

Lower Thames Crossing

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

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Lower Thames Crossing

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.
 - 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.

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

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 ecological 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)

- 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:
 - 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.

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_{dissolved} and Copper_{bioavailable} 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.

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
S08-001/8-002 West Tilbury Main SW07028	Runoff fails toxicity test	EQS: Copper (5.26µg/l) – Fail Zinc (7.12µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass Sediment – Fail
S10-001 Gobions Sewer MUCKY030	Runoff fails toxicity test	EQS: Copper (5.40µg/l) – Fail Zinc (4.95µg/l) – Pass Acute impact: Copper – Fail Zinc – Fail Sediment – Fail
S11-001 Unnamed tributary of the Mardyke AN-MD02	Runoff fails toxicity test	EQS: Copper (8.33µg/l) – Fail Zinc (12.57µg/l) – Fail Acute impact: Copper – Fail Zinc – Pass Sediment – Fail

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 Unnamed tributary of the Mardyke AN-MD05	Runoff fails toxicity test	EQS: Copper (4.09µg/l) – Fail Zinc (0.21µg/l) – Pass Acute impact: Copper – Pass Zinc – Pass Sediment – Pass
S14-003 Unnamed tributary of the Mardyke AN-MD05	Runoff fails toxicity test	EQS: Copper (5.64µg/l) – Fail Zinc (5.80µg/l) – Pass Acute impact: Copper – Fail Zinc – Pass Sediment – Fail
S14-005 Unnamed tributary of the Mardyke AN-MD05	Runoff fails toxicity test	EQS: Copper (5.05µg/l) – Fail 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.

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		
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

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	·		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 EQS pass/fail Copperbioavailable (µg/I)* 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**

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.

Pass

Pass

Pass

0.106

0.116

0.109

- 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

S14-002

S14-003

S14-005

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

Outfall IDs & receiving watercourse	Location of cumulative Assessment Point	Step 2 – In-river impact	Step 3 – Following mitigation	M-BAT bioavailable copper concentration (µg/I)
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:
 - 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.

Table 4.5 Summary of accidental spillage risk calculations

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	-

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.

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
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

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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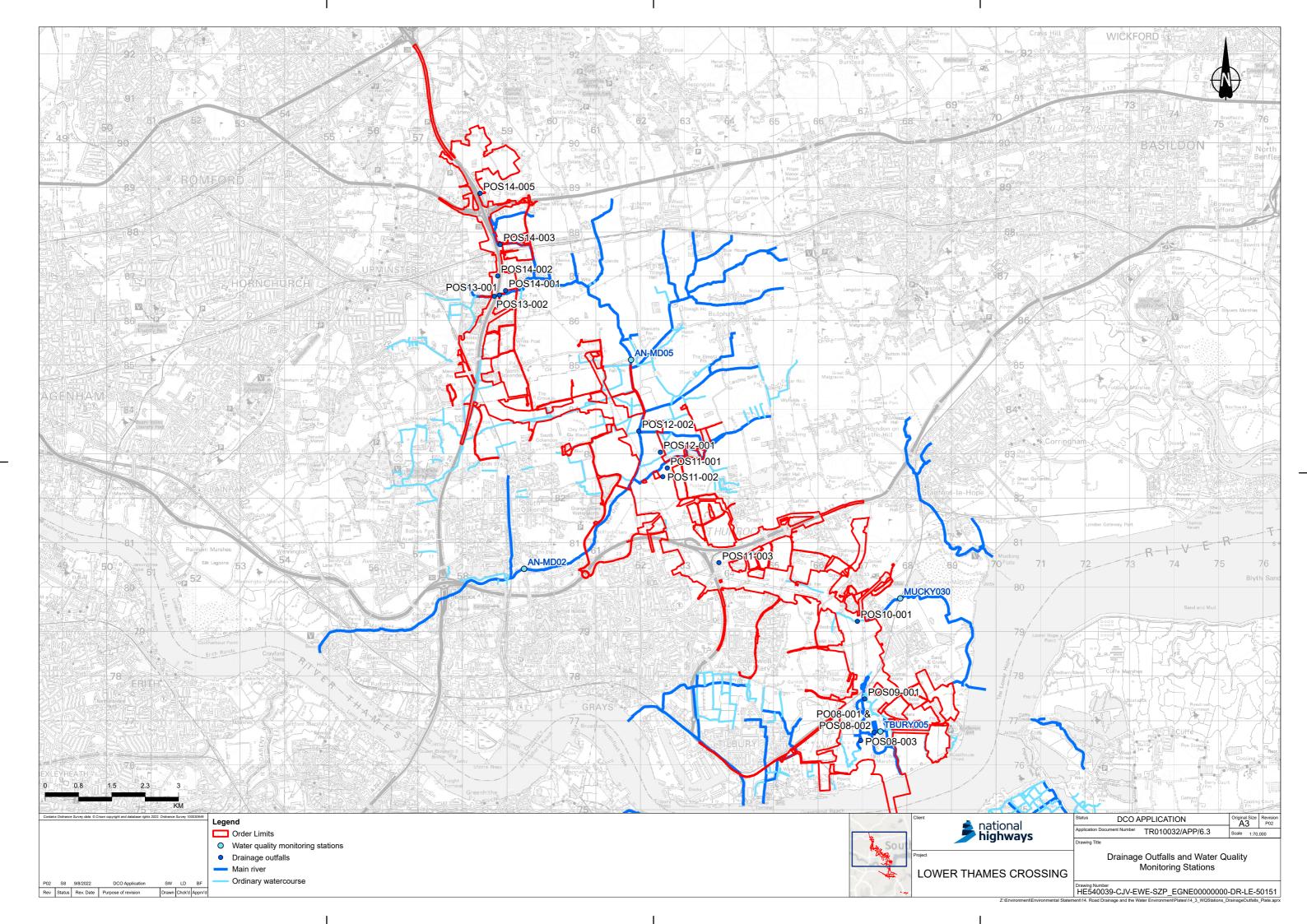
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Annexes

Annex A Outfalls Drawing



Annex B HEWRAT and M-BAT Results

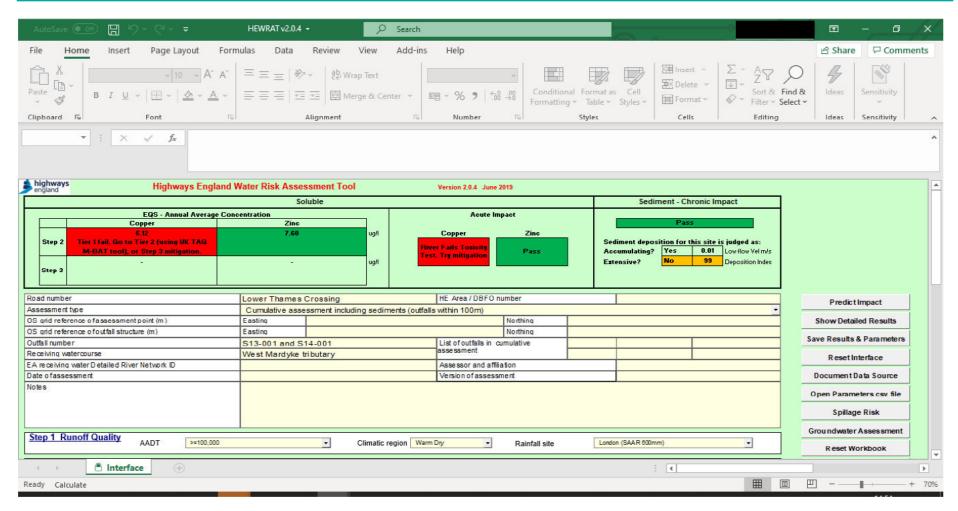
Metal Bioavailability Assessment Tool (M-BAT)

Back Calculate

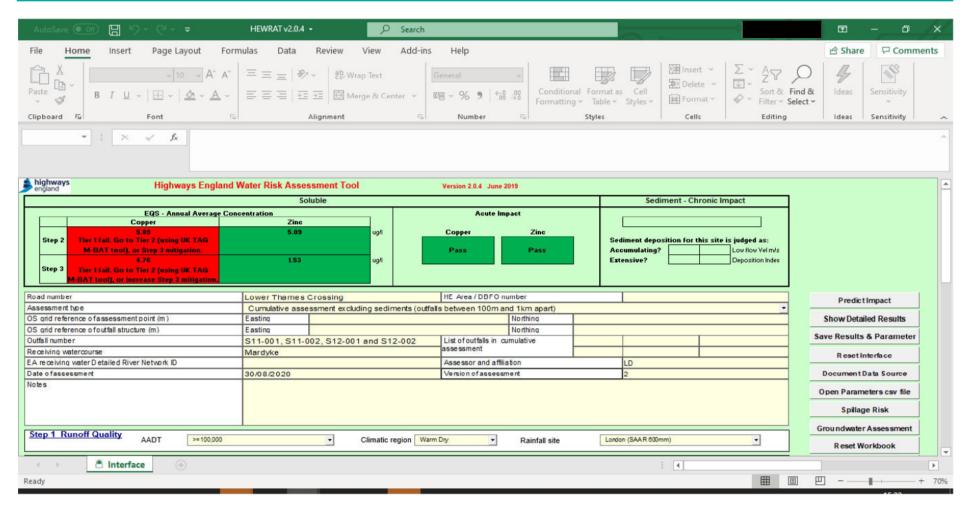
Clear Data

		IN	PUT DATA								RESU	LTS (Copper)	
ID	Location	₩aterbody	Date	Concentration	Concentration	Measured Mn Concentration (dissolved) (µg I ⁻¹)	рН	DOC	Ca	Site-specific PNEC Dissolved Copper (µg l ⁻¹)	BioF	Bioavailable Copper Concentration (µg l ⁻¹)	Risk Charaoterisation Ratio
	1 S8-001	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
:	S11-002	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
	5 S12-002	Mardyke	18.05.22	4.19			7.49	8.81	97.72	40.76	0.02	0.10	0.10
- 1	S13-001	Mardyke west tributary	18.05.22	4.17			7.67	8.81	97.72	37.62	0.03	0.11	0.11
	7 S13-002	Mardyke west tributary	18.05.22	3.8			7.67	8.81	97.72	37.62	0.03	0.10	0.10
	S14-001	Mardyke west tributary	19.05.22	4.03			7.67	8.81	97.72	37.62	0.03	0.11	0.11
	9 S14-002	Mardyke west tributary	19.05.22	4.01			7.67	8.81	97.72	37.62	0.03	0.11	0.11
1	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 <u>S14-005</u>	Mardyke tributary	19.05.22	4.12			7.67	8.81	97.72	37.62	0.03	0.11	0.11
1.	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
1-	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
1	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

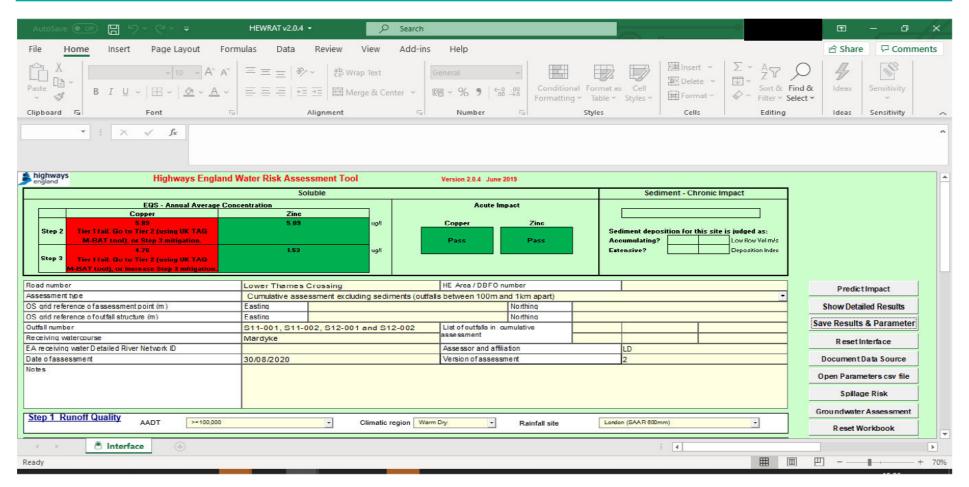
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		C	EQS - Annual Ave	rage Concer	entration Zinc				Acute Impact			Pass		
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	C Tier 2 Bed width (m) 3 Manning's n 0.07 Side slope (m/m) 0.5 Long slope (m/m) 0.0001													
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E	Existing n	neacures						0	D	No restriction -	D 0	D		
- H	Commence of	measures	filter drains, pond with	n sediment fo	rebay and wetland			0		No restriction -	D 90			
	Proposed	measures	filter drains, pond with	n sediment fo	rebay and wetland			0	D	No restriction -	D 90			



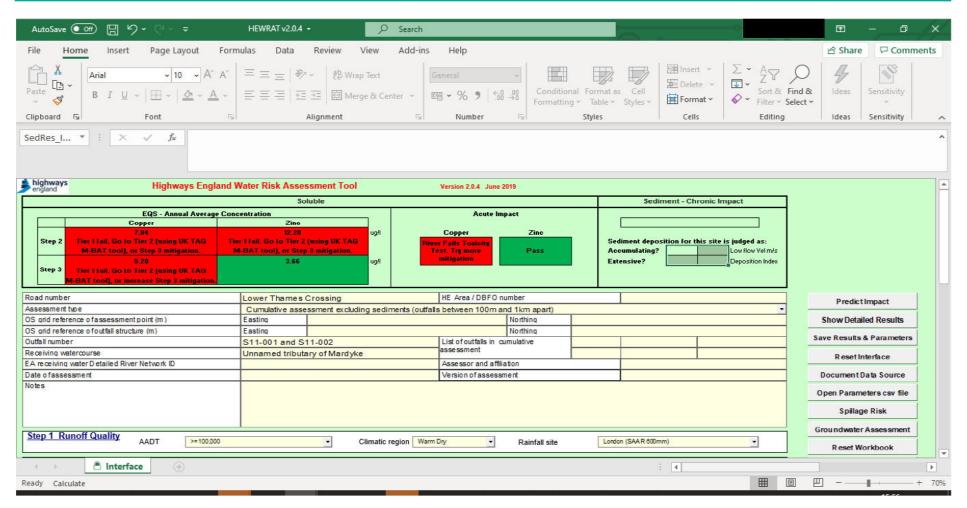
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Annual Q ₉₅ river flow (m³/s) (Enter zero in Annual Q ₉₅ river flow box to assess Step 1 runoff quality only) Base Flow Index (BFI) Annual Q ₉₅ river flow (m³/s) Impermeable road area drained (ha) 22.8 Bioavailable dissolved copper (μg/l) Bioavailable dissolved zinc (μg/l) Bioavailable dissolved zinc (μg/l) Impermeable area draining to outfall (ha) Comparison of a protected site for conservation?	Stan 2 Diver Impacts										
river flow box to assess Step 1 runoff quality only) Permeable area draining to outfall (ha) Base Flow Index (BFI) Description: Bioavailable dissolved zinc (µg/l) Is the discharge in or within 1 km upstream of a protected site for conservation?	Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.006	Freshwater EQS limits:						
Step 1 runoff quality only) Permeable area draining to outfall (ha) Base Flow Index (BFI) Description: Bioavailable dissolved zinc (µg/l) Is the discharge in or within 1 km upstream of a protected site for conservation?		Impermeable road area drained	(ha)	22.8	Bioavailable dissolved	l copper (μg/l)		1 D			
		Permeable area draining to outf	all (ha)	23.021	Bioavailable dissolved zinc (µg/l)						
For dissolved zinc only Water hardness High = >200mg CaCO3/I For dissolved copper only Ambient background concentration (μg/l) 3.795		Base Flow Index (BFI)		0.29	Is the discharge in or within 1 km upstream of a protected site for conservation?						
Tot dissorted copper only Ambient background concentration (µg/r)	For dissolved zinc only	Water hardness	High = >200mg CaCO3/I		For dissolved copper of	nly Ambient bac	karound conce	entration (ug/l)	3 795		
	Tot dissolved Line only	Water hardness High = >200mg CaCO3/I									
For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?	For sediment impact only										
© Tier 1 Estimated river width (m) 5			width (m)	5							
© Tier 2 Bed width (m) 3 Manning's n 0.07 Side slope (m/m) 0.5 Long slope (m/m) 0.0001		© Tier 2 Bed width (m)		3 Man	ning's n 0.07	Side slo	pe (m/m)	0.5 Long sle	ope (m/m) 0.0001		
		200 1100 T				0.903000					
Step 3 Mitigation	Step 3 Mitigation					P					
Estimated effectiveness	Stop o imaganor.										
Treatment for solubles - Settlement of solubles (%) restricted discharge rate (l/s) sediments (%)			5	The state of the s							
Brief description Solubles (%) restricted discharge rate (1/s) sediments (%)			Brief description		Solubles (70) Testill	otou discriaryo rate (Jacolini	(70)			
	Existing measures				70 No re	estriction -	D 0	D			
Existing measures 70 No restriction - 0 0 D	Proposed measures	filter drains, pond with sediment fore	bay and wetland		70 No re	estriction	D 0	D			

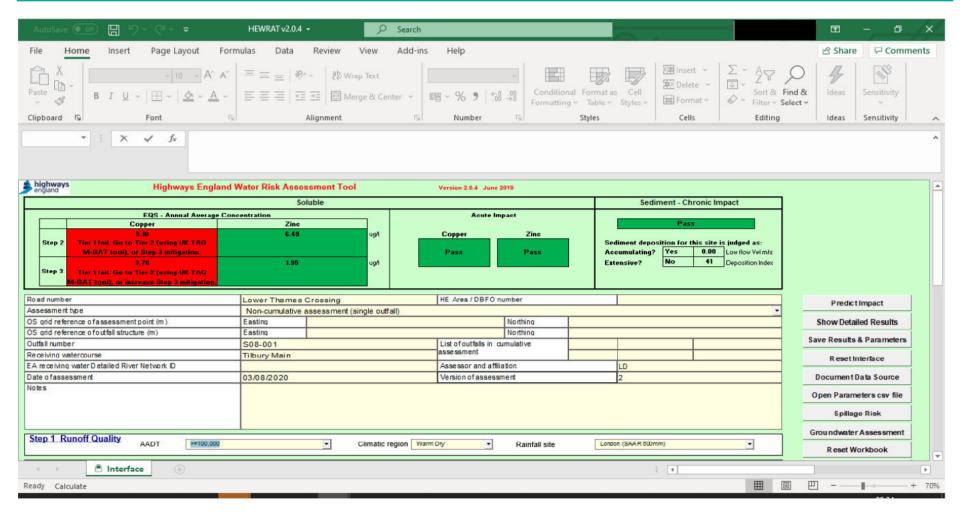


highways england	Highways England Water Risk Assessment Tool Version 2.0.4 June 2019												
So					uble						Sediment - C	hronic Impact	
EQS - Annual Average Concer							Acute Impact						
Copper 6,40			Zinc				©						
			5.47		ug/l	-	Copper	Zinc		di			
Step 2		or Step 3 mitigation						Pass	Pass		diment deposition for this s cumulating?	Low flow Vel m/s	
	III-DAT TOOI),	5.19		1.64		ug/l		1 433	1 433	30.00	tensive?	_Deposition Index	
Step 3	Tier 1 fail. Go t	to Tier 2 (using UK T			7-244-7	Si.							
	M-BAT tool), or in												
Road number	ar.			Lower Thames	Crossing			HE Area / DBFO n	umher				
The second secon						dina co	dimente (or	PRINCIPLE STATE OF THE STATE OF) art \			
OS grid reference of assessment point (m)				Cumulative assessment excluding sedin			difficitis (of	ilians between 10					
				Easting				Northing Northing					
OS grid reference of outfall structure (m) Outfall number			Lasting				Northing List of outfalls in cumulative S11-001			S11-002 S12-001			
Receiving watercourse			Mardyke				List of outfalls in cumulative S11-001 assessment S12-002			311-002	312-001		
EA receiving water Detailed River Network ID				Waltuyke				Assessor and affiliation			LD		
Date of asse	And the last of th	VerticeWork is	19/05/2022	-		sion of assessment							
					sessment updated to reflect revised drainage catchments and traffic model CS67 2045								
Step 2 Rive	er Impacts	ngasaranangang pangga											
	^	Annual Q ₉₅ rive	r flow (m³/s)		0.0	377	Freshv	vater EQS limits:					
(Enter zero ir	n Annual Q ₉₅	Impermeable ro	oad area drained	d (ha)	a) Bioavailable dissolved copper (μg/l)								
river flow box		D		15 (15)		F4	3.						
Step 1 runoff	quality only)	Permeable area draining to outfall (ha)			45.	.51	Bioavailable dissolved zinc (μg/l)						
		Base Flow Inde	ex (BFI)	0.283			Is the dis	scharge in or within 1	km upstream of a p	protected site for	d site for conservation?		
For dissolve	ed zinc only	Water hardness	s	High = >200mg CaCO3	/1	-	For	dissolved copper	only Ambient b	oackground con	ncentration (µg/l)	4.88	
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 🔻 D						
ACCULARMAGE DE LA MARCA CALANTA CALANT													
		© Tier 2	Bed width (m)		.3		Manning's n	0.07	Side	slope (m/m)	0.5 Long sl	ope (m/m) 0.0001	
Step 3 Miti	action											-	
Step 3 Milli	gation							E:	stimated effectiven	ess			
									tenuation for solut		ttlement of		
			·	Brief description	·		SOI	ubles (%) restr	icted discharge rat	e (I/S) sedi	iments (%)		
Existing me	asures						0	D Nor	estriction	D 0	D		
Proposed n		filter drains, pond	d with sediment for	rebay and wetland			70				D		
	A STATE OF THE STA			and the second s					veneral control (Control (Cont				



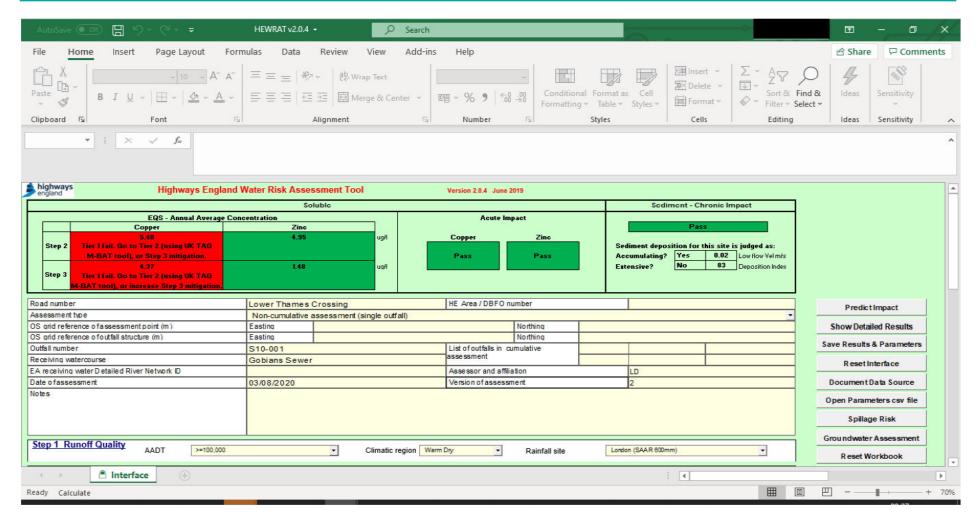
highways england Water Risk Assessment Tool Version 2.0.4 June 2019											
			S	oluble					Sediment - Ch	ronic Impact	
		EQS - Annual Average	Concentration		Acute Impact						
		Copper	Zinc								
		8.65	13.76			Copper	Zinc				
Step 2	7752 27727 7 A	Tier 2 (using UK TAG	**************************************	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.		Fails Toxicity Test.	20	1000	ediment deposition for this sit	te is judged as: Low flow Vel m/s	
	M-BAT tool),	or Step 3 mitigation.	M-BAT tool), or Ste	Acres 1	Try	more mitigation	Pass		ccumulating?	Deposition Index	
Step 3	Tier 1 fail. Go to	Tier 2 (using UK TAG	4.13	ug/l				EX	ttelisiver	Deposition index	
		crease Step 3 mitigation.	o.								
Road number Lower Thames Crossing HE Area / DBFO number											
	Table (1)		Lower Thame			THE RESIDENCE OF THE PROPERTY OF THE PARTY O	MONTH OF THE PARTY				
Assessmer	C. C		5612100_1000002501310000000	sessment excluding s	ediments (o	utfalls between 1	Control of the Contro	art)		La constant de la con	
	ference of assessme	.0. 10. 0.	Easting			Northing					
	ference of outfall stru	ıcture (m)	Easting				Northing	,			
Outfall nun	175794,077					List of outfalls in cumulative S11-001			S11-002		
	watercourse	****	Tributary of th	e Mardyke		GALLACTIC OF PRINCIPAL AND A STATE OF THE ST					
	g water Detailed Riv	er Network ID				Assessor and affili			LD		
Date of ass	sessment		19/05/2022	/05/2022 Version of assessment							
Notes	Assessment updated to reflect revised drainage catchments and traffic model CS67 2045										
Step 2 River Impacts Annual Q ₉₆ river flow (m³/s) O.00401 Freshwater EQS limits:											
	o in Annual Q ₉₅ box to assess	Impermeable road area	drained (ha)	55.06]	Bioavailable dissolv	ed copper (μg/l)		1 D		
	off quality only)	Permeable area drainin	g to outfall (ha)	35.861]	Bioavailable dissolved zinc (μg/l)					
		Base Flow Index (BFI)		0.379	0.379 Is the discharge in or within 1 km upstream of a protected site for conservation?						
For disso	lved zinc only	Water hardness	High = >200mg CaC	03/1] F	or dissolved copper	only Ambient	background co	oncentration (µg/l)	4.88	
For sedim	nent impact only	Is there a downstream s	structure, lake, pond or car	al that reduces the velocity	within 100m o	f the point of dischar	ge?		No 🔻 D		
			ted river width (m)	5	1						
]						
		© Tier 2 Bed wid	dth (m)	3	Manning's n	0.07	Side	slope (m/m)	0.5 Long slo	ope (m/m) 0.0001	
Step 3 M	litigation										
							Stimated effectiver				
							Attenuation for solu tricted discharge ra		ettlement of diments (%)		
			Brief description			old Dies (70)	meted discharge ra	10 (113)	difficilts (70)		
Existing r	measures				0	D No	restriction -	D 0	D		
	d measures	filter drains, pond with sed	liment forebay and wetland		70	No	restriction -	D 0	D		
			A THE STATE OF THE								

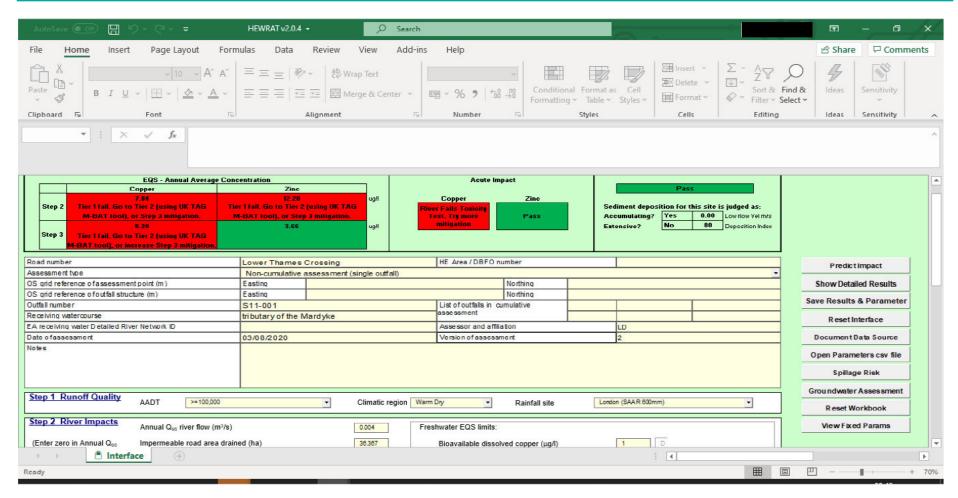


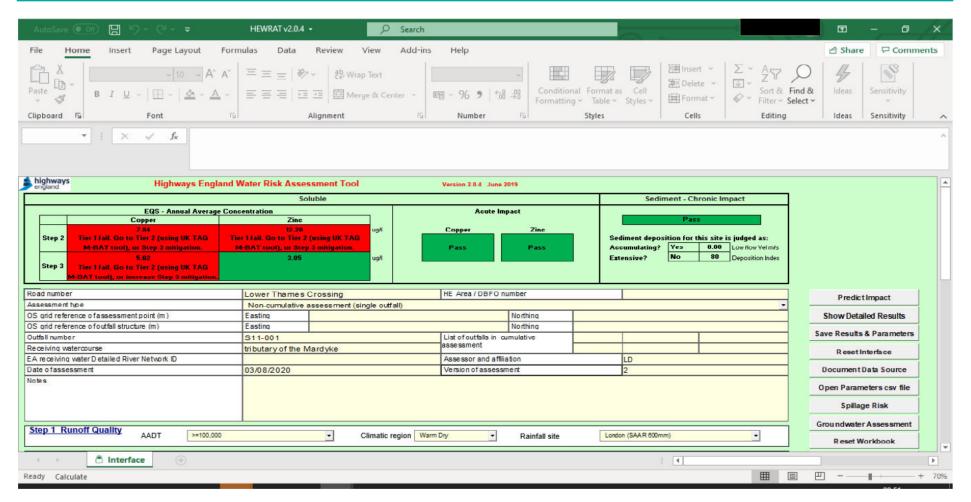


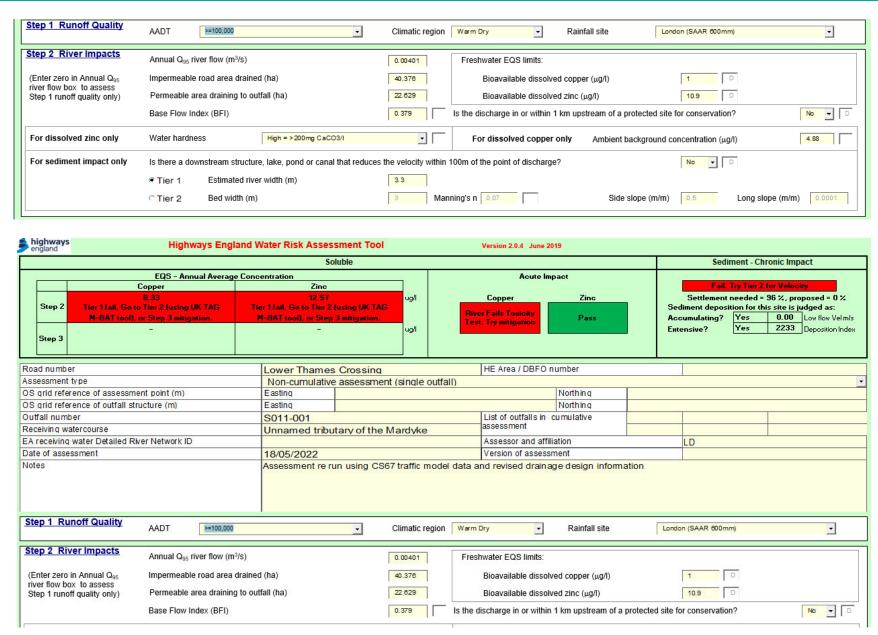
Step 1 Runoff Quality	AADT	>=100,000		-	Climatic reg	gion Wa	rm Dry	Rainfall site	Londo	on (SAAR 600mm)	T
Step 2 River Impacts											
Step 2 Kiver impacts	Annual Q ₉₅ riv	er flow (m³/s)			0.00434	Fi	eshwater EQS limits:				
(Enter zero in Annual Q ₉₅	Impermeable	road area drain	ed (ha)		9.994		Bioavailable dissolv	ed copper (µg/l)		1 D	
river flow box to assess Step 1 runoff quality only)	Permeable are	ea draining to o	utfall (ha)		5.731		Bioavailable dissolv	ed zinc (µg/l)		10.9 D	
	Base Flow Ind	dex (BFI)			0.848	Is th	Is the discharge in or within 1 km upstream of a protected site for conservation?				
For dissolved zinc only	Water hardnes	ss	High = >200mg CaCO3	VI	-		For dissolved copper only Ambient background concentration (µg/l) 3.33				
For eadiment impact only	la thana a daw		lake mand as annul	h = t = = d		ithin 400m					
For sediment impact only			re, lake, pond or canal t	nai reduces i		iunin Toom	or the point or discharge	e?		No T	
	Tier 1	Estimated riv	rer wiath (m)		3.69						
	ି Tier 2	Bed width (m	1)		3	Manning'	s n 0.07	Side	slope (m/m)	0.5 Long s	slope (m/m) 0.0001
highways england	Highwa	ays England	Water Risk Assess	ment Tool			Version 2.0.4 June 20	119			
anglana.	1000	500	Sol	ıble						Sediment - C	hronic Impact
		ıal Average Cor		40.0			Acute Imp	pact			
	opper	100	Zinc 7.12					7.		Fail. Try Tier	
Step 2 Tier 1 fail. Go to	5.26 Tier 2 (using Ul	KTAG	7.12		ug/l	1	Copper	Zinc	Sec	settlement needed diment deposition for t	= 81 %, proposed = 0 % this site is judged as:
M-BAT tool), o	r Step 3 mitigat	tion.					Priver Fails Toxicity Sest. Try mitigation	Pass	3,675,633	cumulating? Yes	0.00 Low flow Vel m/s
Step 3	7				ug/l	1		*	Exte	ensive? Yes	500 Deposition Index
Зсер 3											
Road number			Lower Thames	Crossing			HE Area / DBFO n	umber	N.C.		
Assessment type			Non-cumulative		nt (single o	utfall)				I S	T.
OS grid reference of assessmer	nt point (m)		Easting					Northing			
OS grid reference of outfall stru	cture (m)		Easting					Northing		·	
Outfall number			S08-001/002				List of outfalls in	cumulative			
Receiving watercourse			West Tilbury Ma	ain			assessment				
EA receiving water Detailed Rive	er Network ID						Assessor and affili	ation		LD	
Date of assessment			18/05/2022				Version of assessr	ment		4	
Notes			Assessment re ru	n using CS	67 traffic m	odel dat	a and revised draina	ge design informa	tion		
Step 1 Runoff Quality	AADT	>=100,000			Climatic re	gion Wa	rm Dry 🔻	Rainfall site	Londo	on (SAAR 600mm)	•
Step 2 River Impacts											
	Annual Q ₉₅ riv				0.00434	F	reshwater EQS limits:				
(Enter zero in Annual Q ₉₅ river flow box to assess	Impermeable	road area drain	ed (ha)		9.994		Bioavailable dissolv	ed copper (μg/l)		1 0	
Step 1 runoff quality only)	Permeable ar	ea draining to o	utfall (ha)		5.731		Bioavailable dissolv	red zinc (μg/l)		10.9 D	
	Base Flow Inc	dex (BFI)			0.846	Is th	e discharge in or within	1 km upstream of a p	protected site fo	or conservation?	No 🔻 🗅

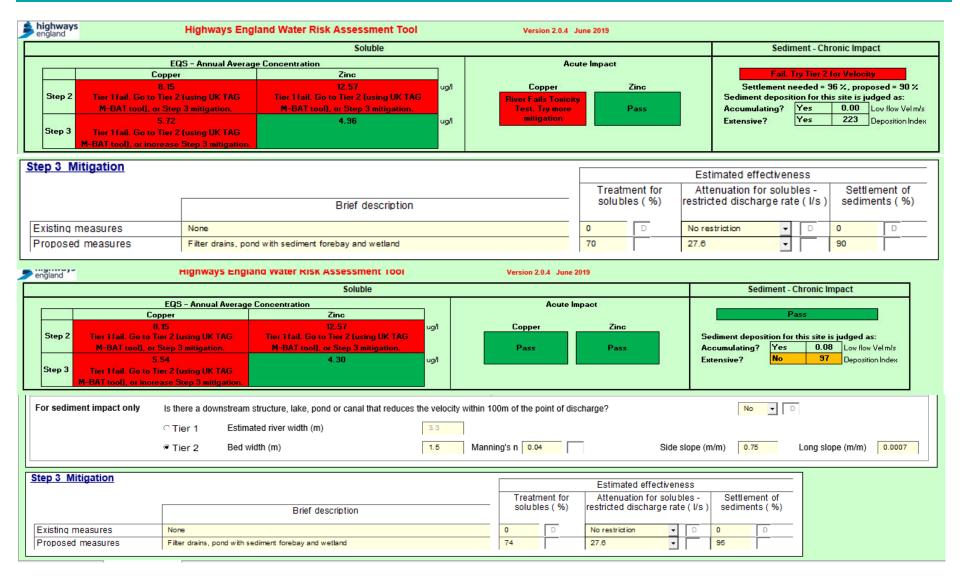
		Soluble					Sediment - Chronic Impact
	EQS - Annual Average Conce	entration			Acute Impact		
Со	pper	Zinc					Pass
Step 2 Tier 1 fail. Go to T	.63 ier 2 (using UK TAG Step 3 mitigation.	7.12	ug/l	Copper	Zine		Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Low flow Velm
Step 3 Tier 1 fail. Go to T	.10 ier 2 (using UK TAG ≥ase Step 3 mitigation.	4.33	ug/l				Extensive? No 53 Deposition Ind
							·
Step 3 Mitigation						Estimat	ed effectiveness
Step 3 Mitigation					Treatment for	Attenua	tion for solubles - Settlement of
Step 3 Mitigation		Brief description				Attenua	
Existing measures	None	Brief description			solubles (%)	Attenua	tion for solubles - discharge rate (l/s) Settlement of sediments (%)

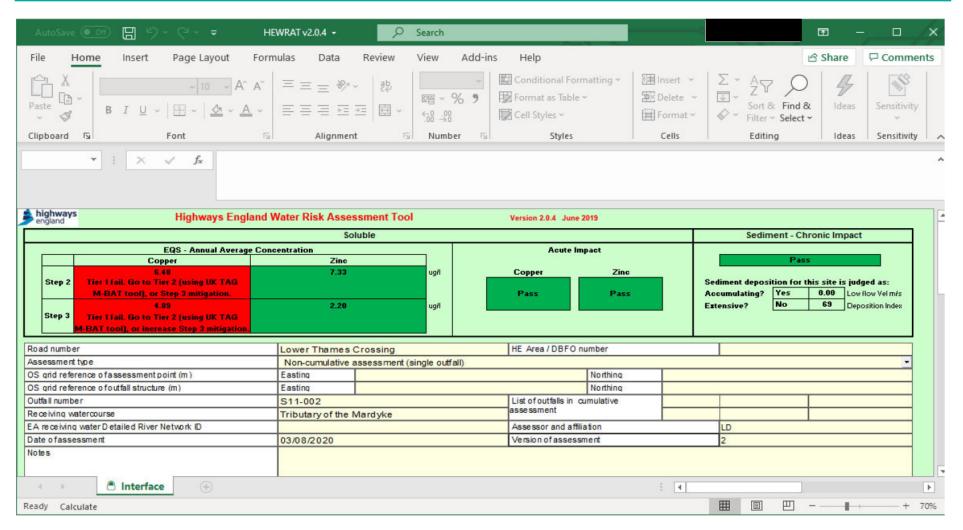






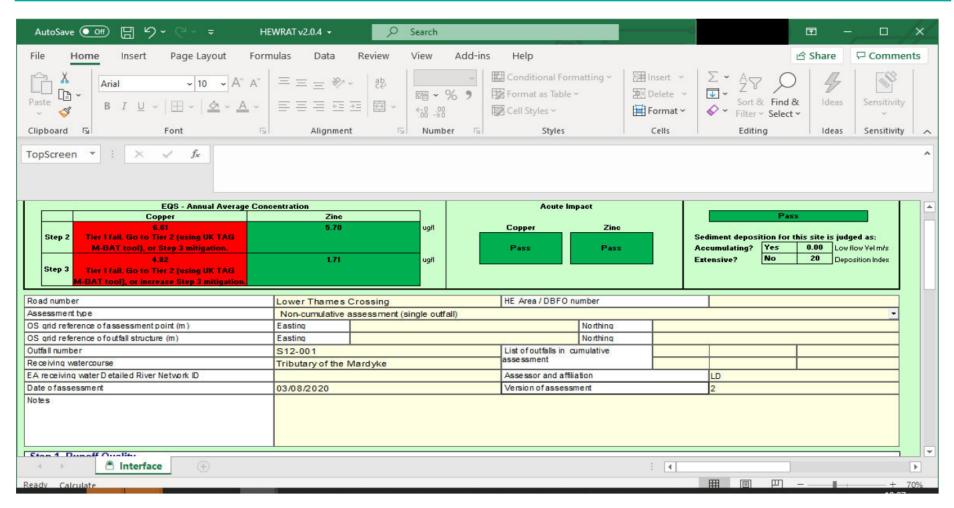






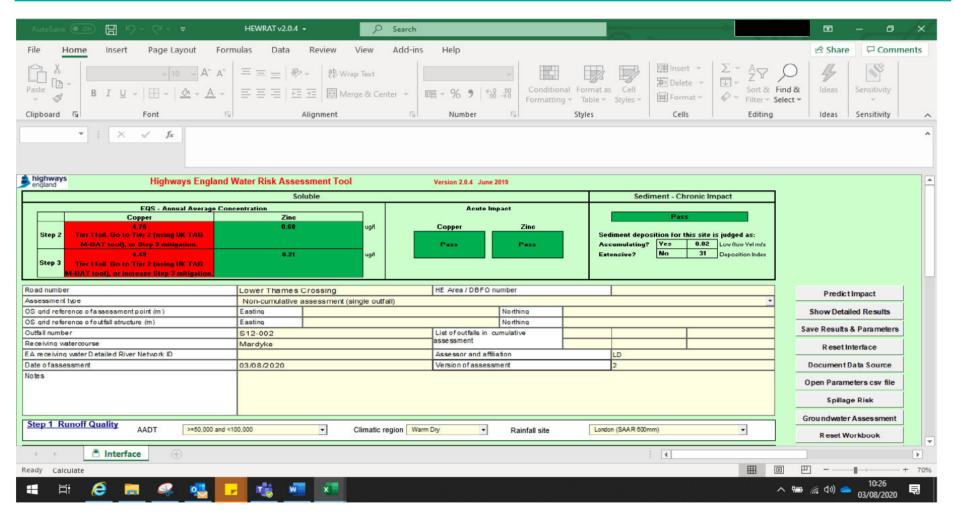
Step 1 Runoff Quality	AADT >=100,000	v	Climatic region	Warm Dry ▼ Rainfall site	London (SAAR 600mm)	1		
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.00401	Freshwater EQS limits:				
(Enter zero in Annual Q ₉₅	Impermeable road area drain	ed (ha)	14.684	Bioavailable dissolved copper (µg/l)	1			
river flow box to assess Step 1 runoff quality only)	Permeable area draining to o	utfall (ha)	13.232	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	<u> </u>	For dissolved copper only Ambient ba	ckground concentration (µg/l) 4.88			
For sediment impact only	Is there a downstream structu	re, lake, pond or canal that reduce	s the velocity within 1	00m of the point of discharge?	No v D			
		er width (m)	3.2					
	Tier 2 Bed width (m)	3 Manr	ning's n 0.07 Side s	lope (m/m) 0.5 Long slope (m/m) 0.000	01		
highways england	Highways England	Water Risk Assessment Too	ol	Version 2.0.4 June 2019				
		Soluble			Sediment - Chronic Impact			
	EQS - Annual Average Cor			Acute Impact				
Step 2 Tier 1 fail. Go t	Copper 7.04 o Tier 2 (using UK TAG or Step 3 mitigation.	Zine 7.91	ug/l	Copper Zinc River Fails Toxicity Test. Try mitigation	Fail. Try Tier 2 for Velocity Settlement needed = 88 %, proposed = 0 Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Low flow Velocity	: /el m/s		
Step 3	-	.	ug/l		Extensive? Yes 832 Deposition	Index		
Road number		Lower Thames Crossing	q	HE Area / DBFO number				
Assessment type		Non-cumulative assessm	nent (single outfall)				
OS grid reference of assessm		Easting		Northing				
OS grid reference of outfall st	ructure (m)	Easting		Northing				
Outfall number Receiving watercourse		S011-002	- M	List of outfalls in cumulative assessment				
EA receiving water Detailed Ri	iver Network ID	Unnamed tributary of th	ie Mardyke	Assessor and affiliation	LD			
Date of assessment	VCI IVCIWOR ID	18/05/2022		Version of assessment	LU			
Notes			CS67 traffic model	data and revised drainage design informati	on			
Step 1 Runoff Quality	AADT ≥=100,000		Climatic region	Warm Dry Rainfall site	London (SAAR 600mm)			
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.00401	Freshwater EQS limits:				
(Enter zero in Annual Q ₉₅	Impermeable road area drain	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 d	utfall (ha)	13.232	Bioavailable dissolved zinc (μg/l)	10.9 D			
	Base Flow Index (BFI)		0.379	Is the discharge in or within 1 km upstream of a pro	otected site for conservation?	D		

highways england	Highways England W	une 2019					
		Soluble				Sediment - Chronic Impact	
y	EQS - Annual Average Concentration			Acu	te Impact		
Сорр	oer	Zine				Pass	
7.0		7.91	ug/l	Copper Zinc Pass Pass			
Step 2 Tier 1 fail. Go to Tier M-BAT tool), or St						Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Low flow Vel m/s	
5.3	2	2.51	ug/l		Lineario	Extensive? No 83 Deposition Index	
Step 3 Tier 1 fail. Go to Tier	27 (1980)						
M-BAT tool), or increas	se Step 3 mitigation.						
Step 3 Mitigation						5-Virginia de Maria	
					Estimated effectiveness		
					Treatment for	Attenuation for solubles - Settlement of	
	Brief description				solubles (%)	restricted discharge rate (I/s) sediments (%)	
Existing measures	None				0	No restriction D D	
	None S Filter drains, pond with sediment forebay and wetland					25.2 - 90	



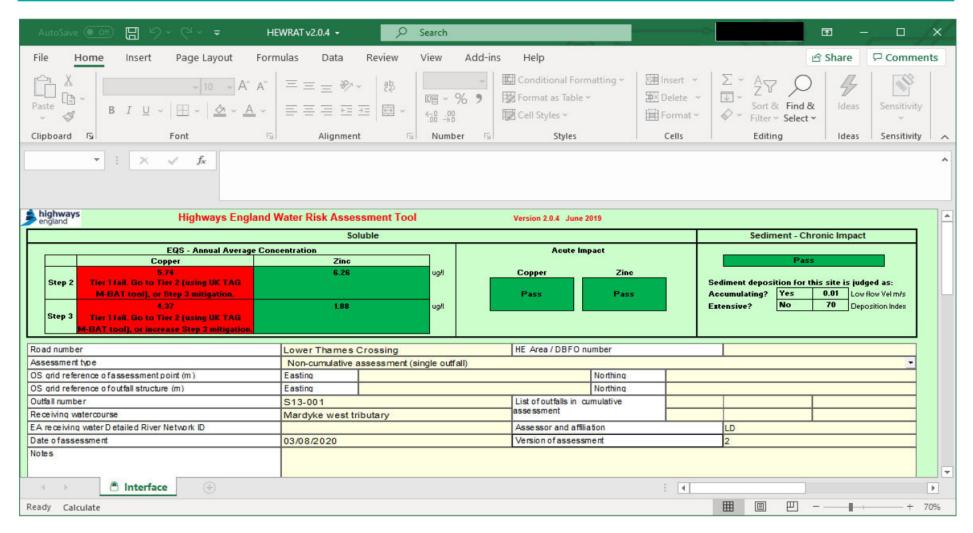
Assessment type Non-cumulative assessment (single outfall) OS grid reference of assessment point (m) Easting Sol grid reference of outfall structure (m) Easting Northing Northin									
(Enter zero in Annual O _{sc} Intermembel rend area drained (ha) 30.88 she in nord quality only) Base Flow Index (BF) Base Flow Index (BF) Base Flow Index (BF) For dissolved zinc only Water hardness High => 200mg CsCO381 For dissolved copper (ng/l) Is the discharge in or within 1 km upstream of a protected site for conservation? For dissolved zinc only Water hardness High => 200mg CsCO381 For dissolved copper only Ambient background concentration (ug/l) Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? For dissolved zinc only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? For dissolved copper only Tier 1 Estimated river width (m) Tier 2 Bed width (m) Base Flow Index (BF) Highways England Water Risk Assessment Tool Version 28.4 June 2819 For dissolved copper only Ambient background concentration (ug/l) Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? For dissolved zinc only Tier 1 Estimated river width (m) Tier 2 Bed width (m) Base Flow Index (BF) Highways England Water Risk Assessment Tool Version 28.4 June 2819 For dissolved copper only Amount of the point of discharge? For dissolved copper only Amount of the point of discharge? Note Index (BF) For dissolved copper only Amount of the point of discharge? For dissolved copper only Amount of the point of discharge? For dissolved copper only Amount of the point of discharge? For dissolved copper only Amount of the point of the Might of	Step 1 Runoff Quality	AADT >=50,000 and <100,	000	Climatic region	Warm Dry Rainfall site	London (SAAR 600mm) ▼			
For dissolved zinc only Water hardness Map = 200mp Cacodal For dissolved copper only Ambient background concentration (µgfl) 4.68 For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? # Tier 1 Estimated river width (m) 2.5 Eung slope (m/m) 2.5 Eung slope	(Enter zero in Annual Q ₉₅ river flow box to assess	Impermeable road area drained Permeable area draining to out		3.088	Bioavailable dissolved copper (µg/l) Bioavailable dissolved zinc (µg/l)	10.9			
For sediment impact only Is there a downstream structure, take, pond or canal that reduces the velocity within 100m of the point of discharge? * Tier 1 Estimated river width (m) * Tier 2 Bed vidth (m) * Tier 2 Bed vidth (m) * Side slope (m/m)	For discolved zine only	Water bardness	High = 2 200 C = COOM						
* Tier 1 Estimated river width (m) Tier 2 Bed width (m) ** Non-cumulating assessment point (m) ** Side slope (m/m) ** Sediment 4-position of this side is placed as: ** Sediment 4-position for this side is placed as: ** Sediment 4-position for this side is placed as: ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as: ** Accumulating? ** Sediment 4-position for this side is placed as:	For dissolved zinc only	water naruness	ngn = >200mg C8CO3/1	<u> </u>	For dissolved copper only Ambient background concentration (µg/l) 4.88				
Highways England Water Risk Assessment Tool Soluble Sol	For sediment impact only	Is there a downstream structure	e, lake, pond or canal that reduces t	the velocity within 1	00m of the point of discharge?	No v			
Highways England Water Risk Assessment Tool Version 2.0.4 Jone 2019			r width (m)	2.5					
Soluble Copper Zinc Copper Zinc Copper Zinc Copper Zinc Settlement needed > 58 ×, proposed = 0 ×, Sedtlement deposition for this site is judged as Non-cumulating Yes 0.00 Lov flow Velm's Entensive? Yes 0.27 Deposition Index Sediment Chronic Impact Copper Zinc Settlement needed > 58 ×, proposed = 0 ×, Sediment deposition for this site is judged as Non-cumulating Yes 0.00 Lov flow Velm's Entensive? Yes 0.00 Lov flow Velm's Velm's 0.00 Lov flow Velm's		ି Tier 2 Bed width (m)		3 Mann	ing's n 0.07 Side slope	e (m/m) 0.5 Long slope (m/m) 0.0001			
Soluble Sequent - Chronic Impact EQS - Annual Average Concentration Copper Zinc T. II Step 2 Tier 1 fail. Go to Tier 2 (using IM TAG) H-BAT tool), or Step 3 mitigation. Step 3	🚅 highways	Highways England V	Vater Risk Assessment Tool		Version 2.0.4 June 2019				
EQS - Annual Average Concentration Copper Zinc Step 2 Ter 1 fall. Co to fier 2 fusing UK TAG M-BAT tool), or Step 3 mitigation. Step 3 Non-curnulative assessment type OS and reference of assessment point (m) Cost and reference of outfall structure (m) Cost affill reference	england				Version 2.5.4 Suite 2515	Sediment - Chronic Impact			
Copper Zinc Step 2 Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Step 3 Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Step 3 Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Step 3 Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 3 intigation Tier 1 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H. BAT tool), or Step 4 [ail. Go to Tier 2 (using UK TAG H.		FOS - Appual Average Conc			Acute Impact	Southern Silvering Impact			
Assessment type Non-cumulative assessment (single outfall) OS grid reference of assessment point (m) Easting Sol grid reference of outfall structure (m) Easting Northing Northin	Step 2 Tier 1 fail. Go to M-BAT tool), o	opper 7.10 Tier 2 (using UK TAG	Zinc		Copper Zinc River Fails Toxicity	Settlement needed = 56 %, proposed = 0 % Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Low flow Velm/s			
Assessment type Non-cumulative assessment (single outfall) OS grid reference of assessment point (m) Easting Northing OS grid reference of outfall structure (m) Easting Northing	Road number		Lower Thames Crossing		HE Area / DBFO number				
OS grid reference of outfall structure (m) Easting Outfall number S012-001 Receiving watercourse Unnamed tributary of the Mardyke EA receiving water Detailed River Network ID Date of assessment Notes Step 1 Runoff Quality AADT P=50,000 and <100,000 Climatic region Varm Dry Rainfall site London (SAAR 600mm) Telephone Step 2 River Impacts	Assessment type			nt (single outfall))	<u> </u>			
Outfall number Receiving watercourse Unnamed tributary of the Mardyke EA receiving water Detailed River Network ID Date of assessment Notes Step 1 Runoff Quality AADT Step 2 River Impacts List of outfalls in cumulative assessment List of outfalls in cumulative assessment Assessor and affiliation LD Version of assessment Version of assessment Rainfall site London (SAAR 600mm) Rainfall site London (SAAR 600mm) Telephone Receiving water Detailed River Network ID Assessor and affiliation LD Rainfall site London (SAAR 600mm) Telephone Step 2 River Impacts	OS grid reference of assessmer	nt point (m)							
Receiving water course EA receiving water Detailed River Network ID Date of assessment Notes Step 1 Runoff Quality AADT >=50,000 and <100,000 Climatic region Warm Dry Rainfall site London (SAAR 600mm) Receiving water course Assessment Assessment Version of assessment Version of assessment Rainfall site London (SAAR 600mm) The property of the Mardyke Assessment Assessment Climatic region Warm Dry Rainfall site London (SAAR 600mm) The property of the Mardyke Assessment Assessment Climatic region Warm Dry Rainfall site London (SAAR 600mm)	OS grid reference of outfall stru	cture (m)	Easting		Northing				
Step 2 River Impacts Unnamed tributary of the Mardyke Assessor and affiliation LD Assessor and affiliation LD Assessment Version of assessment Assessment 18/05/2022 Version of assessment Assessment 28/05/2022 Version of assessment Climatic region Warm Dry Rainfall site London (SAAR 600mm) Step 2 River Impacts	Outfall number		S012-001						
Date of assessment Notes Assessment re run using CS67 traffic model data and revised drainage design information Step 1 Runoff Quality AADT AADT AADT AADT AADT Climatic region Warm Dry Rainfall site London (SAAR 600mm) T	Receiving watercourse		Unnamed tributary of the	Mardyke	assessment				
Assessment re run using CS67 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	EA receiving water Detailed Rive	er Network ID			Assessor and affiliation	LD			
Step 1 Runoff Quality AADT P=50,000 and <100,000 Climatic region Warm Dry Rainfall site London (SAAR 600mm) Step 2 River Impacts	Date of assessment				TO STATE OF THE ST				
AAD1 2=50.000 and < 100.000	Notes		Assessment re run using CS	67 traffic model o	data and revised drainage design information				
Step 2 River Impacts Annual Over river flow (m ³ /s) Freshwater FOS limits:	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 ₉₅ river flow (m ³ /s)		0.00023	Freshwater EQS limits:				
	(Enter zero in Appual O		I (ha)						
(Enter zero in Annual Q ₉₅ Impermeable road area drained (ha) river flow box to assess Step 1 runoff quality only) Permeable area draining to outfall (ha) Bioavailable dissolved copper (μg/l) Bioavailable dissolved zinc (μg/l) 10.9 Display a line of the line of t	river flow box to assess			ARRONGE NO.					
	Step 1 fulloli quality only)	Base Flow Index (BFI)	ion (no.)		s the discharge in or within 1 km upstream of a protect	A 1901 APOLITICAL TO THE PARTY OF THE PARTY			
		Zazo i ion maox (Di i)			2 2.2 2.2 3.2 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1				

		Soluble		A.				Sediment - Chron	nic Impact
<u> 20</u>	EQS - Annual Average Conce	entration		Acute Impact			100		
	Соррег	Zinc	i i	1477 (CALC) ** 03-4500				Pass	
Step 2 Tier	7.09 1 fail. Go to Tier 2 (using UK TAG	5.97	ug/l	Copper	Copper Zinc Pass Pass		Sadiment de	Sediment deposition for this site is judged as:	
50 5000	BAT tool), or Step 3 mitigation.			Pass			Accumulatin		0.00 Low flow Vel m/s
	5.22 1.82 ug/l			· U	Extensive?	Extensive? No 23 Deposition Index			
Step 3 Tier 1 fail. Go to Tier 2 (using UK TAG									
YARRY WINDOW	tool), or increase Step 3 mitigation.								
M-BAT	tool), or increase Step 3 mitigation.						Estimated eff	ectiveness	
V2000 000 000 000 000 000 000 000 000 00	tool), or increase Step 3 mitigation.				Treatmo	ent for	Estimated effort		Settlement of
M-BAT	tool), or increase Step 3 mitigation.	Brief description			Treatmosolu ble			r solubles -	
M-BAT	tion	Brief description					Attenuation fo	r solubles -	

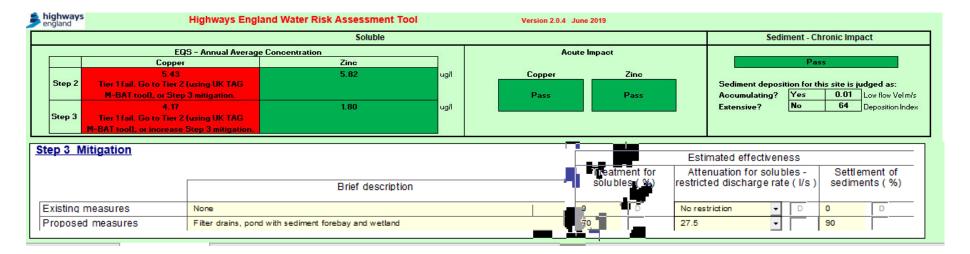


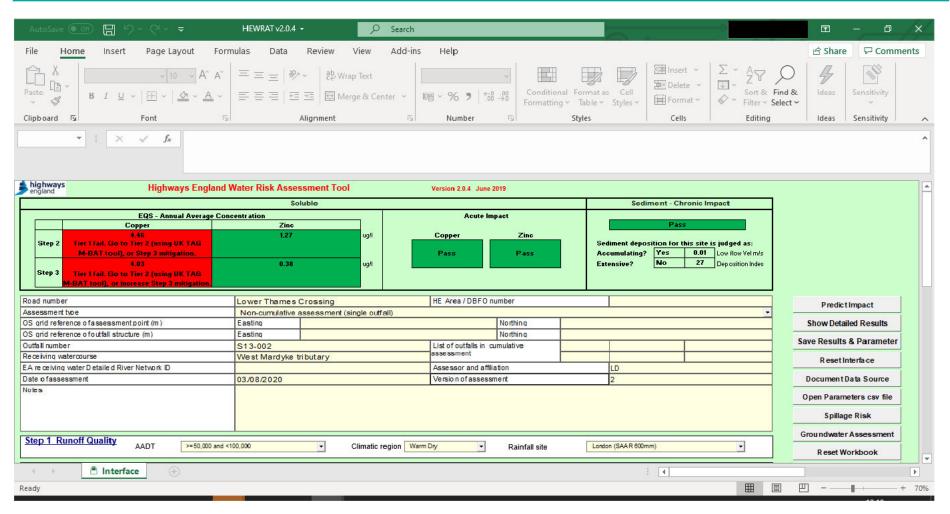
Step 1 Runoff Quality	AADT >=50,000 and <100,	000 _▼	Climatic region	Warm Dry Rainfa	all site L	London (SAAR 600mm)	v	
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.0377	Freshwater EQS limits:				
(Enter zero in Annual Q ₉₅	Impermeable road area drained	i (ha)	15.978	Bioavailable dissolved copper	(μg/l)	1		
river flow box to assess Step 1 runoff quality only)	Permeable area draining to out	fall (ha)	9.649	Bioavailable dissolved zinc (μ	n/l)	10.9		
Step 1 fullon quality only)	Base Flow Index (BFI)	(10)	0.283			100	No ▼ □	
	base riow ilidex (Bri)		0.263	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	d concentration (μg/l)	4.88	
For sediment impact only	Is there a downstream structure	e, lake, pond or canal that reduces	the velocity within	100m of the point of discharge?		No ▼ D		
		r width (m)	6					
	Tier 2 Bed width itii)		3 Man	ning's n 0.07	Side slope (m/n	n) 0.5 Long s	lope (m/m) 0.0001	
highways england	Highways England	Water Risk Assessment Too	ol	Version 2.0.4 June 2019				
		Soluble				Sediment - Ch	ronic Impact	
	EQS - Annual Average Cor			Acute Impact				
	Copper 5.19	Zinc 0.76	ug/l	Copper Zii		Fail. Try Tier 2	for Velocity 72 %, proposed = 0 %	
Step 2 Tier 1 fail. Go	to Tier 2 (using UK TAG	0.10	agii			Sediment deposition for th	is site is judged as:	
M-BAT tool)), or Step 3 mitigation.	2	ug/l	Pass Pa	iss	Accumulating? Yes Extensive? Yes	0.02 Low flow Vel m/s 352 Deposition Index	
Step 3			ugii	ie in the second se		Extensive:	Depositioning	
Road number		Lower Thames Crossing	,	HE Area / DBFO number	<u> </u>			
Assessment type		Non-cumulative assessme	·	III)	99	107		
OS grid reference of assessn	nent point (m)	Easting		Northin				
OS grid reference of outfall s	tructure (m)	Easting		Northin				
Outfall number		S012-002		List of outfalls in cumulativ assessment	e			
Receiving watercourse EA receiving water Detailed F	Diver Network ID	Mardyke		Assessor and affiliation		LD		
Date of assessment	(NET INELWOLK ID	18/05/2022		Version of assessment		LU		
Notes			S67 traffic mode	I data and revised drainage desig	n information			
		~						
4								
Step 1 Runoff Quality								
	AADT >=50,000 and <10	0,000	Climatic region	Warm Dry ▼ Rainf	all site L	London (SAAR 600mm)	<u> </u>	
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.0377	Freshwater EQS limits:				
(Enter zero in Annual Q ₉₅	Impermeable road area drain	ed (ha)	15.978	Bioavailable dissolved coppe	r (ug/l)	1 D		
river flow box to assess Step 1 runoff quality only)	Permeable area draining to o		9.649	Bioavailable dissolved zinc (µ	9787 7 363	10.9 D		
City Francis quality only)	Base Flow Index (BFI)		0.283	Is the discharge in or within 1 km upst	20 80 80 80 80	100 I	No → D	
1 2								

		Soluble			(500.00m)	Sediment - Chronic Impact
	EQS - Annual Average Conce	entration		Acute	Impact	
	Copper	Zine				Pass
	5.18	0.76 uga	a l	Copper Zinc		-
Step 2 Tier 1 fail. Go to	Tier 1 fail. Go to Tier 2 (using UK TAG				1	Sediment deposition for this site is judged as:
	or Step 3 mitigation.			Pass	Pass	Accumulating? Yes 0.02 Low flow Vel m/s
THE PROPERTY AND ADDRESS OF THE PARTY AND ADDR	4.91	0.24 ug	8 <u> </u>			Extensive? No 35 Deposition Inde
CONTRACTOR NO. 100	o Tier 2 (using UK TAG					
M-BAT tool), or inc	crease Step 3 mitigation.					
	crease Step 3 mitigation.					
	crease Step 3 mitigation.					Entirected offsetiveness
	crease Step 3 mitigation.					Estimated effectiveness
	crease Step 3 mitigation.			F	Treatment for	Attenuation for solubles - Settlement of
	crease Step 3 mitigation.	Brief description				
	orease Step 3 mitigation.	Brief description				Attenuation for solubles - Settlement of
tep 3 Mitigation Existing measures	orease Step 3 mitigation.	Brief description			solubles (%) re	Attenuation for solubles - Settlement of

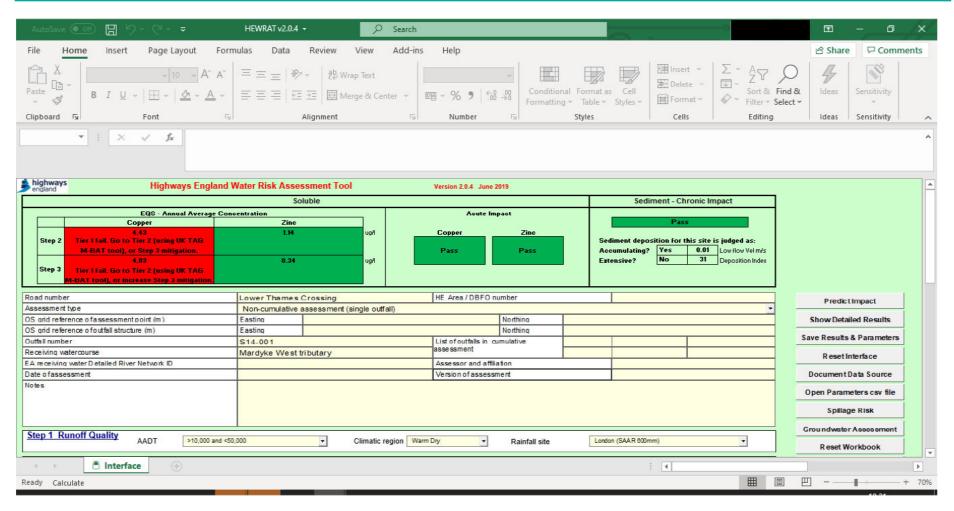


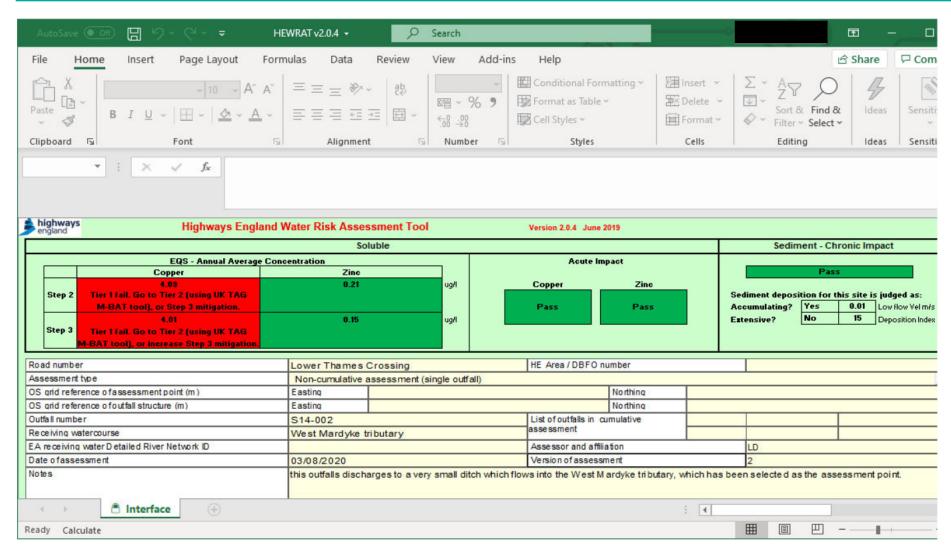
Step 1 Runoff Quality	AADT >=100,000	v	Climatic region	Warm Dry Rainfall site	London (SAAR 600mm)				
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.008	Freshwater EQS limits:					
(Enter zero in Annual Q ₉₅	Impermeable road area draine	ed (ha)	13.018	Bioavailable dissolved copper (µg/l)	1 0				
river flow box to assess Step 1 runoff quality only)	Permeable area draining to or	utfall (ha)	7.679	Bioavailable dissolved zinc (μg/l)					
	Base Flow Index (BFI)		0.29	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	<u> </u>	For dissolved copper only Ambient backg	round concentration (µg/l)				
For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?									
	▼ Tier 1 Estimated riv	er width (m)	3.5						
	Tier 2 Bed width (m)	3 Manni	ing'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. Try Tier 2 for Velocity				
Step 2 Tier 1 fail. Go to	5.44 o Tier 2 (using UK TAG or Step 3 mitigation.	5.82	ug/l	Copper Zinc River Fails Toxicity Test. Try mitigation Pass	Settlement needed = 85 %, proposed = 0 % Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel m/s				
Step 3	1.5.4)	ug/l		Extensive? Yes 637 Deposition Index				
Road number		Lower Thames Crossing		HE Area / DBFO number					
Assessment type		Non-cumulative assessmen	nt (single outfall)	1					
OS grid reference of assessme		Easting		Northing					
OS grid reference of outfall str	ucture (m)	Easting		Northing					
Outfall number Receiving watercourse		S013-001 Mardvke West Tributary		List of outfalls in cumulative assessment					
EA receiving water Detailed Riv	ver Network ID	Mardyke West Hibutary		Assessor and affiliation	LD				
Date of assessment		18/05/2022		Version of assessment					
Notes		Assessment re run using CS6	67 traffic model da	ata and revised drainage design information					
Step 1 Runoff Quality	AADT >=100,000	_	Climatic region V	Narm Dry Rainfall site	London (SAAR 600mm)				
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.006	Freshwater EQS limits:					
(Enter zero in Annual Q ₉₅	Impermeable road area draine	d (ha)	13.018	Bioavailable dissolved copper (µg/l)	1 D				
river flow box to assess Step 1 runoff quality only)	Permeable area draining to ou	itfall (ha)	7.679	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?				

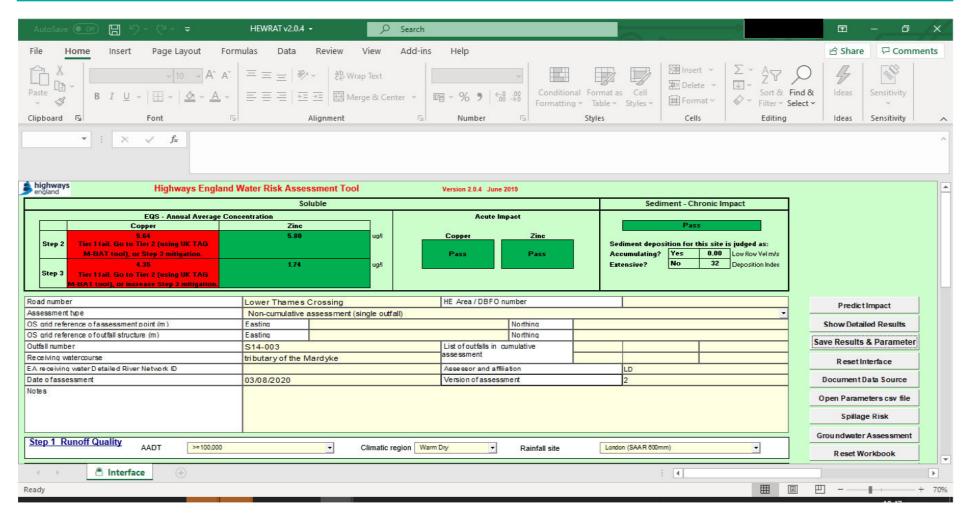


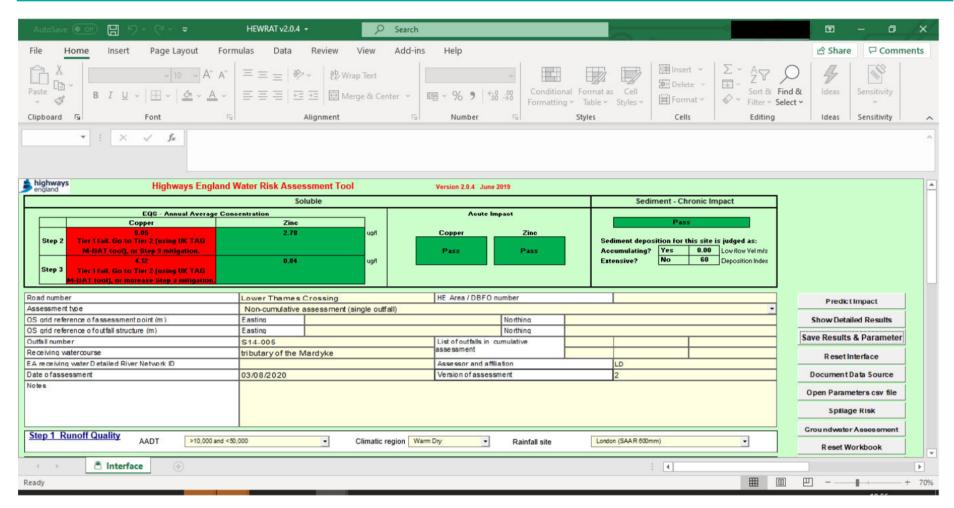


Cotan d Barradi Granita								
Step 1 Runoff Quality	AADT >=50,000 and <100	.000,	Climatic region	Warm Dry ▼ Rainfall site	Lond	on (SAAR 600mm)	_	
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.006	Freshwater EQS limits:				
(Enter zero in Annual Q ₉₅	Impermeable road area draine	d (ha)	3.959	Bioavailable dissolved copper (μg/l)				
river flow box to assess	•							
Step 1 runoff quality only)	Permeable area draining to ou	luali (na)	14.373					
	Base Flow Index (BFI)		0.29	0.29 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	<u> </u>	For dissolved copper only Ambient background concentration (µg/l) 3.795				
For sediment impact only	Is there a downstream structur	e, lake, pond or canal that reduces t	the velocity within 10	0m of the point of discharge?		No ▼ D		
		er width (m)	3.5					
	○ Tier 2 Bed width (m)		3 Manni	ng's n 0.07	Side slope (m/m)	0.5 Long sl	lope (m/m) 0.0001	
highways england	highways england Water Risk Assessment Tool Version 2.0.4 June 2019							
		Soluble				Sediment - Chr	ronic Impact	
	EQS - Annual Average Con-	centration Zinc		Acute Impact		Fail. Try Tier 2	for Volcoitu	
	4.15	0.94	ug/l	Copper Zinc			49 %, proposed = 0 %	
	Tier 2 (using UK TAG				27.543.0	diment deposition for thi	is site is judged as:	
M-BAT tool),	or Step 3 mitigation.	_	ug/l	Pass Pass	1000	cumulating? Yes tensive? Yes	0.01 Low flow Velm/s 194 Deposition Index	
Step 3	- A		l agir		Lat	elisive:		
Road number		Lower Thames Crossing		HE Area / DBFO number				
Assessment type		Non-cumulative assessme	nt (single outfall)					
OS grid reference of assessme	ent point (m)	Easting		Northing				
OS grid reference of outfall stre	ucture (m)	Easting		Northing				
Outfall number		S013-002		List of outfalls in cumulative assessment				
Receiving watercourse		Mardyke West Tributary				0.000		
EA receiving water Detailed Riv	ver Network ID			Assessor and affiliation		LD		
Date of assessment		18/05/2022		Version of assessment				
Notes		Assessment re run using CS	67 traffic model of	ata and revised drainage design info	mation			
Step 1 Runoff Quality			55 50 10 F	5.5 Spides A0				
	AADT >=50,000 and <100	0,000 ▼	Climatic region	Warm Dry Rainfall site	Londo	on (SAAR 600mm)	T	
Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)		0.008	Freshwater EQS limits:				
(Enter zero in Annual Q ₉₅	Impermeable road area draine	d (ha)	3.959	Bioavailable dissolved copper (ug/l)		1 D		
river flow box to assess								
Step 1 runoff quality only)	Permeable area draining to ou	itfall (ha)	14.373	Bioavailable dissolved zinc (ug/l)		10.9 D		
Step 1 runoff quality only)	Permeable area draining to ou Base Flow Index (BFI)	rtfall (ha)		Bioavailable dissolved zinc (μg/l) s the discharge in or within 1 km upstream o	f a protected site for		No 🔻 D	









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