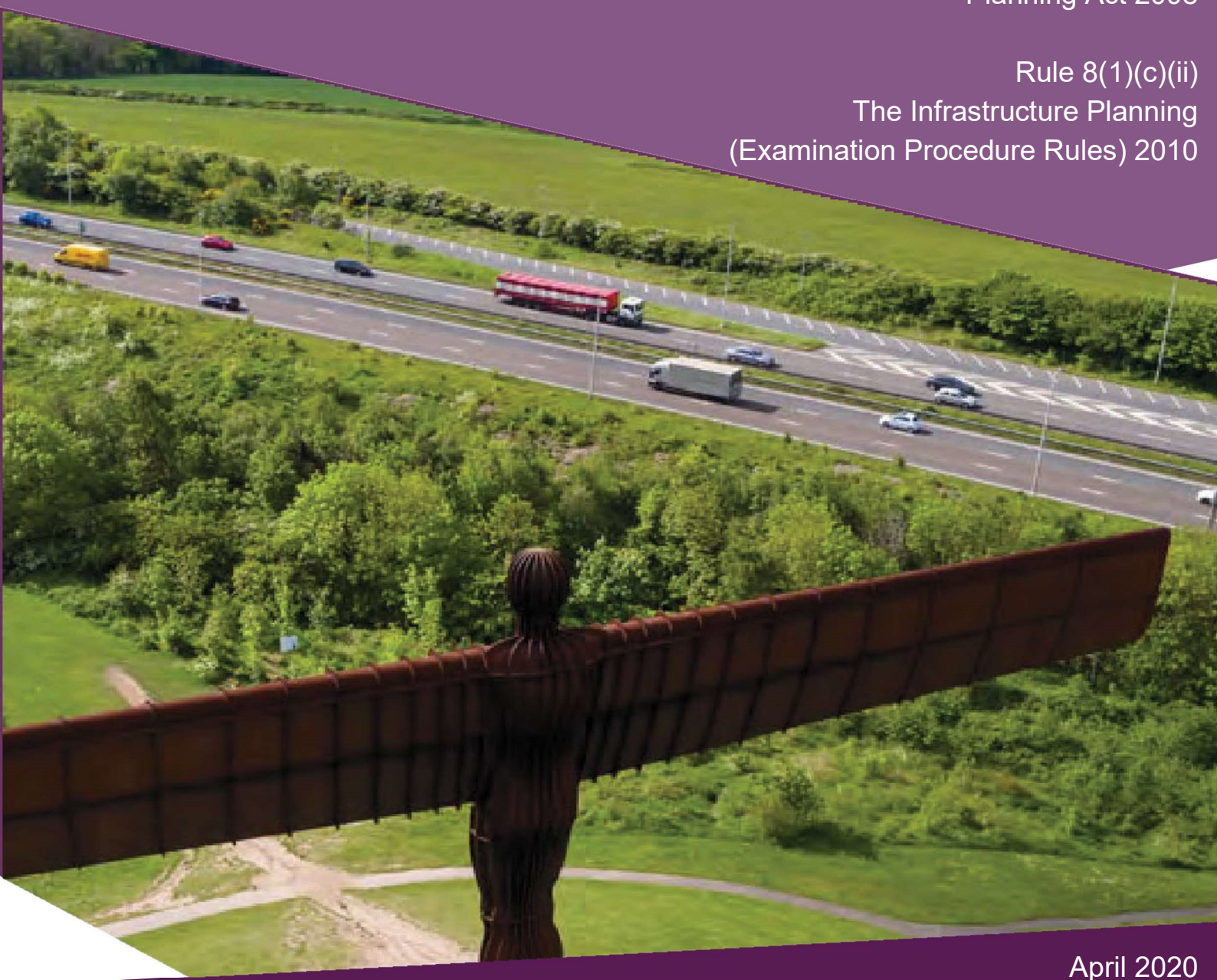
A1 Birtley to Coal House

Scheme Number: TR010031

EXA/D4/029 - Written Question 2.0.12 Appendix 2.0P - DMRB Updates Water HEWRAT Assessment

Planning Act 2008

Rule 8(1)(c)(ii)
The Infrastructure Planning
(Examination Procedure Rules) 2010



April 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure Rules) 2010

The A1 Birtley to Coal House

Development Consent Order 20[xx]

Written Question 2.0.12 Appendix 2.0P -DMRB updates Water HEWRAT Assessment

Rule Number:	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010031
Application Document Reference	EXA/D4/029 - Written Question 2.0.12 Appendix 2.0P - DMRB updates Water HEWRAT Assessment
Author:	A1 Birtley to Coal House Project Team, Highways England

Version	Date	Status of Version
Rev 0	20 April 2020	For Issue

CONTENTS

TABLES

APPENDICES

APPENDIX A

OUTFALL LOCATION PLAN

APPENDIX B

HEWRAT INPUT PARAMETERS

APPENDIX C

HEWRAT DETAILED RESULTS

APPENDIX D

GROUNDWATER RISK PARAMETERS AND RESULTS

1. INTRODUCTION

1.1.1. Following submission of the Development Consent Order (DCO) application for the A1 Birtley to Coal House Scheme (the Scheme), Highways England updated the Standards for Highways – Design Manual for Road and Bridges (DMRB). This included a replacement of the Road Drainage and the Water Environment guidance (HD45/09 was replaced with LA 113) (**Ref. 1**)). These changes have the potential to affect the conclusions set out in **Chapter 13: Road Drainage and the Water Environment** of the Environmental Statement (ES) [**APP-034**].

1.1.2. During the DCO examination, the Examining Authority (ExA) submitted the following Written Question (WQ) to the Applicant:

ExA WQ 1.0.19: "The ExA notes that updates have recently been made to the Design Manual for Roads and Bridges. Please provide a review of these changes where relevant to this application for Development Consent and set out the implications for, and any updates of the assessments provided, in the ES".

1.1.3. An initial response to this question was submitted by the Applicant at Deadline 2 (25 February 2020). However, as identified in that response, additional assessment work was required in order to sufficiently identify any changes in the overall conclusions of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**].

1.1.4. A review of the updated guidance has been undertaken (as set out at **Appendix 1.0.G – DMRB Review Option to the Applicant's Responses to ExA's First Written Questions** [**REP2-008**]) and established that the only change in LA 113 with the potential to impact the findings of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**] is associated with the assessment of water quality associated with routine runoff. These changes require:

a. The inclusion of ambient copper levels within the receiving water (as required in Step 2 (River Impacts) of the Highways England Water Risk Assessment Tool (HEWRAT) spreadsheet).
b. A simple groundwater risk assessment where the Q95 flow of the watercourse is one litre per second or less (paragraph 3.25 of LA 113).

1.1.5. This report:

a. Outlines the further assessment of the routine runoff to the surface watercourses as per the recently updated HEWRAT (2019) (previously referred to as HAWRAT (2009)) in accordance with LA 113.
b. Determines whether there would be changes to the overall conclusions of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**] if the new DMRB guidance had been used for the assessment described in that Chapter.

2. BACKGROUND

2.1.1. The existing A1 between Birtley and Coal House is currently drained by a combination of gully and pipe connections and filter drains. The pipe network drains into a number of ditches, culverts and watercourses which run parallel to the existing highway boundary. An extensive drainage survey was undertaken which identified a total of 14 outfalls; **Appendix A: Outfall Location Plan** of this report contains the outfall location plan for the Scheme which utilises the majority of the existing outfalls. No new outfalls are proposed for the Scheme. The existing outfalls have been used for the purpose of this assessment, with the exception of outfall 10 which is to be decommissioned as part of the Scheme.

2.1.2. **Paragraph 13.4.11** to **13.4.13** of **Chapter 13 – Road Drainage and the Water Environment** of the ES [**APP-034**] provides details on the assumptions for input parameters, which remain unchanged and in compliance with LA 113.

2.1.3. As a groundwater risk assessment is now required by paragraph 3.25 of LA 113, further input parameters are required for this aspect only. Where appropriate, these have been determined by an appropriately qualified hydrogeologist in accordance with Table C.1 within Appendix C of LA 113 and are set out at in **Appendix D: Groundwater Risk Parameters and Results** of this report.

3. METHODOLOGY

3.1.1. This assessment comprises a simple, desk-based assessment which involves utilising the HEWRAT for the routine runoff, with the groundwater spillage risk assessment matrix undertaken in excel for ease of comparison (in accordance with paragraph 3.24.1 of LA 113). The assessment employs Environmental Quality Standards (EQS) relevant at the time of this report (Environment Agency (2010). 'Proposed Environmental Quality Standards for Water Framework Directive') (**Ref. 1**).

3.1.2. The ambient Copper concentrations in the River Team were obtained from the Environment Agency's website (**Ref. 3**).

3.1.3. The groundwater input parameters were derived from:

a. British Geological Survey (2020). Borehole Data **(Ref. 4)**.
b. WSP (2019). Ground Investigation Data.

3.1.4. The drainage ratio was derived based upon the design catchment areas for each segment of the Scheme; these are detailed in **Appendix D: Groundwater Risk Parameters and Results** of the report. As no topographical survey had been undertaken of the watercourses for the assessment reported in **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**], the surface area of the receiving waterbodies has been assumed based upon previous inspections by the Applicant's designer to inform the Scheme design and the assessment (visits on 31 October 2017 and 12 March 2019) and Ordnance Survey (OS) mapping.

3.1.5. The discharge location for each outfall and which outfalls were included in each method of assessment are detailed in **Table 1**, below and shown in **Figure 13.4: Outfall Location Plan** of the ES [**APP-095**] which is replicated in **Appendix A: Outfall Location Plan** of this report:

Table 1 - Outfall Discharge Locations and Method of Assessment

Outfall No.	Discharge Location	Routine Runoff and Surface Water Auality Assessment	Groundwater Quality and Routine Runoff
1	Unknown (possible connection to Gateshead Council highway drains)	Outfalls accumulatively assessed as worst-case scenario	Assessed Individually
2	Leyburnhold Gill		
3 & 4	Bowes View and Leyburnhold Gill		

Outfall No.	Discharge Location	Routine Runoff and Surface Water Auality Assessment	Groundwater Quality and Routine Runoff
5	Longacre Dene via Eighton Lodge Culvert		
6	Ordinary watercourse near Smithy Lane		
7a	Ditch leading to ordinary watercourse near Smithy Lane		
6 & 7	Ordinary watercourse near Smithy Lane		
8	Culvert leading to Allerdene Burn		
9	The River Team		No assessment required as Q_{95} greater than 1 l/s
11			
12			
13			

Note - Outfalls 3 & 4 and 6 & 7 were combined for the assessment of the groundwater quality due to the outfalls discharging into the same watercourse, either side of the Scheme.

4. ASSESSMENT OF POLLUTION IMPACTS FROM ROUTINE RUNOFF ON SURFACE WATER QUALITY

4.1.1. The parameters used for this assessment within HEWRAT are detailed in **Appendix B: HEWRAT Input Parameters** of this report, with the results summarised below and detailed in **Appendix C: HEWRAT detailed results** of this report.

4.1.2. **Paragraph 13.4.4** of **Chapter 13 – Road Drainage and the Water Environment** of the ES [**APP-034**] details that the majority of the receiving watercourses are very small, and it is likely that most, if not all, are ephemeral (with the exception of the River Team). It is therefore unlikely that any of these watercourses support protected water dependent species. As these watercourses discharge to the River Team, with no significant watercourses in between, the outfalls have been assessed as one outfall using the River Team Q95 as derived at the gauging station within the Order limits (23017 - Team at Team Valley) (**Ref. 5**). This is a conservative assumption as it assumes a higher pollutant loading at the single discharge point, as further dilution may occur upstream.

4.1.3. Additionally, DMRB CG 501 (**Ref. 6**) details that the watercourses upstream of the River Team will provide a degree of treatment, as Table 8.6.4N3 states that naturally vegetated ditches reduce copper levels by 15%. This mitigation effect has been incorporated into the assessment.

SOLUBLES – ACUTE IMPACTS AND SEDIMENTS – CHRONIC IMPACTS

4.1.4. The previous assessment tool (HAWRAT), used in **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**], and the updated assessment tool (HEWRAT) used in this report, calculate the acute (short-term) impacts associated with road runoff by assessing acute pollution impacts and chronic (long-term) pollution impacts.

4.1.5. The assessment presented in this report (HEWRAT) demonstrates that there would be no acute (in relation to solubles) or chronic (in relation to sediments) impacts on the water quality of the River Team with respect to soluble pollutants (**Table 2**). This is the same as that concluded in **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**].

Table 2 - Acute and Chronic Impacts from Routine Runoff and Surface Water Quality, HEWRAT Results

Receiving Watercourse	HEWRAT Results			Action
	Soluble: acute impacts - Copper	Soluble: acute impacts - Zinc	Sediments: chronic impacts	
River Team	Pass	Pass	Pass	No further action (expanded upon below)

EQS COMPLIANCE

4.1.6. The previous assessment tool (HAWRAT), used in **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**], and the updated assessment tool (HEWRAT) used in this report, calculate the chronic (long-term) impacts by comparing calculated annual average concentrations of dissolved copper and dissolved zinc with EQS limits.

4.1.7. The assessment presented in this report (HEWRAT) demonstrates that annual average concentrations for dissolved zinc do not exceed the EQS limits. This indicates that there would be no chronic (long-term) effect associated with dissolved zinc within the routine road runoff discharging into the River Team (**Table 3**). This is the same as that concluded in **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**].

Table 3 - Routine Runoff and Surface Water Quality EQS Compliance Results, HEWRAT Results

Receiving Watercourse	Copper	Zinc
Predicted Annual Average Concentrations (µg/l)	2.45 – Fail	0.33 - Pass
Proposed standards	1 µg/l bioavailable	10.9 bioavailable
Ambient Background Concentration (µg/l) dissolved	2.4	Not considered within HEWRAT

4.1.8. As the River Team has a high background concentration of copper (2.4 µg/l), it fails the EQS standard of 1 µg/l without considering the impact of the Scheme. Any increase in copper levels is considered by HEWRAT as a fail. To reduce the dissolved copper loading, the Scheme includes a pond to manage the runoff from one of the catchments (within which it will provide a 40% dissolved copper removal).

4.1.9. There are no opportunities, due to land take requirements, to include additional measures to reduce the dissolved copper load (CG 501 states that the other available measures are ditch, pond, swale or wetland). In any event, that copper load is not the result of the Scheme.

4.1.10. However, measures to offset the small increase in copper levels presented in **Table 3** (noting that this small increase alone does not result in a change of Water Framework Directive (WFD) class or potential not to achieve WFD requirements) against other aspects (hydrocarbons and sediment load) have been agreed with the Environment Agency as part of the **Appendix 13.2: Water Framework Directive assessment** of the ES **[APP-164]**, as evidenced in the **Statement of Common Ground** (SoCG) between Highways England and the Environment Agency (Revision 1) [**REP2-054**].

4.1.11. The potential for the measures detailed in **Appendix 13.2: Water Framework Directive assessment** of the ES [**APP-164**] to be incorporated in the Scheme design to address the Environment Agency's concerns over sediment load are currently being evaluated. The results of this evaluation will be submitted during examination.

4.1.12. The findings of assessment presented in this report do not alter those drawn in **paragraphs 13.10.25** to **13.10.26** of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**]; these are (noting the change from HAWRAT to HEWRAT):

4.1.13. The River Team has been classified as of medium importance, given its overall WFD status as moderate. Based on the results of the HEWRAT assessment, the magnitude of impact on the water quality of the River Team would be negligible, resulting in a **neutral** (not significant) effect.

4.1.14. With the implementation of mitigation measures identified in **Section 13.9** of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**], the likelihood of polluting road discharges occurring in the River Team would be reduced. Hence the magnitude of impact arising during the operation phase would be minor beneficial. This would result in a **slight beneficial** (not significant) effect.

5. ASSESSMENT OF POLLUTION IMPACTS FROM ROUTINE RUNOFF ON GROUNDWATER QUALITY

5.1.1. The groundwater quality risk assessment involves a matrix where risk levels are established and factored (1, 2 or 3) for each input parameter and then multiplied by the corresponding weighting factor. These are summed for each outfall to calculate an overall score which determines whether risk is low, medium or high.

5.1.2. The parameters used in this aspect of the assessment, and the results of the assessment, are detailed in **Appendix D: Groundwater Risk Parameters and Results** of this report. This assessment did not include outfalls 9 – 13 as these outfalls discharge directly into the River Team.

5.1.3. A sensitivity assessment was undertaken on the drainage ratio (detailed in **Appendix D: Groundwater Risk Parameters and Results** of this report) by increasing the score to the highest value (3). This resulted in no change in the overall risk category for all but two outfalls, with only outfalls 1 and 3 straddling the border of low and medium risk, with a score of 150 as detailed in **Table 4** below.

5.1.4. The assessment demonstrates that four of the watercourses are at low risk, with an overall score less than 150 and three watercourses are at medium risk, with an overall score between 150 and 250. The overall scores for this assessment are detail in **Table 4** below.

Table 4 - Outfall Groundwater Risk Results

Outfall No.	Discharge Location	Risk
1	Unknown (possible connection to Gateshead Council highway drains)	140
3	Bowes View	140
5	Longacre Dene via Eighton Lodge Culvert	170
7a	Ditch leading to ordinary watercourse near Smithy Lane	170
8	Culvert leading to Allerdene Burn	140
2 & 4	Leyburnhold Gill	175
6 & 7	Ordinary watercourse near Smithy Lane	140

5.1.5. Further investigation into the risk rating for outfalls 5, 7a and 2 & 4 was undertaken. This identified that, in the absence of watercourse specific Ground Investigation, conservative assumptions had been made by applying worst case risk values presented in Ground Investigation information from boreholes within close proximity to the outfalls. If such a watercourse specific Ground Investigation was undertaken and was found to be in line with borehole logs from the Ground Investigation (**Appendix 9.2a to 9.2e Ground Investigation Factual Report** of the **ES [APP138, APP-139, APP-140, APP-141, APP-142]**), the risk score may well reduce to 150 in which case no further mitigation or assessment would be required. However, given the environment pertaining at the time of this assessment (COVID-19) and working restrictions, it has not been possible to undertake a Ground Investigation to support this revised assessment. In addition, the Scheme includes mitigation measures, as previously outlined (paragraph 4.1.8 and 4.1.9), along with the maintaining of the groundwater at depth by the Coal Authority to manage water levels within the former mines (**paragraph 13.10.15** of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**]) which have not been accounted for in this assessment. Given the largely clay coverage of the catchment and dewatering undertaken by the Coal Authority, the risks to groundwater are considered to be low and no further mitigation or assessment is required.

5.1.6. **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**] does not directly identify any significant effects in terms of groundwater as a result of road drainage (**paragraphs 13.10.49** and **13.10.50**). However, **paragraph 13.10.49** states:

"Additionally, as detailed in paragraphs 13.4.10-13.4.10 the groundwater levels are considered to be substantially lower than the bed of the watercourse given the magnitude of the pumping the coal authority undertake at Kibblesworth. Any remaining groundwater is likely to be associated with localised perched water tables and would therefore be unlikely to have a significant impact on flow rates in the watercourse or flood risk to the Scheme."

5.1.7. Whilst the assessment presented in this report does identify an additional risk to groundwater as a result of the discharges to the ephemeral streams, the risk to groundwater is considered to be low, especially given the pumping undertaken by the Coal Authority. Therefore, there is no change to the significance presented in **paragraph 13.10.50** of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**]:

*"The magnitude of impact arising during the operational phase is considered to be **negligible**, and there would be a potential for a **neutral** (not significant) effect on groundwater during the operational phase."*

6. CONCLUSIONS

6.1.1. The assessment concludes that the discharges to surface water and groundwater meet the requirements of LA 113, with no further mitigation or assessment required with the overall significance of effects in relation to these aspects remaining as **minor beneficial / neutral** (not significant) during the operational phase of the Scheme. As such, there are no changes to the assessment outcomes described in the overall conclusions of **Chapter 13: Road Drainage and the Water Environment** of the ES [**APP-034**] as a result of the updated DMRB guidance. Further information on the potential inclusion of sediment vortexes at all outfalls will be provided during examination.

7. ABBREVIATIONS

Acronym	Definition
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
ES	Environmental Statement
EQS	Environmental Quality Standards
ExA	Examining Authority
HEWRAT	Highways England Water Risk Assessment Tool
SoCG	Statement of Common Ground
OS	Ordinance Survey
WFD	Water Framework Directive
WQ	Written Question

8. REFERENCES

Ref. 1 Highways England *et al.* Design Manual for Roads and Bridges (2019) *LA 113 Road Drainage and the Water Environment.* Revision 1, March 2020.

Ref. 2 HM Government. Available at: https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/500399/Fresh_waters_specific_pollutants_and_operational_EQS.csv (accessed 2020).

Ref. 3 Environment Agency. Available at: https://environment.data.gov.uk/water-quality/view/download/new (accessed 2020).

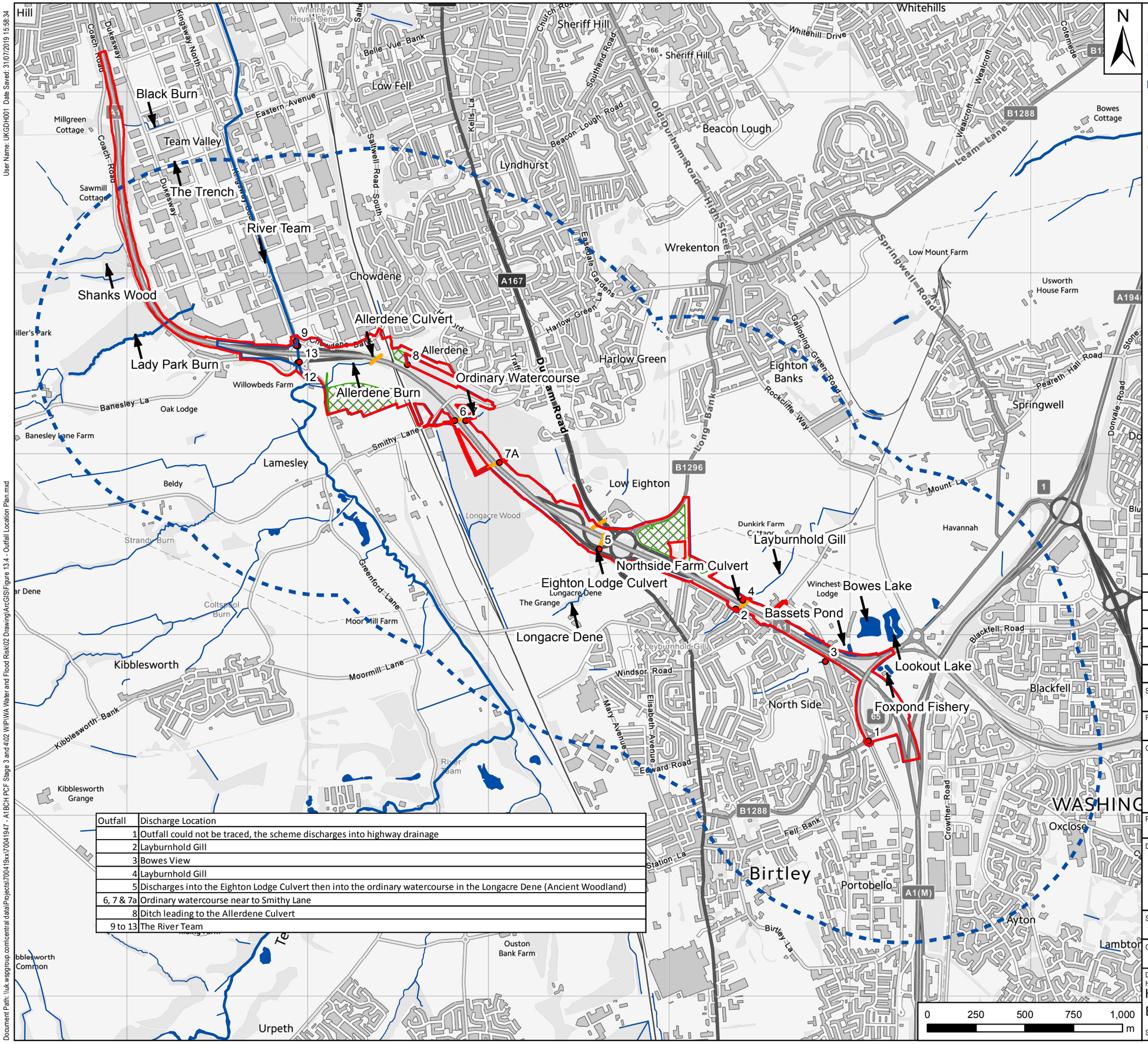
Ref. 4 British Geological Survey. Available at: https://www.bgs.ac.uk/data/boreholescans/home.html (accessed 2020).

Ref. 5 National River Flow Archive, Centre for Ecology & Hydrology (2017) – Gauging Station Data. Available at: http://nrfa.ceh.ac.uk/data/search (access 2020)

Ref. 6 Highways England et al. Design Manual for Roads and Bridges (2019) *CG501 Design of Highway Drainage Systems.* Revision 2, March 2020.

Appendix A

Outfall Location Plan



Outfall	Discharge Location
1	Outfall could not be traced, the scheme discharges into highway drainage
2	Layburnhold Gill
3	Bowes View
4	Layburnhold Gill
5	Discharges into the Eighton Lodge Culvert then into the ordinary watercourse in the Longacre Dene (Ancient Woodland)
6, 7 & 7a	Ordinary watercourse near to Smithy Lane
8	Ditch leading to the Allerdene Culvert
9 to 13	The River Team

Rev	Date	Description	By	Chk'd	App'd
P05	31/07/19	Fourth Issue	GH	SS	AS
P04	24/04/19	Third Issue	EHC	SS	AS
P03	28/02/19	Second Issue	EHC	SS	AS
P02	12/12/18	First Issue	EHC	SS	AS
P01	29/11/18	First Issue	EHC	SS	AS

Suitability: Suitable for Information
Status: S2

PINS Reference Number: TR010031

Client: highways england

Project Title: A1 Birtley to Coal House Scheme

Drawing Title: Figure 13.4 Outfall Location Plan
Regulation 5 (2) (a)

Scale	Drawn	Checked	Approved	Authorised
1:20,000	EHC	SS	AS	NJA
Original Size	Date	Date	Date	Date
A3	29/11/18	04/12/18	06/12/18	12/12/18

Drawing Number
HE PIN: HE551462
B2CH

Originator: WSP
Volume:
Revision: P05
PW Stage Code:

Section | Type | ID | Direction | Type | Role | Number

Appendix B

HEWRAT Input Parameters

User parameters

Location Details

Road Number	A1		**Assessment type**		Non-cumulative assessment (single outfall)			
HE Area/DBFO number								
OS grid reference of assessment point (m)	**Easting**	424935	**Receiving watercourse**		River Team			
	Northing	558620	**EA receiving water Detailed River Network ID**					
OS grid reference of outfall structure (m)	**Easting**	424935	**Assessor and affiliation**		Beth Woolley WSP			
	Northing	558620	**Date of assessment**		03/06/2019			
Outfall number	Whole Scheme		**Version of assessment**		V2			
List of outfalls in cumulative assessment	ALL							
Notes	Sum of all outfall impermeable areas contributing							

Parameter	Units	Default Value	Value used	Notes	
Runoff Risk Assessments					
AADT	vpd	>10,000 and <50,000	***>=100,000***		
Climatic Region	-	Warm Dry	***Colder Dry***		
Rainfall Site	-	Ashford (SAAR 710mm)	***Newcastle upon tyne (SAAR 680mm)***		
Q95 River flow	m3/s	0	***0.382***		
Baseflow Index	-	0.5	***0.67***		
Impermeable road area drained	ha	1	***21.4***		
Permeable area draining to outfall	ha	0	***0***		
Is the discharge in or within 1 km upstream of a protected site for conservation?	-	No	***No***		
Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?	-	No	***No***		
Hardness	-	Low = <50mg CaCO3/l	***Medium = 50-200 CaCO3/l***		
Use Tier 1	-	TRUE	***FALSE***		
Use Tier 2	-	FALSE	***TRUE***		
Tier 1 Estimated river width at Q95	0	5	***6.5***		
Tier2 Bed width	m	3	***6.3***		
Tier2 Side slope	m/m	0.5	***4***		
Tier2 Long slope	m/m	0.0001	***0.0002***		
Tier2 Mannings' n	-	0.07	***0.02***		
Existing treatment for solubles	%	0	***15***	***Description for existing measures***	Vegetated Ditches
Existing attenuation -restricted discharge rate	l/s	No restriction	***No restriction***		
Existing settlement of sediments	%	0	***0***		
Proposed treatment for solubles	%	0	***15***	***Description for proposed measures***	
Proposed attenuation -restricted discharge rate	l/s	No restriction	***No restriction***		
Proposed settlement of sediments	%	0	***0***		
EQS, bio avail dissolved Cu	ug/l	1	***1***		
EQS, bio avail dissolved Zn	ug/l	10.9	***10.9***		
Ambient background concentration, dissolved copper	ug/l	0	***2.4***		

Appendix C

HEWRAT Detailed Results

Highways England Water Risk Assessment Tool

Version 2.0.4 June 2019

Soluble

EQS - Annual Average Concentration

	Copper	Zinc	
Step 2	2.50 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or Step 3 mitigation.	0.39	ug/l
Step 3	2.45 Tier 1 fail. Go to Tier 2 (using UK TAG M-BAT tool), or increase Step 3 mitigation.	0.33	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.28	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number	A1		HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	424935	Northing	558620	
OS grid reference of outfall structure (m)	Easting	424935	Northing	558620	
Outfall number	Whole Scheme		List of outfalls in cumulative assessment	ALL	
Receiving watercourse	River Team				
EA receiving water Detailed River Network ID			Assessor and affiliation	Beth Woolley WSP	
Date of assessment	03/06/2019		Version of assessment	V2	
Notes	Sum of all outfall impermeable areas contributing				

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Colder Dry | Rainfall site: Newcastle upon tyne (SAAR 680mm)

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)	0.382
Impermeable road area drained (ha)	21.4
Permeable area draining to outfall (ha)	0
Base Flow Index (BFI)	0.67

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: Medium = 50-200 CaCO3/l

For dissolved copper only — Ambient background concentration (µg/l): 2.4

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): 6.5
- Tier 2 — Bed width (m): 6.3; Manning's n: 0.02; Side slope (m/m): 4; Long slope (m/m): 0.0002

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures	Vegetated Ditches	15	No restriction	0
Proposed measures		15	No restriction	0

Summary of predictions

		Soluble - Acute Impact		Sediment - Chronic Impact							
		Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Prediction of impact	Step1										
	Step2										
	Step3										

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**76.50**	**99.20**
No. of exceedances/worst year		86	107
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**28.80**	**63.00**
No. of exceedances/worst year		43	75
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	31.55	173.85
	90%ile	60.39	356.07
	95%ile	73.53	485.30
	99%ile	136.52	922.50

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
				Toxicity Threshold				
	1	1	1	1	1	1	1	1
	97.40	**117.50**	**6.10**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
	109	138	12	51	104	51	28	88
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity Threshold	197	315	3.5	16770	875	2355	245	515
	526	2036	1	15858	2743	2632	168	742
	1084	4499	3	35481	6138	5890	376	1661
	1363	6145	3	54904	9498	9114	582	2569
	2130	8873	5	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**0**	**0.1**
No. of exceedances/worst year		0	1
No. of exceedances/summer		0	0.1
No. of exceedances/worst summer		0	1
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0**	**0**
No. of exceedances/worst year		0	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		2.50	0.39
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	0.27	1.55
	90%ile	0.70	3.25
	95%ile	1.19	6.38
	99%ile	3.41	16.75

Step 2

Velocity 0.28 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement - %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**0.00**	**0.00**
No. of exceedances/worst year		0	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.00**	**0.00**
No. of exceedances/worst year		0	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		2.45	0.33
		(ug/l)	*(ug/l)*
Thresholds hresholds	***RST24***	21	92
Thresholds	***RST6***	42	184
Event Statistics	Mean	0.23	1.32
	90%ile	0.60	2.76
	95%ile	1.01	5.42
	99%ile	2.89	14.24

DI -

Details of the chosen rainfall site

SAAR (mm)	**680**
Altitude (m)	**75**
Easting	**4248**
Northing	**5648**
Coastal distance (km)	**18**

Appendix D

Groundwater Risk Parameters and Results

	Source			Pathway						Total Score
	Traffic Flow	Rainfall Depth	Drainage Area Ratio	Infiltration Method	Unsaturated Zone	Flow Type	Unsaturated Zone Clay Content	Organic Carbon	Unsaturated Zone pH	
WEIGHTING	10	10	10	15	20	20	5	5	5	
OUTFALL										
1	3	1	2	1	1	1	1	2	2	140
2	3	1	3	1	2	1	3	2	2	180
3	3	1	2	1	1	1	1	2	2	140
4	3	1	3	1	2	2	2	2	1	190
5	3	1	3	1	1	1	1	2	2	150
6	3	1	2	1	1	1	1	2	2	140
7	3	1	2	1	1	1	1	2	2	140
7a	3	1	3	1	1	1	1	2	2	150
8	3	1	2	1	1	1	1	2	2	140
2 & 4	3	1	3	1	2	1	1	2	2	170
6 & 7	3	1	2	1	1	1	1	2	2	140

KEY

Low Risk	<150
Medium	150-250
High	>250

Outfall	Area [m2]	Bottom Width (m)	length (m)	surface area	Ratio	Value
1	12622.8	0.5	200	100	126.228	2
2	34751	0.5	200	100	347.51	3
3	5764.58	0.5	200	100	57.645787	2
4	16469.8	0.5	200	100	164.698	3
5	28992.2	0.5	200	100	289.922	3
6	7590	0.5	200	100	75.9	2
7	4410	0.5	200	100	44.1	2
7a	40380	0.5	200	100	403.8	3
8	11430	0.5	200	100	114.3	2

Table C.1 Groundwater quality and runoff risk assessment matrix

	Parameter	Weighting factor	Low risk (Score 1)	Medium risk (Score 2)	High risk (Score 3)
Source	Traffic flow	10	≤50,000 AADT	>50,000 AADT to <100,000 AADT	≥100,000 AADT
	Rainfall depth (annual averages)	10	≤740 mm	>740 mm to <1060 mm	≥1060 mm
	Drainage area ratio	10	≤50	>50 to <150	≥150
Pathway	Infiltration method	15	"Continuous" shallow linear (e.g. unlined ditch, swale, grassed channel)	"Region", shallow infiltration systems, (e.g. infiltration basin).	"Point" systems (e.g. chamber soakaways, deep shafts) 2
	Unsaturated zone	20	Depth to water table ≥15 m or unproductive strata	Depth to water table <15 m and >5 m	Depth to water table ≤5 m
	Flow type	20	Dominantly intergranular flow	Mixed fracture and intergranular flow	Flow dominated by fractures/ fissures
	Unsaturated zone clay content	5	≥15 % clay minerals	<15 % to >1 % clay minerals	≤1 % clay minerals
	Organic carbon	5	≥15 % Soil organic matter	<15% to >1% soil organic matter	≤1 % Soil organic matter
	Unsaturated zone soil pH	5	pH ≥8	pH <8 to >5	pH ≤5

If you need help accessing this or any other Highways England information, please call **0300 470 4580** and we will help you.

This document is also available on our website at www.gov.uk /highways

If you have any enquiries about this document A1BirtleytoCoalhouse@highwaysengland.co.uk or call 0300 470 4580*.

*Calls to 03 numbers cost no more than a national rate call to an 01 or 02 number and must count towards any inclusive minutes in the same way as 01 and 02 calls.
These rules apply to calls from any type of line including mobile, BT, other fixed line or payphone. Calls may be recorded or monitored.

Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ
Highways England Company Limited registered in England and Wales number 09346363