

M54 to M6 Link Road

TR010054

Volume 6

6.3 Environmental Statement

Appendices

**Appendix 13.3 Assessment of Routine
Road Runoff and Accidental Spillage
Risk (HEWRAT)**

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

January 2020

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms and
Procedure) Regulations 2009**

**M54 to M6 Link Road
Development Consent Order 202[]**

6.3 Environmental Statement Appendices

**Appendix 13.3 Assessment of Routine Road Runoff and Accidental
Spillage Risk (HEWRAT)**

Regulation Number	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010054
Application Document Reference	6.3
Author	M54 to M6 Link Road Project Team and Highways England

Version	Date	Status of Version
1	January 2020	DCO Application

Table of contents

Chapter	Pages
1 Introduction	1
1.1 Background to the report.....	1
1.2 Approach.....	1
1.3 Drainage networks, strategy and treatment trains	1
2 Methodology	6
2.1 Assessment guidance and approach	6
2.2 Road runoff and spillage risk – Simple assessment.....	7
2.3 Detailed surface water assessment: metal bioavailability assessment tool (M-BAT)	9
2.4 Assumptions and limitations.....	9
3 Assessment findings	12
3.1 Method A results	12
3.2 Comparison of with and without Scheme for existing road catchments.....	16
3.3 Detailed surface water assessment: metal bioavailability assessment tool (M-BAT)	20
3.4 Groundwater assessment	20
3.5 Accidental spillage risk.....	21
4 Conclusions	23
5 References	28

List of Annexes

Annex A: HEWRAT data and assessment results

Annex B: HEWRAT Outputs

1 Introduction

1.1 Background to the report

1.1.1 Highways England are developing a link road between the M54 and M6 to provide a link between Junction 1 of the M54, M6 North and the A460 to Cannock. The M54 to M6 Link Road (herein referred to as 'the Scheme') aims to reduce congestion on local / regional routes, particularly the A449 and A460, and deliver improved transport links to encourage the development of the surrounding area. This Appendix has been prepared to support the impact assessment provided in Chapter 13: Road Drainage and the Water Environment of the Environmental Statement (ES) [TR010054/APP/6.1]). Please also refer to Figure 13.1 [TR010054/APP/6.2] of the ES throughout.

1.1.2 The report presents a summary of the water quality assessment undertaken to assess the impacts of routine runoff and accidental spillage risk to surface watercourses and groundwater as a result of the Scheme.

1.2 Approach

1.2.1 This assessment of routine runoff has been undertaken using the Highways England Water Risk Assessment Tool (HEWRAT), as referred to in the Design Manual for Roads and Bridges (DMRB), LA113 Road Drainage and the Water Environment (formerly HD45/09) (Ref 1.1).

1.2.2 The assessment of accidental spillage risk has been undertaken using the methodology within LA113 (Ref 1.1).

1.3 Drainage networks, strategy and treatment trains

1.3.1 A description of the Scheme is presented in Chapter 2: The Scheme of the ES [TR010054/APP/6.1].

1.3.2 The proposed drainage strategy for the Scheme is presented in Appendix 13.2 [TR010054/APP/6.3]. The strategy adopted for drainage has taken into consideration the requirements of the DMRB (Ref 1.1), as well as stakeholder consultation with the Environment Agency and Staffordshire County Council, as the Lead Local Flood Authority (LLFA).

1.3.3 The proposed drainage network in the area of the M54 Junction 1, M6 Junction 11 and the existing A460 would utilise some existing outfalls (i.e. proposed road catchments 1, 2, 4, 6, 7, and 9, 11, 14, 15 and 16) with some new outfalls being constructed to drain the Scheme and remodelled junctions (i.e. road catchments 3, 5, 8, 10 and 14). Catchment 8 drains to existing outfall for Watercourse 3. Catchments 12 and 13 are drainage networks for Scheme permeable areas only (i.e. embankment runoff). All road network catchments are shown on Figure 2.1 in Appendix 13.2: Drainage Strategy [TR010054/APP/6.3]. The Figure also illustrates the location of each of the 17 road network catchments.

- 1.3.4 The with Scheme road catchments (i.e. road catchments 3, 5, 8, 10 and 14) are discharged to wet attenuation ponds for the purpose of balancing the flow, to provide treatment for pollutants in road runoff, and provide a final means of capturing any significant chemical spillage on the carriageway upstream of the final discharge to the receiving watercourse. Other treatment measures are also provided in combination with these ponds.
- 1.3.5 For some existing catchments, where there is a need and it can be reasonably delivered by the Scheme, new treatment measures are proposed. These are existing catchments 1, 2, 9, 15, 16 and 17. More information on the proposed treatment trains for each road network catchment is provided in Table 1.1.

Table 1.1: Treatment train for road network catchments

Road network catchment and description	Existing or new road catchment	Receiving waterbody (Watercourse =WC)	Existing treatment	Proposed additional treatment train	Other measures considered but discounted
1 - M54 westwards only	Existing	Drains to existing M54 drainage westwards to WC 7	Filter Drains within existing M54 drainage	Hydrodynamic Vortex Separator (HVS) connecting into existing M54 drainage.	Further mitigation options for example ditches/swales were considered; however, due to the site constraints of existing highway features, these were considered not viable.
2 - M54 eastwards only	Existing	Drains to existing M54 drainage westwards to WC 7	Filter Drains within existing M54 drainage	HVS connecting into existing M54 drainage.	Further mitigation options for example ditches/swales were considered; however, due to the site constraints of existing highway features, these were considered not viable.
3 - New roundabout and link roads north of M54 J1	New road catchment, which was part of existing catchment 3	Discharge to WC 1 new outfall	No current treatment – new catchment	Penstock upstream of wet attenuation Pond followed by a swale/grassed channel (lined) (approximately 70-80m) via open ditch.	Further mitigation options for example ditches/swales were considered; however, due to the site constraints of existing highway features, these were considered not viable.
4 - New roundabout and link roads south side of M54 J1	New road catchment, which was part of existing catchment 3	WC 1 - existing	No current treatment – new catchment	HVS and filter drains.	Further mitigation options for example ditches/swales were considered; however, due to the site constraints of existing highway features, these

Road network catchment and description	Existing or new road catchment	Receiving waterbody (Watercourse =WC)	Existing treatment	Proposed additional treatment train	Other measures considered but discounted
					were considered not viable.

Table 1.2: Treatment train for road network catchments - continued

Road network catchment and description	Existing or new road catchment	Receiving waterbody (Watercourse =WC)	Existing treatment	Proposed additional treatment train	Other measures considered but discounted
5 - Remodelled roundabout north east of M54 J1	New road catchment, which was part of existing catchment 3	WC 2 new outfall	No current treatment – new catchment	Penstock upstream of wet attenuation pond.	No comment.
6 - Section A460	Existing	WC 2 existing outfall	No current treatment – new catchment	None required.	No comment.
7 - Section of A460	Existing	WC 3 existing outfall	No current treatment – existing catchment	None as part of Scheme, The A460 is part of SCC network.	No comment.
8 - Link road from new roundabout to existing A460	New road catchment	WC 3 new outfall	No current treatment – new catchment	Penstock upstream of wet attenuation pond.	No comment.
9 - A460, with remodelled Hilton Lane flyover	Existing-modified	WC 4 existing outfall	No current treatment – new catchment	Length of filter drain on altered Hilton Lane.	Further mitigation options for example ditches/swales were considered; however, due to the site constraints of existing highway features, these were considered not viable.
10 - Main line of Scheme	New road catchment	WC 4 new outfall	No current treatment – new catchment	Filter drains where possible to approximately 60-70 m grass swale / ditch channel leading to a penstock then wet attenuation pond. Pond	No comment.

Road network catchment and description	Existing or new road catchment	Receiving waterbody (Watercourse =WC)	Existing treatment	Proposed additional treatment train	Other measures considered but discounted
				discharging via a ditch.	
11 - A460	Existing	WC 5 existing outfall	No current treatment – new catchment	None required.	No Comment
12 - Permeable only	N/A	WC 5 New outfall A	No current treatment – new catchment	None as not draining highway (embankment only) but separate outfall.	No comment
13 - Permeable only	N/A	WC 5 New outfall B	No current treatment – new catchment	None as not draining highway (embankment only) but separate outfall.	No comment

Table 1.3: Treatment train for road network catchments - continued

Road network catchment and description	Existing or new road catchment	Receiving waterbody (Watercourse =WC)	Existing treatment	Proposed Additional treatment train	Other measures considered but discounted
14 - Mainline Scheme and slip road to existing A460	New rod catchment	WC 5 New outfall C	No current treatment – new catchment	Filter drains to penstock, to wet attenuation pond.	Required mitigation was included within the design
15 - A460 north of M6 J11	Existing catchment – modified by the Scheme	WC 6	filter drains	Filter drains and roadside ditch.	Further mitigation options for example ponds were considered; however, due to minor attenuation being required this was not considered necessary.
16 - West roundabout and slip roads of M6 J11	Existing catchment – modified by the Scheme	Via M6 northbound drainage northwards to WC 6	Existing filter drains within the mainline M6	Filter drains within the new remodelled roundabout, and followed by swales on base of slip roads (serving slip roads). Mainline not included in new drainage provision). The	Further mitigation options for example ponds were considered; however, due to site constraints of existing highway features, these were not considered viable.

Road network catchment and description	Existing or new road catchment	Receiving waterbody (Watercourse =WC)	Existing treatment	Proposed Additional treatment train	Other measures considered but discounted
				swales will only take a proportion of the runoff from the roundabout, and half the mitigation potential of these has been used in the calculations accordingly.	
17 - East roundabout and slip roads of M6 J11	Existing catchment – modified by the Scheme	Via M6 southbound drainage northwards to WC 6	Existing filter drains within the mainline M6	As above.	Further mitigation options for example ponds were considered; however, due to site constraints of existing highway features, these were not considered viable

2 Methodology

2.1 Assessment guidance and approach

- 2.1.1 The assessment has been undertaken using guidance presented within LA113 (Ref 1.1) and the downloadable HEWRAT V2.0.4 and DMRB, Volume 4, Section 2, Part 3 – Geotechnics and Drainage (CG501) (Ref 1.2). Specifically, a Method A Step 3 Tier 1 HEWRAT assessment has been carried out for the proposed road catchment outfalls to determine the potential impact of road runoff on the local water environment, the effect of dilution in the watercourse, and the need for treatment measures.
- 2.1.2 Where watercourses discharge to ditches with little to no regular flow, a groundwater assessment from HEWRAT has also been undertaken to determine the risk to groundwater. This applies to road catchment 3 (Watercourse 1) and Catchment 9 (Watercourse 4) only.
- 2.1.3 The outputs of the HEWRAT assessment procedure are as follows;
- Whether the impact of the routine road runoff results in an accumulation of sediment bound pollutants which is unacceptable (i.e. over 100 deposition index);
 - Whether there is a risk of acute dissolved metal impact; and
 - An estimation of the annual average dissolved metal concentration from the routine runoff, taking into account the dilution within the receiving watercourse.
- 2.1.4 The following assessment outcomes and actions are presented in Table 2.1.

Table 2.1: Assessment of output from HEWRAT

Acute soluble and chronic sediment impacts	Annual average concentrations (compliance with EQS)	Action
Pass	Pass	1) No further action
Fail	Pass	1) Factor in effects of proposed mitigation and re-assess 2) Determine implications of redesign and reassess 3) Weight up benefits over whole project 4) Discuss with Overseeing Organisation and EPA and agree action
Pass	Fail	1) Factor in effects of proposed mitigation and re-assess 2) Check Sensitivity of modelling to input parameters (e.g. Q95) 3) Discuss with Overseeing Organisation and EPA and agree action

Acute soluble and chronic sediment impacts	Annual average concentrations (compliance with EQS)	Action
Fail	Fail	1) Factor in effects of proposed mitigation and re-assess 2) Redesign and reassess Discuss with Overseeing Organisation and EPA and agree action.

2.1.5 To establish the current drainage conditions and water quality risks, a HEWRAT analysis of the existing road outfalls was undertaken (i.e. for road catchments serving the existing M54 motorway (road catchments 1 and 2) and M6 motorway (road catchments 16 and 17) and the A460 (road catchment 15). Existing attenuation and treatment are initially not included in the analysis to highlight the background risk to the water environment, and then any existing or proposed treatment measures are considered.

2.1.6 The existing A460 road catchments (to the southwest of the M6) 6, 7, 9 and 11 have an Annual Average Daily Traffic (AADT) flow of less than 10,000 AADT per day. Pollution impacts from routine runoff depends on a large number of variables and confident correlations are difficult to establish. However, generally the risk of a significant impact increases with increasing AADT, and where the AADT exceeds 10,000 vehicles per day (although other factors such as the sensitivity of the receiving water environment are important considerations).

2.1.7 Traffic flows along the A460 are also much larger in the base year than they are predicted to be in the design year of 2039 with Scheme scenario, where the traffic flows are estimated to decrease in the region of 70-80%. As the traffic is less than the 10,000 AADT per day threshold, these existing road catchments (i.e. 6, 7, 9 and 11) have been assessed with a conservative traffic band of >10,000 to < 50,000 AADT (i.e. the lowest traffic band available in HEWRAT). The implementation of the Scheme will result in a decrease in traffic to these road catchments, and therefore represents a reduction in the risk to water quality from routine runoff, albeit the limitations of the HEWRAT assessment prevent this from being modelled directly.

2.2 Road runoff and spillage risk – Simple assessment

Surface Water Runoff Assessment

2.2.1 HEWRAT assesses the impact of routine runoff on receiving surface waters by considering the short-term water quality impacts from key parameters found in highway runoff; the longer term dissolved metal impacts (using copper and zinc as a proxy for a range of metals typically found in highway runoff); and the potential for chronic sediment impact on the receiving WC (and associated sediment-bound pollutants such as certain hydrophobic polyaromatic hydrocarbons (PAHs)).

- 2.2.2 Where the assessment indicates that discharges from the highway outfalls are failing to meet standards, then treatment measures must be considered. The efficiency of various treatment systems in terms of sediment removal, treatment of dissolved metals and hydrocarbons is described in the DMRB CG501 (Ref 1.2) and DMRB HA103/06 Vegetated Drainage Systems for Highway Runoff (Ref 1.3). These treatment efficiencies are based on previous water quality monitoring and testing undertaken by Highways England.
- 2.2.3 For those outfalls that are within 1 km of neighbouring outfalls that discharge to the same watercourses, cumulative assessments have been undertaken for the risk from dissolved metals. Where outfalls discharge to the same watercourse within 100 m of each other the cumulative assessment considers both metals and sediment-bound pollutants. This follows the approach given in DMRB (Ref 1.1).
- 2.2.4 Road catchments 12 and 13 are earthworks drainage catchments with no direct highway runoff and thus no quantitative assessment of these catchments has been undertaken.
- 2.2.5 The data used for the assessment of routine road runoff is summarised in Tables A1-A3 in Annex A.

Groundwater Assessment

- 2.2.6 Within the HEWRAT assessment system, the groundwater assessment considers the risk to groundwater through assessment of the generic processes that influence the level of groundwater protection inherent to different source and pathway characteristics. The risk assessment procedure is based on examination of the 'Source-Pathway-Receptor' protocol. The principle applied is that all elements of the source-pathway-receptor linkage must have to be present to create a pollutant linkage. The presence of the pollutant itself does not pose a risk to groundwater if there is no identifiable pathway.
- 2.2.7 Weighting factors are applied to each of the components in the assessment to reflect the fact that some of these components have a greater or lesser influence on the magnitude of the risk to groundwater. For example, in most circumstances, the depth of the unsaturated zone has a greater influence on risk than the soil organic matter or organic carbon, and so is weighted more heavily. The risk level for each component is then established (low risk = score 1, medium risk = score 2, high risk = score 3) and the relevant score multiplied by the weighting factor to provide component scores for all categories. The component scores are summed to give an overall risk score, with a lowest score of 100 and a highest score of 300. Scores below 150 show a low risk of impact to groundwater, scores of 150-250 show medium risk to groundwater, and scores over 250 indicate a high risk to groundwater.
- 2.2.8 Finally, the data used for the assessment of impacts to groundwater are provided in Tables A8 and A9, together with the results of the assessment.

Spillage risk

- 2.2.9 Within HEWRAT, the risk of an accidental spillage resulting in a serious pollution incident on a receiving water body is contained within the 'spillage risk assessment'. This also guides the need for spillage containment measures.

- 2.2.10 WCs should be protected so that the risk of a serious pollution incident has an annual probability of less than 1% (equivalent to a return period of 1 in 100 years), unless they are considered to be sensitive (e.g. covered by a SSSI designation), in which case a more stringent annual probability of 0.5% is applied (equivalent to a return period of 1 in 200 years). Where the risk is greater than the allowable standard, spillage containment measures can be designed into the drainage catchment to reduce the risk.
- 2.2.11 The data used for the spillage risk assessment is similar to that for the routine road runoff assessment and is summarised in Tables A1-A3 in Annex A.

Presentation of Results

- 2.2.12 The data used for the assessment of accidental spillage risk, and the results, are summarised in Table A10 in Annex A.

2.3 Detailed surface water assessment: metal bioavailability assessment tool (M-BAT)

- 2.3.1 The metal bioavailability tool (M-BAT), which was developed under the Water Framework Directive (WFD), helps to determine how bioavailable some dissolved metals are in the aquatic environment (Ref 3.1).
- 2.3.2 The bioavailability of a metal depends on several physico-chemical factors, which govern both metal behaviour and the interactions of the toxic forms of the metals with a biological receptor. For example, if the metal ions bind to carbonate ions or dissolved organic carbon (DOC), they are less 'bioavailable' and thus less likely to be able to bind to the organism and have an adverse effect.
- 2.3.3 The output from the M-BAT tool has been used to determine the maximum total copper concentration output from the HEWRAT assessment which would then lead to the maximum permitted bioavailable copper concentration of 1 µg/l, when combine with average ambient copper concentrations and taking into account other water quality factors. These are tabulated within Table A7 within Annex A.
- 2.3.4 From the results, the watercourses with the greater concentration of DOC are the watercourses where there may be a greater concentration of total copper within the stream before the permitted limit of 1 µg/l bioavailable copper is reached.

2.4 Assumptions and limitations

- 2.4.1 The assessment has been undertaken in November 2019 using best available data and the drainage design from Figure 2.1 within Appendix 13.2 [TR010054/APP/6.3], and details incorporated into the preliminary design of the Scheme, as described in Chapter 2: The Scheme of the ES [TR010054/APP/6.1].
- 2.4.2 The assessment has been undertaken with reference to the baseline data, information and records pertaining to the water quality derived from desk study sources. These were subsequently validated and enhanced through field surveys where land access was obtained from landowners.

- 2.4.3 The assessment is based on the best available known background water quality data provided by the Environment Agency (for Saredon Brook only), supplemented by project water quality monitoring undertaken between February 2019 to November 2019. Where access and flow in the channel permitted, samples have been collected on four occasions. The data from these samples represents those conditions at the time of the sampling only and the prevailing conditions. Water quality will vary constantly and over time and thus this data only provides an indication of a 'snap-shot' of water quality. However, some data was required to inform aspects of the HEWRAT and M-BAT assessments and this number of samples was considered appropriate, when interpreted in the context of background monitoring data held by the Environment Agency.
- 2.4.4 Water quality data from sampling of Watercourse 2 is being used as a proxy for Watercourses 1 and 7. Watercourse 2 is considered comparable to Watercourses 1 and 7 due to its nearby catchment location and proximity, land use, topography and geological factors. The sampling point for Watercourse 2 is also upstream of the assessment location for Watercourse 7. All three watercourses share the same underlying superficial and solid geology, with similar mainly rural catchments, with some inputs from the transport network.
- 2.4.5 The baseline monitoring had a limit of detection of <3 µg/l dissolved copper. In order to obtain baseline information for copper to add into the M-BAT assessment, the assumption has been made that where a data point is classed as '<' a numerical figure, this has been taken to be equal to the limit of detection for a conservative assessment.
- 2.4.6 As watercourse flow data is unavailable for any of the potentially impacted watercourses, calculation of Q95 low flows (i.e. the flow that is equalled or exceeded 95% of the time) has been undertaken through a desk-based exercise using catchment data and Wallingford Hydrosolutions Ltd LowFlows software. This is an estimation method that can be used for a first order estimate of the natural Q95 flow. The estimated flow data is therefore a best estimate. Locations for all low flow estimations are shown on Figure 13.2 of the Environmental Statement.
- 2.4.7 Road catchments 1 and 2 are known to drain westwards and have been assumed to discharge into Watercourse 7 as the likely recipient of drainage in this area due to the topography of the area. A drainage survey was commissioned to confirm drainage assumptions in June 2019. The drainage survey results confirmed that catchment 4 outfalls into Watercourse 1.
- 2.4.8 Estimates of channel width used in the assessment have been based on estimates obtained during a combination of a site visit undertaken on 25th July 2019, and from online aerial imagery, including Multi-agency Geographical Information for the Countryside (MAGIC) online maps (Ref 2.4).

- 2.4.9 The application of the likely treatment performance of different SuDS methods is based on advice reported in DMRB (Ref 1.1). The treatment performance of individual components of the treatment train is based on available data and best practice guidance contained in the DMRB (Ref 1.2). These are estimates, and professional judgement has been used when deciding on the percentage treatment a particular option may provide, taking into account the design of the SuDS feature and whether it is considered to be optimum or sub-optimum due to other constraints. SuDS and treatment trains are always bespoke and therefore some variance in treatment performance exists when compared to these indicative values. There may also be changes in the treatment performance over time, which is subject to the effectiveness and diligence of any maintenance regime and also to changes in the nature of traffic movements. For example, the conversion to more hybrid cars and the UK Government's policy (Ref 2.3) to ban new petrol and diesel cars by 2040 will reduce the risk from highway runoff as a significant source of highway derived pollutants from vehicle emissions and minor leaks of oil.
- 2.4.10 It is assumed that the ongoing maintenance of the HE assets will be maintained according to their best practice and maintenance schedules.
- 2.4.11 For the assessment of impacts to groundwater, the groundwater assessment used information from the ground investigation water monitoring for unsaturated zone depth. Flow type, effective grain size and lithology have been based on provisional results obtained from a Ground Investigation undertaken for the Scheme (Appendix 9.1 [TR010054/APP/6.3]). Further data on organic carbon, pH of the unsaturated zone and drainage area ratio were provided by the Ground Investigation and the drainage team respectively.
- 2.4.12 Where there are separate outfalls for each direction of travel along a section of trunk road or motorway, only the one-way AADT has been used (i.e. road catchments 16 and 17 draining the M6).

3 Assessment findings

3.1 Method A results

Assessment of existing drainage (without treatment)

- 3.1.1 The Step 1 Runoff quality assessment indicates that for all existing outfalls, runoff at the point of discharge prior to any dilution from receiving waters would be expected to have concentrations over the toxicity thresholds for both soluble metals and sediment-bound pollutants ('Fail'). Due to this result, a Step 2 River Impacts assessment has been undertaken in order to consider dilution in the WC.
- 3.1.2 For Step 2 HEWRAT requires input of ambient dissolved copper concentrations. There is limited background water quality data available from the Environment Agency. An Environment Agency sampling point for Latherford Brook upstream of Hilton Sewage Treatment Works (STW) and the Scheme (sampling point MD-72838180) has a monthly water quality record between 2000 and 2007 (77 samples) and recorded a dissolved copper range of between 2.53 µg/l (7th September 2005) to 17.2 µg/l (on 21st August 2006) with an average of 5.4 µg/l.
- 3.1.3 Ambient copper concentrations used in the HEWRAT assessment are based on watercourse specific water quality monitoring undertaken for the project and reported in Appendix 13.5 Water Quality Monitoring Results [TR010054/APP/6.3]. For all road catchments at Step 2, monitoring data for dissolved copper had a limit of detection of < 3 µg/l, which is above the 1 µg/l EQS concentration for copper. This means that it is not possible to confirm whether ambient dissolved copper concentrations are on average below the EQS of 1 µg/l. However, the nearest background Environmental Agency monitored data would suggest that dissolved copper concentrations are likely to be above the EQS. In light of the ambient dissolved copper data exceeding the EQS, all outfalls will automatically fail the short term dissolved copper test in HEWRAT.
- 3.1.4 The results of the Step 2 River Impacts assessment are presented in Table A4 in Annex A and is summarised below:
- The *existing* M54 road catchments 1 and 2 with no mitigation individually pass the HEWRAT assessment process for sediment-bound pollutants, acute metals and annual average copper concentration (using the MBAT assessment for annual average copper in Table A7 in Annex A).
 - Cumulatively, *existing* M54 road catchments 1 and 2 with no mitigation fail the soluble acute impact assessment for copper (2.2 annual exceedances) and pollutant sediment-bound pollutants (47% mitigation required to pass).
 - *Existing* road catchment 7 (part of the A460) and 8 (A460 north of M6 J11) fails the HEWRAT assessment process for sediment-bound pollutants (63% and 51% settlement required, respectively).
 - *Existing* Road catchment 15 (existing northbound A460 from the M54-M6 / M6 roundabout) fails the HEWRAT assessment process for sediment-bound pollutants (51% settlement required).

- *Existing* Road catchments 16 (west portion of the roundabout and slip roads forming M6 J11) and 17 (east portion of the roundabout and slip roads forming M6 J11) both fail the HEWRAT assessment process soluble acute impact assessment for copper (2.2 and 2.5 annual exceedances, respectively) and sediment-bound pollutants (79% and 82% settlement required, respectively).
- Cumulatively, *existing* M6 road catchments 15, 16 and 17 also fail the assessment process for acute soluble copper (6.3 Exceedances, 47% mitigation required for a pass).

3.1.5 The annual average EQS values are 1 µg/l for dissolved bioavailable copper and 10.9 µg/l for dissolved bioavailable zinc. When using the M-BAT results included in Table A7 in Annex A which shows the maximum total dissolved copper for the watercourse before the maximum permitted bioavailable copper is reached, all annual average total dissolved copper concentrations pass the assessment.

Assessment of Scheme drainage (without treatment)

3.1.6 The Step 1 Runoff quality assessment indicates that for all proposed new or modified outfalls, runoff at the point of discharge prior to any dilution from receiving waters would be expected to have concentrations over the toxicity thresholds for both soluble metals and sediment-bound pollutants ('Fail'). Due to this result, a Step 2 River Impacts assessment has been undertaken in order to consider dilution in the receiving watercourse.

3.1.7 The results of the Step 2 River Impacts assessment of the pollutant risk from routine road runoff from the Scheme is shown in Table A4 in Annex A, and screenshot images from the HEWRAT are presented in Annex B. The results are summarised below from Table A4 in Annex A:

- With Scheme individual road catchments 3, 4, 7, 9, 10, 14, 15, 16, and 17 all fail to meet the sediment-bound pollutants calculation and require the following percentage of treatment: 84%, 65%, 59%, 56%, 79%, 64%, 69%, 84%, and 82%, respectively. Road catchments 7 and 9 are the original A460 catchments to which little change is being made by the Scheme. Road catchments 15, 16 and 17 are existing and also failed this test in the base scenario without the Scheme.
- With Scheme individual proposed road catchments 1, 2, 5, 6, 7, 8, 11 and 14 pass the HEWRAT assessment for soluble acute impact from dissolved metals. The following are the original M54 or A460 road catchments: 1, 2, 6, 7, 8, 11 and 14.
- With Scheme individual road catchments 3, 4, 9, 10, 15, 16 and 17 fail the HEWRAT assessment for soluble acute impact from dissolved copper (note that road catchments 3 and 4 are modified catchment within J1 M54. Road catchments 9, 15, 16 and 17 are existing road catchments and also failed this test in the base scenario without the Scheme. Road catchment 15 passed in the existing scenario due to a smaller impermeable area (1.3 ha existing compared to 2 ha with Scheme).

- All road catchments pass the HEWRAT assessment for short term dissolved zinc and annual average copper and zinc concentrations. For the annual average copper test, this is based on M-BAT analysis and comparison with the maximum permissible dissolved copper concentrations as listed in Table A7 in Annex A.
- Cumulatively, road catchments 1+2, 3+4, 9+10, 15+16+17 fail the HEWRAT assessment for soluble acute impact from dissolved copper (note that road catchment 1+2 and 15+16+17 also fails this test in the base scenario); for catchment 9+10, the traffic predicted with the scheme along road catchment 9 is well below the 10,000 minimum AADT required for HEWRAT and thus the assessment is a conservative calculation and the real risk would be expected to be less and potentially not significant.
- For road catchments 1+2 cumulative, the acute soluble copper test is failed in the existing situation with a potential 2.2 exceedances per year (with 2 allowable) for both the existing and the proposed with Scheme situation. Therefore, there is no change to the existing situation. For road catchments 15+16+17 cumulatively, the acute soluble copper test is failed for the existing situation with potentially 6.3 exceedances per year (2 allowable). With the scheme but including mitigation the number of potential exceedance per year decreases to 4.8. Though a sensitivity analysis with an assessment point upstream of Saredon Brook shows just 3.7 exceedances per year for soluble acute copper.
- As shown in Table A4 in Annex A, no mitigation, for road catchments 3+4, 9+10 and 15+16+17 cumulatively, as the outfalls are further than 100 m apart there are no required for a sediment-bound pollutant assessment. For road catchment 1+2 cumulatively, the sediment-bound pollutant test is failed but there is a decrease in risk illustrated by the reduced treatment that is now required with the Scheme (i.e. from 47% to 41%). Road catchments 7+8 cumulative also fail the sediment-bound pollutant test with the Scheme requiring 67% treatment.

3.1.8 Therefore, the mitigation is required to address the failures described above as much as possible.

Assessment of Scheme drainage (with mitigation)

3.1.9 The treatments trains included for each road catchment are summarised in Table 1.1. A summary of the assessment with the assessments plus sensitivity analysis is included in Table 4.1.

3.1.10 The initial assessment has been repeated for outfalls failing to meet all HEWRAT tests with the incorporation of mitigation measures, using the treatment efficiencies outlined in DMRB CG501 (Ref 1.2), and summarised below in Table A5 in Annex A.

- 3.1.11 All results initially show a failure of the long-term copper EQS for reasons explained earlier. These results have been compared with the detailed M-BAT assessment included in Table A7 in Annex A. This shows the maximum concentrations of dissolved copper within the watercourse before the maximum permissible concentration of bioavailable copper of 1 µg/l is reached. All annual average dissolved copper and zinc concentrations predicted by HEWRAT for each outfall are below the EQS.
- 3.1.12 Results of the assessment of routine road runoff including mitigation are shown in Table A6 in Annex A. Most individual road catchments with the Scheme and mitigation now pass the assessment for acute dissolved copper impacts, with the exception of individual catchment 4 and 9. Sensitivity analysis of these two catchments with an assessment point upstream of the confluence with Saredon Brook results in a Pass in the HEWRAT assessment with the included mitigation.
- 3.1.13 Cumulative road catchments 1+2, 3+4, and 15+16+17 also fail against the acute dissolved copper test. In all cases, these road catchments also failed in the existing base scenario (for road catchments 3+4 this is based on the outcome of existing road catchment 3 as road catchment 4 is within the modified new J1 M54). Road catchment 9 also fails to meet the sediment-bound pollutant test.
- 3.1.14 Individual catchment 4 has mitigated the sediment-bound pollutants to an acceptable level of risk with filter drains and HVS. However, these do not provide any treatment of dissolved metals. The acute copper test results for road catchment 4 suggest that there is the potential for 7.5 exceedances per year. The original point of assessment for this road catchment was selected close to the outfall location, which is also close to the head of the catchment, and thus the estimate low flows are very small (i.e. a Q95 of just 1 l/s). A sensitivity analysis to repeat this assessment at a point slightly further downstream where there will be more dilution has been undertaken as is presented in Section 3.4 Sensitivity Analysis, and Table A6 in Annex A. With sensitivity analysis, Catchment 4 passes the HEWRAT assessment.
- 3.1.15 Individual catchment 9 is the current A460, with an AADT in 2039 predicted to be just 3338 vehicles. The lowest available traffic band used within the HEWRAT assessment is <10,000 to < 50,000 vehicles. It therefore considerably overestimates the risk resulting in a very conservative assessment. Additionally, the exceedances of acute dissolved copper in the existing situation are calculated to be 2.5 times annually, which is the same as the proposed situation. In terms of sediment-bound pollutants, the residual treatment needed once new filter drains along Hilton Lane have been taken into account is 13%, an improvement from 54% for the base scenario. Therefore, the Scheme does not worsen the current situation, and in reality, probably reduces the risk, albeit assessment limitation prevents this from being illustrated accurately in the results. Cumulative assessment of the existing road catchments 1+2 includes consideration of the existing filter drains alongside the M54, the proposed filter drains within the remodelled M54 Junction 1, and new HVS on both individual road catchments to reduce potential impact from suspended solids (including particulate metals and any adsorbed hydrocarbons associated with sediments). However, HVS do not provide any treatment of dissolved metals, and thus there is still a failure against

the acute copper EQS. However, as there is no increase in the number of potential exceedances of short-term copper per year with the Scheme, the Scheme does not worsen the situation. The inclusion of the HVS also provides a trap for any floating plastic waste to stop it reaching the watercourse. The works being carried out within this road catchment area is limited to new signage only and will not have any impact on the pollution risk from highway runoff. This road catchment could be considered as a candidate for designated funds for a future project to address the existing highway runoff risk. Only 4% of treatment of dissolved metals would lead to a pass against the acute soluble copper HEWRAT test. This could be provided by changing the filter media within the filter drains to a substance which adsorbed soluble copper (e.g. zeolite).

- 3.1.16 The cumulative assessment for road catchments 15+16+17 still shows a failure for acute copper concentrations. In the existing situation, the results suggest that there is a potential for 8.2 exceedances per year (which is more than the two allowable exceedances per year). In the proposed Scheme scenario, it is predicted that only 4.8 exceedances per year may occur. However, the chosen assessment location for this assessment was a point near the head of the catchment with a low Q95 flow, a sensitivity analysis has been undertaken. This uses a point upstream of the Saredon Brook confluence. When using this assessment point further downstream, the number of exceedances per year reduce to approximately 3.7. Although still predicted to be above 2 per year target, it is a significant decrease on the existing potential 8.2 exceedances per year.
- 3.1.17 Additionally, the cumulative assessment point for road catchments 15+16+17 is close to the Scheme location, which is towards the head of the catchment, with a resultant low Q95 flow. This catchment is therefore chosen to be a re-assessed using a sensitivity analysis for a point further downstream. Please see Section 3.4 Sensitivity Analysis.

3.2 Comparison of with and without Scheme for existing road catchments

- 3.2.1 The HEWRAT assessment has also been applied to existing road catchments that are affected by the proposed Scheme. The outcome of this HEWRAT assessment has identified some failures for existing road catchments with existing treatment measures. This is described in Table 3.2.
- 3.2.2 Some additional treatment measures have been added, that reduce the risk, but it has not been possible to resolve all the existing failures. The addition of the following represents an improvement in the mitigation provided for the existing outfalls:
- Addition of a HVS to existing road catchments 1 and 2.
 - Addition of filter drains to the section of Hilton Lane being altered within road catchment 9.
 - Addition of filter drains and roadside ditches for existing road catchment 15.
 - Addition of swales at the base of embankments for existing road catchments 16 and 17.

3.2.3 Table 1.1 provides further information on alternative treatments that were considered and why they were not included in the drainage design.

Table 3.2: Comparison of Existing Road Outfalls HEWRAT Results with and without the Scheme (for Design Year)

Road Catchment (Watercourse)	Description of road catchment	Existing HEWRAT outcome without Scheme and mitigation (Design Year)	Description of Proposed Mitigation	HEWRAT outcome with Scheme and mitigation (Design Year)
1+2 (Watercourse)	M54 east and west bound, west of J1	Sediment-bound pollutants failure (47% mitigation required to pass the assessment), and acute dissolved copper concentration (2.2 exceedances per year – 8% mitigation required to pass assessment).	Existing filter drains to be enhanced with HVS to decrease impact from sediment bound pollutants	Acute dissolved copper concentration (2.2 exceedances per year – 4 % mitigation required to pass assessment)
3 (Watercourse 2)	M54 J1 roundabout	Sediment-bound pollutants failure (93% mitigation required for a pass) and acute dissolved copper concentration (8.8 exceedances per year – 53% mitigation required to pass the assessment)	Penstock to catch any spillages, wet attenuation pond and a length of swale	Pass
3+4 (with 4 only existing in the With Scheme) (Watercourse 2)	M54 remodelled J1 roundabout	Failure of acute dissolved copper concentration (10.9 exceedances per year – 53% mitigation required to pass the assessment)	Penstock to catch any spillages, wet attenuation pond and a length of swale to catchment 3, and filter drains and HVS to catchment 4	PASS with 22% treatment for soluble metals included: and with sensitivity analysis with point further downstream Q ₉₅
9 (Watercourse 4)	Section of A460 including Hilton Lane	Existing failure of sediment-bound pollutants (54% mitigation required for a pass), and acute dissolved copper concentrations (2.5 exceedances per year - 13% mitigation required to pass the assessment)	Filter drains to be installed on the remodelled Hilton Lane towards the A460. No other mitigation possible.	Failure of sediment-bound pollutants (43% mitigation required for a pass), and acute dissolved copper concentrations (2.5 exceedances per year). However, a conservative assessment has been undertaken as HEWRAT does not have traffic bands as low as the predicted traffic along this road catchment. Improvement in suspended solids from the catchment.

Table 3.2: Comparison of Existing Road Outfalls HEWRAT Results with and without the Scheme (for Design Year) - continued

Road Catchment (Watercourse)	Description of road catchment	Existing HEWRAT outcome without Scheme and mitigation (Design Year)	Description of Proposed Mitigation	HEWRAT outcome with Scheme and mitigation (Design Year)
15 (Watercourse 6)	A460 north of M6 J11	Sediment-bound pollutants (51% mitigation required for a pass).	Filter drains and roadside ditch alongside remodelled carriageway	Pass
16 (Watercourse 6)	West roundabout and slip roads of M6 J11	Sediment-bound pollutants (79% mitigation required for a pass). Acute copper 2.2 exceedances (requires 4% mitigation for a pass). Sediment-bound pollutants failure.	Filter drains and swales next to slip roads	Pass
17 (Watercourse 6)	East roundabout and slip roads of M6 J11	Sediment-bound pollutants (82% mitigation required for a pass). Acute copper 2.5 exceedances (requires 12% mitigation for a pass).	Filter drains and swales next to slip roads	Pass
15+16+17 (Watercourse 6)	As above	Acute copper 6.3 exceedances (requires 47% mitigation for a pass).	Filter drains and swales next to slip roads for catchment 16+17, filter drains and roadside ditch for road catchment 15	Acute copper 4.8 exceedances (requires an extra 30% treatment to pass but improvement on existing)

3.3 Detailed surface water assessment: Metal bioavailability assessment tool (M-BAT)

- 3.3.1 Due to failure of the HEWRAT simple assessment, this has triggered the use of the M-BAT tool.
- 3.3.2 Table A7 in Annex A tabulates the results of the assessment. The risk characterisation ratio represents a ratio to show the predicted bioavailable copper divided by the bioavailable copper of 1 µg/l. If the risk ratio exceeds the value of 1, this demonstrates a failure, whereby the predicted bioavailable copper is greater than the EQS and may adversely affect biological receptors.
- 3.3.3 Using the M-BAT tool, it is demonstrated that no further mitigation measures are necessary, as the risk characterisation ratio for all relevant road catchments with the Scheme and proposed treatment (See Table 1.1), are below 1.

3.4 Sensitivity analysis

- 3.4.1 For road catchments 4, cumulatively 3+4, and cumulatively 15+16+17, an assessment location was chosen close to the outfall location. However, as these are close to the head of the catchment a low Q95 of 1 l/s was calculated, which increases the risk of a failure. HEWRAT was not designed to assess the risk in drainage ditches, but there is also limited guidance as to where to locate the point of assessment. As per LA113 (Ref. 1.1), the sensitivity of the modelling to Q95 has been examined, as it may be showing failure due to a location near to the head of the stream catchment being chosen. The outcome of this sensitivity analysis is presented in Table A5 in Annex A and summarised below.
- 3.4.2 For road catchment 4 and cumulatively 3+4, a downstream location near the confluence with Watercourse 7 has been chosen. This has a Q95 of 6 l/s. The results of the sensitivity analysis are included within Table A6 in Annex A. At this location road catchment 4 and road catchments 3 + 4 cumulatively pass all the HEWRAT tests. the assessment using a point slightly further downstream.
- 3.4.3 For cumulative road catchment 15+16+17 a point close to the head of the catchment was also assessed and as such a low Q95 value was calculated and used in the original assessment. As a result, a sensitivity analysis was repeated for this cumulative catchment using a Q95 value calculated for a point further downstream near the watercourses' confluence with Saredon Brook. Using the downstream point of assessment, there is still a failure for dissolved acute copper, although the number of annual exceedances reduces from approximately 8.2 per year to approximately 3.7 per year.

3.5 Groundwater assessment

- 3.5.1 Results of the Method C assessment for road catchments 3, 8 and 9 are shown in Tables A8 and A9 in Annex A. All of the sites are assessed as presenting a medium risk to groundwater, due to being located on granular deposits of sand with gravel with a low clay content and a thin unsaturated zone.

- 3.5.2 As the groundwater risk assessment returns the result of a medium risk to groundwater further assessment is required to determine the potential risk to groundwater in the area of Watercourse 1 and Watercourse 4. Additionally, the risk to groundwater from infiltration in the area of M6 Junction 11 has been assessed due to the use of grassed channels/swales in this area.
- 3.5.3 Based on the results of the groundwater level monitoring between July and November 2019, it is considered that the groundwater in the superficial deposits and in the sandstone aquifer is in continuity with the existing surface water system and that groundwater provides baseflow discharge to the watercourses. Accordingly, in most situations the groundwater level is above the water level in the ditch and water in the ditch, including road drainage, cannot infiltrate to the groundwater. In this situation, the ditch does not perform as a soakaway and the groundwater assessment is invalid.
- 3.5.4 In the upper reaches of the ditches, it is possible that the invert of the ditch is above the groundwater level especially during drought periods. In this situation, it is likely that the ditches are dry and could act as a soakaway during road runoff events. However further downstream (possibly only a few 10 m/s), the invert of the ditch will intercept the groundwater level and any water that has infiltrated upstream will discharge to the ditchcourse as baseflow. Accordingly, it is considered that any impacts on groundwater in this situation will be negligible and limited to the short section of the dry ditchcourse.
- 3.5.5 As the sites are of medium risk of road runoff, mitigation measures should be considered to protect groundwater. As described above, treatment measures have been identified for these networks in Appendix 13.2 [TR010054/APP/6.3], and HD33/16 indicates that the use of attenuation ponds and swales are suitable mitigation. Therefore, the mitigation measures identified in Section 13.8 would provide protection of both groundwater resources as well as surface watercourses.

3.6 Accidental spillage risk

- 3.6.1 The probability that an accidental spillage would lead to a serious pollution incident has been calculated for each road catchment and for the cumulative outfalls identified in Section 3. The data used for the assessment of accidental spillage risk is summarised in Table A10 in Annex A.
- 3.6.2 The results are also shown in Table A10 in Annex A for each road catchment in the absence of mitigation. These indicate that the annual probability of a spillage incident is lower than the minimum acceptable standard of 1% (1 in 100 years) in all cases.
- 3.6.3 The road catchments posing the most risk to the receiving water environment are the existing outfalls to Watercourse 6, where the risk of spillage is 1 in 443 and 1 in 477 for road catchments 16 and 17, respectively. This was determined in the absence of mitigation, which indicated that the probability would be further reduced with treatment measures incorporated into the Scheme design. Reductions in the probability of spillage related to the various mitigation measures are as follows, as outlined in DMRB CG501 (Ref 1.2):

- Filter drain – 40%;
- Wetland – 50%;
- Swale – 40%;
- Vegetated ditch – 30%;
- Penstock/valve – 60%; and
- Oil separator – 50%.

3.6.4 All the catchments have returned as acceptable standard of spillage risk, as shown in table A10 in Annex A.

4 Conclusions

- 4.1.1 A HEWRAT assessment of potential impacts of the Scheme on the water environment, including impacts on surface water and groundwater due to routine runoff and an assessment of accidental spillage risk, has been undertaken in accordance with DMRB guidance (Ref 1.1, Ref 1.2).
- 4.1.2 The Scheme design includes a mix of proprietary and sustainable drainage measures reflecting planning policy and site-specific constraints. Depending on the road catchment, filter drains, ponds, and lengths of grassed swales are all included, as shown in Table 1.1.
- 4.1.3 A summary of the assessment process is included in Table 4.1. All of the with Scheme outfalls (individually and cumulatively) for the new link road between the M6 and the M54 pass all aspects of the HEWRAT assessment (i.e. road catchments 3, 4, 5, 8, 10, and 14. For outfalls 4 and 3+4 this is at an assessment point slightly further downstream of the initial discharge, due to this being at the head of a first order ditch where there is very limited dilution. The with Scheme scenario is also an improvement on the current situation.
- 4.1.4 The HEWRAT assessment has also been applied to existing road catchments that are affected by the proposed Scheme. The outcome of this HEWRAT assessment has identified some failures for existing road catchments. Some additional treatment measures have been added by this Scheme that reduce the risk, but it has not been possible to resolve all the existing failures. The comparison of the existing failures with the 'With Scheme' assessment are shown in Table 3.2. This shows that for road catchments 1+2 cumulatively the result for with and without the Scheme for acute copper is the same, a failure with potentially 2.2 exceedances per year. However, the Scheme includes HVSs which will help to treat sediment-bound pollutants. By using a downstream assessment point for sensitivity analysis, the HEWRAT assessment passes for road catchments 1+2 cumulatively. Please note that the only works being undertaken in road catchments 1+2 are improvements to existing road signs.
- 4.1.5 The existing road catchment 3 (M54 Junction 1 roundabout) is currently failing with 93% mitigation required for sediment-bound pollutants, and a predicted 8.8 acute copper exceedance per year. Within the remodelled roundabout, road catchments 3+4 (cumulatively) outfall to Watercourse 1. However, with the mitigation measures proposed the potential acute dissolved copper exceedances is a Pass with 24% treatment for soluble metals included with Scheme measures.
- 4.1.6 Watercourse 4, road catchment 9, currently has a potential failure of sediment-bound pollutants (54% mitigation required for a Pass), and 2.5 potential acute copper exceedances per year. The Scheme will add filter drains on part of Hilton Lane, which will decrease the amount of sediment-bound pollutants discharging to Watercourse 4 and represent an improvement over the existing situation. As illustrated by the sensitivity analysis, using a point slightly further downstream for the assessment, road catchment 9 passes all the HEWRAT assessment. The reach over which the HEWRAT failure applies is therefore small, and is not surprising given the small nature of the receiving watercourses in the headwaters of the catchment.

Additionally, for road catchment 9, the assessment uses a conservation traffic flow band of <10,000 - <50,000 vehicles per day, the lowest available in HEWRAT. As traffic flows are predicted to be significantly lower it is likely that the risk to the receiving watercourse is lower than it has been possible to estimate using HEWRAT.

- 4.1.7 For cumulative road catchment 15+16+17, the existing situation is failure for acute copper with a predicted 6.3 exceedances per year. However, although the failure to meet the test is not eliminated, with the Scheme and mitigation measures the number of exceedances estimated each year falls by almost half to 4.8. The outcome of a sensitivity analysis shows a further decrease to a potential 3.7 exceedances when an assessment point further downstream is used. This is an improvement over the existing situation.
- 4.1.8 Watercourses 1 and 4 (which are discharged to by road catchments 3, 4, 9 and 10) all discharge to minor drainage ditches and have low Q95 flows below 0.001 m³/s, and therefore were assessed as soakaways using Method C. All of the sites have been assessed as representing a medium risk to groundwater. DMRB CG501 (Ref 1.2) indicates that the use of lined swales and constructed wet attenuation ponds in medium groundwater risk areas; therefore, these mitigation measures have been incorporated in the design of the Scheme to also provide protection to groundwater.
- 4.1.9 The assessment has confirmed that all road catchments pass the assessment of accidental spillage risk.

Table 4.1 Summary matrix of results of Proposed Scheme with mitigation

Proposed road catchment, and description	HEWRAT short term metal and chronic sediment-bound pollutant tests	Assessment against annual average EQS
Proposed road catchment 1+2	Failure for Acute copper at 2.2 exceedances (2 acceptable). Existing situation is also 2.2	PASS
Sensitivity assessment of proposed road catchment 1+2	PASS	PASS
Road catchment 3 (new roundabout and link roads north of M54 J1 (this is a new road catchment, which was part of existing road catchment 3))	PASS	PASS
Road catchment 4 (new roundabout and link roads south side of M54 J1 (this is a new road catchment, which was part of existing road catchment 3))	Failure of acute copper at 7.5 exceedances (2 acceptable). Existing situation is 8.8 exceedances for the existing roundabout catchment.	PASS
Sensitivity analysis for road catchment 4 (new roundabout and link roads south side of M54 J1 (this is a new road catchment, which was part of existing road catchment 3))	With sensitivity analysis using a point downstream: PASS	PASS
Proposed cumulative road catchment 3+4	Failure of acute copper at 4.4 exceedances (2 acceptable). Existing situation is 8.8 exceedances for the existing roundabout catchment	PASS
Sensitivity analysis of proposed cumulative road catchment 3+4	PASS	PASS
Road catchment 5 - Remodelled roundabout north east of M54 J1 (this is a new catchment, which was part of existing catchment 3)	PASS	PASS
Road catchment 6 - Section of existing A460	PASS	PASS
Road catchment 7 - Section of existing A460	PASS	PASS
Road catchment 8 - Link road from new roundabout to existing A460 (no existing road in this area)	PASS	PASS
Proposed road catchment 7+8, with mitigation on road catchment 8	PASS	PASS

Table 4.1 Summary matrix of results of Proposed Scheme with mitigation – continued

Proposed road catchment, and description	HEWRAT short term metal and chronic sediment-bound pollutant tests	Assessment against annual average EQS
Road catchment 9 - Existing A460, with remodelled Hilton Lane flyover	Failure of acute copper at 2.5 exceedances (2 acceptable) Existing situation is 2.5 exceedances for the existing catchment	PASS
Road catchment 9 Sensitivity assessment of existing A460	PASS	PASS
Road catchment 10 - Main line of Scheme (new road catchment as proposed as the Scheme)	PASS	PASS
Cumulative road catchment 9+10	Failure of acute copper at 2.8 exceedances (2 acceptable). Existing situation is 2.5 exceedances for road catchment 9	PASS
Sensitivity analysis of road catchment 9+10	PASS	PASS
Road catchment 11 - Existing A460	PASS	PASS
Road catchment 12 - Permeable only	n/a	n/a
Road catchment 13 - Permeable only	n/a	n/a
Road catchment 14 - Mainline Scheme and slip road to existing A460 (new road catchment as proposed as the Scheme)	PASS	PASS
Road catchment 15 - A460 north of M6 J11 (existing catchment, which is modified)	PASS	PASS
Road catchment 16 - West roundabout and slip roads of M6 J11 (existing catchment, which is modified)	PASS	PASS
Road catchment 17 – East roundabout and slip roads of M6 J11 (existing catchment, which is modified)	PASS	PASS

Table 4.1 Summary matrix of results of Proposed Scheme with mitigation – continued

Proposed road catchment, and description	HEWRAT short term metal and chronic sediment-bound pollutant tests	Assessment against annual average EQS
Cumulative for road catchment 15+16+17	Failure of acute copper at 4.8 exceedances (2 acceptable). Existing situation is 6.3 exceedances for catchment 15+16+17. This is an improvement over existing situation	PASS
Sensitivity analysis for cumulative road catchment 15+16+17	Failure of acute copper at 3.7 exceedances (2 acceptable). Existing situation is 6.3 exceedances for catchment 15+6+17.	PASS

5 References

- Ref 1.1 Design Manual for Roads and Bridges (DMRB) LA113 Road Drainage and the Water Environment (formerly HD45/09). Highways Agency (2019).
- Ref 1.2 Design Manual for Roads and Bridges, Volume 4, Section 2, Part 3 – Design of Highway Drainage Systems (CG501). Highways England (2019).
- Ref 1.3 Design Manual for Roads and Bridges, Volume 4, Section 2, Part 1 – Vegetated Drainage Systems for Highway Runoff (HA103/06). Highways Agency (2006).
- Ref 2.1 British Geological Survey's Geindex website. Available at: <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> (accessed October 2019).
- Ref 2.2 Cranfield University's Soilscales website. Available at: <http://www.landis.org.uk/soilscales> (accessed October 2019).
- Ref 2.3 UK Government, 2017 Policy Paper: Air quality plan for nitrogen dioxide (NO₂) in UK. Department for Environment, Food & Rural Affairs (2017).
- Ref 2.4 Multi-agency Geographical Information for the Countryside website. Available at: <https://magic.defra.gov.uk> (last accessed December 2019).
- Ref 3.1 The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. The Stationary Office (2015).
- Ref 3.2 UKTAG, 2014. 'UKTAG River and Lake Assessment Method Specific Pollutants (Metals): Metal Bioavailability Assessment Tool (M-BAT), UK Technical Advisory Group on the Water Framework Directive.'

Annex A: HEWRAT data and assessment results

The following tables present the data used within the HEWRAT assessment, and the analysis of the results of the assessment, as referenced in Sections 1 to 3 of this report.

Table A1: Q95 flow data for the WCs receiving discharge

WC	Q95 estimated from LowFlows Software	Sensitivity Analysis
1	0.001 m ³ /s	As WC 7: 0.006 m ³ /s
2	0.003 m ³ /s	As WC 7: 0.006 m ³ /s
3	0.003 m ³ /s	Upstream of Saredon Brook 0.006 m ³ /s
4	0.001 m ³ /s	Upstream of Saredon Brook 0.01 m ³ /s
5 (WFD Latherford Brook)	0.004 m ³ /s	Upstream of Saredon Brook 0.01 m ³ /s
6	0.002 m ³ /s	0.003 m ³ /s
7	0.006 m ³ /s	0.006 m ³ /s

Table A2: Drainage Data for the catchments (from HE514465-ACM-HDG-M54_SW_PR_Z-D|R-CD-0004 P03.1 rcvd 22nd November 2019)

Water-course	Existing Road catchment	Proposed Road catchment	Description	Proposed impermeable (ha)	Proposed permeable (ha)	Notes
7	1	1	Existing M54 west bound and remodelled Junction 1 M54	1.274	1.209	M54 west
7	2	2	Existing M54 eastbound and remodelled Junction 1 M54	1.063	0.176	M54 east
1	3	3	New roads part of remodelled Junction1 M54 and northbound M54-M6 link	3.189	5.004	WC 1 new outfall
2	n/a	4	New roads part of remodelled Junction1 M54 and southbound M54-M6 link	5.511	5.097	WC 2
	3	5	New roads part of remodelled Junction1 M54 and northbound M54-M6 link	1.151	1.460	WC2 new highway outfall
	4	6	Existing A460 south near J1 M54	0.121	0.082	WC highway outfall 2
3	5	7	Existing A460 in area of Hilton Lane	1.816	0.115	WC Existing 3
	n/a	8	New Link road J1 to A460	0.474	0.783	WC 3 New
4	6	9	Existing A460	1.644	1.035	WC existing 4
	n/a	10	New M54-M6 Link road mainline	3.353	4.050	WC 4 new
5	7	11	Existing A460	0.351	0.017	WC existing 5
	n/a	12	Permeable area only	0	0.513	WC 5 New A
	n/a	13	Permeable area only	0	0.515	WC 5 new B
	n/a	14	New M54-M6 Link road mainline	3.492	3.285	WC 5 new C

Table A2: Drainage Data for the catchments (from HE514465-ACM-HDG-M54_SW_PR_Z-D|R-CD-0004 P03.1 rcvd 22nd November 2019) - continued

Water-course	Existing Road catchment	Proposed Road catchment	Description	Proposed impermeable (ha)	Proposed permeable (ha)	Notes
6	8	15	A460 north from Junction 11 M6 roundabout	2.000	0.798	WC 6
	9	16	Existing M6 northbound and western side of remodelling Junction 11 M6	3.780	3.574	M6 northbound outfall to WC 6
	10	17	Existing M6 southbound and eastern side of remodelling Junction 11	3.964	4.169	M6 southbound outfall to WC 6

Table A3: Data used within the HEWRAT assessment for the Scheme

Parameter	Source	Data
Location description	M54 – M6 Link	Scheme drawings.
AADT BAND	<p>Max AADT:</p> <p>Catchment 1: >50,000-<100,000 (westbound carriageway M54)</p> <p>Catchment 2: >50,000-<100,000 (eastbound carriageway M54)</p> <p>Catchment 3: >50,000-<100,000 (mainline section)</p> <p>Catchment 4: >10,000-<50,000 (southbound from eastern dumb-bell)</p> <p>Catchment 5: >10,000-<50,000 (northbound approach from south)</p> <p>Catchment 6: 10,000-<50,000 (J1 to A460 road)</p> <p>Catchment 7: <10,000 NO HEWRAT REQUIRED (A460)</p> <p>Catchment 8: >10,000-<50,000 (J1 to A460 road)</p> <p>Catchment 9: <10,000 NO HEWRAT REQUIRED (A460)</p> <p>Catchment 10: >50,000 - <100,000 (mainline M54-M6 link)</p> <p>Catchment 11: <10,000 NO HEWRAT REQUIRED (A460)</p> <p>Catchment 12: Permeable area only NO HEWRAT REQUIRED</p> <p>Catchment 13: Permeable area only NO HEWRAT REQUIRED</p> <p>Catchment 14: >50,000 - <100,000 (mainline M54-M6 link)</p> <p>Catchment 15: >50,000 - <100,000 (A460 north from J11 M6)</p> <p>Catchment 16: >10,000 - <50,000 (northbound M6 only)</p> <p>Catchment 17: >10,000 - <50,000 (southbound M6 only)</p>	<p>Traffic (updated) SATURN Plots received by email 8th August 2019.</p> <p>Do something 2039 AADT, % HGV traffic flows,</p>
Climatic Region	Warm/dry	Embedded in HEWRAT programme
Rainfall Site	Birmingham	Embedded in HEWRAT programme
Impermeable Road Area Drained	See Table of impermeable/permeable areas	Figure 2.1 of Appendix 13.2 [TR010054/APP/6.3]
Permeable Road Area Drained	See Table of impermeable/permeable areas	As above

Table A3: Data used within the HEWRAT assessment for the Scheme - continued

Parameter	Source	Data
Annual Q95 flow (m ³ /s)	WC 1: 0.001m ³ /s, use WC 7 point further downstream for sensitivity analysis WC 2: 0.003 m ³ /s, use WC 7 point further downstream for sensitivity analysis WC 3: 0.003 m ³ /s, sensitivity analysis upstream of Saredon Brook, 0.006 m ³ /s WC 4: 0.001 m ³ /s, sensitivity analysis upstream of Saredon Brook, 0.01 m ³ /s WC 5: 0.004 m ³ /s, sensitivity analysis upstream of Saredon Brook, 0.01m ³ /s WC 6: 0.002 m ³ /s, sensitivity analysis upstream of Saredon Brook, 0.003m ³ /s WC 7: 0.006 m ³ /s	Calculated using Wallingford Hydrosolutions Ltd LowFlows software
Baseflow Index (BFI)	0.5	No specific data. Adopted default value as suggested by HEWRAT Manual
Average of monitored dissolved Copper Concentration from March, June and September 2019 Monitoring	WC 1: as WC 2 WC 2: 3 ug/l WC 3: 4 ug/l WC 4: 3 ug/l WC 5: 5 ug/l WC 6: 4 ug/l WC 7: 3 ug/l Where the concentration is <LOD, the value is taken to be equal to the LOD.	Site specific monitoring Data.
Proximity to Area of Ecological Conservation	Lower Pool SBI, the pond (Upstream of Road Drainage outfall) Brookfield Farm SBI, wet woodland (Upstream of Road Drainage outfall)	Ecology Chapter of ES Report
Water Hardness	High >200 mg CaCO ₃ /L.	Environment Agency Data at Saredon/Wyrley/Wash Brook at Wedges Mill. Downstream data on River Penk at Lower Green Coven on WIMS website ¹
Proximity to Downstream Structure	Based on site surveys	

¹ <https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3356>

Table A3: Data used within the HEWRAT assessment for the Scheme - continued

Parameter	Source	Data
Estimated River Width	WC 1: 1 m (from MAGIC map), 2.5m for sensitivity analysis	Approximated at site visit by hydromorphologist, and measured from MAGIC map
	WC 2: 0.5 m (from onsite observation), 2.5m for sensitivity analysis	
	WC 3: 1 m (from onsite observation), 2.5 m for sensitivity analysis (from MAGIC map)	
	WC 4: 1.5 m (from onsite observation), , 2.5 m for sensitivity analysis (from MAGIC map)	
	WC 5: 2.5 m (from onsite observation) , 2.5 m for sensitivity analysis (from MAGIC map)	
	WC 6: 1 m (from onsite observation), 1.5 m for sensitivity analysis (from MAGIC map)	
	WC 7: 2.5 m (from MAGIC map)	

Table A4: HEWRAT assessment results for outfalls to be used in the Scheme

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Existing Catchment 1										
1	WC Existing Outfall 7	WC 7	Pass	Pass	Yes	No	87	n/a	3.22 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	0.54
Proposed Catchment 1 (No mitigation)										
1	M54 West Outfall	WC 7	Pass	Pass	Yes	No	92	n/a	3.23 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	0.56
Existing Catchment 2										
2	WC Existing Outfall 7	WC 7	Pass	Pass	Yes	Yes	100	1%	3.24 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	0.61
Proposed Catchment 2 (No mitigation)										
2	M54 East Outfall	WC 7	Pass	Pass	Yes	No	77	n/a	3.21 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	0.48

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed	EQS: 1 µg/l	EQS: 10.9 µg/l
Existing Cumulative Catchments 1 + 2										
Existing Cumulative Catchment 1 + 2	WC 7	WC 7	Fail (2.2 exceedances, 2 acceptable)	Pass	Yes	Yes	187	47%	3.66 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	2.59
Proposed Cumulative Catchments 1 + 2 (No mitigation)										
Catchment 1 and 2 (M54 east and west)	WC 7 – assumed south and north outfall – within 100m	WC 7	Fail (2.2 exceedances, 2 acceptable)	Pass	Yes	Yes	169	41%	2.12 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	2.39
Existing Catchment 3 (No mitigation) This is equivalent to Proposed Catchment 3 + 4 as existing roundabout catchment split with Scheme.										
Existing Catchment 3 (All M54 J1)	WC 1 New Outfall	WC 1	Fail (8.8 exceedances, 2 acceptable)	Pass	Yes	Yes	1276	93%	4.93 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	5.53
Proposed Catchment (No mitigation)										

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed	EQS: 1 µg/l	EQS: 10.9 µg/l
Catchment 3 (north section of M54 J1)	WC 1 New Outfall	WC 1	Fail (4.7 exceedances, 2 acceptable)	Pass	Yes	Yes	608	84%	4.35 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	3.89
Catchment 4 (south section of M54 J1)	WC 1 New Outfall	WC 1	Fail (2.6 Exceedances, 2 acceptable)	Pass	Yes	Yes	264	65%	3.84 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	2.37
Cumulative Assessment Catchment 3 + 4 (excluding Sediment) of Proposed Catchment (No Mitigation)										
Catchment 3 + 4 (200m) (south & north of M54 J1)	WC 1 existing & outfall	WC 1	Fail (10.9 exceedances, 2 acceptable)	Pass	Not Required				5.13 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	6.09
Proposed Catchment 5 (No mitigation)										
Catchment 5 (northeast of M54 J1)	WC 2 Highway Outfall	WC 2	Pass	Pass	Yes	No	59	n/a	3.28 (less than 5.75 µg/l is a pass using M-BAT for WC 2 – see Table A7)	0.74

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed	EQS: 1 µg/l	EQS: 10.9 µg/l
Proposed Catchment 6 (No mitigation)										
Catchment 6 (A460 – no changes)	WC Highway Outfall	WC 2	Pass	Pass	Yes	No	6	n/a	3.28 (less than 5.75 µg/l is a pass using M-BAT for WC 2 – see Table A7)	0.09
Cumulative Assessment (including Sediment) of Proposed Catchment 5 + 6 (No Mitigation)										
Cumulative assessment of catchment 5 + 6	WC 2	WC 2	Pass	Pass	Not Required				3.31 (less than 5.75 µg/l is a pass using M-BAT for WC 2 – see Table A7)	0.81
Existing Catchment 7										
Catchment 7 (A460)	WC 3 New Outfall	WC 3	Pass	Pass	Yes	Yes	264	63%	4.45 (less than 17.8 µg/l is a pass using M-BAT for WC 3 – see Table A7)	1.21
Proposed Catchment 7 (No mitigation)										

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Catchment 7 (A460)	WC 3 New Outfall	WC 3	Pass	Pass	Yes	Yes	239	59%	4.42 (less than 17.8 µg/l is a pass using M-BAT for WC 3 – see Table A7)	1.12
Existing Catchment 8 (No mitigation)										
Catchment 8 (A460 north of M6 J1)	WC 6 Existing Highway Outfall	WC 6	Pass	Pass	Yes	Yes	204	51%	4.50 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	1.42
Proposed Catchment 8 (No mitigation)										
Catchment 8 (A460 link to junction)	WC 3 new outfall	WC 3	Pass	Pass	Yes	No	64	n/a	4.32 (less than 17.8 µg/l is a pass using M-BAT for WC 3 – see Table A7)	0.87
Cumulative Assessment (including Sediment) of Proposed Catchment 7 + 8 (No Mitigation)										
Cumulative assessment of 7 + 8 (within 100m)	WC 3	WC 3	Pass	Pass	Yes	Yes	301	67%	3.78 (less than 17.8 µg/l is a pass using M-BAT for WC 3 – see Table A7)	1.32

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed	EQS: 1 µg/l	EQS: 10.9 µg/l
Existing Catchment 9										
Catchment 9 (A460 and Hilton Lane)	WC 4 New Outfall	WC 4	Fail (2.5 exceedances, 2 acceptable)	Pass	Yes	Yes	217	54%	4.77 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	2.22
Proposed Catchment 9 (No mitigation)										
Catchment 9 (A460 and Hilton Lane)	WC 4 New Outfall	WC 4	Fail (2.5 exceedances, 2 acceptable)	Pass	Yes	Yes	224	56%	3.80 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	2.25
Proposed Catchment 10 (No mitigation)										
Catchment 10 (Scheme mainline)	WC 4 New Outfall	WC	Fail (5.1 exceedance, 2 acceptable)	Pass	Yes	Yes	456	79%	4.44 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	4.11

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Cumulative Assessment (including Sediment) of Proposed Catchment 9 + 10 (No Mitigation)										
Cumulative assessment of 9 + 10	WC 4	WC 4	Fail (8.1 Exceedances, 2 acceptable)	Pass	Not Required				4.78 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	5.07
Existing Catchment 11										
11 (A460)	WC existing ⁵	WC 5	Pass	Pass	Yes	No	68	n/a	3.20 (less than 13.1 µg/l is a pass using M-BAT for WC 5 – see Table A7)	0.46
Proposed Catchment 11 (No mitigation)										
11 (A460)	WC existing ⁵	WC 5	Pass	Pass	Yes	No	27	n/a	5.14 (less than 13.1 µg/l is a pass using M-BAT for WC 5 – see Table A7)	0.20
12	No assessment and permeable embankment drainage only									
13	No assessment and permeable embankment drainage only									
Proposed Catchment 14 (No mitigation)										

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed	EQS: 1 µg/l	EQS: 10.9 µg/l
14 (Scheme mainline and link to A460)	WC 5 New Outfall C	WC 5	Pass	Pass	Yes	Yes	273	64%	5.61 (less than 13.1 µg/l is a pass using M-BAT for WC 5 – see Table A7)	1.80
Existing Catchment 15 A460 (No Mitigation)										
15 (A460 north of J11 M6)	WC Existing Highway Outfall 6	WC 6	Pass	Pass	Yes	Yes	204	51%	4.50 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	1.42
Proposed Catchment 15 A460 (No mitigation)										
15	WC Proposed Highway Outfall 6	WC 6	Fail (2 exceedances, 2 acceptable)	Pass	Yes	Yes	322	69%	4.71 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.04
Existing Catchment 16										
16	M6 Northbound Outfall	WC 6	Fail (2.2 exceedances, 2 acceptable)	Pass	Yes	Yes	475	79%	4.68 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.02

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Proposed Catchment 16 (No mitigation)										
16	M6 Northbound Outfall	WC 6	Fail (2.6 exceedances, 2 acceptable)	Pass	Yes	Yes	608	84%	4.82 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.41
Existing Catchment 17										
17	M6 Southbound Outfall	WC 6	Fail (2.5 exceedances, 2 acceptable)	Pass	Yes	Yes	542	82%	4.75 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.21
Proposed Catchment 17 (No mitigation)										
17	M6 Southbound Outfall	WC 6	Fail (2.7 exceedances, 2 acceptable)	Pass	Yes	Yes	642	85%	4.84 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.47
Cumulative Assessment Existing 15 + 16 + 17										
15 + 16 + 17	M6 northbound and southbound outfall	WC 6	Fail (6.3 exceedances, 2 acceptable)	Pass	Not required.				4.82 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	4.4

Road Catchment	Outfall/s	Receiving WC	Step 2 Tier 1							
			Soluble Acute Impact Copper	Soluble Acute impact Zinc	Sediment Chronic Impact Annual Average Cu				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed	EQS: 1 µg/l	EQS: 10.9 µg/l
Cumulative Assessment Proposed 15 + 16 + 17 (no mitigation)										
15, 16 and 17	M6 Northbound Outfall, M6 Southbound Outfall and WC 6 Existing Highway Outfall (within 1km)	WC 6	Fail (8.2 exceedances, 2 acceptable)	Pass	Not required.				5.07 less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	5.08

Table A5: Indicative treatment efficiencies of drainage systems (Ref 1-2]

Treatment System Type	Suspended Solids (% removal)	Dissolved Copper (% removal)	Dissolved Zinc (% removal)
Swales and Grassed Channels	80	50	50
Dry/Detention Ponds	50	0	0
Wet/Retention Ponds	60	40	30
Wetlands (Surface Flow)	60	30	50
Vortex Grit Separators	40	0	15
Sediment Tanks	40	0	0
Oil Separators	0	0	0
Reservoir Pavements/Porous Asphalt	50	0	0
Vegetated Filter Strips	25	15	15
Filter Drains	60	0	45
Ditches	25	15	15

Table A6: HEWRAT With Mitigation Steps, and comparison with MBAT maximum from Table A7

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1								
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn	
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed			EQS: 1 µg/l – takes into account the M-BAT results from Table A7
Proposed Catchment 1 + 2 with Mitigation: Passes sediments with existing filter drains: fails copper acute metals											
With Existing Filter Drains (60% sediment bound pollutants)	WC 7	WC 7	Fail (2.2 exceedances)	Pass	Yes	No	68	N/a	3.62 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	2.39	
Sensitivity analysis with point downstream before confluence with River Penk	WC7	WC7	PASS	PASS	Yes	No	34	n/a	3.22 (less than 5.75 µg/l is a pass using M-BAT for WC 7 – see Table A7)	0.74	
Proposed Catchment 3 with Mitigation: Passes acute metals, sediments and long term EQS with a pond and added short length of swale											
Mitigation 1: Wet attenuation pond (40% dissolved copper, 60% suspended solids)	WC 1 New Outfall	WC 1	Fail (2.1 Exceedances)	Pass	Yes	Yes	243	24%	3.71 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	2.37	

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Mitigation 2: Attenuation Pond plus short length of swale (1/2 mitigation amount allowed as short length) (40+25% dissolved metals, 60+40% suspended solids)	WC 1 New Outfall	Water-course 1	Pass	Pass	Yes	No	0	n/a	3.32 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	1.38
Proposed Catchment 4 with mitigation: With HVS and filter drains passes sediments and long term EQS but fails short term copper										
Mitigation 1: Addition of HVS (40% reduction of suspended solids)	WC 1 highway outfall	WC 1	Fail (7.5 exceedances)	Pass	Yes	Yes	708	52%	4.69 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	4.70

Road Catchment	Outfall/s	Receiving Watercourse (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Mitigation 2: Addition of filter drains (100% reduction of sediment bound pollutants)	WC 1 highway outfall	WC 1	Fail (7.5 exceedances)	Pass	Yes	No	n/a	N/a	4.69 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	4.70
Sensitivity analysis using point at WC 7 confluence	WC 7 highway outfall	WC 7	Pass	Pass	Yes	No	n/a	N/a	3.60 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	1.65

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1						Annual Average Cu	Annual Average Soluble Zn
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact					
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
<p>Proposed cumulative catchments 3 + 4 (200 m separated) with mitigation: With HVS and filter drains on Catchment 4, and pond and swale on Catchment 3 fails short term soluble copper but passes chronic sediments and long term EQS. Also passes all at the assessment point of just upstream WC7.</p>										
Mitigation catchment 4: HVS and filter drains with no dissolved metal mitigation, Catchment 3 wet pond and length of swale. Ratios work out with 22% mitigation for dissolved metals overall	WC 1 highway outfall	WC 1	Fail (4.4 exceedances)	Pass	N/a			4.18 (less than 5.75 µg/l is a pass using M-BAT for WC 1 – see Table A7)	3.68	
Sensitivity Analysis using point at WC7 confluence	WC7	WC7	Pass	Pass	N/a			3.45	1.46	

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
further downstream										
<p>Proposed Catchment 5: Passes sediment bound pollutants and short term dissolved metals, so no mitigation proposed. Outfalls to WC 2 with 3.28 µg/l annual average copper EQS. Less than 5.75 µg/l maximum in Table A7, therefore passes EQS test also.</p>										
<p>Proposed Catchment 6: Passes sediment bound pollutants and short term dissolved metals so no mitigation proposed. Outfalls to WC 2 with 3.28 µg/l annual average copper EQS. Less than 5.75 µg/l maximum in Table A7, therefore passes EQS test also.</p>										
<p>Proposed Catchment 7: Passes sediment bound pollutants and short term dissolved metals so no mitigation proposed. Outfalls to WC 3 with 4.42µg/l annual average copper EQS. Less than 17.8 µg/l maximum in Table A7, therefore passes EQS test also.</p>										
<p>Proposed Catchment 8: Passes sediment bound pollutants and short term dissolved metals, so no mitigation. Outfalls to WC 3 with 4.32 µg/l annual average copper EQS. Less than 17.8 µg/l maximum in Table A7, therefore passes EQS test also.</p>										
<p>Proposed Catchment 7 + 8: with mitigation of wet attenuation pond and ditches on catchment 8</p>										
Wet attenuation pond with ditches upstream and downstream from	WC3	WC3	Pass	Pass	Yes	Yes	96	n/a	3.69 (less than 17.8 µg/l is a pass using M-BAT for WC 3 – see Table A7.	1.22

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
the pond (circa 280m).										
Proposed Catchment 9: Existing A460. Filter drain proposed alongside Hilton Lane; No other improvements possible as A460 is managed and maintained by SCC road and is not being improved by the proposed Scheme.										
Mitigation 1: Filter drain along Hilton Lane, so 33% of filter drain mitigation used	WC 4 new outfall	WC 4	Fail (2.5 exceedances)	Pass	Yes	Yes	195	43%	3.68 (less than 13.1 µg/l is a pass using M-BAT for WC 5 – see Table A7)	2.06
Sensitivity analysis using point further downstream	WC4/5 downstream point of assessment	WC 4/5 upstream of Saredon Brook	Pass	Pass	Yes	No	84	n/a	3.10 (less than 13.1 µg/l is a pass using M-BAT for WC 5 – see Table A7)	0.33
Proposed Catchment 10 with mitigation: Passes sediment bound pollutants, soluble acute metals and long term EQS with a pond and new ditchcourse										

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Mitigation 1: Wet attenuation pond (40% dissolved copper, 60% suspended solids)	WC 4 new outfall	WC 4	Fail (2.3 Exceedances)	Pass	Yes	Yes	182	19%	3.74 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	2.46
Mitigation 2: Attenuation pond and short length of swale (40+25% dissolved metals, 60+40% suspended solids)	Water-course 4 new outfalls	WC 4	Pass	Pass	Yes	No	0	n/a	3.34 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	1.44
Proposed Catchment 9 + 10 – with mitigation on Catchment 10										
Mitigation of wet attenuation pond and ditches on Catchment 10 only (44%)	WC 4 new outfall	WC 4	Fail (2.8 Exceedances)	Pass					3.86 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	2.84

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
reduction of dissolved metals). No mitigation on Catchment 9.			Fail	Pass						
Sensitivity analysis of above using downstream analysis point	WC 4/5 upstream of Saredon Brook	WC 4/5	Pass	Pass					3.18 (less than 7.45 µg/l is a pass using M-BAT for WC 4 – see Table A7)	0.65
Proposed Catchment 11: Passes chronic sediment, long term EQS, and acute soluble copper. Outfalls to WC 5 with 5.14 µg/l annual average copper EQS. Less than 13.1 µg/l maximum in Table A7, therefore passes EQS test.										
Proposed Catchment 12: Permeable area only, no assessment required.										
Proposed Catchment 13: Permeable area only, no assessment required.										
Proposed Catchment 14 with mitigation: Passes sediment bound pollutants, acute soluble metals and long term EQS with pond and filter drains										

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Mitigation 1: With wet pond (60% suspended solids, 40% dissolved metal)	WC 5 new outfall c	WC 5	Pass	Pass	Yes	Yes	109	4%	5.25 (less than 13.1 µg/l is a pass using M-BAT for WC 5 – see Table A7)	1.08
Mitigation 2: Pond and filter drains	WC 5 new outfall c	WC 5	Pass	Pass	Yes	No	0	n/a	5.25 (less than 13.1 µg/l is a pass using M-BAT for WC 5 – see Table A7)	1.08
Proposed Catchment 15 with mitigation: Passes sediment bound pollutants, acute metals and long term EQS with filter drains and new ditchcourse										
Mitigation 1: With filter drains	WC existing ⁶	WC 6	Fail exceedances) ⁽²⁾	Pass	Yes	Yes	129	9%	4.71 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.04

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Mitigation 2: With filter drains and roadside ditch	WC existing ⁶	WC 6	Pass	Pass	Yes	No	48	n/a	4.53 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	1.73
Catchment 16 with mitigation: Passes sediment bound pollutants, acute metals and long term EQS with filter drains and additional swales along slip roads										
Mitigation 1: With existing filter drains (60% suspended solids)	WC 6	WC 6	Fail (2.6 exceedances)	Pass	Yes	Yes	243	24%	4.82 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.41

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Mitigation 2: With Filter drains adding lengths of swale at base of embankment which drain half the area of the catchment (100% suspended solids, 25% dissolved copper)	WC 6	WC 6	Pass	Pass	Yes	No	0	n/a	4.51 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	1.80
Propose Catchment 17 with mitigation: Passes sediment bound pollutants, acute metals and long term EQS with existing filter drains and lengths of swale at base of embankment										
With Existing Filter Drains (60% suspended solids)	WC 6	WC 6	Fail (2.7 Exceedances)	Pass	Yes	Yes	255	25%	4.83 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	2.46

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
With Filter drains and adding lengths of swale at base of embankment which drain half the area of the catchment (100% suspended solids, 25% dissolved copper)	WC 6	WC 6	Pass	Pass	Yes	No	0	n/a	4.52 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	1.84
CUMULATIVE Proposed Catchment 15 + 16 + 17 with mitigation (note that the existing cumulative 15+16+17 acute copper exceedance per year is 8.2)										
With lengths of swale for catchments 16 and 17, and roadside ditch in 15 (23% mitigation for soluble metals)	WC 6	WC 6	Fail (4.8 exceedances)	Pass	Not applicable				5.20 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	3.91

Road Catchment	Outfall/s	Receiving Water-course (WC)	Step 2 Tier 1							
			Soluble Acute Impact Copper*	Soluble Acute impact Zinc	Sediment Chronic Impact				Annual Average Cu	Annual Average Soluble Zn
					Accumulating?	Extensive?	Deposition Index	Sediment settlement needed		
Sensitivity analysis using point further downstream before Saredon Brook	WC 6	WC 6	Fail (3.7 exceedances)	Pass	Not applicable				4.937 (less than 42.5 µg/l is a pass using M-BAT for WC 6 – see Table A7)	3.19

Note: EQS for acute soluble copper is two exceedances per year only.

Table A7: M-BAT Results

Road Catchment/s and description of road catchment	Watercourse (WC)	Maximum dissolved copper concentration in the WC for a 1 µg/l Pass Bioavailable Copper Concentration
3: M54 J1 4: M54 J1	WC 1	5.75
5: M54 J1 6: A460	WC 2	5.75
7: A460 8: A460	WC 3	17.8
9: A460 10: Scheme mainline	WC 4	7.45
11: A460 14: Scheme mainline to J11 M6	WC 5	13.1
15: A460 north of J11 M6 16: M6 northbound and western half of J11 M6 17: M6 southbound and eastern half of J11 M6	WC 6	42.5
1: M54 west, 2: M54 east	WC 7	5.75

Note: Catchments 12 and 13 are permeable only and not included within calculations

Table A8: Method C (groundwater) analysis of Road Catchment 3 (WC 1)

Component number	Weighting Factor	Property or Parameter	Source	Risk Score	Component Score	Weighted Component Score
1	10	Traffic Flow	From traffic data	>50,000 - <100,000	2	20
2		Rainfall depth (annual average)	From rainfall data in HEWRAT	740-1060	2	20
3		Drainage area ratio	From drainage team	>150	3	30
4	15	Infiltration method	Receiving WC estimated to have low flow and thus may act like a soakaway	Continuous/shallow	1	15
5		Unsaturated Zone	BH06 Monitored at 3.52 – 3.47 m bgl July / August 2019	Depth to water table < 5 m	3	60
6		Flow Type (incorporate flow type and effective grain size)	Mixed: Flow type from table C1.3 in HD45/09, dual permeability with High matrix porosity, but low permeability, e.g. Sherwood Sandstone.	Mixed fracture and intergranular flow (e.g. medium to coarse sand)	2	40
7		Unsaturated Zone Clay content	>15% clay minerals, based on glacial till overlying the solid geology	>15% clay minerals	1	5
8		Organic Carbon	Organic Carbon is measured at 1.6% in BH03 at 1.5 m bgl	<15% to >1% SOM	2	10
9		Unsaturated zone pH	BH03, at 1.5m ph 7.9	pH <8 to > 5	2	10
Total Score:						210
Risk Screening Level:						Medium

Table A9: Method C (groundwater) analysis of Road Catchments 8 and 9 (WC 4)

Component number	Weighting Factor	Property or Parameter	Source	Risk Score	Component Score	Weighted Component Score
1	10	Traffic Flow	From traffic data	>50,000 - <100,000	2	20
2		Rainfall depth (annual average)	From rainfall data in HEWRAT	740-1060	2	20
3		Drainage area ratio	From drainage team	>150	3	30
4	15	Infiltration method	Receiving WC estimated to have low flow and thus may act like a soakaway	Continuous/shallow	1	15
5		Unsaturated Zone	BH20 Monitored at 12.8 to 12.96m bgl July / August 2019	Depth to water table <15 m to >5 m	2	40
6		Flow Type (incorporate flow type and effective grain size)	Mixed: Flow type from table C1.3 in HD45/09, dual permeability with High matrix porosity, but low permeability, e.g. Sherwood Sandstone.	Mixed fracture and intergranular flow (e.g. medium to coarse sand)	2	40
7		Unsaturated Zone Clay content	>15% clay minerals, based on glacial till overlying the solid geology	>15% clay minerals	1	5
8		Organic Carbon	Organic Carbon is measured at 1.6% in BH20 at 0.5 m bgl	<15% to >1% SOM	2	10
9		Unsaturated zone pH	BH20, at 0.5m pH 7.0	pH <8 to > 5	2	10
Total Score:						190
Risk Screening Level:						Medium

Table A10 Data used in the assessment of accidental spillage risk

Road Catchment	Length of carriageway (m)	Traffic (AADT, %HGV)	Calculation Total	Calculation Totals as a Return Period (years)	Acceptable standard (1 in 100 years for non-sensitive sites)
1	705	51871, 12%	0.0003	2890	YES
2	640	52022, 11%	0.0003	3463	YES
3	1375 405 475 185	29334, 8% 18146, 10% 4825, 6% 17218, 6%	0.005	2161	YES
4	1348 771 610 160 175 350	60535, 14% 18146, 10% 3987, 9% 26491, 7% 31832, 7% 31332, 7%	0.0016	611	YES
5	400 250 400	18146, 7% 4825, 6% 3833, 12%	0.0001	7426	YES
6	220	6	0.000	77091	YES
7	870	6212, 5%	0.0000	54510	YES
8	300 90 25	10138, 10% 6212, 11% 4966, 8%	0.000	37562	YES
9	750 770	5198, 6 3801, 4	0	41967	YES
10	980 330 360	58210, 9% 7777, 5% 10730, 7%	0.0004	2261	YES
11	375	3351, 5%	0	201873	YES
12	No road drainage				Not applicable
13	No road drainage				Not applicable

Table A10 Data used in the assessment of accidental spillage risk - continued

Road Catchment	Length of carriageway (m)	Traffic (AADT, %HGV)	Calculation Total	Calculation Totals as a Return Period (years)	Acceptable standard (1 in 100 years for non-sensitive sites)
14	280 855 835	3351, 5% 29334, 8% 28876, 9%	0.0003	2960	YES
15	500 150	68926, 10% 21880, 11%	0.0002	4043	YES
16	440 360 1200 300	11742, 4% 47173, 11% 41945, 23% 11796, 13%	0.0023	443	YES
17	380 1230 390 335	12507, 4% 40844, 24% 45862, 9% 11578, 8%	0.0021	477	YES

Annex B: HEWRAT Outputs

The following screenshots present the HEWRAT assessment calculations, as referenced in Section 3 of this report.

Individual outfall assessments

Road Catchment 1

Existing Area

Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EQS - Annual Average Concentration		Copper		Zinc	
Step 2	9.54	Pass	Pass	Pass	Pass
Step 3	9.54	Pass	Pass	Pass	Pass

Road number: M54 | HE Area / DBFO number: []
 Assessment type: Non-cumulative assessment (single outfall)
 OS grid reference of assessment point (m): Easting 392739, Northing 304487
 OS grid reference of outfall structure (m): Easting 392739, Northing 304487
 Outfall number: M54 Outfall West Catchment 1 | List of outfalls in cumulative assessment: []
 Receiving watercourse: Watercourse 7
 EA receiving water Detailed River Network ID: [] | Assessor and affiliation: DSH
 Date of assessment: 06/09/2019 | Version of assessment: 1

Step 1 Runoff Quality
 AADT: >=100,000 and <=100,000 | Climatic region: Warm Dry | Rainfall site: Birmingham (SAAR 750mm)

Step 2 River Impacts
 Annual Q₁₀ river flow (m³/s): 0.006
 Impermeable road area drained (ha): 1.208
 Permeable area draining to outfall (ha): 1.273
 Base Flow Index (BFI): 0.5
 Water hardness: High (>=200mg CaCO₃/l)
 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

Step 3 Mitigation
 Existing measures: []
 Proposed measures: []
 Estimated effectiveness: Treatment for solubles (%): 0, Attenuation for solubles - restricted discharge rate (s): 0, Settlement of sediments (%): 0

Proposed Area

Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EQS - Annual Average Concentration		Copper		Zinc	
Step 2	9.54	Pass	Pass	Pass	Pass
Step 3	9.54	Pass	Pass	Pass	Pass

Road number: M54 | HE Area / DBFO number: []
 Assessment type: Non-cumulative assessment (single outfall)
 OS grid reference of assessment point (m): Easting 392739, Northing 304487
 OS grid reference of outfall structure (m): Easting 392739, Northing 304487
 Outfall number: M54 Outfall West Catchment 1 proposed | List of outfalls in cumulative assessment: []
 Receiving watercourse: Watercourse 7
 EA receiving water Detailed River Network ID: [] | Assessor and affiliation: DSH
 Date of assessment: 06/09/2019 | Version of assessment: 1

Step 1 Runoff Quality
 AADT: <=100,000 and >=100,000 | Climatic region: Warm Dry | Rainfall site: Birmingham (SAAR 750mm)

Step 2 River Impacts
 Annual Q₁₀ river flow (m³/s): 0.006
 Impermeable road area drained (ha): 1.208
 Permeable area draining to outfall (ha): 1.273
 Base Flow Index (BFI): 0.5
 Water hardness: High (>=200mg CaCO₃/l)
 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

Step 3 Mitigation
 Existing measures: []
 Proposed measures: []
 Estimated effectiveness: Treatment for solubles (%): 0, Attenuation for solubles - restricted discharge rate (s): 0, Settlement of sediments (%): 0

Road Catchment 2

Existing Area

EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 3.24 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 0.61	Copper Pass	Zinc Pass	Fail. Try Tier 2 for Velocity Settlement needed = 1%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel m/s Extensive? Yes 100 Deposition Index
Step 3	-	-	-	-	-

Road number	M54	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 392740	Northing	304522
OS grid reference of outfall structure (m)	Easting 392740	Northing	304522
Outfall number	M54 Outfall East Catchment 2 existing	List of outfalls in cumulative assessment	
Receiving watercourse			
E.A. receiving water Detailed River Network ID	Assessor and affiliation		DSH
Date of assessment	06/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT <input type="text" value="=>50,000 and <=100,000"/>	Climatic region <input type="text" value="Warm Dry"/>	Rainfall site <input type="text" value="Birmingham (SAAR 750mm)"/>
------------------------------	--	---	--

Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s) <input type="text" value="0.009"/>	Freshwater EQS limits:	
(Enter zero in Annual Q ₉₅ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha) <input type="text" value="1.385"/>	Bioavailable dissolved copper (µg/l) <input type="text" value="1"/>	
	Permeable area draining to outfall (ha) <input type="text" value="0.908"/>	Bioavailable dissolved zinc (µg/l) <input type="text" value="10.9"/>	
	Base Flow Index (BFI) <input type="text" value="0.5"/>	Is the discharge in or within 1 km upstream of a protected site for conservation? <input type="text" value="No"/>	
For dissolved zinc only	Water hardness <input type="text" value="High => 200mg CaCO3/l"/>	For dissolved copper only	Ambient background concentration (µg/l) <input type="text" value="3"/>
For sediment impact only	Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? <input type="text" value="No"/>		
	<input checked="" type="radio"/> Tier 1 Estimated river width (m) <input type="text" value="2.5"/> <input type="radio"/> Tier 2 Bed width (m) <input type="text" value="3"/> Manning's n <input type="text" value="0.07"/> Side slope (m/m) <input type="text" value="0.5"/> Long slope (m/m) <input type="text" value="0.0001"/>		

Step 3 Mitigation	Estimated effectiveness	
	Treatment for solubles (%)	Settlement of sediments (%)
Existing measures	<input type="text" value="0"/>	<input type="text" value="0"/>
Proposed measures	<input type="text" value="0"/>	<input type="text" value="0"/>

Proposed Area

Soluble		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 3.24 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 0.48	Copper Pass	Zinc Pass	Pass Sediment deposition for this site is judged as: Accumulating? No 0.01 Low flow Vel m/s Extensive? No 00 Deposition Index
Step 3	-	-	-	-	-

Road number	M54	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 392740	Northing	304522
OS grid reference of outfall structure (m)	Easting 392740	Northing	304522
Outfall number	M54 Outfall East Catchment 2 proposed	List of outfalls in cumulative assessment	
Receiving watercourse			
E.A. receiving water Detailed River Network ID	Assessor and affiliation		DSH
Date of assessment	06/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT <input type="text" value="Less than 50,000"/>	Climatic region <input type="text" value="Warm Dry"/>	Rainfall site <input type="text" value="Birmingham (SAAR 750mm)"/>
------------------------------	--	---	--

Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s) <input type="text" value="0.009"/>	Freshwater EQS limits:	
(Enter zero in Annual Q ₉₅ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha) <input type="text" value="1.385"/>	Bioavailable dissolved copper (µg/l) <input type="text" value="1"/>	
	Permeable area draining to outfall (ha) <input type="text" value="0.908"/>	Bioavailable dissolved zinc (µg/l) <input type="text" value="10.9"/>	
	Base Flow Index (BFI) <input type="text" value="0.5"/>	Is the discharge in or within 1 km upstream of a protected site for conservation? <input type="text" value="No"/>	
For dissolved zinc only	Water hardness <input type="text" value="High => 200mg CaCO3/l"/>	For dissolved copper only	Ambient background concentration (µg/l) <input type="text" value="3"/>
For sediment impact only	Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? <input type="text" value="No"/>		
	<input checked="" type="radio"/> Tier 1 Estimated river width (m) <input type="text" value="2.5"/> <input type="radio"/> Tier 2 Bed width (m) <input type="text" value="3"/> Manning's n <input type="text" value="0.07"/> Side slope (m/m) <input type="text" value="0.5"/> Long slope (m/m) <input type="text" value="0.0001"/>		

Step 3 Mitigation	Estimated effectiveness	
	Treatment for solubles (%)	Settlement of sediments (%)
Existing measures	<input type="text" value="0"/>	<input type="text" value="0"/>
Proposed measures	<input type="text" value="0"/>	<input type="text" value="0"/>

Cumulative catchments 1 and 2 Existing

EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 3.88 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 2.59	Copper River Fails Toxicity Test. Try mitigation	Zinc Pass	Fail. Try Tier 2 for Velocity. Settlement needed = 47%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Velocity Extensive? Yes 187 Deposition Index
Step 3	-	-	-	-	-

Road number	M54	HE Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 392740	Nothing	304522
OS grid reference of outfall structure (m)	Easting	Nothing	
Outfall number	M54 Outfall : Catchments 1 and 2 Existing	List of outfalls in cumulative assessment	1 2
Receiving watercourse	Watercourse 7		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	09/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT >=100,000	Climatic region Warm Dry	Rainfall site Birmingham (SAAR 750mm)
------------------------------	----------------	--------------------------	---------------------------------------

Step 2 River Impacts	Annual Q ₁₀ river flow (m ³ /s) 0.008	Freshwater EQS limits:	
(Enter zero in Annual Q ₁₀ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha) 2.593	Bioavailable dissolved copper (µg/l) 1	
	Permeable area draining to outfall (ha) 2.241	Bioavailable dissolved zinc (µg/l) 10.9	
	Base Flow Index (BFI) 0.5	Is the discharge in or within 1 km upstream of a protected site for conservation? No	
For dissolved zinc only	Water hardness High > 200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (µg/l) 3
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) 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

Step 3 Mitigation	Estimated effectiveness		
Existing measures	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
Proposed measures	0	No restriction	0

Cumulative catchments 1 and 2 Proposed

EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 2.12 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 2.39	Copper River Fails Toxicity Test. Try mitigation	Zinc Pass	Fail. Try Tier 2 for Velocity. Settlement needed = 41%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Velocity Extensive? Yes 169 Deposition Index
Step 3	-	-	-	-	-

Road number	M54	HE Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 392740	Nothing	304522
OS grid reference of outfall structure (m)	Easting	Nothing	
Outfall number	M54 Outfall : Catchments 1 and 2 Proposed	List of outfalls in cumulative assessment	1 2
Receiving watercourse	Watercourse 7		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	09/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT <=100,000	Climatic region Warm Dry	Rainfall site Birmingham (AAD 750mm)
------------------------------	----------------	--------------------------	--------------------------------------

Step 2 River Impacts	Annual Q ₁₀ river flow (m ³ /s) 0.008	Freshwater EQS limits:	
(Enter zero in Annual Q ₁₀ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha) 2.593	Bioavailable dissolved copper (µg/l) 1	
	Permeable area draining to outfall (ha) 2.241	Bioavailable dissolved zinc (µg/l) 10.9	
	Base Flow Index (BFI) 0.5	Is the discharge in or within 1 km upstream of a protected site for conservation? No	
For dissolved zinc only	Water hardness High > 200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (µg/l) 3
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) 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

Step 3 Mitigation	Estimated effectiveness		
Existing measures	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
Proposed measures	0	No restriction	0

Road Catchment 3

Existing Area

EQS - Annual Average Concentration		Acute Impact		Fail, Trg Tier 2 for Velocity	
Step 2	Copper 4.93 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 5.53	Copper River Fails Toxicity Test. Trg mitigation	Zinc Pass	Settlement needed = 93%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel m/s Extensive? Yes 1276 Deposition Index
Step 3	-	-	-	-	-

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	393410	Northing
OS grid reference of outfall structure (m)	Easting		Northing
Outfall number	Watercourse 1 Catchment 3	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 1	Assessor and affiliation	DSH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	06/09/2019		
Notes			

Step 1 Runoff Quality

AADT: >=50,000 and <100,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR 750mm)

Step 2 River Impacts

Annual Q₁₀ river flow (m³/s): 0.001
 Impermeable road area drained (ha): 6.689
 Permeable area draining to outfall (ha): 9.856
 Base Flow Index (BFI): 0.5

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

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

Estimated river width (m): 1
 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	No restriction	0
Proposed measures	0	No restriction	0

Proposed Area

EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 4.35 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 3.99	Copper River Fails Toxicity Test. Trg mitigation	Zinc Pass	Fail, Trg Tier 2 for Velocity Settlement needed = 84%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 9.81 Low flow Vel m/s Extensive? Yes 688 Deposition Index
Step 3	-	-	-	-	-

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	393410	Northing
OS grid reference of outfall structure (m)	Easting		Northing
Outfall number	Watercourse 1 New Outfall Catchment 3	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 1	Assessor and affiliation	DSH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	06/09/2019		
Notes			

Step 1 Runoff Quality

AADT: <=50,000 and <100,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR 750mm)

Step 2 River Impacts

Annual Q₁₀ river flow (m³/s): 0.004
 Impermeable road area drained (ha): 6.689
 Permeable area draining to outfall (ha): 9.856
 Base Flow Index (BFI): 0.5

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

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

Estimated river width (m): 4
 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	No restriction	0
Proposed measures	0	No restriction	0

Road Catchment 4

Proposed Area (new road)

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact
EQS - Annual Average Concentration		Copper	Zinc	Fail. Try Tier 2 for Velocity Settlement needed - 65%, proposed - 0% Sediment deposition for this site is judged as: Accumulating? Yes <input type="checkbox"/> 0.99 <input type="checkbox"/> Louisa Velmir Extensive? Yes <input type="checkbox"/> 284 <input type="checkbox"/> Deponition Index
Step 2	Tier 1 Fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 2 mitigation.	3.34	2.37	
Step 3	-	-	-	

Road number: M54/M6 Link road | HE Area / DBFO number: |
 Assessment type: Non-cumulative assessment (single outfall)
 OS grid reference of assessment point (m): Easting 394400 | Northing 304770
 OS grid reference of outfall structure (m): Easting | Northing
 Outfall number: Watercourse 2 New Outfall Catchment 4 | List of outfalls in cumulative assessment
 Receiving watercourse: Watercourse 2
 EA receiving water Detailed River Network ID: | Assessor and affiliation: DSH
 Date of assessment: 06/09/2019 | Version of assessment: 1

Notes:

Step 1 Runoff Quality
 AADT: 10,000 and 250,000 | Climatic region: Warm Dry | Rainfall site: Birmingham (CAAD 750mm)

Step 2 River Impacts
 Annual Q₁₀ river flow (m³/s): | Freshwater EQS limits:
 Bioavailable dissolved copper (µg/l): 1
 Bioavailable dissolved zinc (µg/l): 10.9
 Impermeable road area drained (ha): |
 Permeable area draining to outfall (ha): |
 Base Flow Index (BFI): | Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only: Water hardness: | For dissolved copper only: Ambient background 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?
 Estimated river width (m): |
 Bed width (m): | Manning's n: | Side slope (m/m): | Long slope (m/m): |

Step 3 Mitigation

Existing measures	Proposed measures	Brief description	Estimated effectiveness		
			Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
			0	No restriction	0
			0	No restriction	0

Cumulative Assessments

Road Catchments 3+4 Proposed

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact
EQS - Annual Average Concentration		Copper	Zinc	Sediment deposition for this site is judged as: Accumulating? <input type="checkbox"/> Louisa Velmir Extensive? <input type="checkbox"/> Deponition Index
Step 2	Tier 1 Fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	5.13	6.99	
Step 3	-	-	-	

Road number: M54/M6 Link road | HE Area / DBFO number: |
 Assessment type: Cumulative assessment excluding sediments/outfalls between 100m and 1km apart
 OS grid reference of assessment point (m): Easting 394410 | Northing 304709
 OS grid reference of outfall structure (m): Easting | Northing
 Outfall number: Watercourse 1 Cumulative Catchment 3 and 4 | List of outfalls in cumulative assessment
 Receiving watercourse: Watercourse 1
 EA receiving water Detailed River Network ID: | Assessor and affiliation: DSH
 Date of assessment: 06/09/2019 | Version of assessment: 1

Notes:

Step 1 Runoff Quality
 AADT: 10,000 and 250,000 | Climatic region: Warm Dry | Rainfall site: Birmingham (CAAD 750mm)

Step 2 River Impacts
 Annual Q₁₀ river flow (m³/s): | Freshwater EQS limits:
 Bioavailable dissolved copper (µg/l): 1
 Bioavailable dissolved zinc (µg/l): 10.9
 Impermeable road area drained (ha): |
 Permeable area draining to outfall (ha): |
 Base Flow Index (BFI): | Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only: Water hardness: | For dissolved copper only: Ambient background 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?
 Estimated river width (m): |
 Bed width (m): | Manning's n: | Side slope (m/m): | Long slope (m/m): |

Step 3 Mitigation

Existing measures	Proposed measures	Brief description	Estimated effectiveness		
			Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
			0	No restriction	0
			0	No restriction	0

Road Catchment 5

Proposed Area (new road)

EQS - Annual Average Concentration		Acute Impact		Pass	
Step 2	Copper 3.28 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 0.74	Copper Pass	Zinc Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.88 Low flow Vel m/s Extensive? No 59 Deposition Index
Step 3					

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 394210	Northing	304907
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Watercourse 2 New Outfall Catchment 5	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 2		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	06/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality AADT >10,000 and <50,000 Climatic region Warm Dry Rainfall site Birmingham (SAAR 750mm)

Step 2 River Impacts

Annual Q ₉₅ river flow (m ³ /s)	0.003	Freshwater EQS limits:	
Impermeable road area drained (ha)	1.151	Bioavailable dissolved copper (µg/l)	1
Permeable area draining to outfall (ha)	1.460	Bioavailable dissolved zinc (µg/l)	10.9
Base Flow Index (BFI)	0.5	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
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) 0.5	Side slope (m/m)	0.5
Tier 2	Bed width (m) 3	Manning's n	0.07
		Long slope (m/m)	0.0001

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	0

Road Catchment 6

No HEWRAT required as traffic below 10,000 AADT. Used traffic band >10,000 - <50,000 for conservative assessment

EQS - Annual Average Concentration		Acute Impact		Pass	
Step 2	Copper 3.38 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 0.99	Copper Pass	Zinc Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.88 Low flow Vel m/s Extensive? No 6 Deposition Index
Step 3					

Road number	A460	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	catchment 6	List of outfalls in cumulative assessment	
Receiving watercourse	watercourse 2		
EA receiving water Detailed River Network ID		Assessor and affiliation	
Date of assessment	15/11/2019	Version of assessment	
Notes			

Step 1 Runoff Quality AADT >10,000 and <50,000 Climatic region Warm Dry Rainfall site Birmingham (SAAR 750mm)

Step 2 River Impacts

Annual Q ₉₅ river flow (m ³ /s)	0.003	Freshwater EQS limits:	
Impermeable road area drained (ha)	0.121	Bioavailable dissolved copper (µg/l)	1
Permeable area draining to outfall (ha)	0.082	Bioavailable dissolved zinc (µg/l)	10.9
Base Flow Index (BFI)	0.5	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) 3.3
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) 0.5	Side slope (m/m)	0.5
Tier 2	Bed width (m) 3	Manning's n	0.07
		Long slope (m/m)	0.0001

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	0

Cumulative Catchments 5 + 6

EQS - Annual Average Concentration		Acute Impact		Sediment deposition for this site is judged as:	
Step	Concentration (ug/l)	Copper	Zinc	Accumulating?	Extensive?
Step 2	3.91	Pass	Pass	<input type="checkbox"/>	<input type="checkbox"/>
Step 3	-			<input type="checkbox"/>	<input type="checkbox"/>

Notes: Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)		
OS grid reference of assessment point (m)	Easting 394210	Northing	304907
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Watercourse 2 New Outfall Catchment 5 and 6	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 2		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	06/09/2019	Version of assessment	1

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Dry | Rainfall site: Birmingham (SAAR 750mm)

Step 2 River Impacts

Annual Q₉₅ river flow (m³/s): 0.003
 Impermeable road area drained (ha): 1.272
 Permeable area draining to outfall (ha): 1.542
 Base Flow Index (BFI): 0.5

Freshwater EQS limits:
 Bioavailable dissolved copper (ug/l): 1
 Bioavailable dissolved zinc (ug/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 (ug/l): 3

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): 0.5
 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	No restriction	0
Proposed measures		0	No restriction	0

M54 to M6 Link Road
Environmental Statement

Road Catchment 7 Existing

No HEWRAT required as traffic below 10,000 AADT. Used traffic band >10,000 - <50,000 for conservative assessment

EQS - Annual Average Concentration		Acute Impact		Fail, Tier 2 for Velocity Settlement needed = 63%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 0.03 Low flow Vel m/s Extensive? Yes 264 Deposition Index
Step 2	Copper 4.45 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 1.21	Copper Pass	
Step 3	-	-	-	-

Road number	A460	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 384240	Nothing	304990
OS grid reference of outfall structure (m)	Easting	Nothing	Nothing
Outfall number	Catchment 7	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 3		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH AECOM
Date of assessment	23/01/2020	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT	>10,000 and <50,000	Climatic region	Warm Dry	Rainfall site	Birmingham (SAAR 750mm)
------------------------------	------	---------------------	-----------------	----------	---------------	-------------------------

Step 2 River Impacts	Annual Q ₁₀ river flow (m ³ /s)	0.003	Freshwater EQS limits:		
(Enter zero in Annual Q ₁₀ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha)	2.014	Bioavailable dissolved copper (µg/l)	1	
	Permeable area draining to outfall (ha)	0.115	Bioavailable dissolved zinc (µg/l)	10.9	
	Base Flow Index (BFI)	0.5	Is the discharge in or within 1 km upstream of a protected site for conservation?	No	
For dissolved zinc only	Water hardness	High = >200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (µg/l)	4
For sediment impact only	Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?				
	<input checked="" type="radio"/> Tier 1 Estimated river width (m)	1	Side slope (m/m)	0.5	
	<input type="radio"/> Tier 2 Bed width (m)	3	Manning's n	0.07	
			Long slope (m/m)	0.003	

Step 3 Mitigation	Brief description	Estimated effectiveness
Existing measures		Treatment for solubles (%)
Proposed measures		Attenuation for solubles - restricted discharge rate (l/s)
		Settlement of sediments (%)

Road Catchment 7 Proposed

Soluble		Acute Impact		Fail, Tier 2 for Velocity Settlement needed = 59%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 0.03 Low flow Vel m/s Extensive? Yes 239 Deposition Index
Step 2	Copper 4.45 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 1.32	Copper Pass	
Step 3	-	-	-	-

Road number	M54-M6 Link	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 384240	Nothing	304990
OS grid reference of outfall structure (m)	Easting	Nothing	Nothing
Outfall number	Catchment 7	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 3		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	09/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT	>10,000 and <50,000	Climatic region	Warm Dry	Rainfall site	Birmingham (SAAR 730mm)
------------------------------	------	---------------------	-----------------	----------	---------------	-------------------------

Step 2 River Impacts	Annual Q ₁₀ river flow (m ³ /s)	0.003	Freshwater EQS limits:		
(Enter zero in Annual Q ₁₀ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha)	1.816	Bioavailable dissolved copper (µg/l)	1	
	Permeable area draining to outfall (ha)	0.115	Bioavailable dissolved zinc (µg/l)	10.9	
	Base Flow Index (BFI)	0.5	Is the discharge in or within 1 km upstream of a protected site for conservation?	No	
For dissolved zinc only	Water hardness	High = >200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (µg/l)	4
For sediment impact only	Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?				
	<input checked="" type="radio"/> Tier 1 Estimated river width (m)	1	Side slope (m/m)	0.5	
	<input type="radio"/> Tier 2 Bed width (m)	3	Manning's n	0.07	
			Long slope (m/m)	0.003	

Step 3 Mitigation	Brief description	Estimated effectiveness
Existing measures		Treatment for solubles (%)
Proposed measures		Attenuation for solubles - restricted discharge rate (l/s)
		Settlement of sediments (%)

Road Catchment 8 Existing

Road Catchment 8 Proposed

Soluble		Acute Impact		Sediment - Chronic Impact													
EQS - Annual Average Concentration <table border="1"> <tr> <td>Copper</td> <td>4.38</td> <td>Zinc</td> <td>8.87</td> </tr> <tr> <td>Step 2</td> <td>Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.</td> <td></td> <td></td> </tr> <tr> <td>Step 3</td> <td></td> <td></td> <td></td> </tr> </table>		Copper	4.38	Zinc	8.87	Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.			Step 3				Acute Impact Copper: Pass Zinc: Pass		Sediment - Chronic Impact Pass Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Extensive? No 64	
Copper	4.38	Zinc	8.87														
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.																
Step 3																	
Road number: A400		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: Catchment 8		List of outfalls in cumulative assessment:													
Receiving watercourse: Watercourse 3		EA receiving water Detailed River Network ID:		Assessor and affiliation: HU AECOM													
Date of assessment: 09/12/2019		Version of assessment:															
Notes:																	
Step 1 Runoff Quality																	
AADT: >10,000 and <50,000		Climatic region: Warm Dry		Rainfall site: Birmingham (SAAR 750mm)													
Step 2 River Impacts																	
Annual Q ₀₅ river flow (m ³ /s): 0.001		Freshwater EQS limits:															
Impermeable road area drained (ha): 0.474		Bioavailable dissolved copper (µg/l): 1															
Permeable area draining to outfall (ha): 0.783		Bioavailable dissolved zinc (µg/l): 10.9															
Base Flow Index (BFI): 0.5		Is the discharge in or within 1 km upstream of a protected site for conservation? No															
For dissolved zinc only: Water hardness: High > 200mg CaCO ₃ /l		For dissolved copper only: Ambient background concentration (µg/l): 4															
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): 1.5															
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																	
Existing measures:		Proposed measures:		Estimated effectiveness table													

Cumulative Catchments 7 + 8

EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact													
EQS - Annual Average Concentration <table border="1"> <tr> <td>Copper</td> <td>3.78</td> <td>Zinc</td> <td>1.32</td> </tr> <tr> <td>Step 2</td> <td>Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.</td> <td></td> <td></td> </tr> <tr> <td>Step 3</td> <td></td> <td></td> <td></td> </tr> </table>		Copper	3.78	Zinc	1.32	Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.			Step 3				Acute Impact Copper: Pass Zinc: Pass		Sediment - Chronic Impact Fail, Tier 2 for Velocity Settlement needed = 67%, proposed = 0% Sediment deposition for this site is judged as: Accumulating? Yes 0.03 Extensive? Yes 301	
Copper	3.78	Zinc	1.32														
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.																
Step 3																	
Road number: M54-M6 Link		HE Area / DBFO number:															
Assessment type: Cumulative assessment including sediments (outfalls within 100m)		OS grid reference of assessment point (m): Easting 394240, Northing 304990															
OS grid reference of outfall structure (m): Easting, Northing		Outfall number: Catchment 7 and 8		List of outfalls in cumulative assessment:													
Receiving watercourse: Watercourse 3		EA receiving water Detailed River Network ID:		Assessor and affiliation: D SH													
Date of assessment: 09/09/2019		Version of assessment: 1															
Notes:																	
Step 1 Runoff Quality																	
AADT: >10,000 and <50,000		Climatic region: Warm Dry		Rainfall site: Birmingham (SAAR 750mm)													
Step 2 River Impacts																	
Annual Q ₀₅ river flow (m ³ /s): 0.003		Freshwater EQS limits:															
Impermeable road area drained (ha): 2.29		Bioavailable dissolved copper (µg/l): 1															
Permeable area draining to outfall (ha): 0.898		Bioavailable dissolved zinc (µg/l): 10.9															
Base Flow Index (BFI): 0.5		Is the discharge in or within 1 km upstream of a protected site for conservation? No															
For dissolved zinc only: Water hardness: High > 200mg CaCO ₃ /l		For dissolved copper only: Ambient background concentration (µg/l): 3.3															
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): 1															
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																	
Existing measures:		Proposed measures:		Estimated effectiveness table													

Road Catchment 9 Existing

EQS - Annual Average Concentration		Acute Impact		Fail Tier 2 for Velocity	
Step 2	Copper 4.77 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 2.22	Copper River Fails Toxicity Test. Tier mitigation	Zinc Pass	Settlement needed = 54 %, proposed = 0 % Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Low flow Vel m/s Extensive? Yes 217 Deposition Index
Step 3	-	-	-	-	-

Road number	M54 Northbound	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	Nothing	
OS grid reference of outfall structure (m)	Easting	Nothing	
Outfall number	Catchment 9	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH AECOM
Date of assessment	23/01/2020	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT	>10,000 and <50,000	Climatic region	Warm Dry	Rainfall site	Birmingham (SAAR 750mm)
------------------------------	------	---------------------	-----------------	----------	---------------	-------------------------

Step 2 River Impacts	Annual Q _{0.5} river flow (m ³ /s)	0.001	Freshwater EQS limits:			
(Enter zero in Annual Q _{0.5} river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha)	1.607	Bioavailable dissolved copper (µg/l)	1		
	Permeable area draining to outfall (ha)	0.700	Bioavailable dissolved zinc (µg/l)	10.9		
	Base Flow Index (BFI)	0.5	Is the discharge in or within 1 km upstream of a protected site for conservation?	No		
For dissolved zinc only	Water hardness	High = >200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (µg/l)	4	
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	
	Estimated river width (m)	1.5	Side slope (m/m)	0.5	Long slope (m/m)	0.000
	Bed width (m)	3	Manning's n	0.07		

Step 3 Mitigation	Estimated effectiveness	
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)
Existing measures	0	No restriction
Proposed measures	0	No restriction

Road Catchment 9: Proposed :

EQS - Annual Average Concentration		Acute Impact		Fail Tier 2 for Velocity	
Step 2	Copper 3.96 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 2.25	Copper River Fails Toxicity Test. Tier mitigation	Zinc Pass	Settlement needed = 56 %, proposed = 0 % Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Low flow Vel m/s Extensive? Yes 224 Deposition Index
Step 3	-	-	-	-	-

Road number	A460	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	Nothing	
OS grid reference of outfall structure (m)	Easting	Nothing	
Outfall number	Catchment 9	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4		
EA receiving water Detailed River Network ID		Assessor and affiliation	
Date of assessment	15/11/2019	Version of assessment	
Notes			

Step 1 Runoff Quality	AADT	>10,000 and <50,000	Climatic region	Warm Dry	Rainfall site	Birmingham (SAAR 750mm)
------------------------------	------	---------------------	-----------------	----------	---------------	-------------------------

Step 2 River Impacts	Annual Q _{0.5} river flow (m ³ /s)	0.001	Freshwater EQS limits:			
(Enter zero in Annual Q _{0.5} river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha)	1.644	Bioavailable dissolved copper (µg/l)	1		
	Permeable area draining to outfall (ha)	1.035	Bioavailable dissolved zinc (µg/l)	10.9		
	Base Flow Index (BFI)	0.5	Is the discharge in or within 1 km upstream of a protected site for conservation?	No		
For dissolved zinc only	Water hardness	High = >200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (µg/l)	3	
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	
	Estimated river width (m)	1.5	Side slope (m/m)	0.5	Long slope (m/m)	0.0001
	Bed width (m)	3	Manning's n	0.07		

Step 3 Mitigation	Estimated effectiveness	
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)
Existing measures	0	No restriction
Proposed measures	0	No restriction

Road Catchment 10: Proposed

EQS - Annual Average Concentration		Acute Impact	
Copper	Zinc	Copper	Zinc
Step 2 4.44 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 2 mitigation.	4.11	River Fails Toxicity Test. Try mitigation	Pass
Step 3			

Fall. Try Tier 2 for Velocity
Settlement needed = 79 %, proposed = 0 %
Sediment deposition for this site is judged as:
Accumulating? Yes 0.00 Low flow Vel m/s
Extensive? Yes 456 Deposition Index

Road number	M54-M6 Link Road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Eastings 395170	Northings	306270
OS grid reference of outfall structure (m)	Eastings	Northings	
Outfall number	Watercourse 4 new outfall: catchment 10	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4	Assessor and affiliation	D SH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	09/09/2019		
Notes			

Step 1 Runoff Quality
AADT >=50,000 and <100,000 Climatic region Warm Dry Rainfall site Birmingham (SAAR 750mm)

Step 2 River Impacts
Annual Q₀₅ river flow (m³/s) 0.001
Impermeable road area drained (ha) 2.250
Permeable area draining to outfall (ha) 4.05
Base Flow Index (BFI) 0.5
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) 2

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) 1.5
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	No restriction	0
Proposed measures	0	No restriction	0

Cumulative catchments 9 + 10: Proposed

EQS - Annual Average Concentration		Acute Impact	
Copper	Zinc	Copper	Zinc
Step 2 4.78 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 2 mitigation.	5.87	River Fails Toxicity Test. Try mitigation	Pass
Step 3			

Sediment deposition for this site is judged as:
Accumulating? Low flow Vel m/s
Extensive? Deposition Index

Road number	M54-M6 Link Road	HE Area / DBFO number	
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)		
OS grid reference of assessment point (m)	Eastings 395170	Northings	306270
OS grid reference of outfall structure (m)	Eastings	Northings	
Outfall number	Watercourse 4 new outfall: catchment 9 and 10	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4	Assessor and affiliation	D SH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	09/09/2019		
Notes			

Step 1 Runoff Quality
AADT >=50,000 and <100,000 Climatic region Warm Dry Rainfall site Birmingham (SAAR 750mm)

Step 2 River Impacts
Annual Q₀₅ river flow (m³/s) 0.001
Impermeable road area drained (ha) 4.997
Permeable area draining to outfall (ha) 5.085
Base Flow Index (BFI) 0.5
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

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) 1.5
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	No restriction	0
Proposed measures	0	No restriction	0

Road Catchment 11: Existing

EQS - Annual Average Concentration		Soluble		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 3.20 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 0.46	ug/l	Copper Pass	Zinc Pass	Pass Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel m/s Extensive? No 68 Deposition Index	
Step 3	-	-	ug/l	-	-		

Road number	A460	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Eastng	Northng	
OS grid reference of outfall structure (m)	Eastng	Northng	
Outfall number	catchment 10	List of outfalls in cumulative assessment	
Receiving watercourse	watercourse 5		
EA receiving water Detailed River Network ID		Assessor and affiliation	
Date of assessment	15/11/2019	Version of assessment	
Notes			

Step 1 Runoff Quality	AADT	>10,000 and <50,000	Climatic region	Warm Dry	Rainfall site	Birmingham (SAAR 750mm)
------------------------------	------	---------------------	-----------------	----------	---------------	-------------------------

Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)	0.004	Freshwater EQS limits:		
(Enter zero in Annual Q ₉₅ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha)	0.873	Bioavailable dissolved copper (ug/l)	1	
	Permeable area draining to outfall (ha)	0.460	Bioavailable dissolved zinc (ug/l)	10.9	
	Base Flow Index (BFI)	0.5	Is the discharge in or within 1 km upstream of a protected site for conservation?	No	
For dissolved zinc only	Water hardness	High >200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (ug/l)	3
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)	2.5	Manning's n	0.07
	Tier 2	Bed width (m)	3	Side slope (m/m)	0.5
				Long slope (m/m)	0.0001

Step 3 Mitigation	Estimated effectiveness	
Existing measures	Treatment for solubles (%)	Settlement of sediments (%)
Proposed measures	0	0

Road Catchment 11: Proposed

EQS - Annual Average Concentration		Soluble		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 5.14 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 0.20	ug/l	Copper Pass	Zinc Pass	Pass Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel m/s Extensive? No 21 Deposition Index	
Step 3	-	-	ug/l	-	-		

Road number	A460	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Eastng	395170	Northng
OS grid reference of outfall structure (m)	Eastng		308270
Outfall number	WVC 5 Existing Outfall	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 5		
EA receiving water Detailed River Network ID		Assessor and affiliation	HJ AECOM
Date of assessment	09/12/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality	AADT	>10,000 and <50,000	Climatic region	Warm Dry	Rainfall site	Birmingham (SAAR 750mm)
------------------------------	------	---------------------	-----------------	----------	---------------	-------------------------

Step 2 River Impacts	Annual Q ₉₅ river flow (m ³ /s)	0.004	Freshwater EQS limits:		
(Enter zero in Annual Q ₉₅ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha)	0.351	Bioavailable dissolved copper (ug/l)	1	
	Permeable area draining to outfall (ha)	0.017	Bioavailable dissolved zinc (ug/l)	10.9	
	Base Flow Index (BFI)	0.5	Is the discharge in or within 1 km upstream of a protected site for conservation?	No	
For dissolved zinc only	Water hardness	High >200mg CaCO ₃ /l	For dissolved copper only	Ambient background concentration (ug/l)	5
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)	2.5	Manning's n	0.07
	Tier 2	Bed width (m)	3	Side slope (m/m)	0.5
				Long slope (m/m)	0.0001

Step 3 Mitigation	Estimated effectiveness	
Existing measures	Treatment for solubles (%)	Settlement of sediments (%)
Proposed measures	0	0

Road Catchment 12 No HEWRAT required as embankment drainage only.
Road Catchment 13 No HEWRAT required as embankment drainage only.

Road Catchment 14 : Proposed Area (new road)

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EBS - Annual Average Concentration		Copper		Zinc	
Step 2	5.61 Tier 1 fail. Go to Tier 2 (using UK TAG M-RAT tool), or Step 3 mitigation.	1.00	Pass	1.00	Pass
Step 3	-	-	-	-	-

Fail, try Tier 2 for Velocity
Settlement needed = 64 %, proposed = 0 %
Sediment deposition for this site is judged as:
Accumulating? Yes 0.01 Low flow Vel m/s
Extensive? Yes 213 Deposition Index

Road number: M54-M6 Link Road HE Area / DBFO number: []
Assessment type: Non-cumulative assessment (single outfall)
OS grid reference of assessment point (m): Easting 385440 Northing 306580
OS grid reference of outfall structure (m): Easting [] Northing []
Outfall number: WWatercourse 5 new Outfall C: Catchment 14 List of outfalls in cumulative assessment: []
Receiving watercourse: WWatercourse 5 - Latherford Brook
EA receiving water Detailed River Network ID: [] Assessor and affiliation: HU AECOM
Date of assessment: 09/12/2019 Version of assessment: 1
Notes: []

Step 1 Runoff Quality AADT >=50,000 and <100,000 Climatic region Warm Dry Rainfall site Birmingham (SAAR 750mm)

Step 2 River Impacts
Annual Q₁₀ river flow (m³/s) 0.004
Impermeable road area drained (ha) 3.492
Permeable area draining to outfall (ha) 3.285
Base Flow Index (BFI) 0.5
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) 5

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) 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

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	0

Road Catchment 15 A460

Existing Area

Soluble		Acute Impact		Sediment - Chronic Impact	
EBS - Annual Average Concentration				Fail, Try Tier 2 for Velocity	
Copper	Zinc	Copper	Zinc	Settlement needed = 51 %, proposed = 0 %	
4.50	1.42	Pass	Pass	Sediment deposition for this site is judged as:	
Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.				Accumulating?	Yes 0.02
				Extensive?	Yes 204
				Low flow Vel m/s	
				Deposition Index	
Road number		A460 north of J11 M6		HE Area / DBFO number	
Assessment type		Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)		Easting 385965		Northing 307320	
OS grid reference of outfall structure (m)		Easting		Northing	
Outfall number		Watercourse 6: Catchment 14 Existing		List of outfalls in cumulative assessment	
Receiving watercourse		Watercourse 6		Assessor and affiliation	
EA receiving water Detailed River Network ID				DSH	
Date of assessment		09/09/2019		Version of assessment	
Notes				1	
Step 1 Runoff Quality					
AADT		>=50,000 and <100,000		Climatic region	
				Warm Dry	
				Rainfall site	
				Birmingham (SAAR730mm)	
Step 2 River Impacts					
Annual Q ₁₀ river flow (m ³ /s)		0.002		Freshwater EQS limits:	
Impermeable road area drained (ha)		1.268		Bioavailable dissolved copper (µg/l)	
Permeable area draining to outfall (ha)		0.968		Bioavailable dissolved zinc (µg/l)	
Base Flow Index (BFI)		0.5		Is the discharge in or within 1 km upstream of a protected site for conservation?	
				No	
For dissolved zinc only		Water hardness		For dissolved copper only	
		High >>200mg CaCO ₃ /l		Ambient background concentration (µg/l)	
				4	
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)		1	
o 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					
Existing measures		Proposed measures		Brief description	
				Treatment for solubles (%)	
				Attenuation for solubles - restricted discharge rate (l/s)	
				Settlement of sediments (%)	
				0	
				No restriction	
				0	
				No restriction	
				0	

Proposed Area

Soluble		Acute Impact		Sediment - Chronic Impact	
EBS - Annual Average Concentration				Fail, Try Tier 2 for Velocity	
Copper	Zinc	Copper	Zinc	Settlement needed = 69 %, proposed = 0 %	
4.11	2.04	River Fails Toxicity Test. Try mitigation.	Pass	Sediment deposition for this site is judged as:	
Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.				Accumulating?	Yes 0.92
				Extensive?	Yes 322
				Low flow Vel m/s	
				Deposition Index	
Road number		A460 north of J11 M6		HE Area / DBFO number	
Assessment type		Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)		Easting 385965		Northing 307320	
OS grid reference of outfall structure (m)		Easting		Northing	
Outfall number		Watercourse 6: Catchment 15 Proposed		List of outfalls in cumulative assessment	
Receiving watercourse		Watercourse 6		Assessor and affiliation	
EA receiving water Detailed River Network ID				HJ AECOM	
Date of assessment		09/12/2019		Version of assessment	
Notes				1	
Step 1 Runoff Quality					
AADT		>=50,000 and <100,000		Climatic region	
				Warm Dry	
				Rainfall site	
				Birmingham (SAAR730mm)	
Step 2 River Impacts					
Annual Q ₁₀ river flow (m ³ /s)		0.002		Freshwater EQS limits:	
Impermeable road area drained (ha)		2		Bioavailable dissolved copper (µg/l)	
Permeable area draining to outfall (ha)		0.798		Bioavailable dissolved zinc (µg/l)	
Base Flow Index (BFI)		0.5		Is the discharge in or within 1 km upstream of a protected site for conservation?	
				No	
For dissolved zinc only		Water hardness		For dissolved copper only	
		High >>200mg CaCO ₃ /l		Ambient background concentration (µg/l)	
				4	
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)		1	
o 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					
Existing measures		Proposed measures		Brief description	
				Treatment for solubles (%)	
				Attenuation for solubles - restricted discharge rate (l/s)	
				Settlement of sediments (%)	
				0	
				No restriction	
				0	
				No restriction	
				0	

Road Catchment 16 Existing Area

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EQS - Annual Average Concentration		Copper	Zinc	Fail. Try Tier 2 for Velocity Settlement needed = 79 %, proposed = 0 % Sediment deposition for this site is judged as: Accumulating? Yes 0.02 Low flow Vol m/s Extensive? Yes 415 Deposition Index	
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.68	2.92	Copper	Zinc
Step 3	-	-	-	River Fails Toxicity Test. Try mitigation	Pass

Road number: A400 HE Area / DBFO number: [blank]
 Assessment type: Non-cumulative assessment (single outfall)
 OS grid reference of assessment point (m): Easting 395687 Northing 307352
 OS grid reference of outfall structure (m): Easting [blank] Northing [blank]
 Outfall number: M6 Northbound Outfall, Catchment 16 existing List of outfalls in cumulative assessment: [blank]
 Receiving watercourse: Watercourse 0
 EA receiving water Detailed River Network ID: [blank] Assessor and affiliation: DSH
 Date of assessment: 09/09/2019 Version of assessment: 1

Notes: [blank]

Step 1 Runoff Quality
 AADT: >10,000 and <50,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR750mm)

Step 2 River Impacts
 Annual Q₉₅ river flow (m³/s): 0.002 Freshwater EQS limits:
 Impermeable road area drained (ha): 2.951 Bioavailable dissolved copper (µg/l): 1
 Permeable area draining to outfall (ha): 3.632 Bioavailable dissolved zinc (µg/l): 10.9
 Base Flow Index (BFI): 0.5 Is the discharge in or within 1 km upstream of a protected site for conservation? No
 For dissolved zinc only: Water hardness: [blank] For dissolved copper only: Ambient background concentration (µg/l): 4
 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): 1
 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 (%)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	0

Proposed Area

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EQS - Annual Average Concentration		Copper	Zinc	Fail. Try Tier 2 for Velocity Settlement needed = 84 %, proposed = 0 % Sediment deposition for this site is judged as: Accumulating? Yes 0.02 Low flow Vol m/s Extensive? Yes 608 Deposition Index	
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.62	2.41	Copper	Zinc
Step 3	-	-	-	River Fails Toxicity Test. Try mitigation	Pass

Road number: M6 Northbound HE Area / DBFO number: [blank]
 Assessment type: Non-cumulative assessment (single outfall)
 OS grid reference of assessment point (m): Easting 395687 Northing 307352
 OS grid reference of outfall structure (m): Easting [blank] Northing [blank]
 Outfall number: M6 Northbound Outfall, Catchment 16 List of outfalls in cumulative assessment: [blank]
 Receiving watercourse: Watercourse 0
 EA receiving water Detailed River Network ID: [blank] Assessor and affiliation: HU AECOM
 Date of assessment: 09/12/2019 Version of assessment: 1

Notes: [blank]

Step 1 Runoff Quality
 AADT: >10,000 and <50,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR750mm)

Step 2 River Impacts
 Annual Q₉₅ river flow (m³/s): 0.002 Freshwater EQS limits:
 Impermeable road area drained (ha): 3.78 Bioavailable dissolved copper (µg/l): 1
 Permeable area draining to outfall (ha): 3.574 Bioavailable dissolved zinc (µg/l): 10.9
 Base Flow Index (BFI): 0.5 Is the discharge in or within 1 km upstream of a protected site for conservation? No
 For dissolved zinc only: Water hardness: [blank] For dissolved copper only: Ambient background concentration (µg/l): 4
 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): 1
 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 (%)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	0

Road Catchment 17 Existing Area

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact																											
EQS - Annual Average Concentration <table border="1"> <tr> <th></th> <th>Copper</th> <th>Zinc</th> <th>ug/l</th> </tr> <tr> <td>Step 2</td> <td>4.75</td> <td>2.21</td> <td>ug/l</td> </tr> <tr> <td>Step 3</td> <td>-</td> <td>-</td> <td>ug/l</td> </tr> </table>			Copper	Zinc	ug/l	Step 2	4.75	2.21	ug/l	Step 3	-	-	ug/l	Acute Impact <table border="1"> <tr> <th></th> <th>Copper</th> <th>Zinc</th> </tr> <tr> <td>Step 2</td> <td>River Fails Toxicity Test. Try mitigation</td> <td>Pass</td> </tr> </table>			Copper	Zinc	Step 2	River Fails Toxicity Test. Try mitigation	Pass	Sediment - Chronic Impact <p>Fail. Try Tier 2 for Velocity Settlement needed = 82 %, proposed = 0 % Sediment deposition for this site is judged as:</p> <table border="1"> <tr> <td>Accumulating?</td> <td>Yes</td> <td>0.02</td> <td>Low flow Vol m³/s</td> </tr> <tr> <td>Extensive?</td> <td>Yes</td> <td>342</td> <td>Deposition Index</td> </tr> </table>		Accumulating?	Yes	0.02	Low flow Vol m ³ /s	Extensive?	Yes	342	Deposition Index
	Copper	Zinc	ug/l																												
Step 2	4.75	2.21	ug/l																												
Step 3	-	-	ug/l																												
	Copper	Zinc																													
Step 2	River Fails Toxicity Test. Try mitigation	Pass																													
Accumulating?	Yes	0.02	Low flow Vol m ³ /s																												
Extensive?	Yes	342	Deposition Index																												
Road number: M6		HE Area / DBFO number:																													
Assessment type: Non-cumulative assessment (single outfall)		OS grid reference of assessment point (m): Easting 395560 Northing 307169		OS grid reference of outfall structure (m): Easting Northing																											
Outfall number: M6 Southbound: Catchment 17 existing		List of outfalls in cumulative assessment:		43717																											
Receiving watercourse: Watercourse 6		EA receiving water Detailed River Network ID:		HU AECOM																											
Date of assessment: 09/12/2019		Version of assessment:		1																											
Notes:																															

Step 1 Runoff Quality
AADT: >10,000 and <50,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR750mm)

Step 2 River Impacts
Annual Q₉₅ river flow (m³/s): 0.002
Impermeable road area drained (ha): 3.37
Permeable area draining to outfall (ha): 3.98
Base Flow Index (BFI): 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l): 1
Bioavailable dissolved zinc (ug/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 (ug/l): 4

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): 1
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

Existing measures	Proposed measures	Brief description	Estimated effectiveness		
			Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
			0	No restriction	0
			0	No restriction	0

Proposed Area

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact																											
EQS - Annual Average Concentration <table border="1"> <tr> <th></th> <th>Copper</th> <th>Zinc</th> <th>ug/l</th> </tr> <tr> <td>Step 2</td> <td>4.04</td> <td>2.47</td> <td>ug/l</td> </tr> <tr> <td>Step 3</td> <td>-</td> <td>-</td> <td>ug/l</td> </tr> </table>			Copper	Zinc	ug/l	Step 2	4.04	2.47	ug/l	Step 3	-	-	ug/l	Acute Impact <table border="1"> <tr> <th></th> <th>Copper</th> <th>Zinc</th> </tr> <tr> <td>Step 2</td> <td>River Fails Toxicity Test. Try mitigation</td> <td>Pass</td> </tr> </table>			Copper	Zinc	Step 2	River Fails Toxicity Test. Try mitigation	Pass	Sediment - Chronic Impact <p>Fail. Try Tier 2 for Velocity Settlement needed = 85 %, proposed = 0 % Sediment deposition for this site is judged as:</p> <table border="1"> <tr> <td>Accumulating?</td> <td>Yes</td> <td>0.02</td> <td>Low flow Vol m³/s</td> </tr> <tr> <td>Extensive?</td> <td>Yes</td> <td>642</td> <td>Deposition Index</td> </tr> </table>		Accumulating?	Yes	0.02	Low flow Vol m ³ /s	Extensive?	Yes	642	Deposition Index
	Copper	Zinc	ug/l																												
Step 2	4.04	2.47	ug/l																												
Step 3	-	-	ug/l																												
	Copper	Zinc																													
Step 2	River Fails Toxicity Test. Try mitigation	Pass																													
Accumulating?	Yes	0.02	Low flow Vol m ³ /s																												
Extensive?	Yes	642	Deposition Index																												
Road number: M6 Southbound		HE Area / DBFO number:																													
Assessment type: Non-cumulative assessment (single outfall)		OS grid reference of assessment point (m): Easting 395560 Northing 307169		OS grid reference of outfall structure (m): Easting Northing																											
Outfall number: M6 Southbound: Catchment 17 proposed		List of outfalls in cumulative assessment:		43717																											
Receiving watercourse: Watercourse 6		EA receiving water Detailed River Network ID:		HU AECOM																											
Date of assessment: 09/12/2019		Version of assessment:		1																											
Notes:																															

Step 1 Runoff Quality
AADT: >10,000 and <50,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR750mm)

Step 2 River Impacts
Annual Q₉₅ river flow (m³/s): 0.002
Impermeable road area drained (ha): 3.994
Permeable area draining to outfall (ha): 4.169
Base Flow Index (BFI): 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l): 1
Bioavailable dissolved zinc (ug/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 (ug/l): 4

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): 1
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

Existing measures	Proposed measures	Brief description	Estimated effectiveness		
			Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
			0	No restriction	0
			0	No restriction	0

Cumulative Road Catchments 15,16 and 17 – existing

EQS - Annual Average Concentration		Acute Impact		Sediment deposition for this site is judged as:	
Copper	Zinc	Copper	Zinc	Accumulating?	Extensive?
Step 2 4.82 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.48	River Fails Toxicity Test. Try mitigation	Pass	<input type="checkbox"/>	<input type="checkbox"/>
Step 3				<input type="checkbox"/>	<input type="checkbox"/>

Road number	A460/M6	HE Area / DBFO number	
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)		
OS grid reference of assessment point (m)	Easting 395560	Nothing	307169
OS grid reference of outfall structure (m)	Easting	Nothing	
Outfall number	Catchment 15 16 17 Existing	List of outfalls in cumulative assessment	14 15 16
Receiving watercourse	Watercourse 6	Assessor and affiliation	D SH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	09/09/2019		
Notes			

Step 1 Runoff Quality

AA DT: Climatic region: Rainfall site:

Step 2 River Impacts

Annual Q₀₅ river flow (m³/s): Freshwater EQS limits:

Impermeable road area drained (ha): Bioavailable dissolved copper (µg/l):

Permeable area draining to outfall (ha): Bioavailable dissolved zinc (µg/l):

Base Flow Index (BFI): Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only: Water hardness: For dissolved copper only: Ambient background 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 river width (m):
 Tier 2 Bed width (m): Manning's n: Side slope (m/m): Long slope (m/m):

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	<input type="text" value="0"/> <input type="checkbox"/>	No restriction <input type="text" value="0"/> <input type="checkbox"/>	<input type="text" value="0"/> <input type="checkbox"/>
Proposed measures	<input type="text" value="0"/> <input type="checkbox"/>	No restriction <input type="text" value="0"/> <input type="checkbox"/>	<input type="text" value="0"/> <input type="checkbox"/>

Cumulative Road Catchments 15,16 and 17 – Proposed With Scheme

EQS - Annual Average Concentration		Acute Impact		Sediment deposition for this site is judged as:	
Copper	Zinc	Copper	Zinc	Accumulating?	Extensive?
Step 2 5.49 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	5.98	River Fails Toxicity Test. Try mitigation	Pass	<input type="checkbox"/>	<input type="checkbox"/>
Step 3				<input type="checkbox"/>	<input type="checkbox"/>

Road number	A460/M6	HE Area / DBFO number	
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)		
OS grid reference of assessment point (m)	Easting 395560	Nothing	307169
OS grid reference of outfall structure (m)	Easting	Nothing	
Outfall number	Catchment 15 16 17 Proposed	List of outfalls in cumulative assessment	14 15 16
Receiving watercourse	Watercourse 6	Assessor and affiliation	D SH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	09/09/2019		
Notes			

Step 1 Runoff Quality

AA DT: Climatic region: Rainfall site:

Step 2 River Impacts

Annual Q₀₅ river flow (m³/s): Freshwater EQS limits:

Impermeable road area drained (ha): Bioavailable dissolved copper (µg/l):

Permeable area draining to outfall (ha): Bioavailable dissolved zinc (µg/l):

Base Flow Index (BFI): Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only: Water hardness: For dissolved copper only: Ambient background 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 river width (m):
 Tier 2 Bed width (m): Manning's n: Side slope (m/m): Long slope (m/m):

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	<input type="text" value="0"/> <input type="checkbox"/>	No restriction <input type="text" value="0"/> <input type="checkbox"/>	<input type="text" value="0"/> <input type="checkbox"/>
Proposed measures	<input type="text" value="0"/> <input type="checkbox"/>	No restriction <input type="text" value="0"/> <input type="checkbox"/>	<input type="text" value="0"/> <input type="checkbox"/>

HEWRAT Screenshots with Mitigation solutions Cumulative Road Catchments 1 + 2: with existing Filter Drains

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Copper	2.34	Copper	Pass	Pass	
Zinc	2.39	Zinc	Pass		
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 2 mitigation.	Acute Impact	Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel m/s Extensive? No 62 Deposition Index	
Step 3					

Road number: M54 HE Area / DBFO number: [blank]
 Assessment type: Cumulative assessment including sediments (outfalls within 100m)
 OS grid reference of assessment point (m): Easting 392740 Northing 304822
 OS grid reference of outfall structure (m): Easting [blank] Northing [blank]
 Outfall number: M54 Outfall : Catchments 1 and 2 Proposed List of outfalls in cumulative assessment: 1, 2
 Receiving watercourse: Watercourse 7
 EA receiving water Detailed River Network ID: [blank] Assessor and affiliation: DSH
 Date of assessment: 09/09/2019 Version of assessment: 1

Notes: [blank]

Step 1 Runoff Quality AADT: >=100,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAD R 750mm)

Step 2 River Impacts Annual Q₁₀ river flow (m³/s): [blank] Freshwater EQS limits:
 Bioavailable dissolved copper (µg/l): 1
 Bioavailable dissolved zinc (µg/l): 10.9
 (Enter zero in Annual Q₁₀ river flow box, to assess Step 1 runoff quality only)
 Impermeable road area drained (ha): [blank]
 Permeable area draining to outfall (ha): [blank]
 Base Flow Index (BFI): [blank] Is the discharge in or within 1 km upstream of a protected site for conservation? [blank]
 For dissolved zinc only Water hardness: High >200mg CaCO₃/l For dissolved copper only Ambient background concentration (µg/l): [blank]
 For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? [blank]
 Estimated river width (m): [blank] Bed width (m): [blank] Manning's n: [blank] Side slope (m/m): [blank] Long slope (m/m): [blank]

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	62

Sensitivity analysis using downstream assessment location upstream of River Penk

EQS - Annual Average Concentration

EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Copper	0.22	Copper	Pass	Pass	
Zinc	0.74	Zinc	Pass		
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Acute Impact	Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.04 Low flow Vel m/s Extensive? No 34 Deposition Index	
Step 3					

Road number: M54 HE Area / DBFO number: [blank]
 Assessment type: Cumulative assessment including sediments (outfalls within 100m)
 OS grid reference of assessment point (m): Easting 392740 Northing 304522
 OS grid reference of outfall structure (m): Easting [blank] Northing [blank]
 Outfall number: M54 Outfall : Catchments 1 and 2 Proposed List of outfalls in cumulative assessment: 1, 2
 Receiving watercourse: Watercourse 7
 EA receiving water Detailed River Network ID: [blank] Assessor and affiliation: DSH
 Date of assessment: 09/09/2019 Version of assessment: 1

Notes: [blank]

Step 1 Runoff Quality AADT: >=100,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAD R 750mm)

Step 2 River Impacts Annual Q₁₀ river flow (m³/s): [blank] Freshwater EQS limits:
 Bioavailable dissolved copper (µg/l): 1
 Bioavailable dissolved zinc (µg/l): 10.9
 (Enter zero in Annual Q₁₀ river flow box, to assess Step 1 runoff quality only)
 Impermeable road area drained (ha): [blank]
 Permeable area draining to outfall (ha): [blank]
 Base Flow Index (BFI): [blank] Is the discharge in or within 1 km upstream of a protected site for conservation? [blank]
 For dissolved zinc only Water hardness: High >200mg CaCO₃/l For dissolved copper only Ambient background concentration (µg/l): [blank]
 For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? [blank]
 Estimated river width (m): [blank] Bed width (m): [blank] Manning's n: [blank] Side slope (m/m): [blank] Long slope (m/m): [blank]

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	34

Road Catchment 3:

Step 1: with Wet Pond

EQS - Annual Average Concentration		Acute Impact		Fail - In Tier 2 (in Velocity)
Step 2	Copper 4.38 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 3.95 ug/l	Copper River Fails Toxicity Test. Try more mitigation	Settlement needed = 84 %, proposed = 68 % Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Vel(m/s) Extensive? Yes 243 Deposition Index
Step 3	3.71 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	2.37 ug/l	Zinc Pass	

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 393410	Northing	304709
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Watercourse 1 New Outfall Catchment 3	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 1	Assessor and affiliation	D SH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	06/09/2019		
Notes			

Step 1 Runoff Quality

AADT: Climatic region: Rainfall site:

Step 2 River Impacts

Annual Q₉₅ river flow (m³/s): Freshwater EQS limits:
 Bioavailable dissolved copper (ug/l):
 Bioavailable dissolved zinc (ug/l):
 Impermeable road area drained (ha):
 Permeable area draining to outfall (ha):
 Base Flow Index (BFI): Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only: Water hardness: For dissolved copper only: Ambient background concentration (ug/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 river width (m):
 Tier 2 Bed width (m): Manning's n: Side slope (m/m): Long slope (m/m):

Step 3 Mitigation

	Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (lbs)	Settlement of sediments (%)
Existing measures		0	No restriction	0
Proposed measures	With wet Attenuation Pond within design	40	No restriction	60

Step 2, added short length of swale (using half mitigation for swale)

EQS - Annual Average Concentration		Acute Impact		Sediment deposition for this site is judged as:
Step 2	Copper 4.38 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 3.95 ug/l	Copper Pass	Accumulating? Yes 0.01 Low flow Vel(m/s) Extensive? No 0 Deposition Index
Step 3	3.32 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.98 ug/l	Zinc Pass	

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 393410	Northing	304709
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Watercourse 1 New Outfall Catchment 3	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 1	Assessor and affiliation	D SH
EA receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	06/09/2019		
Notes			

Step 1 Runoff Quality

AADT: Climatic region: Rainfall site:

Step 2 River Impacts

Annual Q₉₅ river flow (m³/s): Freshwater EQS limits:
 Bioavailable dissolved copper (ug/l):
 Bioavailable dissolved zinc (ug/l):
 Impermeable road area drained (ha):
 Permeable area draining to outfall (ha):
 Base Flow Index (BFI): Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only: Water hardness: For dissolved copper only: Ambient background concentration (ug/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 river width (m):
 Tier 2 Bed width (m): Manning's n: Side slope (m/m): Long slope (m/m):

Step 3 Mitigation

	Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (lbs)	Settlement of sediments (%)
Existing measures		0	No restriction	0
Proposed measures	With wet Attenuation Pond within design and length swale	65	No restriction	100

Road Catchment 4:

Step 1, with HVS

Copper		Zinc		Fail. Try Tier 2 for Velocity	
Step 2	4.88 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.70	ug/l	River Fails Toxicity Test. Try mitigation	Pass
Step 3			ug/l		

Settlement needed = 92 %, proposed = 40 %
Sediment deposition for this site is judged as:
Accumulating? Yes 0.01 Low flow Vel m/s
Extensive? Yes 708 Deposition Index

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 394400	Northing	304770
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Watercourse 1 New Outfall Catchment 4	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 1		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	27/11/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality
AADT >10,000 and <50,000 Climatic region Warm Dry Rainfall site Birmingham (SAAR 750mm)

Step 2 River Impacts
Annual Q₉₅ river flow (m³/s) 0.001
Impermeable road area drained (ha) 6.185
Permeable area draining to outfall (ha) 2.845
Base Flow Index (BFI) 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l) 1
Bioavailable dissolved zinc (ug/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 (ug/l) 3

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) 1
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 (/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures with HVS	0	No restriction	40

Step 2, with HVS and filter drains

Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EQS - Annual Average Concentration				Pass	
Step 2	4.88 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.70	ug/l	River Fails Toxicity Test. Try mitigation	Pass
Step 3			ug/l		

Sediment deposition for this site is judged as:
Accumulating? Yes 0.01 Low flow Vel m/s
Extensive? No 0 Deposition Index

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 394400	Northing	304770
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Watercourse 1 New Outfall Catchment 4	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 1		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	06/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality
AADT >10,000 and <50,000 Climatic region Warm Dry Rainfall site Birmingham (SAAR 750mm)

Step 2 River Impacts
Annual Q₉₅ river flow (m³/s) 0.001
Impermeable road area drained (ha) 6.185
Permeable area draining to outfall (ha) 2.845
Base Flow Index (BFI) 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l) 1
Bioavailable dissolved zinc (ug/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 (ug/l) 3

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) 1
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 (/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures with HVS and filter drains	0	No restriction	100

Sensitivity analysis of catchment 4, using downstream WC 7 Q95

EQS - Annual Average Concentration		Soluble		Acute Impact		Sediment - Chronic Impact	
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Copper 3.60	Zinc 1.65	Copper Pass	Zinc Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.01 Low flow Yel/miz Extensive? No 0 Deposition Index	
Step 3							

Road number	M54/M6 Link road	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 394400	Northing	304770
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Watercourse 1 New Outfall Catchment 4	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 1, WC7 sensitivity	Assessor and affiliation	DSH
E.A receiving water Detailed River Network ID		Version of assessment	1
Date of assessment	06/09/2019		
Notes			

Step 1 Runoff Quality	AADT <input type="text" value=">16,000 and <50,000"/>	Climatic region <input type="text" value="Warm Dry"/>	Rainfall site <input type="text" value="Birmingham (SAAR 750mm)"/>
------------------------------	---	---	--

Step 2 River Impacts	Annual Q ₁₀ river flow (m ³ /s) <input type="text" value="0.006"/>	Freshwater EQS limits:
(Enter zero in Annual Q ₁₀ river flow box to assess Step 1 runoff quality only)	Impermeable road area drained (ha) <input type="text" value="6.185"/>	Bioavailable dissolved copper (µg/l) <input type="text" value="1"/>
	Permeable area draining to outfall (ha) <input type="text" value="2.945"/>	Bioavailable dissolved zinc (µg/l) <input type="text" value="10.9"/>
	Base Flow Index (BFI) <input type="text" value="0.5"/>	Is the discharge in or within 1 km upstream of a protected site for conservation? <input type="text" value="No"/>
For dissolved zinc only	Water hardness <input type="text" value="High = >200mg CaCO3/l"/>	For dissolved copper only
		Ambient background concentration (µg/l) <input type="text" value="3"/>
For sediment impact only	Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? <input type="text" value="No"/>	
<input checked="" type="radio"/> Tier 1 Estimated river width (m) <input type="text" value="2.5"/> <input type="radio"/> Tier 2 Bed width (m) <input type="text" value="3"/> Manning's n <input type="text" value="0.07"/> Side slope (m/m) <input type="text" value="0.5"/> Long slope (m/m) <input type="text" value="0.0001"/>		

Step 3 Mitigation	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (Vs)	Settlement of sediments (%)
Existing measures	<input type="text" value="0"/>	No restriction	<input type="text" value="0"/>
Proposed measures	<input type="text" value="0"/>	No restriction	<input type="text" value="100"/>

Cumulative Road Catchments 3 + 4 (HVS and filter drains on Catchment 4, and Pond and length of swale on Catchment 3) Ratio method = 24% mitigation on dissolved metals.

Catchment	Impermeable area (ha)	Treatment	Mitigation percentage (as a proportion)	
M54 Catchment 3	3.189	Pond and swale	0.65	2.07285
M54 Catchment 4	5.511			0
			0	0
			0	0
Total Area	8.7		Total Mitigation	2.07285
			Mitigation Percentage for metals	0.24

highways england Highways England Water Risk Assessment Tool Version 2.0.4 June 2018

Soluble		Sediment - Chronic Impact											
EQS - Annual Average Concentration <table border="1"> <tr> <td>Copper</td> <td>Zinc</td> </tr> <tr> <td>4.71 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.</td> <td>4.84 pass</td> </tr> <tr> <td>4.38 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.</td> <td>3.68 pass</td> </tr> </table>		Copper	Zinc	4.71 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.84 pass	4.38 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	3.68 pass	Acute Impact <table border="1"> <tr> <td>Copper</td> <td>Zinc</td> </tr> <tr> <td>River fails Toxicity Test. Try more mitigation.</td> <td>Pass</td> </tr> </table>		Copper	Zinc	River fails Toxicity Test. Try more mitigation.	Pass
Copper	Zinc												
4.71 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.84 pass												
4.38 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	3.68 pass												
Copper	Zinc												
River fails Toxicity Test. Try more mitigation.	Pass												
Sediment Deposition for this site is judged as: Accumulative? <input type="checkbox"/> Low Flow Volume Deposition Index <input type="checkbox"/> Extensive? <input type="checkbox"/>													
Road number	M54/M6 Link road	HE Area / DBF Number											
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km a carb)												
OS grid reference of assessment point (m)	Eastings 394400	Northing 304770											
OS grid reference of outfall structure (m)	Eastings	Northing											
Outfall number	Watercourse 1 Catchment 3 and 4	List of outfalls in cumulative assessment											
Receiving watercourse	Watercourse 1	Assessor and affiliation	DSH										
EA receiving water Detailed River Network ID		Version of assessment	1										
Date of assessment	06/09/2019												
Notes													

Step 1 Runoff Quality AADT Climatic region Rainfall site

Step 2 River Impacts Annual Q₉₅ river flow (m³/s) Freshwater EQS limits:
 Bioavailable dissolved copper (µg/l)
 Bioavailable dissolved zinc (µg/l)
 (Enter zero in Annual Q₉₅ river flow box to assess Step 1 runoff quality only)
 Impermeable road area drained (ha)
 Permeable area draining to outfall (ha)
 Base Flow Index (BFI) Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only Water hardness
 For dissolved copper only Ambient background 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?
 Estimated river width (m)
 Bed width (m) Manning's n Side slope (m/m) Long slope (m/m)

Step 3 Mitigation

	Brief description	Estimated effectiveness		
		Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	No restriction	0
Proposed measures	with HVS and filter drains for catchment 4 and swale/pond catchment 3	7.4	No restriction	4.00

Sensitivity analysis on Cumulative Catchment 3 + 4 with Q95 of 0.006, at confluence with WC 7.

Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble		Acute Impact		Sediment - Chronic Impact	
EQS - Annual Average Concentration					
Step 2	Copper 3.48 Tier 1 Fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 1.92	Copper Pass	Zinc Pass	Sediment deposition for this site is judged as: Accumulating? <input type="checkbox"/> Low flow Volume Excessive? <input type="checkbox"/> Deposition Index
Step 3	3.45 Tier 1 Fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation	1.46			

Road number: M54/M6 Link road HE Area / DBFO number: []
 Assessment type: Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)
 OS grid reference of assessment point (m): Easting 394400 Northing 304770
 OS grid reference of outfall structure (m): Easting [] Northing []
 Outfall number: Watercourse 1 Catchment 3 and 4 List of outfalls in cumulative assessment: []
 Receiving watercourse: Watercourse 1
 EA receiving water Detailed River Network ID: [] Assessor and affiliation: DSH
 Date of assessment: 08/09/2019 Version of assessment: 1

Notes: []

Step 1 Runoff Quality
 AADT: [] Climatic region: Warm Dry Rainfall site: Birmingham (CAAD 760mm)

Step 2 River Impacts
 Annual Q₉₅ river flow (m³/s): [] Freshwater EQS limits:
 Bioavailable dissolved copper (µg/l): 1
 Bioavailable dissolved zinc (µg/l): 10.9
 Impermeable road area drained (ha): []
 Permeable area draining to outfall (ha): []
 Base Flow Index (BFI): [] Is the discharge in or within 1 km upstream of a protected site for conservation? []
 For dissolved zinc only: Water hardness: [] For dissolved copper only: Ambient background 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? []
 Estimated river width (m): []
 Bed width (m): [] Manning's n: [] Side slope (m/m): [] Long slope (m/m): []

Step 3 Mitigation

	Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	[]	0	No restriction	[]
Proposed measures	with HVS and filter drains for catchment 4 and swales/pond catchment 3	7.8	No restriction	4.00

- Road Catchment 5 – Passes so no mitigation proposed
- Road Catchment 6 – Passes so no mitigation proposed
- Road Catchment 7 – Passes so no mitigation proposed
- Road Catchment 8 – Passes so no mitigation proposed

Road Catchment 7 + 8 – Wet attenuation pond and circa 290m ditches on catchment 8, filter drains on catchment 7 – ratios used, provides 68% mitigation for suspended solids and 8% for dissolved metals.

EQS - Annual Average Concentration		Acute Impact		Pass
Step 2	Copper 3.78 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 1.32 ug/l	Copper Pass	Zinc Pass
Step 3	3.68 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.22 ug/l		

Sediment deposition for this site is judged as:
Accumulating? Yes 0.03 Low flow Vel m/s
Extensive? No 36 Deposition Index

Road number	M54-M6 Link	HE Area / DBFO number	
Assessment type	Cumulative assessment including sediments (outfalls within 100m)		
OS grid reference of assessment point (m)	Easting 394240	Northing	304990
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	Catchment 7 and 8	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 3		
EPA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	09/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality
AADT: $\le 10,000$ and $\le 50,000$ Climatic region: W/Am Dry Rainfall site: Rirmingham (SAR 750mm)

Step 2 River Impacts
Annual Q_{10} river flow (m³/s): 0.002
Impermeable road area drained (ha): 0.00
Permeable area draining to outfall (ha): 0.000
Base Flow Index (BFI): 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l): 1
Bioavailable dissolved zinc (ug/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 (ug/l): 2.2

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
Estimated river width (m): 1
Bed width (m): 2
Manning's n: 0.07
Side slope (m/m): 0.5
Long slope (m/m): 0.00

Step 3 Mitigation

Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (ls)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	68

Road Catchment 9 – A460 and Hilton Lane

With filter drains along part of Hilton Lane (50% of ditch parameters used)

EQS - Annual Average Concentration		Acute Impact		Fail. Tier 2 for Yellow
Step 2	Copper 3.68 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 2.25 ug/l	Copper River Fail Toxicity Test. Tier more mitigation	Zinc Pass
Step 3	3.68 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	2.87 ug/l		

Sediment deposition for this site is judged as:
Accumulating? Yes 0.00 Low flow Vel m/s
Extensive? Yes 195 Deposition Index

Settlement needed = 56%, proposed = 12%

Road number	A460	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	catchment 9	List of outfalls in cumulative assessment	
Receiving watercourse	watercourse 4		
EPA receiving water Detailed River Network ID		Assessor and affiliation	
Date of assessment	15/11/2019	Version of assessment	
Notes			

Step 1 Runoff Quality
AADT: $\le 10,000$ and $\le 50,000$ Climatic region: W/Am Dry Rainfall site: Rirmingham (SAR 750mm)

Step 2 River Impacts
Annual Q_{10} river flow (m³/s): 0.001
Impermeable road area drained (ha): 1.84
Permeable area draining to outfall (ha): 1.025
Base Flow Index (BFI): 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l): 1
Bioavailable dissolved zinc (ug/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 (ug/l): 2.2

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
Estimated river width (m): 1.5
Bed width (m): 2
Manning's n: 0.07
Side slope (m/m): 0.5
Long slope (m/m): 0.00

Step 3 Mitigation

Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (ls)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	0	No restriction	12

Road Catchment 9 – A460 and Hilton Lane

Sensitivity analysis using point downstream, upstream of Saredon Brook, Q95 0.01 m³/s

EQS - Annual Average Concentration		Acute Impact		Pass	
Step 2	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Copper 3.16	Zinc 6.36	Copper Pass	Zinc Pass
Step 3	Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	Copper 3.16	Zinc 6.33		

Sediment deposition for this site is judged as:
Accumulating? Yes No Extensive? No Yes Low flow Velocities Deposition Index

Road number	A460	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	Nothing	
OS grid reference of outfall structure (m)	Easting	Nothing	
Outfall number	catchment 9	List of outfalls in cumulative assessment	
Receiving watercourse	watercourse 4		
E.A receiving water Detailed River Network ID		Assessor and affiliation	
Date of assessment	15/11/2019	Version of assessment	
Notes			

Step 1 Runoff Quality
AADT: >10 000 and <50 000 Climatic region: Warm Dry Rainfall site: Birmingham (S.A.D.R 750mm)

Step 2 River Impacts
Annual Q₉₅ river flow (m³/s): 0.01
Impermeable road area drained (ha): 4.844
Permeable area draining to outfall (ha): 1.025
Base Flow Index (BFI): 0.6
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): 2

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
Estimated river width (m): 1.5
Bed width (m): 3
Manning's n: 0.07
Side slope (m/m): 0.5
Long slope (m/m): 0.003

Step 3 Mitigation

Existing measures	Brief description	Estimated effectiveness		
		Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (lis)	Settlement of sediments (%)
Proposed measures	ditch alongside Hilton Lane	0	No restriction	0
		0	No restriction	12

Road Catchment 10

Step 1 wet pond

EQS - Annual Average Concentration		Acute Impact	
	Copper	Zinc	
Step 2	4.44 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.11 ug/l	Copper: River Falls Toxicity Test. Trig more mitigation. Zinc: Pass
Step 3	3.74 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 2 mitigation.	2.46 ug/l	Fail. Trig Tier 2 for Velocity. Sediment deposition for this site is judged as: Accumulating? Yes 0.00 Low flow Vel m/s. Extensive? Yes 182 Deposition Index

Road number	M54-M6 Link Road		HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)	Easting	395170	Nothing	306270
OS grid reference of outfall structure (m)	Easting		Nothing	
Outfall number	Watercourse 4 new outfall: catchment 10		List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4			
EA receiving water Detailed River Network ID			Assessor and affiliation	D SH
Date of assessment	09/09/2019		Version of assessment	1
Notes				

Step 1 Runoff Quality

AADT: >=50,000 and <100,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR 750mm)

Step 2 River Impacts

Annual Q₉₅ river flow (m³/s): 0.001 Freshwater EQS limits:
 Bioavailable dissolved copper (ug/l): 1
 Bioavailable dissolved zinc (ug/l): 10.9
 Impermeable road area drained (ha): 3.353
 Permeable area draining to outfall (ha): 4.05
 Base Flow Index (BFI): 0.5
 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 (ug/l): 3

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): 1.5
 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	No restriction	0
Proposed measures	40	No restriction	80

Step 2 wet pond and short length of swale

EQS - Annual Average Concentration		Acute Impact	
	Copper	Zinc	
Step 2	4.44 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	4.11 ug/l	Copper: Pass Zinc: Pass
Step 3	3.34 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.44 ug/l	Pass

Road number	M54-M6 Link Road		HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)	Easting	395170	Nothing	306270
OS grid reference of outfall structure (m)	Easting		Nothing	
Outfall number	Watercourse 4 new outfall: catchment 10		List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4			
EA receiving water Detailed River Network ID			Assessor and affiliation	D SH
Date of assessment	23/01/2020		Version of assessment	1
Notes				

Step 1 Runoff Quality

AADT: >=50,000 and <100,000 Climatic region: Warm Dry Rainfall site: Birmingham (SAAR 750mm)

Step 2 River Impacts

Annual Q₉₅ river flow (m³/s): 0.001 Freshwater EQS limits:
 Bioavailable dissolved copper (ug/l): 1
 Bioavailable dissolved zinc (ug/l): 10.9
 Impermeable road area drained (ha): 3.353
 Permeable area draining to outfall (ha): 4.05
 Base Flow Index (BFI): 0.5
 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 (ug/l): 3

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): 1.5
 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	No restriction	0
Proposed measures	65	No restriction	100

Cumulative Road Catchment 9 +10, outfalls over 100m

EQS - Annual Average Concentration		Acute Impact	
Step 2	Copper 4.38 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 6.97 ug/l	Copper River Falls Toxicity Test. Try more mitigation
Step 3	Copper 3.86 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	Zinc 2.84 ug/l	Zinc Pass
		Sediment deposition for this site is judged as: Accumulating? <input type="checkbox"/> Low flow Vel m/s Extensive? <input type="checkbox"/> Deposition Index	

Road number	M54-M6 Link Road	HE Area / DBFO number	
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)		
OS grid reference of assessment point (m)	Eastings 395170	Northings	306270
OS grid reference of outfall structure (m)	Eastings	Northings	
Outfall number	Watercourse 4 new outfall: catchment 9 and 10	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	09/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality AADT Climatic region Rainfall site

Step 2 River Impacts

Annual Q₁₀ river flow (m³/s) Freshwater EQS limits:
 Bioavailable dissolved copper (ug/l)
 Bioavailable dissolved zinc (ug/l)
 Impermeable road area drained (ha)
 Permeable area draining to outfall (ha)
 Base Flow Index (BFI) Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only Water hardness For dissolved copper only Ambient background concentration (ug/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?

Estimated river width (m)
 Bed width (m) Manning's n Side slope (m/m) Long slope (m/m)

Step 3 Mitigation

Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	44	No restriction	0

Sensitivity Analysis for analysis point upstream of Saredon Brook, 0.10 m³/s

Cumulative Road Catchment 9 +10, outfalls over 100m

EQS - Annual Average Concentration		Acute Impact	
Step 2	Copper 3.42 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 1.17 ug/l	Copper Pass
Step 3	Copper 3.18 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	Zinc 0.65 ug/l	Zinc Pass
		Sediment deposition for this site is judged as: Accumulating? <input type="checkbox"/> Low flow Vel m/s Extensive? <input type="checkbox"/> Deposition Index	

Road number	M54-M6 Link Road	HE Area / DBFO number	
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)		
OS grid reference of assessment point (m)	Eastings 395170	Northings	306270
OS grid reference of outfall structure (m)	Eastings	Northings	
Outfall number	Watercourse 4 new outfall: catchment 9 and 10	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 4		
EA receiving water Detailed River Network ID		Assessor and affiliation	DSH
Date of assessment	09/09/2019	Version of assessment	1
Notes			

Step 1 Runoff Quality AADT Climatic region Rainfall site

Step 2 River Impacts

Annual Q₁₀ river flow (m³/s) Freshwater EQS limits:
 Bioavailable dissolved copper (ug/l)
 Bioavailable dissolved zinc (ug/l)
 Impermeable road area drained (ha)
 Permeable area draining to outfall (ha)
 Base Flow Index (BFI) Is the discharge in or within 1 km upstream of a protected site for conservation?

For dissolved zinc only Water hardness For dissolved copper only Ambient background concentration (ug/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?

Estimated river width (m)
 Bed width (m) Manning's n Side slope (m/m) Long slope (m/m)

Step 3 Mitigation

Brief description	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures	44	No restriction	0

Road Catchment 11 Passes sediments and acute soluble metals, so no mitigation proposed.

Road Catchment 12 Permeable Area only, no assessment required

Road Catchment 13 Permeable Area only, no assessment required

Road Catchment 14

Step 1 wet pond

Highways England Water Risk Assessment Tool				Version 2.0.4 June 2019																													
Soluble		Acute Impact		Sediment - Chronic Impact																													
EQS - Annual Average Concentration																																	
<table border="1"> <thead> <tr> <th></th> <th>Copper</th> <th>Zinc</th> <th>ug/l</th> </tr> </thead> <tbody> <tr> <td>Step 2</td> <td>5.61</td> <td>1.89</td> <td></td> </tr> <tr> <td>Step 3</td> <td>5.25</td> <td>1.08</td> <td></td> </tr> </tbody> </table>			Copper	Zinc	ug/l	Step 2	5.61	1.89		Step 3	5.25	1.08		<table border="1"> <thead> <tr> <th></th> <th>Copper</th> <th>Zinc</th> </tr> </thead> <tbody> <tr> <td></td> <td>Pass</td> <td>Pass</td> </tr> </tbody> </table>			Copper	Zinc		Pass	Pass	<table border="1"> <thead> <tr> <th colspan="2">Sediment - Chronic Impact</th> </tr> </thead> <tbody> <tr> <td colspan="2">Pass</td> </tr> <tr> <td colspan="2">Sediment deposition for this site is judged as:</td> </tr> <tr> <td>Accumulating?</td> <td>Yes 0.01 Low flow Vol m/s</td> </tr> <tr> <td>Extensive?</td> <td>No 0 Disposition Index</td> </tr> </tbody> </table>		Sediment - Chronic Impact		Pass		Sediment deposition for this site is judged as:		Accumulating?	Yes 0.01 Low flow Vol m/s	Extensive?	No 0 Disposition Index
	Copper	Zinc	ug/l																														
Step 2	5.61	1.89																															
Step 3	5.25	1.08																															
	Copper	Zinc																															
	Pass	Pass																															
Sediment - Chronic Impact																																	
Pass																																	
Sediment deposition for this site is judged as:																																	
Accumulating?	Yes 0.01 Low flow Vol m/s																																
Extensive?	No 0 Disposition Index																																
Road number	M54-M6 Link Road		HE Area / DBFO number																														
Assessment type	Non-cumulative assessment (single outfall)																																
OS grid reference of assessment point (m)	Easting	395440	Northing	300560																													
OS grid reference of outfall structure (m)	Easting																																
Outfall number	Watercourse 5 new Outfall C: Catchment 13		List of outfalls in cumulative assessment																														
Receiving watercourse	Watercourse 5 - Latherford Brook																																
EA receiving water Detailed River Network ID			Assessor and affiliation	DSH																													
Date of assessment	09/09/2019		Version of assessment	1																													
Notes																																	
Step 1 Runoff Quality																																	
AADT	>=50,000 and <100,000		Climatic region	Warm Dry																													
Rainfall site	Birmingham (SAAR750mm)																																
Step 2 River Impacts																																	
Annual Q ₉₅ river flow (m ³ /s)	0.004		Freshwater EQS limits:																														
Impermeable road area drained (ha)	3.492		Bioavailable dissolved copper (µg/l)	1																													
Permeable area draining to outfall (ha)	3.285		Bioavailable dissolved zinc (µg/l)	10.9																													
Base Flow Index (BFI)	0.5		Is the discharge in or within 1 km upstream of a protected site for conservation?																														
For dissolved zinc only			For dissolved copper only																														
Water hardness	High > >200mg CaCO ₃ /l		Ambient background concentration (µg/l)	5																													
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)	2.5																															
o Tier 2	Bed width (m)	3		Manning's n	0.027																												
		Side slope (m/m)	0.5		Long slope (m/m)	0.0001																											
Step 3 Mitigation																																	
Existing measures		Proposed measures		Brief description																													
		with wet pond in design, and filter drains																															
				Estimated effectiveness																													
				Treatment for solubles (%)																													
				Attenuation for solubles - restricted discharge rate (%)																													
				Settlement of sediments (%)																													
				0																													
				No restriction																													
				40																													
				No restriction																													
				0																													
				100																													

Step 2 wet pond and filter drains

Road Catchment 15

Step 1: Filter drains

EQS - Annual Average Concentration		Acute Impact		Fail, Trg Tier 2 for Velocity	
Copper	Zinc	Copper	Zinc	Accumulating?	Extensive?
4.71	2.94	River Fails Toxicity Test. Trg mitigation	Pass	Yes 0.02	Yes 129
4.53	1.73			No	No

Notes: Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.

Settlement needed = 63 %, proposed = 60 %
Sediment deposition for this site is judged as:
Accumulating? Yes 0.02 Low flow Vel m/s
Extensive? Yes 129 Deposition Index

ad number: A460 north of J11 M6
HE Area / DBFO number: [blank]
assessment type: Non-cumulative assessment (single outfall)
OS grid reference of assessment point (m): Easting 395955, Northing 307320
OS grid reference of outfall structure (m): Easting [blank], Northing [blank]
outfall number: Watercourse 6: Catchment 15 Proposed
List of outfalls in cumulative assessment: [blank]
receiving watercourse: Watercourse 6
EA receiving water Detailed River Network ID: [blank]
Assessor and affiliation: D SH
Date of assessment: 09/09/2019
Version of assessment: 1

Step 1 Runoff Quality
AADT: $\leq 50,000$ and $< 100,000$ Climatic region: Warm Dry Rainfall site: Rimmingham (S&DR 750mm)

Step 2 River Impacts
Annual Q_{05} river flow (m³/s): 0.00? Freshwater EQS limits:
Bioavailable dissolved copper (ug/l): 1
Bioavailable dissolved zinc (ug/l): 109
Impermeable road area drained (ha): 0
Permeable area draining to outfall (ha): 0.70?
Base Flow Index (BFI): 0.5 Is the discharge in or within 1 km upstream of a protected site for conservation? No
Water hardness: High = >200mg CaCO₃/l For dissolved copper only Ambient background concentration (ug/l): 4
Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No
Estimated river width (m): 1
Bed width (m): 3 Manning's n: 0.07 Side slope (m/m): 0.5 Long slope (m/m): 0.000

Step 3 Mitigation

Existing measures	Brief description	Estimated effectiveness		
		Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (lb)	Settlement of sediments (%)
Proposed measures	Filter drains on mainline M6	0	No restriction	0
		0	No restriction	0

Step 2: filter drains and additional ditch

EQS - Annual Average Concentration		Acute Impact		Pass	
Copper	Zinc	Copper	Zinc	Accumulating?	Extensive?
4.71	2.94	Pass	Pass	Yes 0.02	Yes 48
4.53	1.73			No	No

Notes: Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.

Sediment deposition for this site is judged as:
Accumulating? Yes 0.02 Low flow Vel m/s
Extensive? No 48 Deposition Index

Road number: A460 north of J11 M6
HE Area / DBFO number: [blank]
assessment type: Non-cumulative assessment (single outfall)
OS grid reference of assessment point (m): Easting 395955, Northing 307320
OS grid reference of outfall structure (m): Easting [blank], Northing [blank]
outfall number: Watercourse 6: Catchment 15 Proposed
List of outfalls in cumulative assessment: [blank]
receiving watercourse: Watercourse 6
EA receiving water Detailed River Network ID: [blank]
Assessor and affiliation: HJ AECOM
Date of assessment: 09/12/2019
Version of assessment: 1

Step 1 Runoff Quality
AADT: $\leq 50,000$ and $< 100,000$ Climatic region: Warm Dry Rainfall site: Rimmingham (S&DR 750mm)

Step 2 River Impacts
Annual Q_{05} river flow (m³/s): 0.00? Freshwater EQS limits:
Bioavailable dissolved copper (ug/l): 1
Bioavailable dissolved zinc (ug/l): 109
Impermeable road area drained (ha): 0
Permeable area draining to outfall (ha): 0.70?
Base Flow Index (BFI): 0.5 Is the discharge in or within 1 km upstream of a protected site for conservation? No
Water hardness: High = >200mg CaCO₃/l For dissolved copper only Ambient background concentration (ug/l): 4
Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No
Estimated river width (m): 1
Bed width (m): 3 Manning's n: 0.07 Side slope (m/m): 0.5 Long slope (m/m): 0.000

Step 3 Mitigation

Existing measures	Brief description	Estimated effectiveness		
		Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (lb)	Settlement of sediments (%)
Proposed measures	Filter drains on A460, and added ditch	15	No restriction	95
		0	No restriction	0

Road Catchment 16

Step one: With filter drains

EQS - Annual Average Concentration		Acute Impact		Fail. To Tier 2 for Velocity	
Step 2	Copper 4.92 Tier 1 fail. Go to Tier 2 (using UK TAG M.BAT tool), or Step 3 mitigation.	Zinc 2.41	Copper River Fails Toxicity Test. Try mitigation	Zinc Pass	Settlement needed = 84 %, proposed = 68 % Sediment deposition for this site is judged as: Accumulating? Yes 0.02 Low flow Vel m/s Extensive? Yes 243 Deposition Index
Step 3	4.51 Tier 1 fail. Go to Tier 2 (using UK TAG M.BAT tool), or increase Step 3 mitigation.	1.88			

Road number	M6	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 395687	Northing	307352
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	M6 Northbound Outfall, Catchment 16 proposed	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 6	Assessor and affiliation	HJ AECOM
EA receiving water detailed River Network ID		Version of assessment	1
Date of assessment	09/12/2019		
Notes			

Step 1 Runoff Quality
AADT >10 000 and <50 000 Climatic region W/arm Dry Rainfall site Rimmingham (S&DR 750mm)

Step 2 River Impacts
Annual Q₁₀ river flow (m³/s) 0.002
Impermeable road area drained (ha) 2.79
Permeable area draining to outfall (ha) 2.574
Base Flow Index (BFI) 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l) 1
Bioavailable dissolved zinc (ug/l) 109
Is the discharge in or within 1 km upstream of a protected site for conservation? No

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures with filter drains	0	No restriction	100

Step two: filter drains and adding length of swale at base of embankment

EQS - Annual Average Concentration		Acute Impact		Pass	
Step 2	Copper 4.92 Tier 1 fail. Go to Tier 2 (using UK TAG M.BAT tool), or Step 3 mitigation.	Zinc 2.41	Copper Pass	Zinc Pass	Sediment deposition for this site is judged as: Accumulating? Yes 0.02 Low flow Vel m/s Extensive? No 0 Deposition Index
Step 3	4.51 Tier 1 fail. Go to Tier 2 (using UK TAG M.BAT tool), or increase Step 3 mitigation.	1.88			

Road number	M6	HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 395687	Northing	307352
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	M6 Northbound Outfall, Catchment 16 proposed	List of outfalls in cumulative assessment	
Receiving watercourse	Watercourse 6	Assessor and affiliation	HJ AECOM
EA receiving water detailed River Network ID		Version of assessment	1
Date of assessment	09/12/2019		
Notes			

Step 1 Runoff Quality
AADT >10 000 and <50 000 Climatic region W/arm Dry Rainfall site Rimmingham (S&DR 750mm)

Step 2 River Impacts
Annual Q₁₀ river flow (m³/s) 0.002
Impermeable road area drained (ha) 2.79
Permeable area draining to outfall (ha) 2.574
Base Flow Index (BFI) 0.5
Freshwater EQS limits:
Bioavailable dissolved copper (ug/l) 1
Bioavailable dissolved zinc (ug/l) 109
Is the discharge in or within 1 km upstream of a protected site for conservation? No

Step 3 Mitigation

Brief description	Estimated effectiveness		
	Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (1/s)	Settlement of sediments (%)
Existing measures	0	No restriction	0
Proposed measures with filter drains, and adding lengths of swale along base of embankments	25	No restriction	100

Road Catchment 17

Step one: existing filter drains

Highways England Water Risk Assessment Tool				Version 2.0.4 June 2019	
Soluble EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 4.83 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 2.46	ug/l	Copper River Fails Toxicity Test. Try mitigation.	Zinc Pass
Step 3	-	-	ug/l		
Sediment deposition for this site is judged as: Settled = 85%, proposed = 60% Accumulating? Yes 0.02 Low flow Vel m/s Extensive? Yes 255 Deposition Index					
Road number		M6		HE Area / DBFO number	
Assessment type		Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)		Easting 395560		Northing 307169	
OS grid reference of outfall structure (m)		Easting		Northing	
Outfall number		M6 Southbound: Catchment 17 proposed		List of outfalls in cumulative assessment	
Receiving watercourse		Watercourse 6		43717	
EA receiving water Detailed River Network ID		Assessor and affiliation		DSH	
Date of assessment		09/09/2019		Version of assessment	
Notes		1			
Step 1 Runoff Quality					
AADT		>10,000 and <50,000		Climatic region Warm Dry Rainfall site Birmingham (SAAR750mm)	
Step 2 River Impacts					
Annual Q ₀₅ river flow (m ³ /s)		0.002		Freshwater EQS limits:	
Impermeable road area drained (ha)		3.984		Bioavailable dissolved copper (ug/l) 1	
Permeable area draining to outfall (ha)		4.169		Bioavailable dissolved zinc (ug/l) 10.9	
Base Flow Index (BFI)		0.5		Is the discharge in or within 1 km upstream of a protected site for conservation? No	
For dissolved zinc only		Water hardness High = >200mg CaCO ₃ /l		For dissolved copper only Ambient background concentration (ug/l) 4	
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) 1		Side slope (m/m) 0.5 Long slope (m/m) 0.0001	
Tier 2		Bed width (m) 3 Manning's n 0.07			
Step 3 Mitigation					
Existing measures		Proposed measures		Estimated effectiveness	
		Existing filter drains		Treatment for solubles (%) 0 Attenuation for solubles - restricted discharge rate (l/s) 0 Settlement of sediments (%) 0	
				0 No restriction 0	

Step two: filter drains and adding length of swale at base of embankment

Highways England Water Risk Assessment Tool				Version 2.0.4 June 2019	
Soluble EQS - Annual Average Concentration		Acute Impact		Sediment - Chronic Impact	
Step 2	Copper 4.83 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	Zinc 2.46	ug/l	Copper Pass	Zinc Pass
Step 3	4.52 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	1.84	ug/l		
Sediment deposition for this site is judged as: Settled = 85%, proposed = 60% Accumulating? Yes 0.02 Low flow Vel m/s Extensive? No 0 Deposition Index					
Road number		M6		HE Area / DBFO number	
Assessment type		Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)		Easting 395560		Northing 307169	
OS grid reference of outfall structure (m)		Easting		Northing	
Outfall number		M6 Southbound: Catchment 17 proposed		List of outfalls in cumulative assessment	
Receiving watercourse		Watercourse 6		43717	
EA receiving water Detailed River Network ID		Assessor and affiliation		DSH	
Date of assessment		09/09/2019		Version of assessment	
Notes		1			
Step 1 Runoff Quality					
AADT		>10,000 and <50,000		Climatic region Warm Dry Rainfall site Birmingham (SAAR750mm)	
Step 2 River Impacts					
Annual Q ₀₅ river flow (m ³ /s)		0.002		Freshwater EQS limits:	
Impermeable road area drained (ha)		3.984		Bioavailable dissolved copper (ug/l) 1	
Permeable area draining to outfall (ha)		4.169		Bioavailable dissolved zinc (ug/l) 10.9	
Base Flow Index (BFI)		0.5		Is the discharge in or within 1 km upstream of a protected site for conservation? No	
For dissolved zinc only		Water hardness High = >200mg CaCO ₃ /l		For dissolved copper only Ambient background concentration (ug/l) 4	
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) 1		Side slope (m/m) 0.5 Long slope (m/m) 0.0001	
Tier 2		Bed width (m) 3 Manning's n 0.07			
Step 3 Mitigation					
Existing measures		Proposed measures		Estimated effectiveness	
		Existing filter drains, and adding lengths of swale at base of embankment		Treatment for solubles (%) 0 Attenuation for solubles - restricted discharge rate (l/s) 0 Settlement of sediments (%) 0	
				0 No restriction 0	
				25 No restriction 100	

Road Catchments 15 +16 +17

With swales at base of embankment for catchments 15 and 16. Ratios used to calculate 23% mitigation from swales on 16 and 17, and roadside ditch on 15).

Soluble		Acute Impact		Sediment - Chronic Impact							
EQS - Annual Average Concentration <table border="1"> <tr> <th>Copper</th> <th>Zinc</th> </tr> <tr> <td>5.72</td> <td>5.08</td> </tr> <tr> <td colspan="2">ug/l</td> </tr> </table>		Copper	Zinc	5.72	5.08	ug/l		Copper River Falls Toxicity Test: Tri-axons mitigation		Zinc Pass	
Copper	Zinc										
5.72	5.08										
ug/l											
Step 2 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.				Sediment deposition for this site is judged as: Accumulating? <input type="checkbox"/> Low flow Vol m/s Extensive? <input type="checkbox"/> Deposition Index							
Step 3 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.											
Road number	A480/N18	HE Area / DBFO number									
Assessment type	Cumulative assessment excluding sediments (outfalls between 100m and 1km apart)										
OS grid reference of assessment point (m)	Easting	385580	Northing	307189							
OS grid reference of outfall structure (m)	Easting	Nothing									
Outfall number	Catchment 15 16 17 Proposed	List of outfalls in cumulative assessment	15	16	17						
Receiving watercourse	Watercourse 6	Assessor and affiliation	DSH								
EA receiving water Detailed River Network ID											
Date of assessment	09/09/2019	Version of assessment	1								
Notes											
Step 1 Runoff Quality											
AADT	=50,000 and <100,000		Climatic region	Warm Dry							
Rainfall site	Birmingham (SAAR750mm)										
Step 2 River Impacts											
Annual Q ₉₅ river flow (m ³ /s)	0.002		Freshwater EQS limits:								
Impermeable road area drained (ha)	0.744		Bioavailable dissolved copper (ug/l)	1							
Permeable area draining to outfall (ha)	0.451		Bioavailable dissolved zinc (ug/l)	10.9							
Base Flow Index (BFI)	0.5		Is the discharge in or within 1 km upstream of a protected site for conservation?								
For dissolved zinc only			For dissolved copper only								
Water hardness	High >200mg CaCO ₃ /l		Ambient background concentration (ug/l)	4							
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											
Estimated river width (m)	0		Manning's n	0.07							
Bed width (m)	0		Side slope (m/m)	0.5							
		Long slope (m/m)	0.0001								
Step 3 Mitigation											
Brief description		Estimated effectiveness									
Existing measures		Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (%)	Settlement of sediments (%)							
Proposed measures	lengths of swales for catchments 15 and 16	0	No restriction	0							
		23	No restriction	0							

Sensitivity analysis of cumulative catchment 15 + 16 + 17 using watercourse 6 downstream Q95 value. WC 1: 4.76

Screenshot of MBAT spreadsheet with the following ambient Copper EQSs added:

WC 1: 4.76 µg/l

WC 4: 3.34 µg/l

WC 5: 3.68 µg/l

WC 6: 3.86 µg/l

MBAT screen shot

INPUT DATA				RESULTS (Copper)						RESULTS (Zn)			RESULTS (Ni)										
ID	Location	Waterbody	Date	Measured Cu Concentration (µg l ⁻¹)	Measured Zn Concentration (µg l ⁻¹)	Measured Ni Concentration (µg l ⁻¹)	Measured Ni Concentration (µg l ⁻¹)	pH	DDC	Cu	Site-specific PNEC Dissolved Copper (µg l ⁻¹)	Risk	Bioavailable Copper Concentration (µg l ⁻¹)	Risk Characterisation Ratio	Site-specific PNEC Dissolved Zn (µg l ⁻¹)	Risk	Bioavailable Zn Concentration (µg l ⁻¹)	Risk Characterisation Ratio	Site-specific PNEC Dissolved Ni (µg l ⁻¹)	Risk	Bioavailable Ni Concentration (µg l ⁻¹)	Risk Characterisation Ratio	
1	watercourse 1	data at watercourse 2		4.76							0.03				0.07								
2					16						0.03				0.07								
3					6.6						0.03				0.07								
4						0.7					0.03				0.07								
5	watercourse 2			3							0.03	0.52	0.52	0.52	0.07								
6					16						0.03				0.07								
7						6.9					0.03				0.07								
8											0.03				0.07								
9	watercourse 3			3.3							0.03	0.08	0.08	0.08	0.07								
10											0.03				0.07								
11						897.2					0.03				0.07								
12											0.03				0.07								
13						12					0.03	0.45	0.45	0.45	0.07								
14											0.03				0.07								
15						28.9					0.03				0.07								
16											0.03				0.07								
17	watercourse 4			3.34							0.03	0.28	0.28	0.28	0.07								
18						6.1					0.03				0.07								
19											0.03				0.07								
20											0.03				0.07								
21	watercourse 5			3.88							0.03	0.28	0.28	0.28	0.07								
22											0.03				0.07								
23											0.03				0.07								
24											0.03				0.07								
25	watercourse 6			3.88							0.03	0.09	0.09	0.09	0.07								
26											0.03				0.07								
27											0.03				0.07								
28											0.03				0.07								
29	watercourse 7	data at watercourse 2		3.83							0.03	0.63	0.63	0.63	0.07								
30											0.03				0.07								
31											0.03				0.07								
32											0.03				0.07								
33											0.03				0.07								
34											0.03				0.07								
35											0.03				0.07								
36											0.03				0.07								
37											0.03				0.07								
38											0.03				0.07								
39											0.03				0.07								
40											0.03				0.07								
41											0.03				0.07								
42											0.03				0.07								
43											0.03				0.07								
44											0.03				0.07								
45											0.03				0.07								
46											0.03				0.07								