

# Lower Thames Crossing

6.3 Environmental Statement Appendices Appendix 14.3 – Operational Surface Water Drainage Pollution Risk Assessment

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## Appendix 14.3 – Operational Surface Water Drainage Pollution Risk Assessment

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### **1** Executive summary

- 1.1.1 This document examines the risk of pollution from the A122 Lower Thames Crossing (the Project) to surface water bodies that would receive drainage during operation of the Project. Routine runoff pollution risks, as well as the risk of pollution being caused by an accidental spillage incident, have been assessed.
- 1.1.2 This document is an appendix to Chapter 14: Road Drainage and the Water Environment, of the Environmental Statement (Application Document 6.1). Chapter 14 has several other technical appendices that appraise the potential effects of the Project on different aspects of the water environment. These studies in a Hydromorphology Assessment (Application Document 6.3, Appendix 14.4), a Hydrogeological Risk Assessment, (Application Document 6.3, Appendix 14.5), a Flood Risk Assessment (Application Document 6.3, Appendix 14.6) and a Water Framework Directive Assessment (Application Document 6.3, Appendix 14.7). Part 7 of the Flood Risk Assessment (Application Document 6.3, Appendix 14.6) provides an overview of the Project's drainage principles.
- 1.1.3 The assessment has followed the methodology set out in Design Manual for Roads and Bridges (DMRB) LA 113: Road Drainage and the Water Environment (Highways England, 2020a), which focuses on soluble pollutants (represented by dissolved copper and zinc) and sediment-bound pollutants.
- 1.1.4 Measures embedded in the preliminary drainage design to treat and attenuate runoff prior to discharge have been factored into the assessment to determine if the Project would cause acute pollution and/or environmental quality standards non-compliance for soluble and sediment-bound pollutants.
- 1.1.5 Results demonstrate that the proposed treatment measures are effective at safeguarding the water quality of receiving watercourses. Subject to the detailed design of the treatment measures, the assessment concludes that the objectives of the Water Framework Directive would not be compromised by discharge of routine runoff from the Project.
- 1.1.6 The accidental spillage risk assessment concludes that the calculated percentages of a spillage causing a serious pollution incident are below the set thresholds except for two drainage catchments. However, when risk reduction factors are taken into account, the two catchments achieve compliance with the assessment criteria.

### 2 Introduction

- 2.1.1 This document presents the assessment of pollution risks to surface water bodies that would receive discharges of highway drainage from the Project. The assessment excludes drainage from the Project tunnels. The tunnel drainage would discharge into the tidal River Thames via a bespoke tunnel drainage system that would include treatment measures and spillage containment, and the Highways England Water Risk Assessment Tool (HEWRAT) (HEWRAT; National Highways was formerly known as Highways England), methodology is not suitable for the assessment of effects on tidally dominated watercourses such as the River Thames within the study area. An overview of the Project's drainage principles is provided in Part 7 of the Flood Risk Assessment (Application Document 6.3, Appendix 14.6).
- 2.1.2 The assessment has been undertaken in accordance with the methodologies set out in the Design Manual for Roads and Bridges (DMRB) LA 113 Road Drainage and the Water Environment (Highways England, 2020a). These methods have been implemented using the HEWRAT and its accompanying user guide the Water Framework Directive UK Technical Advisory Group (WFD-UKTAG), Metals-Bioavailability Assessment Tool (M-BAT) and accompanying user guidance (WFD-UKTAG, 2014).
- 2.1.3 Routine runoff pollution risks, as well as the risk of pollution being caused by an accidental spillage incident, have been assessed.
- 2.1.4 The assessment, which constitutes a mix of 'simple' and 'detailed' levels of assessment in accordance with LA 113, has generated data that has been used to inform Environmental Statement Chapter 14: Road Drainage and the Water Environment (Application Document 6.1), and Appendix 14.7: Water Framework Directive Assessment (Application Document 6.3).
- 2.1.5 The assessment of drainage-related pollution risks to groundwater bodies is presented in Appendix 14.5: Hydrogeological Risk Assessment (Application Document 6.3).

## 3 Methodology

### 3.1 Routine runoff – simple assessment

- 3.1.1 The method focuses on acute impacts from soluble pollutants (represented by dissolved copper and zinc) and chronic impacts from sediment bound pollutants.
- 3.1.2 Proposed outfalls, which are illustrated in the drawing in Annex A, are each assessed individually. Where discharges to the same reach of a watercourse are proposed, a cumulative assessment is also undertaken using a 1km study area for solubles and a 100m study area for sediments.
- 3.1.3 The method follows a three-step approach, as follows:
  - a. Step 1 indicates the 'end of pipe' toxicity of the discharge.
  - b. Step 2 factors in dilution of the discharge by flow in the receiving watercourse.
  - c. Step 3 allows the effectiveness of mitigation (treatment) measures to be tested, such that each outfall either passes or fails the tests for soluble pollutants and sediments.

#### 3.2 Routine runoff – detailed assessment

- 3.2.1 Where the results of Step 3 of the simple assessment result in a failing outfall (indicating potential for pollution of the receiving water environment), a detailed assessment is required. The recommended method of detailed assessment is to use M-BAT (WFD-UKTAG, 2014) to consider the bioavailability of copper and zinc.
- 3.2.2 M-BAT (WFD-UKTAG, 2014) is a metal bioavailability assessment model that allows estimates of the bioavailable concentration of a dissolved metal under site-specific water chemistry conditions to be calculated.
- 3.2.3 The Environmental Quality Standard (EQS) (annual average) for bioavailable dissolved copper in freshwater is currently 1µg/l. For an outfall to achieve a pass in the HEWRAT, the contribution of bioavailable dissolved copper from the outfall combined with the ambient background concentration (ABC) of bioavailable dissolved copper must not exceed this EQS.
- 3.2.4 For zinc, an outfall achieves a pass in the HEWRAT if the contribution of bioavailable dissolved zinc is less than 10.9µg/l. The ABC for zinc is not considered and is not an input parameter in HEWRAT.

### 3.3 Spillage risk

3.3.1 The method initially estimates the risk that there will be an incident causing the spillage of a potentially polluting substance on the length of road being assessed. It then calculates the risk, assuming a spillage has occurred, that the pollutant will reach and impact on the receiving watercourse. The risks are expressed as annual probabilities of such an event occurring.

- 3.3.2 The risk of a serious pollution incident is deemed acceptable if the Annual Exceedance Probability (AEP) is less than 1% (1 in 100). Where the spillage could affect sensitive areas or activities, for example a designated nature conservation site or potable water supply abstraction, the risk of a serious pollution incident is deemed acceptable if the AEP is less than 0.5% (1 in 200).
- 3.3.3 Mitigation systems that reduce the likelihood of a spillage leading to a pollution incident (termed risk reduction factors) are defined in DMRB CG 501 Design of Highway Drainage Systems (Highways England, 2020b). These can be factored into the assessment to establish the mitigated AEP.

#### 3.4 Input data sources

3.4.1 Table 3.1 and Table 3.2 provide a summary of sources that have been referenced to generate the data required for the HEWRAT and M-BAT (WFD – UKTAG, 2014) pollution risk calculations.

Data	Source		
Climatic region	Maps showing climatic regions in the HEWRAT user guide		
Rainfall site	Standard annual average rainfall: London (600mm), selected using maps in the HEWRAT user guide showing available rainfall sites		
Q95 flow (m3/s)	Derived for each receiving watercourse using the UK Centre for Ecology and Hydrology's LowFlow software		
Base Flow Index	Extracted for relevant catchments from the Flood Estimation Handbook Web Service (UK Centre for Ecology and Hydrology, 2020)		
Presence of designated areas and downstream velocity reducing features (e.g., pond, weir)	Designations layers on the MAGIC website (Natural England, 2022), OS mapping and site visit observations and ecologica site walkovers		
Water hardness	Environment Agency water quality data records and data collected during the Project's Phase 2 ground investigation, where available. See further information in the assumptions section, below.		
ABC of dissolved copper	Environment Agency water quality data records, and data collected during the Project's Phase 2 ground investigation, where available. See further information in the assumptions section, below		
Estimated river width (m)	Water features field survey observations and desk study measurements (using the MAGIC website)		
Channel bed width (m), side slope and long slope (m/m)	Site visit observations and topographical watercourse channel survey data		
Manning's n	Selected with reference to photographs taken during Water Features Surveys and published values in Open-Channel Hydraulics (Chow, 1959)		

# Table 3.1 Summary of HEWRAT (2022) input data sources – routine runoff assessment

- 3.4.2 The routine runoff assessment also requires traffic flow data, specifically, annual average daily traffic data, for the design year of the Project. This information, in the form of number of vehicles along relevant links, has been extracted from the operational traffic model (simulation reference ID: LR\_CS67 2045, dated May 2022) which is representative of the 2045 operational year. Details of the traffic model are provided in the Combined Modelling and Appraisal Report (Application Document 7.7).
- 3.4.3 Information to define outfall locations, permeable and impermeable areas draining to each outfall and the proposed highway runoff treatment measures was obtained from the preliminary drainage design.

#### Table 3.2 Summary of M-BAT (WFD-UKTAG, 2014) input data sources

Data	Source
pH, dissolved organic carbon (DOC) and calcium concentration	Environment Agency water quality data records and data collected during the Project's Phase 2 ground
Dissolved copper concentration	investigation. See further information in the assumptions section, below.

#### 3.5 Assumptions

- 3.5.1 The following assumptions and limitations apply to the sources of input data used.
- 3.5.2 Water quality records from historic and current Environment Agency monitored sites have been accessed via the water quality data archive (Environment Agency, 2022). Datasets for pH, DOC, calcium and hardness were available from the following stations listed below:
  - a. Mardyke at Stifford Bridge (Station ID AN-MD02), an open station, providing data records from 2000 to March 2022.
  - b. Mardyke West at Fen Lane (Station ID AN-MD05), an open station, providing data records from 2000 to April 2022.
  - c. Gobions Sewer (Station ID AN-MUCKY030), a closed station, providing data records from 2000 to November 2008.
  - d. West Tilbury Main (Station ID TBURY005), a closed station, providing data records from 2000 to April 2006.
- 3.5.3 Other stations are located on the watercourses within the study area but have been discounted from use (TBURY010, TBURY004 and AN-MD04), as they do not record all the water quality parameters required.
- 3.5.4 The HEWRAT assessment has been informed by traffic data generated from the Project operational traffic models, described in Section 3.4 above. Since the HEWRAT assessments were originally completed in January 2020, traffic modelling has been updated. New data was provided from the CS67 2045 traffic model runs, reflecting the revised Project opening year. The new traffic flows have been reviewed, and where applicable, updates to the assessments reported herein have been undertaken using the updated traffic flow data.

- 3.5.5 The assessments have been informed by available water quality data records, described above. However, the Project has committed, as detailed in the Register of Environmental Actions and Commitments (REAC), which forms part of Appendix 2.2: Code of Construction Practice (CoCP) (Application Document 6.3) entry RDWE025 to undertake further survey and sampling to define the flow regime and water quality of receiving watercourses at proposed points of highway drainage discharge. This data will inform the detailed design of treatment measures, which will be informed by a new HEWRAT assessment that incorporates data from the detailed drainage design.
- 3.5.6 Table 3.3 provides a summary of the Environment Agency data (Environment Agency, 2022) available to derive ABCs of dissolved copper for the watercourses proposed to receive road drainage discharges.

# Table 3.3 Summary of available ABC copper data from Environment Agency monitoring sites

Station ID and name	Data available
AN-MD02 Mardyke at Stifford Bridge	Dissolved copper
	Copperbioavailable
AN-MD05 Mardyke West at Fen Lane	Total copper
	Dissolved copper
MUCKY030 Gobions Sewer	Total copper
TBURY005 West Tilbury Main	Total copper

- 3.5.7 In addition to the data available from Environment Agency monitoring stations, water quality samples have been collected and analysed to inform pumping test consent applications, as part of the Project's package of ground investigations. Watercourses local to the proposed North Portal have been sampled monthly for a suite of parameters for a duration of three months (May to July 2019) and more recently during ecology surveys during spring 2022. Available data has been reviewed and data from a sampling site on the West Tilbury Main has been used to inform the ABC copper calculations for this watercourse in preference to data from the Environment Agency station TBURY005. This is because partitioning total copper into its dissolved and solids components is subject to considerable uncertainty, the data record length at TBURY005 is limited to six samples, and the data is older, with the most recent sample in April 2006.
- 3.5.8 Bioavailable concentrations of copper have been calculated using M-BAT (WFD-UKTAG, 2014) using the best available dissolved copper data. At the Environment Agency monitoring station on the Gobions Sewer (MUCKY030), dissolved copper has been approximated using the relationship between total and dissolved copper at the Mardyke West Fen Lane site (AN-MD05). Where no data is available for a receiving watercourse, reasonable assumptions have been made. For example, unmonitored tributaries of the Mardyke are assumed to share similar chemistry to the Mardyke/West Mardyke tributary.

3.5.9 In line with the guidance that accompanies the HEWRAT tool, assessment points (APs) have been selected to focus on the receiving natural (or heavily modified) watercourse, rather than any drain or other short reach of drainage ditch that conveys flow to the primary watercourse. APs correspond with the outfall locations illustrated in on the drawing in Annex A, with one exception: S14-002. This outfall is proposed to discharge to a small ditch that flows into the West Mardyke watercourse after a short distance. The AP for this outfall has therefore been located on the Mardyke West watercourse.

### 4 Assessment results

#### 4.1 ABC copper concentrations

- 4.1.1 Analysis of data from station AN-MD02, where both Copper<sub>dissolved</sub> and Copper<sub>bioavailable</sub> concentrations are recorded, shows that, while the average concentration of dissolved copper (calculated from 20 samples collected from July 2019 to March 2022) is equal to 4.88µg/l, indicating a EQS breach (threshold is 1µg/l), only 0.23µg/l of this is bioavailable. The bioavailable component is key, as it is this which can be absorbed and therefore cause toxicity to aquatic organisms. The amount of dissolved copper that is bioavailable is dependent on water chemistry.
- 4.1.2 This comparison highlights the importance of using robust Copperbioavailable data, rather than dissolved copper concentrations, to assess the pollution potential of the proposed road drainage discharges. The data triggers the application of the M-BAT methodology to determine Copperbioavailable at all outfalls.

### 4.2 Routine runoff pollution risk results

4.2.1 A summary of the results of the in-river impacts of the proposed discharges, prior to any treatment/mitigation, is provided in Table 4.1 for individual outfalls.

Outfall ID receiving watercourse & station ID for ABC copper	Step 1 – Initial assessment	Step 2 – In-river impact
S08-001/8-002	Runoff fails toxicity test	EQS:
West Tilbury Main		Copper (5.26µg/l) – Fail
SW07028		Zinc (7.12µg/l) – Pass
		Acute impact:
		Copper – Fail
		Zinc – Pass
		Sediment – Fail
S10-001	Runoff fails toxicity test	EQS:
Gobions Sewer		Copper (5.40µg/l) – Fail
MUCKY030		Zinc (4.95µg/l) – Pass
		Acute impact:
		Copper – Fail
		Zinc – Fail
		Sediment – Fail
S11-001	Runoff fails toxicity test	EQS:
Unnamed tributary of the Mardyke		Copper (8.33µg/l) – Fail
AN-MD02		Zinc (12.57µg/l) – Fail
		Acute impact:
		Copper – Fail
		Zinc – Pass
		Sediment – Fail

 Table 4.1 Summary of individual outfall assessment results

Outfall ID receiving watercourse & station ID for ABC copper	Step 1 – Initial assessment	Step 2 – In-river impact
S11-002 Unnamed tributary of the Mardyke AN-MD02	Runoff fails toxicity test	EQS: Copper (7.04µg/l) – Fail Zinc (7.91µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass Sediment – Fail
S12-001 Unnamed tributary of the Mardyke AN-MD02	Runoff fails toxicity test	EQS: Copper (7.10µg/l) – Fail Zinc (5.97µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass Sediment – Fail
S12-002 Mardyke AN-MD02	Runoff fails toxicity test	EQS: Copper (5.19µg/l) – Fail Zinc (0.76µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Fail
S13-001 Mardyke West Tributary AN-MD05	Runoff fails toxicity test	EQS: Copper (5.44µg/l) – Fail Zinc (5.82µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass Sediment – Fail
S13-002 Mardyke West Tributary AN-MD05i	Runoff fails toxicity test	EQS: Copper (4.15µg/l) – Fail Zinc (0.94µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Fail
S14-001 Mardyke West Tributary AN-MD05	Runoff fails toxicity test	EQS: Copper (4.43µg/l) – Fail Zinc (1.14µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass

Outfall ID receiving watercourse & station ID for ABC copper	Step 1 – Initial assessment	Step 2 – In-river impact
		Sediment – Fail
S14-002	Runoff fails toxicity test	EQS:
Unnamed tributary of the Mardyke		Copper (4.09µg/l) – Fail
AN-MD05		Zinc (0.21µg/l) – Pass
		Acute impact:
		Copper – Pass
		Zinc – Pass
		Sediment – Pass
S14-003	Runoff fails toxicity test	EQS:
Unnamed tributary of the Mardyke		Copper (5.64µg/l) – Fail
AN-MD05		Zinc (5.80µg/l) – Pass
		Acute impact:
		Copper – Fail
		Zinc – Pass
		Sediment – Fail
S14-005	Runoff fails toxicity test	EQS:
Unnamed tributary of the Mardyke		Copper (5.05µg/l) – Fail
AN-MD05		Zinc (2.78µg/l) – Pass
		Acute impact:
		Copper – Fail
		Zinc – Pass
		Sediment – Fail

4.2.2 The Step 2 results showed multiple outfall failures for both solubles and sediment. The results were used to guide the preliminary drainage design in terms of the measures provided to treat runoff prior to discharge into a receiving watercourse. Details of these measures are provided in Table 4.2 for each road drainage outfall. Each treatment measure included in the preliminary drainage design also provides for the necessary attenuation of flows to achieve discharges to receiving watercourses at the 1 in 1-year greenfield rate (or 1 litre per second, whichever is higher), or to achieve a minimum of 50% betterment (i.e., reduction) where existing M25 drainage infrastructure would be used to drain the Project. This is secured by commitments RDWE025 and RDWE035 in the REAC, which forms Appendix 2.2: CoCP (Application Document 6.3), which is secured in Schedule 2 of the DCO.

Outfall ID	HEWRAT Step 2 results	Proposed runoff treatment measures		HEWRAT Step 3 results
	Sediment settlement needed	Solubles treatment		
S08- 001/8-002	Yes – 81%	Yes – Cu (EQS and acute)	Pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (4.10µg/l) – Fail Zinc (4.33µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S10-001	Yes – 88%	Yes – Cu and Zn	Filter drains discharging to a pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (4.37µg/l) – Fail Zinc (1.48µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S11-001	Yes – 96%	Yes – Cu (EQS and acute) and Zn (EQS)	Filter drains discharging to a pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (5.72µg/l) – Fail Zinc (4.96µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass Sediment – Fail
S11-002	Yes – 88%	Yes – Cu (EQS and acute)	Filter drains discharging to a pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (5.32µg/l) – Fail Zinc (2.51µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S12-001	Yes – 56%	Yes – Cu (EQS and acute)	Pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (5.22µg/l) – Fail Zinc (1.82µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S12-002	Yes – 72%	Yes – Cu (EQS)	Filter drains discharging to a pond incorporating	EQS: Copper (4.19µg/l) – Fail

#### Table 4.2 Proposed treatment measures and HEWRAT Step 3 results

Outfall ID	HEWRAT Step 2 results	Proposed runoff treatment measures		HEWRAT Step 3 results
	Sediment settlement needed	Solubles treatment		
			a sediment forebay and surface flow wetland	Zinc (0.24µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S13-001	Yes – 85%	Yes – Cu (EQS and acute)	Filter drains discharging to a pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (4.17µg/l) – Fail Zinc (1.80µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S13-002	Yes – 49%	Yes – Cu (EQS)	Filter drains discharging to a pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (3.80µg/l) – Fail Zinc (0.24µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S14-001	Yes – 68%	Yes – Cu (EQS)	Pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (4.03µg/l) – Fail Zinc (0.34µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S14-002	No	Yes – Cu (EQS)	Pond with vortex separator	EQS: Copper (4.01µg/l) – Fail Zinc (0.15µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S14-003	Yes – 70%	Yes – Cu (EQS and acute)	Pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (4.35µg/l) – Fail Zinc (1.74µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass

Outfall ID	HEWRAT Step 2 results	Proposed runoff treatment measures		HEWRAT Step 3 results
	Sediment settlement needed	Solubles treatment		
				Sediment – Pass
S14-005	Yes – 84%	Yes – Cu (EQS and acute)	Pond incorporating a sediment forebay and surface flow wetland	EQS: Copper (4.12µg/l) – Fail Zinc (0.84µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass

- 4.2.3 The treatment potential associated with the proposed measures has been drawn from Table 8.6.4N3 of DMRB CG 501 Drainage Design, Design of Highways Drainage Systems (Highways England, 2020b). Regarding suspended sediments, a pond with a sediment forebay and surface flow wetland is reported to achieve up to 100% settlement. Filter drains in the upstream catchment also have a high settlement efficiency (60%).
- 4.2.4 Some of the most efficient measures for removal of copper and zinc are surface flow wetlands and ponds (in combination 70% removal), with filter drains of benefit for the removal of zinc (45%).
- 4.2.5 Where no settlement of sediments is necessary (e.g., S14-002), the pond included in the design provides for storage to achieve the required attenuation of runoff rates.
- 4.2.6 The results show that, except for S11-001, all outfalls pass for sediment at Step 3. S11-001 has a marginal failure, with HEWRAT noting an additional 6% settlement needed to achieve a Pass. Tier 2 of Step 2 was therefore applied, defining the necessary parameters using available field data. Using this methodology, the outfall passes for sediment when the mitigation proposed within the preliminary drainage design, described in Table 4.2, is accounted for.
- 4.2.7 With regard to solubles, where at Step 2, failures were recorded for acute soluble pollution risk, outfalls all pass at Step 3 with one exception at outfall S11-001, with fails for copper. This is discussed further in Section 4.3.
- 4.2.8 All outfalls comply with the EQS for Zinc but exceed the EQS for copper, and a detailed assessment, using M-BAT, was therefore carried out to determine bioavailable copper concentrations.

#### 4.3 Detailed assessment results

4.3.1 The M-BAT (WFD-UKTAG, 2014) calculation results are summarised in Table 4.3.

Outfall ID	Copper <sub>bioavailable</sub> (µg/l)*	EQS pass/fail
S08-001/8-002	0.623	Pass
S10-001	0.107	Pass
S11-001	0.140	Pass
S11-002	0.131	Pass
S12-001	0.128	Pass
S12-002	0.103	Pass
S13-001	0.111	Pass
S13-002	0.101	Pass
S14-001	0.107	Pass
S14-002	0.106	Pass
S14-003	0.116	Pass
S14-005	0.109	Pass

#### Table 4.3 Summary of M-BAT (WFD-UKTAG, 2014) detailed assessment

\*note recorded values of DOC and Ca exceed the upper validated range in M-BAT. Calculations have therefore adopted the upper range values for these two parameters.

- 4.3.2 The results of the detailed assessment method demonstrate that the proposed treatment measures are effective at safeguarding the water quality of receiving watercourses. With one exception, outfalls achieve passes in terms of both acute impacts and EQS compliance for soluble and sediment-bound pollutants.
- 4.3.3 The exception is a large road drainage catchment, discharging at S11-001 to a small tributary of the Mardyke. At Step 3 of the HEWRAT assessment, the outfall fails for acute impacts (copper). This failure would constitute a minor adverse magnitude of impact on the receiving watercourse, which had been assigned a moderate value in terms of its water quality attributes, with an effect overall of slight adverse significance. The methodology for assigning receptor value, impact magnitude and effect significance is described in Section 14.3 of Chapter 14: Road Drainage and the Water Environment (Application Document 6.1).
- 4.3.4 In line with the guidelines provided in DMRB LA 113 (Highways England, 2020a), sensitivity tests have been carried out in the HEWRAT to determine the percentage treatment efficiency that would be required at this outfall to achieve compliance. The results are provided in Annex B.
- 4.3.5 An increase in the value adopted for the Q95 flow of the receiving watercourse of more than 10% is required to achieve a pass and an increase of this magnitude in the low-flow parameter is not considered to be appropriate. Tests on mitigation/treatment at Step 3, reveal that a treatment efficiency of 74% for solubles is required to achieve acute impact compliance for copper. This is a small increase from the 70% treatment that the guidance (Highways England, 2019b) suggests the proposed treatment measures can deliver. Also, the detailed results at Step 3 show that the Runoff Specific Threshold 24 hour

(RST24) for dissolved copper would be exceeded 3.2 times per year, only marginally above the allowable two failures per year.

- 4.3.6 During detailed design, the treatment measures would be sized and configured within the confines of the Order Limits, to ensure the required retention times and through-flow rates to achieve this degree of treatment, such that this drainage catchment would achieve a pass. This requirement is secured by REAC Ref. RDWE025.
- 4.3.7 Three further outfalls to surface water are proposed in the preliminary drainage design. One of these (reference ID S08-003) conveys runoff from the earthworks at Tilbury Field in the vicinity of the northern tunnel entrance, as well as a service road that would provide access for maintenance vehicles, and discharges to the West Tilbury Main. A second outfall (reference ID S09-001) would also serve roads at the northern tunnel entrance that are provided for use by emergency vehicles and for access to the portal building by operational and maintenance personnel. This outfall would discharge to the West Tilbury Main.
- 4.3.8 The road drainage catchment areas draining to these outfalls is small, vehicle usage would be low and at S08-003, runoff from the service road would be combined with runoff from a grassed landscaped area (Tilbury Fields). Pollution risk to the West Tilbury Main from routine runoff from these outfalls is therefore negligible.
- 4.3.9 The third outfall would discharge runoff, collected from within the Project tunnels, to the River Thames. To safeguard the water quality of the Thames, the preliminary drainage design includes spillage capture and containment, as well as treatment of effluent prior to discharge. This is secured by REAC Ref. RDWE026. This commitment states that the operational drainage system would include provision for the capture and isolation of contaminated waters to prevent pollution of the receiving watercourse. Discharges would be restricted to high tide conditions to maximise available dilution and mixing and to prevent scour/erosion of the intertidal zone. The discharge of tunnel drainage to the River Thames would also be governed by the conditions set out in an Environmental Permit granted by the Environment Agency.

#### 4.4 Cumulative assessment

- 4.4.1 Where more than one outfall discharges into the same reach of a watercourse, in accordance with LA 113, the outfalls should be aggregated for the purposes of a cumulative risk assessment within HEWRAT. Assessments associated with soluble pollutants should consider outfalls with 1km on a common reach of watercourse. When assessing the potential impacts associated with sediment-bound pollutants, outfalls lying within 100m should be aggregated for assessment.
- 4.4.2 The results of the cumulative outfalls assessment are presented in Table 4.4. Those rows shaded highlight outfalls that fail the cumulative assessment, for either EQS compliance or acute impact, at Step 3, triggering a detailed assessment using M-BAT, to determine solubles bioavailability.

Table 4.4 Summar	y of M-BAT	(WFD-UKTAG,	2014)	detailed	assessment
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Outfall IDs & receiving watercourse	Location of cumulative Assessment Point	Step 2 – In-river impact	Step 3 – Following mitigation	M-BAT bioavailable copper concentration (µg/l)
S11-001 and S11- 002 Unnamed tributary of the Mardyke Solubles	562465 182673	EQS: Copper (8.65µg/l) – Fail Zinc (13.76µg/l) – Fail Acute impact: Copper – Fail Zinc – Pass	EQS: Copper (5.67µg/l) – Fail Zinc (4.13µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass	0.139 – Pass
S11-001, S11- 002, S12-001 and S12-002 Mardyke Solubles	561853 182444	EQS: Copper (6.40µg/l) – Fail Zinc (5.47µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass	EQS: Copper (5.19µg/l) – Fail Zinc (1.64µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass	0.127 – Pass
S13-001, S13-002 and S14-001 West Mardyke Solubles	559250 186674	EQS: Copper (5.94µg/l) – Fail Zinc (7.62µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass	EQS: Copper (4.28µg/l) – Fail Zinc (2.29µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass	0.114 – Pass
S13-001 and S14- 001 West Mardyke Sediments	559250 186674	Sediment – Fail at Tier 1	Sediment – Pass	N/A

4.4.3 The results confirm that following treatment, with one exception, cumulative discharges do not result in pollution of the receiving water environment.

4.4.4 The exception is the combined discharge from outfalls S11-001 and S11-002, where a 900m reach of a tributary of the Mardyke would be affected by acute copper impacts. The current drainage design provides for a marginal failure that would constitute a minor adverse magnitude of impact on the receiving watercourse, which had been assigned a moderate value in terms of its water quality attributes. Overall, the significance of this effect is classified as permanent slight adverse, which is not significant. The methodology for assigning receptor value, impact magnitude and effect significance is described

in Section 14.3 of Chapter 14: Road Drainage and the Water Environment (Application Document 6.1).

4.4.5 Sensitivity tests have been conducted for this cumulative assessment and the results indicate that 75% treatment of solubles is required to avoid acute impacts. This is a small increase from the 70% treatment that the guidance suggests the proposed treatment measures can deliver. During detailed design, the treatment measures would be sized and configured to ensure the required retention times and through-flow rates to achieve this degree of treatment, such that, cumulatively, these drainage catchments would achieve a pass. This requirement is secured by REAC Ref. RDWE025.

### 4.5 Accidental spillage pollution risk

- 4.5.1 The results of the assessment, which was informed by the data described in Section 3.4 above, including traffic data for the design year (2045), are presented in Table 1.8, which reports the risk of a pollution incident without the pollution risk reduction factors that are incorporated into the preliminary drainage design.
- 4.5.2 In accordance with recommendations in DMRB LA 113 (Highways England, 2020a), the study area was assessed to identify the following:
  - a. Local industries that may increase the proportion of hazardous materials transported along the Project.
  - b. Designated areas (Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas, Water Protection Zones, Ramsar sites and salmonid waters) within 1km of road runoff outfalls.
  - c. Water abstraction sites and their usages.
- 4.5.3 The standard protection threshold that should not be exceeded is 1% (1 in 100). A higher standard of protection (0.5%, or 1 in 200) is required at S10-001 due to the proximity of this discharge to the Linford potable water abstraction site.

Outfall ID	Spillage risk (%)	Thresholds exceeded?	Residual return period (%)
S08-001 & 8-002	0.08	No	-
S10-001	0.50	Yes	0.19
S11-001	1.22	Yes	0.49
S11-002	0.98	No	-
S12-001	0.08	No	-
S12-002	0.39	No	-
S13-001	1.01	Yes	0.40
S13-002	0.18	No	-
S14-001	0.32	No	-

Table 4.5 Summary of accidental spillage risk calculations

Outfall ID	Spillage risk (%)	Thresholds exceeded?	Residual return period (%)
S14-002	0.01	No	-
S14-003	0.28	No	-
S14-005	0.84	No	-

4.5.4 With reference to Table 8.6.4N3 of DMRB CG 501 Drainage Design, Design of Highways Drainage Systems (Highways England, 2020b), the treatment measures embedded in the preliminary drainage design, detailed in Table 4.2, deliver risk reduction factors (RRF) ranging between 0.4 and 0.6. When appropriate RRF are applied in catchments S10-001, S11-001 and S13-001, the residual spillage risk does not exceed the acceptable threshold.

## 5 Summary and conclusions

5.1.1 Table 5.1 provides a summary of the assessment of the risk of pollution of watercourses receiving drainage from the Project during its operation, as well as the findings of the spillage risk assessment, accounting for the treatment proposed.

Outfall ID	Receiving watercourse and value	Residual (Stage 3) routine runoff risk and impact magnitude	Spillage risk	Significance of residual effect
S08- 001	West Tilbury Main – Medium	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% – Negligible	Neutral
S10- 001	Gobions Sewer – Medium	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% after application of RRF – Negligible	Neutral
S11- 001	Unnamed tributary of the Mardyke – Medium	Pass for EQS, and sediment, individual and cumulative fail for acute impacts (Cu) – Minor adverse	Risk < 0.5% after application of RRF – Negligible	Slight adverse
S11- 002	Unnamed tributary of the Mardyke – Medium	Pass for EQS and sediment, cumulative fail for acute impacts (Cu) – Minor adverse	Risk < 0.5% – Negligible	Slight adverse
S12- 001	Unnamed tributary of the Mardyke – Medium	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% – Negligible	Neutral
S12- 002	Mardyke – High	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% – Negligible	Slight adverse
S13- 001	Mardyke West tributary – High	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% after application of RRF – Negligible	Slight adverse
S13- 002	Mardyke West tributary – High	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% – Negligible	Slight adverse
S14- 001	Mardyke West tributary – High	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% - Negligible	Slight adverse
S14- 002	Mardyke West tributary – High	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% – Negligible	Slight adverse

Table 5.1	Summary	of	pollution	risk	assessments

Outfall ID	Receiving watercourse and value	Residual (Stage 3) routine runoff risk and impact magnitude	Spillage risk	Significance of residual effect
S14- 003	Unnamed tributary of the Mardyke – Medium	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% – Negligible	Neutral
S14- 005	Unnamed tributary of the Mardyke – Medium	Pass for EQS, acute impacts and sediment – Negligible	Risk < 0.5% – Negligible	Neutral

- 5.1.2 A residual significance of effect for several outfalls is reported as slight adverse, however, it should be noted that these outfalls pass the HEWRAT and M-BAT tests when the proposed treatment measures are accounted for. The residual significance has been derived by applying the assessment criteria in LA 113 of the DMRB (Highways England, 2020a), which do not provide for an impact magnitude of no change, which is appropriate for these outfalls. The residual significance presented is therefore conservative and precautionary for the receiving watercourses of high value.
- 5.1.3 The results of the assessment of the risk of pollution from routine runoff therefore demonstrate that, with the exception of one outfall, the treatment measures proposed in the preliminary drainage design would protect the quality of the receiving water environment. One outfall, draining to an unnamed tributary of the Mardyke, requires slightly enhanced mitigation to achieve full compliance and this mitigation is secured by REAC Ref. RDWE025, which commits to undertaking further survey and sampling of receiving watercourses at the proposed points of discharge, using the data to inform the detailed drainage design, including design of treatment measures.
- 5.1.4 Subject to the detailed design of the treatment measures, the assessment concludes that the objectives of the Water Framework Directive (WFD) would not be compromised by discharge of runoff from the operational phase of the Project.
- 5.1.5 The accidental spillage risk assessment concludes that the calculated percentages of a spillage causing a serious pollution incident are below the set thresholds except for three drainage catchments (S10-001, S11-001 and S13-001). When RRF are taken account of in the assessment, all three catchments achieve compliance with the assessment criteria.

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## Annexes

Annex A Outfalls Drawing



# Annex B HEWRAT and M-BAT Results

#### Metal Bioavailability Assessment Tool (M-BAT)

Back		INPUT DATA RESUL															
Calculate														LTS (Copper)			
Clear Data					Measured Cu Concentration (dissolved) (µg	Measured Zn Concentration (dissolved) (µg	Measured Mn Concentration (dissolved) (µg	Measured Ni Concentration (dissolved) (µg				Site-specific PNEC Dissolved Copper		Bioavailable Copper Concentration	Risk Characterisation		
	ID	Location	Waterbody	Date	I <sup>-1</sup> )	I <sup>-1</sup> )	[ <sup>-1</sup> ]	I <sup>-1</sup> )	pН	DOC	Ca	(µg l <sup>-1</sup> )	BioF	(µg l <sup>-1</sup> )	Ratio		
		58-001	West Tilbury Main	18.05.22	4.1				8.05	15	92	6.58	0.15	0.62	0.62		
		S11-001	Mardyke tributary	18.05.22	5.72				7.49	8.81	97.72	40.76	0.02	0.14	0.14		
	1	3 511-002	Mardyke tributary	18.05.22	5.32				7.49	8.81	97.72	40.76	0.02	0.13	0.13		
		S12-001	Mardyke tributary	18.05.22	5.22				7.49	8.81	97.72	40.76	0.02	0.13	0.13		
	Ę	512-002	Mardyke	18.05.22	4.19				7.49	8.81	97.72	40.76	0.02	0.10	0.10		
	6	S13-001	Mardyke west tributary	18.05.22	4.17				7.67	8.81	97.72	37.62	0.03	0.11	0.11		
		S13-002	Mardyke west tributary	18.05.22	3.8				7.67	8.81	97.72	37.62	0.03	0.10	0.10		
	8	S14-001	Mardyke west tributary	19.05.22	4.03				7.67	8.81	97.72	37.62	0.03	0.11	0.11		
		S14-002	Mardyke west tributary	19.05.22	4.01				7.67	8.81	97.72	37.62	0.03	0.11	0.11		
	10	S14-003	Mardyke tributary	19.05.22	4.35				7.67	8.81	97.72	37.62	0.03	0.12	0.12		
	1	1 S14-005	Mardyke tributary	19.05.22	4.12				7.67	8.81	97.72	37.62	0.03	0.11	0.11		
	12	S10-001	Gobions Sewer	19.05.22	4.37				7.49	8.81	97.72	40.76	0.02	0.11	0.11		
	1.	Cumulative S11 outfalls	Mardyke tributary	19.05.22	5.67				7.49	8.81	97.72	40.76	0.02	0.14	0.14		
	14	Cumulative S11 and S12 outfalls	Mardyke	19.05.22	5.19				7.49	8.81	97.72	40.76	0.02	0.13	0.13		
	15	Cumulative S13 outfalls and S14-001	Mardyke west tributary	19.05.22	4.28				7.67	8.81	97.72	37.62	0.03	0.11	0.11		

5	Inghways         Highways England Water Risk Assessment Tool         Version 2.0.4         June 2019										
				So	luble					Sediment - Cl	nronic Impact
			EQS - Annual Average C	Concentration			Acute	Impact			
		C	opper	Zinc						Pas	S
	Step 2	Tier 1 fail. Go to M-BAT tool), or	5.84 Tier 2 (using UK TAG r Step 3 mitigation,	7.23	ug/l	River	Copper Fails Toxicity Test.	Zinc Pass	S A	Sediment deposition for this s Accumulating? Yes	ite is judged as: 0.01 Low flow Vel m/s
	Step 3		252	558	ug/l				E	Extensive? No	92 Deposition Index
R	ad numb	er		Lower Thames	Crossing		HE Area / DBFC	) number			
As	sessment	t type		Cumulative ass	essment including se	diments (ou	tfalls within 10	0m)			-
0	grid refe	erence of assessmen	t point (m)	Easting				Northing			(2
0	grid refe	erence of outfall struc	cture (m)	Easting			с.	Northing			
Ou	itfall num	ber					List of outfalls in	n cumulative	S13-001	S14-001	
Re	Receiving watercourse Mardyke West Tributary assessment										
EA	receiving	g water Detailed Rive	r Network ID			Assessor and affiliation LD				LD	
Da	te of asse	essment		19/05/2022	Version of assessment						
NC	les			Assessment upd	ated to reflect revised	drainage ca	chments and ti	affic model CS67 2	045		
1	or sedim	nent impact only	Is there a downstream st	ructure, lake, pond or cana	al that reduces the velocity	within 100m c	f the point of disch	arge?			
			Tier 1     Estimate	ed river width (m)	3.5						
			C Tier 2 Bed widt	th (m)	3	Manning's n	0.07	Side	slope (m/m)	) 0.5 Long s	lope (m/m) 0.0001
5	tep 3 M	litigation				1		Estimated effectiven	ess		
						Т	reatment for	Attenuation for solu	bles -	Settlement of	
				Brief description		S	olubles (%)	estricted discharge rat	te(l/s) s	ediments (%)	
Γ	Existing r	measures				0	D	No restriction -	D 0	D	
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Outfall number	S13-001 and S14-001	List of outfalls in cumulative assessment			
FA receiving water Detailed River Network D	vvestiviaroyke tributary	Assessor and affliation			R eset Interface
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M-BAT tool), or	increase Step 3 mitigation.								
Road number		Lower Thames	Crossing	HEA	rea / DBFO number		1		
Assessment type		Cumulative asse	essment excluding sedir	ments (outfalls	between 100m and 1km	apart)		-	
OS grid reference of assessm	nent point (m)	Easting			Northing				
OS grid reference of outfall st	tructure (m)	Easting			Northing				
Outfall number				List o	f outfalls in cumulative	S13-001	S13-002	S14-001	
Receiving watercourse		Mardyke West	Tributary	asses	sment				
EA receiving water Detailed F	River Network ID			Asse	ssor and affiliation	dù	LD		
Date of assessment		19/05/2022		Versi	on of assessment				
Notes		Assessment upda	ted to reflect revised dra	ainage catchme	nts and traffic model CS6	7 2045			
Step 2 River Impacts				1					
	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.006	Freshwater E	QS limits:				
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area drained	(ha)	22.8	Bioavail	able dissolved copper (µg/l)		1 D		
river flow box to assess	Dermochie area draining to out	fall (ha)	22.021	Bioavailable dissolved zinc (µg/l)					
Step 1 runon quality only)	Permeable area draining to out	iali (lia)	23.021						
	Base Flow Index (BFI)		0.29	Is the discharge	in or within 1 km upstream of a	a protected site	e for conservation?	No 🖵 D	
For dissolved zinc only	Water hardness	High = >200mg CaCO3/I		For dissol	ved copper only Ambient	t background o	concentration (µg/l)	3.795	
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For sediment impact only	is there a downstream structure	, lake, poild of carlai th		r room or the poir	t of discharge?				
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OS grid reference of assessment point (m)	Easting	Northing			Show Detailed Results		
OS grid reference of outfall structure (m)	Easting	Northing		s	ave Results & Parameter		
Receiving watercourse	Mardyke	assessment					
EA receiving water Detailed River Network ID	in a sync	Assessor and affliation	LD		Reset Interface		
Date of assessment	30/08/2020	Version of assessment	2		Document Data Source		
Notes					Open Parameters csv file		
					Spillage Risk		
Step 1 Runoff Quality	1				Groundwater Assessment		
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		Soluble				1	Sediment - Ch	nronic Impact	
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	Copper	Zinc							
	6.40	5.47	ug/l	Copper	Zinc	n			
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M-BAT tool)	5 19	1.64	ug/l	Pass	Pass	ACC Exte	ansive?	Deposition Index	
Step 3 Tier 1 fail. Go	to Tier 2 (using UK TAG		ugn						
M-BAT tool), or in	ncrease Step 3 mitigation.								
Road number		Lower Thames Crossi	ng	HE Area / DBEO	number				
Assessment type		Cumulative assessmen	ng texcluding sedir	ments (outfalls between	100m and 1km an	art)			
OS grid reference of assessme	ent point (m)	Easting	t excluding sedi	itents (outians between	Northing				
OS grid reference of outfall str	aucture (m)	Easting			Northing				
Outfall number				List of outfalls in	cumulative	\$11.001	S11 002	IS12 001	
Receiving watercourse		Mardyka		assessment	cumulative	S11-001	311-002	512-001	
EA receiving water Detailed Ri	ver Network ID	Inaldyke		Assessor and aff	iliation	312-002			
Date of assessment		19/05/2022		Version of asses	sment		LU		
Notes		Assessment undated to r	profect revised drainage actionments and traffic model CS67 2045						
Step 2 River Impacts	nationalizada - contra televizione di Licite							î	
	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.0377	Freshwater EQS limits:					
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area draine	ed (ha)	74.106	Bioavailable dissolved copper (µg/l)					
river flow box to assess	Bernetti ere destricter te er	45-11 (h - N	45.54						
Step 1 runoff quality only)	Permeable area draining to ou	uttali (na)	45.51 Bioavailable dissolved zinc (µg/l)						
	Base Flow Index (BFI)		0.283	Is the discharge in or within	1 km upstream of a p	rotected site fo	r conservation?	No 🗸 D	
For dissolved zinc only	Water hardness	High = >200mg CaCO3/I		For dissolved coppe	r only Ambient ba	ackground con	centration (µg/l)	4.88	
For sediment impact only	Is there a downstream structu	re, lake, pond or canal that reduc	es the velocity withi	n 100m of the point of dischar	ge?	[	No 🔻 D		
	Tier 1 Estimated rive	er width (m)	5						
	Tier 2 Bed width (m)	)	3 Ma	nning's n 0.07	Side s	lope (m/m)	0.5 Long slo	ope (m/m) 0.0001	
Step 3 Mitigation									
N					Estimated effectivene	SS			
				Treatment for	Attenuation for solub	les - Sett	lement of		
		Brief description		Solubles ( 70) Tes	cheteu uischarge falt	("S) Seul			
Existing measures				0 D No	restriction -	D 0	D		
Proposed measures	filter drains, pond with sediment for	prebay and wetland		70 No	restriction -	0	D		

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	Soluble			Sei	diment - Chronic Ir	npact		
EQS - Annual Average Con	Zina	Acute	Impact					
Colspan="2">Colspan="2"           Step 2         Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.           5tep 3         Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or lincrease Step 3 mitigation.	1.53 ug/l	Copper Pass	Zine Pass	Sediment dep Accumulating Extensive?	osition for this site	is judged as: Low flow Vel m/s Deposition Index		
Road number	Lower Thames Crossing	HE Area / DBFO	number				Dradiet	Impact
Assessment type	Cumulative assessment excluding sediment	ts (outfalls between 100m	and 1km apart)	·		•	Fieuci	impact
OS grid reference of assessment point (m)	Easting		Northing				Show Detail	led Results
OS and reference of outfall structure (m)	Easting		Northing			S	ave Results	& Parameter
Receiving watercourse	S11-001, S11-002, S12-001 and S12-0 Mardyke	assessment	cumulative					
EA receiving water D etailed River Network ID	Marayko	Assessor and af	filation	LD			ResetIn	terface
Date of assessment	30/08/2020	Version of asses	sment	2			Document	ata Source
Notes							Open Param	eters csv file
							Spillag	e Risk
Step 1 Runoff Quality							Groundwater	Assessment
AADT >-100,000	Climatic regio	Warm Dry +	Rainfall site	London (SAAR 60	imm)	<u> </u>	R eset We	orkbook
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		Solut	ple					Sediment - C	Chronic Impact
	EQS - Annual Average Conce	ntration			Acute Imp	pact			
	Copper	Zinc							
Star 2	8.65	13.76	ug/l	_	Copper	Zinc			
Step 2 Her 1 Tall. Go	to Her 2 (Using UK TAG	M BAT tool) or Step 3 m	ng UK TAG	River	Fails Toxicity Test.	Dass	5	ediment deposition for this	site is judged as:
	5.67	4.13	ug/l	Try	more mitigation	1 433	E	xtensive?	Deposition Index
Step 3 Tier 1 fail. Go	to Tier 2 (using UK TAG								
M-BAT tool), or in	ncrease Step 3 mitigation.								
Road number		Lower Thames C	Crossing		HE Area / DBFO n	number			
Assessment type		Cumulative asses	sment excluding se	diments (ou	utfalls between 10	00m and 1km ap	art)		-
OS grid reference of assessm	ent point (m)	Easting	5			Northing			
OS grid reference of outfall str	ructure (m)	Easting				Northing			
Outfall number					List of outfalls in o	cumulative	S11-001	S11-002	
Receiving watercourse		Tributary of the M	lardyke		assessment	6			
EA receiving water Detailed Ri	ver Network ID				Assessor and affili	iation		LD	
Date of assessment		19/05/2022			Version of assessr	ment			
Notes		Assessment update	ed to reflect revised o	drainage cat	chments and traf	fic model CS67 20	045		
Step 2 Diver Impacts				-					
Step 2 River impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.00401	Fresh	water EQS limits:				
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area draine	d (ha)	55.06		Bioavailable dissolv	ed copper (μg/l)		<b>1</b> D	
Step 1 runoff quality only)	Permeable area draining to ou	tfall (ha)	35.861	Bioavailable dissolved zinc (µg/l)					
	Base Flow Index (BFI)		0.379	Is the discharge in or within 1 km upstream of a protected site for conservation?					
For dissolved zinc only	Water hardness	High = >200mg CaCO3/I	-	E Fo	or dissolved copper	ronly Ambient t	background o	concentration (µg/l)	4.88
For sediment impact only	Is there a downstream structur	e, lake, pond or canal th	at reduces the velocity v	vithin 100m of	the point of discharg	ge?		No 🔻 D	
	@ Tior 1 Estimated rive	er width (m)	5						
	a nei 1 Estimated ive								
	© Tier 2 Bed width (m)		3	Manning's n	0.07	Side	slope (m/m)	0.5 Long	slope (m/m) 0.0001
L			16					76	
Step 3 Mitigation					-				
				T.	controport for	Attenuation for column	ess	Cottlomont of	
		Drief description		S0	lubles (%) rest	tricted discharge rat	te ( I/s ) se	ediments (%)	
		Bhei description					( )		
Existing measures				0	D No	restriction -	D 0	D	
Proposed measures	filter drains, pond with sediment fo	rebay and wetland		70	No	restriction -	D 0	D	
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	Soluble		Sediment - Chronic Im	pact	
Copper 7.84 Step 2 Tier I fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. M 5.20 Step 3 Tier I fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	Zino 12.20 r 1 fail. Go to Tier 2 (using UK TAG UK	Copper Zinc er Fails Tozicity est. Try more mitigation Pass	Sediment deposition for this site i Accumulating? Extensive?	s judged as: Low flow Velm/s Deposition Index	
Road number	Lower Thames Crossing	HE Area / DBFO number			PredictImpact
Assessment type	Cumulative assessment excluding sediments (outfall	Is between 100m and 1km apart)			reastinpact
OS grid reference of assessment point (m)	Easting	Northing			Show Detailed Results
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Receiving watercourse	Unnamed tributary of Mardyke	assessment			Peset Interface
EA receiving water D etailed River Network ID		Assessor and affiliation			Reactimentate
Date of assessment		Version of assessment			Document Data Source
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	Soluble		Sediment - Chronic	mpact		
EQS - Annual Average Conc	centration	Acute Impact	Page			1
5.10 Step 2 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	6.49 ug/	Copper Zinc Pass Pass	Sediment deposition for this site Accumulating? Yes 0.00	e is judged as: Low flow Vel m/s		
Step 3 Tier 1 fail. Go to Tier 2 (asing UK TAG M-BAT tool), or increase Step 3 mitigation.	i dign		Extensive?	Deposition index		
Road number	Lower Thames Crossing	HE Area / DBFO number			Predict Impact	
Assessment type	Non-cumulative assessment (single outfall)			•	Predictimpact	
OS grid reference of assessment point (m)	Easting	Northing			Show Detailed Results	
OS grid reference of outfall structure (m)	Easting	Northing		s	ave Results & Parameters	
Receiving watercourse	Tilbury Main	assessment				
EA receiving water D etailed River Network ID	Thomas and the second se	Assessor and affiliation	LD		Reset Interface	
Date of assessment	03/08/2020	Version of assessment	2		Document Data Source	
Notes					Open Parameters csv file	
					Spillage Risk	
Stop 1 Dupoff Quality				(	Groundwater Assessment	
AADT >=100,000	Climatic region Warm	Dry   Rainfall site	London (SAAR 600mm)	-	R eset Workbook	-
< > Interface			1		•	
Ready Calculate					+ 709	96

Step 1 Runoff Quality	AADT >=100,00	0 🔽	Climatic region	Warm Dry   Rainfall site	London (SAAR 600mm)			
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>2</sup>	<sup>3</sup> /s)	0.00434	Freshwater EQS limits:				
(Enter zero in Annual Qos	Impermeable road area	drained (ha)	9 994	Bioavailable dissolved copper (ug/l)				
river flow box to assess	Permeable area draining	a to outfall (ba)	5 731					
Step 1 runon quality only)			3.731	Bioavailable dissolved zinc (µg/i)				
[	Base Flow Index (BFI)		0.848	Is the discharge in or within 1 km upstream of a protec	ted site for conservation?			
For dissolved zinc only	Water hardness	High = >200mg CaCO3/I	•	For dissolved copper only Ambient backg	round concentration (µg/l)			
For sediment impact only	Is there a downstream s	tructure, lake, pond or canal that reduc	es the velocity within	100m of the point of discharge?	No 🔽 🛛			
	Tier 1     Estimate	ed river width (m)	3.69					
	ି Tier 2 Bed wid	th (m)	3 Man	ning's n 0.07 Side slope	e (m/m) 0.5 Long slope (m/m) 0.0001			
highways	Highways Engl	and Water Risk Assessment To	ool	Version 2.0.4 June 2019				
Chigidina		Soluble			Sediment - Chronic Impact			
	EQS - Annual Average	e Concentration		Acute Impact				
C	Copper	Zinc		<b>6</b> 7	Fail. Try Tier 2 for Velocity			
Step 2 Tier 1 fail. Go to	Tier 2 (using UK TAG	1.12	ugn	Diver Eatly Training	Sediment deposition for this site is judged as:			
M-BAT tool), c	or Step 3 mitigation.			Test. Try mitigation Pass	Accumulating? Yes 0.00 Low flow Velm/s			
Step 3	7		lugn					
Road number		Lower Thames Crossin	nq	HE Area / DBFO number				
Assessment type		Non-cumulative assess	ment (single outfal	1)	•			
OS grid reference of assessme	nt point (m)	Easting		Northing				
OS grid reference of outfall stru	icture (m)	Easting						
Receiving watercourse		West Tilbury Main		assessment				
EA receiving water Detailed Riv	er Network ID	vvest hibury Main		Assessor and affiliation	LD.			
Date of assessment		18/05/2022		Version of assessment				
Notes		Assessment re run using	CS67 traffic model	data and revised drainage design information				
Step 1 Runoff Quality	AADT >=100,00	0.	Climatic region	Warm Dry Rainfall site	London (SAAR 600mm)			
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m	<sup>3</sup> /S)	0.00434	Freshwater EQS limits:				
(Enter zero in Annual Qas	Impermeable road area	drained (ha)	9.994	Bioavailable dissolved copper (uo/l)	1			
river flow box to assess	Permeable area drainin	a to outfall (ha)	5.731	Bioavailable dissolved zinc (uq/l)	10.9			

Is the discharge in or within 1 km upstream of a protected site for conservation?

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	Zinc		Acute imp	Jact		Pass				
Step 2     5.40       Step 2     Tier 1 fail, Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.       Step 3     4.37       Tier 1 fail, Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	4.95 ugi 1.48 ugi		Copper Pass	Zinc Pass	Sedim Accun Extens	ent deposition for this s nulating? Yes 0.1 sive? No 8	ite is judged as: 12 Low flow Vel m/s 3 Deposition Index			
Road number	Lower Thames Crossing		HE Area / DBFO nu	umber				Dendia	timment	
Assessment type	Non-cumulative assessment (single outfal	II)					-	Predic	timpact	
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Outral number	S10-001 Cobiana Sawar		assessment	mulative						
EA receiving water D etailed River Network ID	Gobians Sewer		Assessor and affilia	tion		)		Reset	Interface	
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AADT >=100,000	Climatic re	gion Warm I	Dry 🔸	Rainfall site	London (S	SAAR 600mm)	•	R eset V	Vorkbook	+
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Step 2 Tier 1 fail. Go to Tier 2 (using UK TAG Tie	er 1 fail. Go to Tier 2 (using UK TAG	er Fails Toxicity	diment deposition for this site is judged as:	
M-BAT tool), or Step 3 mitigation.	M-BAT tool), or Step 3 mitigation.	est. Irg more Pass Ac	comulating? Yes 0.00 Low How Vel m/s	
5.20 Step 3 Tier 1 fail Go to Tier 2 (using UK TAG	3.66 ug/l		ttensive? NO 80 Deposition Index	
M-BAT tool), or increase Step 3 mitigation.				
Road number	Lower Thames Crossing	HE Area / DBFO number		Dendistignant
Assessment type	Non-cumulative assessment (single outfall)			Predictimpact
OS grid reference of assessment point (m)	Easting	Northing		Show Detailed Results
OS grid reference of outfall structure (m)	Easting	Northing		Save Results & Parameter
Outfall number	S11-001	List of outfalls in cumulative		sure nesults a runaneter
Receiving watercourse	tributary of the Mardyke	Appropriate and a filling from		ResetInterface
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				Groundwater Assessment
Step 1 Runoff Quality AADT >=100,000	Climatic region Warn	n Dry Rainfall site	ion (SAAR 600mm)	R eset Workbook
Step 2 River Impacts Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)	0.004 Fre	shwater EQS limits:		View Fixed Params
(Enter zero in Annual Q., Impermeable road area drain	ned (ba) 36.367	Bioavailable dissolved copper (ug/l)		
A Interface	outer line	Divarianabic dissolved copper (µgn)		
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EQS - Annual Average Con       Copper       Copper       7.84       Step 2     Tier 1 fail. Go to Tier 2 (using UK TAG       M-BAT tool), or Step 3 mitigation.       5.02       Step 3       Tier 1 fail. Go to Tier 2 (using UK TAG       M-BAT tool), or tier 2 (using UK TAG       M-BAT tool), or tier 2 (using UK TAG	Incentration     Zinc       12.20     ug/l       ier 1 fail. Go to Tier 2 (using UK TAG     M-BAT tool), or Step 3 mitigation.       3.05     ug/l	Acute Impact Copper Zine Pass Pass	Pass           Sediment deposition for this site is judged as:           Accumulating?         Yes         0.00         Low flow Velm/s           Extensive?         No         80         Deposition Index	
Road number	Lower Thames Crossing	HE Area / DBFO number		PredictImpact
Assessment type	Non-cumulative assessment (single outfall)			
OS grid reference o fassessment point (m)	Easting Easting	Northing		Show Detailed Results
Outfall number	S11-001	List of outfalls in cumulative		Save Results & Parameters
Receiving watercourse	tributary of the Mardyke	assessment		R east Interface
EA receiving water Detailed River Network ID		Assessor and affiliation	LD	
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Stop 1 Pupoff Quality				Groundwater Assessment
AADT >=100,000	Climatic region Warm	Dry   Rainfall site	London (SAAR 600mm)	R eset Workbook
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Step 1 Runoff Quality	AADT >=100,000	Climatic region Warm Dry   Rainfall site London (SAAR 600mm)
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)	0.00401 Freshwater EQS limits:
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area drained (ha)	40.378 Bioavailable dissolved copper (μg/l)
Step 1 runoff quality only)	Permeable area draining to outfall (ha)	22.829     Bioavailable dissolved zinc (μg/l)     10.9
	Base Flow Index (BFI)	0.379 Is the discharge in or within 1 km upstream of a protected site for conservation?
For dissolved zinc only	Water hardness High = >200mg CaCO3/I	For dissolved copper only Ambient background concentration (µg/l)
For sediment impact only	Is there a downstream structure, lake, pond or canal that reduce	es the velocity within 100m of the point of discharge?
	Tier 1 Estimated river width (m)	3.3
	C Tier 2 Bed width (m)	3         Manning's n         0.07         Side slope (m/m)         0.5         Long slope (m/m)         0.0001

highways england Highways England V	Vater Risk Assessment Too	bl	Version 2.0.4 June 20	19			
	Soluble				Sediment -	Chronic Impact	
EQS - Annual Average Conc Copper	entration Zinc 12,57	الحرر	Acute Imp	Zine	Fail. Try Tic	er 2 for Velocity	
Step 2 Tier 1 fail. Go to Tier 2 (using UK TAG Ti M-BAT tool), or Step 3 mitigation.	er 1 fail. Go to Tier 2 (using UK TA M-BAT tool), or Step 3 mitigation.	IG	River Fails Toxicity Test. Try mitigation	Pass	Sediment deposition for Accumulating? Yes	or this site is judged as: 0.00 Low flow Velm/s	
- Step 3	85. 	ug/l			Extensive? Yes	ZZ33 Deposition Index	
Road number	Lower Thames Crossing	1	HE Area / DBFO n	umber			
Assessment type	Non-cumulative assessme	ent (single outf	all)			-	
OS grid reference of assessment point (m)	Easting			Northing			
OS grid reference of outfall structure (m)	Easting			Northing			
Outfall number	S011-001		List of outfalls in c	cumulative			
Receiving watercourse	Unnamed tributary of the	e Mardyke	assessment				
EA receiving water Detailed River Network ID			Assessor and affilia	ation	LD		
Date of assessment	18/05/2022		Version of assessn	nent			
Notes	Assessment re run using C	S67 traffic mode	el data and revised draina <u>c</u>	ge design informatior	n		
Step 1 Runoff Quality AADT		Climatic region	Warm Dry 💌	Rainfall site	London (SAAR 600mm)	•	
Step 2 River Impacts         Annual Q <sub>BS</sub> river flow (m³/s)		0.00401	1 Freshwater EQS limits:				
(Enter zero in Annual Q <sub>95</sub> Impermeable road area draine	d (ha)	40.376	40.378 Bioavailable dissolved copper (μg/l)				
Step 1 rupoff quality only) Permeable area draining to our	ifall (ha)	22.629					
Step Frankin quality (my)							
Base Flow Index (BFI)		0.379	Is the discharge in or within	1 km upstream of a prote	ected site for conservation?	No 🔽 D	

highways england	Highways Engl	and Water Risk Assessment Tool		Version 2.0.4 J	June 2019			
		Soluble				Sedin	nent - Chronic Impact	
EQS - Annual Average Concentration       Acute Impact         Copper       Zinc       ugil       Copper       Z         Step 2       Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.       Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.       M-BAT tool), or Step 3 mitigation.       Biver Fails Toxicity Test. Try more mitigation       P         Step 3       Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.       M-BAT tool)       ugil       Mitigation       P		Zinc Zinc Pass	Fail. Settlement n Sediment deposit Accumulating? Extensive?	iny Tier 2 for Velocity eeded = 96 %, proposed = 90 % ion for this site is judged as: Yes 0.00 Low flow Vel m/s Yes 223 Deposition Index				
Step 3 Mitigation         Estimated effectiveness         Treatment for solubles - solubles - solubles - solubles - solubles (%)       Settlement of solubles - settiments (%)         Existing measures       None       0       0       No restriction       0 <td< th=""></td<>								
england	Highways England Water KISK ASSESSMENT 1001         Version 2.0.4 June 2019							
Step 2 Step 2 Step 3 Step 3 Tier 1 fail. Go to Tier M-BAT tool), or Increase M-BAT tool), or increase	EQS - Annual Average ( er 2 (using UK TAG ep 3 mitigation. 4 2 (using UK TAG es Step 3 mitigation.	Zinc         12,57       ug/l         Tier 1 fail. Go to Tier 2 (using UK TAG.         M-BAT tool), or Step 3 mitigation.         4.30       ug/l		Acute In Copper Pass	npact Zinc Pass	P Sediment deposition for Accumulating? Yes Extensive? No	this site is judged as: 0.08 Low flow Velm/s 97 Deposition Index	
For sediment impact only       Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?       No       Image: Construction of the point of discharge?         Tier 1       Estimated river width (m)       3.3       Image: Construction of the point of discharge?       Image: Construction of the point of the poi								
Step 3 Mitigation	N	Brief description		Treatment for solubles (%)	Estimated effectivenes Attenuation for soluble restricted discharge rate	SS es - Settlement of (I/s) sediments (%)		
Proposed measures	Filter drains, pond with sec	diment forebay and wetland		74 D	27.6	95		

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england inginity's England	Soluble		Version 2.0.4 Suite 2015		Sediment - Chro	nic Impact	
EQS - Annual Average Con	centration		Acute Impact		ocument - cinto	ine impuer	
Copper       6.48       Step 2     Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.       4.89       Step 3     Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	Zinc 7.33 2.20	ug/l	Copper Zinc Pass Pass		Pass Sediment deposition for this Accumulating? Yes Extensive? No	s site is judge 0.00 Low flo 69 Depos	r <b>d as:</b> ow Vel m <i>is</i> ition Index
Road number	Lower Thames Crossing		HE Area / DBFO number				
Assessment type OS grid reference of assessment point (m) OS grid reference of outfall structure (m)	Non-cumulative assessment           Easting           Fasting	(single outfall)	No rthing				
Outfall number Receiving watercourse	S11-002 Tributary of the Mardyke		List of outfalls in cumulative assessment				
EA receiving water Detailed River Network ID			Assessor and affiliation		LD		
Date of assessment Notes	03/08/2020		Version of assessment		2		
🔹 🕨 🖹 Interface 🕀							•
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Step 1 Runoff Quality	AADT >=100,000	•	Climatic region Wa	rm Dry   Rainfall site	London (SAAR 600mm)				
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.00401 F	reshwater EQS limits:					
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area draine	d (ha)	14.684	Bioavailable dissolved copper (µg/l)	1				
river flow box to assess Step 1 runoff quality only)	Permeable area draining to ou	tfall (ha)	13.232	Bioavailable dissolved zinc (uq/l)	10.9 D				
crop i ranon quanty only,	Base Flow Index (BEI)			e discharge in or within 1 km unstream of a protec	cted site for conservation?				
	Base How mack (BH)								
For dissolved zinc only	Water hardness	High = >200mg CaCO3/I	•	For dissolved copper only Ambient backg	ground concentration (µg/l)				
For sediment impact only	Is there a downstream structur	e, lake, pond or canal that reduces	the velocity within 100n	of the point of discharge?					
	Tier 1 Estimated rive	er width (m)	3.2						
	ି Tier 2 Bed width (m)		3 Manning	s n 0.07 Side slope	e (m/m) 0.5 Long slope (m/m) 0.0001				
highways england	Highways England Water Risk Assessment Tool     Version 2.0.4     June 2019								
		Soluble			Sediment - Chronic Impact				
	EQS - Annual Average Con	centration Zinc		Acute Impact	Fail. Tru Tier 2 for Velocity				
	7.04	7.91	ug/l	Copper Zinc	Settlement needed = 88 %, proposed = 0 %				
Step 2 Tier 1 fail. Go to	o Tier 2 (using UK TAG			River Fails Toxicity Base	Sediment deposition for this site is judged as:				
Step 3		2 <b>.</b>	ug/l	est. Try mitigation	Extensive? Yes 832 Deposition Index				
Road number		Lower Thames Crossing		HE Area / DBEO number					
Assessment type		Non-cumulative assessme	nt (single outfall)		-				
OS grid reference of assessme	ent point (m)	Easting		Northing					
OS grid reference of outfall str	ructure (m)	Easting		Northing					
Outfall number		S011-002		List of outfalls in cumulative					
Receiving watercourse		Unnamed tributary of the	Mardyke	assessment					
EA receiving water Detailed Ri	ver Network ID			Assessor and affiliation	LD				
Date of assessment		18/05/2022		Version of assessment					
Notes	Assessment re run using CS67 traffic model data and revised drainage design information								
Step 1 Runoff Quality	AADT >=100,000		Climatic region we	rm Dry - Rainfall site	London (SAAR 600mm)				
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.00401 F	reshwater EQS limits:					
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area draine	ed (ha)	14.684         Bioavailable dissolved copper (μg/l)         1         D						
river flow box to assess Step 1 runoff quality only)	Permeable area draining to ou	utfall (ha)	13.232     Bioavailable dissolved zinc (µg/l)       10.9						
	Base Flow Index (BFI)		0.379 Is th	e discharge in or within 1 km upstream of a protec	cted site for conservation?				

3	highways england	High	ways England Water Risk As	sessment Tool		Version 2.0.4 Jun	e 2019			
				Soluble					Sediment - Chr	onic Impact
Г	·	EQS - An		8	Acute	Impact				
1		Copper	Zi	nc					Pass	
1	0.0	7.02	7.	91	ug/l	Copper	Zi	nc		
	Step 2	lier Thail. Go to Tier 2 lusing	UK TAG				/ <b>D</b> .		Sediment deposition for thi	s site is judged as:
		PT-DAT (OOI), of Step 5 milig 5 32	jation. 2	51	ual	Pass	1	155	Extensive? No	83 Deposition Index
	Step 3	Tier 1 fail. Go to Tier 2 fusing	UK TAG	3.	agn					Depositor index
	M-E	BAT tool), or increase Step 3	mitigation.							
_										
	Step 3 Mit	tigation							Estimated offectiveness	
									Estimated enectiveness	
							Treatn	nent for	Attenuation for solubles -	Settlement of
				Brief description			solubl	es(%)	restricted discharge rate ( I/s	) sediments ( %)
				-						
	Existing m	easures No	one				0	D	No restriction	0 D
	Proposed	ed measures Filter drains, pond with sediment forebay and wetland					70		25.2 🔹	90

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EQS - Annual Average Con	centration		Acute Impact				_	
Copper           6.61           Step 2         Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zine 5.70 v	ugil	Copper Zinc Pass Pass	Se	Pass ediment deposition for t coumulating? Yes	h <b>is site is judg</b> 0.00 Lowf	ed as: low Vel m/s	
4.82 Step 3 Tier 1 fail, Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.71	ugil		E	itensive? No	20 Depo	sition Index	
Road number	Lower Thames Crossing		HE Area / DBFO number					
Assessment type	Non-cumulative assessment (single	e outfall)					-	
OS grid reference of assessment point (m)	Easting		Northing					
OS grid reference of outfall structure (m)	Easting		Northing					
Outfall number	S12-001		List of outfalls in cumulative			-		
Receiving watercourse	Tributary of the Mardyke		Approximent		1.0			
Date a faggegement	02/02/02/02		Assessor and amilaton					
Date of lassessment	03/08/2020		Version of assessment		2			
Stan 1 Dunoff Quality				: 4				
G interface								1
Ready Calculate				_			+ 70%	%



highways england	Highways England	Water Risk Asses	sment Tool		Version 2.0.4 June 20	019			
		So	luble					Sediment - C	hronic Impact
	EQS - Annual Average Co	ncentration			Acute Im	pact		19	
	Copper	Zinc						Fail. Try Tier	2 for Velocity
Step 2 Tier 1 fail. Go M-BAT tool	7.10 o to Tier 2 (using UK TAG I), or Step 3 mitigation.	5.97	ug/l	Rive	Copper r Fails Toxicity	Zinc Pass	Sec	Settlement needed diment deposition for t cumulating? Yes	= 56 %, proposed = 0 % his site is judged as: 0.00 Low flow Velm/s
Step 3	-	2 	ugil				Ext	ensive? Yes	227 Deposition Index
Road number		Lower Thames	Crossing		HE Area / DBFO r	number			
Assessment type		Non-cumulative	assessment (single	outfall)			63		•
OS grid reference of assessi	ment point (m)	Easting				Northing			
OS grid reference of outfall s	structure (m)	Easting				Northing			
Outfall number		S012-001	il.		List of outfalls in	cumulative			
Receiving watercourse		Unnamed tribu	tary of the Mardyke	1	assessment				
EA receiving water Detailed	River Network ID				Assessor and affil	iation		LD	
Date of assessment		18/05/2022			Version of assess	ment			
Notes		Assessment re ri	in using CS67 traffic n	nodel data a	nd revised draina	ige design inform	ation		
Step 1 Runoff Quality	AADT >=50,000 and <1	00,000	Climatic re	egion Warm I	Dry 🔽	Rainfall site	Londo	on (SAAR 600mm)	•
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.00023	Frest	water EQS limits:				
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area drair	ned (ha)	3.068	í l	Bioavailable dissolv	ved copper (µg/l)		1 D	
river flow box to assess	box to assess most audity only) Permeable area draining to outfall (ha)								
Step Tranon quality only)	, officable area draining to t	Secon (rich)	(**)						
	Base Flow Index (BFI)		0.379	Is the d	ischarge in or within	1 km upstream of a	protected site for	or conservation?	No 👻 D

highways england	5	Highways England	Water Risk Assessment Too	bl	Version 2.0.4 Jun	e 2019					
			Soluble					Se	diment - Chror	nic Impact	
<u> 20</u>	EQ	Acute	Impact		100						
	Copper		Zinc						Pass		
	7.09		5.97	ug/l	Copper	Zin	c				
Step Z	Tier 1 fail. Go to Tier 2 M-BAT tool), or Step	Lusing UK TAG 3 mitigation.			Pass	Pas	s	Sediment dep Accumulating	Sition for this s	<b>0.00</b> Low flow	as: «Velm/s
	5.22		1.82	ug/l	Contrary and		ā (	Extensive?	No	23 Deposit	tion Index
Step 3	p 3 Tier 1 fail. Go to Tier 2 (using UK TAG										0.000
	M-BAT tool), or increase	Step 3 mitigation.									
Step 3	Mitigation							Estimated offer	tivanaaa		
								Estimated ener	uveness		
						Treatm	ent for	Attenuation for	solubles -	Settlem	ent of
			Brief description	on		soluble	es(%)	restricted discharg	ge rate ( I/s )	sedimen	ts(%)
<b>F</b>											
Existing	a measures	easures None						No restriction		0	D
Propos	ed measures	Neasures Filter drains, pond with sediment forebay and wetland						6.2	- I	90	

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highways Highways England N	Water Risk Assessment Tool	Version 2.0.4 June 2019		<b>A</b>
	Soluble		Sediment - Chronic Impact	
EQS - Annual Average Cone Conner	Zine	Acute Impact	Pass	
4.75       Step 2       Iter 1 Fail. Go to Tier 2 (using UK TAG M-DAT tool), or Step 3 mitigation.       4.49       Step 3       Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	0.68 ug/l 0.21 ug/l	Copper Zinc Pass Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.02 Low flow Yel m/s Extensive? No 31 Deposition Index	
Road number	Lower Thames Crossing	HE Area / DBFO number		PredictImpact
Assessment type	Non-cumulative assessment (single outfall)		· · · · · · · · · · · · · · · · · · ·	
OS grid reference of assessment point (m)	Easting Easting	Northing		Show Detailed Results
Outfall number	S12-002	List of outfalls in cumulative		Save Results & Parameters
Receiving watercourse	Mardyke	assessment		Reset Interface
EA receiving water Detailed River Network ID		Assessor and affiliation	LD	Reset manage
Date of assessment	03/08/2020	Version of assessment	2	Document Data Source
NOTES				Open Parameters csv file
				Spillage Risk
Step 1 Runoff Quality AADT >=50,000 and <1	100.000 Climatic region Warm	Drv Painfall eite	Lordon (SAAR 600mm)	Groundwater Assessment
	cintato rogion			R eset Workbook
A Design Interface			•	•
Ready Calculate				<u>□</u> – — + 70%
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Step 1 Runoff Quality	AADT >=50	0,000 and <100,000	2	•	Climatic reg	ion War	m Dry	•	Rainfall site	Londo	n (SAAR 600mm)	•
Step 2 River Impacts	Annual Q <sub>95</sub> river flo	w (m <sup>3</sup> /s)			0.0377	Fre	eshwater EQS	limits:				
(Enter zero in Annual Qor	Impermeable road	area drained (l	ha)		15 978		Binavailah	a dissolva	d copper (ug/l)		1	
river flow box to assess	Demochie eres de		1. (h = )				Dioavailabi					
Step 1 runoff quality only)	Permeable area dra	aining to outrai	ii (na)		9.049		Bioavailab	e dissolve	d zinc (µg/l)		10.9	
	Base Flow Index (B	3FI)			0.283	1.283       Is the discharge in or within 1 km upstream of a protected site for conservation?						No 🖵 D
For dissolved zinc only	Water hardness	1	High = >200mg CaCO3	/I	•	_	For dissolve	l copper (	only Ambient	background con	ncentration (µg/l)	4.88
For sediment impact only	Is there a downstre	am structure, I	ake, pond or canal t	hat reduces t	he velocity wi	thin 100m	of the point of	discharge	?		No 🔻 D	
	Tier 1 Es	timated river w	/idth (m)		6							
	ି Tier 2 ା Be	ed vældth <u>((m</u> ))			3	Manning's	<b>n</b> 0.07		Side	slope (m/m)	0.5 Long	3 slope (m/m) 0.0001
Pighways england	Highways	England W	ater Risk Asses	sment Too	l.		Version 2.0.	4 June 201	19			
			So	uble							Sediment -	Chronic Impact
	EQS - Annual A	Average Conce	entration					Acute Imp	act	2		
	Copper		Zinc				6		-		Fail. Try Tier	2 for Velocity
Step 2 Tier 1 fail. Go	to Tier 2 (using UK TA	AG	U. 76		ugri		Lopper		Zinc	Sed	Settlement needed	this site is judged as:
M-BAT tool	), or Step 3 mitigation.	-					Pass		Pass	Acc	umulating? Yes	0.02 Low flow Vel m/s
Step 3	-		-		ug/l	_				Exte	ensive? Yes	352 Deposition Index
Road number			Lawar Thansan	Creating			HE Area	DREO N	umber		1	
Assessment type			Non-cumulative	assessme	ent (single o	utfall)		DDI O III	univer		-	•
OS grid reference of assess	nent point (m)		Easting	abocoome	And (onlight o	uturi)			Northing			
OS grid reference of outfall s	tructure (m)		Easting						Northing			
Outfall number			S012-002				List of our	falls in c	umulative			
Receiving watercourse			Mardγke				assessme	nt				
EA receiving water Detailed F	River Network ID						Assessor	and affilia	ation		LD	
Date of assessment			18/05/2022				Version o	fassessm	nent			
Notes		1	Assessment re ru	n using CS	367 traffic m	odel data	a and revised	d drain ag	e design informa	ation		
Step 1 Runoff Quality	AADT 🎦	50,000 and <100,0	00	•	Climatic re	gion Wa	rm Dry	•	Rainfall site	Londo	n (SAAR 600mm)	•
Step 2 River Impacts	Annual Q <sub>95</sub> river f	flow (m <sup>3</sup> /s)			0.0377	FI	eshwater EQS	limits:				
(Enter zero in Annual Q <sub>95</sub>	Q <sub>95</sub> Impermeable road area drained (ha)			15.978     Bioavailable dissolved copper (µg/l)								
Step 1 runoff quality only)	Permeable area draining to outfall (ha)				9.649 Bioavailable dissolved zinc (µg/l)							
	Base Flow Index (BFI)				0.283	Is th	e discharge in	or within 1	1 km upstream of a	protected site fo	or conservation?	No - D



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highways Highways England	Nater Risk Assessment Tool		Version 2.0.4 June 2019					
	Soluble				Sediment - Chro	onic Impact		
EQS - Annual Average Cone	centration	_	Acute Impact		Dest			
Copper       5.74       Step 2     Tier 1 fail. Go to Tier 2 [using UK TAG M-BAT tool], or Step 3 mitigation.       4.37       Step 3     Tier 1 fail. Go to Tier 2 [using UK TAG M-BAT tool], or increase Step 3 mitigation.	2inc 6.26 1.88	ugłi	Copper Zinc Pass Pass		Pass Sediment deposition for thi Accumulating? Yes Extensive? No	is site is judgo 0.01 Low fl 70 Depos	ed as: ow Velm/s sition Index	
Road number	Lower Thames Crossing		HE Area / DBFO number					
Assessment type	Non-cumulative assessment (si	ngle outfall)					-	
OS grid reference of assessment point (m)	Easting		Northing					
OS grid reference of outfall structure (m)	Easting		Northing					
Outfall number	S13-001		List of outfalls in cumulative					
Receiving watercourse	Mardyke west tributary		assessment					
EA receiving water D etailed River Network ID			Assessor and affiliation		LD			
Date of assessment	03/08/2020		Version of assessment		2			
Notes								-
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Ready Calculate						· · · · · · · ·	+	70%

Step 1 Runoff Quality	AADT >=100,000	V	Climatic region	Warm Dry Rainfall site	London (SAAR 600mm)
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.006	Freshwater EQS limits:	
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area drain	ed (ha)	13.018	Bioavailable dissolved copper (µg/l)	1
river flow box to assess Step 1 rupoff quality only)	Permeable area draining to o	utfall (ha)	7.679	Bioavailable dissolved zinc (uq/l)	10.9
otop i ranon quanty only)	Base Flow Index (BEI)		0.29	Is the discharge in or within 1 km unstream of a protect	ted site for conservation?
	Dase How Index (DFT)		0.20		
For dissolved zinc only	Water hardness	High = >200mg CaCO3/I	•	For dissolved copper only Ambient backg	round concentration (µg/l)
For sediment impact only	Is there a downstream structu	ire, lake, pond or canal that reduces	the velocity within 1	100m of the point of discharge?	No V
	Tier 1 Estimated riv	ver width (m)	3.5		
	ି Tier 2 Bed width (m	1)	3 Man	ning's n 0.07 Side slope	(m/m) 0.5 Long slope (m/m) 0.0001
highways england	Highways England	Water Risk Assessment Tool		Version 2.0.4 June 2019	
ungiona		Soluble			Sediment - Chronic Impact
	EQS - Annual Average Con	centration		Acute Impact	
	5.44	Zinc 5.82	uall	Copper Zinc	Settlement needed = 85%, proposed = 0%
Step 2 Tier 1 fail. Go to	o Tier 2 (using UK TAG			River Fails Toxicity	Sediment deposition for this site is judged as:
	-	-	ug/l	Test. Try mitigation Pass	Extensive? Yes 637 Deposition Index
Step 3					
Road number		Lower Thames Crossing		HE Area / DBFO number	
Assessment type		Non-cumulative assessme	nt (single outfall)	<u> </u>	
OS grid reference of assessme	ent point (m)	Easting		Northing	
OS grid reference of outfall str	ucture (m)	Easting		Northing	
Receiving watercourse		S013-001 Marduke West Tributany		assessment	
EA receiving water Detailed Ri	ver Network ID	Mardyke West Hibutary		Assessor and affiliation	LD
Date of assessment		18/05/2022		Version of assessment	
Notes		Assessment re run using CS	67 traffic model o	lata and revised drainage design information	
Step 1 Runoff Quality	AADT >=100,000		Climatic region	Warm Dry 🔹 Rainfall site	London (SAAR 600mm)
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.006	Freshwater EQS limits:	
(Enter zero in Annual Qos	Impermeable road area draine	ed (ha)	13.018	Bioavailable dissolved copper (ug/l)	
river flow box to assess Step 1 runoff quality only)	Permeable area draining to o	utfall (ha)	7.679	Bioavailable dissolved zinc (ug/l)	10.9
ctop ( ranon quality only)	Base Flow Index (BFI)		0.29	s the discharge in or within 1 km upstream of a protecte	d site for conservation?



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	Soluble		Sediment - Chronic In	npact	
EQS - Annual Average Con	icentration Zinc	Acute Impact	Pass		
4.46 Step 2 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	1.27 ug/i	Copper Zinc Pass Pass	Sediment deposition for this site Accumulating? Yes 0.01	is judged as: Low flow Vel m/s	
4.03 Step 3 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	0.38 ug/l		Extensive? No 27	Deposition Index	
Road number	Lower Thames Crossing	HE Area / DBFO number			Dendistingenet
Assessment type	Non-cumulative assessment (single outfall)		I		Predict impact
OS grid reference of assessment point (m)	Easting	Northing			Show Detailed Results
OS grid reference o foutfall structure (m)	Easting	Northing		s	ave Results & Parameter
Outrall number	S13-002 West Mardyke tributary	assessment			
EA receiving water D etaile d River Network ID		Assessor and affiliation	LD		R eset Interfa ce
Date o fassessment	03/08/2020	Version of assessment	2		Document Data Source
Notes					Open Parameters csv file
					Spillage Risk
Step 1 Runoff Quality					Groundwater Assessment
AADT >= 50,000 and <	Climatic region	n Dry 💽 Rainfall site	London (SAAR 800mm)		R eset Workbook
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Step 1 Runoff Quality	AADT >=50,000 and <100,	<b>000</b>	Climatic region	Warm Dry   Rainfall site	London (SAAR 600mm)			
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.006	Freshwater EQS limits:				
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area drained	l (ha)	3.959	Bioavailable dissolved copper (µg/l)	1			
Step 1 runoff quality only)	Permeable area draining to out	fall (ha)	14.373	Bioavailable dissolved zinc (µg/l)	10.9			
	Base Flow Index (BFI)		0.29	Is the discharge in or within 1 km upstream of a protecte	ed site for conservation?			
For dissolved zinc only	Water hardness	High = >200mg CaCO3/I	•	For dissolved copper only Ambient backgro	ound concentration (µg/l)			
For sediment impact only	Is there a downstream structure	e, lake, pond or canal that reduces	the velocity within 1	00m of the point of discharge?	No 🔻 D			
	Tier 1 Estimated rive	width (m)	3.5					
	C Tier 2 Bed width (m)		3 Manr	ning's n 0.07 Side slope (i	m/m) 0.5 Long slope (m/m) 0.0001			
highways england	Highways England V	Vater Risk Assessment Too	Ì	Version 2.0.4 June 2019				
		Soluble			Sediment - Chronic Impact			
Step 2 Tier 1 fail. Go to	EQS - Annual Average Conc Copper 4.15 Tier 2 (using UK TAG or Step 3 mitigation	entration Zinc 0.94	ugil	Acute Impact Copper Zinc Pass Pass	Fail. Try Tier 2 for Velocity           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 49 %, proposed = 0 %           Settlement needed = 40 %			
Step 3	5	ι.	ug/l		Extensive? Yes 194 Deposition Index			
Road number		Lower Thames Crossing	i.	HE Area / DBFO number				
Assessment type		Non-cumulative assessme	ent (single outfall	)				
OS grid reference of assessme	ent point (m)	Easting		Northing				
OS grid reference of outfall stru	ucture (m)	Easting		Northing				
Outrall number		S013-002		List of outfalls in cumulative				
EA receiving water Detailed Riv	er Network ID	Mardyke Vvest Inbutary		Assessor and affiliation				
Date of assessment	er Network ID	18/05/2022		Version of assessment				
Notes		Assessment re run using CS	667 traffic model	data and revised drainage design information				
Step 1 Runoff Quality	AADT >=50,000 and <100	000	Climatic region	Warm Dry   Rainfall site	London (SAAR 600mm)			
Step 2 River Impacts	Annual Q <sub>95</sub> river flow (m <sup>3</sup> /s)		0.006	Freshwater EQS limits:				
(Enter zero in Annual Q <sub>95</sub>	Impermeable road area drained	i (ha)	3.959	Bioavailable dissolved copper (µg/l)	1			
Step 1 runoff quality only)	Permeable area draining to out	fall (ha)	14.373	Bioavailable dissolved zinc (µg/l)				
na na mana na 1940 1960 1960 1960 1960 1960 1960 1960 196	Base Flow Index (BFI)		0.29	Is the discharge in or within 1 km upstream of a protecte	ed site for conservation?			

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EQS - Annual Average Con Conner	Zine	Aoute Impaot	Pass				
Copper           4.43           Step 2         Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.           4.03           Step 3         Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Increase Step 3 mitigation.	0.34 ug/l	Copper Zinc Pass Pass	Sediment deposition for this site Accumulating? Yes 0.01 Extensive? No 31	e is judged as: Low Row Vel m/s Deposition Index			
Road number	Lower Thames Crossing	HE Area / DBEO number					
Assessment type	Non-cumulative assessment (single outfall)			-	PredictImpact		
OS arid reference of assessment point (m)	Easting	Northina			Show Detailed Results		
OS grid reference of outfall structure (m)	Easting	Northing			ave Results & Parameters		
Outfall number	S14-001	List of outfalls in cumulative					
E A receiving water Distailed Diver Network D	Mardyke West tributary	Assessor and affiliation			R eset Interface		
Date of assessment		Version of assessment			Document Data Source		
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AADT >10,000 and <50	0,000 Climatic region Warm	Dry   Rainfall site	London (SAA R 600mm)	<u> </u>	R eset Workbook		
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4.09 Step 2 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. 4.01 Step 3 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	0.21	ug/l ug/l		Copper Pass	Zine Pass		Sediment ( Accumulat Extensive?	leposition for t ing? Yes No	his site is juo 0.01 Lou 15 De	<b>dged as:</b> w flow Vel m/s position Index
Road number	Lower Thames Crossing			HE Area / DBFO nu	umber					
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OS grid reference of assessment point (m)	Easting				Northing					
OS grid reference o foutfall structure (m)	Easting			Land and the second second	Northing					
Outrall number	S14-002 List of outfalls in cumulat			imulative		_				
E A receiving water Detailed Diver Network ID	vve st Mardyke tributary			Assessor and affilia	ation		LD.			
Date of assessment	03/08/2020 Version of as			Version of assessm	nent	2				
Notes	this outfalls discharges to a ver	ry small di	tch which flow	vs into the West M	ardyke tributary, v	which has t	been selec	ted as the asse	essment po	int.
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Exps - Annual Average Long       Copper     5.64       Step 2     Tier I fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.       Step 3     Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	Zinc         ug/l           5.80         ug/l           1.74         ug/l	Pass Pass	Pass       Sediment deposition for this site is       Accumulating?     Yes     0.00       Extensive?     No     32	i <b>udged as:</b> Low flow Vel m/s Deposition Index		
Road number	Lower Thames Crossing	HE Area / DBFO number			PredictImpact	
Assessment type	Non-cumulative assessment (single outfall)			· -	rieucempace	
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Duta i number	514-003 tributery of the Marduke	assessment				<u></u>
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Date of assessment	03/08/2020	Version of assessment	2		Document Data Source	
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EQG - Annual Average Con- Copper Step 2 5.05 Tier I fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. 4.12 Step 3 Tier I fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	Zinc       2.78       0.84	Asute Impast Copper Zinc Pass Pass	Pass           Sediment deposition for this site           Accumulating?           Yes         0.00           Extensive?	<b>is judged as:</b> Low flow Vel m <i>is</i> Deposition Index	
Road number	Lower Thames Crossing	HE Area / DBFO number			Predict Impact
Assessment type	Non-cumulative assessment (single outfall)			· -	- roue compact
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EA receiving water Detailed River Network ID		Assessor and affiliation	LD		Reset interface
Date of assessment	03/08/2020	Version of assessment	2		Document Data Source
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Step 1 Runoff Quality				(	Groundwater Assessment
AADT >10,000 and <50	Climatic region Warm	Dry Rainfall site	London (SAAR 800mm)	•	R eset Workbook
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