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.

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.

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 investigation. See further information in the assumptions section, below.
Dissolved copper concentration	

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 $Copper_{bioavailable}$
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 $Copper_{dissolved}$ 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 $Copper_{bioavailable}$ 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 $Copper_{bioavailable}$ 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	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.

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

Outfall ID	$Copper_{bioavailable}$ (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

**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 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/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.

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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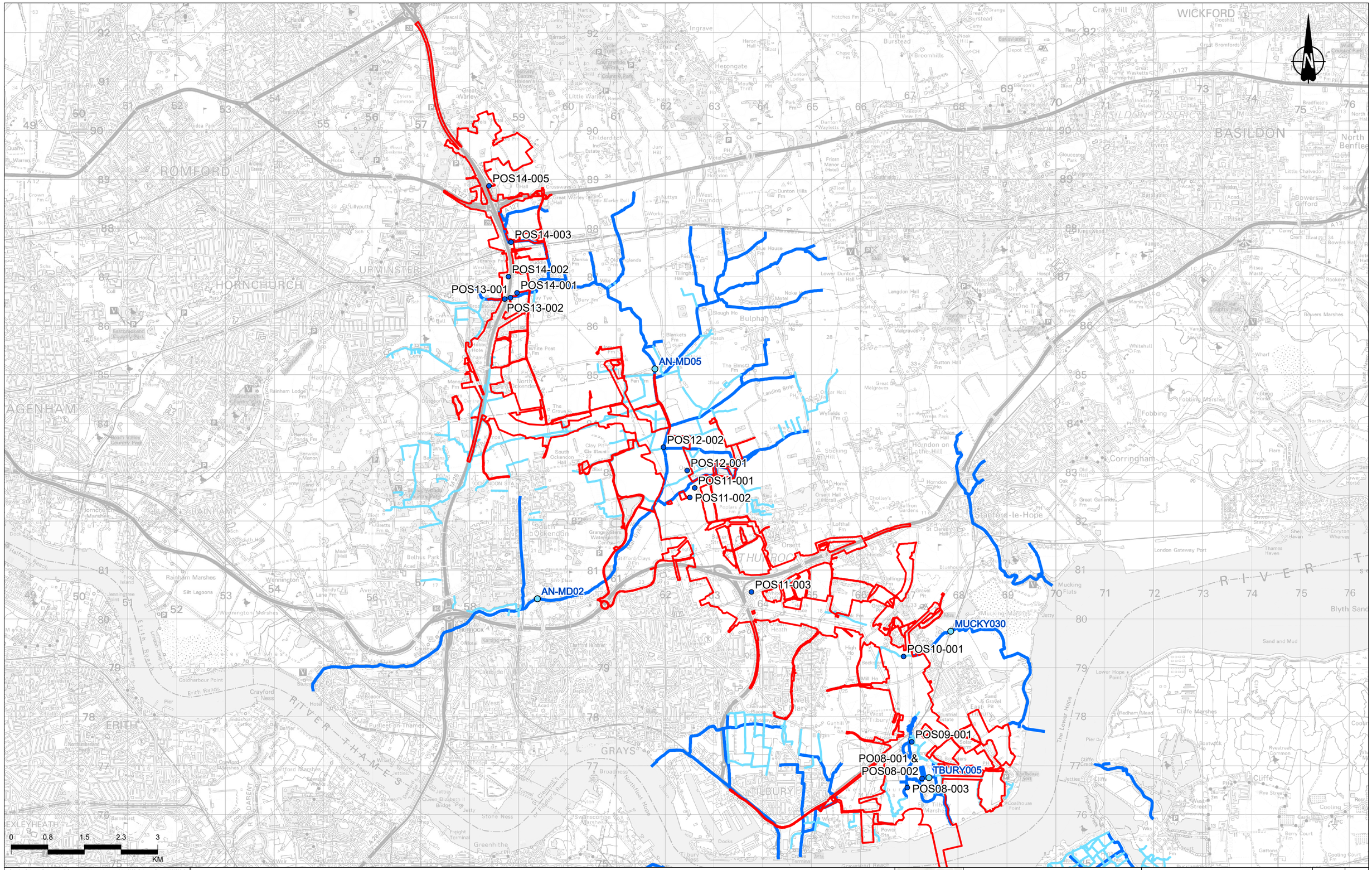
Annexes

Annex A Outfalls Drawing



Legend

- Order Limits
- Water quality monitoring stations
- Drainage outfalls
- Main river
- Ordinary watercourse

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P02	S8	9/8/2022	DCO Application	SW	LD	BF

Client: national highways

Project: LOWER THAMES CROSSING

Status	DCO APPLICATION	Original Size	Revision
Application Document Number	TR010032/APP/6.3	A3	P02
		Scale	1:70,000

Drawing Title: Drainage Outfalls and Water Quality Monitoring Stations

Drawing Number: HE540039-CJV-EWE-SZP_EGNE00000000-DR-LE-50151

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Annex B HEWRAT and M-BAT Results

Metal Bioavailability Assessment Tool (M-BAT)

Back

Calculate

Clear Data

INPUT DATA											RESULTS (Copper)				
ID	Location	Waterbody	Date	Measured Cu Concentration (dissolved) (µg l^{-1})	Measured Zn Concentration (dissolved) (µg l^{-1})	Measured Mn Concentration (dissolved) (µg l^{-1})	Measured Ni Concentration (dissolved) (µg l^{-1})	pH	DOC	Ca	Site-specific PNEC Dissolved Copper (µg l^{-1})	BioF	Bioavailable Copper Concentration (µg l^{-1})	Risk Characterisation Ratio	
1	S8-001	West Tilbury Main	18.05.22	4.1				8.05	15	92	6.58	0.15	0.62	0.62	
2	S11-001	Mardyke tributary	18.05.22	5.72				7.49	8.81	97.72	40.76	0.02	0.14	0.14	
3	S11-002	Mardyke tributary	18.05.22	5.32				7.49	8.81	97.72	40.76	0.02	0.13	0.13	
4	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	
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	
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	
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	
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	
10	S14-003	Mardyke tributary	19.05.22	4.35				7.67	8.81	97.72	37.62	0.03	0.12	0.12	
11	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	
13	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	

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Version 2.0.4 June 2019

Soluble				Sediment - Chronic Impact
EQS - Annual Average Concentration			Acute Impact	
	Copper	Zinc		Pass
Step 2	5.84 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. ug/l	7.23 ug/l	Copper: River Fails Toxicity Test. Try mitigation; Zinc: Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel m/s; Extensive? No 92 Deposition Index
Step 3	- ug/l	- ug/l		

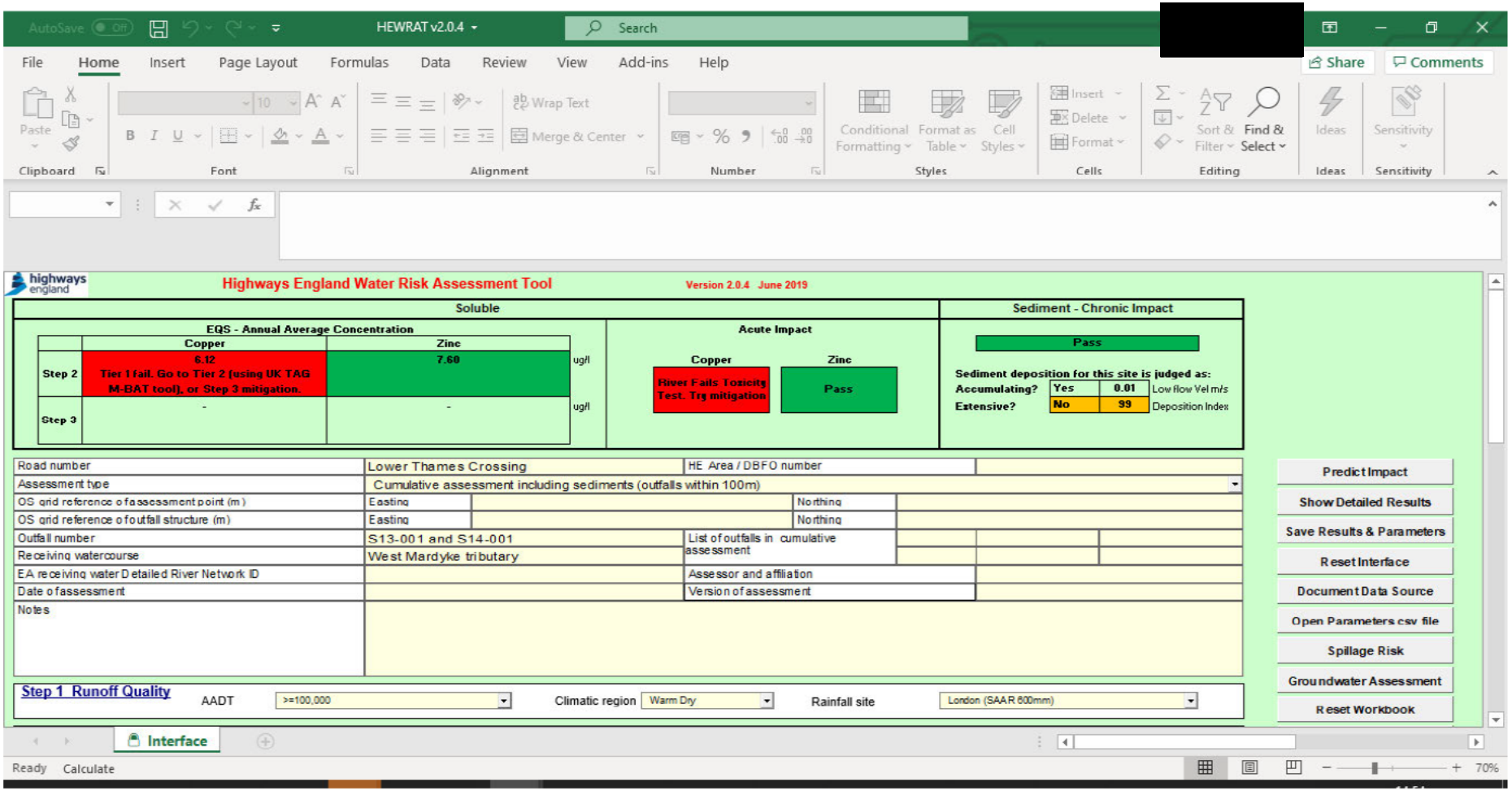
Road number	Lower Thames Crossing		HE Area / DBFO number		
Assessment type	Cumulative assessment including sediments (outfalls within 100m)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number		List of outfalls in cumulative assessment	S13-001	S14-001	
Receiving watercourse	Mardyke West Tributary				
EA receiving water Detailed River Network ID		Assessor and affiliation		LD	
Date of assessment	19/05/2022	Version of assessment			
Notes	Assessment updated to reflect revised drainage catchments and traffic model CS67 2045				

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

- (•) Tier 1 — Estimated river width (m): 3.5
- ( ) Tier 2 — Bed width (m): 3; Manning's n: 0.07; Side slope (m/m): 0.5; Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures	filter drains, pond with sediment forebay and wetland	0 D	No restriction D	90



Highways England Water Risk Assessment Tool

Version 2.0.4 June 2019

Soluble				Sediment - Chronic Impact
EQS - Annual Average Concentration			Acute Impact	
	Copper	Zinc		
Step 2	5.94 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	7.62	Copper: Pass; Zinc: Pass	Sediment deposition for this site is judged as: Accumulating? Extensive? Low flow Vel m/s Deposition Index
Step 3	4.28 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	2.29		

ug/l

Road number	Lower Thames Crossing	HE Area / DBFO number			
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number		List of outfalls in cumulative assessment	S13-001	S13-002	S14-001
Receiving watercourse	Mardyke West Tributary				
EA receiving water Detailed River Network ID		Assessor and affiliation		LD	
Date of assessment	19/05/2022	Version of assessment			
Notes	Assessment updated to reflect revised drainage catchments and traffic model CS67 2045				

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.006	
Impermeable road area drained (ha)	22.8	
Permeable area draining to outfall (ha)	23.021	
Base Flow Index (BFI)	0.29	

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1	D
Bioavailable dissolved zinc (µg/l)	10.9	D

Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only — Water hardness: High = >200mg CaCO3/l

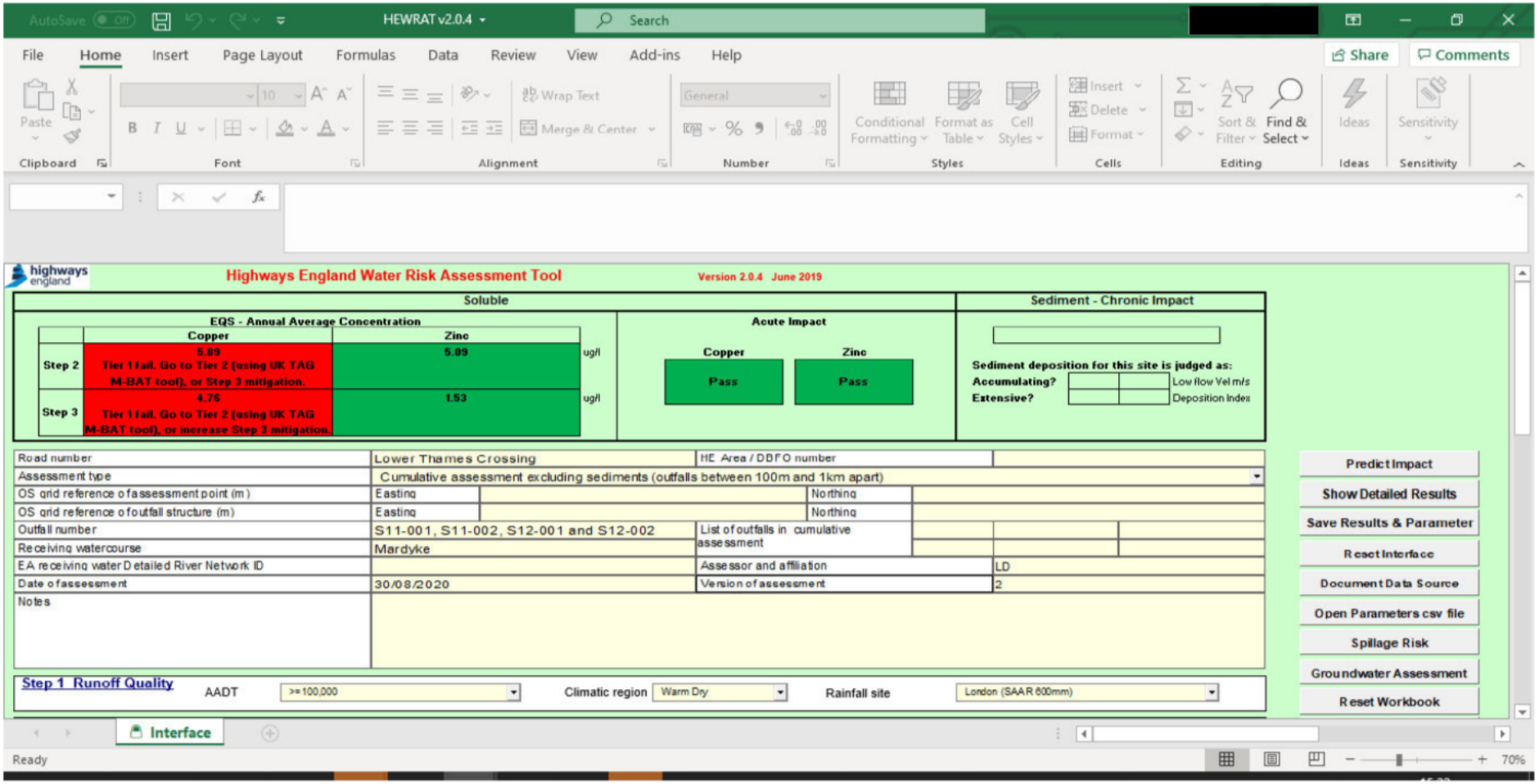
For dissolved copper only — Ambient background concentration (µg/l): 3.795

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

Tier 1	Estimated river 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

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		70	No restriction D	0 D
Proposed measures	filter drains, pond with sediment forebay and wetland	70	No restriction D	0 D



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Soluble			Acute Impact		Sediment - Chronic Impact
EQS - Annual Average Concentration					
	Copper	Zinc	Copper	Zinc	
Step 2	6.40 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. ug/l	5.47	Pass	Pass	Sediment deposition for this site is judged as:
Step 3	5.19 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation. ug/l	1.64			Accumulating? Low flow Vel m/s Extensive? Deposition Index

Road number	Lower Thames Crossing	HE Area / DBFO number			
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)				
OS grid reference of assessment point (m)	Easting	Northing			
OS grid reference of outfall structure (m)	Easting	Northing			
Outfall number		List of outfalls in cumulative assessment	S11-001	S11-002	S12-001
Receiving watercourse	Mardyke		S12-002		
EA receiving water Detailed River Network ID		Assessor and affiliation		LD	
Date of assessment	19/05/2022	Version of assessment			
Notes	Assessment updated to reflect revised drainage catchments and traffic model CS67 2045				

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.0377	
Impermeable road area drained (ha)	74.106	
Permeable area draining to outfall (ha)	45.51	
Base Flow Index (BFI)	0.283	

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1	D
Bioavailable dissolved zinc (µg/l)	10.9	D

Is the discharge in or within 1 km upstream of a protected site for conservation? No D

For dissolved zinc only — Water hardness: High = >200mg CaCO3/l

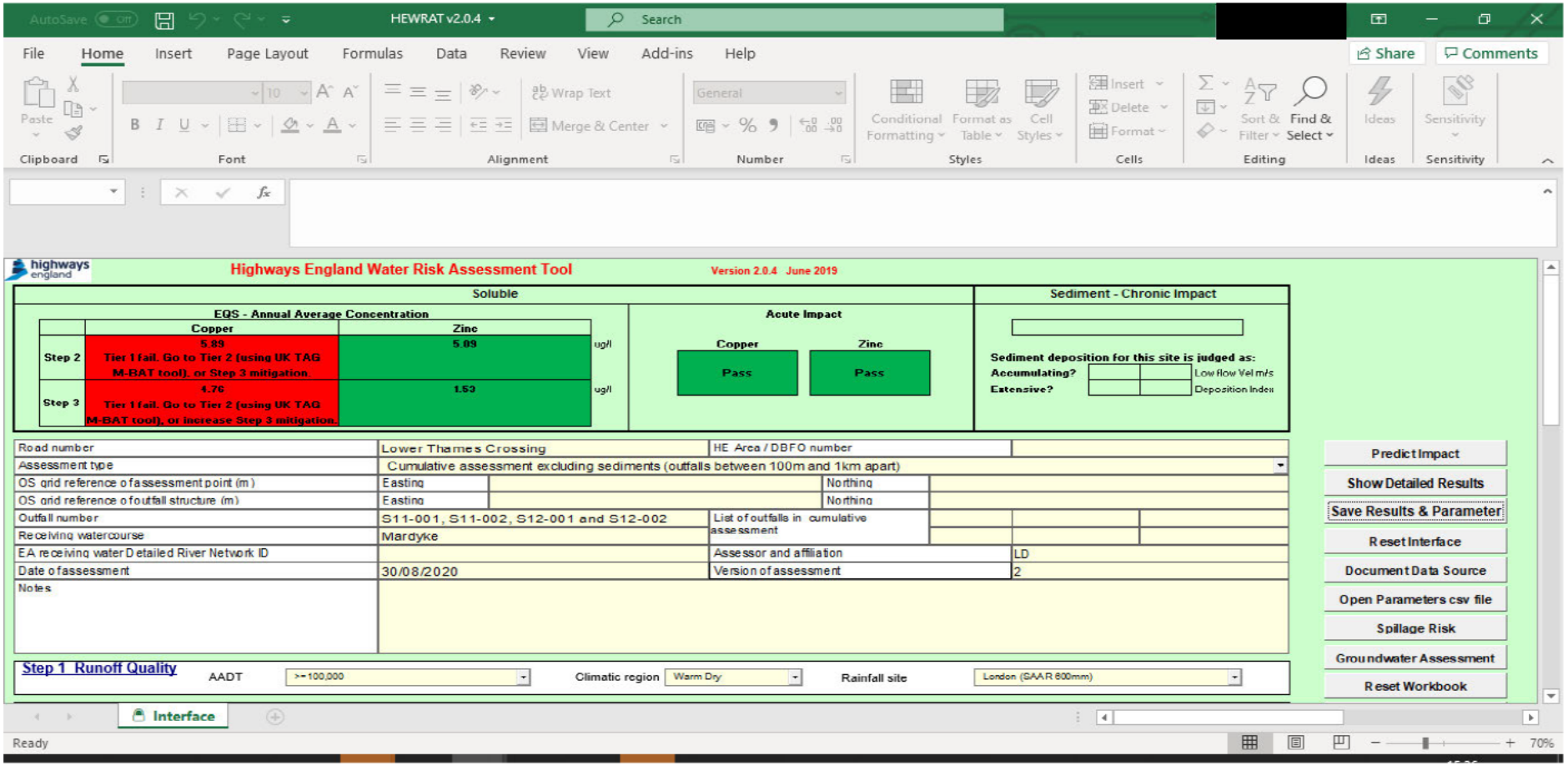
For dissolved copper only — Ambient background concentration (µg/l): 4.88

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

Tier 1	Estimated river 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

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	No restriction	D	0	D
Proposed measures	filter drains, pond with sediment forebay and wetland	70		No restriction	D	0	D



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Version 2.0.4 June 2019

Soluble			Acute Impact		Sediment - Chronic Impact
EQS - Annual Average Concentration					
	Copper	Zinc	Copper	Zinc	
Step 2	8.65 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	13.76 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. ug/l	River Fails Toxicity Test. Try more mitigation	Pass	Sediment deposition for this site is judged as:
Step 3	5.67 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	4.13 ug/l			Accumulating? Low flow Vel m/s
					Extensive? Deposition Index

Road number	Lower Thames Crossing		HE Area / DBFO number			
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)					
OS grid reference of assessment point (m)	Easting		Northing			
OS grid reference of outfall structure (m)	Easting		Northing			
Outfall number		List of outfalls in cumulative assessment	S11-001	S11-002		
Receiving watercourse	Tributary of the Mardyke					
EA receiving water Detailed River Network ID		Assessor and affiliation		LD		
Date of assessment	19/05/2022	Version of assessment				
Notes	Assessment updated to reflect revised drainage catchments and traffic model CS67 2045					

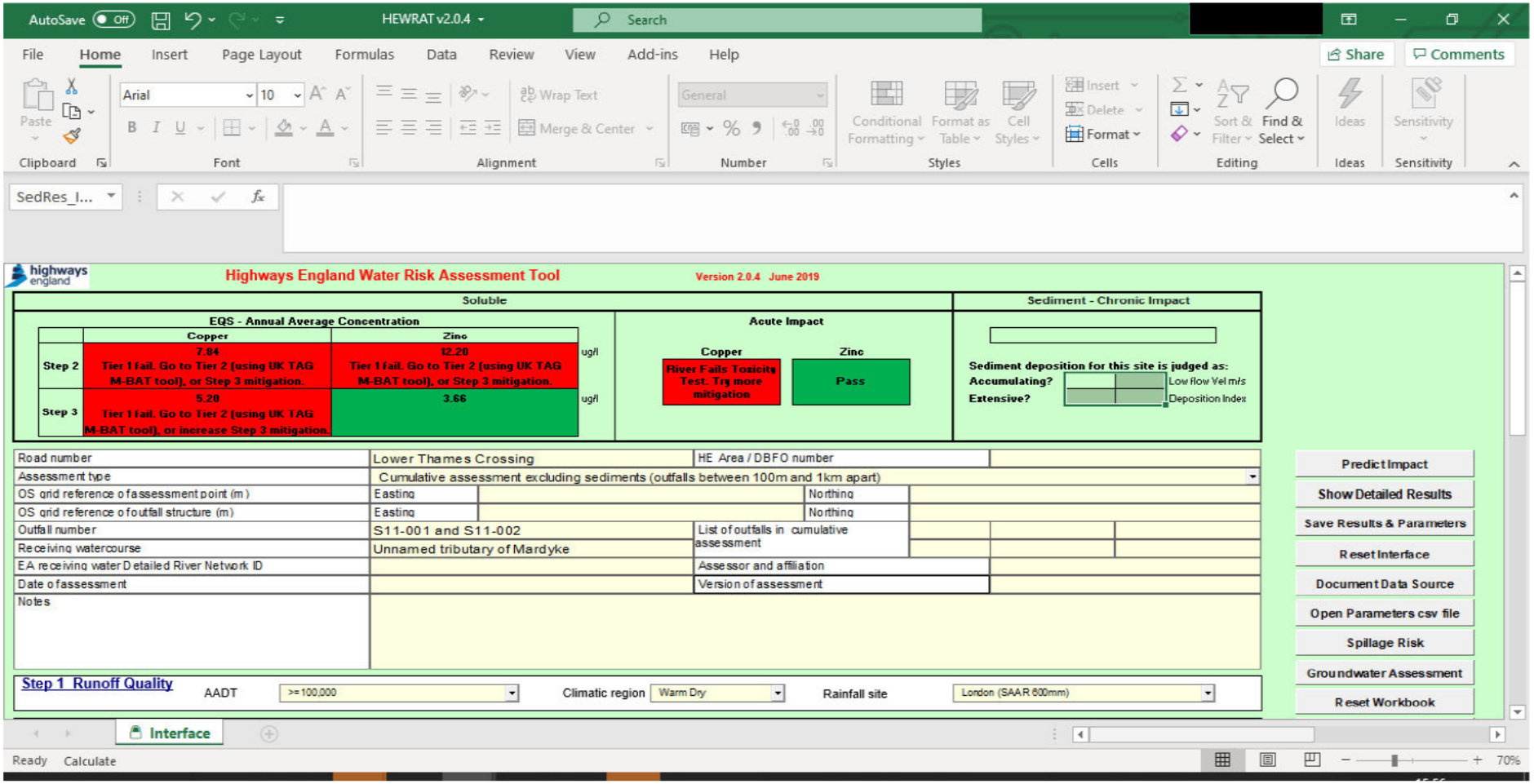
Step 2 River Impacts

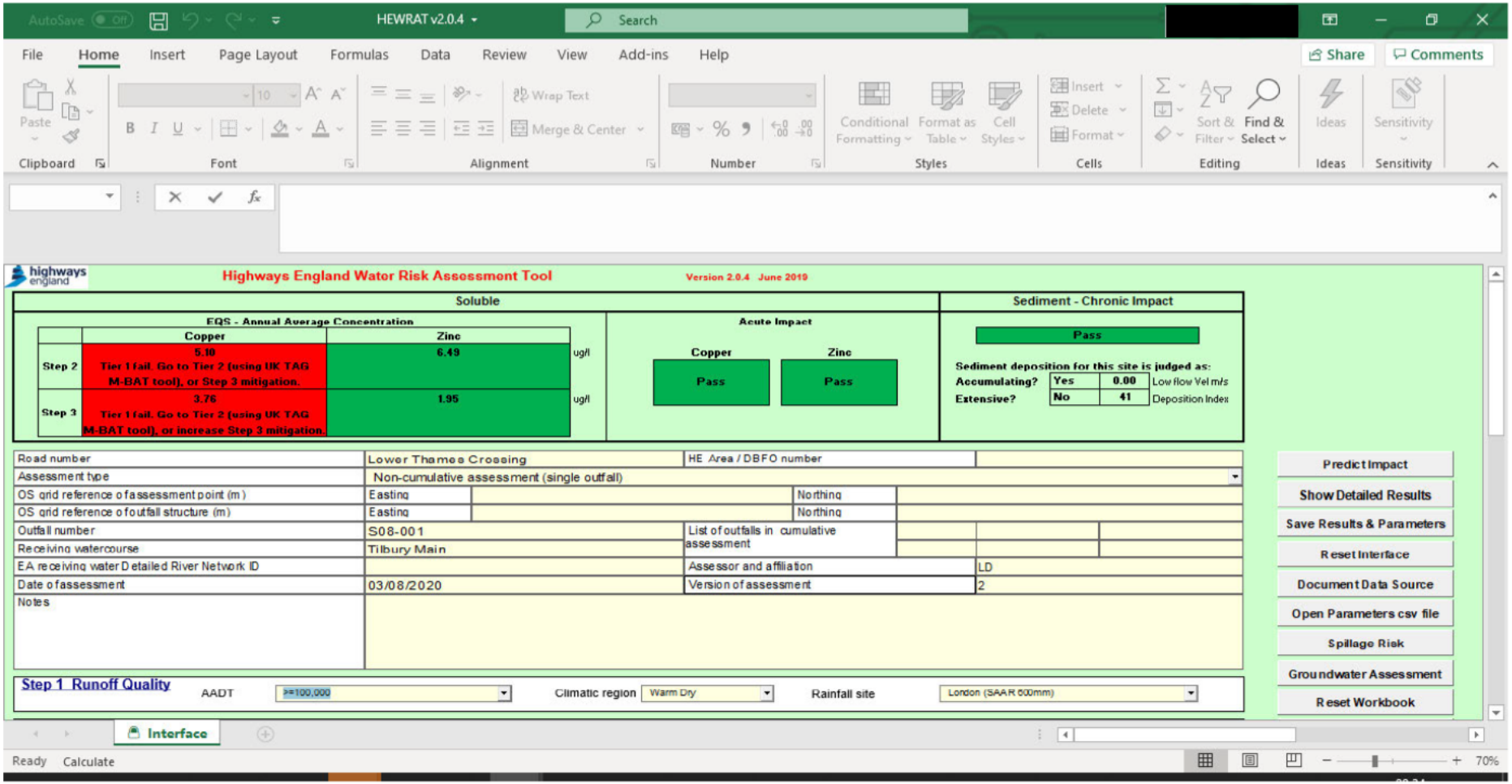
(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.00401		Freshwater EQS limits:	
Impermeable road area drained (ha)	55.06		Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	35.861		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 protected site for conservation?	No D
For dissolved zinc only Water hardness	High = >200mg CaCO3/l		**For dissolved copper only** Ambient background concentration (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
Tier 1 Estimated river 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

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures	filter drains, pond with sediment forebay and wetland	70	No restriction D	0 D





Step 1 Runoff Quality

AADT	>=100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.00434	Freshwater EQS limits:		
Impermeable road area drained (ha)	9.994	Bioavailable dissolved copper (µg/l)	1	D
Permeable area draining to outfall (ha)	5.731	Bioavailable dissolved zinc (µg/l)	10.9	D
Base Flow Index (BFI)	0.846	Is the discharge in or within 1 km upstream of a protected site for conservation?	No	D

For dissolved zinc only	Water hardness	High = >200mg CaCO3/l		**For dissolved copper only**	Ambient background concentration (µg/l)	3.33	
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			
	◉ Tier 1	Estimated river width (m)	3.69				
	○ 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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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	5.26 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	7.12	ug/l
Step 3	-	-	ug/l

Acute Impact

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

Fail. Try Tier 2 for Velocity

Settlement needed = 81%, proposed = 0 %

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	Yes	500	Deposition Index

Road number	Lower Thames Crossing	HE Area / DBFO number	
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	
Outfall number	S08-001/002	List of outfalls in cumulative assessment	
Receiving watercourse	West Tilbury Main		
EA receiving water Detailed River 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	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

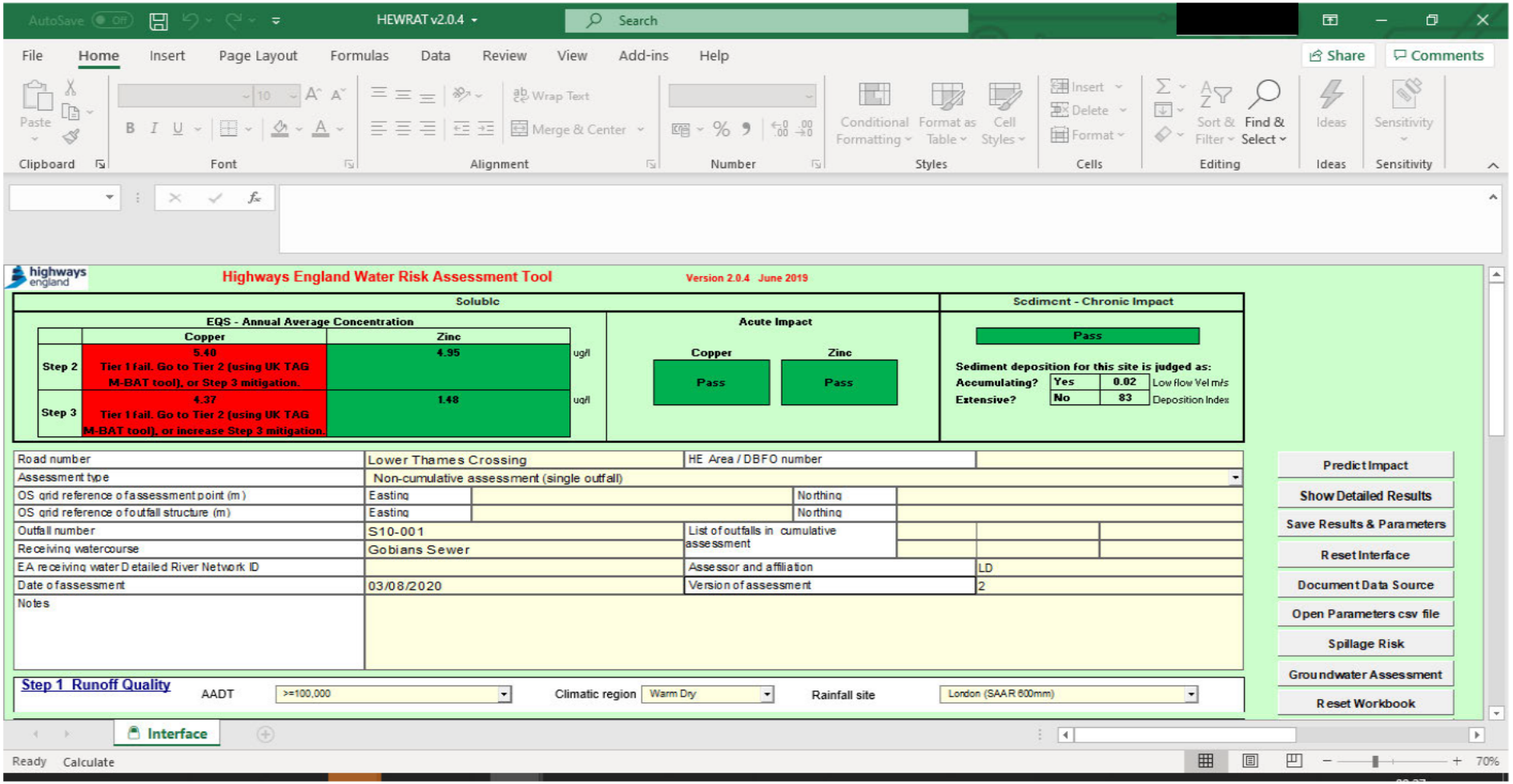
(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

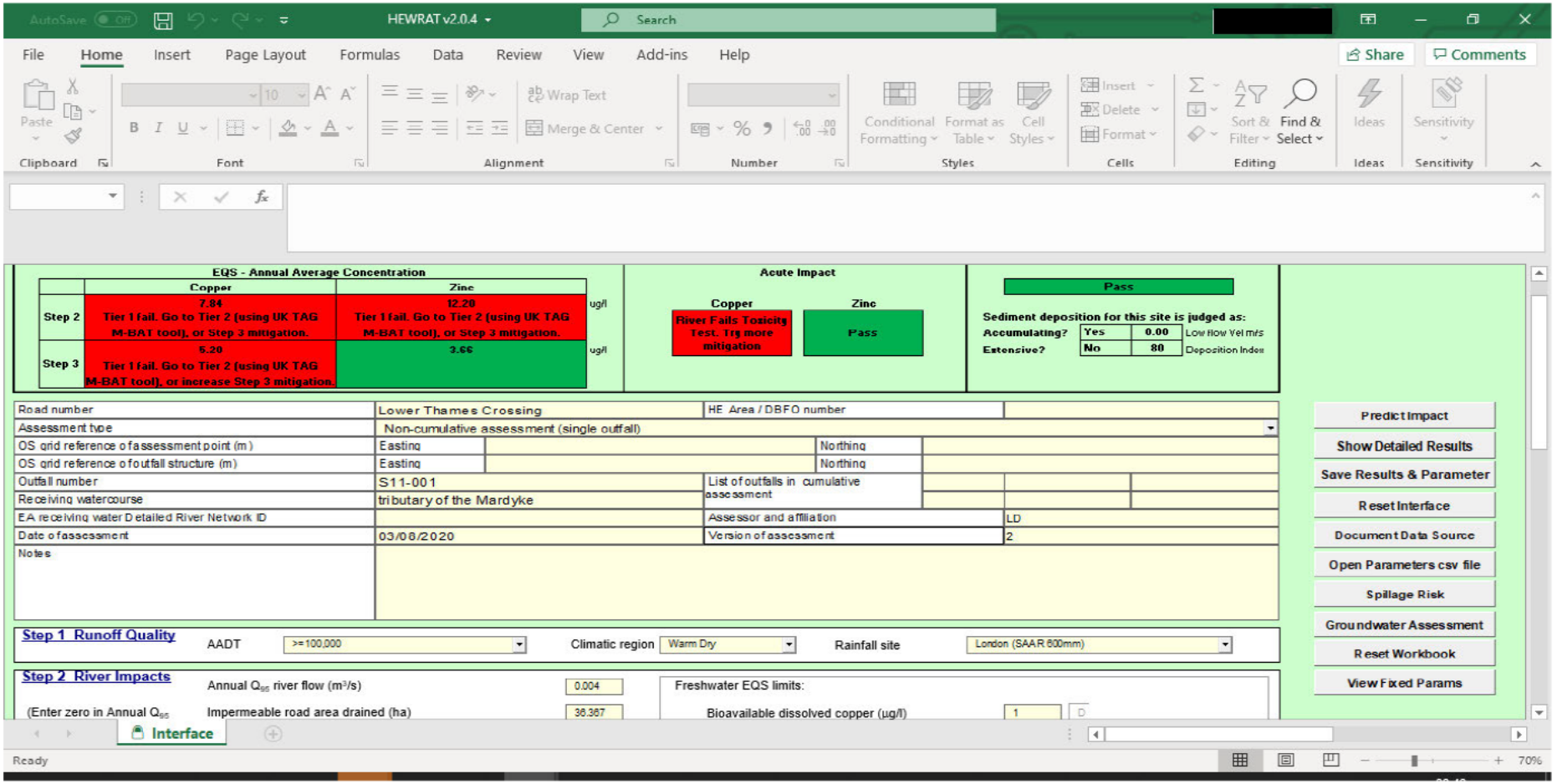
Annual Q_{95} river flow (m^3/s)	0.00434	Freshwater EQS limits:		
Impermeable road area drained (ha)	9.994	Bioavailable dissolved copper (µg/l)	1	D
Permeable area draining to outfall (ha)	5.731	Bioavailable dissolved zinc (µg/l)	10.9	D
Base Flow Index (BFI)	0.846	Is the discharge in or within 1 km upstream of a protected site for conservation?	No	D

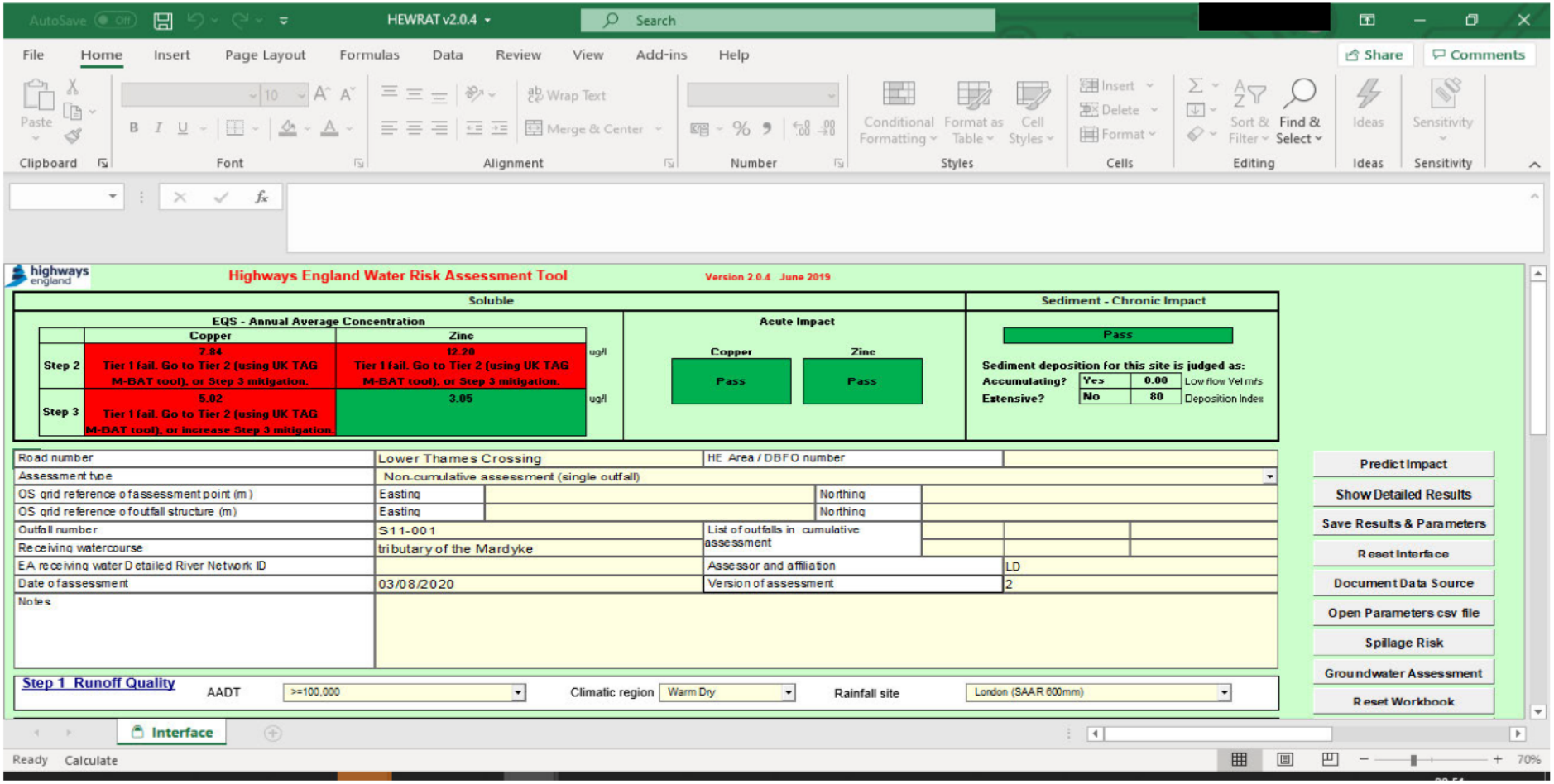
Soluble				Sediment - Chronic Impact
EQS – Annual Average Concentration			Acute Impact	
	Copper	Zinc		Pass
Step 2	2.63 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	7.12 ug/l	Copper: Pass	Sediment deposition for this site is judged as:
Step 3	4.10 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	4.33 ug/l	Zinc: Pass	Accumulating? Yes 0.00 Low flow Vel m/s
				Extensive? No 53 Deposition Index

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	None	0 D	No restriction D	0 D
Proposed measures	Pond with sediment forebay and wetland	70	1	90







Step 1 Runoff Quality						
	AADT	>=100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts				
(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)	Annual Q_{95} river flow (m^3/s)	0.00401	Freshwater EQS limits:	
	Impermeable road area drained (ha)	40.376	Bioavailable dissolved copper (µg/l)	1 D
	Permeable area draining to outfall (ha)	22.629	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 protected site for conservation?	No D
For dissolved zinc only	Water hardness	High = >200mg CaCO3/l	For dissolved copper only: Ambient background concentration (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
	Tier 1 — Estimated river width (m)	3.3		
	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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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	8.33 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	12.57 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	ug/l
Step 3	-	-	ug/l

Acute Impact

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

Fail. Try Tier 2 for Velocity

Settlement needed = 96 %, proposed = 0 %

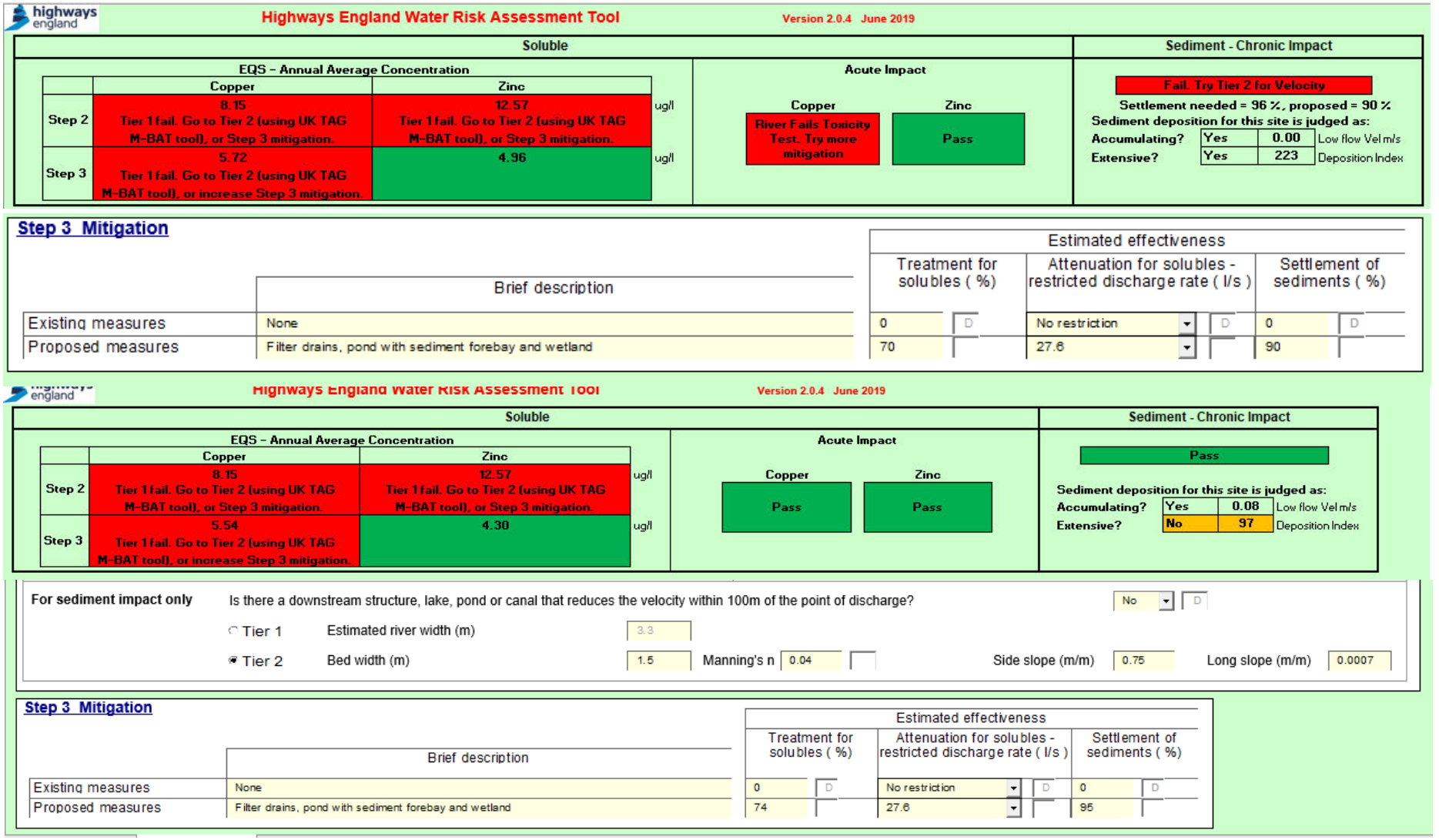
Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	Yes	2233	Deposition Index

Road number	Lower Thames Crossing	HE Area / DBFO number	
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	
Outfall number	S011-001	List of outfalls in cumulative assessment	
Receiving watercourse	Unnamed tributary of the Mardyke		
EA receiving water Detailed River 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	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts				
(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)	Annual Q_{95} river flow (m^3/s)	0.00401	Freshwater EQS limits:	
	Impermeable road area drained (ha)	40.376	Bioavailable dissolved copper (µg/l)	1 D
	Permeable area draining to outfall (ha)	22.629	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 protected site for conservation?	No D



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Soluble				Sediment - Chronic Impact
EQS – Annual Average Concentration			Acute Impact	
	Copper	Zinc		Fail. Try Tier 2 for Velocity
Step 2	8.15 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	12.57 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. ug/l	Copper: River Fails Toxicity Test. Try more mitigation	Settlement needed = 96 %, proposed = 90 %
Step 3	5.72 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	4.96 ug/l	Zinc: Pass	Sediment deposition for this site is judged as:
				Accumulating? Yes 0.00 Low flow Vel m/s
				Extensive? Yes 223 Deposition Index

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	D	Attenuation for solubles - restricted discharge rate (l/s)	D	Settlement of sediments (%)	D
Existing measures	None	0	D	No restriction	D	0	D
Proposed measures	Filter drains, pond with sediment forebay and wetland	70		27.6		90	

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Soluble				Sediment - Chronic Impact
EQS – Annual Average Concentration			Acute Impact	
	Copper	Zinc		Pass
Step 2	8.15 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	12.57 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. ug/l	Copper: Pass	Sediment deposition for this site is judged as:
Step 3	5.54 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	4.30 ug/l	Zinc: Pass	Accumulating? Yes 0.08 Low flow Vel m/s
				Extensive? No 97 Deposition Index

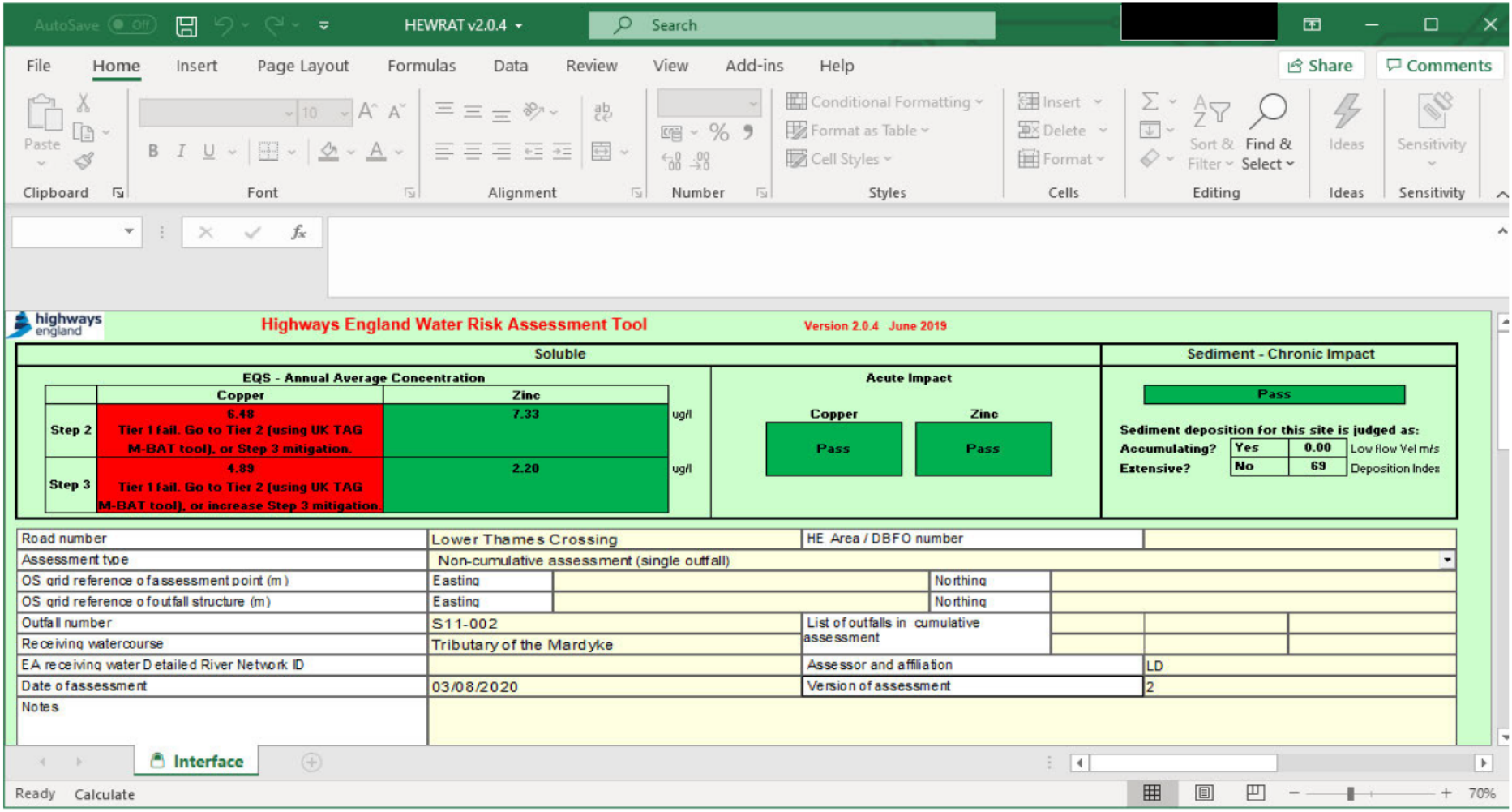
For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 Estimated river width (m) 3.3

Tier 2 Bed width (m) 1.5 Manning's n 0.04 Side slope (m/m) 0.75 Long slope (m/m) 0.0007

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	D	Attenuation for solubles - restricted discharge rate (l/s)	D	Settlement of sediments (%)	D
Existing measures	None	0	D	No restriction	D	0	D
Proposed measures	Filter drains, pond with sediment forebay and wetland	74		27.6		95	



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Soluble				Acute Impact		Sediment - Chronic Impact
EQS - Annual Average Concentration						Pass
	Copper	Zinc		Copper	Zinc	Sediment deposition for this site is judged as:
Step 2	6.48 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	7.33	ug/l	Pass	Pass	Accumulating? Yes 0.00 Low flow Vel m/s
Step 3	4.89 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	2.20	ug/l			Extensive? No 69 Deposition Index

Road number	Lower Thames Crossing		HE Area / DBFO number		
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		
Outfall number	S11-002	List of outfalls in cumulative assessment			
Receiving watercourse	Tributary of the Mardyke				
EA receiving water Detailed River Network ID		Assessor and affiliation		LD	
Date of assessment	03/08/2020	Version of assessment		2	
Notes					

Interface

Ready Calculate 70%

Step 1 Runoff Quality

AADT	>=100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.00401	Freshwater EQS limits:	
Impermeable road area drained (ha)	14.684	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (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 protected site for conservation?	No D

For dissolved zinc only	Water hardness	High = >200mg CaCO3/l	**For dissolved copper only**	Ambient background concentration (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

(•) Tier 1	Estimated river width (m)	3.2					
( ) 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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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	7.04 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	7.91	ug/l
Step 3	-	-	ug/l

Acute Impact

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

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 Vel m/s
Extensive?	Yes	832	Deposition Index

Road number	Lower Thames Crossing		HE Area / DBFO number		
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		
Outfall number	S011-002		List of outfalls in cumulative assessment		
Receiving watercourse	Unnamed tributary of the Mardyke				
EA receiving water Detailed River 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	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.00401	Freshwater EQS limits:	
Impermeable road area drained (ha)	14.684	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (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 protected site for conservation?	No D

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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	7.02 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	7.91	ug/l
Step 3	5.32 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	2.51	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

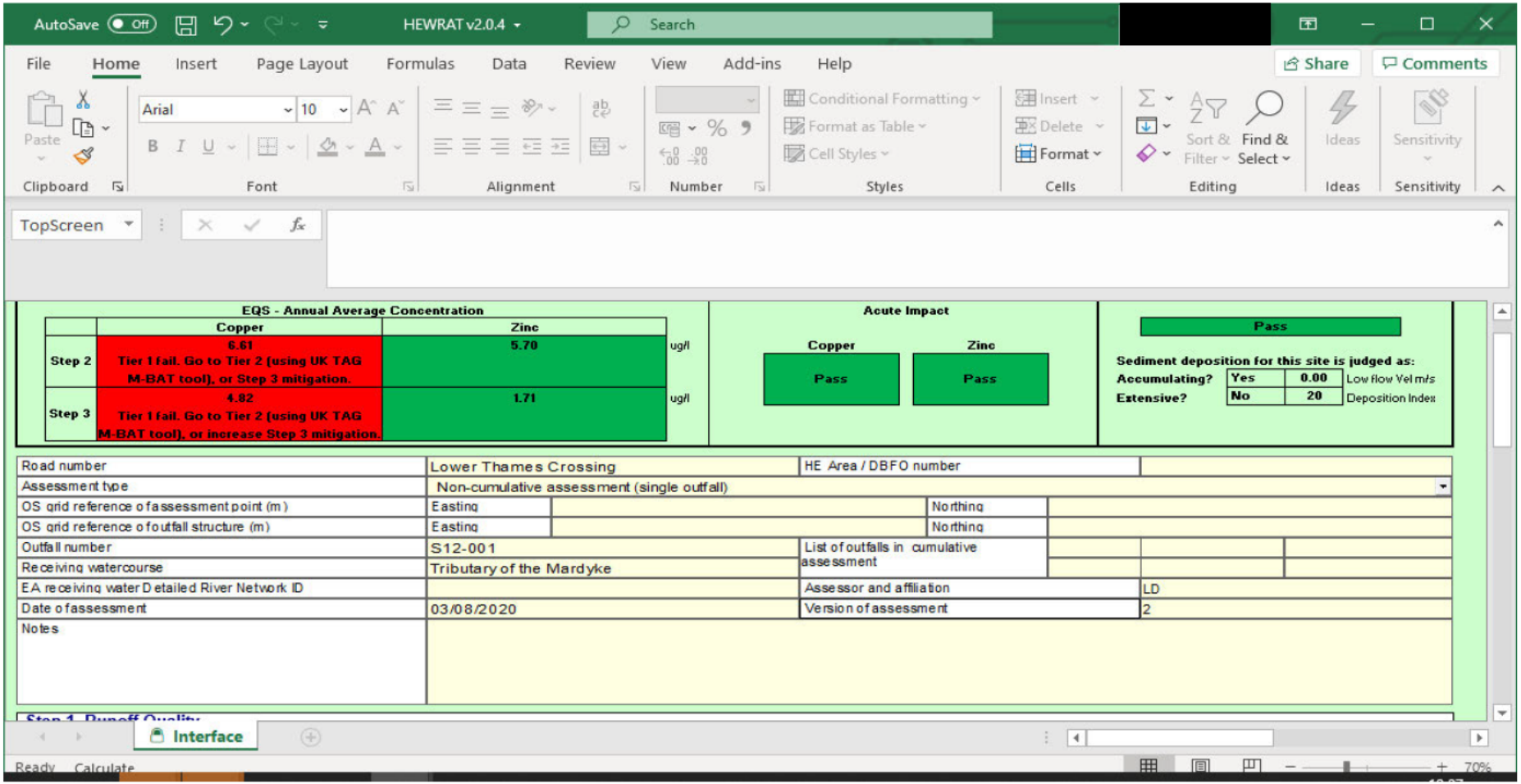
Pass

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	No	83	Deposition Index

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures	None	0	D	No restriction	D	0	D
Proposed measures	Filter drains, pond with sediment forebay and wetland	70		25.2		90	



Step 1 Runoff Quality

AADT	>=50,000 and <100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.00023	Freshwater EQS limits:	
Impermeable road area drained (ha)	3.068	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	0	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 protected site for conservation?	No D

For dissolved zinc only	Water hardness	High = >200mg CaCO3/l	**For dissolved copper only**	Ambient background concentration (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

◉ Tier 1	Estimated river width (m)	2.5					
○ 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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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	7.10 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	5.97	ug/l
Step 3	-	-	ug/l

Acute Impact

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

Fail. Try Tier 2 for Velocity

Settlement needed = 56 %, proposed = 0 %

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	Yes	227	Deposition Index

Road number	Lower Thames Crossing	HE Area / DBFO number	
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	
Outfall number	S012-001	List of outfalls in cumulative assessment	
Receiving watercourse	Unnamed tributary of the Mardyke		
EA receiving water Detailed River 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	>=50,000 and <100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.00023	Freshwater EQS limits:	
Impermeable road area drained (ha)	3.068	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	0	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 protected site for conservation?	No D

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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	7.09 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	5.97	ug/l
Step 3	5.22 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.82	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

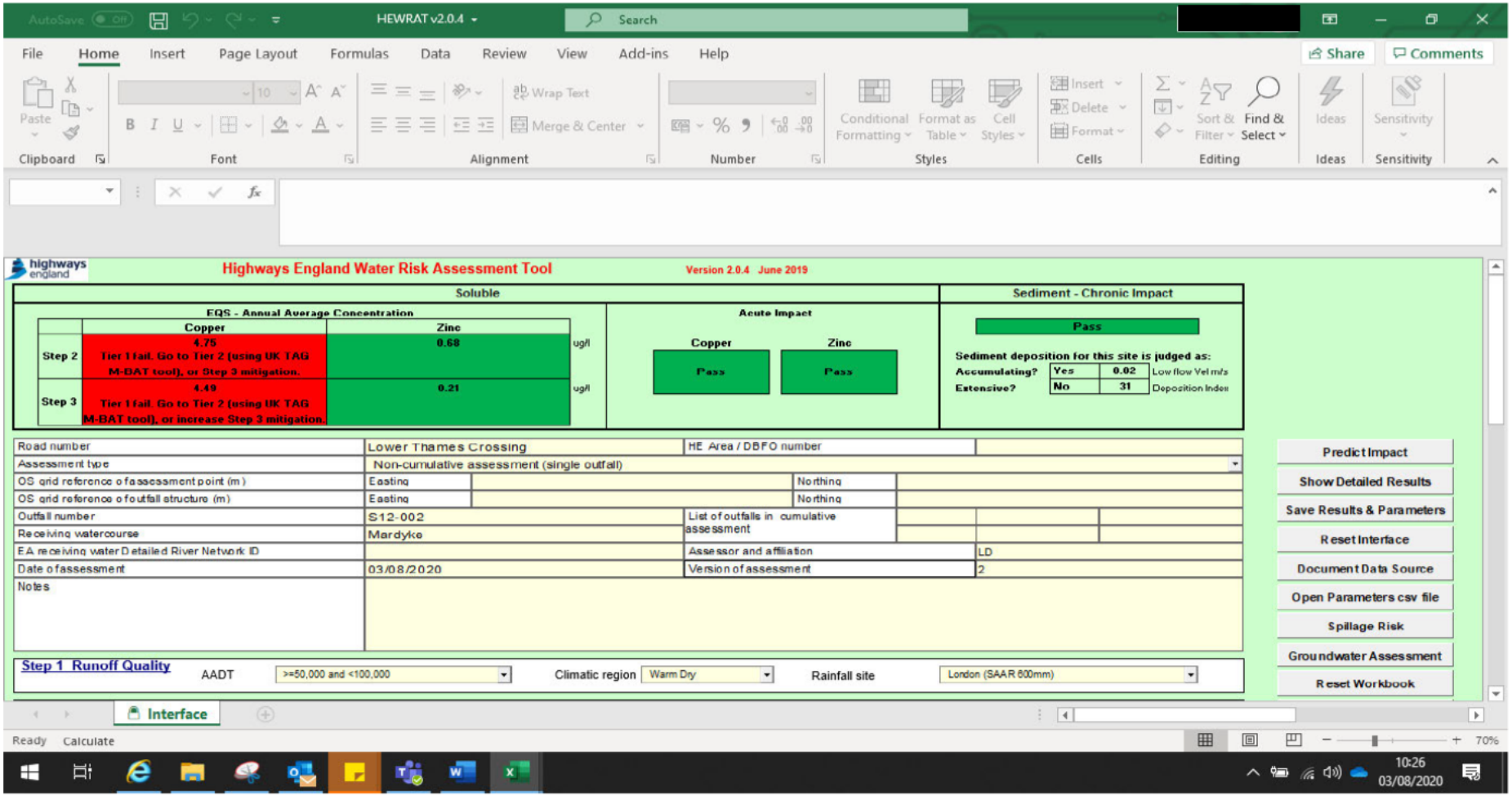
Pass

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	No	23	Deposition Index

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures	None	0	D	No restriction	D	0	D
Proposed measures	Filter drains, pond with sediment forebay and wetland	70		6.2		90	



Step 1 Runoff Quality

AADT	>=50,000 and <100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.0377	Freshwater EQS limits:	
Impermeable road area drained (ha)	15.978	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	9.649	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.283	Is the discharge in or within 1 km upstream of a protected site for conservation?	No D

For dissolved zinc only	Water hardness	High = >200mg CaCO3/l	**For dissolved copper only**	Ambient background concentration (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		
	◉ Tier 1	Estimated river width (m)	6				
	○ 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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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	5.19 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	0.76	ug/l
Step 3	-	-	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Fail. Try Tier 2 for Velocity

Settlement needed = 72 %, proposed = 0 %

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.02	Low flow Vel m/s
Extensive?	Yes	352	Deposition Index

Road number	Lower Thames Crossing	HE Area / DBFO number	
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	
Outfall number	S012-002	List of outfalls in cumulative assessment	
Receiving watercourse	Mardyke		
EA receiving water Detailed River 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		

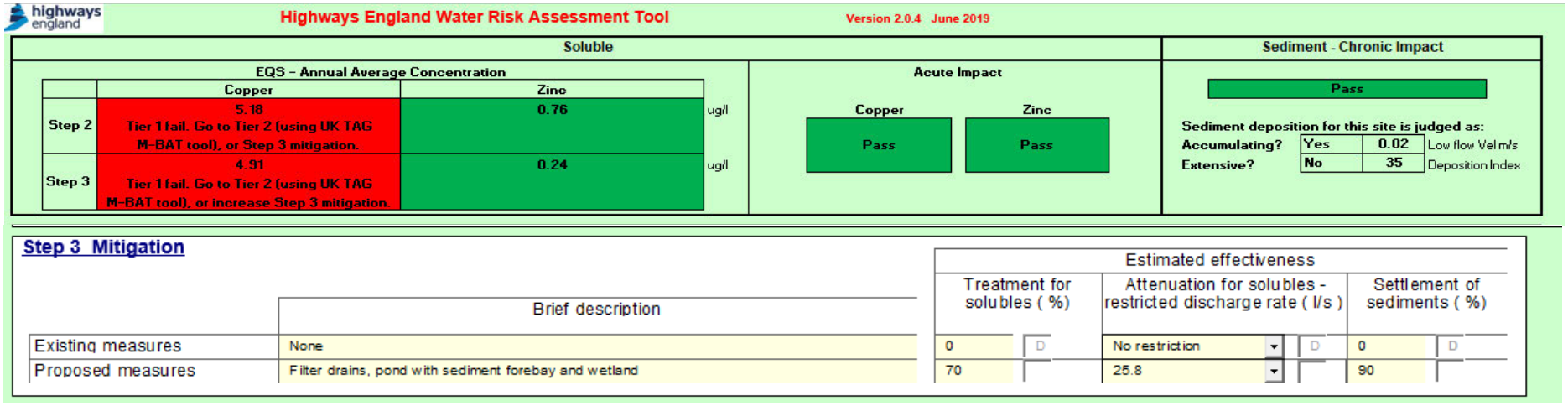
Step 1 Runoff Quality

AADT	>=50,000 and <100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.0377	Freshwater EQS limits:	
Impermeable road area drained (ha)	15.978	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	9.649	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.283	Is the discharge in or within 1 km upstream of a protected site for conservation?	No D



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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	5.18 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	0.76	ug/l
Step 3	4.91 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	0.24	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

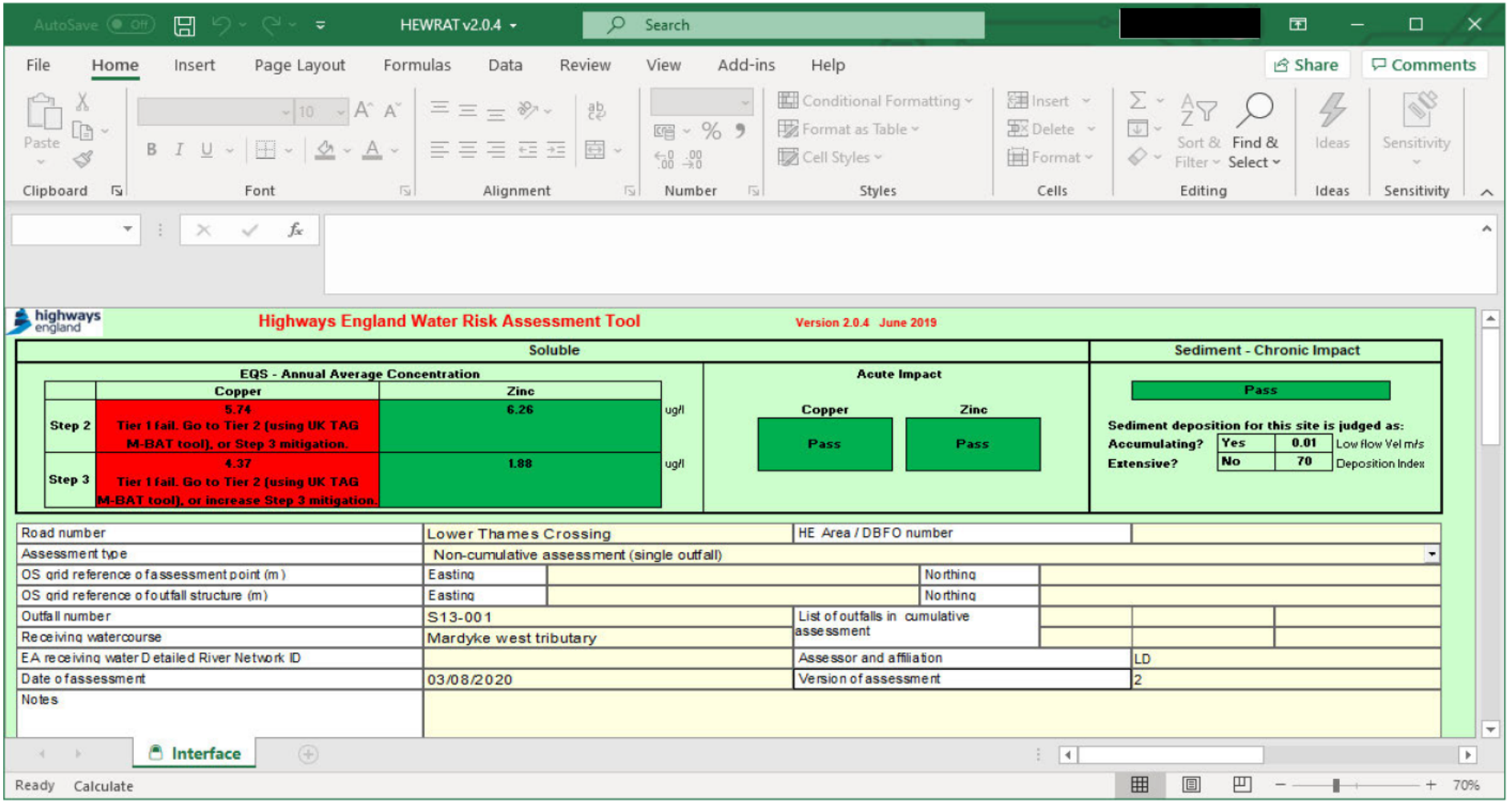
Pass

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.02	Low flow Vel m/s
Extensive?	No	35	Deposition Index

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures	None	0	D	No restriction	D	0	D
Proposed measures	Filter drains, pond with sediment forebay and wetland	70		25.8		90	



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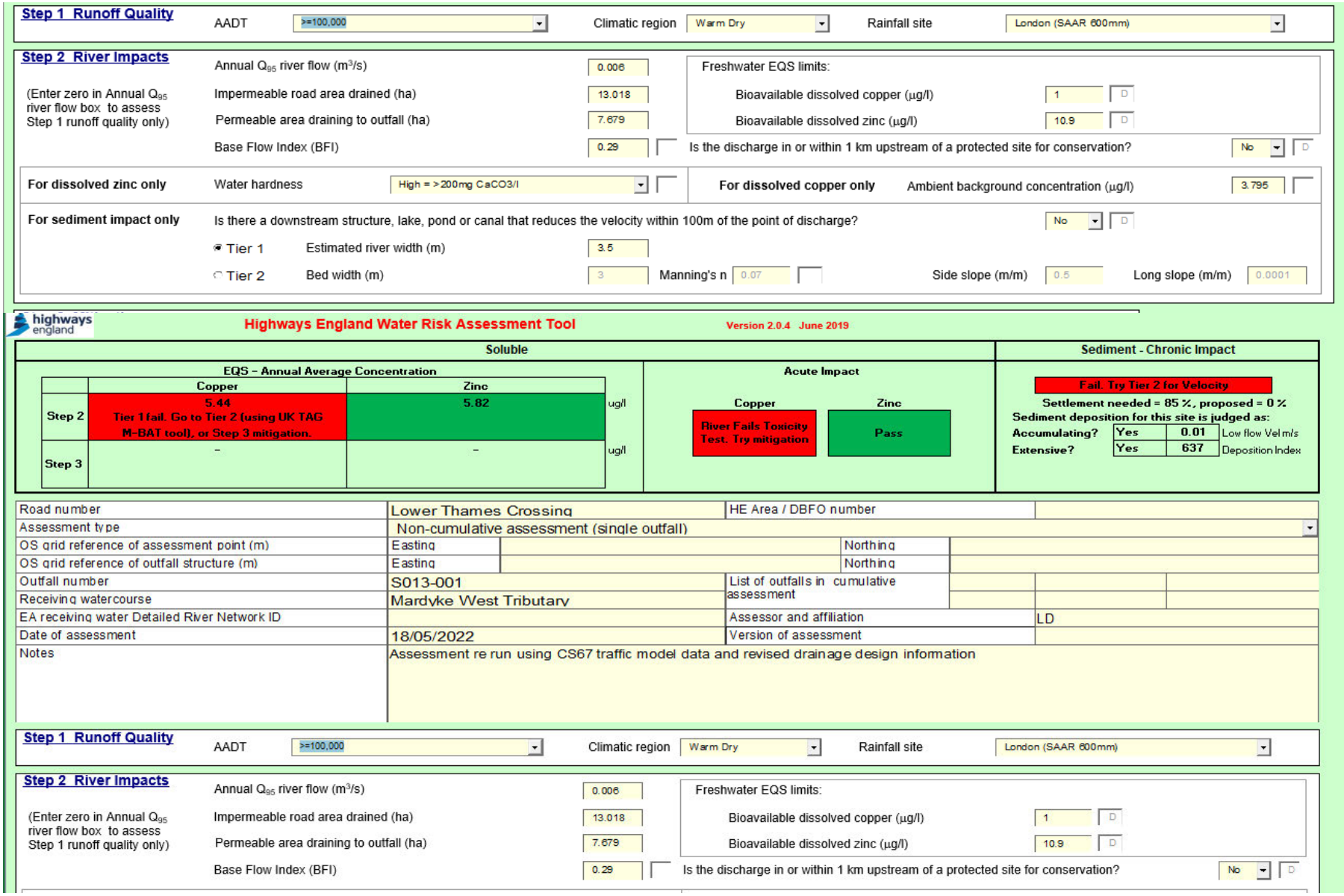
Soluble				Acute Impact		Sediment - Chronic Impact
EQS - Annual Average Concentration						Pass
	Copper	Zinc		Copper	Zinc	Sediment deposition for this site is judged as:
Step 2	5.74 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	6.26	ug/l	Pass	Pass	Accumulating? Yes 0.01 Low flow Vel m/s
Step 3	4.37 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.88	ug/l			Extensive? No 70 Deposition Index

Road number	Lower Thames Crossing		HE Area / DBFO number		
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		
Outfall number	S13-001	List of outfalls in cumulative assessment			
Receiving watercourse	Mardyke west tributary				
EA receiving water Detailed River Network ID		Assessor and affiliation		LD	
Date of assessment	03/08/2020	Version of assessment		2	
Notes					

Interface

Ready Calculate 70%



Step 1 Runoff Quality

AADT	>=100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.006	Freshwater EQS limits:	
Impermeable road area drained (ha)	13.018	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	7.679	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.29	Is the discharge in or within 1 km upstream of a protected site for conservation?	No D

For dissolved zinc only	Water hardness	High = >200mg CaCO3/l	**For dissolved copper only**	Ambient background concentration (µg/l)	3.795
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
(•) Tier 1	Estimated river width (m)	3.5			
( ) 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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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	5.44 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	5.82	ug/l
Step 3	-	-	ug/l

Acute Impact

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment - Chronic Impact

Fail. Try Tier 2 for Velocity

Settlement needed = 85 %, proposed = 0 %

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.01	Low flow Vel m/s
Extensive?	Yes	637	Deposition Index

Road number	Lower Thames Crossing	HE Area / DBFO number	
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	
Outfall number	S013-001	List of outfalls in cumulative assessment	
Receiving watercourse	Mardyke West Tributary		
EA receiving water Detailed River 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		

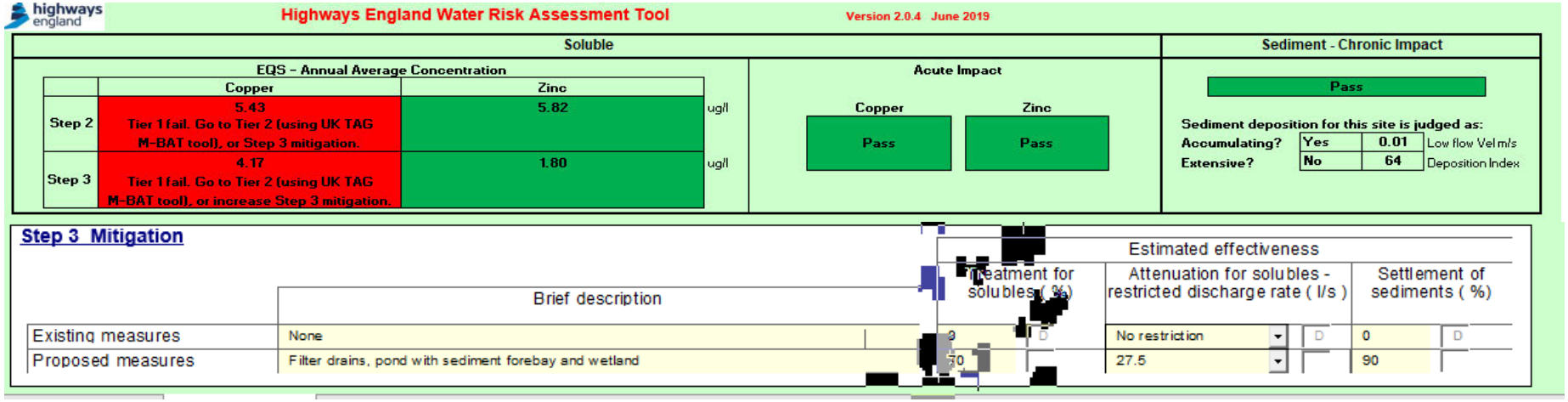
Step 1 Runoff Quality

AADT	>=100,000	Climatic region	Warm Dry	Rainfall site	London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.006	Freshwater EQS limits:	
Impermeable road area drained (ha)	13.018	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	7.679	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.29	Is the discharge in or within 1 km upstream of a protected site for conservation?	No D



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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	5.43 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	5.82	ug/l
Step 3	4.17 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.80	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

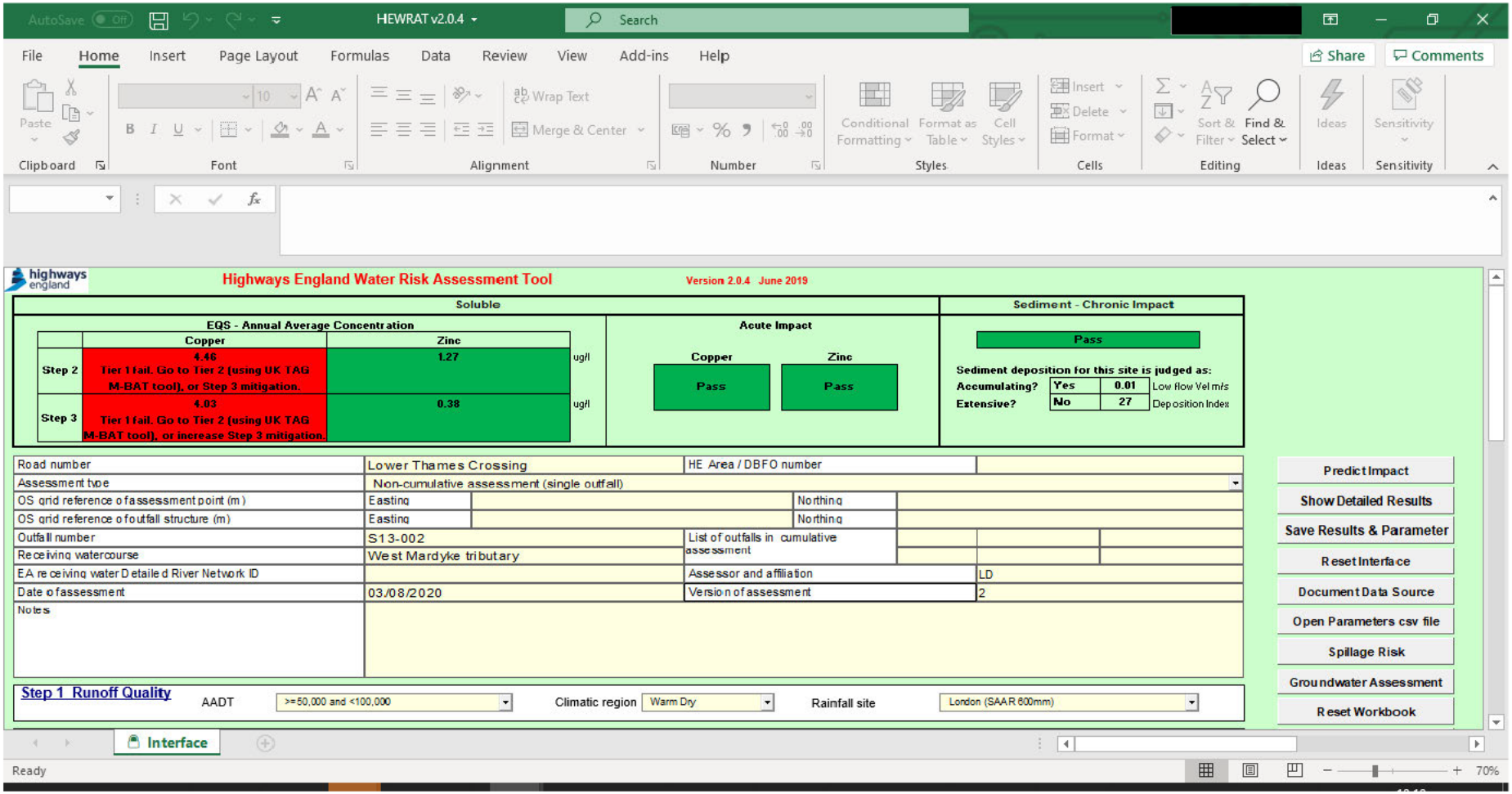
Pass

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.01	Low flow Vel m/s
Extensive?	No	64	Deposition Index

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures	None	0	D	No restriction	D	0	D
Proposed measures	Filter drains, pond with sediment forebay and wetland	50		27.5		90	



Step 1 Runoff Quality

AADT: >=50,000 and <100,000 | Climatic region: Warm Dry | Rainfall site: London (SAAR 600mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.006
Impermeable road area drained (ha)	3.959
Permeable area draining to outfall (ha)	14.373
Base Flow Index (BFI)	0.29

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1
Bioavailable dissolved zinc (µg/l)	10.9

Is the discharge in or within 1 km upstream of a protected site for conservation? No

For dissolved zinc only — Water hardness: High = >200mg CaCO3/l

For dissolved copper only — Ambient background concentration (µg/l): 3.795

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

(•) Tier 1 — Estimated river width (m): 3.5

( ) 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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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	4.15 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	0.94	ug/l
Step 3	-	-	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Fail. Try Tier 2 for Velocity

Settlement needed = 49 %, proposed = 0 %

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.01	Low flow Vel m/s
Extensive?	Yes	194	Deposition Index

Road number	Lower Thames Crossing	HE Area / DBFO number	
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	
Outfall number	S013-002	List of outfalls in cumulative assessment	
Receiving watercourse	Mardyke West Tributary		
EA receiving water Detailed River 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: >=50,000 and <100,000 | Climatic region: Warm Dry | Rainfall site: London (SAAR 600mm)

Step 2 River Impacts

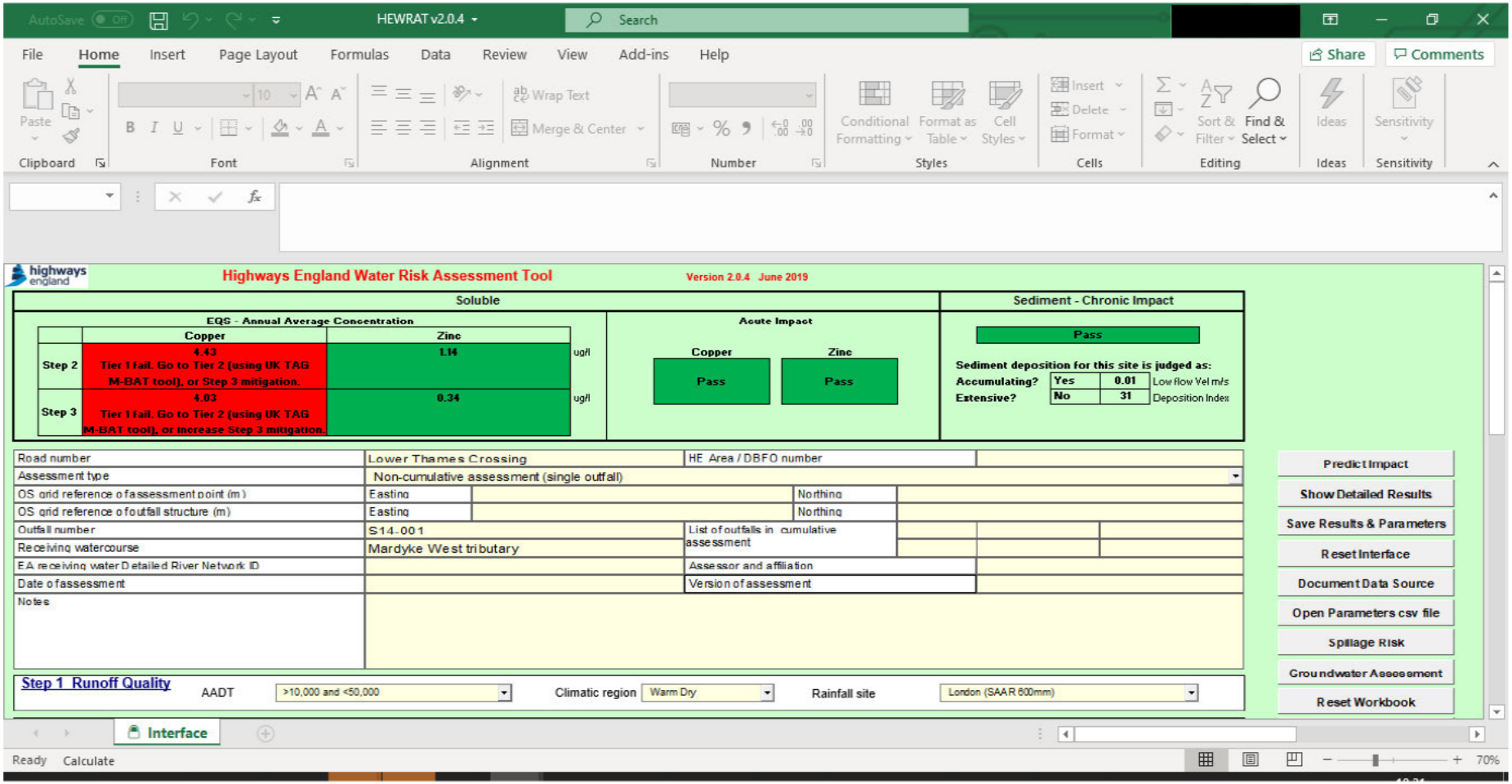
(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

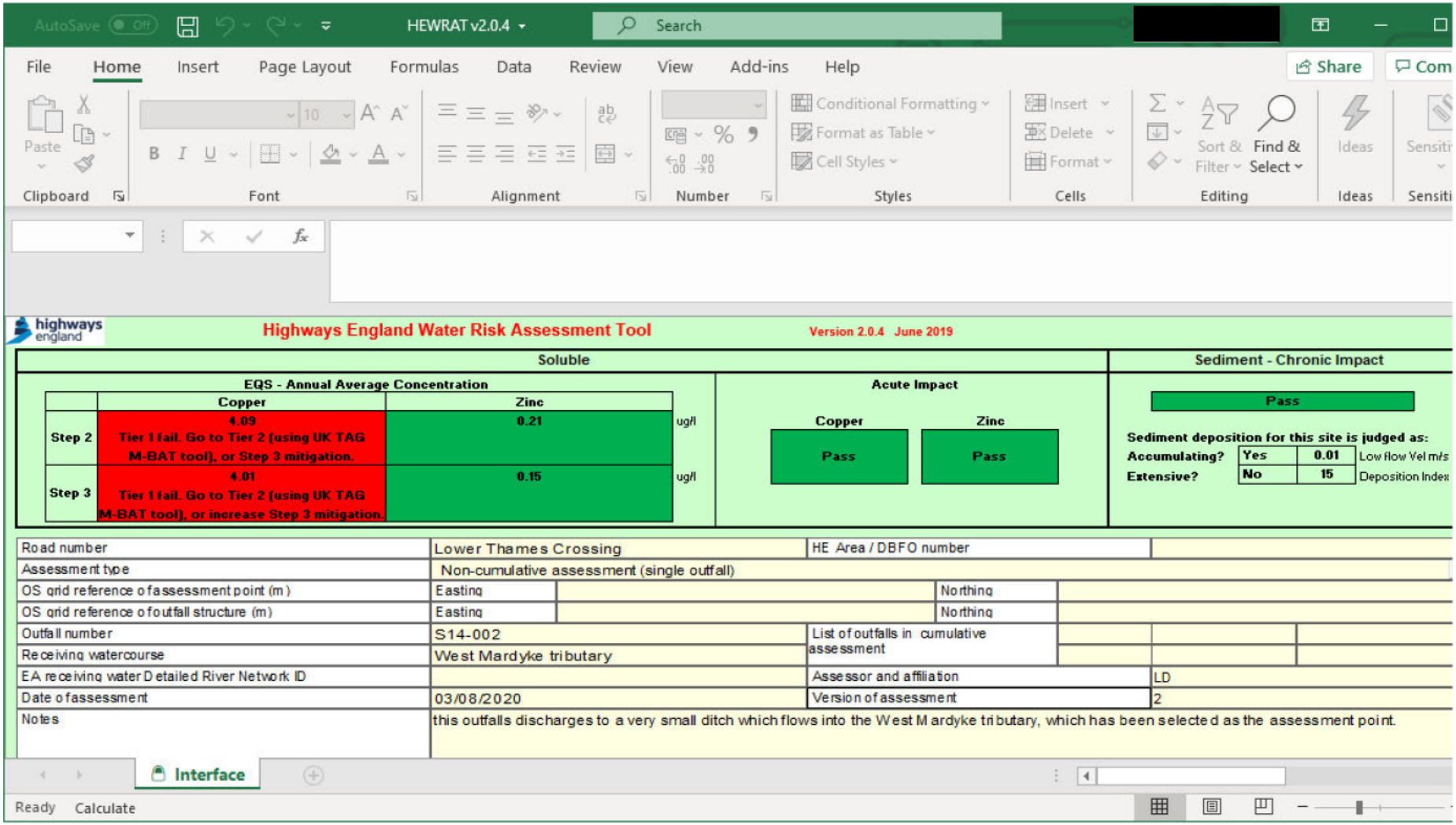
Annual Q_{95} river flow (m^3/s)	0.006
Impermeable road area drained (ha)	3.959
Permeable area draining to outfall (ha)	14.373
Base Flow Index (BFI)	0.29

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1
Bioavailable dissolved zinc (µg/l)	10.9

Is the discharge in or within 1 km upstream of a protected site for conservation? No





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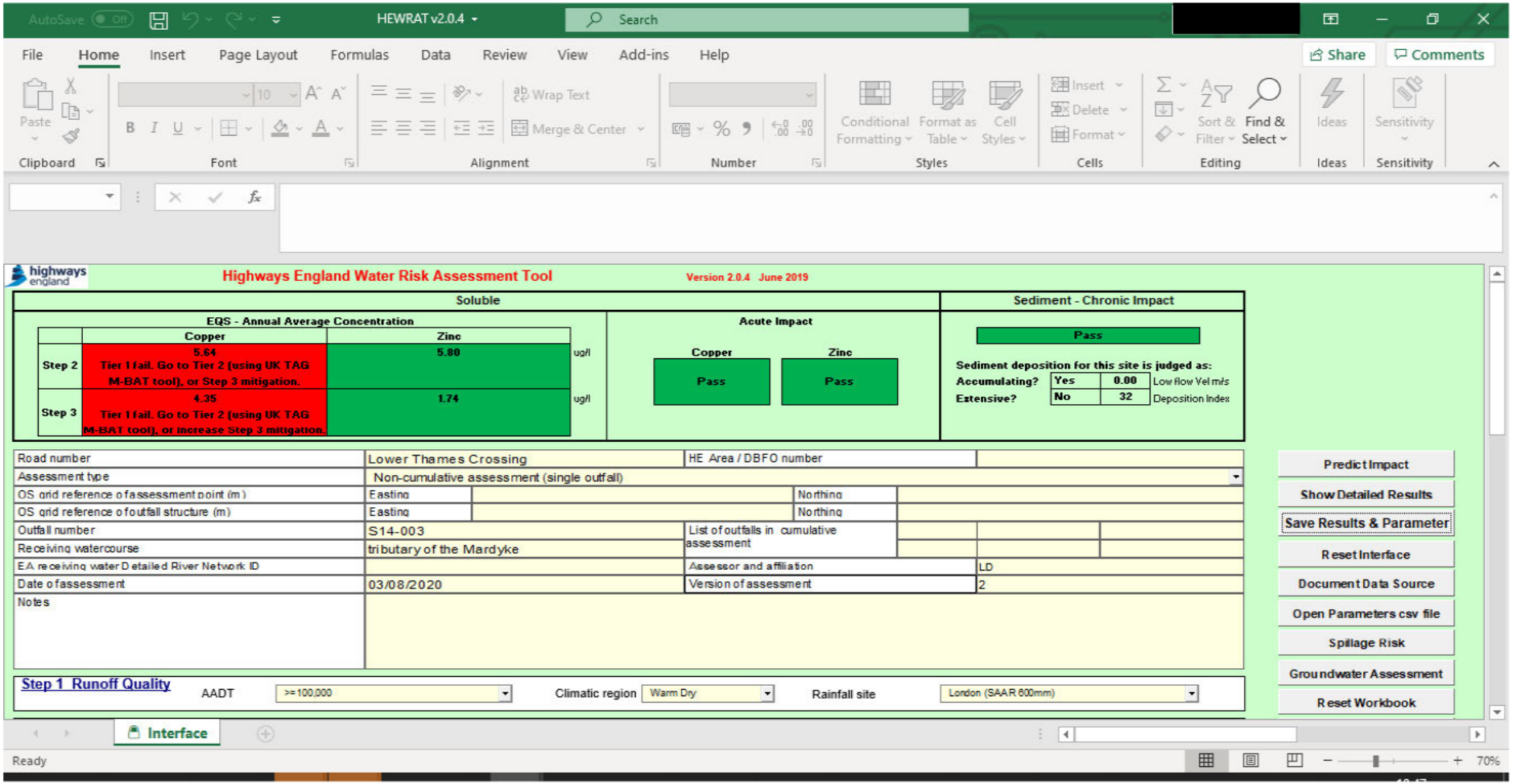
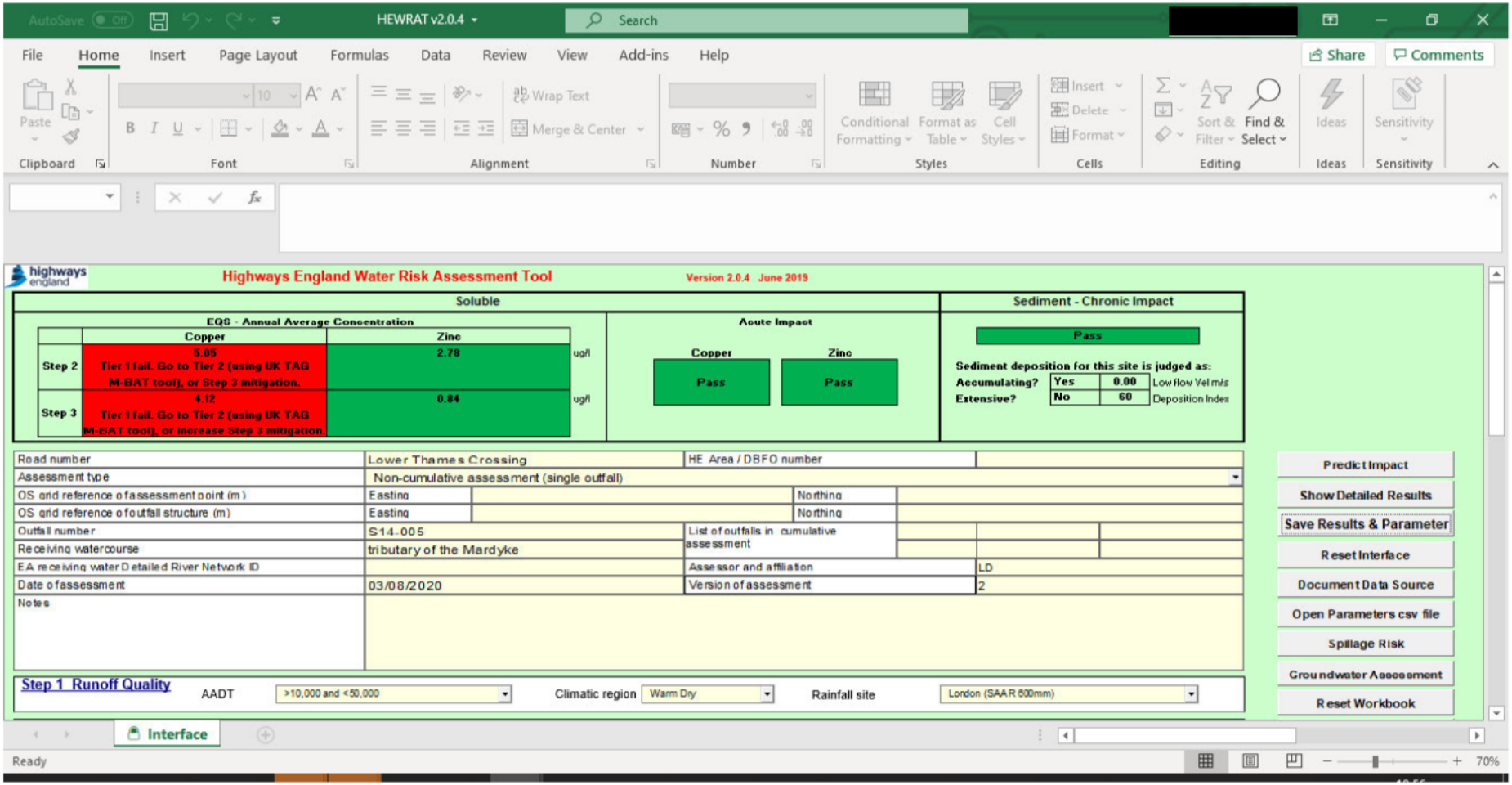
Soluble				Sediment - Chronic Impact
EQS - Annual Average Concentration			Acute Impact	Pass
	Copper	Zinc	Copper / Zinc	Sediment deposition for this site is judged as:
Step 2	4.09 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation. ug/l	0.21 ug/l	Pass / Pass	Accumulating? Yes 0.01 Low flow Vel m/s
Step 3	4.01 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation. ug/l	0.15 ug/l		Extensive? No 15 Deposition Index

Road number	Lower Thames Crossing		HE Area / DBFO number		
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		
Outfall number	S14-002	List of outfalls in cumulative assessment			
Receiving watercourse	West Mardyke tributary				
EA receiving water Detailed River Network ID		Assessor and affiliation	LD		
Date of assessment	03/08/2020	Version of assessment	2		
Notes	this outfalls discharges to a very small ditch which flows into the West Mardyke tributary, which has been selected as the assessment point.				

Interface

Ready Calculate





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