A47/A11 Thickthorn Junction

Scheme Number: TR010037

Volume 6
6.3 Environmental Statement Appendices
Appendix 13.4 – Water Quality Assessment

APFP Regulation 5(2)(a)

Planning Act 2008

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

March 2021

Infrastructure Planning

Planning Act 2008

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

The A47/A11 Thickthorn Junction Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT APPENDICES
Appendix 13.4 – Water Quality Assessment

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010037
Application Document Reference	TR010037/APP/6.3
BIM Document Reference	HE551492-GTY-EWE-000-RP-LE-30006
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Version	Date	Status of Version
Rev 0	March 2021	Application Issue

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Captions

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1. Introduction

1.1.1. This appendix describes the approach and findings of the surface water quality impact assessment for the Proposed Scheme. The methodologies are presented in this appendix, whilst the assessment of the magnitude and significance of impacts and any subsequent requirements for mitigation are presented in the Environmental Statement (ES) Chapter 13 Road drainage and water environment **(TR010037/APP/6.1)**.

1.1.2. The Proposed Scheme will utilise three existing outfalls and five new outfalls which discharge to Cantley Stream. The assessment methodology for estimating the routine runoff impacts and accidental spillage risk to the water features during the operational phase of the Proposed Scheme is described in Section 3 and 4, respectively. The approach follows the guidance within the Design Manual for Roads and Bridges (DMRB) LA113 (Highways England, 2019). The purpose of the assessment is to determine whether mitigation measures in the form of pollution control or spillage containment are required during the operational phase. Surface water quality impacts during construction are considered in the ES Chapter 13 (Road drainage and water environment) **(TR010037/APP/6.1)**.

1.1.3. The DMRB LA113 guidance proposes the use of the Highways England Water Risk Assessment Tool (HEWRAT), a pollution risk screening tool to determine the routine runoff impacts of surface water discharges.

2. Background

2.1.1. The Proposed Scheme comprises of ten highway drainage catchment areas discharging to watercourses via eight outfalls. Of the eight outfalls, five are new and three are existing Highways England outfalls:

- proposed drainage catchment A and K discharges to one new outfall
- existing drainage catchment A discharges to one existing outfall
- drainage catchments B, H and I discharges to one new outfall
- drainage catchment E discharges to one new outfall
- drainage catchment E2 discharges to one new outfall
- drainage catchment F discharges to one existing outfall
- drainage catchment F2 discharges to one new outfall
- drainage catchment J discharges to one existing outfall

2.1.2. A number of existing Highways England outfalls have been identified on Highways Agency Drainage Data Management System (HA DDMS) (Highways England, 2020) in the area where the existing A11 and A47 cross Cantley Stream (Figure 13.6 (Surface water flood risk) (**TR010037/APP/6.2**)). The assets need to be verified through a drainage survey. However, for the purposes of the HEWRAT assessment, the total existing drainage catchment is assumed to discharge via three existing outfalls to Cantley Stream, namely:

- catchment A - outfall reference TG1704_9384d
- catchment F2 - outfall reference TG1904_1886e
- catchment J – outfall reference TG1804_1886e

2.1.3. The location of the drainage catchments and outfalls for the existing and Proposed Scheme can be found in Annex A. Any outfall draining only natural catchment drainage is not assessed as it does not contain pollutants from highway drainage.

2.1.4. Prior to the runoff reaching the outfalls, filter drains, vegetated detention basins and swales are proposed in the drainage design. However, the filter drains and swale measures were omitted from the surface water HEWRAT assessment to represent a worst case scenario for surface water pollution risk. This is because further assessment of the pollution risk from discharging to ground via filter drains and swales is required following supplementary ground investigations due to start in March 2021. The drainage strategy for the Proposed Scheme is described in Appendix 13.2 (Drainage Strategy) (**TR010037/APP/6.3**).

2.1.5. Annual average daily traffic (AADT) forecasts with and without the Norwich Western Link Road scheme were reviewed. The results considered in this assessment are based on those with the Norwich Western Link Road scheme in place, which does not represent the worst case scenario traffic forecast. However, using the worst case scenario (without Norwich Western Link Road) would not affect the water quality mitigation required as the AADT forecasts do not vary enough to affect the outcome of the HEWRAT routine runoff and spillage assessments.

3. Routine runoff quality

3.1. Overview

3.1.1. This section presents the results of HEWRAT assessment that considers the risk of routine runoff from the road drainage catchments that discharge to Cantley Stream.

3.2. Method

3.2.1. The water quality impacts of routine road drainage on surface water bodies have been assessed using HEWRAT as described in DMRB LA113 (Highways England, 2019). The HEWRAT assessment adopts a tiered approach assessing the impacts of both soluble and sediment-bound pollutants and determines whether the drainage system would 'pass' or 'fail' (or prompt an 'alert') in terms of water quality in the receiving water features during operation. The three-step approach is as follows:

- Step 1 assesses the quality of direct highway runoff against toxicity thresholds, assuming no in-river dilution, treatment or attenuation.
- Step 2 assesses the diluting capacity of the watercourse for acute impacts of soluble pollutants, and the likelihood and extent of sediment deposition for chronic impacts of sediment-bound pollutants.
- Step 3 assesses the effectiveness of existing and proposed treatment systems for soluble pollutants and if the site is predicted to accumulate sediments, the percentage of settlement required to ensure that the extent of sediment coverage complies with the threshold deposition index value.

3.2.2. Step 2 and 3 also contain two tiers of assessment for sediment accumulation: Tier 1 is a simple assessment requiring only an estimate of the river width, while Tier 2 is a more detailed assessment which requires further watercourse parameters including Manning's roughness, bed gradient, side slopes and channel width.

3.2.3. For assessment of impacts associated with soluble pollutants, outfalls within 1km (measured along the watercourse) shall be aggregated for purposes of cumulative assessment. For assessment of impacts associated with sediment related pollutants, outfalls within 100m (measured along the watercourse) shall be aggregated for purposes of cumulative assessment.

3.2.4. The assessment considers the impact of dissolved copper and zinc on the water quality of the receiving waters. These metals are used as indicators of the level of impact as they are generally the main metallic pollutants associated with road drainage and can be toxic to aquatic life.

3.2.5. An alert is given for outfalls that would otherwise pass the assessment for sediment-bound pollutants, were it not for the following features being present downstream:

- a protected site within 1km of the point of discharge; and
- a structure, lake or pond within 100m of the point of discharge.

3.2.6. If any specific issues are raised then further measures should be agreed, otherwise the alert message can then be dismissed.

3.2.7. Where the discharge fails the HEWRAT assessment for annual average concentrations of soluble pollutants, and proportionate mitigation cannot be readily incorporated, a detailed assessment shall be carried out using the UKTAG Rivers and Lakes Metal Bioavailability Assessment Tool (M-BAT).

3.2.8. The annual average concentrations predicted by HEWRAT or M-BAT must be lower than the Environmental Quality Standards (EQS) to achieve compliance with the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. The ambient background copper concentrations can be manually input into HEWRAT, if known. There were no existing water quality data available for any of the water bodies or watercourses within the study area therefore water quality sampling was undertaken. Six samples were taken from Cantley Stream upstream of the Proposed Scheme as part of a 6-month sampling regime. The results show that the average ambient bioavailable copper concentration is 0.077 µg/l (see Annex B).

3.2.9. The EQS for dissolved copper in freshwaters is 1 µg/l and 10.9 µg/l for dissolved zinc (UKTAG, 2014).

3.2.10. The rainfall site selected for the HEWRAT assessment is Huntingdon, as it is the closest rainfall gauge geographically. The standard average annual rainfall (SAAR) for Huntingdon is identified in HEWRAT as 600mm. The site-specific SAAR at the downstream extent of the Proposed Scheme is 623mm which is sufficiently similar to the value at Huntingdon.

3.3. Assessment results

3.3.1. All of the outfalls passed the HEWRAT assessment with the inclusion of the measures outlined in the proposed drainage design.

3.3.2. A summary of the parameters used in the HEWRAT assessment can be found in Table 3.1.

Table 3.1 Parameters used in the HEWRAT assessment

Network	Proposed Scheme		Mitigation identified by HEWRAT	Mitigation proposed in drainage design (subject to supplementary ground investigation)
	Road Area (ha)	Green/verge Area (ha)		
A (proposed and existing) and K	2.744	0.276	N/A	Filter drains
B, H and I	6.275	9.535	Detention basin (vegetated)	Detention basin (vegetated) and filter drains
E	0.359	0.088	N/A	Filter drains and swale
E2	0.14	0.158	N/A	Filter drains and swale
F	1.79	4.555	N/A	Filter drains and vegetated detention basin
F2	1.234	0.47	N/A	Filter drains
J	0.979	0.679	N/A	Filter drains

3.3.3. The results from each HEWRAT assessment can be seen in Captions 3.1 to 3.16 with and without mitigation measures in place.

3.3.4. A summary of the HEWRAT assessment for each outfall is as follows:

- Catchment A (proposed and existing) and K outfalls passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants.
- Catchments B, H and I outfall initially failed step 2 (pre mitigation) due to acute copper concentrations, which would require treatment to mitigate this. However, with the inclusion of a vegetated detention basin as a proposed measure in step 3, this outfall passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants. The detention basin will be grassed and dry except at times of heavy rainfall. The vegetated detention basin provides the same or better removal rate of copper than a grass channel due to it being flatter and wider, more likely to disperse the water over the surface area and will have a longer detention time. For the purpose of the HEWRAT assessment, the removal rate of a grassed channel for copper (50%) has been included in step 3 of the assessment.
- Catchment E outfall passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants.
- Catchment E2 outfall passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants.
- Catchment F outfall passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants.
- Catchment F2 outfall passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants.
- Catchment J outfall passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants.

3.3.5. A cumulative assessment was undertaken for the three outfalls which discharge to Cantley Stream from catchments A, K, B, H, I and J as they are within 100m of each other. This cumulative area initially failed step 2 (pre mitigation) due to acute copper concentrations, which would require treatment to mitigate this. However, with the inclusion of a vegetated detention basin as a proposed measure in step 3, these outfalls passed the HEWRAT assessment for soluble pollutants and sediment bound pollutants. The results from this can be seen in Captions 3.9 and 3.10.

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Soluble – EQS – Annual Average Concentration	Copper	Zinc	
Step 2	0.22	0.38	ug/l
Step 3	-	-	ug/l

Acute Impact	Copper	Zinc
	Pass	Pass

Sediment - Chronic Impact: Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number	A11		HE Area / DBFO number			
Assessment type	Cumulative assessment including sediments (outfalls within 100m)					
OS grid reference of assessment point (m)	Easting	617949	Northing	304845		
OS grid reference of outfall structure (m)	Easting	617935	Northing	304841		
Outfall number	TG1704 9384d		List of outfalls in cumulative assessment	617857	304858	
Receiving watercourse	Cantley Stream					
EA receiving water Detailed River Network ID	eaew1001000000564062		Assessor and affiliation	KD Sweco		
Date of assessment	12/02/2021		Version of assessment	2		
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model.					

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Dry | Rainfall site: Huntingdon (SAAR 600mm)

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013
Impermeable road area drained (ha)	2.7438
Permeable area draining to outfall (ha)	0.276
Base Flow Index (BFI)	0.617

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): 0.077

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

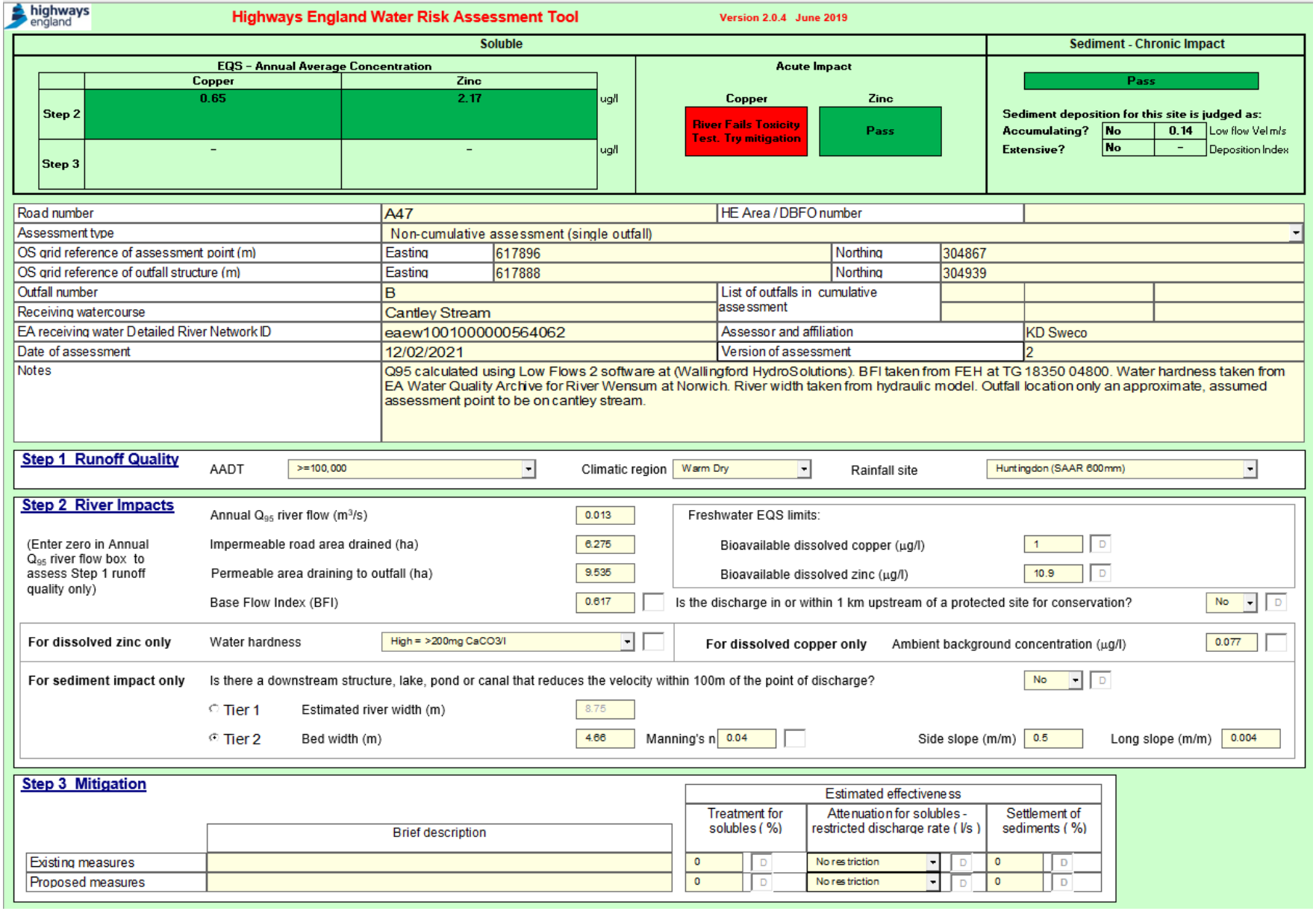
Tier 1 — Estimated river width (m): 1

Tier 2 — Bed width (m): 4.66 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.004

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

Caption 3.1 Routine runoff assessment results for the outfalls from catchment A and K (prior to mitigation)



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Soluble			Sediment - Chronic Impact
EQS – Annual Average Concentration	Acute Impact		Pass
Copper / Zinc	Copper	Zinc	Sediment deposition for this site is judged as:
Step 2: 0.65 / 2.17 ug/l	River Fails Toxicity Test. Try mitigation	Pass	Accumulating? No 0.14 Low flow Vel m/s
Step 3: - / - ug/l			Extensive? No - Deposition Index

Road number	A47		HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	617896	Northing	304867	
OS grid reference of outfall structure (m)	Easting	617888	Northing	304939	
Outfall number	B		List of outfalls in cumulative assessment		
Receiving watercourse	Cantley Stream				
EA receiving water Detailed River Network ID	eaew1001000000564062		Assessor and affiliation	KD Sweco	
Date of assessment	12/02/2021		Version of assessment	2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model. Outfall location only an approximate, assumed assessment point to be on cantley stream.				

Step 1 Runoff Quality

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

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013	Freshwater EQS limits:	
Impermeable road area drained (ha)	6.275	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	9.535	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.617	Is the discharge in or within 1 km upstream of a protected site for conservation?	No D

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

For dissolved copper only — Ambient background concentration (µg/l): 0.077

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

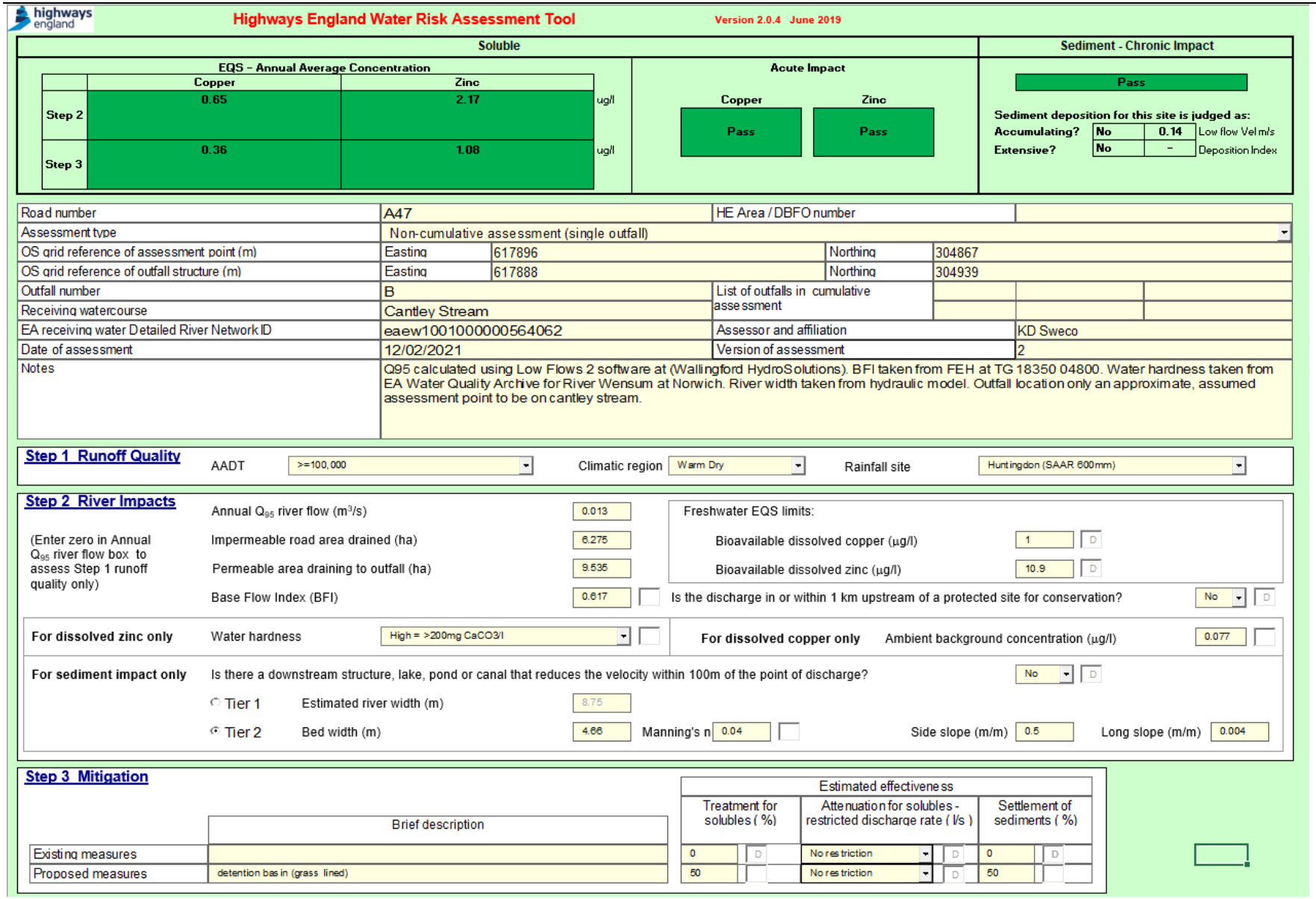
Tier 1 — Estimated river width (m): 8.75

Tier 2 — Bed width (m): 4.66 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.004

Step 3 Mitigation

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

Caption 3.2 Routine runoff assessment results for the outfall from catchments B, H and I (prior to mitigation)



Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble – EQS – Annual Average Concentration	Copper	Zinc	
Step 2	0.65	2.17	ug/l
Step 3	0.36	1.08	ug/l

Soluble – Acute Impact	Copper	Zinc
	Pass	Pass

Sediment - Chronic Impact			
Pass			
Sediment deposition for this site is judged as:			
Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	–	Deposition Index

Road number	A47		HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	617896	Northing	304867	
OS grid reference of outfall structure (m)	Easting	617888	Northing	304939	
Outfall number	B		List of outfalls in cumulative assessment		
Receiving watercourse	Cantley Stream				
EA receiving water Detailed River Network ID	eaew1001000000564062		Assessor and affiliation	KD Sweco	
Date of assessment	12/02/2021		Version of assessment	2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model. Outfall location only an approximate, assumed assessment point to be on cantley stream.				

Step 1 Runoff Quality

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

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013
Impermeable road area drained (ha)	6.275
Permeable area draining to outfall (ha)	9.535
Base Flow Index (BFI)	0.617

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): 0.077

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): 8.75

Tier 2 Bed width (m): 4.66 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.004

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	detention basin (grass lined)	50	No restriction	50

Caption 3.3 Routine runoff assessment results for the outfall from catchments B, H and I with proposed measures included

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Soluble			Sediment - Chronic Impact
EQS – Annual Average Concentration	Acute Impact		Pass
Copper / Zinc	Copper	Zinc	Sediment deposition for this site is judged as:
Step 2: 0.10 / 0.06 ug/l	Pass	Pass	Accumulating? No 0.25 Low flow Vel m/s
Step 3: – / – ug/l			Extensive? No – Deposition Index

Road number	Cantley Lane S	HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)	Easting 618408		Northing	304838
OS grid reference of outfall structure (m)	Easting 618408		Northing	304838
Outfall number	E	List of outfalls in cumulative assessment		
Receiving watercourse	Cantley Stream			
EA receiving water Detailed River Network ID	eaew1001000000555330	Assessor and affiliation	KD Sweco	
Date of assessment	12/02/2021	Version of assessment	2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width found taken from hydraulic model. Outfall location only approximate, assumed to discharge to Cantley Stream			

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Dry | Rainfall site: Huntingdon (SAAR 600mm)

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013
Impermeable road area drained (ha)	0.359
Permeable area draining to outfall (ha)	0.088
Base Flow Index (BFI)	0.617

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): 0.077

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): 1.481 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.007

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

Caption 3.4 Routine runoff assessment results for the outfall from catchment E (prior to mitigation)

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Soluble			Sediment - Chronic Impact
EQS – Annual Average Concentration	Acute Impact		Pass
Copper: Step 2 = 0.09 ug/l; Step 3 = –	Copper: Pass	Zinc: Pass	Sediment deposition for this site is judged as: Accumulating? No (0.25 Low flow Vel m/s); Extensive? No (– Deposition Index)
Zinc: Step 2 = 0.02 ug/l; Step 3 = –			

Road number	ES	HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)	Easting 618324	Northing 304763		
OS grid reference of outfall structure (m)	Easting 618324	Northing 304763		
Outfall number	E2	List of outfalls in cumulative assessment		
Receiving watercourse	Cantley Stream			
EA receiving water Detailed River Network ID	eaew1001000000555330	Assessor and affiliation	KD Sweco	
Date of assessment	12/02/2021	Version of assessment	2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width found taken from hydraulic model. Outfall assumed to discharge to Cantley Stream			

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Dry | Rainfall site: Huntingdon (SAAR 600mm)

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013
Impermeable road area drained (ha)	0.14
Permeable area draining to outfall (ha)	0.158
Base Flow Index (BFI)	0.617

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): 0.077

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

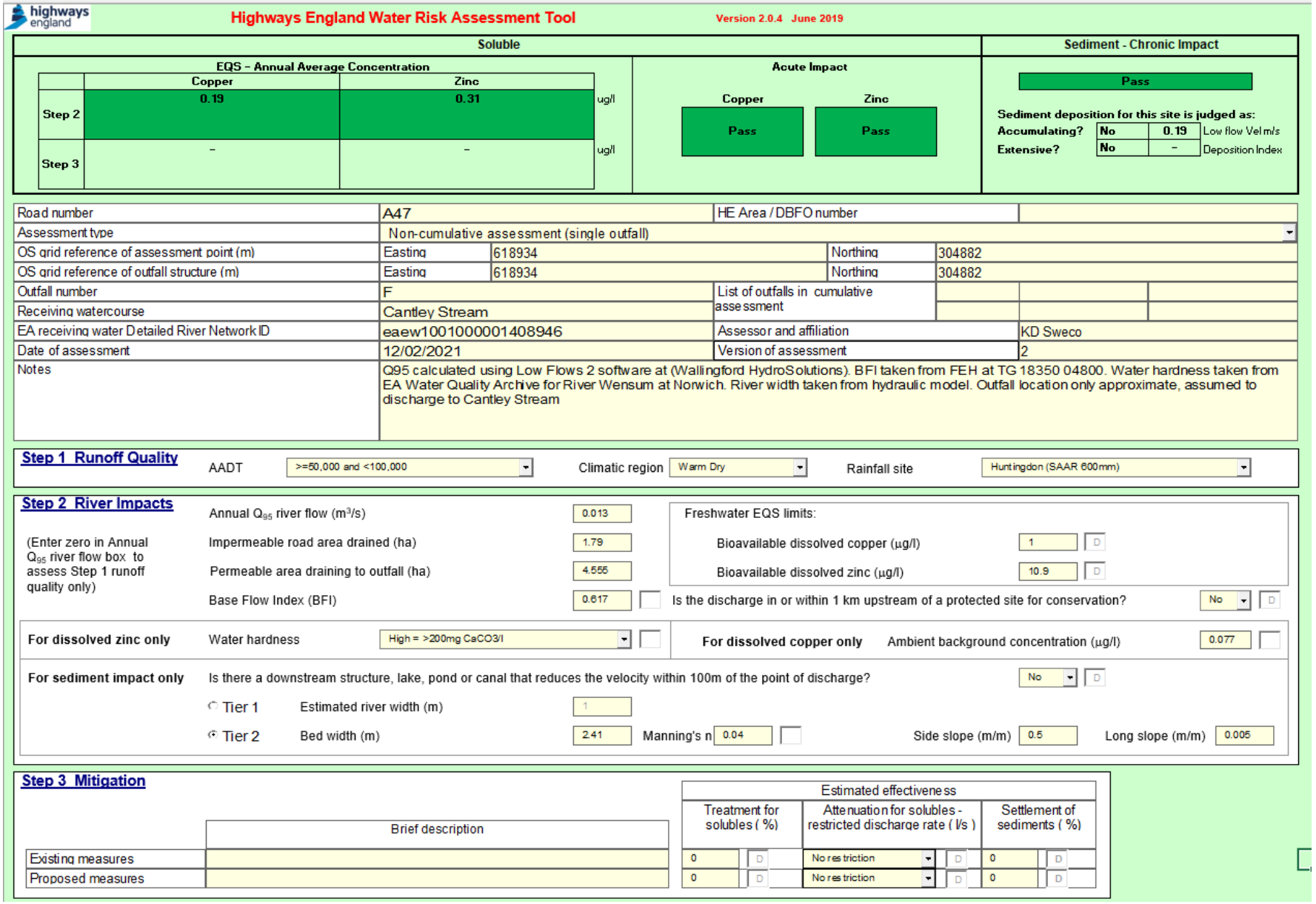
Tier 1 — Estimated river width (m): 1

Tier 2 — Bed width (m): 1.48 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.007

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

Caption 3.5 Routine runoff assessment results for the outfall from catchment E2 (prior to mitigation)



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Soluble				Sediment - Chronic Impact
EQS – Annual Average Concentration			Acute Impact	Pass
	Copper	Zinc	Copper / Zinc	Sediment deposition for this site is judged as:
Step 2	0.19	0.31 ug/l	Pass / Pass	Accumulating? No 0.19 Low flow Vel m/s
Step 3	–	– ug/l		Extensive? No – Deposition Index

Road number	A47		HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	618934	Northing	304882	
OS grid reference of outfall structure (m)	Easting	618934	Northing	304882	
Outfall number	F		List of outfalls in cumulative assessment		
Receiving watercourse	Cantley Stream				
EA receiving water Detailed River Network ID	eaew1001000001408946		Assessor and affiliation	KD Sweco	
Date of assessment	12/02/2021		Version of assessment	2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model. Outfall location only approximate, assumed to discharge to Cantley Stream				

Step 1 Runoff Quality

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

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013		
Impermeable road area drained (ha)	1.79		
Permeable area draining to outfall (ha)	4.555		
Base Flow Index (BFI)	0.617		

Freshwater EQS limits:

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

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

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

For dissolved copper only — Ambient background concentration (µg/l): 0.077

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

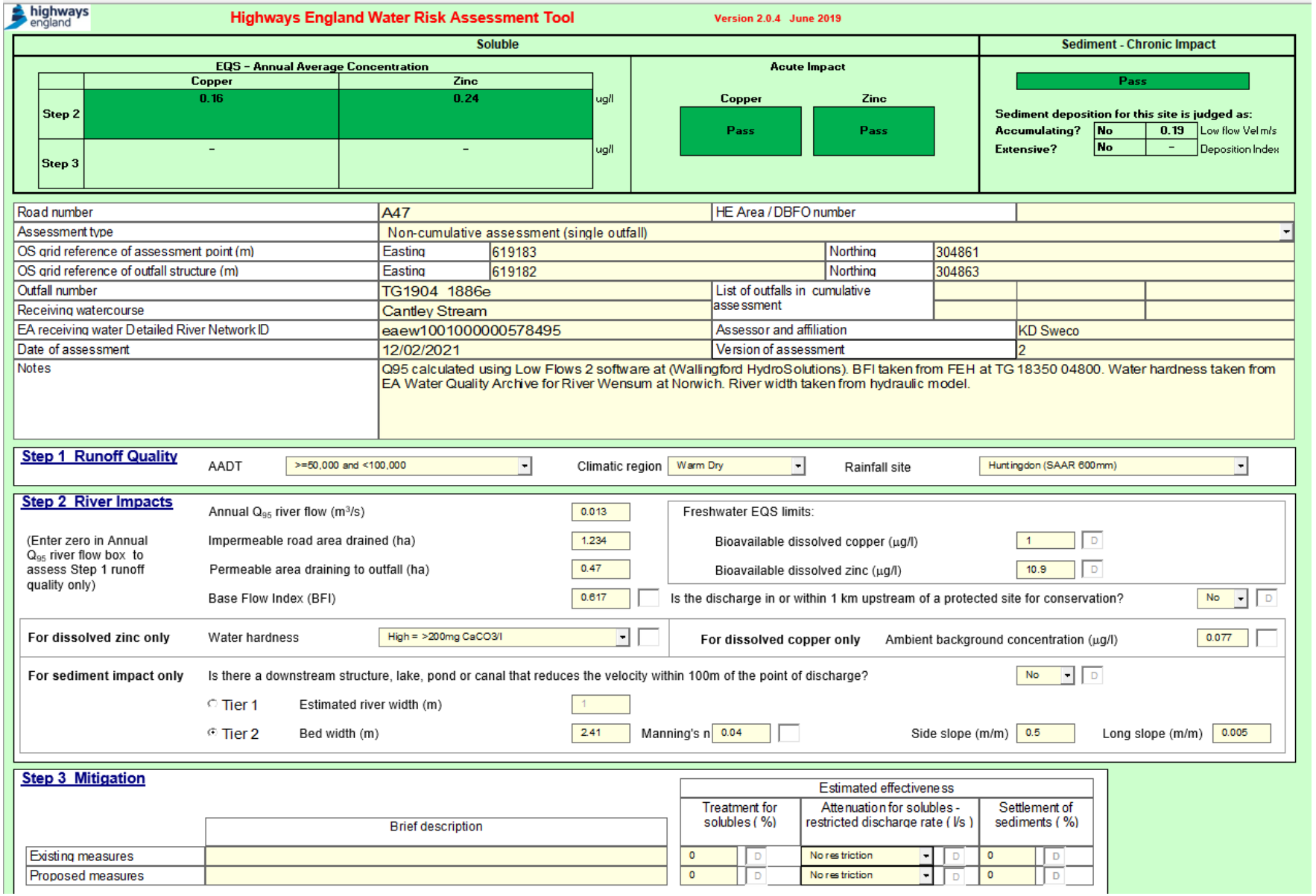
Tier 1 — Estimated river width (m): 1

Tier 2 — Bed width (m): 2.41 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.005

Step 3 Mitigation

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

Caption 3.6 Routine runoff assessment results for the outfall from catchment F (prior to mitigation)



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Soluble				Sediment - Chronic Impact
EQS – Annual Average Concentration			Acute Impact	
	Copper	Zinc		Pass
Step 2	0.16 ug/l	0.24 ug/l	Copper: Pass; Zinc: Pass	Sediment deposition for this site is judged as: Accumulating? No 0.19 Low flow Vel m/s; Extensive? No – Deposition Index
Step 3	– ug/l	– ug/l		

Road number	A47	HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)			
OS grid reference of assessment point (m)	Easting 619183	Northing 304861		
OS grid reference of outfall structure (m)	Easting 619182	Northing 304863		
Outfall number	TG1904 1886e	List of outfalls in cumulative assessment		
Receiving watercourse	Cantley Stream			
EA receiving water Detailed River Network ID	eaew1001000000578495	Assessor and affiliation	KD Sweco	
Date of assessment	12/02/2021	Version of assessment	2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model.			

Step 1 Runoff Quality

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

Step 2 River Impacts

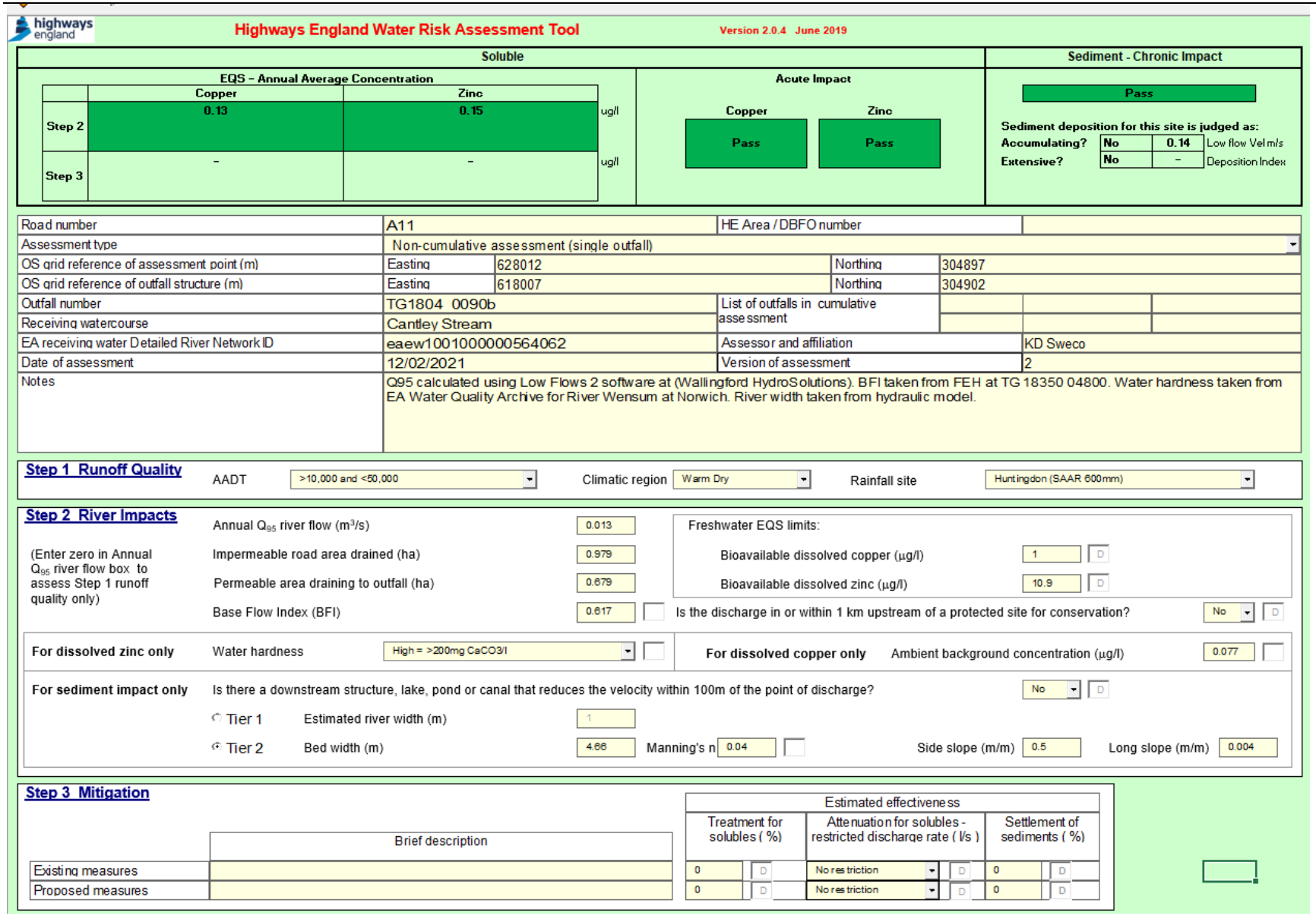
(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	0.013	Freshwater EQS limits:	
Impermeable road area drained (ha)	1.234	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	0.47	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.617	Is the discharge in or within 1 km upstream of a protected site for conservation?	No D
For dissolved zinc only Water hardness	High = >200mg CaCO3/l	**For dissolved copper only** Ambient background concentration (µg/l)	0.077
For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?			No D
Tier 1 Estimated river width (m)	1		
Tier 2 Bed width (m)	2.41	Manning's n 0.04	Side slope (m/m) 0.5 Long slope (m/m) 0.005

Step 3 Mitigation

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

Caption 3.7 Routine runoff assessment results for the outfall from catchment F2 (prior to mitigation)



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Soluble				Sediment - Chronic Impact
EQS – Annual Average Concentration			Acute Impact	Pass
	Copper	Zinc	Copper / Zinc	Sediment deposition for this site is judged as:
Step 2	0.13	0.15 ug/l	Pass / Pass	Accumulating? No 0.14 Low flow Vel m/s
Step 3	-	- ug/l		Extensive? No - Deposition Index

Road number	A11		HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	628012	Northing	304897	
OS grid reference of outfall structure (m)	Easting	618007	Northing	304902	
Outfall number	TG1804 0090b		List of outfalls in cumulative assessment		
Receiving watercourse	Cantley Stream				
EA receiving water Detailed River Network ID	eaew1001000000564062		Assessor and affiliation	KD Sweco	
Date of assessment	12/02/2021		Version of assessment	2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model.				

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Dry | Rainfall site: Huntingdon (SAAR 600mm)

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013	Freshwater EQS limits:	
Impermeable road area drained (ha)	0.979	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	0.679	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.617	Is the discharge in or within 1 km upstream of a protected site for conservation?	No D

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

For dissolved copper only — Ambient background concentration (µg/l): 0.077

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

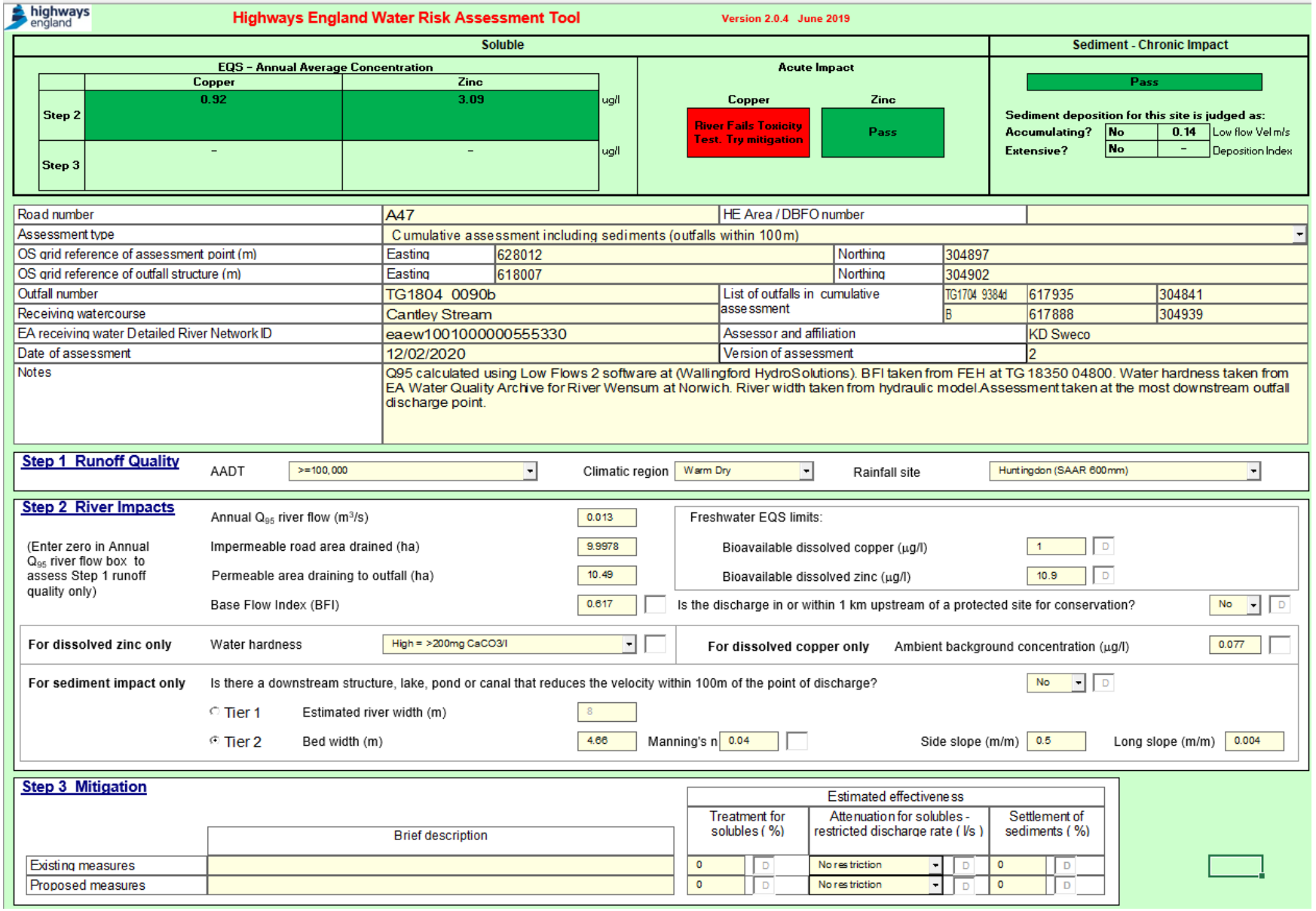
Tier 1 — Estimated river width (m): 1

Tier 2 — Bed width (m): 4.66 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.004

Step 3 Mitigation

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

Caption 3.8 Routine runoff assessment results for the outfall from catchment J (prior to mitigation)



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Soluble				Sediment - Chronic Impact
EQS – Annual Average Concentration				Pass
	Copper	Zinc		
Step 2	0.92	3.09	ug/l	
Step 3	–	–	ug/l	

Acute Impact

Copper	Zinc
River Fails Toxicity Test. Try mitigation	Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	–	Deposition Index

Road number	A47		HE Area / DBFO number			
Assessment type	Cumulative assessment including sediments (outfalls within 100m)					
OS grid reference of assessment point (m)	Easting	628012	Northing	304897		
OS grid reference of outfall structure (m)	Easting	618007	Northing	304902		
Outfall number	TG1804 0090b	List of outfalls in cumulative assessment		TG1704 9384d	617935	304841
Receiving watercourse	Cantley Stream			B	617888	304939
EA receiving water Detailed River Network ID	eaew1001000000555330	Assessor and affiliation		KD Sweco		
Date of assessment	12/02/2020	Version of assessment		2		
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model.Assessment taken at the most downstream outfall discharge point.					

Step 1 Runoff Quality

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

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013
Impermeable road area drained (ha)	9.9978
Permeable area draining to outfall (ha)	10.49
Base Flow Index (BFI)	0.617

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): 0.077

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

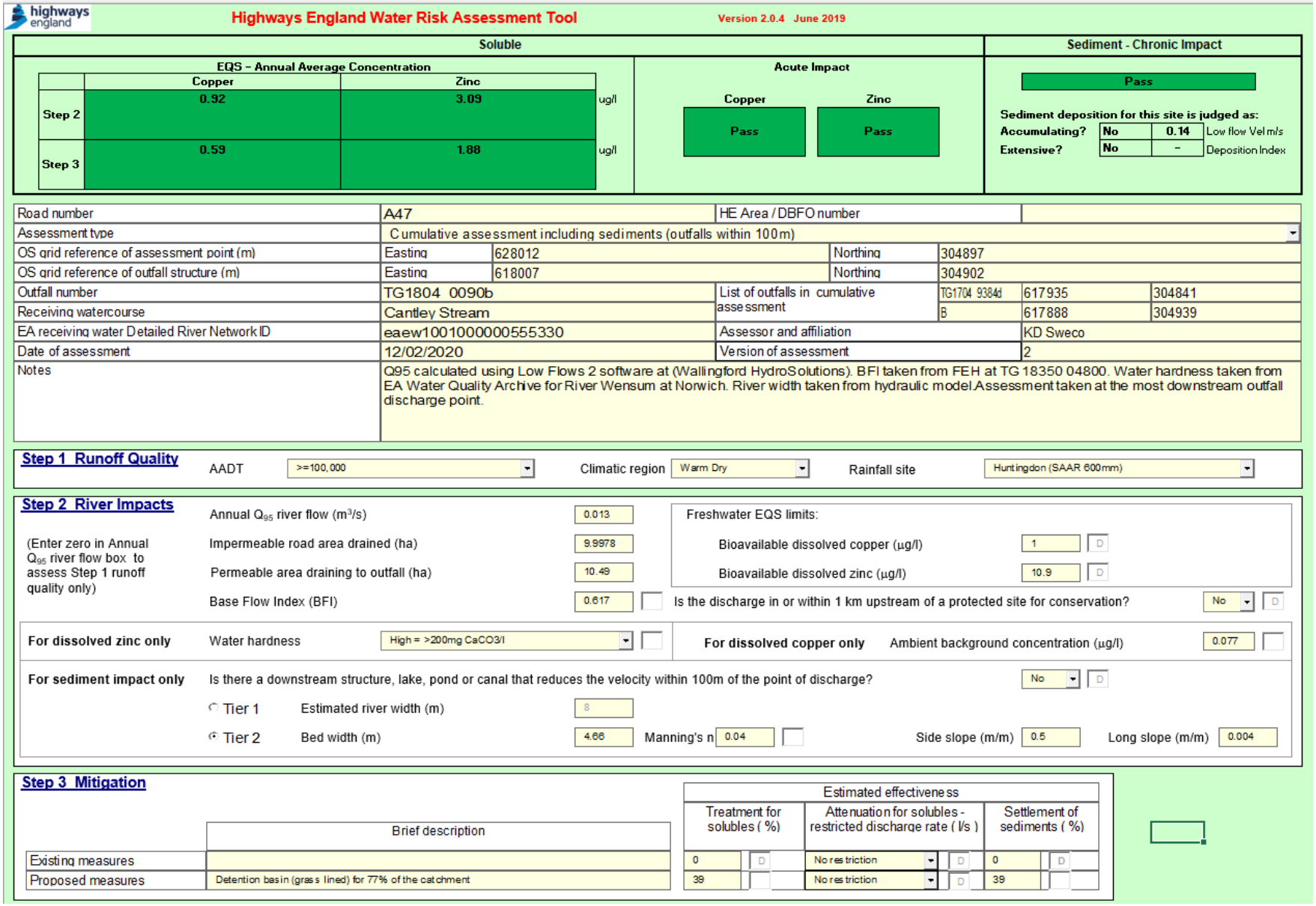
Tier 1 — Estimated river width (m): 8

Tier 2 — Bed width (m): 4.66 | Manning's n: 0.04 | Side slope (m/m): 0.5 | Long slope (m/m): 0.004

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

Caption 3.9 Cumulative routine runoff assessment results for the outfalls from catchments A, B, H, I and J (prior to mitigation)



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Soluble

EQS – Annual Average Concentration

	Copper	Zinc	
Step 2	0.92	3.09	ug/l
Step 3	0.59	1.88	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number	A47		HE Area / DBFO number			
Assessment type	Cumulative assessment including sediments (outfalls within 100m)					
OS grid reference of assessment point (m)	Easting	628012	Northing	304897		
OS grid reference of outfall structure (m)	Easting	618007	Northing	304902		
Outfall number	TG1804 0090b		List of outfalls in cumulative assessment	TG1704 9384d	617935	304841
Receiving watercourse	Cantley Stream			B	617888	304939
EA receiving water Detailed River Network ID	eaew1001000000555330		Assessor and affiliation		KD Sweco	
Date of assessment	12/02/2020		Version of assessment		2	
Notes	Q95 calculated using Low Flows 2 software at (Wallingford HydroSolutions). BFI taken from FEH at TG 18350 04800. Water hardness taken from EA Water Quality Archive for River Wensum at Norwich. River width taken from hydraulic model.Assessment taken at the most downstream outfall discharge point.					

Step 1 Runoff Quality

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

Step 2 River Impacts

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

Annual Q_{95} river flow (m^3/s)	0.013
Impermeable road area drained (ha)	9.9978
Permeable area draining to outfall (ha)	10.49
Base Flow Index (BFI)	0.617

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): 0.077

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)	8				
Tier 2	Bed width (m)	4.66	Manning's n	0.04	Side slope (m/m) 0.5	Long slope (m/m) 0.004

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	Detention basin (grass lined) for 77% of the catchment	39	No restriction	39

Caption 3.10 Routine runoff assessment results for the outfall from catchment A, B, H, I and J with proposed measures included

4. Accidental spillage assessment

4.1. Overview

4.1.1. This section presents the results of the accidental spillage assessment. This considers the risk of pollution impacts from accidental spillages onto the drainage catchments which discharge to the Cantley Stream.

4.2. Method

4.2.1. Spillage assessments were completed for all outfalls, using the approach as detailed within the Appendix D of DMRB LA113. The methodology uses a prepared spreadsheet to input parameters relating to waterbody type, road type, annual average daily traffic (AADT) and location. This determines an overall risk expressed as probability. For this methodology, the probability is defined in two ways:

- The probability that there will be a spillage with the potential to cause a serious pollution incident
- The probability, assuming such a spillage has occurred, that the pollutant will cause a serious pollution incident

4.2.2. The following formula is used to calculate the annual probability of a spillage for each section of road:

$$P_{SPL}=RL \times SS \times (AADT \times 365 \times 10^{-9}) \times (\%HGV/100)$$

4.2.3. Where:

- P_{SPL} = annual probability of a spillage with the potential to cause a serious pollution incident
- RL = Road Length (in km)
- SS = Spillage rates from Table D1 (which is included with the results below)
- AADT = annual average daily traffic (design year for new road used)
- %HGV = Percentage of heavy goods vehicles

4.2.4. The predicted annual probability of a serious pollution incident for each section of road, using this formula:

$$P_{INC}= P_{SPL} \times P_{POL}$$

4.2.5. Where:

- P_{INC} = the probability of a spillage with an associated risk of a serious pollution incident occurring
- P_{POL} = the probability, given a spillage, that a serious pollution incident will result. An appropriate value for this is selected from Table D2 in DMRB LA113 for outfalls. This will depend on the sensitivity of the water course and how soon it can be reached by the emergency services.

4.3. Assessment results

4.3.1. All of the outfalls passed the accidental spillage assessment with the results indicating all drainage areas would have <0.5% annual risk of pollution, which is the annual acceptable threshold for discharge to a sensitive designated site. The annual acceptable pollution risk threshold is set at 0.5% due to the presence of coastal and floodplain grazing Priority Habitats located within the vicinity of, and downstream of, the outfalls. This assessment included the additional mitigation measures noted in section 3.3.

4.3.2. The results from each accidental spillage assessment can be seen in Captions 4.1 to 4.8.

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View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

			Additional columns for use if other roads drain to the same outfall							
		A (main road)	B	C	D	E	F		
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	1,084.00							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	No junction							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	48,800							
D8	% HGV	5.4							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00030	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00018	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**	**No**	**No**	**Totals**	**Return Period (years)**
D13	Return period without pollution reduction measures	0.00018	0.00000	0.00000	0.00000	0.00000	0.00000	0.0002	5512
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction	0.00018	0.00000	0.00000	0.00000	0.00000	0.00000	0.0002	5512
D16	Proposed measures factor	1							
D17	Residual with proposed Pollution reduction measures	0.00018	0.00000	0.00000	0.00000	0.00000	0.00000	0.0002	5512

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.1 Accidental spillage assessment results for the outfall from Catchment A (existing and proposed)

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

			Additional columns for use if other roads drain to the same outfall							
		A (main road)	B	C	D	E	F		
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse	Surface watercourse	Surface watercourse	Surface watercourse		
D2	Length of road draining to outfall *(m)*	653.00	1,000.00	853.00	220.00	342.00	350.00		
D3	Road Type *(A-road or Motorway)*	A	A	A	A	A	A		
D4	If A road, is site urban or rural?	Rural	Rural	Rural	Rural	Rural	Rural		
D5	Junction type	No junction	Side road	Slip road	Slip road	Slip road	Slip road		
D6	Location (response time for emergency services)	< 1 hour	< 1 hour	< 1 hour	< 1 hour	< 1 hour	< 1 hour		
D7	Traffic flow (AADT two way)	13,300	1,100	12,200	12,800	8,900	10100		
D8	% HGV	3	18	4	5	3	4		
D8	Spillage factor *(no/10^8 HGVkm/year)*	0.29	0.93	0.83	0.83	0.83	0.83		
D9	Risk of accidental spillage	0.00003	0.00007	0.00013	0.00004	0.00003	0.00004		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00002	0.00004	0.00008	0.00003	0.00002	0.00003		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**	**No**	**No**	**Totals**	**Return Period (years)**
D13	Return period without pollution reduction measures	0.00002	0.00004	0.00008	0.00003	0.00002	0.00003	0.0002	4989
D14	Existing measures factor	1	1	1	1	1	1		
D15	Return period with existing pollution reduction	0.00002	0.00004	0.00008	0.00003	0.00002	0.00003	0.0002	4989
D16	Proposed measures factor	0.6	0.6	0.6	0.6	0.6	0.6		
D17	Residual with proposed Pollution reduction measures	0.00001	0.00002	0.00005	0.00002	0.00001	0.00002	0.0001	8315

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

detention basin (grass lined)

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.2 Accidental spillage assessment results for the outfall from Catchments B, H and I

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall: B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	288.00	391.00						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Rural	Rural						
D5	Junction type	Roundabout	No junction						
D6	Location (response time for emergency services)	< 1 hour	< 1 hour						
D7	Traffic flow (AADT two way)	36,660	15,180						
D8	% HGV	4	4						
D8	Spillage factor *(no/10^9 HGVkm/year)*	3.09	0.29						
D9	Risk of accidental spillage	0.00048	0.00003	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00029	0.00002	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No	No	No	No	No	No		
D13	Return period without pollution reduction measures	0.00029	0.00002	0.00000	0.00000	0.00000	0.00000	0.0003	3324
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction	0.00029	0.00002	0.00000	0.00000	0.00000	0.00000	0.0003	3324
D16	Proposed measures factor	0.6	0.6						
D17	Residual with proposed Pollution reduction measures	0.00017	0.00001	0.00000	0.00000	0.00000	0.00000	0.0002	5540

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

detention basin (grass lined)

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.3 Accidental spillage assessment results for the outfall from Catchments B, H and I continued

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall: B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	284.00	148.00						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Rural	Rural						
D5	Junction type	Side road	No junction						
D6	Location (response time for emergency services)	< 1 hour	< 1 hour						
D7	Traffic flow (AADT two way)	1,100	1,100						
D8	% HGV	18	18						
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.93	0.29						
D9	Risk of accidental spillage	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**	**No**	**No**		
D13	Return period without pollution reduction measures	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	75110
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	75110
D16	Proposed measures factor	1	1						
D17	Residual with proposed Pollution reduction measures	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	75110

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.4 Accidental spillage assessment results for the outfall from Catchment E

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall: B	C	D	E	F		
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	50.00	243.00						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Rural	Rural						
D5	Junction type	Side road	No junction						
D6	Location (response time for emergency services)	< 1 hour	< 1 hour						
D7	Traffic flow (AADT two way)	1,100	1,100						
D8	% HGV	18	18						
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.93	0.29						
D9	Risk of accidental spillage	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**	**No**	**No**	**Totals**	**Return Period (years)**
D13	Return period without pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	197159
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	197159
D16	Proposed measures factor	1	1						
D17	Residual with proposed Pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	197159

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.5 Accidental spillage assessment results for the outfall from Catchment E2

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		Additional columns for use if other roads drain to the same outfall							
		A (main road)	B	C	D	E	F		
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	626.00	492.00						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Rural	Rural						
D5	Junction type	No junction	Slip road						
D6	Location (response time for emergency services)	< 1 hour	< 1 hour						
D7	Traffic flow (AADT two way)	68,700	12,200						
D8	% HGV	4	4						
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29	0.83						
D9	Risk of accidental spillage	0.00018	0.00007	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00011	0.00004	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**	**No**	**No**	**Totals**	**Return Period (years)**
D13	Return period without pollution reduction measures	0.00011	0.00004	0.00000	0.00000	0.00000	0.00000	0.0002	6540
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction	0.00011	0.00004	0.00000	0.00000	0.00000	0.00000	0.0002	6540
D16	Proposed measures factor	1	1						
D17	Residual with proposed Pollution reduction measures	0.00011	0.00004	0.00000	0.00000	0.00000	0.00000	0.0002	6540

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.6 Accidental spillage assessment results for the outfall from Catchment F

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall: B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	660.00							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	No junction							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	68,700							
D8	% HGV	4							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00019	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00012	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No	No	No	No	No	No		
D13	Return period without pollution reduction measures	0.00012	0.00000	0.00000	0.00000	0.00000	0.00000	0.0001	8682
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction	0.00012	0.00000	0.00000	0.00000	0.00000	0.00000	0.0001	8682
D16	Proposed measures factor	1							
D17	Residual with proposed Pollution reduction measures	0.00012	0.00000	0.00000	0.00000	0.00000	0.00000	0.0001	8682

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.7 Accidental spillage assessment results for the outfall from Catchment F2

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall: B	C	D	E	F		
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	387.00							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	No junction							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	36,600							
D8	% HGV	4							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00006	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60	0.60	0.60	0.60	0.60	0.60		
D11	Risk of pollution incident	0.00004	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**	**No**	**No**	**Totals**	**Return Period (years)**
D13	Return period without pollution reduction measures	0.00004	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	27791
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction	0.00004	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	27791
D16	Proposed measures factor	1							
D17	Residual with proposed Pollution reduction measures	0.00004	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	27791

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Caption 4.8 Accidental spillage assessment results for the outfall from Catchment J

5. Summary of impacts

5.1.1. The routine runoff assessment for outfalls was undertaken using HEWRAT. The assessment indicates that there is a negligible impact following dilution in the channel for both soluble and sediment-bound pollutants. A vegetated detention basin is required to treat catchments B, H and I to mitigate an acute copper pollution risk. No other water quality mitigation is required for the remaining catchments. The results of the HEWRAT assessment are summarised in Table 5-1.

5.1.2. This assessment represents a worst case scenario for environmental impacts to surface water features. There is an intention to provide filter drains and swales prior to discharging via the outfall, the locations can be found in Table 5-1. However, this is subject to further assessment following the supplementary ground investigations due to start in March 2021.

5.1.3. The accidental spillages assessment was undertaken using the HEWRAT spillage assessment. The assessment indicates that the risk of serious pollution incident is considerably less than the annual acceptable threshold of 0.5% for discharge to a sensitive designated site (see Table 5-1).

Table 5-1 Summary of predicted routine runoff and accidental spillages assessment

Drainage catchment	Mitigation identified by HEWRAT	Mitigation proposed (subject to supplementary ground investigation)	Soluble				Sediment	Spillage assessment
			EQS Annual average concentration		Acute impact			
			Copper (µg/l)	Zinc (µg/l)	Copper	Zinc		
A (existing and proposed) and K	None	Filter drains	Pass (0.22)	Pass (0.38)	Pass	Pass	Pass	Pass
B, H and I	Detention basin (vegetated)	Detention basin (vegetated) and filter drains	Pass (0.36)	Pass (1.08)	Pass	Pass	Pass	Pass
E	None	Filter drains and swale	Pass (0.10)	Pass (0.06)	Pass	Pass	Pass	Pass
E2	None	Filter drains and swale	Pass (0.09)	Pass (0.02)	Pass	Pass	Pass	Pass
F	None	Filter drains and (vegetated) detention basin	Pass (0.19)	Pass (0.31)	Pass	Pass	Pass	Pass
F2	None	Filter drains	Pass (0.16)	Pass (0.24)	Pass	Pass	Pass	Pass
J	None	Filter drains	Pass (0.13)	Pass (0.15)	Pass	Pass	Pass	Pass
A, K, B, H, I and J (cumulative)	Detention basin (vegetated)	Detention basin (vegetated) and filter drains	Pass (0.59)	Pass (1.88)	Pass	Pass	Pass	N/A

6. Enhancement measures

6.1.1. A detention basin would attenuate highway drainage from catchment F. The detention basin will be planted with suitable local species to provide further water quality and biodiversity enhancements. Filter drains and swales are also proposed, subject to supplementary ground investigations, which would provide further water quality enhancements. Vegetated detention basins would also reduce nitrate and phosphate concentrations through biological uptake. In addition to providing additional pollution treatment, the vegetated detention basins will provide some biodiversity improvement.

7. References

- Highways England (2019) Design Manual for Roads and Bridges LA 113 Road Drainage and the Water Environment. Available at https://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/LA%20113%20Road%20drainage%20and%20the%20water%20environment-web.pdf, accessed September 2020
- Highways England (2020) Highways Agency Drainage Data Management System v5.12.0 (HADDMS). Available at: http://www.haddms.com, accessed September 2020
- UKTAG (2014) Updated recommendations on environmental standards; river basin management (2015-21). Available at: http://www.wfduk.org/sites/default/files/Media/Environmental%20standards/UKTAG%20Environmental%20Standards%20Phase%203%20Final%20Report%2004112013.pdf, accessed September 2020

Appendix A. Existing and proposed drainage catchment areas

IMPORTANT

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

TO BE READ IN CONJUNCTION WITH HAZARD REGISTER
DOC. REF: HE551492-GTY-GHS-000-HS-ZZ-30002.

HAZARD REF AND BRIEF DESCRIPTION OF HAZARD:-

	HAZARD REF	CATCHMENT INFO ONLY
⚠		

Catchment Reference	Pre development Catchment Area (m2)	Pre development Catchment Area (Ha)
Catchment A (existing)	29230	2.923
Catchment F2	68675	6.868
Catchment J	120971	12.097
Natural A	244783	24.478
Natural B	115207	11.521
Natural B1	1553765	155.377
Natural C	191876	19.188
Natural D	56164	5.616

NOTES

KEY TO SYMBOLS

- CATCHMENT A
- CATCHMENT F2
- CATCHMENT J
- CATCHMENT E
- NATURAL CATCHMENT A
- NATURAL CATCHMENT B
- NATURAL CATCHMENT C
- NATURAL CATCHMENT D
- DCO BOUNDARY
- OVERLAND FLOW PATHS

REV	DATE	REVISION NOTE	ORG	CHK'D	APP'D
P01	02/02/21	general updates	SG	CBuc	BWil
P02	09/03/21	area updated	SG	CBuc	BWil
P03	12/03/21	areas updated	SG	CBuc	BWil

DESIGNER
SWECO

CONTRACTOR
GallifordTry

CLIENT
highways england

PROJECT TITLE
A47/A11 THICKTHORN JUNCTION

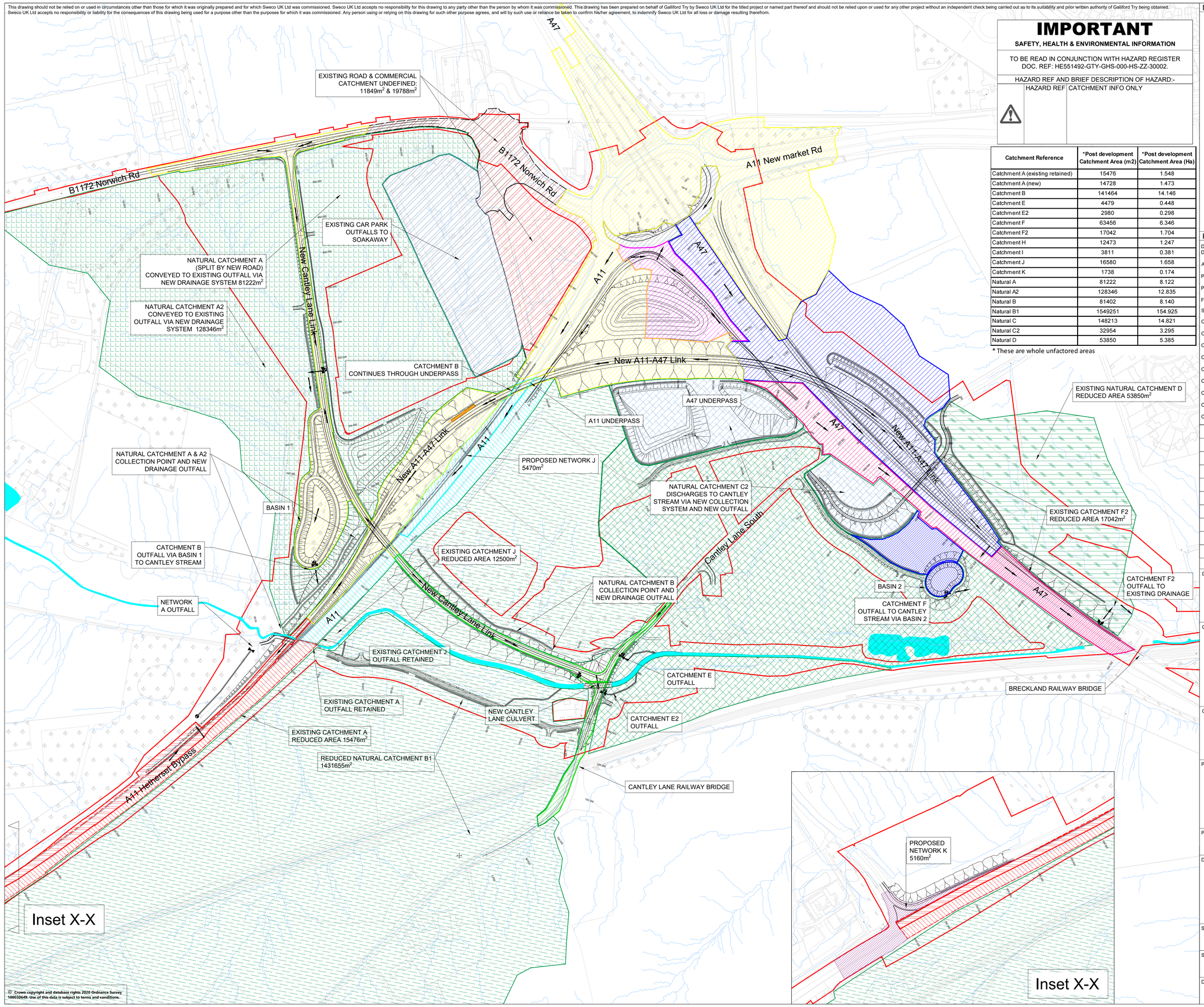
PROJECT STAGE
PCF STAGE 3

DRAWING TITLE
EXISTING DRAINAGE CATCHMENTS

SUITABILITY
SUITABLE FOR INFORMATION

SHEET SIZE	SCALE	STATUS	REVISION
A1	1:2500	S2	P03

DRAWING NUMBER
HE551492-GTY-HDG-000-SK-CD-30010



IMPORTANT

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

TO BE READ IN CONJUNCTION WITH HAZARD REGISTER
DOC. REF: HE551492-GTY-GHS-000-HS-ZZ-30002.

HAZARD REF AND BRIEF DESCRIPTION OF HAZARD:-

	HAZARD REF	CATCHMENT INFO ONLY
⚠		

Catchment Reference	*Post development Catchment Area (m2)	*Post development Catchment Area (Ha)
Catchment A (existing retained)	15476	1.548
Catchment A (new)	14728	1.473
Catchment B	141464	14.146
Catchment E	4479	0.448
Catchment E2	2980	0.298
Catchment F	63456	6.346
Catchment F2	17042	1.704
Catchment H	12473	1.247
Catchment I	3811	0.381
Catchment J	16580	1.658
Catchment K	1738	0.174
Natural A	81222	8.122
Natural A2	128346	12.835
Natural B	81402	8.140
Natural B1	1549251	154.925
Natural C	148213	14.821
Natural C2	32954	3.295
Natural D	53850	5.385

* These are whole unfactored areas

NOTES

KEY TO SYMBOLS

DIRECTION OF SURFACE WATER DRAINAGE
ATTENUATION TANK
PUMPING CHAMBER
PUMP SHAFT
FLOW CONTROL DEVICE
SHUT-OFF VALVE
CATCHMENT A (existing)
CATCHMENT A (new)
CATCHMENT B
CATCHMENT E
CATCHMENT E2
CATCHMENT F
CATCHMENT F2
CATCHMENT H
CATCHMENT I
CATCHMENT J
CATCHMENT K
NATURAL CATCHMENT A & A1
NATURAL CATCHMENT B & B1
NATURAL CATCHMENT C
NATURAL CATCHMENT C 2
NATURAL CATCHMENT D
DCO BOUNDARY
OVERLAND FLOW PATHS

REV	DATE	REVISION NOTE	ORG	CHK'D	APP'D
P01	02/02/21	GENERAL UPDATES	SG	CBuc	BWil
P02	12/03/21	area updated	SG	CBuc	BWil

DESIGNER
SWECO

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highways england

PROJECT TITLE
A47/A11 THICKTHORN JUNCTION

PROJECT STAGE
PCF STAGE 3

DRAWING TITLE
DRAINAGE OUTFALL CATCHMENTS
SCHEME LAYOUT PLAN
SHEET 1 OF 1

SUITABILITY
SUITABLE FOR INFORMATION

SHEET SIZE	SCALE	STATUS	REVISION
A1	1:2500	S2	P02

DRAWING NUMBER
HE551492-GTY-HDG-000-DR-CD-30009

Appendix B. Metal bioavailability assessment

MBAT results for copper

Metal Bioavailability Assessment Tool (M-BAT)

Back

Calculate

Clear Data

INPUT DATA											RESULTS (Copper)			
ID	Location	Waterbody	Date	Measured Cu Concentration (dissolved) (µg l^{-1})	Measured Zn Concentration (dissolved) (µg l^{-1})	Measured Mn Concentration (dissolved) (µg l^{-1})	Measured Ni Concentration (dissolved) (µg l^{-1})	pH	DOC	Ca	Site-specific PNEC Dissolved Copper (µg l^{-1})	BioF	Bioavailable Copper Concentration (µg l^{-1})	Risk Characterisation Ratio
1	Thickthorn	Cantley Stream	03/09/2020	1	2	2	1	7.9	4.2	116	13.96	0.07	0.07	0.07
2	Thickthorn	Cantley Stream	24/09/2020	1	2	6	1	7.9	4.3	106	14.37	0.07	0.07	0.07
3	Thickthorn	Cantley Stream	29/10/2020	1	2	5	1	8	4.9	164	15.20	0.07	0.07	0.07
4	Thickthorn	Cantley Stream	01/12/2020	1	2	7	1	8.1	4	186	10.26	0.10	0.10	0.10
5	Thickthorn	Cantley Stream	16/12/2020	1	3	2	1	8	4.3	165	12.87	0.08	0.08	0.08
6	Thickthorn	Cantley Stream	12/01/2021	2	3	43	1	8	4.2	158	12.48	0.08	0.16	0.16