain serving the 130/140 stands. The extremity of the flood extents just touch the boundary of the additional area footrpint boundary	5968	Based on the CH2M fluvial modelling there are no flood extents present on the proposed Push and Hold stands footprint and so no mitigation is recommeded within the development footprint itself. However, the nearby taxiways, namely Taxiway Kilo to the north in addition to Taxiway Papa and Taxiway November to the east are inundated with flood water from the 1 in 75 annual chance event up to the 1 in 100 annual chance plus climate change event which could restrict accessability (depending on flood depths) to the proposed Push and Hold Stands during a major storm event. Given that it's open airfield at this location the options available are limited to the following: (1) Introduce a hard flood defence (e.g. flood wall) along the left-hand bank of the Gatwick Stream to retain the flow in channel and prevent flooding of the airfield. This would prevent the flood extents encroaching on the aforementioned taxiways. This would be an expensive option but would offer the best fluvial flood protection to the airfield; (2) Employ bank raising along the Gatwick Stream to contain the water in channel and prevent it flooding the airfield. This would prevent the flood extents encroaching on the aforementioned taxiways. This would offer similar protection to the aforementioned flood wall.	(1) The surface flooding at the existing 130/140 stands could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally; (2) For large return period and short duration storm events (i.e. high rainfall intensity) there will be an increased risk of surface water flooding as the surface water drainage system collection area at the ground surface has a fixed capacity to accept rainfall runoff. Surface water ponding on the stands could be mitigated through the provision of attenuation storage in the drainage system to contain additional flood water; (3) For large return period and long duration events (i.e. lower rainfall intensity but sustained rainfall) if the existing surface water drainage system has insufficient attenuation to contain large volumes of surface water runoff (i.e. resulting in surcharging the drainage system and flooding the airfield) then an option may be to retrofit the drainage system as part of the proposed Push and Hold Stands development and employ increased attenuation storage on the drainage system (e.g. offline underground attenuation storage tank, replace drainage system with larger capacity system, etc.) thereby reducing the risk of surface water surcharging the drainage system and flooding the airfield ground surface.	(1) Once outline/detailed design is commenced on the proposed Push and Hold Stands a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and proivde effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) Given that existing permeable area will be lost as part of this proposed development potentially a project could be undertaken to identify redundant pavement across the airfield to balance the permeable/paved area split and to reduce the hydraulic loading on the drainage system which could improve drainage locally; (4) The footprint of the proposed Push and Hold Stands development is crossed by existing surface water sewers. Consideration should therefore be given to re-routing these sewers around the footprint of the new development, although this would require a detailed assessment of feasibility. If this is not possible then the hydraulic capacity and structural integrity of the sewers should be assessed to confirm, that they can withstand the additional loading, but the development could have an impact on the ability of GAL to maintain these sewers.
6	Lima Taxiway	This project will extend the existing Lima Taxiway to link Tango and Uniform Taxiways together at their northern ends. This will ease congestion on the Juliet taxiway, improve the efficiency of routings, and facilitate the creation of a north/south split of the airfield for the tower controllers to improve capacity. Space is being safeguarded to the south of the Lima Taxiway for the provision of 6 proposed Code C stands and to the north for the provision of 5 proposed Code E stands, if and when required (previously described under "Remote Parking Stands"). According to GAL the project will comprise of 62,000m^2 of concrete. The proposed Lima Taxiway developmnet location is currently a car parking facility which is primarily paved. However, there will be a loss of small pockets of existing permeable areas and replacement with the aforementioned concrete paving. This project is currently programmed to commence in 2020 and be complete in 2022. The project will include the relocation of 4 substations.	Pond D	N	N	N	N	N	N	Y	Y	Y	The proposed Lima Taxiway footprint is not impacted by fluvial flood extents for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change events from the River Mole. However, the fluvial flood extents for the 1 in 100 annual chance plus climate change event get within approx. 20m to the east and 30m to the south of the proposed development footprint on Taxiway Union. This potential flooding of Taxiway Union could limit access to the proposed Lima Taxiway depending on the flood depths.	Flood extents encroach on the proposed Lima Taxiway development footprint from the east for the 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events. The flood extents only affect a small portion of the development footprint in the east. These flood extents appear to originate from the existing slot drain systems serving the aircraft stands on Lima Taxiway to the east of the proposed development. No surface water flooding is shown from the existing car park surface water drainage system within the development boundary. However, it is likely that this car park surface water drainge system may not have been modelled. It is recommended that the existing car park surface water drainage system is modelled for the aforementioned design events to gain a representative picture of surface water flooding within proposed Lima Taxiway development footprint.	3045	Based on the CH2M fluvial modelling there are no flood extents present on the proposed Taxiway Lima footprint and so no mitigation is recommeded within the development footprint itself. However, the nearby taxiway, namely Taxiway Sierra to the south is inundated with flood water from the 1 in 100 annual chance event and the 1 in 100 annual chance plus climate change uplift storm event which could restrict accessability (depending on flood depths) to the proposed Taxiway Lima during a major storm event. Given that it's open airfield at this location the options available are limited to the following: (1) Introduce a hard flood defence (e.g. flood walls) along the banks of the River Mole just downstream of the existing culvert under the runway to retain the flow in channel and prevent flooding of the airfield. This would prevent the flood extents encroaching on the aforementioned taxiway; (2) Employ bank raising along the River Mole to contain the water in channel and prevent it flooding the airfield. This would prevent the flood extents encroaching on Taxiway Sierra. This would offer similar protection to the aforementioned flood wall; (3) An alternative to the aforementioned flood wall and bank raising options is to provide flood bunds just south of the proposed Boeing Hangar site application boundary (see Boeing Hangar entry further along in this table) and along the western boundary of the aggregate grading facility to the north-east of River Mole. This would contain the floodwaters in a reduced floplain and avoid encroachment	(1) The surface flooding from the existing Taxiway Lima to the east encroaching on the proposed Taxiway Lima could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally at Taxiway Lima. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally at Taxiway Lima and preventing flood extents encroaching on the proposed Taxiway Lima development footprint; (2) For large return period and short duration storm events (i.e. high rainfall intensity) there will be an increased risk of surface water flooding as the proposed surface water drainage system collection areas at the ground surface will have a fixed capacity to accept rainfall runoff. Surface water modelling of the proposed drainage systems should be undertaken to assess the movement of the surface water that evades the drainage system at the ground surface such that design measures can be employed. For example the ground can be profiled to fall certain directions away from less critical areas to eventually drain into the drainage system, etc). Also, potential surface water ponding on the stands could be mitigated through the provision of attenuation storage in the drainage system to contain additional flood water; (3) For large return period and long duration storm events (i.e. lower rainfall intensity but sustained rainfall) attenuation storage can be provided within the proposed drainage systems for the proposed Taxiway Lima to mitigate surface water surcharging the proposed drainage system and encroching on the proposed development. The attenuation provision can be an underground attenuation tank or oversized carrier drains/slot drains with a flow control device to limit the dischagre rate.	(1) Once outline/detailed design is commenced on the proposed Lima Taxiway development a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and provide effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) An existing car park is located within the proposed Lima Taxiway development footprint. It does not appear that the existing car park surface water drainage system has been modelled by CH2M. It is recommended that the existing car park surface water drainage system is modelled to understand the existing surface water flood risk and to determine the allowable discharge rates for the proposed Lima Taxiway development (i.e. there are pockets of permeable area within the development boundary); (4) Given that existing permeable area will be lost as part of this proposed development potentially a project could be undertaken to identify redundant pavement across the airfield to balance the permeable/paved area split and to reduce the hydraulic loading on the drainage system which could improve drainage locally; (5) With regards to the relocation of 4 existing substations a study must be undertaken to ensure these are relocated to an area of no flood risk. If this is not feasible then mitigation measures should be put in place to ensure flood resilience (e,g, raising critical equipment above floodwater levels, ensuring accessability to substations even during a flood event,

Proposed Development Number	Proposed Development	Development Works	Surface Water Drainage Catchment	Fluvial Flood Risk						Surface Water Flood Risk			Potential Flooding Description		Existing Permeable Areas Loss	Potential Flood Mitigation Options		Recommendations
				Storm Return Period						Storm Return Period								
				5yr	20yr	50yr	75yr	100yr	100yr+20% CC	10yr	100yr	100yr+20% CC	Fluvial	Surface Water		Fluvial	Surface Water	
															(m^2)			
7	Domestic/CTA Baggage Reclaim (South Terminal)	The proposed Domestic/CTA Baggage Reclaim will be located immediately to the south-east corner of Pier 1 on the South Terminal. The development provides a new baggage reclaim hall & VCC at level 10. A separate exit leading to the Pier 1 corridor to link back to the South Terminal is proposed. The airside road will require realignment and the perimeter fence to east repositioned to accomodate the new development.The proposed CTA Baggage Reclaim building will have a footprint of 470m^2 according to the GAL presentation titled "Gatwick Airport Master Plan Production Workshop" from the 4th May 2017.	Pond D	N	N	Y	Y	Y	Y	Y	Y	Y	The proposed Domestic/CTA Baggage Reclaim building footprint is not impacted by fluvial flood extents for the 1 in 5 annual chance and 1 in 20 annual chance events from the Gatwick Stream. However, fluvial flood extents for the 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events encroach on the proposed Domestic/CTA Baggage Reclaim building footprint completely surrounding the proposed development.	Surface water flood extents for the 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events encroach on the proposed Domestic / CTA Baggage Reclaim building footprint.The surface water flooding originates from the existing surface water drainage system that serves a portion of the airfield in the east in the vicinity of the proposed Domestic / CTA Baggage Reclaim facility.	Google aerial imagery from 2017 indicates that this site is presently a paved/brownfield site. The GIS World Imagery basemap illustrates the presence of a building. However, it is understood that this basemap is outdated and the building has been demolished recently.	(1) Introduce a hard flood defence (e.g. flood wall) along the left-hand bank of the Gatwick Stream to retain the flow in channel and prevent flooding of the airfield.This would be an expensive option but would offer the best fluvial flood protection to the airfield; (2) Instead of a flood wall employ bank raising along the Gatwick Stream to contain the water in channel and prevent it flooding the airfield. This would offer a similar level of protection as the hard flood defence in Point (1). If the options to provide a flood wall or bank raising along the Gatwick Stream are not pursued then the following less expensive mitigation options could be considered: (3) The propsoed CTA Baggage Reclaim building could be designed with added resilience to fluvial flooding (e.g. increased floor level thresholds, placement of critical assets above fluvial flood water levels, etc.). Accessability to the Domestic / CTA Baggage Reclaim facility would have to be looked into in the event of a major fluvial flood event; (4) Demountable flood defences could also be stored on site and employed where appropriate (e.g. doorways) in the event of a flood event to limit flood inundation of the building interior. This would be a last resort mitigation measure in the event of a major flood event. An assessment to identify potential underground flowpaths (e.g. cable	(1) The surface flooding from the existing airfield and buildings drainage encroaching on the proposed CTA could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally at the CTA site. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally at the CTA site and preventing flood extents encroaching on the proposed CTA Baggage Reclaim development footprint; (2) For large return period and short duration storm events (i.e. high rainfall intensity) there will be an increased risk of surface water flooding as the proposed surface water drainage system collection areas at the ground surface will have a fixed capacity to accept rainfall runoff. Surface water modelling of the proposed drainage systems should be undertaken to assess the movement of the surface water that evades the drainage system at the ground surface such that design measures can be employed and to assess the feasibility of providing storage elsewhere to mitigate flood risk from the surface water drainage system. For example the ground can be profiled to fall certain directions away from less critical areas to eventually drain into the drainage system after the storm event has passed, etc); (3) For large return period and long duration storm events (i.e. lower rainfall intensity but sustained rainfall) attenuation storage can be provided within the proposed building and road drainage systems for the proposed CTA Baggage Reclaim development to mitigate surface water surcharging the proposed drainage system and encroching on the proposed development. The attenuation provision can be an underground attenuation tank or oversized carrier drains/slot drains with a flow control device to limit the dischagre rate.	(1) Once outline/detailed design is commenced on the proposed CTA Baggage Reclaim building a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and proivde effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) Potentially a project could be undertaken to identify redundant pavement across the airfield to reduce the hydraulic loading on the drainage system which could improve drainage locally at the proposed development location.
8	Long Stay Car Parking	The existing Long Stay Car Parking facilities are located east of the A23 and railway line. GAL propose to provide decked car parking facilities for long-stay car parking as it offers the potential to increase the number of long-stay spaces within the existing car park footprint. Phase 1 of this development is planned for the South Terminal car parking zones in 2018. Phase 1 in 2017/18 will comprise of: (i) The provision of 1,123 decked spaces (net gain of 981 self-parking spaces) in Zone G of the South Terminal long stay parking. (ii) Existing passenger bus operations are assumed to continue without change.	Pond G	-	-	-	-	-	-	-	-	-	The proposed long-stay car parking facility footprint within the existing Zone G is located outside the main airfield. The car park appears to be outside the flood extents of the Gatwick Stream for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and the 1 in 100 annual chance plus climate change uplift events. However, looking at Google maps it appears that there may be a series of drainage ditches/small watercourse which may not have been modelled yet. If not it is recommended that these drainage dithces are assessed to understand the existing flood risk to the Zone G car parking facility.	The proposed long-stay car parking facility footprint within the existing Zone G cap park is located outside the main airfield. It doesn't appear that a surface water drainage model has been built for the existing Zone G car park and the adjacent car parks surface water drainage systems. It is recommended that this is undertaken to gain an understanding of the existing surface water flood risk to the Zone G car park and to understand the allowable discharge rates for the proposed development.	Google aerial imagery of the development area (i.e. existing car park) shows that its currently fully paved. No net gain in paved area. **Note**: Also, no increase in paved area to be drained as the majority of the decked levels, with the exception of the top-most deck, will remain dry being sheltered by the deck levels above and the building façade.	Based on the CH2M fluvial modelling there are no flood extents from the nearby Gatwick Stream present on the proposed decked long-stay car parking site (i.e. existing Zone G) and so no mitigation is recommeded within the development footprint itself. However, according to Google aerial imagery there are potentially some local drainage ditches nearby which may not have been modelled as they are a distance outside the main airfield. It is recommneded that these are verified and if so modelled to assess the potential flood risk and determine if any flood protection measures are required.	(1) It does not appear that the existing surface water drainage system serving this existing car parking site has been developed due to the lack of flood extents for large return period storm events such as the 1 in 100 annual chance event plus climate change uplift. It is therefore recommended that a surface water drainage model of the existing car park surface water drainage system is developed to understand the existing flood risk and to facilitate the determination of the allowable discharge rate for the proposed decked long-stay car park development; (2) When designing the surface water drainage system the proposed long stay multi-storey car park development the discharge rate must not exceed the existing site runoff rate; (3) Pollution control measures will be required as vehicles will be stationary on the top deck of the facility which will be exposed to rainfall which could wash engine oils, petroleum, lubricants, etc. off the ground surface and into the drainage system. The lower decks will also require pollution control measures due to wet cars entering the facility and wind blown rain.	(1) Once outline/detailed design is commenced on the proposed Long Stay Car Park development a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and provide effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) The proposed long stay car park development is located outside the main airfield and therefore fluvial flood modelling undertaken by CH2M. It is recommended that any minor watercourses/drains are identified and if found to be present are modelled to understand fluvial flood risk to the proposed long stay car park development; (4) The proposed long stay development is located outside the main airfield and therefore outside the scope of the surface water drainage flood modelling undertaken by CH2M. It is recommended that the existing car park surface water drainage system is modelled to understand the existing surface water flood risk and to determine the allowable discharge rate for the proposed long stay car park
9	Multi-Storey Car Park 4	This project would create approximately 1,200 spaces in a multi-storey car parking structure on the site of a current high-sided vehicle car park adjacent to the other South Terminal multi-storey car parks. No firm development plans have been seen by Jacobs to inform this high level flood risk assessment. Only a broad-brush boundary has been provided as shown in the GAL presentation titled "Gatwick Airport Master Plan Production Workshop" dated 4th May 2017. Based on this broad-brush boundary there will be a loss of small pockets of existing permeable areas and replacement with paved surfacing. GAL Assumptions include: (i) 1,200 spaces (11.5m^2 per space); (ii) 5 storeys (6 floors); (iii) No requirement for flood attenuation in South Terminal.	Pond F	N	N	N	N	N	N	-	-	-	The proposed Multi-Storey Car Park 4 facility boundary polygon is located outside the main airfield. The car park appears to be outside the flood extents of the Gatwick Stream for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and the 1 in 100 annual chance plus climate change uplift events. However, looking at Google maps aerial imagery it appears that there may be a series of drainage ditches/small watercourse which may not have been modelled yet. If not it is recommended that these drainage dithces are assessed to understand the existing flood risk within and around the proposed Multi-Storey Car Park facility boundary polygon.	The proposed Multi-Storey Car Park 4 facility boudary polygon is located outside the main airfield. There is an existing car parking facility located within the boundary polygon for MSCP 4. It doesn't appear that a surface water drainage model has been built for the existing car park surface water drainage system. It is recommended that this is undertaken to gain an understanding of the existing surface water flood risk and to understand the allowable discharge rates for the proposed development.	2018 **Note:** the MSCP4 polygon is only a loose boundary and not a fixed development footprint. Therefore, it is potentially subject to change.	Based on the CH2M fluvial modelling there are no flood extents from the nearby Gatwick Stream present on the proposed multi-storey car park 4 site boundary and so no mitigation is recommended within the development footprint itself. However, according to Google aerial imagery there are some local drainage ditches nearby which may not have been modelled as they are a distance outside the main airfield. It is recommended that these are modelled to assess the potential flood risk and determine if any flood protection measures are required.	(1) It does not appear that the existing surface water drainage system serving this existing car parking site has been developed due to the lack of flood extents for large return period storm events such as the 1 in 100 yannual chance event plus climate change uplift. It is therefore recommended that a surface water drainage model of the existing car park surface water drainage system is developed to understand the existing flood risk and to facilitate the determination of the allowable discharge rate for the proposed Multi-Storey Car Park 4 development; (2) When designing the surface water drainage system the proposed Multi-Storey Car Park 4 development attenuation storage must be provided to restrict the discharge rate to the existing site condition runoff rate (e.g. the existing site has a combination of permeable and paved area whereas the proposed development is likely to be completely paved with increased runoff rates). Attenuation storage could be provided in the form of an underground attenuation tank, oversized carrier drains, etc; (3) Pollution control measures will be required as vehicles will be stationary on the top deck of the facility which will be exposed to rainfall which could wash engine oils, petroleum, lubricants, etc. off the ground surface and into the drainage system. The lower decks will also require pollution control measures due to wet cars entering the facility and wind blown rain.	(1) Once outline/detailed design is commenced on the proposed MSCP 4 development a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and provide effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) The proposed MSCP 4 development is located outside the main airfield and therefore fluvial flood modelling undertaken by CH2M. It is recommended that any minor watercourses/drains are identified and if found to be present are modelled to understand fluvial flood risk to the proposed MSCP 4 development; (4) The proposed MSCP 4 development is located outside the main airfield and therefore outside the scope of the surface water drainage flood modelling undertaken by CH2M. It is recommended that the existing car park surface water drainage system is modelled to understand the existing surface water flood risk and to determine the
10	Multi-Storey Car Park 7	GAL currently assume that this project would create approximately 3,168 spaces in a multi-storey car parking structure on the site of an existing car park located north of the North Terminal building. No firm development plans have been seen by Jacobs to inform this high level flood risk assessment. Only a broad-brush boundary has been provided as shown in the GAL presentation titled "Gatwick Airport Master Plan Production Workshop" dated 4th May 2017. Based on this broad-brush boundary there will be no loss of permeable areas as the present car park site appears to be paved according to aerial imagery. GAL current assumptions: (i) 7 storeys (8 floors); (ii) 3,168 spaces (each space assumed 11.5m^2); (iii) Link bridge to North Terminal = 100m x 7m with travelators; (iv) Flood attenuation tank underneath = 4,000m^2 / 2,900m^3.	Pond D	N	N	N	N	N	N	Y	Y	Y	The proposed Multi-Storey Car Park 7 boundary polygon appears to be outside the flood extents of the Gatwick Stream for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and the 1 in 100 annual chance plus climate change uplift events.	Surface water flood extents for the 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events encroach upon the proposed Multi-Storey Car Park 7 facility boudary polygon. This surface water flooding appears to originate from the existing surface water drainage system (likely to be slot drains) serving the aircraft stands at Pier 5 near the North Terminal flowing east to the MSCP 7 site. There is an existing car parking facility located within the boundary polygon for MSCP 7. It doesn't appear that a surface water drainage model has been built for the existing car park surface water drainage system. It is recommended that this is undertaken to gain an understanding of the existing surface water flood risk and to understand the allowable discharge rate for the proposed development. **Note:** surface water flood extents are shown on existing building locations. This is so as generally buildings are modelled as areas of increased roughness as opposed to the buidlings providing a complete barrier to the floodwaters. In reality water will still flow through the buildings just at a slower rate.	Google aerial imagery suggests that this development area (i.e. existing car park) is currently completely paved. No net gain in paved area. **Note:** Also, no increase in paved area to be drained as the majority of the decked levels, with the exception of the top-most deck, will remain dry being sheltered by the deck levels above and the building façade.	Based on the CH2M fluvial modelling there are no flood extents from the nearby Gatwick Stream and River Mole present on the proposed Multi-Storey Car Park 7 site boundary and so no fluvial flood mitigation is recommended for this development.	(1) It does not appear that the existing surface water drainage system serving this existing car parking site has been developed The flood extents shown appear to be from the Pier 5 vicinity to the west. It is therefore recommended that a surface water drainage model of the existing car park surface water drainage system is developed to understand the existing flood risk and to facilitate the determination of the allowable discharge rate for the proposed multi-storey car park development; (2) The surface flooding from the existing Pier 5 to the west encroaching on the proposed MSCP 7 site could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally at Pier 5. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally at the Pier 5 stands and preventing flood extents encroaching on the proposed MSCP 7 development footprint; (3) Discharge rates from the proposed MSCP 7 development should be similar to the existing car park given that the exposed deck at the top of the proposed MSCP 7 should have a similar area to the existing car park footprint. Attenuation storage required if betterment in the runoff rates is sought over the existing site paved area (e.g. greenfield runoff rates). The ground level deck should be considered for the placement of attenuation storage (e.g. easier accessability for maintenance, etc.); (4) Pollution control measures will be required as vehicles will be stationary on the top deck of the facility which will be exposed to rainfalll which could wash engine oils, petroleum, lubricants, etc. off the ground surface and into the drainage system. The lower decks will also require pollution control measures due to wet cars entering the facility and wind blown rain.	(1) Once outline/detailed design is commenced on the proposed MSCP 7 development a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and provide effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) It does not appear that the existing car park drainage within the footprint of the proposed MSCP 7 development has been modelled by CH2M. It is recommended that the existing car park surface water drainage system is modelled to understand the existing surface water flood risk and to determine the allowable discharge rate for the proposed MSCP 7 development; (4) The footprint of the proposed MSCP 7 development is crossed by a large (approximately 3m) diameter surface water sewer which conveys runoff from a large part of the airport to Pond D. Pond D is the most critical surface water drainage pond in the network and it would be advisable to avoid having such a critical asset beneath MSCP 7. Consideration should therefore be given to re-routing the sewer around the footprint of the new development, although this would require a detailed assessment of feasibility. If this is not possible then the hydraulic capacity and structural integrity of the sewer should be assessed to confirm, that it can withstand the additional loading, but the development
11	Boeing Hangar	The proposed Boeing Hangar development site application boundary is located immediately south of Pond M on a primarily greenfield site. Looking at the development drawings and google imagery the proposed development will pave over the upsteam catchment of Man's Brook and the Brook itself. The proposed development will include an aircraft hangar, paved access roads and paved service yard in front and around the proposed hangar. A new substation is proposed as part of the development (shown north of the proposed aircraft hangar). Looking at the 3D imagery for the proposed development small pockets of permeable area will be retained as landscaped areas around the proposed development site.	River Mole and / or Man's Brook (Greenfield site presently)	N	N	N	Y	Y	Y	Y	Y	Y	The proposed Boeing Hangar footprint and wider site application boundary is not impacted by fluvial flood extents for the 1 in 5 annual chance, 1 in 20 annual chance and 1 in 50 annual chance events from the nearby River Mole. Fluvial flood extents for the 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change events from the River Mole encroach on the proposed Boeing Hangar footprint and the wider site application boundary. The River Mole is located a short distance south of the proposed development and so the fluvial flood extents flow in a south to north direction across the proposed development site and ending up on Taxiway Union. The 1 in 100 annual chance plus climate change uplift flood extents cover a large majority of the proposed development application site boundary. It is noted that a small watercourse known as Man's Brook flows through the site. There appear to be no flood extents from Man's Brook up to and including the 1 in 100 annual chance plus climate change uplift event. This appears an unlikely scenario and it may be that the watercourse has not been modelled. If not then it is recommended that the watercourse is modelledto gain a fully informed understanding of fluvial flood risk to the proposed Boeing Hangar development.	The proposed Boeing Hangar development site is primarily greenfield and so it is assumed that there is no formal surface water drainage system in place from which surface water flooding can occur. The greenfield site likely drains to the nearby Man's Brook. Surface water flood extents for the 1 in 10 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift encroach on a small portion of the north-east corner of the site application boundary. This surface water flooding appears to originate from the existing surface water drainage system serving the aircraft stands on the nearby Taxiway Union to the east. Based on the proposed development plans for the Boeing Hangar development (Drawing No. 777-D5A-00-XX-DR-A-010-0002 developed by Mott McDonald) a proposed access road would be subjected to this potential surface water flooding.	The potential permeable area that could be lost has not been determined for the Boeing hangar development. Without the proposed development technical drawings in CAD (PDF drawings are available and have been used in this assessment) one cannot accurately assess the loss of permeable area.	Based on the CH2M fluvial modelling fluvial flood extents for the 1 in 75 annual chance, 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events extend from south to north from the River Mole across the proposed hangar site. To prevent this fluvial flooding encroaching on the proposed development the following flood mitigation measures could be employed: (1) Introduce a hard flood defence (e.g. flood walls) along the banks of the River Mole just downstream of the existing culvert under the runway to retain the flow in channel and prevent flooding proposed development site. This would be an expensive option but would offer the best fluvial flood protection to the airfield; (2) Employ bank raising along the River Mole to contain the water in channel and prevent it flooding the proposed development site. This would offer similar protection to the aforementioned flood wall; (3) A less expensive alternative to the aforementioned hard flood defence and bank raising options on the River Mole is to provide flood bunds immediately south of the proposed Boeing Hangar site application boundary and along the wesern boundary of the aggregate grading facility to the north-east of River Mole. This would contain the floodwaters in a reduced flooplain and avoid encroachment of the	(1) The surface flooding from Taxiway Union could be arising from the drainage system being at capacity further downstream (i.e. backing up) and preventing effective drainage locally at Taxiway Union. An exercise could be undertaken to identify redundant pavement across the airport which can be removed and returned to permeable surfacing, reducing runoff into the downstream drainage system thereby reducing backing up and potentially promoting more effective drainage locally at Taxiway Union and preventing flood extents encroaching on the proposed Boeing Hangar site application boundary; (2) A flood bund could be provided at the north-eastern boundary of the application site boundary to form a barrier against the potential surface water flood extents encroaching on the Boeing Hangar site boundary; (3) Given that the proposed hangar development will be using significant paved areas on a presently greenfield site attenuation storage will be required to facilitate the restriction of the surface water discharge rates to greenfield runoff rates. Attenuation could be provided in the form of an underground tank and/or oversized carrier drains/slot drains.	(1) It appears that fluvial flood modelling may not have been undertaken of Man's Brook (i.e. no fluvial flood extents present up to and including the 1 in 100 annual chance plus climate change uplift event from this watercourse). Only fluvial flood extents from the River Mole appear to be present. If this modelling of Man's Brook has not been undertaken then it is recommended that it is done to understand the fluvial flood risk (if any) to the proposed Boeing Hangar development from Man's Brook; (2) According to the development drawings it appears that the upstream end of Man's Brook will be paved over by the proposed Boeing Hangar development. Without site visit knowledge of this specific location we are unsure if there is a further upstream catchment to Man's Brook that needs to be culverted or routed around the proposed Boeing Hangar development. If this has not already been assessed (i.e.not clear from the present development drawings) then it is recommended that the catchment area to Man's Brook is understood and if any measures such as a culvert or re-routed channel are required to maintain the flow conveyance associated with any upstream catchment area; (3) With regards to the proposed surface water drainage system for the Boeing Hangar development a form of attenuation storage will be required (e.g. underground tank, pond, oversized carrier drains, etc.) to facilitate the restriction of the discharge rate to greenfield runoff rates since existing site is primarily greenfield. The presence of any proposed attenuation storage is not clear on the development drawings made available
12	South Terminal Car Rental Re-location	There is limited information available on the South Terminal car rental facility relocation at present. There is only a single presentation slide available (i.e. in GAL presentation titled "Gatwick Airport Master Plan Production Workshop" from 04/05/2017 - Slide 24) which presents a basic layout of the proposed car rental facility. The proposed development appears that it will be developed within the footprint of the existing Courtlands Parking facility which is enclosed by Buckingham Gate to the north and Balcombe Road to the east. The existing parking facility is primaily paved with some very small pockets of permeable areas that could potentially be lost should the proposed South Terminal car rental development go ahead (i.e. based on the basic layout in the GAL presentation it appears that the proposed car rental development will be completely paved). Based on the GAL presentation basic layout the proposed development will include the following: (i) Car maintenance bays; (ii) Car wash facilities; (iii) Fuel canopy (with 12 fuelling positions); (iv) Car rental spaces area (approx. 260 spaces); (v) Bus pick-up and drop-off area; (vi) Customer service building	Unknown - Not located within a delineated pond catchment boundary. (Pond F and Pond G catchment boundaries are located immediately north and west of Car Rental location respectively though)	N	N	N	N	N	N	-	-	-	The proposed South Terminal Car Rental facility boundary polygon is located outside the main airfield to the east. The car park appears to be outside the flood extents of the Gatwick Stream for the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance, 1 in 75 annual chance, 1 in 100 annual chance and the 1 in 100 annual chance plus climate change uplift events. However, looking at Google Maps it appears that there may be a few drainage ditches which may not have been modelled yet. If not it is recommended that these drainage dithces are assessed to understand the existing flood risk to the proposed development.	The proposed South Terminal Car Rental facility boudary polygon is located outside the main airfield to the east. The proposed car rental facility site is an existing car parking facility. It doesn't appear that a surface water drainage model has been built for the existing car park surface water drainage system. It is recommended that this is undertaken to gain an understanding of the existing surface water flood risk and to understand the allowable discharge rate for the proposed development.	285	Based on the CH2M fluvial modelling there are no flood extents from the nearby Gatwick Stream present on the proposed South Terminal Car Rental facility site boundary and so no mitigation is recommended within the development footprint itself. However, according to Google aerial imagery there are some local drainage ditches nearby which may not have been modelled as they are a distance outside the main airfield. It is recommended that these are modelled to assess the potential flood risk and determine if any flood protection measures are required.	(1) It does not appear that the existing surface water drainage system serving this existing car parking site has been developed due to the lack of flood extents for large return period storm events such as the 1 in 100 annual chance event plus climate change. It is therefore recommended that a surface water drainage model of the existing car park surface water drainage system is developed to understand the existing flood risk and to facilitate the determination of the allowable discharge rate for the proposed development; (2) When designing the surface water drainage system the car rental development attenuation storage may be required to restrict the discharge rate to the existing site condition runoff rate (e.g. the existing site has small pockets of permeable and paved area whereas the proposed development is likely to be completely paved with marginally increased runoff rates). Attenuation storage could be provided in the form of an underground attenuation tank, oversized carrier drains, etc; (3) Pollution control measures will be required as a fuel canopy is proposed, car washing facilities and car maintenace bays are proposed which could release engine oils, petroleum, lubricants, etc. to the ground surface which could be washed into the drainage system during a storm event. The proposed fule station will require a full retention interceptor and a connection to the existing foul drainage system due to the potential for serious contamination.	(1) Once outline/detailed design is commenced on the proposed South Terminal Car Rental development a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and provide effective surface water drainage of the site); (2) As part of the FRA/drainage strategy study it is recommended that a study is undertaken into the feasibility of attenuation storage at the proposed development site to benefit the wider drainage capacity in the downstream surface water drainage system; (3) The proposed car rental re-location development is located outside the main airfield and therefore outside the scope of the fluvial flood modelling undertaken by CH2M. It is recommended that any minor watercourses/drains are identified and if found to be present are modelled to understand fluvial flood risk to the proposed car rental facility development; (4) The proposed car rental re-location development is located outside the main airfield and therefore outside the scope of surface water drainage flood modelling undertaken by CH2M. It is recommended that the existing car park surface water drainage system is
13	Gatwick Airport Rail Station Extension	The report "Gatwick Airport Station Development - Single Option Concept Report" (Report No. 142637-COT-REP-EAR-000001) originated by the Gatwick Airport Station Development (GASD) team which describes the concept design. The proposed Gatwick Railway Station development will inlcude the introduction of a new concourse in the space between the existing GAL Northern and Southern footbridges in addition to the South Terminal Bulding and PTI to the west and east respectively. The proposed concourse floor plate will be elevated above track level and will likely tie into the floor level of the South Terminal building. The roof for the proposed development will span between the existing GAL Northern footbridge and the GAL Southern footbridge. The concept report has enabled the determination of approximate concourse and roof layout polygons to be generated to assess the flood risk to the proposed development.	Unknown - Not located within a delineated pond catchment boundary. (Pond F and Pond D catchment boundaries are located immediately east and west of the Railway Station complex respectively though)	N	N	N	N	Y	Y	N	Y	Y	The Gatwick Stream is culverted from approx. 100m upstream of the South Terminal building to approx. 215m downstream of the South Terminal building. The floodwaters go out of bank at the upstream culvert headwall, flow west and subsequently north across the airfield and towards the South Terminal building. The proposed rail station concourse and roof layout polygons are not encroached upon by the 1 in 5 annual chance, 1 in 20 annual chance, 1 in 50 annual chance and 1 in 75 annual chance events from the Gatwick Stream. Fluvial flood extents from the Gatwick Stream encroach on the proposed concourse and roof layout polygons for the 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events. However, the proposed new concourse will be above the railway track level with the proposed roof further elevated above the concourse and so should be above any potential fluvial floodwaters. **Note:** fluvial flood extents are shown on existing building locations. This is so as generally buildings are modelled as areas of increased roughness as opposed to the buidlings providing a complete barrier to the floodwaters. In reality water will still flow through the buildings just at a slower rate.	The Gatwick Airport Rail Station proposed concourse and roof footprint polygons are not encroached upon by the 1 in 10 annual chance event surface water flood extents. Surface water flood extents encroach on a small portion of the proposed concourse and roof layout polygons for the 1 in 100 annual chance and 1 in 100 annual chance plus climate change uplift events. However, the proposed new concourse will be above the railway track level with the proposed roof further elevated above the concourse and so should be above the surface water flood extents shown (i.e. flooding at ground level). **Note:** surface water flood extents are shown on existing building locations. This is so as generally buildings are modelled as areas of increased roughness as opposed to the buidlings providing a complete barrier to the floodwaters. In reality water will still flow through the buildings just at a slower rate.	3229	Based on the CH2M fluvial modelling there are minimal flood extents for the 1 in 100 annual chance and 1 in 100 annual chance event plus climate change uplift from the nearby Gatwick Stream present on the Gatwick Rail Station proposed concourse and roof polygons. However, these developments are likely to be elevated above any such fluvial extents as the concourse and roof will be elevated above track level (i.e. the fluvial flood extents will flow along ground level and potentially track level). If the potential proposed fluvial flood protection measures described previously along the Gatwick Stream (e.g. the flood wall and the bank raising) with regards to the other proposed developments the aforementioned flood extents could potetnailly be eliminated from the Gatwick Airport Rail Station proposed concourse and roof location.	(1) It does not appear that the surface water drainage system serving the existing GAL North and South footbridges and Rail Station Building has been developed due to the lack of surface water flood extents for large return period storm events such as the 1 in 100 annual chance event plus climate change. It is therefore recommended that a surface water drainage model of the existing aforementioned surface water drainage systems are developed to understand the existing flood risk; (2) When designing the proposed surface water drainage system for the proposed rail station extension roof attenuation storage will be required to restrict the discharge rate to the existing site condition runoff rate (e.g. the existing site has permeable brownfield and paved areas whereas the proposed development is likely to have a roof structure with increased runoff rates). Attenuation storage could be provided in the form of an underground attenuation tank, oversized carrier drains, etc. the feasability of which will have to be assseseed at concept design stage. The proposed roof structure could also be designed as a green roof which would limit the amount of runoff directly to the surface water drainage system (e.g. absorption and evapotraspiration).	(1) Once outline/detailed design is commenced on the proposed Rail Station expansion a detailed Flood Risk Assessment (FRA) and surface water drainage strategy will need to be developed to inform the proposed development design (i.e. mitigate flood risk and provide effective surface water drainage of the site); (2) Given that the existing permeable area (i.e. brownfield ground between and adjacent to platforms) will be sheltered by the proposed roof for the new station expansion eliminating any infiltration a surface water runoff model should be built of the existing site condition to inform the allowable discharge rate and attenuation storage requirements for the proposed development; (3) Given that existing permeable area will be sheltered (i.e. loss of infiltration, generating more runoff from proposed roof) as part of this proposed development potentially a project could be undertaken to identify redundant pavement across the airfield to balance the permeable/paved area split and to reduce the hydraulic loading on the airport drainage system which could improve drainage locally at the railway station.



Preliminary Environmental Information Report
Appendix 12.3.1: Summary of Stakeholder Scoping Responses - Traffic and Transport

September 2021

Table of Contents

1 Introduction

1.1 General

1.1.1 This document forms Appendix 12.3.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description.

1.1.2 This document provides the summary of stakeholder scoping responses for traffic and transport for the Project.

2 Summary of Stakeholder Scoping Responses for Traffic and Transport

Consultee	Date	Details	How/where addressed in PEIR
Burstow Parish Council	28 September 2019	The general surface transport infrastructure gives cause for alarm as both the rail and road links are already over-crowded. The M23 Smart motorway is being constructed for today's traffic because so much congestion already occurs so will be inadequate for the proposed expansion despite the protestations to the contrary that there will only be a 1% increase per year over the next 10 years.	Highways England's M23 Smart Motorways has added additional running lane capacity to the strategic network serving Gatwick at peak times and has been constructed to provide capacity for future growth. In addition, Gatwick Airport enjoys a very high level of rail connectivity, with 20 trains to and from central London in the morning peak hour (10 to London Bridge and 10 to London Victoria, of which four are Gatwick Express services). As demonstrated by strategic transport modelling, these enhancements provide capacity for background traffic as well as Gatwick's growth out to 2047. These results are described in Appendix 12.9.1.
Burstow Parish Council	28 September 2019	Network Rail have tried to squeeze every drop of timetable utilization out of the main London-Brighton line that has included losing most of the dedicated 'premium' services of the Gatwick Express since extending many of the train services to Brighton. This service must be allowed to return to a dedicated service in any expansion.	Whilst two peak hour Gatwick Express services will continue to run to Brighton to provide the maximum benefit of these valuable train paths, Gatwick Express will continue to provide a dedicated 4 trains per hour service between the Airport and London Victoria, departing every 15 minutes and taking around 30 minutes.
Burstow Parish Council	28 September 2019	Collaboration will be necessary with government departments in order to improve the surface access infrastructure. Both the A22 and A23 roads need upgrading to dual carriageways in many places in order to help avoid the massively increased use of country lanes that is already being experienced.	As demonstrated by strategic transport modelling, there is appropriate capacity on A22 and A23 to provide capacity for background traffic as well as Gatwick's growth out to 2047. These results are described in Appendix 12.9.1.
Charlwood Parish Council	30 September 2019	The forecast 34% increase in traffic and freight will mean more cars, white vans and more HGVs. An increasing proportion of Gatwick road traffic passes through Charlwood as result of Satnavs or smart phones indicating that this is the shortest route to and from the north west. The community also suffers an increase in traffic when Satnavs automatically divert traffic when the M23 or M25 are blocked, or when there is a traffic jam on the A217 through Reigate. This could get much worse. The Assessment should include an impact of increased traffic on the villages of Hookwood and Charlwood.	As demonstrated by strategic transport modelling, any redistribution of traffic on roads through Hookwood or Charlwood as a result of Gatwick's growth to 2047 with Project is minimal – 5% or less. During highway construction, some traffic redistribution is likely to occur with works on the M23 Spur. GAL is looking at further options to mitigate these effects and these will be described and tested for the submission of the DCO application and final ES. Strategic modelling results for highway construction are described in Appendix 12.9.1.

Consultee	Date	Details	How/where addressed in PEIR
Crawley Borough Council	30 September 2019	There is concern about the level of uncertainty around proposed surface access improvements as set out in para 5.2.44. It would appear that a road traffic assessment has not been undertaken and there is an acknowledgement that potential solutions may need to be designed. The extent of the EIASR scoping boundary is very limited which falsely implies that there would be limited impacts outside of the airport development area. The impacts on surface access must therefore be extended from the limited boundaries drawn by the EIASR.	A road traffic assessment has been undertaken of the Gatwick Diamond area, down from the M25 to the A27. Strategic highway modelling results are described in Appendix 12.9.1.
Crawley Borough Council	30 September 2019	CBC question the assumption in para 5.2.45 that the increase in traffic volumes is likely to be greatest at the South and North Terminal junctions which appear to necessitate the scoping option of an 8m tall flyover at both junctions. Both these junctions are fed from the M23 Junction 9 spur which is not identified as being impacted and it not even wholly with the Project scoping boundary (see figure 5.2.1d). The impacts on this junction as a minimum must be fully scoped in.	The effects of Gatwick's growth and growth in background traffic on the M23 and M23 Spur, including Junction 9, are demonstrated by the strategic highway modelling. The project scoping boundary only includes junctions where physical works are required.
Crawley Borough Council	30 September 2019	CBC is also concerned that the only other road capacity issue identified is at the Longbridge Roundabout (para 5.2.50) and there is little consideration of the impacts upon the wider road network. With the transport modelling not finalised the scope of impact on the highway network cannot be defined and the report is therefore incomplete.	Strategic highway modelling results for a much wider area including the Gatwick Diamond area, from the M25 to the A27, as described in described in Appendix 12.9.1. This assessment includes roads in Crawley with the strategic transport model having been built using network coding from West Sussex's Crawley SATURN model.
Crawley Borough Council	30 September 2019	Increased impacts will be experienced on Crawley's local roads such as the A2011/A2004 Hazelwick Roundabout which is an AQMA, and routes such as the A23 to the airport which will experience increased traffic from new employees and passengers. Until initial highway modelling has been undertaken, following consultation with all local authorities, an accurate scope of impact on the highway network, and additional mitigation which may be required as part of the Project cannot be established.	As above.
Crawley Borough Council	30 September 2019	The area of detailed modelling for highways, shown in Figure 7.6.1, excludes significant centres of population yet paragraph 7.10.5 describes a wide area for the Labour Market assessments. Paragraph 7.10.24 asserts that "Future labour demand will be distributed across a wide labour catchment area so no significant impacts on population levels or housing and community infrastructure needs are expected". CBC consider that surface transport modelling for all modes must include this full area, including the major urban areas along the south coast, Tunbridge Wells and Guildford, and detailed assessment of the impact on in-commuting needs to take place.	Strategic highway modelling results for the Gatwick Diamond area, from the M25 to the A27, are described in Appendix 12.9.1. The urban areas of Guildford and Tunbridge Wells are included in the model and traffic on roads through these urban areas has been simulated.
Crawley Borough Council	30 September 2019	In respect to the rail network the report para 5.2.52 assumes that no further rail improvements are required. It is considered that this assumption is incorrect as the report also states that "studies will be undertaken to explore the need for further improvement to the rail station". In addition, assessment should be made of the capacity of the rail network itself. The option to further improve rail capacity and encourage this sustainable form of travel must be included as part of the ES.	Modelling results for rail and railway station capacity are described in Appendix 12.9.1
Crawley Borough Council	30 September 2019	Paragraph 7.6.12 asserts that improvements to train capacity provides "sufficient overall capacity for Gatwick to continue to grow its rail mode share over the next decade". For the ES, full assessment of the capacity of the rail network to accommodate growth in passengers and staff, as well as increasing rail mode share for access to the airport, should be undertaken. This should include the Arun Valley line as well as the Brighton Mainline, and Southern and GWR services as well as Thameslink and the Gatwick Express. Cumulative impacts of planned and anticipated growth in the area should also be taken into account in determining the need for enhancements to capacity.	Modelling results for rail capacity including the Arun Valley and Brighton Mainline as well as specific services are described in Appendix 12.9.1
Crawley Borough Council	30 September 2019	Effects to be assessed in the ES, as set out in para 7.6.47, should take account of any cumulative impacts should there be cross over between the Gatwick Station works and early	There will not be an overlap between Gatwick Station works and the Project. The Gatwick station works will be complete by 2023.

Consultee	Date	Details	How/where addressed in PEIR
		works on the Project.	
Crawley Borough Council	30 September 2019	There is no reference at all in part 5 of the EIASR to improvements to bus services and facilities or other sustainable travel modes such as cycles. This is a major omission that must be included as an integral part of the project and part of the ES.	These modes have been considered in the ES chapter presented for consultation and will also be included in the ES.
Crawley Borough Council	30 September 2019	The Transport Assessment which, as stated in para 7.6.61 will include Gatwick's Surface Assess Strategy, should prioritise sustainable access to the airport and include challenging modal shift targets which will then inform the identification of transport mitigations which may not be highway schemes. It should include a Car Parking strategy as a key part of the mode share target, with the aim of reducing the amount of access to the airport by private car.	The Transport Assessment which accompanies the ES will include the full Airport Surface Assess Strategy (ASAS). The ASAS provided with the Preliminary Transport Assessment Report (PTAR) provides a draft framework and this includes challenging mode share targets. The PTAR is provided in Appendix 12.9.1.
Crawley Borough Council	30 September 2019	The reference in paragraph 7.6.63 to *"Reviewing the extent to which the Sustainable Transport Fund….provides benefits….."* is welcomed but should also consider other possible options and measures to significantly improve public and active transport modes, using the profitability of on-airport parking to help provide funding.	GAL uses its Sustainable Transport Fund to support such measures.
London Borough of Croydon	1 October 2019	The key rail interchange at Croydon (presumably East Croydon) is mentioned. The data collection and scope of the transport assessment should therefore analyse the impact of the proposed development and increased airport capacity on this recognised key interchange which is beyond the airport. The scoping report should indicate how, as part of the Transport Assessment, the impact of airport growth on passenger numbers and interchange trips at East Croydon Station and other rail stations within Croydon is understood and adequately addressed.	Strategic rail modelling has been undertaken and additional passenger demand associated with the Project is described in Appendix 12.9.1. The majority of air passengers remain on rail services through East Croydon into central London.
London Borough of Croydon	1 October 2019	The effects of freight being moved to and from the airport appears to be missing from the scoping, but must be included within the assessment.	The strategic modelling used to inform this PEIR includes freight and logistics movements related to the Airport. These have been uplifted in line with the projected increase in freight tonnage through the Airport in the future baseline and with Project scenario.
London Borough of Croydon	1 October 2019	The focus on introducing incentives to reduce the number of staff travelling by car and mitigating the impacts of parking at the airport is acknowledged. However, there still appear to be plans to increase overall car parking numbers at the airport (7.6.63). It is considered that the airport needs to make a full commitment to traffic demand management measures in order to enable ongoing reductions in the number of car journeys.	The ASAS provided with the PTAR includes challenging mode share targets and demand management measures to deliver them, as described in Appendix 12.9.1.
East Sussex County Council	30 September 2019	Paragraph 4.4.25: When looking at existing baseline conditions, staff travel data will be just as important as passenger travel figures. While existing staff numbers have been set out, no forecast of staff numbers has been provided. It is impossible, therefore, to quantify the potential for significant impact of employment on local populations or the road network and other infrastructure in East Sussex.	Growth in staff travel has been included in strategic modelling as described in Appendix 12.9.1.
East Sussex County Council	30 September 2019	Paragraph 7.6.5: Traffic data has also been provided by East Sussex County Council (Transport Monitoring team) and should be reflected as such.	Noted and referenced.
East Sussex County Council	30 September 2019	In paragraph 7.6.6 reference is made to the proportion of Gatwick passengers (27%) travelling to or from the nearby counties of Kent, Surrey and Sussex. It will be important to provide a breakdown by County and to also examine the commuting patterns of Gatwick employees. The transport mode figures for staff and passengers vary significantly between counties and it is important to recognise that for the many parts of East Sussex there is an absence of non-car alternatives – due to the extremely limited options for rail travel and bus/coach travel to Gatwick, particularly from the central parts of the county.	Further work will be undertaken for the application for development consent including a more detailed assessment of future mode shares by Local Authority area. This PEIR assessment includes an initial assessment for comment.

Consultee	Date	Details	How/where addressed in PEIR
East Sussex County Council	30 September 2019	Paragraph 7.6.12 states that "Train capacity serving Gatwick has more than doubled since 2014, with new rolling stock on most of the services calling at the airport. This provides sufficient overall capacity for Gatwick to continue to grow its rail mode share over the next decade." However, the increase in capacity has not been shared equally across all routes. It is occurred due to the increase in capacity of Gatwick Express and Thameslink services, whereas the capacity of Southern services into East Sussex has remained fairly static, and there continues to be no direct rail services to/from Kent. The study will need to establish if the capacity of different routes is sufficient to at least the design year of 2038, or if maintaining Gatwick's sustainable mode share to the level indicated beyond 2029 is dependent on further investment in rail capacity such as Network Rail's "Croydon Area Remodelling scheme, which is not currently a committed scheme, so cannot be relied upon.	Modelling of rail capacity is described in Appendix 12.9.1.
East Sussex County Council	30 September 2019	Paragraph 7.6.18: the focus is on the M23/A23 corridor with some reference to the A27 and A272 as east – west routes linking into this arterial corridor. However, for south coast towns in East Sussex such as Eastbourne and Hastings, and also towns within the centre of the county (e.g. Uckfield, Heathfield, Crowborough), other north – south and east – west routes are more important for access to the Airport and the connection into the A23/M23 corridor. Therefore GAL need to recognise the role that routes such as the A21, A22, A267 and A264 perform in providing access between the south coast, as well as central East Sussex, and the Airport.	The strategic highway model includes these roads and modelling results are described in Appendix 12.9.1.
East Sussex County Council	30 September 2019	Paragraph 7.6.19: The text alludes to a 1 hour 20 minute journey time between Folkestone and Gatwick via the A23/A27/A259 corridors however these journey times can only be achieved via alternative routes (via the M20/M25). This needs to be clarified within the body of the text to avoid any mis-interpretation of the situation.	Text modified.
East Sussex County Council	30 September 2019	Paragraph 7.6.25: GAL should review the sustainable transport mode share for employees, which is currently shown as 42%. Whilst progress has been made in increasing the sustainable transport mode share for air passengers, this has been more challenging for staff. Therefore, consideration should be given to different mode share scenarios for employee trips with an assessment of the worst case scenario (continuation of current staff travel patterns).	Strategic modelling has been undertaken including both passenger and employee journeys, with mode choice interventions tested, as described in Appendix 12.9.1.
East Sussex County Council	30 September 2019	Paragraph 7.6.33 – 34: As the Gatwick Airport version of the South East Regional Transport Model (SERTM) has not yet been developed and finalised, it cannot yet be used to determine the area over which significant changes to travel demand flows are likely. This means that the assessment of the extent of network over which mitigation has to be considered will be less accurate. GAL should complete their assessment and identify what mitigation measures are required before the scoping area is finalised. In addition, from an East Sussex perspective, additional network detail and coding is available from the A22/A26 Corridors model which has also been derive from SERTM, which can be made available at request.	Strategic modelling has been undertaken and is described in Appendix 12.9.1.
East Sussex County Council	30 September 2019	Paragraph 7.6.41:	The strategic highway model has simulated the A27 which is now on the edge of the Aera of Detailed Modelling. Modelling results are described in Appendix 12.9.1 and Annex B.

Consultee	Date	Details	How/where addressed in PEIR
		It is not clear if the A27 corridor is outside the area of detailed modelling. There is a prevalence of long-standing congestion issues on the corridor that could be exacerbated by the Project. Planned housing development will not be equally distributed across the south coast and there is a choice of competing routes between A22, A21 and A23 so travel patterns can be expected to change as a result of the Project. The A27 corridor is located within the wider area of simulation modelling for which it is proposed to keep the SERTM level of detail. To ensure that the Model will accurately route traffic to/from Gatwick based on a realistic simulation of main junctions along the coastal corridor between Eastbourne, Wealden and Lewes (and potentially Bexhill/Hastings) the most affected parts of the A27/A259 corridor (such as A27 Lewes – Polegate and Bexhill) extending to Hastings should be included in the area of detailed modelling.	
East Sussex County Council	30 September 2019	As shown in Diagram 7.6.1, the proposed structure of the demand model splits airport related highway demand into passenger and employee trips. It should be clarified that the model will also handle demand made by trips by suppliers to airport businesses and airlines –goods delivery trips - and visitors to the airport, such as people using the airport hotels without being air passengers or staff, whether being guests or attendees of the hotel conferencing facilities or visitors to on-airport businesses.	See Section 12.5 on Assumptions and Limitations of the Assessment. Airport supplier, cargo and logistics, ie delivery trips, as well as non-airport users including visitors and commuters are included in the modelling.
East Sussex County Council	30 September 2019	Paragraph 7.6.42: It is noted that rail modelling will extend down to and along the Sussex Coast, which is welcomed. To ensure consistency to assessing mode share, it is desirable that both the rail and highway modelling should be undertaken over a similar geographical area.	Noted. GAL's strategic multimodal transport model (comprising highway and public transport – rail and bus/coach) covers the same area between South London and the South Coast.
East Sussex County Council	30 September 2019	Paragraph 7.6.61 (Wider Assessment of Traffic and Transport) makes reference to the Transport Assessment which will be produced, and which will include mitigation proposals. It also makes reference to the existing Airport Surface Access Strategy (ASAS). The increase in staff and passengers travelling to and from East Sussex will need to be mitigated effectively. Careful consideration will need to be made of how bus/coach and rail services to and from Gatwick can be improved to encourage non-car travel to the airport.	A Preliminary Transport Assessment Report is provided as Appendix 12.9.1 and this includes draft targets and actions for a future ASAS, including describing any improvements to rail, bus and coach services.
East Sussex County Council	30 September 2019	Taxis are often utilised by East Sussex residents who have no public transport alternative, for whom taking a car not a viable option, or those who have limited mobility. Such commuters also rely on lifts to / from the airport from family or friends. Whilst we recognise that restricting the use of drop-off / pick-up areas reduces congestion outside the front of the airport entrance and improves safety, it increases overall journey time for passengers who require a lift to/from the airport, and disrupts the end-to-end journey, therefore impacting on the overall journey experience. It is therefore important that these drop-off / pick-up facilities are retained and potentially enhanced if no additional public transport provision is made available. Integration of all modes needs to be a key consideration, with options available which cater for all needs.	Since 2019, GAL has introduced forecourt charging. However, free pick-up and drop-off is provided at both terminal long-stay car parks, with shuttle buses operating to both terminals.
East Sussex County Council	30 September 2019	It is likely that the details of the mitigation required will need to go beyond the details included within the ASAS. Therefore we would expect an updated ASAS to be developed as part of the DCO process.	A draft ASAS will be developed and submitted as part of the DCO application, to include measures refined following the PEIR. Draft targets and actions for this future ASAS are described in Chapter 12 of this EIA and in the PTAR in Appendix 12.9.1.
East Sussex County Council	30 September 2019	Paragraph 7.6.63:	Mitigation proposals tested for PEIR include increasing physical highway capacity as well as additional bus and coach services.

Consultee	Date	Details	How/where addressed in PEIR
		The proposed approaches to mitigation should additionally include provision to increase physical highway capacity to address residual issues. It may also be necessary to consider additional bus/coach services which are likely to see significant employee commuter and passenger demand to Gatwick.	
East Sussex County Council	30 September 2019	The Gatwick Area Transport Forum only meets annually and is not constituted as a consultative body. The Gatwick Area Transport Forum Steering Group - which includes the local transport authorities, local planning authorities, the train operation company, Highways England, the local bus operator and other stakeholders - provides a more suitable forum for consultation and coordination of approach to delivering transport objectives and initiatives.	Noted.
East Sussex County Council	30 September 2019	Paragraph 7.6.65 - 66: The Construction Traffic Management Strategy should include appropriate routes for the movement of construction materials to site by road; proposals for how construction workers will travel to and from the site – including how this will be achieved by sustainable modes – and if construction workers do travel by car, where they will park.	The Construction Traffic Management Strategy will be developed as part of the DCO process and submitted alongside the application for development consent.
Elmbridge Borough Council	30 September 2019	In regards to the Area of Detailed Modelling it is felt that this should be extended to include the A3 heading north from the M25 Junction 10 up to New Malden. Whilst paragraph 7.6.18 acknowledges the A23 as a key route connecting south London and Croydon to Gatwick Airport, there is no reference to the similar role that the A3 plays in connecting central and other areas of south London to the M25 and Gatwick Airport.	The A3 from M25 Junction 10 up to New Malden is included in the model with a fixed speed assumption on this link. Whilst not in the Area of Detailed Modelling, the effects of the Project on traffic on this road have been modelled and analysed.
Epsom and Ewell Borough Council	27 September 2019	Proposed scope of traffic and transport assessment is agreed. Epsom and Ewell is interested in the impacts to the strategic highway network that serves the Borough, and ensuring that the modelling covers the Borough where appropriate.	Strategic modelling as described in Appendix 12.9.1.
Highways England	1 October 2019	Highways England's principal concern with any development proposal is the impact generated on the SRN. The Applicant has commenced traffic modelling which will be used to support their proposals and is sharing information on the early development of these models with Highways England. Prior to DCO submission, Highways England will need to be satisfied that the impact of the development on the SRN has been modelled robustly and, if necessary, all works to provide capacity on the network to accommodate the development will achieve their objectives. This should include microsimulation modelling of the area.	Strategic and microsimulation modelling is as described in Appendix 12.9.1. An ongoing programme of engagement is proposed between GAL and Highways England on modelling and mitigation prior to DCO submission.
Highways England	1 October 2019	An assessment of transport related impacts of the proposal should be carried out and reported as described in the Department for Transport 'Guidance on Transport Assessment (GTA)'. It is noted that this guidance has been archived, however it still provides a good practice guide in preparing a Transport Assessment. In addition, the Ministry of Housing, Communities and Local Government (MHCLG) also provide guidance on preparing Transport Assessments. Highways England would appreciate early sight of the scheme's Transport Assessment and should be consulted on the scope of this assessment to ensure all relevant tests have been included.	Noted and referenced. The Preliminary Transport Assessment Report (PTAR) is provided in Appendix 12.9.1.
Highways England	1 October 2019	The Applicant will need to demonstrate that all proposals for changes to the SRN to mitigate the impact of the development are in line with the various tests described in the Circular.	Noted and understood.
Highways England	1 October 2019	The Applicant shall identify the distribution of traffic on the SRN as a result of the expansion proposals and will complete capacity assessments of relevant SRN links and junctions to ensure that the SRN is able to continue to fulfil its strategic function. This assessment should include impacts of both construction traffic and the reduction in capacity as a result of the construction work itself.	The assessment is provided in Appendix 12.9.1. Further work will be undertaken for the application for development consent including a more detailed assessment of highway construction impacts in conjunction with Highways England.
Highways England	1 October 2019	The Applicant shall confirm locations to be assessed in the Transport Assessment through engagement with Highways England via Topic Working Groups. This shall include all locations where there is a material change to	Engagement with Highways England has been ongoing since 2019.

Consultee	Date	Details	How/where addressed in PEIR
		traffic flows as a result of the application, including those distant from the boundary of the Proposed Development.	
Highways England	1 October 2019	Traffic and environmental impact arising from changes to the SRN, the increase/re-routing of traffic post-opening (including phased opening) of the Proposed Development, during construction, traffic volume (including cumulative effects), composition or routing change and transport infrastructure modification should be fully assessed and reported. Adverse changes to noise and air quality should be particularly considered, including in relation to compliance with the European air quality limit values and/or in local authority designated Air Quality Management Areas (AQMAs).	See Chapter 12 and the PTAR as provided in Appendix 12.9.1 which describes the assessment of operational and construction effects.
Horsham District Council	27 September 2019	The Council is very concerned that the extent of the transport model should be wider, particularly to include impacts on major urban areas (in particular along the south coast) and the impact on more localised transport infrastructure. The proposed restrictive area of the study is not acceptable, especially if, as GAL claims, the housing requirements arising from this proposal are not being considered as part of this application and is instead relying on the delivery of supporting housing to come through Local Plans that are being prepared. Not enough consideration is given to the impacts on major links including A roads within Horsham District. The assessment should also include impacts on these roads, together with highway links, not just junctions.	A roads through Horsham district are included in the Area of Detailed Modelling in the strategic transport model. Urban areas along the South Coast are also included in the model and have been modelled and analysed.
Horsham District Council	27 September 2019	We would urge GAL to consider more challenging modal shift targets, particularly in relation to parking. The impact of transport construction traffic is also omitted and needs to be considered as part of the assessment. Changing the location of the development will change the impacts and this needs to be better considered with an appropriate supporting evidence base. In any EIA the worst-case scenario should be considered.	GAL has set itself challenging mode share targets of 60% passengers and employees by sustainable modes by 2030. GAL has also modelled construction traffic scenarios. This is provided in Appendix 12.9.1.
Horsham District Council	27 September 2019	The Council considers that there is too much reliance on the planned improvements across the transport network, such as the M23 Smart Motorway Project and the improvements to Gatwick Railway Station. These upgrades are required to create additional capacity in the transport network to accommodate existing requirements and do not take account of the additional burden that will be placed on the network even with these upgrades as a result of airport expansion. It is therefore imperative that sufficient studies are undertaken to understand these impacts and to enable the provision of suitable mitigation.	Modelling has been undertaken to test the capacity and performance of the highway and railway networks as well as the railway station with Project to 2047 as described in Chapter 12 of the EIA and Appendix 12.9.1.
Horsham District Council	27 September 2019	We would also like to request that Horsham District Council's Infrastructure Delivery Plan (2014 & 2016), or any updates which emerge through our Local Plan preparation process, are added to the list of relevant Policy, Legislation and Guidance documents to consider, particularly given that we think the scope of the transport assessment should incorporate the traffic impacts in Horsham district. We are also updating our infrastructure Delivery Plan as part of the Council's Local Plan Review and we strongly suggest GAL takes this document into consideration as it emerges.	This Plan has been considered and included.
Horsham District Council	27 September 2019	There has already been an increase in road traffic 'spillage' from the main highways to the side roads and country lanes. Even though the total noise will not be comparable to the main roads, the increase in noise can be large and proportionally more disturbing due its close proximity to residents and due to the fact it is made up of multiple 'events' rather than a general hum. Therefore, an assessment should be made of traffic flows on local roads and how this traffic is associated with Gatwick and how it can be mitigated.	Strategic transport modelling output has been provided to environmental consultants to undertake noise modelling on the highway network around the Airport.
Kent County Council	1 October 2019	Consideration should also be given to proposed significant development sites in Tunbridge Wells and again in Tonbridge and Malling. The Tonbridge and Malling Local Plan has been submitted to the Secretary of State and	Local Plan development growth is included in the strategic transport model.

Consultee	Date	Details	How/where addressed in PEIR
		the Tunbridge Wells Local Plan Regulation 18 Draft Local Plan is currently out for consultation. A Saturn transport model has recently been completed for Tunbridge Wells.	
Kent County Council	1 October 2019	Sensitivity testing should consider the impact on other routes when strategic routes are disrupted by congestion and incidents. This is particularly an issue for communities on the A25, which is significantly impacted when there are issues on the M25. Areas in West Kent are impacted by rat running on the rural highway network.	The strategic highway model includes the M25 and A25 and has tested peak period operations to 2047 without and with the Project. The resilience of the M25 is important to the whole of the south of England and goes beyond the scope of just the Gatwick project.
Kent County Council	1 October 2019	Objectives, targets and measures to support and encourage trips by sustainable modes, as well as to mitigate highways impacts, will need updating. Measures for sustainable staff travel should also be an important part of the Travel Plan, as a reasonable proportion of the 24,000 employees working at Gatwick live in Kent.	GAL has set itself challenging mode share targets of 60% passengers and employees by sustainable modes by 2030. Interventions have been tested and are described in Appendix 12.9.1.
Kent County Council	1 October 2019	A Construction Management Plan (CMP) is to be provided. The County Council requests involvement in the preparation of the CMP as the proposals are refined, including an investigation of likely construction impact on Kent roads and mitigation of any resulting impact.	The Construction Management Plan (CMP) will be developed for the final ES and application for development consent. Engagement with Local Authorities will be undertaken as appropriate.
Kent County Council	1 October 2019	It is noted that GAL aims to increase public transport mode share for passengers from 44% to 48% by 2022. Impact on and consideration of options to improve rail services within Kent to accommodate Gatwick bound passengers, such as an enhanced service between Tonbridge and Redhill in order to connect to Gatwick, should be considered. This service currently operates at two trains per hour (tph) in the peaks and could be enhanced to a two tph service all day Monday to Saturday.	GAL has included rail upgrades in the strategic modelling for PEIR. In line with TAG, only those interventions which are near certain or more than likely to occur have been included in the modelling. Gatwick is supportive of other interventions which will improve access by sustainable modes.
Kent County Council	1 October 2019	GAL is encouraged to undertake further research into the destinations that passengers are travelling to and from. Gatwick is the closest airport to Kent, and yet poor public transport connections mean the majority of those travelling to the airport from Kent travel by car. Therefore, KCC requests that the traffic model be extended further to include the whole of Kent. This will allow for the consideration of mitigation measures which may be required on the Strategic Road Network across the region.	Strategic transport modelling now includes highway and public transport networks in Kent as described in Appendix 12.9.1.
Kent County Council	1 October 2019	Paragraph 7.6.63: Public transport connections (in particular rail) to the east of the airport are particularly poor. If GAL is to appropriately mitigate the impact of increased traffic volumes on the highway network and increase public mode share to the airport, it is encouraged to work with Network Rail to improve rail connectivity from the airport into Kent. Currently, most rail journeys to Gatwick from Kent are reliant on interchanging in London which results in journey times more than double that of driving.	GAL has included rail upgrades in the strategic modelling for PEIR. In line with TAG, only those interventions which are near certain or more than likely to occur have been included in the modelling. Gatwick is supportive of other interventions which will improve access by sustainable modes.
Mid Sussex District Council	1 October 2019	Having prematurely scoped out housing implications there is concern about the robust nature of the transport modelling. The parameters of the transport modelling work need to include population centres, including along the south coast. The local labour market covers a much more extensive area than the area subject to detailed transport modelling. This is significant as the impact of the Project on the transport network will not be fully assessed without understanding relationship between where people live and work. It is also important that existing and consented highway and rail improvement schemes (such as the M23 Smart Motorway and Gatwick Airport Station improvements) are not seen as a solution to mitigate the impact of future growth at Gatwick beyond that already consented. These schemes are required, even without the additional demand that the Northern Runway will bring.	The PEIR assessment is based on strategic modelling which includes urban areas along the South Coast. Trips to and from these locations have been modelled and analysed. Additional mitigation beyond M23 Smart Motorways and the Gatwick Airport railway station improvements have been considered as described in the chapter and in Appendix 12.9.1.
Mid Sussex District Council	1 October 2019	It should be clarified as to which works will clarify as a highways NSIP, and for GAL to consult with MSDC (and other stakeholders) when the package of improvements has been finalised.	The highway works constitute an NSIP and have been included in the application for development consent with the airfield works.

Consultee	Date	Details	How/where addressed in PEIR
Mid Sussex District Council	1 October 2019	Provide information indicating where the new parking stands for aircrafts will be located and how many there will be to accommodate the increase in departing aircraft capacity.	See Chapter 5: Project Description
Mid Sussex District Council	1 October 2019	Provide evidence and justification for the car parking and increased cargo throughput.	The proposed car parking strategy is indicative of whare car parking capacity could be provided as opposed to a commitment to build all of this car parking. As per draft actions and targets for the ASAS as set out in Chapter 12 and the PTAR provided in Appendix 12.9.1, interventions including increasing the cost of parking have been tested to increase sustainable mode share. Cargo growth has been forecast and included in the PEIR.
Mid Sussex District Council	1 October 2019	Enter into dialogue with MSDC to identify residential and employment allocations and proposals already with planning permission in Mid Sussex (or allocated in the Local Plan), to devise a list of known and planned developments for highways purposes and to identify further where there are likely to be an increase in traffic as a result of the Project.	Gatwick has engaged with Local Authorities to inform the cumulative schemes included in the strategic modelling work.
Mid Sussex District Council	1 October 2019	To confirm the capacity assumptions made when the planning consent for Gatwick Railway Station improvements, and then to identify if there is any further need for rail improvements and to properly identify the uplift in the number of passengers.	Crowding in Gatwick Airport railway station has been modelled in Legion using the calibrated and validated model developed by Network Rail for AM and PM peak periods. See Chapter 12 of the PTAR (Appendix 12.9.1).
Mid Sussex District Council	1 October 2019	Given the proximity of Gatwick Airport to the Strategic Road Network (SRN) the assessment should have cognisance to Department for Transport (DfT) Circular 02/13 'The Strategic Road Network and the Delivery of Sustainable Development'.	Noted and references added.
Mid Sussex District Council	1 October 2019	The assessment should also consider the guidance contained within Manual for Streets (MfS) and Manual for Streets 2 (MfS2) where applicable.	Noted.
Mid Sussex District Council	1 October 2019	The guidance contained within the IEMA Guidelines is dated and its application should be treated with due prudence.	This is noted and the PTAR (Appendix 12.9.1) contains further assessments.
Mid Sussex District Council	1 October 2019	Reference should also be made to DMRB Volume 11 Section 3 Part 8 'Pedestrians, Cyclists, Equestrians and Community Effects', Part 9 'Vehicle Travelers', and Interim Advice Note (IAN) 125/15 'Environmental Assessment Update'.	DMRB Volume 11 Section 3 Parts 8 and 9 have been superseded by LA 112 Population and Human Health, which do not contain the same assessments. Assessments under LA 112 are included in the Agricultural Land Use and Recreation Chapter.
Mid Sussex District Council	1 October 2019	It is noted that some of the identified data sources relate to data collected in 2016, consistent with the baseline of the modelling tools being used. This raises a concern that the baseline data, when utilised by the assessment, will be more than three years old and potentially unreliable. The validity of this data to inform the current assessment should be demonstrated. Should validity of baseline data not be demonstrated, additional data sources should be explored, comprising additional data collection and/or utilising existing local authority traffic models.	Surveys were undertaken in 2016 to capture a representative data set prior to the construction of M23 Smart Motorways from 2018 to 2020. The ongoing Covid-19 pandemic means that it has not been possible to update these data sources. 2016 therefore remains an appropriate base for the assessment.
Mid Sussex District Council	1 October 2019	The scope and methodology for each assessment model should be agreed with the relevant authorities and stakeholders. The applicant should explore the availability of more recently modelled information available from local authority transport models e.g. the MSDC transport model.	See Section 12.3 on Consultation and Engagement.
Mid Sussex District Council	1 October 2019	The proposed assessment criteria should be established at this scoping stage and agreed with the relevant authorities and stakeholders.	See Section 12.3 on Consultation and Engagement.

Consultee	Date	Details	How/where addressed in PEIR
Mid Sussex District Council	1 October 2019	The study area comprising the AoDM should be reviewed and agreed with the relevant authorities and stakeholders as there is justification to extend the catchment area of the AoDM.	See Section 12.3 on Consultation and Engagement. Chapter 9 of the PTAR (Appendix 12.9.1) sets out further information on the strategic modelling work.
Mid Sussex District Council	1 October 2019	In order to fully understand the impacts on the Ashdown Forest SAC/SPAC, transport modelling needs to extend beyond the SAC/SPAC boundary to ensure an Appropriate Assessment is properly evidenced.	Noted and included.
Mid Sussex District Council	1 October 2019	It is considered that a baseline of 2019 would be more appropriate, the validity of 2016 base data to inform the assessment should be demonstrated. Additionally, a 'worst case' scenario should be considered where a third runway at Heathrow is not delivered at all within the period of assessment to 2038.	The assessments undertaken do not include a third runway at Heathrow. See comment above regarding 2016 base data.
Mid Sussex District Council	1 October 2019	The scope and methodology for supporting technical studies should be agreed with the relevant authorities and stakeholders. Technical studies relating to traffic and transport should be appended to the ES where applicable.	See Section 12.3 on Consultation and Engagement, technical studies have been appended.
Mid Sussex District Council	1 October 2019	Current staff origin/destination and mode share patterns should be identified.	Staff O/D and mode share patterns are included based on Gatwick's 2016 Staff Travel Survey.
Mid Sussex District Council	1 October 2019	Various improvements to rail and bus infrastructure are referenced, however the assessment will need to establish the extent to which these schemes are committed and whether the existing and/or committed capacity of each service (i.e. each rail and bus route) is sufficient to accommodate passenger demand in the design year 2038.	See Chapters 7 and 8 of the PTAR (Appendix 12.9.1.)
Mid Sussex District Council	1 October 2019	Mitigation in respect of Highway England's M23 Smart Motorway project (due to be completed in Spring 2020), enhancements to the M25 South-West Quadrant, and allocated funding in the GAL Capital Investment Programme to improve South and North Terminal roundabouts are referenced and the assessment will need to establish the extent to which these schemes increase capacity on an already congested network.	See Chapter 9 of the PTAR (Appendix 12.9.1.) on the schemes included in the future network.
Mid Sussex District Council	1 October 2019	The assessment should also acknowledge alternative routes to the M23/A23 corridor such as the A24/A264 to the west and the A22/A264 to the east in providing north-south access between the Airport and the south coast.	These are included in the strategic model and acknowledged in Chapter 9 of the PTAR (Appendix 12.9.1.)
Mid Sussex District Council	1 October 2019	The applicant should have cognisance to the emerging Crawley Borough Council 'Local Cycling and Walking Infrastructure Plan' (LCWIP).	Noted and reference added.
Mid Sussex District Council	1 October 2019	Future staff mode share patterns should be identified, and projections provided for the assessment years 2026 (first full year of operation), 2029 (interim assessment year) and 2038 (design year).	Future mode share targets have been identified and what can be achieved with a given set of interventions has been output from the model. Further work will be undertaken for DCO.
Mid Sussex District Council	1 October 2019	No reference is made to collision data on the surrounding highway network. It is considered that a review of baseline collision data for a minimum of the most recently available three-year period within the study area should be reviewed and assessed.	Collision data included in both ES Chapter 12 and PTAR (Appendix 12.9.1).
Mid Sussex District Council	1 October 2019	No evidence appears to have been presented in the EIA Scoping Report to demonstrate how the content of consultation discussions has been incorporated into the assessment methodology. Whilst it is recognised that the consultation process is ongoing, further consultation is required with relevant authorities and stakeholders to adequately determine the scope of the assessment and the geographical study area with respect to transport and traffic.	See Section 12.3.4 on Consultation and Engagement.
Mid Sussex District Council	1 October 2019	The proposed approaches to mitigation are considered appropriate, however they should additionally include provision for physical highway improvements where such measures are demonstrated to be required by the assessment after these approaches have been evaluated.	A description of the highway works is included in Chapter 5: Project Description. More details will be provided in the final ES as design development evolves in consultation with Highways England and local highway authorities.
Mid Sussex District Council	1 October 2019	The identified effects and sensitive receptors are considered broadly appropriate and reasonable; however, the effects should also consider the absolute change in traffic generation where the local road network is already	See Section 12.5 on Assumptions and Limitations of the Assessment, including on construction and operational traffic. Further work will be

Consultee	Date	Details	How/where addressed in PEIR
		observed and/or forecast to be operating at or close to capacity in the baseline and/or future baseline scenarios. The assessment of driver delay and effects on other public transport services and users (i.e. bus and coach) should include journey times and journey reliability on key routes to/from the airport.	undertaken for the application for development consent including a more detailed assessment of highway construction impacts in conjunction with Highways England. The potential effects of any redistribution of traffic can only be undertaken once a strategic highway model is available which will be for the submission of the DCO application and final ES.
Mole Valley District Council	30 September 2019	Paragraph 7.6.1: For the avoidance of doubt, the Council would like to make clear that not all of the Mole Valley Local Plan 2000 policies listed as relevant to Traffic and Transport were saved following review of the 2000 Local Plan in 2007. Policy MOV1 was not saved and is therefore not applicable.	Noted and MOV1 removed.
Mole Valley District Council	30 September 2019	Paragraph 7.6.12: The Council questions the Applicant's assertion that there is sufficient overall capacity in the rail network for Gatwick to continue to grow its rail mode share over the next decade. We would suggest that through the EIA, a full assessment of the rail network's capacity is undertaken to ensure that the growth in passenger throughput can be accommodated, as well as increasing rail mode share for access to the airport.	Assessment on rail capacity has been undertaken, this is contained in both the ES Chapter 12 and PTAR (Appendix 12.9.1)
Mole Valley District Council	30 September 2019	Paragraph 7.6.18: The Applicant should also recognise the various other local highway network routes that provide access to the airport.	Strategic modelling work has informed the PIER and further VISSIM work has been included in the PTAR (Appendix 12.9.1).
Mole Valley District Council	30 September 2019	Paragraph 7.6.20: The Council is concerned by the Applicant's apparent assumption that Highways England's M23 Smart Motorway improvement scheme will add spare capacity to the strategic network serving Gatwick. We are aware of Highways England's apparent concerns with the impacts on the strategic road network associated with the allocation of Horley Business Park and growth at Gatwick will only exacerbate this problem.	This is noted and strategic modelling work has been undertaken to inform the PEIR submission (see the Strategic Modelling Report contained in Annex B of Appendix 12.9.1). This shows the results of the assessment undertaken to date and the modelling will be further reviewed during future workstreams in preparation for the DCO.
Mole Valley District Council	30 September 2019	Paragraph 7.6.34: The Council believes that all highway modelling and assessment should be undertaken prior to finalising the scoping area, as otherwise it is impossible to know which parts of the local highway network might require mitigation	This is the approach that has been undertaken for PEIR as per 12.4 in Chapter 12.
Mole Valley District Council	30 September 2019	Paragraph 7.6.41: The Council is concerned that the Area of Detailed Modelling (as shown in Figure 7.6.1) does not encompass a wide enough area. The boundary does not include large urban conurbations such as Brighton and Hove, Tunbridge Wells, Guildford and some areas of South London that should be included to fully understand the potential impacts on the highways network. To miss out these areas negates to include a significant proportion of the regional population that use the highways network.	These areas are included in the strategic model albeit not all of them are in the Area of Detailed Modelling. The effects of the Project on traffic in these locations has been considered. See Chapter 9 of the PTAR on the approach to the strategic modelling as well as Annex B for the PTAR (Appendix 12.9.1).

Consultee	Date	Details	How/where addressed in PEIR
Public Health England	30 September 2019	The overall risk to NMU and impact on active travel should be considered on a case-by-case basis, taking into account, the number and type of users and the effect that the temporary traffic management system will have on their journey and safety. Any traffic counts and traffic assessment should, as far as reasonably practicable, identify informal routes used by NMU or potential routes used due to displacement, as well as established or formal routes. The final ES should identify the temporary traffic management system design principles or standards that will be maintained with specific reference to NMU. This may be incorporated within the Code of Construction Practice. The scheme should continue to identify any additional opportunities to contribute to improved infrastructure provision for active travel and physical activity.	This is noted. The temporary traffic management system is under development and further information will be included in the final ES for the DCO. Additional opportunities to contribute to active travel is set out in Chapter 11 of the PTAR (Appendix 12.9.1). Access to public open space and footpaths are considered within Chapter 18: Agricultural Land Use and Recreation. The resultant effects on participation in physical activity and recreation are communicated within the health and wellbeing chapter. Furthermore, Chapter 12: Traffic and Transport assesses the potential effects on pedestrians and cyclists from changes in transport nature and flow rate, the results of which are communicated within the health and wellbeing chapter.
Public Health England	30 September 2019	The ES should consider the impact of the development on community severance from changes to the transport infrastructure and usage within both the construction and operational phases.	The impact on community severance is covered in Chapter 12: Traffic and Transport
Reigate and Banstead Borough Council	27 September 2019	Also following the adoption of the DMP references to the following saved Borough Local Plan Policies should be removed from Paragraph 7.6.1 of the EIA Scoping Report: • M04 “Development Related Funding for Highways Schemes” • M05 “Design of Roads” • M06 “Servicing Provision” • M07 “Car Park Strategy & Standards”	Noted and these have been removed.
Reigate and Banstead Borough Council	27 September 2019	We note GAL is proposing to use SATURN software and the SERTM strategic highway model to assess the strategic highways impacts and three VISSIM traffic simulation models and a Corridor Model to assess the local highways impact. Given that Surrey County Council are the transport authority responsible for roads within Reigate & Banstead and given that a number of the key transport routes to the airport more generally pass through Surrey, the models need to take into consideration Surrey County Council’s SINTRAM 7 using OMNITRANS model.	Strategic modelling has been undertaken and is described in Appendix 12.9.1 and Annex B.
Reigate and Banstead Borough Council	27 September 2019	In relation to the SERTM model, we note that as the Gatwick Airport version of SERTM has not yet been developed and finalised it cannot yet be used to determine the area over which significant changes to travel demand flows are likely. This means that the assessment of the extent of the network over which mitigation has to be considered will be less accurate. This means, for example, that the local highway network such as the A23 London Road (in Reigate & Banstead) close to the Airport is not included within the scoping area. Given that it is likely to be affected by the Project, we expect GAL to complete their assessment and identify what mitigation measures are required before the scoping area is finalised.	Strategic modelling has been undertaken and is described in Appendix 12.9.1 and Annex B.
Reigate and Banstead Borough Council	27 September 2019	We also note that Paragraph 7.6.37 which discusses the Corridor Model states that “in 2016, the Corridor Model was recalibrated based on an extensive data collection exercise. Calibration of the 2016 Corridor Model shows that the model satisfies WebTAG requirements …” and that Paragraph 7.6.38 states that “given this high degree of calibration and validation, the updated 2016 Corridor Model is considered a robust base to take forward and uplift for future analysis of impacts”. Given the potential for transport impacts associated with the Project, the Council seeks confirmation that the transport authorities responsible for the strategic and local highways	Strategic modelling has been undertaken and is described in Appendix 12.9.1 and Annex B.

Consultee	Date	Details	How/where addressed in PEIR
		(namely, Highways England, West Sussex County Council and Surrey County Council) are satisfied with the use of this model and the assumptions made.	
Reigate and Banstead Borough Council	27 September 2019	The Council considers that the information provided in Table 5.4.1. of the EIA Scoping Report provides a useful summary of the key parameters of the proposed Project. This will be useful in assisting in modelling of future impacts if current generations and impacts on the existing levels are known. Where data does not exist on current impacts/ generations, the Council considers that this needs to be gathered as soon as possible in order for the transport impacts of the surface access strategy to be properly understood/ assessed and then mitigated.	Noted.
Reigate and Banstead Borough Council	27 September 2019	In relation to data collected so far, we would welcome clarity regarding the dates on which traffic counts have been collected. We are concerned that the M23 Smart Motorway Works may have impacted upon the traffic counts. We also consider that the scope of the baseline information should be extended to include contribution from housing sites (planning permissions and allocations) of less than 100 units as in a constrained area like Reigate & Banstead, housing completions from smaller sites represent a major component of housing supply and any modelling which does not factor in the contribution from small sites therefore risks significantly underestimating cumulative impacts.	Surveys were undertaken in 2016 in order to capture a representative data set prior to the construction of M23 Smart Motorways from 2018 to 2020. The strategic modelling work which informs the PEIR includes local development assumptions (latest local plans, committed development as confirmed with Local Authorities) and TEMPRO (v.7.2) growth factors which have been adjusted to align with cumulative developments in the scheme area in line with TAG guidelines. Future year networks have been updated in consultation with Highways England and Local Authorities to reflect the committed schemes for which funding has been secured.
Reigate and Banstead Borough Council	27 September 2019	With regards to the proposed information to be included within the future baseline conditions, the Council notes that Paragraph 6.2.5 states that “a number of improvements are proposed at Gatwick Airport to accommodate the predicted increase in passenger numbers in the absence of the Project” and that “the likely timing of these improvements will be taken into account through the use of future baseline scenarios and assessment years”. The Council would welcome clarity as to the nature of the proposed improvements and their planning status (i.e. whether they are consented or are ambitions). If they are not consented, we consider that they should not be included within the Future Baseline Conditions.	A description of the future baseline for development is described in Chapter 4. More details will be provided in the final ES as design development evolves in consultation with Highways England and local highway authorities.
Reigate and Banstead Borough Council	27 September 2019	We note that Paragraph 5.2.5 of the EIA Scoping Report states that robotics will be used to increase capacity of long stay carparks by 2,500 spaces. We seek clarity regarding whether this constitutes ‘development’ which requires consent. If so, we do not consider that this additional capacity should be considered within the baseline.	This measure does not constitute development in planning terms but a technological improvement which will provide additional capacity.
Reigate and Banstead Borough Council	27 September 2019	In relation to Paragraph 7.6.6 of the EIA Scoping Report we consider that current employee travel patterns should also be considered.	This is now included in the Chapter 12.
Reigate and Banstead Borough Council	27 September 2019	The Council notes that the proposed assessment years (relating to transport impacts) do not correspond with the proposed construction period. Given that Paragraph 5.3.20 states that “it is anticipated that construction would require an average workforce of approximately 700 personnel, with up to approximately 2,000 personnel during the peak construction period”, the Council considers that the scope of the assessment should include at least one additional assessment year to take into consideration the peak impact of construction.	See Chapter 13 of the PTAR (Appendix 12.9.1) on the programme for construction. The construction programme shows a peak construction activity over winter 2026/27, with over 1,200 construction workers on site. The airfield construction scenario modelled reflects this peak construction activity, albeit modelled in a summer month when Airport and background traffic is higher.
Reigate and Banstead Borough Council	27 September 2019	We also consider that the scope of the assessment should include at least one additional assessment year to take into consideration the proposed early growth at Heathrow airport (25,000ATMs from 2022), especially considering that this timeframe corresponds with the beginning of construction works for the proposed routine use of the northern runway, no surface access improvements are being proposed by Heathrow to facilitate this proposed early growth and that a number of the key transport links around Heathrow and Gatwick are the same	Modelling assumes growth at Heathrow with two runways from Heathrow’s Future Baseline as published during its DCO consultation on its third runway. The PEIR assessment does not consider the Heathrow Third Runway which would include these early ATMs, given that Heathrow has stopped the work it had been doing to seek

Consultee	Date	Details	How/where addressed in PEIR
		roads/ link (and that these roads pass through our borough). We consider that this should be 2023 to take into consideration a full year of proposed early growth and construction at Gatwick.	development consent this project. The Heathrow Third Runway will be considered further for ES.
Reigate and Banstead Borough Council	27 September 2019	We also question whether there is a need for an additional assessment year later in the 2030s to assess what would happen if Heathrow R-3 didn't open. Whilst the Council recognises the planning policy context behind the proposed expansion of Heathrow, the Council question whether there is a need for such an assessment given recent comments by government and given that the information provided as part of the EIA Scoping Report suggests that if Heathrow was delayed there would be additional growth at Gatwick.	The assessments undertaken do not include a third runway at Heathrow. Please see cumulative effects section in Chapter 12 and the PTAR (Appendix 12.9.1).
Reigate and Banstead Borough Council	27 September 2019	With regards to the proposed study area, we note that Paragraph 7.6.36 of the EIA Scoping Report states that the assessment of the impact of traffic from the proposed Project on local roads will be taken into consideration on "the A23 London Road into North Crawley … roads connecting to the Manor Royal estate and the A2011 Crawley Avenue to Hazelwick Roundabout". We consider that the study area should also take into consideration the impact on the local roads within Reigate & Banstead (and Surrey more generally) including the impact on the A217, A23, B2036 and A264/A22 given that these are key local transport routes (including key local transport routes to the airport) and that past experience suggests that disturbance on the strategic network severely impacts these routes as people use re-route onto local roads to access the airport.	The PEIR assessment is based on strategic modelling work which includes A217, A23, B2036 and A264/A22. The extent of the strategic modelling work is contained in the Chapter 12 and PTAR (Appendix 12.9.1).
Reigate and Banstead Borough Council	27 September 2019	We would expect any assessment to consider the interaction between the North Downs line and the road network in Reigate, specifically in respect of Reigate level crossing.	The strategic modelling includes rail and road links through Reigate but is not used for a capacity assessment of level crossing impacts in this location.
Reigate and Banstead Borough Council	27 September 2019	The Council considers that the scope of the effects proposed to be assessed for 'use of the airport including upgraded highway junctions' should be expanded to include changes in vehicular kilometres driven given the significant additional carparking proposed.	The proposed car parking strategy is indicative of whare car parking capacity could be provided as opposed to a commitment to build all of this car parking. Draft targets and actions for a future ASAS are set out in Chapter 12 and the PTAR provided in Appendix 12.9.1. Interventions including increasing the cost of parking have been tested to increase sustainable mode share.
Reigate and Banstead Borough Council	27 September 2019	With regards to Paragraph 7.6.47 of the EIA Scoping Report which details the effects to be assessed within the PEIR/ES, the Council notes that whilst the IEA Guidelines are appropriate for the environmental assessment of the impacts of additional traffic on network, that they are not necessarily transferable to the assessment of other impacts on the network in terms of performance. The scope of the assessment therefore also needs to take into consideration the consequential need to mitigate these.	See PTAR (Appendix 12.9.1) which sets out additional assessments to the IEA Guidelines.
Reigate and Banstead Borough Council	27 September 2019	The Council considers that given the substantial increase in parking provision planned, that the scope of the wider assessment of traffic and transport detailed within Paragraph 7.6.61 of the EIA Scoping Report should also include an assessment of the potential increases in kilometres travelled as a result of the end state scenario when compared with the base.	The proposed car parking strategy is indicative of whare car parking capacity could be provided as opposed to a commitment to build all of this car parking. As per Gatwick's draft ASAS, interventions including increasing the cost of parking have been tested to increase sustainable mode share.
Reigate and Banstead Borough Council	27 September 2019	The Council notes that GAL is proposing a number of mitigation measures in order offset the potential impact of the proposed Project. The Council is however disappointed that much of these measures are soft/ management type measures and that there is an absence of hard infrastructure and service provision measures referred to.	See Section 12.8 on the Mitigation and Enhancements Measures. A description of the highway works is included in Chapter 5: Project Description. More details will be provided in the final ES as design development evolves in consultation with Highways England and local highway authorities.

Consultee	Date	Details	How/where addressed in PEIR
Reigate and Banstead Borough Council	27 September 2019	With regards to the mitigation methods proposed, the Council notes that the majority are from the Airport Surface Access Strategy (ASAS). The Council would welcome clarity regarding the status of the ASAS given that the Council understands that the ASAS referred to in the EIA Scoping Report, available on GAL's website and referred to in the masterplan is the draft ASAS which was produced in May 2018 and circulated to local authorities for comment. We subsequently provided comments on this document, but our understanding is that they have not been taken into consideration/incorporated into a final ASAS. Our understanding is also that comments provided by residents, town and parish councils, business representatives etc. who made comments on the draft ASAS as part of the masterplan consultation have not been taken into consideration and note that Paragraph 4.20 of the National Aviation Strategy (2013) states that "local people, town and parish councils which have qualifying airports within their boundaries, business representatives, health and education providers, environmental and community groups should be involved in the development of airport surface access strategies" and the Aviation 2050: The Future of UK Aviation Consultation Document highlights the importance of ASAS and their role in setting targets for modal share and environmental targets.	The ASAS is under development. Draft targets and actions for the ASAS are included in the EIA chapter and PTAR (Appendix 12.9.1).
Reigate and Banstead Borough Council	27 September 2019	With regards to the mitigation methods proposed in the ASAS, the Council notes that bullet point 8 of Paragraph 7.6.63 of the EIA Scoping Report which discusses mitigating the impacts of increased carparking on the airport states that "GAL is committed to providing all of the carparking required for the Project on Gatwick land whilst working with local planning authorities such as Crawley Borough Council to reduce unauthorised off-airport parking and to re-provide this on-airport in line with GAT3 [of Crawley Borough Council's Local Plan] commitments". The Council would welcome clarity as to how this would work in practice, for example whether GAL is proposing a mechanism by which additional on-site parking is only permitted following the closure of off-site spaces (both authorised and unauthorised).	Adequate parking would be provided for the forecast passenger numbers. This would reduce need for offsite parking. Chapter 5: Project description outlines the car parks and their capacities.
Reigate and Banstead Borough Council	27 September 2019	The Council would also welcome clarity regarding the practicality of how GAL is proposing to bring construction materials to and from the site by rail. Whilst we note – and welcome - GAL's commitment to "delivering as much of the construction associated with the Project as is practicable by sustainable modes", we are concerned that opportunities to bring construction materials to and from the site by rail would require a rail head. We therefore question the practicality of this (for example where a railhead would be located/ whether the deliverability of a railhead is feasible etc.) and consider that the scope of the assessment should consider the likely scenario of a railhead not being delivered and the majority of construction materials being delivered by road.	See Section 12.5 on Assumptions and Limitations. Further work is being undertaken by GAL's construction team and the assessment will be refined for the final ES once more details are known.
Reigate and Banstead Borough Council	27 September 2019	The Council also notes that the Gatwick Area Transport Forum only meets annually and is not a consultative body. Instead we consider that the Gatwick Area Transport Forum Steering Group which meets quarterly provides a more suitable forum for consultation and coordination of approach to delivering transport objectives and initiatives.	Noted and Transport Forum Steering Group is referenced.
Reigate and Banstead Borough Council	27 September 2019	We note that Gatwick's ongoing sustainability objective with regards to surface access is to "increase sustainable access options for passengers and staff" but that GAL only intends to increase their passenger modal shift by 4% (from a current 44% to 48% by 2022). We question how ambitious this is given that the already consented capacity growth on the railway station will be delivered by 2022 and that 2022 is before the proposed commencement of the routine use of the northern runway.	Gatwick is committed to low-carbon growth and its Decade of Change strategy (June 2021) sets ambitious carbon reduction targets. The headline targets are set out in Chapter 6 of the PTAR (see Appendix 12.9.1), which includes achieve 60% public transport mode share for airport passengers by 2030 and achieve 60% of staff journeys to work by sustainable modes. Modelling for rail capacity

Consultee	Date	Details	How/where addressed in PEIR
		We also question how likely it is to be achieved once the proposed Project is completed given the scale of carparking proposed (an additional 17,500 parking spaces on site on top of an already committed 6,750 additional parking spaces proposed/consented for continued one runway operation); that the ASAS commits GAL to reducing staff parking20 which will lead to further passenger parking as current staff parking is made available for passenger parking; and that Paragraph 5.2.52 of the EIA Scoping Report suggests that GAL are not planning for additional rail capacity to accommodate the proposed passenger growth associated with the routine use of the northern runway.	has been undertaken and contained in both the ES Chapter 12 and the PTAR.
Reigate and Banstead Borough Council	27 September 2019	Following on from concerns in the previous section regarding the scale of parking proposed, the Council would welcome more clarity as to the location of the proposed additional carparking given that this will impact upon traffic movements and therefore needs to be accounted for in the traffic modelling. We also note that Paragraph 5.2.43 of the EIA Scoping Report states that some of the existing carparking provision will need to be demolished to make way for other development and reprovided elsewhere on the site; we would therefore also welcome clarity as to which carparks are proposed to be demolished and reprovided elsewhere given that this will also impact upon traffic movements.	A description of the highway works and car parking is included in Chapter 5: Project Description. The car parking provision is included in the traffic modelling. More details will be provided in the final ES as design development evolves in consultation with Highways England and local highway authorities.
Reigate and Banstead Borough Council	27 September 2019	We would also request additional clarity regarding the proposed scope of junction improvements and potential road widening given that land in our borough including the Riverside Garden Park and the Horley Business Park site allocation is identified in the for-junction improvements. The Council notes that Paragraphs 5.2.48 and 5.2.49 of the EIA Scoping Report suggests that at-grade junctions may be required at both the northern and southern roundabouts. The Council considers that the scope of the assessment should include the potential for 0-2 at-grade junctions.	A description of the highway works and car parking is included in Chapter 5: Project Description. More details will be provided in the final ES as design development evolves in consultation with Highways England and local highway authorities.
Reigate and Banstead Borough Council	27 September 2019	We also note that Paragraphs 7.6.12-7.6.15 and 7.6.20-7.6.21 of the EIA Scoping Report describe a number of transport improvements which have already been committed to/ planned including the railway expansion, new rolling train stock on services calling at the airport, new waiting areas for rail passengers, M23 Smart Motorway and Highways England's proposals to improve traffic flow on the M25. The Council notes that these projects are proposed to mitigate current problems and not facilitate additional capacity from any future growth at Gatwick Airport. This should be taken into consideration in the scope of the assessment.	Noted.
Reigate and Banstead Borough Council	27 September 2019	The Council notes that there is considerable uncertainty within the location regarding the scale and location of future growth in the region beyond current local plans which end in the early-2030s. In the absence of a long-term strategic land use plan, we consider that there is a need for GAL to consider a range of potential future growth scenarios and at the very least undertake a cumulative assessment of the worst case.	The strategy modelling work which informed the PEIR includes TEMPRO (v.7.2) growth factors which have been adjusted to align with cumulative developments in the scheme area in line with TAG guidelines. Future year networks have been updated in consultation with Highways England and Local Authorities to reflect the committed schemes for which funding has been secured.
Reigate and Banstead Borough Council	27 September 2019	The Council notes that Paragraph 5.3.14 of the EIA Scoping Report states that "a temporary logistics facility may be required in order to allow scheduling of deliveries to the appropriate work sites" and that Paragraph 5.3.15 states that "the use of a logistics facility would allow HGV deliveries to the airport to be consolidated, reducing the overall number of deliveries on the local road network". The Council would welcome clarity as to whether a construction logistics consolidation centre will be required, and if so where it will be located as if it does not have internal access to the airfield and the main construction locations then it will not reduce the overall number of deliveries on the local road network but cause additional secondary journeys on the local road network around the airfield.	See Section 12.5 on Assumptions and Limitations

Consultee	Date	Details	How/where addressed in PEIR
Reigate and Banstead Borough Council	27 September 2019	The Council considers that it is encouraging that Paragraph 5.2.48 of the EIA Scoping Report recognises that any improvement scheme should take into consideration the allocated Horley Strategic Employment Site to the north of the southern roundabout, but considers that consideration of this planned development should also be taken into consideration in the assessment stage.	The Horley Strategic Employment site will be considered in development scenario sensitivity testing for the final ES.
Reigate and Banstead Borough Council	27 September 2019	With regards to traffic and transport assessments, the Council would welcome some clarity regarding what assumptions have been made regarding the Horley Strategic Business Park, namely assumptions regarding: i. Access to the strategic road network ii. Timeframes for the construction and operation of the business park iii. Proposed operational uses (uses, quantities of floorspace, job numbers)23 iv. Proposed construction phasing v. Proposed road improvements vi. Modal shift during both construction and operation vii. The requirement for the land for road improvements and construction works	The Horley Strategic Employment site will be considered in development scenario sensitivity testing for the final ES.
Reigate and Banstead Borough Council	27 September 2019	The site allocation in the DMP requires "a new dedicated, direct access onto the strategic road network (M23 spur)". As part of the proposed Project, GAL includes the southern part of the site (which would deliver the access onto the strategic road network) in their Project site area. Given this, the Council would welcome clarity regarding whether the proposed inclusion of this land in the site boundary will prevent the business park from being developed. We would also question what other sites have been looked at for temporary construction use and expect strong justification to be provided as to why this site has been chosen given its existing site allocation.	Please see Chapter 3: Need and Alternatives Considered. The Southern part of the allocated land is only to be used for temporary construction compound. This development has been included and considered within Chapter 19: Cumulative and Inter-relationships.
Reigate and Banstead Borough Council	27 September 2019	If the inclusion of this land within the Project site boundary doesn't prevent the business park from being developed, the Council would welcome clarity as to whether it will impact upon the timeframe for the construction and operation of the business park. The site is being developed by Horley Business Park Ltd. which is a joint venture in which Reigate & Banstead Borough Council is a partner, the developers are currently in the process of preparing for the submission of a planning application, however we note that in Figure 5.2.1f of the EIA Scoping Report the southern part of the site is proposed to be used for construction and that Paragraph 6.2.9 of the EIA Scoping Report states that construction will last from 2022 to 2034.	This development has been included and considered within Chapter 19: Cumulative and Inter-relationships.
Reigate and Banstead Borough Council	27 September 2019	The Council would also welcome clarity regarding what assumptions are being taken into consideration with regards to proposed uses of the site. The local plan site allocation is for predominantly B1a accommodation with limited B1b, B8 and non-B Class uses including appropriate airport-related Sui Generis uses and ancillary retail, hotel and conference facilities, gym, crèche and medical services and that there is no definitive floorspace within the site allocation (although work undertaken for the DMP Examination suggested 200,000sqm). Instead the policy allocation requires that a masterplan to be submitted at the outline planning application stage and for this to detail the proposed quantum of development and uses. We query what assumptions are being made given that the Business Park masterplan has not yet been agreed and that the Council (as part of the joint venture) has not been approached by GAL to discuss proposed uses/ floorspace.	No specific information has been included as there is nothing available. It is considered in the cumulative assessment as a Tier 3 development and appropriate weighting has been allocated to this development.
Reigate and Banstead Borough Council	27 September 2019	We would also welcome clarity regarding what assumptions are being made regarding construction phasing given that this will be informed by the proposed uses/ scale of development and given that Policy HOR9 requires the Business Park masterplan to provide a detailed programme of infrastructure. Work undertaken by the	As noted, Policy HOR9 requires the Business Park masterplan requires the developer to provide a detailed programme of infrastructure and GAL would welcome provision of this detailed information.

Consultee	Date	Details	How/where addressed in PEIR
		Council's Planning Policy Team suggested that construction would most likely take place over a twenty-year period and therefore there is a need to give proper consideration to construction phasing.	
Reigate and Banstead Borough Council	27 September 2019	We consider that there is a need for GAL to provide strong justification for the inclusion of the business park land for road improvement and construction storage within the Project site boundary. We also question what other sites have been looked at for road improvement and construction storage and expect to see strong justification for the selection of this site given its existing site allocation.	An optioneering process has been untaken as part of Chapter 3 Needs and Alternatives.
Reigate and Banstead Borough Council	27 September 2019	The Council has concern with the statement that "for the purpose of this scoping report, it is assumed that schemes up to and including grade separation of the roundabout may be considered" as during the DMP Examination there was extensive debate between the Council, the promoters of the Horley Business Park and GAL regarding the design of the junction for the southern roundabout irrespective of the growth associated with this Project. GAL insisted throughout the DMP examination that there was a requirement for a grade separated junction to accommodate the business park growth irrespective of any additional growth proposed at the airport therefore we consider that there is a likelihood that will be a need for a grade separated junction to accommodate the proposed growth as a result of this Project.	GAL is proposing grade-separation of South Terminal Roundabout to accommodate growth associated with the Project. See Annex C of the PTAR (Appendix 12.9.1) on the Scheme Development / Concept Design report for the highway mitigation.
Reigate and Banstead Borough Council	27 September 2019	The Council notes that in addition to the highway junction improvements planned at the North and South terminal roundabouts that it is likely that further highways and transport improvements (not constrained to junctions) will be required off-site to meet the NPPF requirement of resolving severe residual cumulative impacts. We therefore do not consider that at this time the potentially significant impacts of the development on the transport network (and the subsequent required scope of mitigation measures required) have been fully assessed. We consider that GAL should complete the Transport Model and undertake a transport assessment before the scope of development is finalised. To ensure that the highway impacts of the proposed development are properly mitigated, we consider that there is a need to ensure that in designing highway improvements that this does not lead to traffic redistribution and create new congestion hotspots or exacerbate existing ones.	This is noted and the strategic modelling work which accompanies the PEIR submission (see the Strategic Modelling Report contained in Annex B of Appendix 12.9.1) shows the results of the assessment undertaken to date. The modelling will be further reviewed during future workstreams in preparation for the DCO and mitigation will be identified for any significant effects where required.
Reigate and Banstead Borough Council	27 September 2019	The Council notes that planning permission has recently been granted to facilitate additional rail capacity and that Paragraph 5.2.52 states that "studies will be undertaken to explore the need for further improvement to the rail station, but taking into account the improvements that are currently planned, it is not currently considered that any further improvements will be required to the rail station platforms or concourse". The Council notes that the current consented permission is to accommodate current use/ planned growth and not growth associated with the Project. We consider that this paragraph seems to pre-judge the outcome of the study work and consider that GAL should await the outcome of the study before confirming whether or not further improvements are needed and finalising the scope of the development.	Crowding in Gatwick Airport railway station has been modelled in Legion using the calibrated and validated model developed by Network Rail for AM and PM peak periods. See Chapter 12 of the PTAR (Appendix 12.9.1).
Reigate and Banstead Borough Council	27 September 2019	The Council notes that Paragraph 7.6.12 of the EIA Scoping Report states that "train capacity serving Gatwick has more than doubled since 2014, with new rolling stock on most of the services calling at the airport. This provides sufficient overall capacity for Gatwick to continue to grow its rail mode share over the next decade". We note that this increase in capacity has not been shared equally across all routes as it occurred due to the increase in the capacity of the Gatwick Express and Thameslink services, whereas the capacity of Southern and GWR have remained fairly static. We note for example that there are no direct rail services to/from Kent even though this is an area which is assessed as part of the employment effects. We consider that there is a need for	Assessment on rail capacity has been undertaken by line. This is contained in both the ES Chapter 12 and PTAR.

Consultee	Date	Details	How/where addressed in PEIR
		the study to establish if the capacity of the different routes (rather than just 'overall') is sufficient to at least the design year of 2038 or whether this is dependent on further investment in rail capacity, such as Assessment on rail capacity has been undertaken by line. This is contained in both the ES Chapter 12 and PTAR. Network Rail's "Croydon Triangle" scheme which is not currently a committed scheme and therefore cannot be relied upon.	
Reigate and Banstead Borough Council	27 September 2019	The Council notes that Paragraph 7.6.14 of the EIA Scoping Report states that "Gatwick also has an extensive, 24-hour, local bus network provided by Metrobus". We however note that this is subsidised by GAL through the Sustainable Transport Fund. We consider that this should be acknowledged as it is not necessarily guaranteed to continue. More generally we consider that there is a need to clarity which local bus services are subsidised and set out whether there are plans to change levels of subsidy which could result in changes to bus service patterns.	The baseline environment has been characterised by the existing public transport network for the baseline year assessed.
Surrey County Council	1 October 2019	Southern terminal roundabout (paragraphs 5.2.46 to 5.2.48, p.37): The County Council welcomes the recognition of the need for any improvement scheme for the roundabout to take account of the business park that is proposed for development on the land to the north of the junction (identified under Policy HOR09 of the Reigate & Banstead Local Plan, 2019). The assessment should take account of the traffic that would be expected to arise from that Reigate & Banstead Local Plan designation, and from extant urban extensions to the settlement of Horley.	The Horley Strategic Employment site will be considered in development scenario sensitivity testing for the final ES.
Surrey County Council	1 October 2019	Construction Logistics Consolidation Centre (paragraphs 5.3.14 to 5.3.16, p.44): The County Council notes that a decision has yet to be made in respect of the provision of a construction logistics consolidation centre as part of the development, but wishes to highlight the potential for such a facility to affect traffic on the network around the airport. The location of the potential centre will determine whether there will be a net decrease in total traffic movements at the site access points. A key determinant will be whether it has an internal access to the airfield and main construction locations within the campus which thus avoids secondary journeys on the local road networks around the airfield. The assessment should adopt a worst-case approach, and modelling of traffic impacts should include the likely effects of a construction logistics consolidation centre, and of all the construction staff required to deliver the project.	See Section 12.5 on Assumptions and Limitations
Surrey County Council	1 October 2019	Strategic Highways Modelling (paragraphs 7.6.33 to 7.6.34, p.116): The County Council recommends the use of its model for the county of Surrey as an input to the proposed strategic highways model, alongside input from the West Sussex and Transport for London models.	GAL is engaging with Surrey County Council's transport modelling lead on strategic model development.
Surrey County Council	1 October 2019	Local Highways Modelling (paragraphs 7.6.35 to 7.6.38, p.116): The County Council is concerned that the extent of the model into Surrey is too limited. The County Council would recommend that the local highways model be extended to take account of the A217, A23, B2036 and A264/A22.	The PEIR assessment is based on strategic modelling work which includes A217, A23, B2036 and A264/A22. The extent of the strategic modelling work is contained in the ES Chapter 12 and PTAR (Appendix 12.9.1).
West Sussex County Council	11 October 2019	In reference to Paragraph 5.2.43: The effect of increasing car parking spaces by 17,500 net on mode share will need to be taken into account in forecasting. Should provision of additional spaces run at a faster rate than demand for additional travel capacity and employee numbers, this could affect pricing policy for parking which could, in turn, attract car travel and change the impacts of the Project. GAL should ensure the Transport Assessment methodology identifies trigger points that can be linked to mode share targets and traffic flow monitoring to inform the design and phasing of the development and the Airport Surface Access Strategy (ASAS).	The strategic modelling work which informed the PEIR includes the increase in car parking spaces. Surface access monitoring is proposed to be able to respond to changes in demand. Gatwick will also monitor those surface access impacts as required by Highways England, Network Rail and the Department for Transport to demonstrate the successful mitigation of the effects of the Project. This is set out in Section 12.8 of the ES and will be part of the ASAS.

Consultee	Date	Details	How/where addressed in PEIR
West Sussex County Council	11 October 2019	In reference to Paragraph 5.2.45 - 5.2.50: The Scoping Report notes that the increase in traffic volumes is likely to be greatest at the North and South terminal junctions, so highway junction improvements are planned at these roundabouts. However, this is not necessarily the case, and it is likely that further highways and transport improvements (not constrained to junctions) will be required off-site to be identified through the Transport Assessment process to meet the NPPF criterion of resolving severe residual cumulative impacts on the road network. These may include increased segregation of sustainable modes of transport whilst maintaining capacity for general traffic or in some locations could require additional capacity for all vehicles. Care needs to be taken to ensure in designing highway improvements that they do not lead to traffic redistribution and create new congestion hotspots or exacerbate existing ones, particularly if new journey opportunities are created – for example the North Terminal Roundabout providing access to the A23 London Rd southbound. As well as Highways England, GAL should involve Local Highway Authorities in the development of junction improvements, given the close proximity of the respective jurisdictions, notably the North Terminal roundabout. At this stage, therefore, the potentially significant impacts of the development on the transport network, and the scope of mitigation measures have not been fully established. The scope of the development cannot be confirmed until GAL has completed the Transport Model and undertaken a Transport Assessment, including developing a new ASAS in liaison with relevant stakeholders.	This is noted and the strategic modelling work which accompanies the PEIR submission (see the Strategic Modelling Report contained in Annex B of Appendix 12.9.1) shows the results of the assessment undertaken to date. The modelling will be further reviewed during future workstreams in preparation for the DCO and mitigation will be identified for any significant effects where required. A description of the highway works is included in Chapter 5: Project Description. More details will be provided in the final ES as design development evolves in consultation with Highways England and local highway authorities.
West Sussex County Council	11 October 2019	In reference to Paragraph 5.2.52: The conclusion that further works to the rail station are unnecessary is premature, given that studies to confirm rail station capacity are still being undertaken. It is unclear what the conclusion is based on: what rail share mode has been assumed, and how this relates to maximum passenger throughput.	Rail share modes are contained in the PTAR (Appendix 12.9.1) and assessment on rail station crowding has been undertaken, contained in both ES Chapter 12 and the PTAR.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.2: In addition to the guidance listed, the following should be included: - WSCC Guidance on Parking at New Developments; - WSCC Transport Assessment Methodology; - West Sussex Cycling Design Guide; - Manual for Streets; - Manual for Streets 2.	These additional guidance documents have been added, as listed in the PTAR (Appendix 12.9.1).
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.5: Traffic count data has also been collected from WSCC's traffic count database.	Added reference to the ES Chapter.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.6: This relates solely to passenger transport patterns. It should also include employees, particularly given the significant numbers (as per paragraph 4.2.25 - 24,000 staff currently work at the airport).	Information on staff travel and mode shares have been incorporated into the ES Chapter 12 and PTAR (Appendix 12.9.1).
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.12: The paragraph states that:	Assessment on rail capacity has been undertaken by line. This is contained in both the ES Chapter 12 and PTAR.

Consultee	Date	Details	How/where addressed in PEIR
		"Train capacity serving Gatwick has more than doubled since 2014, with new rolling stock on most of the services calling at the airport. This provides sufficient overall capacity for Gatwick to continue to grow its rail mode share over the next decade." However, the increase in capacity has not been shared equally across all routes. It is occurred due to the increase in capacity of Gatwick Express and Thameslink services, whereas the capacity of Southern and GWR services have remained fairly static, and there continue to be no direct rail services to/from Kent. The study will need to establish if the capacity of different routes is sufficient to at least the design year of 2038, or if maintaining Gatwick's sustainable mode share to the level indicated beyond 2029 is dependent on further investment in rail capacity (such as Network Rail's "Croydon Triangle" scheme, which is not currently a committed scheme so cannot be relied upon). GAL should assess the impacts of the Project and identify infrastructure and service enhancements for different routes that will be needed to facilitate the development and delivery of the ASAS to at least the design year of 2038.	
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.14: The 24 hour, local bus service (Metrobus) is in part subsidised by GAL through the Sustainable Transport Fund. Clarity should be provided over whether this will be secured through legal agreement attached to the DCO (if granted), and to what degree – whether there would be an increase or decrease in subsidy, which may affect the level of service provided.	The baseline environment has been characterised by the existing public transport network for the baseline year assessed. Subsidies are outside the scope of the PEIR.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.15: The proposal should include provision to investigate ways to improve bus services to/from the airport, to minimise the impact of the increase passenger and staff numbers on people, the road network, and the environment.	See Chapter 8 of the PTAR (Appendix 12.9.1).
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.18: The focus here is on the M23/A23, but for south coast towns such as Worthing west to Southampton, other north-south routes are more important for access to the Airport. GAL should recognise the role that other local highway network routes such as the A22, A264, A24 and A29 perform in providing access between the Airport and the south coast.	Noted and these routes are included in the strategic model. The M23/A23 carries the highest proportion of Gatwick traffic.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.25: GAL should not assume that sustainable transport mode share for employees will be 42%. Increasing sustainable transport mode share for employees has been challenging and progress has not proved as successful as it has been with air passengers. Therefore, GAL should consider different mode share scenarios for employee West Sussex County Council: Response to Gatwick Airport Northern Runway Scoping Request Page 12 trips and assess the worst case, which is likely to be the continuation of current staff travel patterns. GAL should also include mechanisms to improve the uptake of sustainable travel initiatives for staff to help achieve more ambitious targets.	Mode share targets have been tested through the strategic modelling process, see Chapter 6 of the PTAR (Appendix 12.9.1).
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.28:	Noted. This data and the model network have been included in the assessment.

Consultee	Date	Details	How/where addressed in PEIR
		The bulleted list includes "West Sussex model data, including the network for the Crawley Local Transport Model, traffic counts, signal timings and details on future infrastructure and development assumptions." However, this data has already been supplied. The exception is any further committed highways schemes which were not already included in the Crawley Model future year networks supplied, largely those in locations beyond the study area for that model. These will be supplied to GAL's transport consultant, Arup.	
West Sussex County Council	11 October 2019	In reference to Paragraphs 7.6.33-34: As the Gatwick Airport version of SERTM has not yet been developed and finalised, it cannot yet be used to determine the area over which significant changes to travel demand flows are likely. This means that the assessment of the extent of network over which mitigation has to be considered will be less accurate. It means, for example, that the local highway network such as A23 London Road close to the Airport is not included in the scoping area but is likely to be affected by the Project. GAL should complete their assessment and identify what mitigation measures are required before the scoping area is finalised.	Strategic modelling work which accompanies the PEIR submission is set out in the Strategic Modelling Report contained in Annex B of Appendix 12.9.1. A summary is also provided in Chapter 9 of the PTAR (Appendix 12.9.1).
West Sussex County Council	11 October 2019	In reference to Paragraphs 7.6.34 - 7.6.38: The VISSIM Models referenced have a limited study area with inclusion of West Sussex County Council roads largely limited to the A23 between the airport and the A2011 Tushmore Junction, plus a single section of A2011 eastwards to the Hazelwick Roundabout. This means that the consideration of other WSCC managed roads which may experience changes to demand patterns due to the Project will need to be assessed through the Gatwick Strategic Model - including Gatwick Road, the remainder of Crawley Borough, and roads in Mid Sussex and Horsham districts and further afield. The impacts on these roads may require mitigation to ensure the residual cumulative impacts of development are not severe in line with NPPF. Therefore, GAL should add local detail to the Gatwick Strategic Model in these areas and the County Council should be consulted on its calibration and validation on County Council roads.	See above comment.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.41 and Diagram 7.6.1: The proposed structure of the demand model splits airport-related highway demand into passenger and employee trips. It should be clarified that the model will also handle demand made by trips by suppliers to airport businesses and airlines –goods delivery trips - and visitors to the airport, such as people using the airport hotels without being air passengers or staff, whether being guests or attendees of the hotel conferencing facilities or visitors to on airport businesses.	See Section 12.5 on Assumptions and Limitations of the Assessment. Airport supplier, cargo and logistics, ie delivery trips, as well as non-airport users including visitors and commuters are included in the modelling.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.41: The extent of the model coverage is proposed to be assessed using "confirmed assessment criteria" but these are not stated here. The West Sussex County Council: Response to Gatwick Airport Northern Runway Scoping Request Page 13 criteria should be established at this scoping stage. WSCC is concerned that the A27 corridor is outside the area of detailed modelling. There is a prevalence of long-standing congestion issues on the corridor that could be exacerbated by the Project. Planned housing development will not be equally distributed across the south coast and there is a choice of competing routes between A29, A24 and A23 so travel patterns can be expected to change as a result of the Project. The A27 corridor is located within the wider area of simulation modelling for which it is proposed to keep the SERTM level of detail. However, to ensure that the	Strategic modelling work which accompanies the PEIR submission is set out in the Strategic Modelling Report contained in Annex B of Appendix 12.9.1. A summary is also provided in Chapter 9 of the PTAR (Appendix 12.9.1).

Consultee	Date	Details	How/where addressed in PEIR
		Model will accurately route traffic to/from Gatwick based on a realistic simulation of main junctions along the coastal corridor between Arun, Worthing and Brighton and Hove, the most affected parts of the A27, including the section between A27/A29 Fontwell in the west and the county boundary in the east (potentially extending to A22/A27 Polegate in East Sussex) should be included in the area of detailed modelling.	
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.42: WSCC notes that the rail modelling will extend down to and along the Sussex Coast, which is supported. It is desirable that the rail and highway modelling should be kept to a comparable standard over a similar area, so that mode share is assessed consistently, rather than being influenced by the level of modelling of travel costs in certain areas according to mode of travel.	See the updated assessment on rail capacity contained in both the ES Chapter 12 and PTAR.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.43: For both the construction and operational phases it would be helpful to provide information on both the absolute and percentage change in traffic generation and assigned flows.	Absolute and percentage change in traffic flows for the EIA study area is contained in Appendix 12.9.2.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.47: It is noted that the criteria for percentage change in flow for consideration of delay relates to the environmental assessment of the network. However, for the supporting Transport Assessment, tighter figures, such as the West Sussex starting point of 100PCU/hr, may be necessary to assess delays at congested junctions, as a relatively small percentage increase in flow can lead to a much higher increase in delay at peak times for road travel when the network is already congested. GAL should include journey times and reliability on key routes to/from the airport via both the local and strategic road networks.	The driver delay assessment has been undertaken based on Volume to Capacity (V/C) at junctions rather change in traffic flows. See Chapter 12, Chapter 9 of the PTAR (Appendix 12.9.1) and the Strategic Modelling Report (Annex B).
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.53: As well as those listed, local highway authorities also hold information about committed developments and schemes.	Local highway authorities have been consulted on the committed developments included in the strategic modelling work.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.59: The later delivery of Heathrow in 2030 is a highly plausible and worthwhile scenario to include, but it does not seem to be a worst case, that being that Heathrow does not get delivered at all in the period under consideration to 2038. If this occurred, then growth at Gatwick would be likely to occur at a faster rate than currently anticipated, potentially accelerating impacts and the need for improvements that are currently planned for later phases. GAL should also assess the impacts of a 'without Heathrow Runway 3' scenario.	The PEIR assessment does not include Heathrow third runway.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.60: TEMPRO does not take Gatwick Expansion into account. Expanding the Airport may generate a greater level of economic growth in the region. A potential way to overcome this could be to develop a scenario where the further development to overall. TEMPRO totals by Local Planning Authority area are distributed according to the sites already considered through the SHELAA process but not yet allocated rather than through TEMPRO's defaults. This would help to ensure that additional background demand in the cumulative impact assessment originates where it is most likely to occur, rather than in proportion to existing population sizes. GAL should also	Gatwick's impact on direct, indirect and catalytic employment has been assessed and included in the strategic transport modeling.

Consultee	Date	Details	How/where addressed in PEIR
		consider other potential future growth scenarios and assess the cumulative impacts of development on the transport network in the worst case to ensure that impacts can be managed in line with NPPF.	
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.61: As stated above, the Transport Assessment will need to use tighter criteria for traffic flow increases than those indicated in paragraph 7.6.47 to consider all relevant locations where a severe impact under NPPF criteria could occur and require mitigation, due to the sensitivity of congested networks. Thresholds of 5% increase or 100pcu/hr, whichever is greater, could be considered reasonable for routes which are already congested at peak times. Also as stated above, the Transport Assessment should take into account the West Sussex Transport Assessment Methodology for the County Council network, as well as the County Council's Guidance on Parking at New Developments and on cycling design.	These two comments are made above (Paragraph 7.6.47 and Paragraph 7.6.2), see responses.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.63: The proposed approaches to mitigation are appropriate. However, they should additionally include provision to increase physical highway capacity for residual issues after these approaches have been tested, whether this is widening to allow additional segregated facilities for sustainable modes without reduction to general traffic or for increased capacity for all traffic depending on the nature of the location and transport corridor. It may also be necessary to consider additional off-site public transport infrastructure facilities in areas which are likely to see significant employee commuter demand to Gatwick. In practice, the Gatwick Area Transport Forum only meets annually and is not constituted as a consultative body. The Gatwick Area Transport Forum Steering Group provides a more suitable forum for consultation and coordination of approach to delivering transport objectives and initiatives.	More details will be provided in the final ES as design development evolves in consultation with Highways England and local highway authorities.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.65: The Construction Traffic Management Strategy needs to include consideration of how construction workers will get to site, how sustainable transportation will be encouraged, and if travelling by car, where they will park.	See Section 12.5 on Assumptions and Limitations. The Construction Traffic Management Strategy will be developed as part of the DCO process and submitted alongside the application for development consent.
West Sussex County Council	11 October 2019	In reference to Paragraph 7.6.66: Consideration must be given to providing buses or other sustainable transport options for construction workers, given that up to 2,000 will be on site at peak times (see paragraph 5.3.20).	Chapter 13 of the PTAR (Appendix 12.9.1) contains further information on construction. The construction programme shows a peak construction activity over winter 2026/27, with over 1,200 construction workers on site. For rest of the duration, there are less than 1,000 construction workers on site. An outline Construction Workforce Travel Plan (CWTP) is being developed for the Project. It will focus on how the construction workforce will travel to and from the Airport, including measures that encourage alternatives to the use of private car in particular single-occupancy car journeys. The intent of the Travel Plan is to put forward a range of travel options for the construction workforce which encourage and deliver a high sustainable mode share and, through this, reduce any potential capacity and environmental impacts of the Project.

Consultee	Date	Details	How/where addressed in PEIR
Waverley Borough Council	30 September 2019	In relation to transport matters, the Council would be interested in understanding further how sustainable access to the Airport can be improved for Waverley residents and businesses as part of the development.	Transport links through Waverley is included in the strategic transport model.
Transport for London	11 October 2019	It is noted that that nothing has been scoped out of the traffic and transport assessment for the Environmental Impact Assessment (EIA), which is entirely appropriate at this early stage. Although no issues have been de-scoped, TfL is keen to ensure that GAL continues to have sufficient regard for any potential impacts identified on London's transport networks. TfL looks forward to continuing engagement with GAL on these issues.	See Section 12.4.3 on Scope of the Assessment. No effects identified in the scoping and consultation process to date have been scoped out, other than driver stress and view from the road assessments which no longer form part of DMRB. GAL will continue to engage with TfL as an important stakeholder for the Project.
Transport for London	11 October 2019	As part of the assessment of transport, GAL should have regard for relevant London policies including the Mayor's Transport Strategy (MTS). The MTS sets a target for 80% of all Greater London trips to be taken by sustainable modes, including public transport, walking and cycling. It is essential that development proposals outside Greater London, but which are significant generators of trips to and from London have regard for this target and support its delivery.	This is noted and understood. Gatwick's highest sustainable mode share is between the Airport and London, owing to the excellent rail connectivity Gatwick has with the capital.
Transport for London	11 October 2019	In the case of the Gatwick Airport, Greater London is currently its largest market, representing 42% of passengers travelling through the airport. It is the mode share of both passengers and staff travelling between London and the airport which is of most relevance to TfL.	Noted and understood. Please see above.
Transport for London	11 October 2019	The MTS sets out a transport policy based on Healthy Streets, as part of a wider strategy to improve public health and support good growth. TfL Healthy Streets indicators should be used as a measure of amenity within Greater London, and TfL recommends that the Healthy Streets indicators be applied across the wider study area in order to support sustainable development.	Noted. Gatwick is keen replicate elements of Healthy Streets through greater active travel, particularly by staff, to and from the Airport.
Transport for London	11 October 2019	GAL's analysis of the surface access dimension of its proposals is an essential part of its wider assessment of the full range of environmental impacts, which needs to explicitly draw out the impacts on London and associated mitigation required.	Noted and understood.
Transport for London	11 October 2019	In accordance with DfT WebTAG guidance, GAL should agree with stakeholders what surface transport infrastructure and operations will exist in the future baseline without airport expansion. GAL will test the 'with scheme' against the 'without scheme' scenario to determine what impacts will need to be mitigated against. The baseline scenario cannot include uncommitted schemes.	Background traffic in the strategic modelling work is based on the latest TEMPRO (v.7.2) growth factors which have been adjusted to align with cumulative developments in the scheme area in line with TAG guidelines. Future year networks have been updated in consultation with Highways England and Local Authorities. In line with TAG, only those interventions which are near certain or more than likely to occur have been included in the modelling.
Transport for London	11 October 2019	The Scoping Report highlights that 42% of Gatwick passengers travel to or from Greater London. As this is the largest market for Gatwick passengers and the demographic of greatest relevance to TfL, GAL should provide the mode share split (main mode), for passengers from Greater London in the baseline conditions. This should be given for the baseline, future baseline and with project scenarios.	Noted. Gatwick intends to output mode share by travel corridor for the final ES which will accompany the application for development consent. The primary corridor between Gatwick and London is the Brighton Main Line and mode choice modelling indicates that a rail mode share of 43% is achievable in 2047 with Project on a busy summer day, meaning a higher annual average moving towards a 50% rail mode share.
Transport for London	11 October 2019	The baseline staff mode share has not yet been made available and should be included. This is critical for assessing future staff flows and mode share.	Baseline staff mode shares are included in both the ES Chapter 12 and the PTAR (Appendix 12.9.1).
Transport for London	11 October 2019	As well as the Brighton Main Line (BML) that directly serves the airport, the modelling will need to assess the impact on onward routes and key interchanges in Greater London. Modelling will in general need to assess the impact on bus and coach routes.	The rail modelling includes the LU network. Please see Annex B of PTAR (Appendix 12.9.1) for a full discussion on impacts. Volume changes on the London Underground are small in comparison to the

Consultee	Date	Details	How/where addressed in PEIR
			overall volumes forecast on these services, with a maximum forecast change related to the Project being ~140 passengers from Green Park on the Victoria Line in the 2047 peak hour. Changes of this magnitude will be unnoticeable when compared to background activity on the wider London Underground network.
Transport for London	11 October 2019	Public transport connections to Gatwick for locations in southeast and southwest London – i.e. without easy access to the BML – can be relatively weak relative to private car. Any baseline modelling should seek to understand the flows between these areas on all modes.	Gatwick intends to output mode share by travel corridor for the final ES which will accompany the application for development consent.
Transport for London	11 October 2019	TfL is satisfied that the proposed detailed highways modelling area is appropriate for the proposed project, covering key corridors and town centres in south London. TfL is also satisfied that the strategic highway modelling area is appropriate for the project, which includes all of Greater London.	Noted.
Transport for London	11 October 2019	Should junctions, corridors or wider areas be identified in the strategic modelling as likely to be impacted by the proposed project, detailed modelling should be completed for the affected area.	The strategic highway modelling included in PEIR includes the potential effects of any redistribution of traffic. Further work will be undertaken for the submission of the DCO application and final ES.
Transport for London	11 October 2019	Modelling will need to assess any direct and indirect impacts from the proposed development, including the potential for induced growth.	Modelling includes the effects of direct, indirect and catalytic employment growth associated with the Project based on the Economic Impact Report produced by Oxera.
Transport for London	11 October 2019	The A23 corridor, which forms part of the Transport for London Road Network (TLRN), is the corridor of most interest for TfL in relation to the proposed project, with Fiveways Junction and Purley Gyratory of particular concern. For the purposes of modelling, the Fiveways Junction capacity upgrade should be treated as a committed scheme, while the Purley Gyratory upgrade is not committed.	Noted. Gatwick has consulted with TfL on the development of the highway model.
Transport for London	11 October 2019	TfL is satisfied that the proposed public transport modelling arrangements are generally appropriate for this project.	Noted
Transport for London	11 October 2019	It is noted that the proposed scope of assessment does not explicitly include tram services in South London. GAL should ensure that the trams are included in the public transport study.	The modelling includes Croydon Tramlink which will serve an important role for access to Gatwick via East Croydon from Addiscombe, Mitcham, New Addington. Refer to 5.2.2 of Annex B of the PTAR Appendix 12.9.1.
Transport for London	11 October 2019	TfL requests that any data obtained and used by GAL for the purposes of the EIA, the Transport Assessment (TA) and the Surface Access Strategy is made publicly available.	This is noted, subject to any confidentiality agreements between Gatwick and the data provider.
Transport for London	11 October 2019	TfL can advise on types of baseline condition survey needed for walking and cycling, such as Healthy Streets assessments.	Noted.
Transport for London	11 October 2019	Issues which have not been identified in Table 7.6.1 include: ▪ Collisions specifically between cyclists and HGVs ▪ Air, light and noise pollution due to construction traffic ▪ Air quality impact of construction	The transport assessment includes road safety. An assessment of air quality relating to both construction activities and construction traffic movements is provided in Chapter 13: Air Quality. An assessment of construction noise is provided in Chapter 14: Noise
Transport for London	11 October 2019	TfL would like to highlight the potential impact on Tram, Underground, Overground and other national rail services feeding into the BML. These should be adequately modelled in order to determine any potential further crowding on these services.	These services are all included in the strategic transport model.
Transport for London	11 October 2019	TfL recommends GAL works with it to determine the magnitude of any impacts on transport within, to and from Greater London.	Noted and agreed. Gatwick is keen to engage with TfL as an important stakeholder.

Consultee	Date	Details	How/where addressed in PEIR
Transport for London	11 October 2019	GAL should consider luggage load factor on public transport services as luggage can have a significant impact on crowding, particularly during peak hours.	Gatwick is keen to understand how TfL would model this in a strategic model of rail crowding.
Transport for London	11 October 2019	GAL should make use of TfL's Construction and Logistics Plan (CLP) guidance, as it sets out how TfL expects construction to be assessed in the planning stages. TfL's CLP guidance has been used for other nationally significant infrastructure projects, such as Thames Tideway Tunnel and HS2, as best practice. GAL should forecast construction traffic, both workers and materials, for the entire build programme, and assess lane usage and track possessions during the build programme. GAL should provide modelling for all phases of construction.	See Section 12.5 on Assumptions and Limitations. Further work is being undertaken in conjunction with GAL's construction team and the assessment will be refined for the final ES once more details are known.
Transport for London	11 October 2019	Based on the results of the assessment, GAL should implement measures to avoid, minimise and mitigate impacts on the TLRN and the Strategic Road Network (SRN) as part of the Mayor's Vision Zero and air quality targets.	This is noted and the strategic modelling work which accompanies the PEIR submission (see the Strategic Modelling Report contained in Annex B of Appendix 12.9.1) shows the results of the assessment undertaken to date. The modelling will be further reviewed during future workstreams in preparation for the DCO and mitigation will be identified for any significant Project-related effects as appropriate.
Transport for London	11 October 2019	GAL should seek to set out measures for encouraging mode shift from private vehicles, not only for meeting surface access targets, but for reducing air pollution, noise, carbon emissions and limiting climate change impacts.	This is noted and agreed and as reflected in Gatwick's draft ASAS targets.
Transport for London	11 October 2019	GAL has separately indicated that it aims to increase rail mode share for passengers to 50% by 2040 from the present mode share of 39%. This is a sensible approach so long as this increase in rail mode share is not at the expense of other sustainable modes. GAL also needs to set out its plan for staff trips.	This is noted and the current Gatwick draft ASAS targets are provided below and in Section 6 of the PTAR in Appendix 12.9.1: ▪ Achieve 60% public transport mode share for airport passengers by 2030 under the scrutiny of the Transport Forum Steering Group. Demonstrate clear progress towards reaching a rail mode share aspiration of 50% by 2030. ▪ Achieve 60% of staff journeys to work by sustainable modes (public transport, active travel modes and group travel provided).
Transport for London	11 October 2019	In the context of the MTS target, and recognising the already strong rail connections between Gatwick and London, TfL has called on GAL to commit to an ambitious mode share target specifically for airport passenger and staff trips to and from Greater London.	Gatwick is committed to low-carbon growth and its Decade of Change strategy sets ambitious carbon reduction targets. The headline targets in Gatwick's draft ASAS are set out in Chapter 6 of the PTAR in Appendix 12.9.1.
Transport for London	11 October 2019	GAL's assessment should consider how it will meet its mode shift objectives and how the network is able to support the increase in public transport trips.	Mode share targets have been tested through the strategic modelling process to understand the impact of 'pull' and 'push' measures that are required to deliver these targets. Chapter 6 of the PTAR contains further details. Rail and station crowding assessments have also been undertaken to demonstrate how the network is able to support the increase in rail trips. These are contained in both the ES Chapter 12 and PTAR.
Transport for London	11 October 2019	It is noted that GAL proposes to construct approximately 17,500 new car parking spaces to support the project. TfL recognises the spatial context of Gatwick Airport; however, any proposed uplift in car parking needs to be evidence-based. Too much car parking availability risks making driving to the airport an attractive option compared to sustainable modes.	The proposed car parking strategy is indicative of whare car parking capacity could be provided as opposed to a commitment to build all of this car parking. As per Gatwick's draft ASAS, interventions including increasing the cost of parking have been tested to increase sustainable mode share.

Consultee	Date	Details	How/where addressed in PEIR
Tandridge District Council	30 September 2019	Comments from West Sussex County Council (as local highway authority for the Project area) are endorsed. Surrey County Council, as the highway authority covering Tandridge and other host and neighbouring authority Surrey Districts, is best placed to comment in detail in relation to this topic.	See Section 12.3.4 on Consultation and Engagement.

3 Glossary

3.1 Glossary of terms

Table 3.1.1: Glossary of Terms

Term	Description
AODM	Area of Detailed Modelling
AQMA	Air Quality Management Area
ASAS	Airport Surface Access Strategy
ATM	Air Traffic Movements
CLP	Construction Logistics Plan
CMP	Construction Management Plan
DCO	Development Consent Order
DMP	Development Management Plan
EIA	Environmental Impact Assessment
EIASR	Environmental Impact Assessment Scoping Report
ES	Environmental Statement
GAL	Gatwick Airport Limited
GTA	Guidance on Transport Assessment
HGV	Heavy Goods Vehicle
IAN	Interim Advice Notes
LCWIP	Local Cycling and Walking Infrastructure Plan
MHCLG	Ministry of Housing, Communities and Local Government
MTS	Mayor's Transport Strategy
NMU	Non-Motorised User
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Information Report
SAC	Special Area of Conservation
SERTM	South Eastern Regional Transport Model
SRN	Strategic Road Network