Gatwick Airport Northern Runway Project

Environmental Statement
Appendix 11.9.3: Water Quality HEWRAT Assessment

Book 5

VERSION: 1.0

DATE: JULY 2023

Application Document Ref: 5.3

PINS Reference Number: TR020005

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

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0 Executive Summary

0.1.1 The proposal to make best use of London Gatwick Airport's existing runways and infrastructure will include modifications to the existing highways network in the vicinity of Gatwick Airport and increase car parking capacity to accommodate the additional passengers that would use the airport. These modifications would potentially increase the risk of pollution reaching the watercourses that receive its rainfall runoff.

0.1.2 This appendix provides the supporting technical information that supports the assessment of impact of the highways improvements on the water quality of the receiving watercourses reported in Chapter 11 of the Environmental Statement.

0.1.3 The assessment demonstrates that the highways elements and car parking proposals would not result in a significant impact upon the water quality of receiving watercourses.

1 Introduction

1.1 General

1.1.1 This document forms Appendix 11.9.3 of the Environmental Statement (ES) prepared on behalf of Gatwick Airport Limited (GAL) for the proposal to make best use of London Gatwick Airport's existing runways and infrastructure (referred to within this report as 'the Project').

1.1.2 This document covers the water quality assessments undertaken for the Project, relating to the surface access (highways) improvement works and new car parking provision. The document details the data, methodologies and results from the water quality assessments undertaken for consideration of potential impacts during the operational phase of the Project. In this instance, the Highways England Water Risk Assessment Tool (HEWRAT) assessment considers the road traffic volumes during the design year, 2047.

1.2 The Project and Water Quality

1.2.1 As part of the Project, there is anticipated be an increase in airport passenger and staff capacity, therefore, there is also predicted to be an increase in road traffic volumes within the immediate vicinity of the airport.

1.2.2 Highway improvements are proposed which will see the upgrade of the existing highway layout to support this increase in road traffic volumes. The highway improvement works are situated between the M23 Spur from Gatwick Interchange to the South Terminal Junction and onto Airport Way to the North Terminal Junction and finally the Longbridge Junction.

1.2.3 The Project also proposes several new, and upgrades to existing, car parking areas to serve the expected increase in passenger and staff numbers.

1.2.4 The potential effects of the Project on surface water quality as a result of increased air traffic movements and consequently use of de-icer are addressed separately in **ES Appendix 11.9.4**: **Water Quality De-Icer Impact Assessment** (Doc Ref. 5.3).

2 Assessment Methodology

2.1 Highways Improvement Works Drainage Design

2.1.1 The proposed drainage design (full details are included in **Annex 2** of the **ES Appendix 11.9.6 Flood Risk Assessment (FRA)** (Doc Ref. 5.3) comprises 13 surface water outfalls. The current drainage design incorporates the use of SuDS features, where feasible, for attenuation purposes. Two of the 13 outfalls provide drainage for permeable discharges only (i.e. clean water from earthworks), therefore, these have not been taken forward for assessment.

2.1.2 Similarly, it is assumed that there are no direct discharges to the ground proposed as part of the proposed highways drainage design. However, based upon flow data and professional judgement, two outfalls associated with the proposed drainage design have been identified that discharge to low flow watercourses, i.e. with potential to dry up for part of the year thus acting like a soakaway. No information is available regarding whether the ditches into which the water would be discharged that have been identified as having low flow conditions are lined or unlined. In adherence with the precautionary principle, it is assumed they are unlined and hence are taken forward for assessment.

Routine Runoff Assessment

2.1.3 The assessment of surface water quality during the operational phase of the highway improvements aspect of the Project has been undertaken in line with the methods detailed in DMRB LA 113 (Highways England, 2020a). In accordance with DMRB LA 113 (Highways England, 2020a), the assessment for routine runoff uses the HEWRAT.

2.1.4 HEWRAT is designed to be used to assess the impacts of road runoff where Annual Average Daily Traffic (AADT) volumes are >10,000 vehicles. The HEWRAT assessment uses statistically based models for predicting the quality of road runoff in terms of specific soluble and sediment-bound pollutants.

2.1.5 The HEWRAT routine runoff assessment uses a three-step approach to assess the impacts of both soluble and sediment-bound pollutants. The three-step approach is as follows:

- Step 1: estimates pollutant concentrations in the undiluted road runoff.
- Step 2: estimates pollutant concentrations after dilution within the receiving water body.
- Step 3: estimates pollutant concentrations after mitigation (ie the treatment provided by the proposed SuDS) and dilution within the receiving water body.

2.1.6 Under Step 1, undiluted pollutant concentrations in the drainage discharges are determined. These values are then used in Step 2 to estimate the pollutant concentrations after dilution in the receiving watercourse. For Step 2, the HEWRAT model results are compared to a set of compliance thresholds for sediments, acute impacts from soluble copper and zinc (compared with Runoff Specific Thresholds (RSTs)) and the annual average concentrations of (soluble) copper and zinc which are compared with an Environmental Quality Standard (EQS). Results are recorded and compliance is indicated in the model outputs by a 'pass' or 'fail'.

2.1.7 Chronic impacts associated with sediment-bound pollutants are assessed on whether polluted sediment will accumulate on the riverbed or disperse in the river downstream (based on the stream velocity under low flow conditions).

2.1.8 Step 2 is carried out in two tiers: Tier 1 requires input of the estimated river width at Q_{95} (the flow in the receiving watercourse that is exceeded 95% of the time) only, whilst Tier 2 requires information regarding the physical properties of the receiving watercourse, for example the bank side slopes and longitudinal gradient. Step 2 Tier 2 assessments are generally undertaken following a sediment failure of Step 2 Tier 1.

2.1.9 Step 3 allows the HEWRAT tool to apply levels of treatment (as “percentages”) to provide an indication of the type of mitigation required for both sediment-bound and soluble pollutants. Treatment values (efficiencies) are in accordance with DMRB CG 501 (Highways England, 2020b). Where there is more than one level of treatment provided through a treatment train, a bespoke percentage using the values for each component is calculated.

2.1.10 In accordance with DMRB LA 113 (Highways England, 2020a), outfalls discharging to the same watercourse within 100m of each other have been assessed cumulatively for soluble and sediment-bound pollutants and within 1km of each other for soluble pollutants.

Groundwater Assessment

2.1.11 Routine runoff can pose a risk to groundwater quality, especially when the receiving watercourses have little or no flow. The groundwater assessment for routine runoff has been undertaken in line with the methods detailed in DMRB LA 113 (Highways England, 2020a).

2.1.12 A source-pathway-receptor (SPC) conceptual site model (CSM) is used as the basis for the assessment. The source comprises pollutants contained within road runoff that enter the ground, the pathway is the drainage system and unsaturated zone, and the receptor is groundwater and associated groundwater users, receiving surface waters and the environment.

2.1.13 As part of Appendix C of DMRB LA 113 (Highways England, 2020a), the source is defined by the following:

- Road traffic volumes, expressed as AADT flow.
- Annual average rainfall depth (mm).
- Drainage area ratio. This is the ratio of the drainage area of the road to the active surface area of the infiltration device.

2.1.14 The key factors affecting the persistence and movement of pollutants through the pathway are as follows:

- Infiltration method – either a ‘continuous’ shallow linear system such as:
  - an unlined ditch, a ‘regional’ shallow system such as an infiltration basin, or;
  - a ‘point’ system such as a deep soakaway.
- Unsaturated zone thickness, ie depth to water table.
- Flow type – whether groundwater flow is dominated by intergranular or fracture flow.
- Unsaturated zone clay content expressed as % clay minerals.
- Organic carbon, expressed as % soil organic matter (SOM).
- Unsaturated zone soil pH.

2.1.15 Each source and pathway parameter is assigned a numerical weighting factor to represent its relative influence on the overall risk to groundwater.

2.1.16 The value of each parameter (or “type” of parameter in the case of infiltration method and flow type) will fall into one of three risk levels (low, medium, high), with an associated risk factor (1, 2, 3). The risk factor is then multiplied by the weighting factor to provide a score for each parameter. The scores for all parameters are then added together to provide an overall risk score. The overall risk scores relate to an overall risk to groundwater as follows:

- Low risk: Overall risk score less than 150.
- Medium risk: Overall risk score 150 to 250.
- High risk: Overall risk score greater than 250.

2.1.17 Road traffic volumes are based on the results of traffic flow modelling. The modelling results indicate that the AADT flow will be less than or equal to 50,000 vehicles per day for the outfalls considered for the groundwater assessment.

2.1.18 Annual average rainfall depth was taken from Southampton which has a standardised annual average rainfall (SAAR) of 820 mm. This is the closest location to the Project which is available within HEWRAT and must be applied in accordance with the methodology.

2.1.19 All receiving watercourses are assumed to be unlined ditches and are, therefore, categorised as continuous shallow linear infiltration systems. Catchment areas are based on impermeable pavement areas indicated in the drainage plan (Arup, 2022). The dimensions of the drainage ditches were not available but are assumed to be between 1.5-5m wide and 50-150m long, yielding a ratio of the drainage area of less than or equal to 50.

2.1.20 Groundwater levels were based on the results from ground investigation (SOCOTEC, 2022b), conservatively using the highest groundwater level (2mbgl) in the vicinity of Longbridge roundabout.

2.1.21 Based on British Geological Survey (BGS) mapping and ground investigation (SOCOTEC, 2022b), the underlying geology in the unsaturated zone is assumed to be 1 to 5m of made ground overlying the upper weathered Weald Clay formation.

2.1.22 Groundwater flow within the unsaturated zone is assumed to be dominated by intergranular flow.

2.1.23 Clay content, organic carbon content and pH of the unsaturated zone was available from the ground investigation in the vicinity of Longbridge roundabout (SOCOTEC, 2022b).

2.1.24 Where medium or high risks have initially been identified, the results from the routine runoff assessments have been used to screen the predicted metal concentrations against suitable water quality standards protective of groundwater and groundwater receptors. As the receptors are all low flow features (<0.0011 m^3/s) with negligible dilution it was considered suitable to use the Step 2 (without mitigation) results in the assessment. No treatment is proposed.

Research undertaken by National Highways in collaboration with the Environment Agency (Highways Agency, 2010), concluded that dissolved Polyaromatic Hydrocarbons (PAHs) are not classified as ‘significant pollutants’ to groundwater. PAHs are strongly absorbed to the organic fraction, and do not penetrate deeply into most soils, therefore limiting leaching to groundwater. The fate of PAHs in the unsaturated zone was reported by the Highways Agency (Highways Agency, 2010). It was concluded that in porous media, residual concentrations of these organic compounds would be reduced to below the limit of laboratory analytical detection within approximately 0.5m depth of the unsaturated zone. Hence discernible concentrations entering groundwater are considered unlikely from the Project and therefore PAHs are not considered to be contaminants of concern for the routine runoff assessment for groundwater.

2.1.25 The pertinent groundwater receptors are considered to be either private or licenced groundwater abstraction wells or surface water features which are groundwater fed.

Spillage Risk Assessment

2.1.26 For all roads, there is a risk that a spillage may lead to an acute pollution incident. Where spillages do reach a surface watercourse the pollution impact can be severe, but is usually of short duration, typical of an acute pollution impact.

2.1.27 The spillage risk assessment within DMRB LA 113 (Highways England, 2020a) has been designed to calculate spillage risk during the operation of the Project and the associated probability of a serious pollution incident. The risk is calculated assuming an accident involving the spillage of a potentially polluting substance onto the carriageway would occur at an assumed frequency based on calculated road traffic volumes, the percentage of that road traffic volume considered as Heavy Good Vehicles (HGV), and the type of road/junction. The annual probability of an accidental spillage leading to a serious pollution incident is also dependent on the response time of the emergency services. A risk factor is applied depending on the location and road/junction type and the sensitivity of the receiving watercourse.

2.1.28 DMRB LA 113 (Highways England, 2020a) states that the risk of a serious pollution incident is deemed within acceptable limits if the annual probability is less than a 1% (1 in 100) Annual Exceedance Probability (AEP). If this requirement is met, no further spillage prevention measures are required.

2.2 Car Parking Surface Water Quality Assessment

CIRIA Simple Index Approach

2.2.1 Assessment of surface water quality during the operational phase of the new and upgraded car parking areas has been assessed using the Simple Index Approach (SIA) as outlined in The SuDS Manual (CIRIA, 2015).

2.2.2 The SIA defines proposed developments through the application of land use classifications, and measures proposed water quality treatment methods (mitigation) against these land use classifications.

2.2.3 The SIA comprises two key components:

- Pollution Hazard Indices (PHI) of between 0 and 1, based on the pollutant levels likely for different land-use types, where higher values indicate higher pollutant levels; and
- Pollution Mitigation Indices (PMI) of between 0 and 1, based on the ability of Sustainable Drainage Systems (SuDS) components to treat pollutants, where higher values indicate higher treatment efficiency.

2.2.4 PHI and PMI values are given for three broad pollutant categories: Total suspended solids (TSS), Metals, and Hydrocarbons. Where PHI is assessed to be less than PMI, the proposed mitigation or proposed SuDS is considered sufficient to treat runoff from the pollution source.

2.2.5 Where multiple SuDS components are proposed to provide mitigation, it is suggested that a factor of 0.5 is applied to secondary and then subsequent mitigation components to account for a reduction in performance due to reduced inflow concentrations. This aligns with guidance set out in The SuDS Manual (C753).

2.2.6 The PHI classifications used within the SIA assessments for the Project are outlined in Table 2.2.1. A medium PHI has been selected for the car parking areas based upon the development land use 'non-residential car parking with frequent change'.

Table 2.2.1: Pollution hazard level/indices for the Project (taken from CIRIA SuDS Manual C753) (CIRIA, 2015)

Development Land Use	Pollution Hazard Level (PHI)	TSS	Metals	Hydrocarbons
Commercial yard and delivery areas, non-residential car parking with frequent change (eg, hospitals, retail), all roads except low traffic roads and trunk roads/motorways.	Medium	0.7	0.6	0.7

2.3 Limitations and Assumptions

2.3.1 The following limitations and assumptions have been identified:

- The assessments are based upon the most recent drainage design available at the time of writing and may be subject to change during the detailed design stage.
- Some data and details associated with the assessments have been established through a desktop study only. These data and details have been obtained on the understanding that this is the most up-to-date information available from the sources.
- Estimates of channel dimensions and characteristics used in the assessments have been informed from online aerial imagery.
- The use of the minimum Q_{95} value (0.0011 m^3/s) within the HEWRAT tool for receiving watercourses where this could not be established through reasonable means. The use of this minimum value presents the worst-case scenario in the results. For these outfalls, as a precautionary measure, groundwater assessments have also been undertaken.
- The assessment assumes no infiltration to ground from SuDS features prior to discharge via outfalls and these features have not been included in the assessment. As the detailed design evolves, assessment of infiltration from SuDS features may be required.
- Limited ground investigation data is available in the vicinity (ie within 100-200m) of the individual outfall locations (see SOCOTEC, 2022b) and professional judgement has been used to extrapolate groundwater levels, lithologies and physiochemical properties. Ground Investigation data will be reviewed at detailed design stage and should groundwater conditions be proved to be different to those assumed in this assessment, the assessment will be revisited. To be secured via a requirement in Schedule 2 of the draft DCO (Doc Ref. 2.1)
- For the assessment of water quality impacts during the operational phase of the car parks, at this stage there is limited information available on the proposed treatments. Therefore, an assumption has been made that adequate treatment will be provided within the surface water drainage systems in line with best environmental practice, to be secured via a requirement in Schedule 2 of the draft DCO (Doc Ref. 2.1)
- No information was available on unlicensed abstractions at the time of writing.

3 Assessment Results

3.1 Introduction

3.1.1 This section presents the results from surface water quality assessments for the Project. **Annex 1** provides a summary of the input data used within the assessments.

3.2 Routine Runoff Assessment

3.2.1 The results of the routine runoff assessments are presented in this section in the tables outlined in Table 3.2.1. Within the tables referenced in Table 3.2.1 a traffic light system has been used to aid results interpretation: green shading indicates a HEWRAT 'Pass', and red shading indicates HEWRAT 'Fail'.

Table 3.2.1: HEWRAT results tables

Table	Table Title
Table 3.2.2	HEWRAT Step 2 Tier 1 (pre-mitigation) Results
Table 3.2.3	HEWRAT Step 3 (post-mitigation) Results
Table 3.2.4	HEWRAT Step 2 Tier 1 (pre-mitigation) Cumulative Results
Table 3.2.5	HEWRAT Step 3 (post-mitigation) Cumulative Results

Single Outfall Assessment

3.2.2 The results of the Step 2 Tier 1 HEWRAT routine runoff assessments for the outfalls associated with the Project are shown in Table 3.2.2.

Table 3.2.2: HEWRAT Step 2 Tier 1 (pre-mitigation) Results

Out-fall	EQS (Annual Average Concentration)		Acute Soluble RST (Number of exceedances per year)				Sediment Bound Pollutants (Pass or Fail)
	Cu (µg/l)	Zn (µg/l)	RST24 Cu	RST6 Cu	RST24 Zn	RST6 Cu	
0	0.01	0.02	0.00	0.00	0.00	0.00	Pass
1	0.10	0.55	0.10	0.00	0.30	0.00	Pass
1b	0.00	0.01	0.00	0.00	0.00	0.00	Pass
2	0.04	0.14	0.00	0.00	0.00	0.00	Pass
3	0.00	0.00	0.00	0.00	0.00	0.00	Pass
4	0.02	0.06	0.00	0.00	0.00	0.00	Pass
5	0.04	0.15	0.00	0.00	0.00	0.00	Pass
6	0.03	0.13	0.00	0.00	0.00	0.00	Pass
7	0.02	0.05	0.00	0.00	0.00	0.00	Pass
11	0.00	0.02	0.00	0.00	0.00	0.00	Pass
12	0.00	0.01	0.00	0.00	0.00	0.00	Pass
13	0.06	0.22	0.00	0.00	0.00	0.00	Pass
14	0.10	0.35	0.10	0.00	0.00	0.00	Pass

3.2.3 The Step 2 Tier 1 (pre-mitigation) results highlight that all outfalls 'Pass' the HEWRAT routine runoff assessment for soluble pollutants and sediment-bound pollutants.

3.2.4 As all outfalls 'Pass' the HEWRAT routine runoff assessment without consideration of mitigation, the inclusion of SuDS as treatment for surface water quality is not therefore required. However, SuDS have been included within the drainage design for some outfalls within the Project, as features which currently exist, or as new SuDS features which are required for flood risk attenuation purposes, but that could also provide a degree of treatment of runoff. Therefore, these SuDS have been included, where present or proposed, in the Step 3 HEWRAT assessments.

3.2.5 No assessments are presented for outfalls 8, 9 and 10 as under the proposed scheme these will discharge via outfall 11.

3.2.6 The results of the Step 3 (post-mitigation) routine runoff assessment are shown in Table 3.2.3. No treatment options are proposed for outfalls 4, 6, 12, 13 and 14, so these have not been assessed at Step 3.

Table 3.2.3: HEWRAT Step 3 (post-mitigation) Results

Out fall	EQS (Annual Average Concentration)		Acute Soluble RST (Number of exceedances per year)				Sediment Bound Pollutants (Pass or Fail)
	Cu (µg/l)	Zn (µg/l)	RST24 Cu	RST6 Cu	RST24 Zn	RST6 Cu	
0	0.00	0.02	0.00	0.00	0.00	0.00	Pass
1	0.06	0.39	0.00	0.00	0.00	0.00	Pass
1b	0.00	0.01	0.00	0.00	0.00	0.00	Pass
2	0.03	0.12	0.00	0.00	0.00	0.00	Pass
3	0.00	0.00	0.00	0.00	0.00	0.00	Pass
5	0.02	0.07	0.00	0.00	0.00	0.00	Pass
7	0.01	0.04	0.00	0.00	0.00	0.00	Pass
11	0.01	0.01	0.00	0.00	0.00	0.00	Pass

3.2.7 For those outfalls where treatment is proposed, the soluble concentrations for the EQS and RSTs have been reduced further from the pre-mitigation (Step 2) levels, where treatment efficiencies allow, therefore resulting in a betterment.

Cumulative Outfall Assessment

3.2.8 Those outfalls that discharge to the same watercourse within 1km of each other have been assessed cumulatively. Outfalls with <100m distance between their discharge points have been assessed for soluble and sediment-bound pollutants, while outfalls discharging between 100m and 1km have been assessed for soluble pollutants only.

3.2.9 The results of the Step 2 Tier 1 (pre-mitigation) cumulative assessments are shown in Table 3.2.4. 'N/A' for sediment-bound pollutants denotes that the cumulative assessment is between 100m and 1km and the outfalls are therefore not assessed for sediment-bound pollutants.

Table 3.2.4: HEWRAT Step 2 Tier 1 (pre-mitigation) Cumulative Results

Outfall	EQS (Annual Average Concentration)		Acute Soluble RST (Number of exceedances per year)				Sediment Bound Pollutants (Pass or Fail)
	Cu (µg/l)	Zn (µg/l)	RST24 Cu	RST6 Cu	RST24 Zn	RST6 Cu	
0+1	0.11	0.59	0.10	0.00	0.30	0.00	N/A
2+3+4	0.05	0.19	0.00	0.00	0.00	0.00	N/A
3+4	0.02	0.07	0.00	0.00	0.00	0.00	Pass
5+6+7	0.09	0.34	0.00	0.00	0.00	0.00	N/A
5+6	0.07	0.28	0.00	0.00	0.00	0.00	Pass
11+12	0.01	0.02	0.00	0.00	0.00	0.00	N/A
5+6+7+11+12	0.03	0.11	0.00	0.00	0.00	0.00	N/A

3.2.10 The Step 2 Tier 1 (pre-mitigation) results highlight that all outfalls 'Pass' the HEWRAT cumulative assessments for soluble pollutants and sediment-bound pollutants, where assessed.

3.2.11 The results of the Step 3 (post-mitigation) cumulative assessments are shown in Table 3.2.5.

Table 3.2.5: HEWRAT Step 3 (post-mitigation) Cumulative Results

Outfall	EQS (Annual Average Concentration)		Acute Soluble RST (Number of exceedances per year)				Sediment Bound Pollutants (Pass or Fail)
	Cu (µg/l)	Zn (µg/l)	RST24 Cu	RST6 Cu	RST24 Zn	RST6 Cu	
0+1	0.07	0.41	0.00	0.00	0.10	0.00	N/A
2+3+4	0.03	0.13	0.00	0.00	0.00	0.00	N/A
3+4	0.02	0.07	0.00	0.00	0.00	0.00	Pass
5+6+7	0.05	0.19	0.00	0.00	0.00	0.00	N/A
5+6	0.04	0.14	0.00	0.00	0.00	0.00	Pass
11+12	0.00	0.01	0.00	0.00	0.00	0.00	N/A
5+6+7+11+12	0.02	0.06	0.00	0.00	0.00	0.00	N/A

3.2.12 For those outfalls where treatment is proposed, the soluble concentrations for the EQS and RSTs have been reduced further from the pre-mitigation (Step 2) levels, therefore resulting in a betterment.

3.3 Groundwater Assessment

3.3.1 A summary of input parameters and results of the assessment is presented in **Annex 1**.

3.3.2 The assessment results indicate that the two outfalls, outfall 13 and outfall 14, identified for groundwater assessment have a total score of 160. It is noted that a score of 150 is the upper limit for low risk, so the score of 160 is considered a borderline medium risk to groundwater quality. In accordance with Table 3.71 in DMRB LA 113 (Highways England, 2020a), a medium risk of pollution to groundwater from routine runoff is considered a medium adverse impact on groundwater quality where run-off discharges to watercourses with low flow conditions.

3.3.3 However, based on the fact that the outfall locations are located in an area overlying the Weald Clay formation, which is classed as an unproductive aquifer of negligible sensitivity, and the further assessment (presented in **Annex 1**) which indicates that predicted metals concentrations are below EQS and DWS standards, it is considered that the risk to groundwater quality is reduced to low which corresponds to a low adverse impact. Therefore, the effects are negligible to minor adverse and therefore, no significant effects on groundwater quality are predicted.

3.3.4 As detailed in **ES Chapter 11: Water Environment** (Doc Ref. 5.1), there are no pertinent groundwater receptors in the vicinity of the outfall locations:

- There are no Source Protection Zones for public water supplies within the groundwater study area, and no groundwater drinking water safeguard zones.
- No licensed groundwater abstractions have been identified within 1 km of the outfall locations. No information was available on unlicensed abstractions at the time of writing.
- No potential Groundwater Dependent Terrestrial Ecosystems (GWDTE) have been identified within the study area. See **ES Chapter 9: Ecology and Nature Conservation** (Doc Ref. 5.1).

3.3.5 For the accidental spillage risk assessment see Section 3.4 as the criteria for assessing both risks to surface and groundwater receptors are the same within the HEWRAT methodology.

3.4 Spillage Risk Assessment

3.4.1 This section presents the results of the spillage risk assessment for the highways improvements element of the Project.

3.4.2 The spillage risk assessment has been undertaken for each outfall, with the results shown in Table 3.4.1.

Table 3.4.1: Spillage Risk Assessment Results

Outfall	Frequency of Spillage (years)	Probability of Incident (%)	Within acceptable limits (Yes/No)
0	11,414	0.0095	Yes
1	377,063	0.0021	Yes
2	34,593	0.0115	Yes
3	371,058	0.0003	Yes
4	77,065	0.0021	Yes
5	668,845	0.0054	Yes
6	190,263	0.0012	Yes
7	22,332	0.0066	Yes
8	172,415	0.0025	Yes
9	466,333	0.0002	Yes
10	126,163	0.0008	Yes
11	405,339	0.0021	Yes

3.4.3 The annual probability of a serious pollution incident occurring in each drainage catchment draining to an individual outfall is estimated to be well below the 1% annual exceedance probability threshold as quoted in DMRB LA 113 (Highways England, 2020a).

3.5 CIRIA SIA

3.5.1 The results from the SIA assessment are presented in Table 3.5.1.

Table 3.5.1: CIRIA SIA Results

Car Park	Existing Treatment	PHI (PMI)		
		TSS	Metals	Hydro-carbons
Car Park J Site	Vortex Separator + Retention Pond	0.7(0.85)	0.6 (0.75)	0.7 (1.05)
Car Park Y Site	Retention Pond	0.7 (0.7)	0.6 (0.7)	0.7 (0.5)
Car Park H Site	Retention Pond	0.7 (0.7)	0.6 (0.7)	0.7 (0.5)
North Terminal Long Stay Decking	Retention Pond	0.7 (0.7)	0.6 (0.7)	0.7 (0.5)
Surface Parking Site	None	0.7 (0)	0.6 (0)	0.7 (0)
Car Park X – Purple Parking Reprovision	None	0.7 (0)	0.6 (0)	0.7 (0)
Hilton Hotel Site	Retention Pond	0.7 (0.7)	0.6 (0.7)	0.7 (0.5)

3.5.2 The existing treatment in place for car parking areas is insufficient. However, as part of the ongoing drainage design for the car parks, it is anticipated that sufficient treatment for water quality will be included as embedded design mitigation for all car parks to provide adequate attenuation and treatment of runoff prior to discharge to the receiving watercourses. The provision of this mitigation will be developed further at later stages of design.

4 Impact Assessment

4.1.1 The impact assessment for the operational phase of the Project is based upon the results from the routine runoff and spillage risk assessments. The detailed impact assessment is included within **ES Chapter 11: Water Environment** (Doc Ref. 5.1).

4.1.2 Watercourses receiving discharges from the Project have been assigned a sensitivity and a magnitude of impact has been established based upon criteria outlined in DMRB LA 113 (Highways England, 2020a). Overall significance of effect is determined using the receptor sensitivity and magnitude of impact based upon criteria outlined in **ES Chapter 11: Water Environment** (Doc Ref. 5.1].

4.1.3 During the operational phase, the impact assessment established the Project would have a **negligible** magnitude of impact upon receiving watercourses. As such, the overall significance of effect on receiving watercourses has been established as **minor adverse**. The impact assessment summary is included in Table 4.1.1.

Table 4.1.1: Impact Assessment Summary

Outfall	Receiving Watercourse (Receptor)	Receptor Sensitivity	Magnitude of Impact	Significance of Effect
0	Burstow Stream	High	Negligible	Minor Adverse
1	Burstow Stream	High	Negligible	Minor Adverse
2	Gatwick Stream	High	Negligible	Minor Adverse
3	Gatwick Stream	High	Negligible	Minor Adverse
4	Gatwick Stream	High	Negligible	Minor Adverse
5	River Mole	High	Negligible	Minor Adverse
6	River Mole	High	Negligible	Minor Adverse
7	River Mole	High	Negligible	Minor Adverse
11	River Mole	High	Negligible	Minor Adverse
12	River Mole	High	Negligible	Minor Adverse
13	Unknown	N/A – Receiving Watercourse not known		
14	Withy Brook	Medium	Negligible	Minor Adverse

4.1.4 The groundwater assessment for the two outfalls discharging to low-flow watercourses concluded that the risk to groundwater quality is reduced to low. Therefore, the residual magnitude of impact is low adverse. The significance of effects is therefore negligible to minor adverse and as such, no significant effects on groundwater quality are predicted.

5 Summary

5.1.1 Water quality assessments have been undertaken to consider the impact of the highways improvements and car parking elements of the operational phase of the Project. This has considered the risk of potential pollution from routine runoff and accidental spillage from the highways, and from the new and upgraded car parks. Assessments have been undertaken in accordance with guidance and the standards outlined in DMRB LA 113 (Highways England, 2020a) and The CIRIA SuDS Manual.

5.1.2 The results from the surface water quality assessments for the upgraded highway Project present no failures for soluble or sediment-bound pollutants in routine runoff, and the overall spillage risk for each catchment is within acceptable limits of below the 1% annual exceedance probability threshold. The results from the groundwater assessment for the two outfalls discharging to low-flow watercourses has established the risk to groundwater is low.

5.1.3 The results from the SIA assessment for the new and upgraded car parking areas indicate that once embedded design mitigation is implemented, all car parks will include sufficient mitigation to ensure no reduction in water quality of receiving watercourses.

6 References

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7 Glossary

7.1 Glossary of Terms

Term	Definition
AADT	Annual Average Daily Traffic flow
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).
BFI	Base Flow Index - The proportion of the flow in a watercourse made up of groundwater and discharges. Base flow sustains the watercourse in dry weather.
CSM	Conceptual Site Model
EQS	Environmental Quality Standards. The maximum permissible concentration of a potentially hazardous chemical. The Environmental Quality Standard is used to assess the risk to the health of aquatic flora and fauna.
DMRB	National Highways, Design Manual For Roads And Bridges
HEWRAT	Highways England Water Risk Assessment Tool
GI	Ground Investigation - a means of determining the condition of the ground, ideally before beginning construction works.
GWDTE	Groundwater dependent terrestrial ecosystems
Outfall	Point of discharge into a waterbody.
PHI	Pollution Hazard Indices
PMI	Pollution Mitigation Indices
Q_{95}	The flow rate of the watercourse that is exceeded for 95% of the time.
Routine Runoff	The normal runoff from roads including any contaminants washed off the surface in rainfall events which can result in either acute or chronic impacts. Routine runoff excludes the effect of spillages and major leaks which usually result in acute impacts.
Runoff Specific Threshold	Time dependent (24 hour or six hour) soluble pollutant concentration above which adverse effects may be observed in aquatic fauna.
SIA	Simple Index Approach.
SPR	The 'source-pathway-receptor' model defines those receptors considered to be at risk. The term 'source' describes the origin of potential effects (e.g. construction activities) and the term 'pathway' describes the means (e.g. through air, water or ground) by which the effect reaches the receiving sensitive 'receptor' (e.g. terrestrial habitats/species, human receptors). If the source, pathway or receptor is absent, no link exists and thus there will be no potential for an impact to occur.
SPZ	Source Protection Zones - Zones around groundwater sources used for potable supply or food processing, including wells, boreholes and springs, which show the level of risk to the source from contamination.
TSS	Total suspended solids - Solids in water that can be trapped by a filter

Annex 1

Assessment Data

Data Sources

Traffic Data

A1.1 Traffic data has been obtained from a traffic model prepared by the transport modelling team. Annual Average Daily Traffic (AADT) flow data was provided for the 'with-scheme' scenario for the design year 2047. Two-way AADT traffic volumes have been extracted from the model for use within HEWRAT as shown in Table A1.1.

Table A1.1: Traffic Data

Outfall	Total two-way AADT
0	65,171
1	115,175
2	66,688
3	58,856
4	87,275
5	48,722
6	58,153
7	33,575
11	49,296
12	40,868
13	12,274
14	22,074

Q95 Low-flow Hydrology Data and Baseflow Index

A1.2 The Q_{95} (the flow that is exceeded for 95% of the time) and Baseflow Index (BFI) values for the receiving watercourses have been obtained from the Wallingford Hydro Solutions (WHS) LowFlows Enterprise model (Wallingford Hydro Solutions, 2022). The LowFlows Enterprise model relates flow statistics to climate and hydrological characteristics for the catchment of interest, and so can estimate low flow data for a watercourse. Withy Brook receives discharges from Outfall 11. The LowFlows Q_{95} estimate for Withy Brook was returned as 0 m^3/s due to a small catchment size. The minimum allowable Q95 value for use within HEWRAT is 0.0011 m^3/s, therefore, this minimum value has been applied for Outfall 11, a baseflow index (BFI) of 0.26 has been applied as reported in the LowFlows estimate. The receiving watercourse for Outfall 10 has not been identified so the minimum Q_{95} and standard BFI of 0.5 have been applied for this outfall.

Data used within Single Outfall HEWRAT Assessments

A1.3 Table A1.2 outlines the assessment data used within the routine runoff assessments in HEWRAT. The Annual Average Daily Traffic (AADT) banding chosen is based upon the calculated traffic model outlined in section A1.1. Q_{95} data has been obtained from the LowFlows estimation service where possible, as outlined in section A1.2 and A1.3 (Wallingford Hydro Solutions, 2022). River width at Q_{95} has been estimated for the based upon measurements taken from aerial imagery.

Table A1.2: HEWRAT Assessment Data

Outfall	Receiving Watercourse	Approximate Outfall Location	Climatic Region & Rainfall Site	Annual Average Daily Traffic (AADT)	Total Drainage Catchment Impermeable Area (ha)	Total Drainage Catchment Permeable Area (ha)	Q_{95} (m^3/s)	Baseflow Index (BFI)
0	Burstow Stream	530395, 141702	Warm Wet/Southampton	50,000 – 100,000	0.17	0.20	0.024	0.51
1	Burstow Stream	529932, 141746	Warm Wet/Southampton	>100,000	2.06	0.07	0.024	0.51
2	Gatwick Stream	528541, 141633	Warm Wet/Southampton	50,000 – 100,000	2.64	3.91	0.056	0.6
3	Gatwick Stream	529134, 141499	Warm Wet/Southampton	50,000 – 100,000	0.10	0.07	0.056	0.6
4	Gatwick Stream	528514, 141725	Warm Wet/Southampton	50,000 – 100,000	1.31	0.7	0.056	0.6
5	River Mole	527598, 142343	Warm Wet/Southampton	10,000 – 50,000	2.10	4.95	0.033	0.4
6	River Mole	527578, 142297	Warm Wet/Southampton	50,000 – 100,000	1.74	0.7	0.033	0.4
7	River Mole	527266, 142173	Warm Wet/Southampton	10,000 – 50,000	0.89	1.2	0.033	0.4
11	River Mole	527850, 142409	Warm Wet/Southampton	10,000 – 50,000	0.96	0.27	0.137	0.47
12	River Mole	527547, 142609	Warm Wet/Southampton	10,000 – 50,000	0.29	0.08	0.137	0.47
13	Unknown	527392, 142451	Warm Wet/Southampton	10,000 – 50,000	0.12	0	0.0011	0.5
14	Withy Brook	527335, 142610	Warm Wet/Southampton	10,000 – 50,000	0.28	0.02	0.0011	0.26

A1.4 The proposed treatment for use within HEWRAT at Step 3 is outlined in Table A1.3. Treatment efficiencies have been taken from Table 8.6.4N3 ‘Pollution and flow control measures options’ in DMRB CG 501 Design of highway drainage systems. Where more than one treatment option is proposed for an outfall, the bespoke treatment efficiency has been calculated to include all treatment components.

Table A1.3: HEWRAT Treatment Efficiencies

Outfall	Proposed Treatment	Treatment of Copper (%)	Treatment of Zinc (%)	Treatment of Sediment-bound pollutants (%)
0	Vegetated Ditch	15	15	25
1	Retention Pond	40	30	60
1b	Vegetated Ditch	15	15	25
2	Detention Pond + Vegetated Ditch	15	15	62
3	Retention Pond	40	30	60
4	None	0	0	0
5	Detention Pond + Swale + Vegetated Ditch	57	57	92
6	None	0	0	0
7	Retention Pond	40	30	60
11	Detention Pond + Vegetated Ditch	15	15	62
12	None	40	30	60
13	None	0	0	0
14	None	0	0	0

Data used within Cumulative Outfall Assessments

A1.5 Cumulative outfall assessments have been undertaken for those outfalls that discharge within 1km of each other. If discharge points are within 100m and 1km of one another sediment-bound pollutants are not considered. The highest AADT of any catchment within the assessment has been selected, and the Q_{95} of the most downstream outfall has been selected, where required. Assessment data for the cumulative outfall assessments is detailed in Table A1.4.

Table A1.4: HEWRAT Cumulative Assessment Data

Outfall	Receiving Watercourse	Type of Cumulative Assessment	Climatic Region & Rainfall Site	Annual Average Daily Traffic (AADT)	Total Drainage Catchment Impermeable Area (ha)	Total Drainage Catchment Permeable Area (ha)	Q_{95} (m^3/s)	Baseflow Index (BFI)
0+1	Burstow Stream	100m-1km (not including sediment-bound pollutants)	Warm Wet/Southampton	>100,000	2.23	0.27	0.024	0.51
2+3+4	Burstow Stream	100m-1km (not including sediment-bound pollutants)	Warm Wet/Southampton	50,000-100,000	4.05	4.68	0.056	0.51
3+4	Gatwick Stream	<100m (including sediment-bound pollutants)	Warm Wet/Southampton	50,000 – 100,000	1.41	0.77	0.056	0.6
5+6+7	Gatwick Stream	100m-1km (not including sediment-bound pollutants)	Warm Wet/Southampton	50,000 – 100,000	4.73	6.85	0.033	0.6
5+6	Gatwick Stream	<100m (including sediment-bound pollutants)	Warm Wet/Southampton	50,000 – 100,000	3.84	5.65	0.033	0.6
11+12	River Mole	100m-1km (not including sediment-bound pollutants)	Warm Wet/Southampton	50,000 – 100,000	1.25	0.35	0.137	0.4
5+6+7+11+12	River Mole	100m-1km (not including sediment-bound pollutants)	Warm Wet/Southampton	50,000 – 100,000	5.98	7.20	0.137	0.4

Data inputs and results for Groundwater Assessments

Table A1.5: Groundwater quality assessment – inputs and results

Location		Input Parameters									Results	
Route Section	**Outfall ID**	**Traffic density**	**Rainfall depth (annual average)**	**Drainage area ratio**	**Infiltration method**	**Unsaturated zone**	**Flow type**	**Unsaturated zone clay content**	**Organic carbon**	**Unsaturated zone soil pH**	**Total Score**	**GW Risk Factor**
Longbridge roundabout	10	≤50,000 AADT	>740mm to <1060mm	≤50	"Continuous" shallow linear (eg unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
Longbridge roundabout	11	≤50,000 AADT	>740mm to <1060mm	≤50	"Continuous" shallow linear (eg unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Table A1.6: Further Assessment (Water Quality Screening)

Location		Receiving Watercourse	Q95	Proposed Treatment	Copper			Zinc		
Route Section	**Outfall ID**				**Maximum runoff concentrations (ug/l)**	**EQS (ug/l)**	**DWS (ug/l)**	**Maximum runoff concentrations (ug/l)**	**EQS (ug/l)**	**DWS (ug/l)**
Longbridge roundabout	10	Unknown	0.0011	None	0.06	1	2000	0.22	10.9	5000
Longbridge roundabout	11	Withy Brook	0.0011	None	0.12			0.44		

Data used within Spillage Risk Assessments

A1.6 The spillage risk assessment has been undertaken using the guidance outlined in Appendix D of DMRB LA 113 (Highways England, 2020a). Risk weightings have been established based upon Table D.1 in LA 113 and the Project has been assigned as 'Urban trunk roads', with each section being assigned an appropriate road type. The probability score has been established from Table D.2 in LA 113, and the Project scheme has been assigned as 'Urban (response time to site <20 minutes)' for a surface watercourse.

A1.7 Traffic data inputs (AADT and %HGV) and length of road within the catchment have been obtained using the traffic model for each node.