APPENDIX 14.1 HAWRAT ASSESSMENT

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APPENDIX 14.1 RESULTS FROM THE ROUTINE RUNOFF AND SPILLAGE RISK

The HAWRAT assessments were carried out to both Step 2 (without mitigation) and Step 3 (with mitigation) for the proposed scheme. The results of steps 2 and 3 of the assessment are shown at the top of the routine runoff results sheets and summarised in Table 14.1.1 below. The results are colour coded with a red meaning a fail, green a pass, and amber an alert.

Table 14.1.1: Summary of routine runoff assessment

Outfall	Step 2 – In-River Impacts								Step 3 – Post-mitigation							
	Soluble Pollutants						Sediment-bound pollutants		Soluble Pollutants						Sediment-bound pollutants	
	RST 24 (exc./year)		RST6 (exc./year)		AA-EQS (µg/l)		Low-flow velocity (m/s)	DI value	RST 24 (exc./year)		RST 6 (exc./year)		AA-EQS (µg/l)		Low-flow velocity (m/s)	DI Value
	Cu	Zn	Cu	Zn	Cu	Zn			Cu	Zn	Cu	Zn	Cu	Zn		
Catchment 4 (Tier 2)	0.40	0.00	0.10	0.00	0.49	2.03	0.14	-	0.10	0.00	0.00	0.00	0.30	1.42	0.14	-
Catchment 6	4.50	0.00	0.50	0.00	1.46	5.72	0.00	88.00	0.90	0.00	0.10	0.00	0.87	4.00	0.00	35.00
Catchment 7	1.70	0.00	0.10	0.00	0.97	3.81	0.00	58.00	1.00	0.00	0.10	0.00	0.80	3.24	0.00	42.00
Catchment 8a (Tier 2)	2.00	0.00	0.10	0.00	1.00	3.95	0.19	-	0.20	0.00	0.00	0.00	0.60	2.76	0.19	-
Catchment 8b	2.00	0.00	0.10	0.00	1.00	3.95	0.00	62.00	0.20	0.00	0.00	0.00	0.60	2.76	0.00	25.00

Legend	
RST	Runoff Specific Threshold
DI	Deposition Index
AA-EQS	Annual Average Environmental Quality Standard
S	Section
C	Catchment
Green	Pass
Amber	Alert
Red	Fail

Parameter	Catchment 4	Catchment 6	Catchment 7	Catchment 8	
				8a	8b
Easting of outfall	434147	434243	433936	434621	434976
Northing of outfall	560248	560021	559319	558783	558558
Receiving watercourse	River Don	River Don Tributary	Minor Watercourse	Piped Connection (ultimately River Wear	Minor Watercourse (ultimately River Wear)
Step 1: Runoff Quality					
Two Way AADT broad group	>50,000 and <100,000	>10,000 to <50,000	>10,000 to <50,000	>10,000 to <50,000	
Climatic Region	Colder Dry	Colder Dry	Colder Dry	Colder Dry	
Rainfall Site	Newcastle upon Tyne	Newcastle upon Tyne	Newcastle upon Tyne	Newcastle upon Tyne	
Step 2: In-River Impacts (Tier 1)					
95%ile River Flow (m^3/s)	0.0099	0.00014	0.00023	0.00047	0.00047
Baseflow Index (BFI)	0.5	0.5	0.5	0.5	0.5
Existing Impermeable road area drained (ha)	5.344	0.774	0.833	0.768	0.768
Existing Permeable area draining to outfall (ha)	3.559	0.191	0.494	1.528	1.528
Proposed Impermeable road area drained (ha)	5.680	0.936	0.689	1.296	1.296
Proposed Permeable area draining to outfall (ha)	4.179	0.689	1.120	1.600	1.600
Water Hardness	High = >200mg $CaCO_3$ mg/l	High = >200mg $CaCO_3$ mg/l	High = >200mg $CaCO_3$ mg/l	High = >200mg $CaCO_3$ mg/l	
Within 1km upstream of a protected site?	Yes	Yes	No	Yes	
Downstream structure that reduces the velocity <100m?	No	No	No	No	
Use Tier 1	TRUE	TRUE	TRUE	TRUE	
Use Tier 2	TRUE	FALSE	FALSE	TRUE	FALSE
Estimated river width at Q95 (m)	3.2	4.63	4.69	0.9	9
Step 3: Mitigation					
Tier 2 Bed width (m)	2.2	0.648	1.579	0.072	3
Tier 2 Side slope (m/m)	2	0.522	0.638	0.1	3.5
Tier 2 Long slope (m/m)	0.008	0.036	0.005	0.005	0.0001
Tier 2 Manning's n	0.07	0.07	0.07	0.015	0.07
Proposed treatment of Solubles (%)	30/40	30/40	17.9/15.1	30/40	30/40
Proposed attenuation – restricted discharge rate (l/s)	38.8	6.2	10.3	32.2	32.2
Settlement of sediments (%)	60	60	26.7	60	60

Catchment 4: Pre-mitigation

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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										

DETAILED RESULTS

In Runoff

	Step 1 Copper	Step 1 Zinc	Step 1 Copper	Step 1 Zinc	Step 1 Cadmium	Step 1 Total PAH	Step 1 Pyrene	Step 1 Fluoranthene	Step 1 Anthracene	Step 1 Phenanthrene
	RST24		Toxicity Threshold							
Allowable Exceedances/year	1	1	1	1	1	1	1	1	1	1
No. of exceedances/year	**38.00**	**50.80**	**64.60**	**99.40**	**1.50**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	53	61	72	120	3	51	104	51	28	88
	RST6									
Allowable Exceedances/year	1	1								
No. of exceedances/year	**6.80**	**18.60**								
No. of exceedances/worst year	19	25								
	(ug/l)	(ug/l)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Thresholds RST24	21	385	Toxicity 197	315	3.5	16770	875	2355	245	515
Thresholds RST6	42	770								
Event Statistics Mean	18.21	69.98	271	1219	1	15858	2743	2632	168	742
90%ile	34.86	143.33	602	2862	2	35481	6138	5890	376	1661
95%ile	42.45	195.35	784	4051	3	54904	9498	9114	582	2569
99%ile	78.81	371.34	1304	6078	4	89125	15419	14795	945	4171

In River (no mitigation)

	Step 2 Copper	Step 2 Zinc
	RST24	
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.4**	**0**
No. of exceedances/worst year	2	0
No. of exceedances/summer	0.3	0
No. of exceedances/worst summer	1	0
	RST6	
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.49	2.03
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	1.81	6.95
90%ile	5.19	17.73
95%ile	7.72	29.38
99%ile	15.36	70.64

Step 2

Velocity 0.14 m/s — Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

	Step 3 Copper	Step 3 Zinc
	RST24	
Allowable Exceedances/year	1	1
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
	RST6	
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	-	-
90%ile	-	-
95%ile	-	-
99%ile	-	-

Step 3

DI -

Details of the chosen rainfall site	
SAAR (mm)	680
Altitude (m)	75
Easting	4248
Northing	5648
Coastal distance (km)	18

Catchment 4: Post-mitigation (Zn)

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Summary of predictions

Soluble - Acute Impact

Sediment - Chronic Impact

Prediction of impact		Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Step1										
	Step2										
	Step3										

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
		RST24		Toxicity Threshold							
Allowable Exceedances/year		1	1	1	1	1	1	1	1	1	1
No. of exceedances/year		**38.00**	**50.80**	**64.60**	**99.40**	**1.50**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year		53	61	72	120	3	51	104	51	28	88
		RST6									
Allowable Exceedances/year		1	1								
No. of exceedances/year		**6.80**	**18.60**								
No. of exceedances/worst year		19	25								
		(ug/l)	*(ug/l)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Thresholds	***RST24***	21	385	***Toxicity*** 197	315	3.5	16770	875	2355	245	515
Thresholds	***RST6***	42	770								
Event Statistics	Mean	18.21	69.98	271	1219	1	15858	2743	2632	168	742
	90%ile	34.86	143.33	602	2862	2	35481	6138	5890	376	1661
	95%ile	42.45	195.35	784	4051	3	54904	9498	9114	582	2569
	99%ile	78.81	371.34	1304	6078	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.4**	**0**
No. of exceedances/worst year		2	0
No. of exceedances/summer		0.3	0
No. of exceedances/worst summer		1	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.1**	**0**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		0.49	2.03
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics	Mean	1.81	6.95
	90%ile	5.19	17.73
	95%ile	7.72	29.38
	99%ile	15.36	70.64

Step 2

Velocity 0.14 m/s — **Tier 2** is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.20**	**0.00**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0.1	0
No. of exceedances/worst summer		1	0
		RST6	
Allowable Exceedances/year		0.5	0.5
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)		0.34	1.42
		(ug/l)	*(ug/l)*
Thresholds hresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics	Mean	1.26	4.85
	90%ile	3.64	12.38
	95%ile	5.39	20.56
	99%ile	10.66	49.45

DI -

Details of the chosen rainfall site

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

Catchment 4: Post-mitigation (Cu)

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Summary of predictions

Soluble - Acute Impact

Prediction of impact		Copper	Zinc
	Step1		
	Step2		
	Step3		

Sediment - Chronic Impact

Prediction of impact		Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Step1								
	Step2								
	Step3								

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**38.00**	**50.80**
No. of exceedances/worst year		53	61
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**6.80**	**18.60**
No. of exceedances/worst year		19	25
		(ug/l)	*(ug/l)*
Thresholds	*RST24*	21	385
Thresholds	*RST6*	42	770
Event Statistics Mean		18.21	69.98
90%ile		34.86	143.33
95%ile		42.45	195.35
99%ile		78.81	371.34

Step 1

		Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
						Toxicity Threshold			
Allowable Exceedances/year		1	1	1	1	1	1	1	1
No. of exceedances/year		**64.60**	**99.40**	**1.50**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year		72	120	3	51	104	51	28	88
		(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Thresholds	*Toxicity*	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean		271	1219	1	15858	2743	2632	168	742
90%ile		602	2862	2	35481	6138	5890	376	1661
95%ile		784	4051	3	54904	9498	9114	582	2569
99%ile		1304	6078	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.4**	**0**
No. of exceedances/worst year		2	0
No. of exceedances/summer		0.3	0
No. of exceedances/worst summer		1	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.1**	**0**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		0.49	2.03
		(ug/l)	*(ug/l)*
Thresholds	*RST24*	21	385
Thresholds	*RST6*	42	770
Event Statistics Mean		1.81	6.95
90%ile		5.19	17.73
95%ile		7.72	29.38
99%ile		15.36	70.64

Step 2

Velocity 0.14 m/s — **Tier 2** is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.10**	**0.00**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
		RST6	
Allowable Exceedances/year		0.5	0.5
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)		0.30	1.22
		(ug/l)	*(ug/l)*
Thresholds hresholds	*RST24*	21	385
Thresholds	*RST6*	42	770
Event Statistics Mean		1.08	4.16
90%ile		3.12	10.61
95%ile		4.62	17.63
99%ile		9.13	42.38

DI -

Details of the chosen rainfall site	
SAAR (mm)	**680**
Altitude (m)	**75**
Easting	**4248**
Northing	**5648**
Coastal distance (km)	**18**

Catchment 6: Pre-mitigation

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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										

DETAILED RESULTS

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**26.40**	**39.70**
No. of exceedances/worst year	42	49
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**3.60**	**11.90**
No. of exceedances/worst year	10	15
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	14.99	55.66
90%ile	28.69	114.01
95%ile	34.93	155.39
99%ile	64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
				Toxicity Threshold				
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	59	97	3	51	104	51	28	88
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	222	842	1	15858	2743	2632	168	742
90%ile	503	2063	1	35481	6138	5890	376	1661
95%ile	663	3004	2	54904	9498	9114	582	2569
99%ile	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**4.5**	**0**
No. of exceedances/worst year	11	0
No. of exceedances/summer	3.9	0
No. of exceedances/worst summer	9	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.5**	**0**
No. of exceedances/worst year	2	0
No. of exceedances/summer	0.3	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	1.46	5.72
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	4.92	18.73
90%ile	12.66	50.40
95%ile	17.72	72.62
99%ile	32.32	151.75

Step 2

Velocity 0.00 m/s — Tier 1 is used for the calculation

DI 87.74

% settlement needed 0 %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	-	-
90%ile	-	-
95%ile	-	-
99%ile	-	-

DI -

Details of the chosen rainfall site

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

Catchment 6: Post-mitigation (Zn)

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Summary of predictions

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

DETAILED RESULTS

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**26.40**	**39.70**
No. of exceedances/worst year	42	49
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**3.60**	**11.90**
No. of exceedances/worst year	10	15
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	14.99	55.66
90%ile	28.69	114.01
95%ile	34.93	155.39
99%ile	64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Toxicity Threshold							
	1	1	1	1	1	1	1	1
	51.50	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
	59	97	3	51	104	51	28	88
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
	222	842	1	15858	2743	2632	168	742
	503	2063	1	35481	6138	5890	376	1661
	663	3004	2	54904	9498	9114	582	2569
	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**4.5**	**0**
No. of exceedances/worst year	11	0
No. of exceedances/summer	2.5	0
No. of exceedances/worst summer	7	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.5**	**0**
No. of exceedances/worst year	2	0
No. of exceedances/summer	0.2	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	1.46	5.72
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	4.92	18.73
90%ile	12.66	50.40
95%ile	17.72	72.62
99%ile	32.32	151.75

Step 2

Velocity 0.00 m/s — **Tier 1** is used for the calculation

DI 87.74

% settlement needed 0 %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**1.50**	**0.00**
No. of exceedances/worst year	4	0
No. of exceedances/summer	0.7	0
No. of exceedances/worst summer	3	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.10**	**0.00**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	1.02	4.00
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	3.44	13.11
90%ile	8.86	35.28
95%ile	12.40	50.84
99%ile	22.62	106.22

DI 35.10

Details of the chosen rainfall site

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

Catchment 6: Post-mitigation (Cu)

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Summary of predictions

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

DETAILED RESULTS

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**26.40**	**39.70**
No. of exceedances/worst year	42	49
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**3.60**	**11.90**
No. of exceedances/worst year	10	15
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	14.99	55.66
90%ile	28.69	114.01
95%ile	34.93	155.39
99%ile	64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
				Toxicity Threshold				
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	59	97	3	51	104	51	28	88
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	222	842	1	15858	2743	2632	168	742
90%ile	503	2063	1	35481	6138	5890	376	1661
95%ile	663	3004	2	54904	9498	9114	582	2569
99%ile	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**4.5**	**0**
No. of exceedances/worst year	11	0
No. of exceedances/summer	3.9	0
No. of exceedances/worst summer	9	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.5**	**0**
No. of exceedances/worst year	2	0
No. of exceedances/summer	0.3	0
No. of exceedances/worst summer	1	0
Annual average concentration (ug/l)	1.46	5.72
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	4.92	18.73
90%ile	12.66	50.40
95%ile	17.72	72.62
99%ile	32.32	151.75

Step 2

Velocity 0.00 m/s — **Tier 1** is used for the calculation

DI 87.74

% settlement needed 0 %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.90**	**0.00**
No. of exceedances/worst year	2	0
No. of exceedances/summer	0.7	0
No. of exceedances/worst summer	2	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.10**	**0.00**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.87	3.43
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	2.95	11.24
90%ile	7.60	30.24
95%ile	10.63	43.57
99%ile	19.39	91.05

DI 35.10

Details of the chosen rainfall site

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

Catchment 7: Pre-mitigation

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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										

DETAILED RESULTS

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**26.40**	**39.70**
No. of exceedances/worst year	42	49
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**3.60**	**11.90**
No. of exceedances/worst year	10	15
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	14.99	55.66
90%ile	28.69	114.01
95%ile	34.93	155.39
99%ile	64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
				Toxicity Threshold				
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	59	97	3	51	104	51	28	88
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	222	842	1	15858	2743	2632	168	742
90%ile	503	2063	1	35481	6138	5890	376	1661
95%ile	663	3004	2	54904	9498	9114	582	2569
99%ile	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**1.7**	**0**
No. of exceedances/worst year	4	0
No. of exceedances/summer	1.5	0
No. of exceedances/worst summer	3	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.97	3.81
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	3.32	12.50
90%ile	8.83	34.25
95%ile	12.60	49.54
99%ile	22.28	96.54

Step 2

Velocity 0.00 m/s — Tier 1 is used for the calculation

DI 57.65

% settlement needed 0 %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	-	-
90%ile	-	-
95%ile	-	-
99%ile	-	-

DI -

Details of the chosen rainfall site

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

Catchment 7: Post-mitigation (Zn)

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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										

DETAILED RESULTS

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**26.40**	**39.70**
No. of exceedances/worst year	42	49
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**3.60**	**11.90**
No. of exceedances/worst year	10	15
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	14.99	55.66
90%ile	28.69	114.01
95%ile	34.93	155.39
99%ile	64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
				Toxicity Threshold				
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	59	97	3	51	104	51	28	88
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	222	842	1	15858	2743	2632	168	742
90%ile	503	2063	1	35481	6138	5890	376	1661
95%ile	663	3004	2	54904	9498	9114	582	2569
99%ile	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**1.7**	**0**
No. of exceedances/worst year	4	0
No. of exceedances/summer	1.5	0
No. of exceedances/worst summer	3	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.97	3.81
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	3.32	12.50
90%ile	8.83	34.25
95%ile	12.60	49.54
99%ile	22.28	96.54

Step 2

Velocity 0.00 m/s — **Tier 1** is used for the calculation

DI 57.65

% settlement needed 0 %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	**1.00**	**0.00**
No. of exceedances/worst year	3	0
No. of exceedances/summer	0.8	0
No. of exceedances/worst summer	2	0
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.10**	**0.00**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.82	3.24
	(ug/l)	(ug/l)
Thresholds *RST24*	21	385
Thresholds *RST6*	42	770
Event Statistics Mean	2.82	10.62
90%ile	7.50	29.08
95%ile	10.70	42.06
99%ile	18.92	81.96

DI 42.26

Details of the chosen rainfall site	
SAAR (mm)	**680**
Altitude (m)	**75**
Easting	**4248**
Northing	**5648**
Coastal distance (km)	**18**

Catchment 7: Post-mitigation (Cu)

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Summary of predictions

Soluble - Acute Impact

Prediction of impact		Copper	Zinc
	Step1		
	Step2		
	Step3		

Sediment - Chronic Impact

Prediction of impact		Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Step1								
	Step2								
	Step3								

DETAILED RESULTS

In Runoff

Step 1 (Soluble - Acute Impact)

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**26.40**	**39.70**
No. of exceedances/worst year		42	49
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**3.60**	**11.90**
No. of exceedances/worst year		10	15
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		14.99	55.66
90%ile		28.69	114.01
95%ile		34.93	155.39
99%ile		64.85	295.37

Step 1 (Sediment - Chronic Impact)

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
					Toxicity Threshold			
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	59	97	3	51	104	51	28	88
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	222	842	1	15858	2743	2632	168	742
90%ile	503	2063	1	35481	6138	5890	376	1661
95%ile	663	3004	2	54904	9498	9114	582	2569
99%ile	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2 (Soluble - Acute Impact)

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**1.7**	**0**
No. of exceedances/worst year		4	0
No. of exceedances/summer		1.5	0
No. of exceedances/worst summer		3	0
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.1**	**0**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		0.97	3.81
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		3.32	12.50
90%ile		8.83	34.25
95%ile		12.60	49.54
99%ile		22.28	96.54

Step 2 (Sediment - Chronic Impact)

Velocity 0.00 m/s — **Tier 1** is used for the calculation

DI 57.65

% settlement needed 0 %

In River (with mitigation)

Step 3 (Soluble - Acute Impact)

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**1.00**	**0.00**
No. of exceedances/worst year		3	0
No. of exceedances/summer		0.8	0
No. of exceedances/worst summer		2	0
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.10**	**0.00**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		0.80	3.13
		(ug/l)	*(ug/l)*
Thresholds nresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		2.73	10.27
90%ile		7.25	28.12
95%ile		10.34	40.67
99%ile		18.30	79.26

Step 3 (Sediment - Chronic Impact)

DI 42.26

Details of the chosen rainfall site

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

Catchment 8a: Pre-mitigation

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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										

DETAILED RESULTS

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**26.40**	**39.70**
No. of exceedances/worst year	42	49
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**3.60**	**11.90**
No. of exceedances/worst year	10	15
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	14.99	55.66
90%ile	28.69	114.01
95%ile	34.93	155.39
99%ile	64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
					Toxicity Threshold			
	1	1	1	1	1	1	1	1
	51.50	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
	59	97	3	51	104	51	28	88
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
	222	842	1	15858	2743	2632	168	742
	503	2063	1	35481	6138	5890	376	1661
	663	3004	2	54904	9498	9114	582	2569
	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**2**	**0**
No. of exceedances/worst year	4	0
No. of exceedances/summer	1.8	0
No. of exceedances/worst summer	3	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	1.00	3.95
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	3.44	12.95
90%ile	9.16	35.09
95%ile	13.07	51.45
99%ile	23.17	98.88

Step 2

Velocity 0.19 m/s — Tier 2 is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**-**	**-**
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-
	(ug/l)	(ug/l)
Thresholds nresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	-	-
90%ile	-	-
95%ile	-	-
99%ile	-	-

DI -

Details of the chosen rainfall site	
SAAR (mm)	680
Altitude (m)	75
Easting	4248
Northing	5648
Coastal distance (km)	18

Catchment 8a: Post-mitigation (Zn)

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Summary of predictions

Soluble - Acute Impact

Sediment - Chronic Impact

Prediction of impact		Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Step1										
	Step2										
	Step3										

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**26.40**	**39.70**
No. of exceedances/worst year		42	49
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**3.60**	**11.90**
No. of exceedances/worst year		10	15
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		14.99	55.66
90%ile		28.69	114.01
95%ile		34.93	155.39
99%ile		64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
					Toxicity Threshold			
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	59	97	3	51	104	51	28	88
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
	222	842	1	15858	2743	2632	168	742
	503	2063	1	35481	6138	5890	376	1661
	663	3004	2	54904	9498	9114	582	2569
	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**2**	**0**
No. of exceedances/worst year		4	0
No. of exceedances/summer		1.8	0
No. of exceedances/worst summer		3	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.1**	**0**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		1.00	3.95
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		3.44	12.95
90%ile		9.16	35.09
95%ile		13.07	51.45
99%ile		23.17	98.88

Step 2

Velocity 0.19 m/s — **Tier 2** is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.70**	**0.00**
No. of exceedances/worst year		2	0
No. of exceedances/summer		0.6	0
No. of exceedances/worst summer		1	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.10**	**0.00**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		0.70	2.76
		(ug/l)	*(ug/l)*
Thresholds nresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		2.41	9.07
90%ile		6.41	24.56
95%ile		9.15	36.02
99%ile		16.22	69.22

DI -

Details of the chosen rainfall site

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

Catchment 8a: Post-mitigation (Cu)

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Summary of predictions

Soluble - Acute Impact

Prediction of impact	Copper	Zinc
Step1		
Step2		
Step3		

Sediment - Chronic Impact

Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene

DETAILED RESULTS

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**26.40**	**39.70**
No. of exceedances/worst year	42	49
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**3.60**	**11.90**
No. of exceedances/worst year	10	15
	(ug/l)	*(ug/l)*
Thresholds ***RST24***	21	385
Thresholds ***RST6***	42	770
Event Statistics Mean	14.99	55.66
90%ile	28.69	114.01
95%ile	34.93	155.39
99%ile	64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year	59	97	3	51	104	51	28	88
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Thresholds ***Toxicity***	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	222	842	1	15858	2743	2632	168	742
90%ile	503	2063	1	35481	6138	5890	376	1661
95%ile	663	3004	2	54904	9498	9114	582	2569
99%ile	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**2**	**0**
No. of exceedances/worst year	4	0
No. of exceedances/summer	1.8	0
No. of exceedances/worst summer	3	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.1**	**0**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	1.00	3.95
	(ug/l)	*(ug/l)*
Thresholds ***RST24***	21	385
Thresholds ***RST6***	42	770
Event Statistics Mean	3.44	12.95
90%ile	9.16	35.09
95%ile	13.07	51.45
99%ile	23.17	98.88

Step 2

Velocity 0.19 m/s — **Tier 2** is used for the calculation

DI -

% settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.20**	**0.00**
No. of exceedances/worst year	1	0
No. of exceedances/summer	0.1	0
No. of exceedances/worst summer	1	0
RST6		
Allowable Exceedances/year	0.5	0.5
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)	0.60	2.37
	(ug/l)	*(ug/l)*
Thresholds ***RST24***	21	385
Thresholds ***RST6***	42	770
Event Statistics Mean	2.07	7.77
90%ile	5.50	21.06
95%ile	7.84	30.87
99%ile	13.90	59.33

DI -

Details of the chosen rainfall site	
SAAR (mm)	**680**
Altitude (m)	**75**
Easting	**4248**
Northing	**5648**
Coastal distance (km)	**18**

Catchment 8b: Pre-mitigation

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Summary of predictions

Soluble - Acute Impact

Sediment - Chronic Impact

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

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**26.40**	**39.70**
No. of exceedances/worst year		42	49
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**3.60**	**11.90**
No. of exceedances/worst year		10	15
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		14.99	55.66
90%ile		28.69	114.01
95%ile		34.93	155.39
99%ile		64.85	295.37

Step 1

		Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
						Toxicity Threshold			
Allowable Exceedances/year		1	1	1	1	1	1	1	1
No. of exceedances/year		**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year		59	97	3	51	104	51	28	88
		(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Thresholds	***Toxicity***	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean		222	842	1	15858	2743	2632	168	742
90%ile		503	2063	1	35481	6138	5890	376	1661
95%ile		663	3004	2	54904	9498	9114	582	2569
99%ile		1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**2**	**0**
No. of exceedances/worst year		4	0
No. of exceedances/summer		1.8	0
No. of exceedances/worst summer		3	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.1**	**0**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		1.00	3.95
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		3.44	12.95
90%ile		9.16	35.09
95%ile		13.07	51.45
99%ile		23.17	98.88

Step 2

Velocity 0.00 m/s — **Tier 1** is used for the calculation

DI 62.45

% settlement needed 0 %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**-**	**-**
No. of exceedances/worst year		-	-
No. of exceedances/summer		-	-
No. of exceedances/worst summer		-	-
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**-**	**-**
No. of exceedances/worst year		-	-
No. of exceedances/summer		-	-
No. of exceedances/worst summer		-	-
Annual average concentration (ug/l)		-	-
		(ug/l)	*(ug/l)*
Thresholds nresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		-	-
90%ile		-	-
95%ile		-	-
99%ile		-	-

DI -

Details of the chosen rainfall site

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

Catchment 8b: Post-mitigation (Zn)

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Summary of predictions

Soluble - Acute Impact

Prediction of impact		Copper	Zinc
	Step1		
	Step2		
	Step3		

Sediment - Chronic Impact

Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**26.40**	**39.70**
No. of exceedances/worst year		42	49
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**3.60**	**11.90**
No. of exceedances/worst year		10	15
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		14.99	55.66
90%ile		28.69	114.01
95%ile		34.93	155.39
99%ile		64.85	295.37

Step 1

		Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
						Toxicity Threshold			
Allowable Exceedances/year		1	1	1	1	1	1	1	1
No. of exceedances/year		**51.50**	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
No. of exceedances/worst year		59	97	3	51	104	51	28	88
		(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Thresholds	***Toxicity***	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean		222	842	1	15858	2743	2632	168	742
90%ile		503	2063	1	35481	6138	5890	376	1661
95%ile		663	3004	2	54904	9498	9114	582	2569
99%ile		1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**2**	**0**
No. of exceedances/worst year		4	0
No. of exceedances/summer		1.8	0
No. of exceedances/worst summer		3	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.1**	**0**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		1.00	3.95
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		3.44	12.95
90%ile		9.16	35.09
95%ile		13.07	51.45
99%ile		23.17	98.88

Step 2

Velocity 0.00 m/s — **Tier 1** is used for the calculation

DI 62.45

% settlement needed 0 %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.70**	**0.00**
No. of exceedances/worst year		2	0
No. of exceedances/summer		0.6	0
No. of exceedances/worst summer		1	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.10**	**0.00**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		0.70	2.76
		(ug/l)	*(ug/l)*
Thresholds nresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		2.41	9.07
90%ile		6.41	24.56
95%ile		9.15	36.02
99%ile		16.22	69.22

DI 24.98

Details of the chosen rainfall site

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

Catchment 8b: Post-mitigation (Cu)

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Summary of predictions

Soluble - Acute Impact

Sediment - Chronic Impact

Prediction of impact		Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Step1										
	Step2										
	Step3										

DETAILED RESULTS

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**26.40**	**39.70**
No. of exceedances/worst year		42	49
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**3.60**	**11.90**
No. of exceedances/worst year		10	15
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		14.99	55.66
90%ile		28.69	114.01
95%ile		34.93	155.39
99%ile		64.85	295.37

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
					Toxicity Threshold			
	1	1	1	1	1	1	1	1
	51.50	**81.70**	**1.40**	**41.50**	**96.30**	**41.50**	**19.20**	**78.90**
	59	97	3	51	104	51	28	88
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
	222	842	1	15858	2743	2632	168	742
	503	2063	1	35481	6138	5890	376	1661
	663	3004	2	54904	9498	9114	582	2569
	1125	4644	4	89125	15419	14795	945	4171

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**2**	**0**
No. of exceedances/worst year		4	0
No. of exceedances/summer		1.8	0
No. of exceedances/worst summer		3	0
		RST6	
Allowable Exceedances/year		0.5	0.5
No. of exceedances/year		**0.1**	**0**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		1.00	3.95
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		3.44	12.95
90%ile		9.16	35.09
95%ile		13.07	51.45
99%ile		23.17	98.88

Step 2

Velocity 0.00 m/s — **Tier 1** is used for the calculation

DI 62.45

% settlement needed 0 %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0.20**	**0.00**
No. of exceedances/worst year		1	0
No. of exceedances/summer		0.1	0
No. of exceedances/worst summer		1	0
		RST6	
Allowable Exceedances/year		0.5	0.5
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)		0.60	2.37
		(ug/l)	*(ug/l)*
Thresholds hresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		2.07	7.77
90%ile		5.50	21.06
95%ile		7.84	30.87
99%ile		13.90	59.33

DI 24.98

Details of the chosen rainfall site	
SAAR (mm)	**680**
Altitude (m)	**75**
Easting	**4248**
Northing	**5648**
Coastal distance (km)	**18**

Spillage Risk Results

Drainage Catchment 4

2036 Do Something Catchment 4		Total Annual Accident Probability (Pacc)					Annual Pollution Incident Probability (Pinc)			
	Link Number	Road Length (km)	Serious Spillage Risk Factor	Two-way AADT	%HGV	Annual Probability (Pacc)	Probability Factor (Ppol)	Probability	Return Period (years)	Percentage Probability (%)
A19 Central road no junction	6053/12031	0.55	0.31	33364	2.7	0.00006	0.45	2.52274E-05	39639.5177	0.003
A19 Central road no junction	6123/12029	0.42	0.31	25397	2.1	0.00003	0.45	1.14056E-05	87676.24142	0.001
A19 Slip Road (NE)	95101/99703	0.68	0.36	5455	5.3	0.00003	0.45	1.16249E-05	86022.60376	0.001
A19 Slip Road (NW)	99702/95100	0.74	0.36	6243	5.7	0.00003	0.45	1.55707E-05	64223.23987	0.002
A19 Slip Road (SW)	6123/99707	0.19	0.36	2640	3.2	0.00000	0.45	9.49107E-07	1053621.477	0.000
A19 Slip Road (SE)	99706/12031	0.22	0.36	4120	1.9	0.00000	0.45	1.01831E-06	982016.1343	0.000
Roundabout (W)	99708/99709	0.04	5.35	3384	4.7	0.00001	0.45	5.59046E-06	178876.2312	0.001
Roundabout (W)	99707/99708	0.017	5.35	11150	4.0	0.00001	0.45	6.66259E-06	150091.8324	0.001
Roundabout (W)	99709/99702	0.022	5.35	10266	4.4	0.00002	0.45	8.73244E-06	114515.4865	0.001
Roundabout (N)	99702/99703	0.14	5.35	4023	2.5	0.00003	0.45	1.23731E-05	80820.72888	0.001
	Total for Catchment 4					0.00022	0.45	9.91545E-05	10085.27497	0.010

Drainage Catchment 5

2036 Do Something Catchment 5		Total Annual Accident Probability (Pacc)					Annual Pollution Incident Probability (Pinc)			
	Link Number	Road Length (km)	Serious Spillage Risk Factor	Two-way AADT	%HGV	Annual Probability (Pacc)	Probability Factor (Ppol)	Probability	Return Period (years)	Percentage Probability (%)
DHL (W)	12200/12201	0.63	1.81	3824	2.5	0.00004	0.6	2.38738E-05	41886.96256	0.002
	Total for Catchment 5					0.00004	0.45	1.79053E-05	55849.28341	0.002

Drainage Catchment 6

2036 Do Something Catchment 6		Total Annual Accident Probability (Pacc)					Annual Pollution Incident Probability (Pinc)			
	Link Number	Road Length (km)	Serious Spillage Risk Factor	Two-way AADT	%HGV	Annual Probability (Pacc)	Probability Factor (Ppol)	Probability	Return Period (years)	Percentage Probability (%)
A19 slip road (SE)	95581/99717	0.19	0.36	9868	3.3	0.00001	0.45	3.65851E-06	273335.1218	0.000
Roundabout (S)	99706/99707	0.14	5.35	8510	4.2	0.00010	0.45	4.3971E-05	22742.27745	0.004
Roundabout (SE)	99705/99706	0.034	5.35	12630	3.4	0.00003	0.45	1.28298E-05	77943.4554	0.001
Roundabout (E)	99704/99705	0.017	5.35	6967	3.6	0.00001	0.45	3.74676E-06	266896.9477	0.000
Roundabout (NE)	99703/99704	0.029	5.35	8472	4.4	0.00002	0.45	9.49939E-06	105269.9019	0.001
Downhill Lane (E)	40000/6587	1.2	0.31	3997	1.2	0.00001	0.6	3.90753E-06	255916.066	0.000
	Total for Catchment 6					0.00011	0.45	4.76295E-05	20995.39915	0.005

Drainage Catchment 7

2036 Do Something Catchment 7		Total Annual Accident Probability (Pacc)					Annual Pollution Incident Probability (Pinc)			
	Link Number	Road Length (km)	Serious Spillage Risk Factor	Two-way AADT	%HGV	Annual Probability (Pacc)	Probability Factor (Ppol)	Probability	Return Period (years)	Percentage Probability (%)
A1290 sliproad (W)	99701/12200	0.15	0.36	7766	3.6	0.00001	0.45	2.4797E-06	403274.6983	0.000
A1290 sliproad (E)	99708/99701	0.007	0.36	7766	3.6	0.00000	0.45	1.15719E-07	8641600.678	0.000
	Total for Catchment 7					0.00002	0.45	8.21315E-06	121755.8969	0.001

Drainage Catchment 8

2036 Do Something Catchment 8		Total Annual Accident Probability (Pacc)					Annual Pollution Incident Probability (Pinc)			
	Link Number	Road Length (km)	Serious Spillage Risk Factor	Two-way AADT	%HGV	Annual Probability (Pacc)	Probability Factor (Ppol)	Probability	Return Period (years)	Percentage Probability (%)
A19 central no junction	12066/6123	1.9	0.31	27986	2.2	0.00013	0.45	5.9564E-05	16788.65159	0.006
A19 central no junction	12031/12032	2	0.31	37484	2.7	0.00023	0.45	0.000103064	9702.714195	0.010
	Total for Catchment 8					0.00036	0.45	0.000162628	6149.003015	0.016

Caveats to HAWRAT:

Catchment 8:

HAWRAT was designed to assess watercourses not piped networks. Therefore, assessing the connection point 8a was testing the limits of the tool.

The side slope had to be rounded from the calculated 0.04 to 0.1 and HAWRAT will not accept a value smaller than 0.1

The long slope for the 900mm diameter pipe had to be estimated, as the original pipe network drawings are from 1969 and do not contain sufficient detail.

Assessment point 8b is approximately 230m downstream from where the watercourse surfaces, however, due to accessibility and safety issues river measurements could not be taken at this point.

APPENDIX 14.2 FLOOD RISK ASSESSMENT

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A19 Downhill Lane Junction Improvement

Scheme Number: TR010024

6.3 Environmental Statement Vol. 3: Appendices
Appendix 14.2: Flood Risk Assessment

Volume 6

January 2019

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EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) report has been prepared to support the Development Consent Order application for the proposed development of the A19 Downhill Lane Junction Improvement Scheme (the Scheme).

The proposed improvements at Downhill Lane junction involve:

- replacing a signalised priority, grade-separated junction with a single bridge crossing, with a two-bridge, grade-separated roundabout junction;
- constructing a new overbridge to the south of the existing A19 overbridge to create a circulatory carriageway;
- constructing a new NMU bridge south of Downhill Lane junction; and
- realigning Washington Road and Downhill Lane to the east of the junction.

The development is located in an Environment Agency defined Flood Zone 1. However, the northern section of the development is located beside Flood Zones 2 and 3. The Sequential Test was considered to be passed because this development would involve improvements to an existing highway; hence there are no alternative sites in an area of lower flood risk available for this development. No application of the Exception Test was required.

This FRA has demonstrated that flood risk to this development would be low. In addition, this FRA has demonstrated that flood risk elsewhere in this catchment would not be increased as a result of this development and that there may be a negligible to minor betterment.

1 INTRODUCTION

1.1 Objectives

1.1.1 Jacobs UK Ltd was commissioned by Costain, under their contract with Highways England, to complete a Flood Risk Assessment (FRA) for the improvement of the A19 Downhill Lane junction (the Scheme) to the south-west of West Boldon, near Sunderland.

1.1.2 The aim of this FRA was to ascertain if the Scheme would be safe from flooding and whether it would increase flood risk elsewhere. The assessment takes into account the requirements of the following:

- National Planning Policy Framework (NPPF) (2018);
- Planning Practice Guidance (2014);
- South Tyneside Local Development Framework (2011); and
- Sunderland Core Strategy and Development Plan (2017).

1.1.3 The objectives of this FRA were to:

- provide an overview of the above national and local flood risk policy and set out how it applies to the development site;
- assess the sources of flood risk at the development site; and
- set out the measures incorporated within the design of the development to mitigate any residual risk from all sources of flooding associated with the development.

1.1.4 This FRA was intended to support an Environmental Impact Assessment also being undertaken by Jacobs UK Ltd for Costain, under their contract with Highways England.

1.2 Sources of Information

1.2.1 The following sources of information have been reviewed and assessed for the purpose of this FRA:

- National Planning Policy Framework (2018);
- Planning Practice Guidance (2014);
- Environment Agency Flood Zone Mapping (January 2015);
- South Tyneside Strategic Flood Risk Assessment (February 2011);
- South Tyneside Preliminary Flood Risk Assessment (June 2011);
- South Tyneside Local Development Framework (2011);
- Sunderland Core Strategy and Development Plan (2017);
- Sunderland City Council Level 1 Strategic Flood Risk Assessment (2017);
- Tyne Catchment Flood Management Plan (2009);

- British Geological Survey Website;
- Design Manual for Roads and Bridge: Vol 4, Section 2, Part 3 (HD33/16) (2016); and
- Design Manual for Roads and Bridge: Vol 11, Section 3, Part 10 (HD45/09) (2009).

2 SITE DESCRIPTION AND PROPOSAL

2.1 Site Location

2.1.1 The Scheme would be located in South Tyneside in the north-east of England at National Grid Reference NZ341598. The development would be approximately 5 km south of the Tyne Tunnel entrance at Jarrow and approximately 1.2 km south of the A19/A184 Testo's junction. Downhill Lane lies in a narrow belt of countryside that separates the urban areas of South Tyneside and Sunderland. The A19 / A1231 junction is located approximately 2.6 km south of Downhill Lane.

2.1.2 The River Don is culverted under the A19 approximately immediately north of Downhill Lane junction. An unnamed tributary of the River Don, in the north-east section of the Scheme's DCO boundary, flows in a northerly direction from Downhill Lane into the River Don. Assessment of the topography shows that the land falls from south to north towards the road. For further details, see Figure 14.1 of the Environmental Statement for the Scheme **(Application Document Reference: TR010024/APP/6.2)**, which is also presented in Appendix A of this FRA.

2.1.3 Drains to the west and south-west of the Scheme, shown in Figure 14.1 of the Environmental Statement, ultimately discharge to the River Wear at NGR NZ367582 via Hylton Dene Burn. The River Wear is located approximately 3 km south of the junction, where it flows in an easterly direction towards the coast at Sunderland. The River Wear is tidal at this point.

2.1 Scheme Description

2.1.1 The Scheme would be an upgrading of a signalised priority, grade-separated junction with a single bridge crossing to a two-bridge, grade-separated signalised roundabout junction.

2.1.2 The proposed improvement works would involve (further details are included in Chapter 2 of the ES):

- The construction of a new bridge spanning the A19 south of the existing junction bridge. The new bridge and the existing bridge will be used to form a grade separated roundabout junction layout above the A19.
- The realignment of the existing northbound and southbound A19 slip roads to tie in with the new roundabout layout. The slip roads north of the junction will serve as link roads between Downhill Lane Junction and the proposed Testo's junction. The slip roads south of the junction will continue to provide direct access to and from the A19.
- The realignment of the A1290, Downhill Lane (West), Downhill Lane (East) and Washington Road (East) local roads to suit the new junction layout.
- The construction of a segregated non-motorised user facility featuring a dedicated overbridge for walkers, cyclists, horse riders and wheelchair users to the south of the junction.

2.1.3 The Scheme is included within the Department of Transport's Road Investment Strategy (December 2014) and Highways England's Delivery Plan 2015-2020.

2.1.4 A FRA was required as the Scheme exceeds one hectare in Flood Zone 1.

3 PLANNING POLICY REVIEW

3.1 National Planning Policy

3.1.1 The aim of this section of the report is to discuss the main aspects of the local and national planning policies that are relevant to any proposed development on the site.

3.1.2 The National Policy Statement for National Networks (NNNPS) sets out the need for, and Government's policies to deliver, development of Nationally Significant Infrastructure Projects (NSIPs). Paragraph 5.92 outlines that applications in the following locations should be accompanied by a FRA:

- Flood Zones 2 and 3, medium and high probability of river and sea flooding;
- Flood Zone 1 (low probability of river and sea flooding) for projects of 1 hectare or greater, projects which may be subject to other sources of flooding (local watercourses, surface water, groundwater or reservoirs), or where the Environment Agency has notified the local planning authority that there are critical drainage problems.

3.1.3 The Scheme would be in excess of 1 hectare, therefore a FRA is required under the NNNPS. Paragraphs 5.92- 5.97 outlined what is required by the assessment and links to the National Planning Policy Framework (NPPF) as outlined below.

3.1.4 Flood risk in England is considered by the planning process through the NPPF[1], produced by the Department for Communities and Local Government (now the Ministry of Housing, Communities and Local Government).

3.1.5 The principle aim of the NPPF assessment of flood risk is that:

> *"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk but where development is necessary making it safe without increasing flood risk elsewhere."*

3.2 Assessment of Flood Risks

3.2.1 The main sources of flood risk used to steer development at the planning stage are Main Rivers and the Sea. The flood risk from these sources is assessed using the Environment Agency National Fluvial and Coastal Flood Map, also called the Flood Map for Planning. This map has 3 main zones of different flood risk, the third of which is subdivided in to two categories:

- **Zone 1 'Low probability of flooding'** – This zone comprises land assessed as having a less than 1 in 1,000 annual probabilities of river or sea flooding (<0.1%).
    - Suitable development – all uses of land
- **Zone 2 'Medium probability of flooding'** – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.

[1] Communities and Local Government (2018) National Planning Policy Framework

- Suitable development – less and more vulnerable uses of land and essential infrastructure. Highly vulnerable uses are only appropriate upon passing the Exception test.

- **Zone 3a 'High probability of flooding'** – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
    - Suitable development – more vulnerable and essential infrastructure only appropriate upon passing the Exception test. Highly vulnerable uses are not permitted.
- **Zone 3b 'Functional Floodplain'** – A sub-part of Zone 3, this zone comprises land where water has to flow or be stored in times of flood. This zone is not normally included within the national Flood Map for Planning and is calculated where necessary using detailed hydraulic modelling. This flood zone is identified as being likely to flood with annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in extreme scenarios.
    - Suitable development – water compatible and essential infrastructure if exception test is passed and infrastructure is designed and constructed to meet flood risk targets. Less, more or highly vulnerable uses are not permitted.

3.2.2 As part of the FRA, the NPPF requires that developers consider not just the flood risk to the development but also the impact that the proposed development might have on flood risk elsewhere. As well as Main Rivers and the Sea, it is also necessary to consider flood risk from all other sources, including surface water, groundwater, Ordinary Watercourses, and artificial drainage systems and infrastructure failure.

3.3 The Sequential Test

3.3.1 The NPPF requires a risk-based sequential approach to determine the suitability of land for development in flood risk areas which should be applied at all stages of the planning process.

3.3.2 The Sequential Test should be applied to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development proposed.

3.3.3 The Environment Agency's Flood Zones are the starting point for the Sequential Test and refer to the probability of sea and river flooding. They are defined on a 'worst case' basis, ignoring the presence of existing defences. The overall aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding.

3.3.4 The proposed Scheme along the A19, A1290 and Downhill Lane would be located in Flood Zone 1, which has the lowest probability of flooding. Hence the Scheme has been located in the area of lowest flood risk. However, the northern extent of

the Scheme, beside where the Don is culverted in the north-western corner of the DCO boundary, and in the north-eastern corner of the DCO boundary are located immediately adjacent to Flood Zones 2 and 3 of the River Don (see Figure 14.1 in Appendix A). The unnamed tributary in the north-eastern section would not be crossed by the development, but would be located within the Scheme DCO boundary.

3.3.5 The improvement works are to an existing road which links the Tyne and Wear conurbation with Teesside and cannot be located in another area irrespective of flood risk. Therefore, the requirements of the Sequential Test are met.

3.4 Assessment of development vulnerability

3.4.1 The Scheme has to be assigned a Flood Risk Vulnerability Classification in accordance with NPPF[2]. The Flood Risk Vulnerability Classification for all of the Scheme is '**Essential Infrastructure'**.

3.4.2 The NPPF defines what development is suitable for construction within each flood risk zone based upon the level of vulnerability of the development, as set out in Table 3.1.

Table 3.1 - Flood risk vulnerability and flood zone 'compatibility'[3]

Flood risk vulnerability classification	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	×	Exception Test required	✓
Zone 3b	Exception Test required	✓	×	×	×

3.4.3 The Scheme would be located in Flood Zone 1, so no application of the Exception Test was required.

Flood risk vulnerability and flood zone 'compatibility' of the proposed development:

- Essential Infrastructure development is permitted in Flood Zone 1 and Flood Zone 2; and
- Essential Infrastructure development can only be permitted in Flood Zone 3a if the Exception Test is passed.

[2] NPPF Planning Practice Guidance, Table 2, accessible via http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-2-flood-risk-vulnerability-classification/

[3] Planning Practice Guidance, Table 3, accessible via http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-3-flood-risk-vulnerability-and-flood-zone-compatibility/

3.5 Local Flood Risk Policies

3.5.1 National Planning Policy is supplemented at a local level by additional plans and policies set out in Unitary Development Plans, Local Development Frameworks and Supplementary Planning Documents.

3.5.2 Locally set flood risk policies relate to specific, local issues, such as drainage requirements for development within critical drainage areas, restrictions on infill development, or minimum threshold levels for properties within the floodplain.

3.5.3 The Scheme would be predominantly located in the administrative area of South Tyneside Metropolitan Borough Council. South Tyneside Council completed a Level 2 Strategic Flood Risk Assessment (STC SFRA)[4] in February 2011.

3.5.4 A very small section at the southern extent of the development would be located in the administrative area of Sunderland City Council. Sunderland City Council completed a Level 1 SFRA[5] (the SCC SFRA) in September 2017.

South Tyneside Strategic Flood Risk Assessment

3.5.5 The main purpose of the STC SFRA is to provide the information needed for planning authority to take flood risk into account when making land use allocations and determining planning applications. It will also help a planning authority to:

- prepare policies for managing flood risk;
- take flood risk into account when preparing strategic land use policies;
- identify the level of detail required for site-specific FRAs; and
- ascertain the implications of flood risk on emergency plans.

3.5.6 The SFRA provides little site-specific information for the location of the works other than identifying a relatively narrow floodplain associated with the River Don. Surface water flood risk is shown to occupy the same narrow floodplain as the fluvial flood risk. No other sources of flooding are identified.

Sunderland City Council Strategic Flood Risk Assessment

3.5.7 The main purpose of the SCC SFRA is to understand flood risk from all sources and to investigate the extent and severity of flood risk in the area. It will also help a planning authority to:

- provide recommendations on the suitability of potential development sites based on flood risk;
- provide guidance for developers and planning officers on planning applications; and
- provide a straightforward risk based approach to development management.

3.5.8 The SFRA provides little site-specific information for the location of the works other than identifying a relatively narrow floodplain associated with the River Don and River Wear. There were no critical drainage areas identified near the Scheme.

[4] South Tyneside Strategic Flood Risk Assessment (2011)
[5] Sunderland City Council Level 1 Strategic Flood Risk Assessment Draft (2017)

Tyne Catchment Flood Management Plan

3.5.9 The Tyne Catchment Flood Management Plan (Tyne CFMP) sets out the Environment Agency's flood risk management policies for the tidal River Tyne. Downhill Lane junction is located in the Don sub-area.

3.5.10 The Tyne CFMP policy for this sub area is Policy 3:

"Areas of low to moderate flood risk where we are generally managing existing flood risk effectively. This policy will tend to be applied where the risks are currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future."

3.5.11 The Scheme would have no impact on the implementation of this policy.

Wear Catchment Flood Management Plan

3.5.12 The Wear Catchment Flood Management Plan (Wear CFMP) sets out the Environment Agency's flood risk management policies for the River Wear. The runoff from southern extent Downhill Lane junction would discharge to the River Wear.

3.5.13 The Wear CFMP policy for this sub area is Policy 3:

"*Areas of low to moderate flood risk where we are generally managing existing flood risk effectively. This policy will tend to be applied where the risks are currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future."*

3.6 Other Relevant Studies

3.6.1 A review of other relevant studies and reports has also been undertaken to determine if they contain information, guidance or policies of relevance to this FRA.

River Don Partnership – Don Integrated Catchment Project

3.6.2 River Don Partnership comprises Northumbrian Water, South Tyneside Council, Sunderland City Council, Gateshead Council, Environment Agency and private sector partners amongst others.

3.6.3 The River Don Partnership aims are:

- to take a new approach to maximise benefits for all partners for flood risk and river water quality; and
- for strategic developments, such as the International Advanced Manufacturing Park (IAMP) and transport enhancements of the A19 junctions, to '*integrate into the landscape, delivering spaces capable of providing multiple benefits and truly sustainable developments'*.

South Tyneside Local Development Framework – Core Strategy

3.6.4 The majority of the Scheme would be located within the South Tyneside District Council administrative area. The South Tyneside Local Development Framework contains a policy within its Core Strategy[5] relating to the use of Sustainable Urban Drainage Systems. Policy ST2 states:

[5] South Tyneside Local Development Framework Core Strategy (2007)

"*High quality in sustainable urban living will be promoted by ensuring that: use is made of 'sustainable urban drainage systems' and water conservation features including 'grey water recycling' and other technologies wherever possible."*

3.6.5 Policy ST2 will assist in achieving:

"The reduction of the adverse impacts of flooding, by controlling surface water run-off, requiring Sustainable Urban Drainage Systems (SUDS) and grey-water recycling."

South Tyneside Local Development Framework – Sustainable Construction and Development

3.6.6 The South Tyneside Local development framework[6] for sustainable construction and development mentions:

"The Council will expect major and significant planning applications to demonstrate how a more sustainable approach to drainage has been incorporated into their development proposals, through the submission of a Sustainable Urban Drainage Programme. This should include sufficient detail to demonstrate how to control the quality or run-off from a development, improve the quality of run-off, and enhance the nature conservation, landscape and amenity value of the site and its surroundings."

3.6.7 Overall, the South Tyneside local flood risk policies indicate that SUDS will be required for the Scheme. In particular SUDS should be used to control the quality and amount of run-off generated from the site and therefore should be included in the surface water drainage design.

Sunderland Core Strategy and Development Plan 2015-2033 (draft)

3.6.8 The Sunderland Core Strategy and Development Plan mentions:

"Direct development away from those locations which are most at risk from flooding and ensure that development does not have an adverse impact upon groundwater quality within the Source Protection Zones."

3.6.9 Policy CM4 states:

- *"All developments must follow the sequential approach.*
- *FRAs must demonstrates that the development will not increase flood risk on site or elsewhere.*
- *Drainage of new development shall be designed to reduce surface water runoff rates and include the implementation of SUDS where feasible.*
- *Development should not adversely affect the quality or quantity of surface or groundwater."*

3.6.10 Policy CM5 states:

- *"All developments must pass the sequential test.*
- *FRAs must demonstrates that the development will not increase flood risk on site or elsewhere.*

[6] South Tyneside Local Development Framework for sustainable construction and development works (2007)

- *Drainage of new development shall be designed to reduce surface water runoff rates and include the implementation of SUDS where feasible.*
- *Development must discharge at greenfield runoff rates.*
- *Ensure adequate protection where sites may be susceptible to overland flood flows."*

3.6.11 The information presented in this FRA supports a conclusion that the Scheme is compliant with both Policy CM4 and CM5.

4 ASSESSMENT OF FLOOD RISKS TO THE SCHEME

4.1 Criteria

4.1.1 As set out earlier in this document, the NPPF requires a FRA to be undertaken and the assessment must consider all potential sources of flooding to determine:

- the flood risk to the proposed development site; and
- the potential impact of the proposed development on flood risk elsewhere.

4.1.2 This section will outline the assessment of all potential sources of flood risk to the Scheme.

4.2 Flood Risk to the Scheme

4.2.1 There are several potential sources of flooding to the Scheme that the NPPF requires to be considered:

- Tidal and fluvial – flooding from the sea, Main Rivers and Ordinary Watercourses;
- Surface water – flooding from run-off and overland flow as a result of rainfall events;
- Failure of artificial drainage systems and infrastructure – flooding that occurs as a direct result of infrastructure failure or overflow; including canals;
- Reservoirs, sewers and land drainage and flood risk management assets;
- Groundwater – flooding due to the rising of the water table below ground;
- Reservoirs – flooding due to the breaching of reservoirs; and
- Canals – flooding due to overtopping or failure of canals.

4.2.2 The tidal limit of the River Don is at Cemetery Road, approximately 4.8 km downstream of the Scheme. Therefore, it was considered that the application site would not be at risk of flooding from tidal flooding.

4.3 Flood Risk from Main Rivers

4.3.1 As discussed in Section 3.2 there are four zones of flood risk from Main Rivers and the Sea, assessed using the Environment Agency's National Fluvial and Coastal Flood Map.

4.3.2 Downhill Lane junction lies within Flood Zone 1. However, the River Don is located immediately north of the Scheme's construction work areas. Flood Zones 2 and 3, associated with the River Don, are shown to be virtually overlapping at this point and they both extend up to, but do not encroach into, the DCO boundary in the north western corner. The unnamed tributary of the River Don falls within the DCO boundary, but would not be crossed by the Scheme; though it would have a new outfall installed for drainage purposes.

4.3.3 The River Don is a Main River which flows in a north-easterly direction. A recent flood model commissioned in support of a nearby development concluded that the flood extents on the upstream side of the A19 culvert are now predicted to be larger and to abut the existing A19 and the Downhill Lane junction, following updated flow estimates[7]. At this location the River Don passes under the A19 via an existing culvert 10 m lower than the existing road level. The Scheme would not make any changes to this existing culvert or adjacent floodplain and so would not change the existing risk from this source.

4.3.4 It should be noted that the flood extents from this model do differ slightly from the Environment Agency's current Flood Zone Map. It is understood from discussions with the Environment Agency that these flood extents will also be adopted and will replace those in the current Flood Zone Map in the near future. A small area of the Scheme's construction work area falls within the flood zones presented, though only tree planting is proposed within this area. No additional mitigation would be required beyond that already contained within the Construction Environmental Management Plan (CEMP) (see Section 5.7 of the Environmental Statement).

The risk of flooding from Rivers was considered to be low and there would be no impact on flood risk, therefore no mitigation measures would be required. During construction of the Scheme, the changes in the Environment Agency's Flood Zone Map should be noted.

4.4 Flood Risk from Surface Water

4.4.1 Surface water run-off was defined as water flowing over the ground that has not yet entered a drainage channel or similar. It usually occurs as a result of an intense period of rainfall, which exceeds the infiltration capacity of the ground.

4.4.2 Typically, run-off occurs on sloping land or where the ground surface is relatively impermeable. The ground can be impermeable either naturally through the soil type or geology or due to development, which places large areas of impervious material over the ground surface (e.g. paving and roads).

4.4.3 Using the Environment Agency's Flood Risk from Surface Water maps, areas that are at risk from surface water flooding can be identified. There are three zones of risk for surface water flooding, with everywhere else defined as Very Low Risk:

- High risk - area that has a chance of flooding of greater than 1 in 30 (3.3%);
- Medium risk – area that has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%); and
- Low risk - area that has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%).

4.4.4 The A19 and central junction are at low risk from surface water flooding. However, in a small proportion of the site the risk from surface water flooding is medium or high (Figure 4-1). These areas include:

- immediately south-west of Downhill Lane junction, where the A1290 and Downhill Lane converge;

[7] JBA Consulting, 2017, River Don at Washington Flood Modelling.

- immediately south-east of Downhill Lane junction, west and east of Washington Road; and
- adjacent to the A19 on its west side at the southern end of the Scheme and in fields adjacent to the A1290.

4.4.5 The topography of the area surrounding the Scheme shows there is a slight fall to the north-west near Downhill Lane and the A1290 on both the east and west side of the junction. The surface water flooding shown on the Flood Risk from Surface Water maps suggests that the road in these locations is raised above the flooding and that these areas of medium and high risk are areas of ponding against the edge of the road.

4.4.6 Ponding in fields adjacent to the A1290 and to the south of the Scheme was noted and this was related to a flow path that drains south-eastwards. Again, as with the area described above, there was also localised ponding against the existing road infrastructure.

4.4.7 The proposed drainage design includes toe drains at these locations, which would provide some attenuation of the water that is shown to pond. To the west of the junction, a ditch is proposed which would include check dams that would provide some additional attenuation to surface water flows in this area, before the flow is discharged westwards into a small watercourse. The exact level of attenuation would be determined in detail design, but this is likely to be provided for a 1 in 30-year storm event to provide betterment and so an existing local surface water flood risk is not passed downstream.

4.4.8 In all locations, the drainage infrastructure proposed would mean runoff can continue to drain in existing directions without increasing the risk of flooding to surrounding land and making sure there is no risk of flooding from this source to the Scheme.

4.4.9 In the south of the Scheme, an area of ponding adjacent to the A19 would be avoided by the Scheme, resulting in no impact on risk.

The risk of flooding from surface water is considered to be moderate to high but embedded mitigation measures ensure that there is no risk of flooding to the Scheme and no impact from the scheme on flood risk elsewhere.

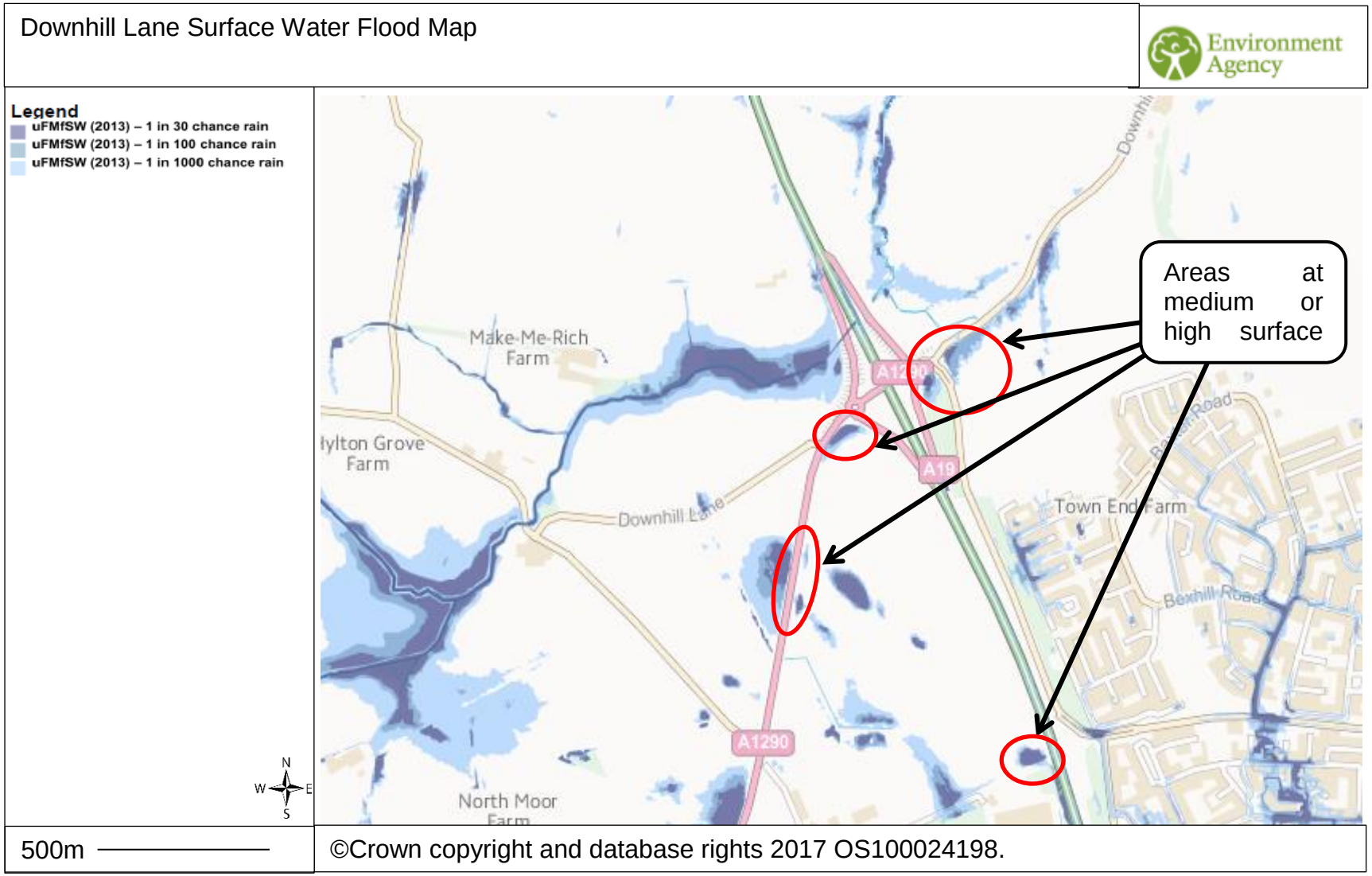


Figure 4-1 - Environment Agency Flood Map for Surface Water

4.5 Flood Risk from Groundwater

4.5.1 Groundwater flooding occurs when the natural level of water stored within the ground rises above local ground level. This can result in deep and long-lasting flooding of low lying or below ground areas such as underpasses and basements.

4.5.2 Information from the Environment Agency's Groundwater Vulnerability maps, the British Geological website, groundwater source protection zones, aquifer types and soil information can be drawn together to help understand the presence and likely risk of groundwater flooding in an area.

4.5.3 There are no groundwater source protection zones (SPZ) in the vicinity of the development. The bedrock is designated as a Secondary A aquifer. The deposits are likely to be fractured or potentially fractured rocks, which do not have a high primary permeability. These aquifers are important for local supplies and in supplying base flow to rivers. The superficial deposits are Pelaw Clay classified as unproductive strata due to their low permeability.

4.5.4 Groundwater strikes were encountered in four exploratory holes undertaken in the vicinity of the site boundary in 2017. The depth of water strike varied from 5.6 m below ground level (mbgl) to 15 mbgl. Groundwater levels in the superficial deposits were generally 1 to 4 mbgl, though some depths were recorded up to 8.16 mbgl.

4.5.5 Historically, no evidence has been provided which indicates groundwater flooding. It is possible that, at the levels identified during monitoring, groundwater may contribute to flood risk from other sources, potentially during wetter periods, however, in general the low permeability of the strata suggests that this is only likely as a result of waterlogging in winter.

4.5.6 Due to the ground characteristics and lack of historical evidence it was determined that the risk to the site from groundwater flooding would be low and no specific mitigation would be required.

The risk of flooding from groundwater was considered to be low and no mitigation measures would be required.

4.6 Flood Risk from Reservoirs/Lakes

4.6.1 In accordance with Environment Agency's Flood Risk from Reservoirs map, there are no reservoirs identified in the vicinity of the study area. Therefore, the proposed development would not be affected by reservoir flooding.

There was considered to be no risk of flooding from reservoirs or lakes and no mitigation measures would be required.

4.7 Flood Risk from Sewers and Artificial Drainage Systems

4.7.1 Flooding from surface water and combined sewers can be contaminated by foul sewage. If this occurs flooding can represent a significant hazard to human health.

4.7.2 There are no sewers identified in the vicinity of the Downhill Lane junction, so it was considered that there would currently be no risk from this source.

4.7.3 Flooding from artificial drainage systems can correlate with surface water ponding identified on the Flood Risk from Surface Water maps. In this case, there are no additional artificial drainage systems within the vicinity of the site and therefore no risk from this source.

There would be no flood risk from sewers or artificial drainage systems, therefore no mitigation would be required.

4.8 Summary of Flood Risk to the Scheme

4.8.1 The table below summarises the results of the assessment of flood risks to the Scheme.

Table 4.1 - Summary of Flood Risks to the Scheme

Source of Flooding	Risk Assessment	Additional Mitigation Required
Fluvial	Low	×
Surface Water	Moderate to high in adjacent areas	×
Groundwater	Low	×
Reservoirs	No risk	×
Sewers	No risk	×
Artificial Drainage systems	No risk	×

5 THE IMPACT OF THE SCHEME ON FLOOD RISK ELSEWHERE

5.1 Assessment Criteria

5.1.1 This section of the report assesses the potential impact that the Scheme may have on the risk of flooding elsewhere.

5.2 Impact on Flood Risk from Main Rivers

5.2.1 As discussed in Section 3.3, the Scheme would be located within Flood Zone 1. The Scheme would not impact on the river or floodplain storage and the flood risk elsewhere would therefore remain unchanged.

5.2.2 It is understood that the Flood Zone map will change in the near future, resulting in a slight encroachment of the red line boundary and resulting in some tree planting works lying within Flood Zone 2. This would not impact on flood risk.

The Scheme would have no impact on flood risk from main rivers and no mitigation would be required.

5.3 Impact on Flood Risk from Surface Water

5.3.1 The Scheme would lead to an increase in the amount of impermeable and permeable surfaces with the improvement of NMU routes and road realignment. The increase in impermeable area has the potential to increase the amount of surface water run-off from the site that, if unmitigated, could locally increase flood risk.

5.3.2 The change in land use is presented in the Table 5.1 below.

Table 5.1 - Summary of changes in land use (hectares)

Existing Catchment	4	5	6	R. Don Sum	7	8	R. Wear Sum
Impermeable	5.344	0.085	0.774	6.203	0.833	0.768	1.601
Permeable	3.559	0.078	0.191	3.828	0.494	1.528	2.022
Sum	**8.903**	**0.163**	**0.965**	**10.031**	**1.327**	**2.296**	**3.623**
Proposed Catchment	**4**	**5**	**6**	**R. Don Sum**	**7**	**8**	**R. Wear Sum**
Impermeable	5.680	0.081	0.935	6.696	0.623	1.296	1.919
Permeable	4.179	0.059	0.689	4.927	1.120	1.666	2.786
Sum	**9.859**	**0.14**	**1.624**	**11.623**	**1.743**	**2.962**	**4.705**

Change	4	5	6	R. Don Sum	7	8	R. Wear Sum
Impermeable	0.336	-0.004	0.161	0.493	-0.210	0.510	0.30
Permeable	0.620	-0.019	0.498	1.099	0.626	0.138	0.764
Sum	**0.956**	**-0.023**	**0.659**	**1.592**	**0.416**	**0.648**	**1.064**

5.3.3 The catchments areas referred to in Table 5.1 are shown on Figures 2.5 and 2.6 of the Environmental Statement for the Scheme (also see Appendix A to this report) and a description of the drainage strategy is provided in Section 2 of the Environmental Statement. Catchments 4 and 6 drain to the River Don, with Catchment 6 draining via a tributary. Catchment 5 has no formal drainage, but is likely to ultimately discharge to the River Don through infiltration and contribution to baseflow or overland flow. Catchment 7 drains to the River Wear via an existing piped drainage system, with 75% passing through an attenuation ditch with check dams. Catchment 8 drains to an attenuation pond then an existing piped highway drainage system heading east under the Town End Farm housing estate. This system also ultimately discharges to the River Wear via Hylton Dene Burn.

5.3.4 If unmitigated, the 0.493 hectare (ha) increase in impermeable surface area and an additional 1.099 ha of permeable surfaces that are to be formally drained to the River Don would have a slight impact on flood risk from surface water. Embedded mitigation includes restriction of additional discharge from catchments 4, 6, 7 and 8 to greenfield runoff rates and the provision of attenuation above greenfield rates for events up to and including the 1 in 100-year event plus climate change. Therefore, the Scheme would result in marginal benefit to areas downstream during rainfall events more extreme than the greenfield rate.

5.3.5 There would be an overall decrease in both permeable and impermeable areas in Catchment 5, which means that there would be no overall increase in runoff rate. Therefore, there would actually be a small benefit to receiving watercourses provided by this restriction of runoff.

5.3.6 In light of the 0.30 ha increase in impermeable surface and 0.764 ha of permeable surface draining to the River Wear, it was determined that the Scheme would also have a slight effect on flood risk from surface water if unmitigated. Embedded mitigation in the form of runoff restrictions to greenfield rates from Catchment 8 and the provision of additional attenuation above greenfield rates means there would be no increase in runoff; for events in excess of the 1 in 1-year storm event, there would actually be a small benefit to receiving drainage network provided by this restriction of runoff. Runoff from Catchment 7 would be restricted resulting in a significant decrease in the runoff rate.

5.3.7 The new layout of the A19 Downhill Lane junction results in encroachment onto adjacent land that in the baseline situation is shown to have a moderate to high

surface water flood risk. Unmitigated this would displace surface water onto adjacent agricultural land. Embedded mitigation within the Scheme includes the introduction of toe drainage at the base of embankments in these areas and check dams adjacent to the A1290 with the continued provision of connectivity to the receiving watercourses that ultimately drained these areas; namely the minor tributary of the River Don to the north-east of the Downhill Lane junction and the small watercourse that runs southwards from the A1290 to the west of the Scheme. The result is that encroachment into these areas would not result in an increased risk elsewhere from displacement of surface water ponding.

5.3.8 The area within the DCO boundary reflecting temporary land-take during construction extends over an area of low surface water flooding to the north-east of the Scheme. Any potential impact on surface water flood risk here would be dealt with as part of the works site drainage.

Embedded mitigation within the design of the Scheme would mean there would be no increased surface water risk to local watercourses, receiving drainage networks or adjacent land. Attenuation of runoff would provide a small beneficial impact on flood risk downstream.

5.4 Impact on Flood Risk from Groundwater

5.4.1 The Scheme does not incorporate any deep excavations. The online storage would be shallow or incorporated into existing drainage systems and the attenuation ponds would not be fully below ground. Therefore, this would not impact the natural storage capacity of the ground or subsurface flow regimes. The Scheme was classified as having a low risk on the impact of groundwater flooding.

The potential impact of Scheme on the risk of flooding from groundwater was considered to be low and no mitigation would be required.

5.5 Impact on Flood Risk from Reservoirs

5.5.1 The Scheme would not involve any works which would impact on the risk of flooding from reservoirs.

There would be no risk of flooding from reservoirs or canals and no mitigation measures would be required.

5.6 Impact on Flood Risk from Sewers and Artificial Drainage Systems

5.6.1 As identified in Section 5.3 the Scheme would increase the amount of impermeable area and as a result surface water runoff would increase. Embedded mitigation would mean there would be no increased risk on receiving drainage networks and no additional mitigation is required.

Embedded mitigation within the design of the Scheme would mean there would be no increased surface water risk to local watercourses, receiving drainage networks or adjacent land. Attenuation of runoff would provide a small beneficial impact on flood risk downstream.

5.7 Summary of Flood Risk Elsewhere

5.7.1 Table 5.2, below, summarises the results of the assessment of the potential impact of the Scheme on the proposed site and on flood risk elsewhere.

Table 5.2 - Summary of impacts on flood risk from the Scheme on the site

Source of Flooding	Risk Assessment	Additional Mitigation Required
Fluvial	No impact on flood risk	×
Surface water	Slight reduction in risk downstream	×
Groundwater	No impact on flood risk	×
Reservoirs	No risk	×
Sewers	No displacement of flood water. Slight reduction in risk downstream.	×
Artificial drainage systems	No displacement of flood water. Slight reduction in risk downstream.	×

6 CLIMATE CHANGE

6.1.1 The NPPF requires consideration of the impact of future climate change to be taken into account on the proposed development. Climate change is predicted to increase sea levels, river flows and increase precipitation.

6.1.2 The Scheme was considered to be essential infrastructure and NPPF guidance states the allowances for climate change according to the region, timescales under investigation and scenario of assessment. For developments that require the upper end allowance to be applied in Northumbria (including essential infrastructure), the allowances range from 20 % to 50 % increase in fluvial flows depending on the timescales being examined[8]. The same guidance identifies a 5 % to 20 % increase in rainfall intensity as a central estimate, depending upon timescales considered, with a 10 % to 40 % increase for the upper end.

6.1.3 The Scheme would not alter the existing regime for the River Don and would therefore have no effect on flood risk in the future. At present, the preliminary drainage system, including attenuation, includes a 20 % increase to rainfall intensity to allow for climate change. A 40 % increase to rainfall scenario would be modelled at the detailed design stage as a sensitivity check with a view to understanding and managing any significant effect from the Scheme where practicable.

6.1.4 Surface water runoff from adjacent land would also increase as a result of climate change. This increase in surface water run-off would be accounted for in the design of the toe drainage.

[8] Environment Agency Guidance (2016), Flood risk assessments: climate change allowances, Table 1

7 MITIGATION MEASURES AND RESIDUAL RISKS

7.1 Fluvial Flood Risk

7.1.1 Recently updated flood extents, discussed in Section 4.3, do not impact the operation of the Scheme. However, the presence of an adjacent floodplain should be taken into consideration in the planning and management of safe working areas during construction. Mitigation could include signing up to receive Environment Agency flood warnings relating to the River Don alongside heightened observation of these areas during flood events.

7.2 Surface Water Flood Risk

7.2.1 As described in Sections 4.4. and 5.3, embedded mitigation was incorporated into the design which would mean there would be no flood risk to the Scheme or increase in flood risk elsewhere. This embedded mitigation includes:

- management of runoff from the Scheme to greenfield rates, with the provision of attenuation above this rate for events up to and including the 1 in 100-year storm event, with a 20 % allowance for climate change;
- locating a SuDS pond at the southern end of the Scheme outside of an existing surface water flood risk area; and
- provision of suitably sized check dams and toe drainage with the continuation of existing connectivity in areas of ponding to the south of Downhill Lane and the A1290 where the Scheme encroaches into areas of existing surface water flooding.

7.2.2 Additional mitigation beyond the embedded mitigation described above is not considered necessary. Sensitivity testing of more extreme climate change scenarios would be undertaken once the drainage designs are finalised to test whether additional attenuation is required.

8 CONCLUSION

8.1.1 This FRA has been carried out to support Highways England's Environmental Impact Assessment for the improvement of the A19 Downhill Lane junction to the south-west of West Boldon. The FRA was required as the Scheme is greater than 1 hectare.

8.1.2 In accordance with NPPF, the Scheme was classified as 'Essential Infrastructure'. This type of development is permitted in Flood Zone 1 and 2; it is only permitted in Flood Zone 3 provided the Exception Test is passed.

8.1.3 The NPPF applies a risk-based sequential approach to determine the suitability of land for development in flood risk areas. The Sequential Test should be applied to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development proposed.

8.1.4 The Scheme would be located in a Flood Zone 1, which has the lowest probability of flooding. Future updates to EA Flood Zones are expected to encroach in to the red line boundary and there would be a small amount of tree planting in Flood Zone 2. The road is existing essential infrastructure which connects Sunderland and Gateshead. The improvement works would be to an existing road, so cannot be located in an area of lower flood risk. Therefore, the requirements of the Sequential Test are considered met. The Exception Test is not required.

8.1.5 This FRA considered the risk from all sources of flooding to and from the Scheme. There would be no significant risks to the Scheme and embedded mitigation would mean the existing surface water flood risk would not be increased and that the increased impermeable area and formal drainage of some permeable areas would not increase risk in receiving watercourses or drainage networks.

8.1.6 As described in Sections 4.4. and 5.3, embedded mitigation has been incorporated into the design which would mean there would be no flood risk to the Scheme or increase in flood risk elsewhere. This embedded mitigation includes:

- management of runoff from the Scheme to greenfield rates, with the provision of attenuation above this rate for events up to and including the 1 in 100-year storm event, with a 20 % allowance for climate change;
- locating a SuDS pond at the southern end of the Scheme outside of an existing surface water flood risk area; and
- provision of suitably sized check dams and toe drainage with the continuation of existing connectivity in areas of ponding to the south of Downhill Lane junction and the A1290 where the Scheme encroaches into areas of existing surface water flooding.

8.1.7 No additional mitigation measures are proposed or considered necessary.

APPENDIX A: FIGURES

Please see on the following pages Figures 14.1, 2.5 and 2.6 of the Environmental Statement, Volume 2 for the Scheme **(Application Document Reference: TR010024/APP/6.2)**.

FIGURE 14.1

BOLDON LAKE
TESTO'S JUNCTION
RIVER DON
A19
DOWNHILL LANE
BOLDON HILLS
DOWNHILL LANE JUNCTION
TOWN END FARM
WASHINGTON ROAD
A1290
NISSAN PLANT
A19

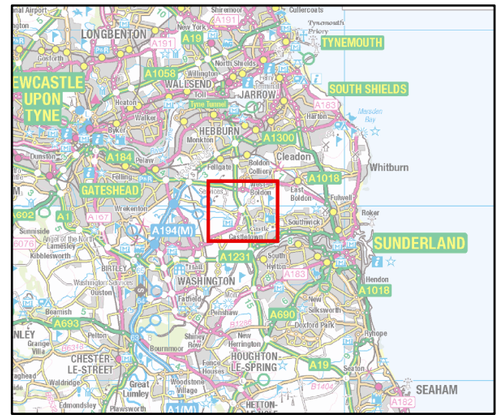
N
W
E
S

0 500 Metres

Legend

- DCO Boundary
- Land over which rights of way permanently extinguished or reinstated (see Note 1)
- Testo's main site compound – shared use option area
- 1km Buffer
- Testo's Scheme Footprint
- Indicative IAMP One Site Boundary
- Preliminary Design
- Drain
- Water Feature
- Flood Zone 3
- Flood Zone 2

Note:
1. See section 1.5 in document TR010024/APP/6.1 (Volume 6) and document TR010024/APP/7.5.
2. No specific groundwater constraints, so only surface water constraints shown.
3. The Ordnance Survey background displayed in this drawing has been modified to show the neighbouring Testo's and IAMP One consented schemes. This reflects the most likely baseline scenario for the opening year of the Downhill Lane scheme.



Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	JAN 19	Application Issue	IM	NM	PR	GW

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Project: A19 DOWNHILL LANE JUNCTION IMPROVEMENT

Drawing Title: WATER ENVIRONMENT CONSTRAINTS

Drawing Status: DCO SUBMISSION

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Jacobs No.	B0140301	
Client No.		

Drawing No.: B0140301_DLJ_ES_1401

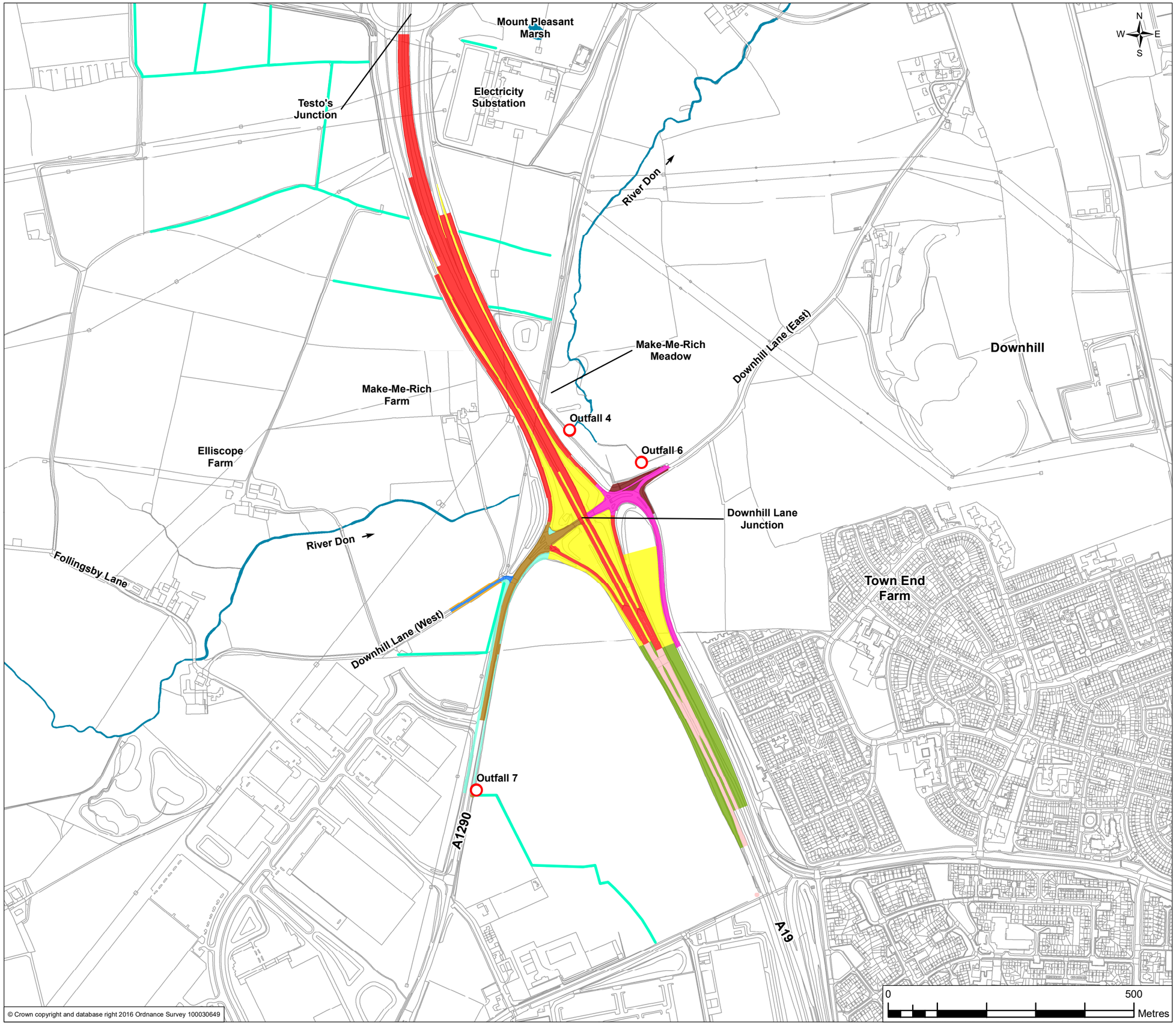

FIGURE 2.5

Legend

- Existing Discharge Points
- Drain
- Waterbody

Existing Drainage Catchment Area

- Network 4 outfall to the River Don - Impermeable catchments
- Network 4 outfall to the River Don - Permeable catchments
- Network 5 - Impermeable catchments
- Network 5 - Permeable catchments
- Network 6 outfall to a tributary of the River Don - Impermeable catchments
- Network 6 outfall to a tributary of the River Don - Permeable catchments
- Network 7 drainage continues south to the Wear - Impermeable catchments
- Network 7 drainage continues south to the Wear - Permeable catchments
- Network 8 drainage continues south to the Wear - Impermeable catchments
- Network 8 drainage continues south to the Wear - Permeable catchments

The Ordnance Survey background displayed in this drawing has been modified to show the neighbouring Testo's and IAMP One consented schemes. This reflects the most likely baseline scenario for the opening year of the Downhill Lane scheme.

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	JAN 19	Application Issue	IM	EA	MR	GW

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Project: A19 DOWNHILL LANE JUNCTION IMPROVEMENT

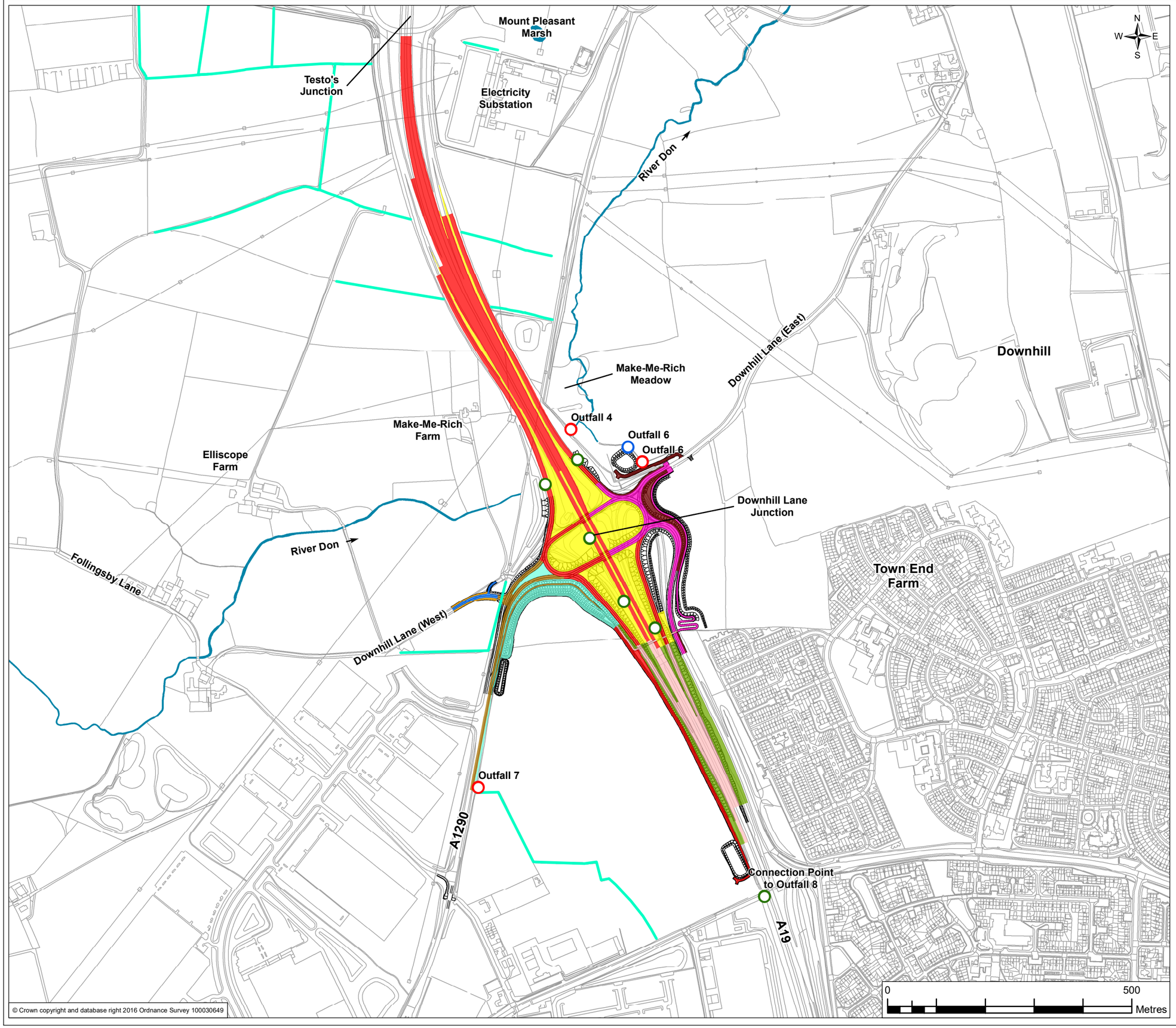
Drawing Title: FEATURES OF THE WATER ENVIRONMENT

Drawing Status: DCO SUBMISSION

Scale @ A3	1:7,500	DO NOT SCALE
Jacobs No.	B0140301	
Client No.		

Drawing No. B0140301_DLJ_ES_0205

FIGURE 2.6



Legend

- Preliminary Design
- Existing Discharge Points
- Proposed New Discharge Points
- Connection Points
- Drain
- Waterbody

Proposed Catchments

- Network 4 existing outfall to the River Don - Impermeable catchments
- Network 4 existing outfall to the River Don - Permeable catchments
- Network 5 - Impermeable catchments
- Network 5 - Permeable catchments
- Network 6 outfall to the tributary of the River Don - Impermeable catchments
- Network 6 outfall to the tributary of the River Don - Permeable catchments
- Network 7 outfall connecting into existing highway drainage - Impermeable catchments
- Network 7 outfall connecting into existing highway drainage - Permeable catchments
- Network 8 outfall connecting into existing highway drainage - Impermeable catchments
- Network 8 outfall connecting into existing highway drainage - Permeable catchments

The Ordnance Survey background displayed in this drawing has been modified to show the neighbouring Testo's and IAMP One consented schemes. This reflects the most likely baseline scenario for the opening year of the Downhill Lane scheme.

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	JAN 19	Application Issue	IM	EA	MR	GW

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Project: A19 DOWNHILL LANE JUNCTION IMPROVEMENT

Drawing Title: PROPOSED DRAINAGE DESIGN

Drawing Status: DCO SUBMISSION

Scale @ A3	1:7,500	DO NOT SCALE
Jacobs No.	B0140301	
Client No.		

Drawing No.: B0140301_DLJ_ES_0206

APPENDIX 14.3 WATER FRAMEWORK DIRECTIVE ASSESSMENT

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A19 Downhill Lane Junction Improvement

Scheme Number: TR010024

6.3 Environmental Statement, Vol. 3: Appendices

Appendix 14.3: Water Framework Directive Compliance Assessment

Volume 6

January 2019

CONTENTS

EXECUTIVE SUMMARY

The Environment Agency (EA) requires an assessment of the impact of any construction and/or modification to water bodies in the UK that are classified under the European Union (EU) Water Framework Directive (WFD). This Directive was transposed into UK law as The Water Environment (WFD) (England and Wales) Regulations 2017 (as amended). The primary aim of the WFD is to improve/maintain the Ecological Status/Potential of all WFD water bodies. The Ecological Status comprises a series of biological, physico-chemical and hydromorphological 'quality elements'.

The A19 Downhill Lane Junction Improvement Scheme provides for the upgrading of the existing A19 junction with the A1290 and Downhill Lane, in the metropolitan borough of South Tyneside.

The Scheme drainage would make use of an outfall constructed as part of the Testo's scheme that discharges to the River Don and two outfalls connecting to existing road drainage which discharge indirectly to the River Wear. The Scheme would also construct one new outfall to a tributary of the River Don; existing highway discharge to an existing nearby outfall on this tributary would be diverted to this new outfall to align with a new attenuation pond. The rate of additional discharge from the outfalls would be restricted to greenfield runoff rates, resulting in a decrease from the existing rates. As a consequence, the Environment Agency requires a WFD assessment of the potential impact of the Scheme on the River Don and River Wear WFD water bodies. As two of the outfalls that connect to existing drainage (outfalls 7 and 8) indirectly discharge to the River Wear, an assessment of the impact on the River Wear is also made. The potential construction impacts are not considered as part of this WFD assessment, as they are considered temporary. Any permanent activities are included.

The proposed new outfall headwall would remove a small portion of natural bank and riparian vegetation of a drainage ditch that discharges to the River Don. It has been assessed that the impacts upon hydromorphological and ecological elements would be negligible and at a local scale.

The attenuation ponds proposed as part of the drainage design are expected to encourage siltation prior to discharge to the water body (removing fine sediments derived from the road surfaces) and lead to entrapment of some pollutants and nutrients (such as those attached to fine sediment from carriageway runoff). Due to the presence of the new attenuation ponds, it is possible that the water quality of the River Don and the River Wear (through the addition of a new attenuation ditch and two new attenuation ponds) could see a minor benefit from the Scheme.

This assessment has shown that the Scheme is compliant under the WFD, and that the works would be unlikely to result in the deterioration or prevention of an improvement in the overall WFD status of the River Don water body or any downstream water bodies.

1 INTRODUCTION

1.1 Overview

1.1.1 Under the European Union Water Framework Directive (WFD) and The Water Environment (WFD) (England and Wales) Regulations 2017, there is a legal requirement to carry out an assessment of the impact of any construction and/or modification to classified water bodies in the UK. The Environment Agency is the regulatory body responsible for ensuring WFD compliance in the England. The primary aim of the WFD is to improve/maintain the Ecological Status/Potential of all water bodies. The ecological status comprises a series of biological, physico-chemical and hydromorphological 'quality elements'.

1.1.2 The proposed A19 Downhill Lane Junction Improvement Scheme (see Figure 1.1) (hereafter referred to as 'the Scheme') involves utilising two existing outfalls (referred to as outfalls 7 and 8), both of which discharge indirectly (through existing drainage) to the River Wear (outfall 7 to the south-west and outfall 8 to the south-east). Outfall 4 to the River Don would be abandoned as part of the Scheme and the drainage system for Catchment 4 would discharge via outfall 1, which is to be constructed as part of the Testo's scheme. The Scheme also includes the construction of one new outfall that discharges to a tributary of the River Don to the east of the A19 (referred to as outfall 6); existing highway discharge to an existing nearby outfall on this tributary would be diverted to this new outfall to align with a new attenuation pond.

1.1.3 Three new attenuation ponds would be constructed: one for outfall 6, one with a new attenuation ditch for outfall 7 and one for outfall 8; these would be in addition to the attenuation ponds proposed for the Testo's junction improvement scheme, which includes a new attenuation pond for outfall 1. The Environment Agency requires a WFD assessment of the impacts of the Scheme on the River Don and River Wear, WFD water bodies.

1.1.4 This report provides a WFD assessment of the impacts of the channel modifications and discharges from the Scheme on the 'Don from Source to Tidal Limit' water body (hereafter referred to as the River Don)

1.2 Assessment background

1.2.1 The WFD (Directive 2000/60/EC) is a substantial piece of EU water quality legislation that came into force in 2000, with the overarching objective to get all water bodies in Europe to attain Good or High ecological status. The WFD is implemented in England and Wales by The Water Environment (WFD) (England and Wales) Regulations 2017(SI 3242/2003). River Basin Management Plans (RBMP) have been created to set out measures to ensure water bodies in England and Wales achieve 'Good Ecological Status'.

1.2.2 For surface water bodies to achieve overall 'Good Ecological Status' (GES) or 'Good Ecological Potential' (GEP), both ecological and chemical parameters must be judged to be at least 'Good'. GES refers to situations where the ecological characteristics show only a slight deviation from natural/near natural conditions. In such a situation the biological, chemical/physico-chemical and hydromorphological conditions are associated with limited or no human pressure. Artificial and Heavily

Modified Water Bodies (A/HMWB) have a target to achieve GEP, which recognises their important uses whilst making sure all quality elements are protected as far as possible.

1.2.3 The WFD has a number of objectives, including:

- Prevent deterioration in the status of water bodies.
- Aim to achieve Good ecological and Good surface water chemical status in water bodies by 2015, 2021 or 2027 (depending on feasibility).
- For water bodies that are designated as artificial or heavily modified, aim to achieve GEP by 2015, 2021 or 2027 (depending on feasibility).
- Comply with objectives and standards for protected areas where relevant.
- Reduce pollution from priority substances and cease discharges, emissions and losses of priority hazardous substances.

1.2.4 Introduction of a new modification or change in activity/structure on a water body needs to be considered in relation to whether it could cause deterioration in the Ecological Status or Potential of any water body. This could also result in any proposed mitigation measures or actions to achieve GES/GEP being ineffective or inappropriate. This could result in the water body failing to meet GES/GEP.

1.2.5 Where a development is considered to cause deterioration or where it could contribute to the failure of the water body to meet GES or GEP, then an Article 4.7 assessment would be required. Should the Scheme meet all of the conditions set out in Article 4.7 (see Annex A) then the Scheme would be considered to be WFD compliant.

1.2.6 The purpose of this WFD assessment is to evaluate the potential effects of the Scheme on the River Don and River Wear.

1.3 Study area

1.3.1 The River Don water body runs from a source in Springwell (west of the A194) to its confluence with the tidal Tyne at Jarrow. It is crossed by the A19 in three places: immediately north of Downhill Lane junction; in Hedworth (just under 3 km north of Downhill Lane junction); and in Jarrow, almost 4 km north of the Downhill Lane junction.

1.3.2 The study area for this assessment covers a small reach to the west of the A19, just north of the A19/A1920 connection, and the downstream reach stretching from the A19 east towards A184 at Boldon Bridge. The study area is shown in navy blue in Figure 1.1 overleaf.

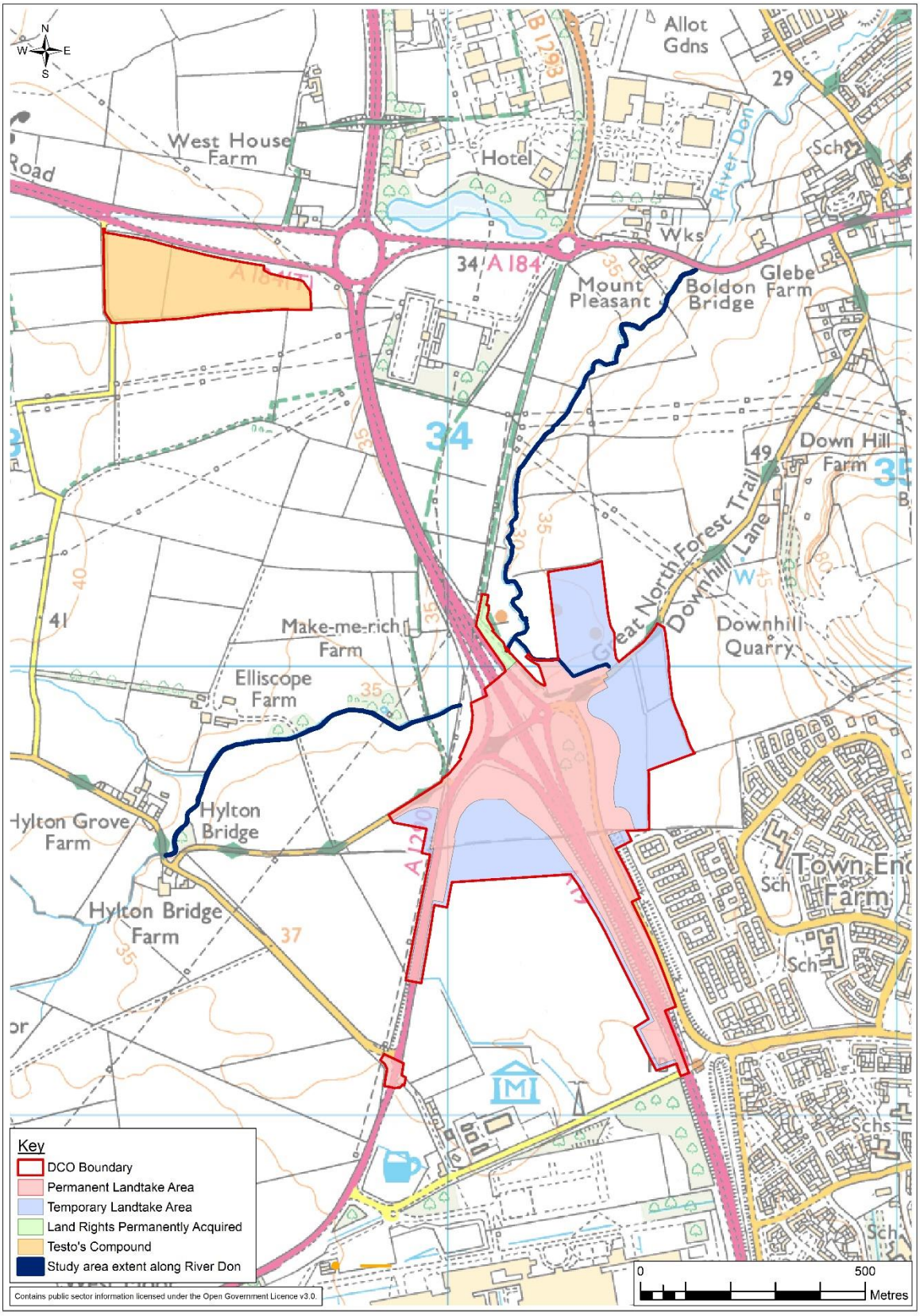

Figure 1.1 Scheme location and study area

1.4 Current WFD designation

1.4.1 The details of the River Don WFD water body, as assessed under the WFD, are detailed in Table 1.1. Details of the Wear transitional water body, are detailed in Table 1.2.

Table 1.1 Water Framework Directive information for the River Don water body

Element	Classification
Water Body ID	GB103023075690
Water Body Name	Don from Source to Tidal Limit
Water Body Length	15 km
Catchment Area	42.7 km2
River Basin District	Northumbria
Overall Water Body Status	Moderate Potential
Biological supporting Elements	
Invertebrates	Good
Macrophytes	No data
Macrophytes and Phytobenthos Combined	No data
Phytobenthos	No data
Hydromorphological Supporting Elements	
Hydrological Regime	Supports Good
Physico-chemical supporting Elements	
Ammonia	High
Dissolved Oxygen	High
pH	High
Phosphate	High
Temperature	High
Supporting Elements	
Mitigation Measures	Moderate or less

Table 1.2 Water Framework Directive information for the WEAR transitional water body

Element	Classification
Water Body ID	GB510302402900
Water Body Name	Wear
Surface Area	2.08 km2
River Basin District	Northumbria
Overall Water Body Status	Moderate Potential
Biological supporting Elements	
Invertebrates	No Data
Fish	No data
Macroalgae	High
Hydromorphological Supporting Elements	
Hydrological Regime	Supports Good
Physico-chemical supporting Elements	
Dissolved Organic Nitrogen	Moderate
Dissolved Oxygen	High
Supporting Elements	
Mitigation Measures	Moderate or less

2 METHODOLOGY

2.1 Desk study and field survey

2.1.1 Information for the assessment was obtained through a desk study, which utilised the following types of information:

- geology and soil maps (BGS, 2017; Cranfield University, 2017);
- OS Maps (Magic, 2017) (OS Open Data, 2015);
- historic maps (British Library, 2017);
- aerial photography (Google Earth, 2017);
- designated areas (Magic, 2017);
- flood map for planning (EA, 2017);
- hydrological information (CEH, 2015); and
- Environment Agency Catchment Data Explorer (EA, 2017).

2.1.2 Additionally, a walkover survey was undertaken in November 2014 to assess the baseline condition of the River Don. The survey provided an understanding of the existing conditions of the water body both within and outside of the red line boundary. A photographic record of the general character of the watercourse was collected. The survey provided information on the geomorphological character of the river which will be used in this assessment to determine the potential impacts of the Scheme. This was updated by a walkover survey completed in November 2017 to verify and update where necessary the baseline condition of the watercourses from the previous surveys.

2.1.3 The findings of the desk study and walkover survey are presented in Section 3. These findings have been drawn upon to identify potential impacts of the works on the hydromorphology of the water body at both local and water body scales. The findings have also been used to determine whether the works could cause a detrimental effect to the WFD status of the water body or prevent the achievement of GEP in the future.

2.2 WFD assessment stages

2.2.1 The WFD assessment follows guidance previously provided by UKTAG (2008). A sequence for undertaking an assessment of the compliance under the WFD has been developed in line with the guidance. Taking this into account the report structure is summarised below:

- Step 1: Identification of baseline conditions of the biological, physico-chemical and hydromorphological quality elements;
- Step 2: Identification of potential generic impacts from the Proposed Scheme on quality elements;
- Step 3: Site specific assessment of the proposed scheme against biological, physico-chemical and hydromorphological quality elements;
- Step 4: Review of actions to deliver WFD mitigation measures; and

- Step 5: Assessment of the Scheme against WFD status objectives, other EU legislation and overall compliance.

2.2.2 The Scheme has been assessed against the following three WFD objectives:

- That the Scheme does not cause a deterioration in the status of the biological quality elements of the water body.
- That the Scheme does not compromise the ability of the water body to achieve its WFD status objectives (including achievement of mitigation measures and/or actions).
- That the Scheme does not cause a permanent exclusion or compromise achievement of the WFD objectives in other water bodies within the same River Basin District (RBD) (Article 4.8 of the WFD legislation, see Annex A).

3 BASELINE CONDITIONS

3.1 River Don

Catchment overview

3.1.1 The River Don flows for approximately 15 km from its source in Springwell (west of the A194) to its confluence with the tidal Tyne at Jarrow. The river falls within the Environment Agency's Northumbria River Basin District under the Tyne Management Catchment. The river has an irregular meandering planform that appears to have been historically straightened in sections, including within the eastern reach of the River Don.

3.1.2 The surrounding land use is predominantly agricultural, particularly adjacent to the western reach. Elsewhere, the study area consists of grazed pasture, grassland and arable crop. The River Don channel corridor is vegetated by large grasses and scattered tree clusters to the west and a more continuous mature wooded corridor to the west. The eastern reach, whilst largely agricultural, also has a large urban area to the north-east of the A19 Downhill Lane junction, comprising West Boldon, East Boldon, Boldon and Boldon Colliery.

3.1.3 Tributaries include Whittle Burn, which flows into the River Don near Follingsby plus Monkton Burn, Calfclose Burn and Bede's Burn which join near Jarrow. In addition, there are several field drains and outfalls, which include: a tributary immediately east of the A19 Downhill Lane junction and fed by an existing Highways England outfall from Downhill Lane; a channel flowing between Hylton Grove Farm and Elliscope Farm; and a drain which flows from Washington.

Historical channel changes

3.1.4 Historic maps dating to 1862 reveal changes to the river channel are minimal and, where present, are generally associated with the construction and development of the A19.

3.1.5 Between 1967 and 1975 the railway that crossed the River Don channel was dismantled. The location of the dismantled trackway was replaced with the construction of the A19, the A1290 and the associated junction occupying its former position. These construction activities required culverting of the channel under the A19 and associated slip roads.

3.1.6 This junction was further developed between 1980 and 1992 where roundabouts were added to the A1290 from the east and west to provide means of access to the A19. Slip roads were added to the northern section of the A19 to allow access northbound and exit from the A19 heading southbound. This development required extension of the culvert to account for the new junction arms.

3.1.7 Additional modifications to the River Don which are not associated with the construction of the A19 include localised channel straightening immediately west of the North Eastern Railway (1862 and 1898) and downstream of Boldon bridge (1952 and 1967), and urban development.

3.1.8 Notably, between 1921 and 1967 Boldon Colliery expanded significantly. There was also an increase in the area of land being used by industrial buildings, particularly on the left bank of the channel from New Road. From 1952 to 1980

West Boldon and Boldon also expanded, with the urban areas adjacent to the right bank of the channel leaving a narrow river corridor of undeveloped land. During this time period (1952-1956) a new footbridge was installed over the channel between Shelley Avenue and Owen Drive.

Contemporary channel characteristics

Downstream of A19

3.1.9 The contemporary channel morphology of the River Don is varied with some signs of bankside erosion. At most locations the water was noted to be turbid and the channel bed could not be observed. However, where visible, bed material appeared to be predominantly silt. This was confirmed by a local farmer during the field visit. The majority of the banks appeared to have been historically impacted by dredging, and were high and vertical with very little riparian zone. Land use was observed to be primarily agricultural on both banks and extended to the river's edge (Figure 3.1). The lack of riparian vegetation, coupled with the short grass sword with shallow rooting, results in banks susceptible to erosion (Figure 3.2); erosion of the bank is further exacerbated by poaching caused by livestock.

Figure 3.1: Lack of riparian zone to the east of the A19

Figure 3.2: Eroding bank exacerbated by poaching

Upstream of A19

3.1.10 The upstream reach of the River Don has semi-continuous tree cover along both channel banks, thus it is unlikely to be poached by cattle or grazing animals. Additionally, tree roots assist with soil binding and bank strengthening and subsequently reduce rates of bank erosion.

WFD status

3.1.11 A baseline description of the biological, physico-chemical and hydromorphological quality elements for the surveyed stretch of the River Don is provided in Table 3.1.

Table 3.1 Baseline description of biological, physico-chemical and hydromorphological quality elements for River Don water body

Water body ID	GB103023075690
Water body name	Don from Source to Tidal Limit
Overall Ecological Status	Moderate Ecological Potential
Biological quality elements	
Composition and abundance of aquatic flora	Limited in-channel macrophytes throughout the reach. Majority of banks were vegetated with terrestrial vegetation.
Composition and abundance of benthic invertebrate fauna	No data.
Composition, abundance and age of structure of fish fauna	No data.
Physico-chemical quality elements	
Thermal conditions Oxygenation conditions Salinity Acidification status Nutrient conditions	EA monitoring is conducted on the River Don near Mount Pleasant. 40 determinands are taken for the water course including pH, temperature, conductivity, ammonia, nitrogen, and dissolved oxygen. The latest measurements (Oct 2015 -Jan 2018) taken by EA monitoring for displayed below in the following format: • Determinand (unit) – Range low-Range high (Most recent) • pH – 7.76-8.26 (5.3) • Temperature (°C) – 5-14.4 (7.76) • Conductivity (µs/cm) – 968-1968 (1277) • Ammonia N (mg/l) - <0.03-0.05 (0.04) • Total Nitrogen (mg/l) – 1.27-5.42 (2.23) • Dissolved O2 (mg/l) – 8.76-15.7 (11.7) • The River Don has High physico-chemical quality according to 2016 cycle 2 WFD data.
Hydromorphological quality elements	
Quantity and dynamics of water flow	The majority of the river had a uniform flow type, primarily consisting of smooth flow with occasional run sequences. The river was observed at high flow.
Connection to groundwater bodies	Both reaches lie over a Secondary A bedrock aquifer. The reach downstream of the A19 also passes over a Principal Aquifer to the east of the study area for a short length. The channel lies over Tyne Carboniferous Limestone and Coal Measures WFD groundwater body (GB40302G701500)1 which is currently achieving good quantitative quality status and poor chemical quality status.
River continuity	Longitudinal connectivity was impacted in the reach downstream of the A19 by a small weir feature, the A184

[1] Note that the proposed scheme does not include any drainage to the ground and it is assumed that the Tyne Carboniferous Limestone and Coal Measures WFD groundwater body (GB40302G701500) will be unaffected.

	road bridge and a culvert under the current A19 road. Lateral connectivity was impacted throughout the reach downstream of the A19 with an incised channel and the presence of a small embankment on the right bank (0.2-0.3m). However, communication with a local farmer confirmed that the floodplain on both banks flooded regularly.
River depth and width variation	Channel width remained uniform at approximately 1.5m throughout the reach immediately downstream of the A19. The depth of the channel was not visible due to high turbidity at the time of survey.
Structure and substrate of the river bed	The structure and substrate of the river bed was not visible due to high flows and turbidity at the time of survey. Communication with a local farmer confirmed that the bed of the channel downstream of the A19 predominantly consisted of silt.
Structure of the riparian zone	No substantial vegetated buffer zone throughout the length of surveyed water body. Riparian zone consisted of isolated trees and some shrubs downstream of the A19. The upstream reach differed, with vegetation consisting of shrubs and more continuous woodland riparian corridor

3.2 River Wear

Catchment Overview

3.2.1 The River Wear has its source 13 km upstream of Wearhead, County Durham and flows a total of 121 km in an easterly direction to the North Sea at Sunderland. The river falls within the Environment Agency's Northumbria River Basin District under the Tyne Management Catchment.

3.2.2 Being a large watercourse the channel has a range of modified and natural reaches; however, the channel has a primarily meandering planform.

3.2.3 The land use within the catchment west of Chester-le-Street is rural, with a mixture of pastoral and arable agricultural land. Several areas of woodland are present within the catchment and the river is lined with trees from Frosterly to Bishop Auckland. This provides bank stability, marginal shading and a buffer for silt laden run-off. Downstream of Bishop Auckland tree lining is fragmented with lengths of very little tree cover and lengths of dense woodland, notably from Sunderland Bridge to Chester le-Street. A number of urban areas are present within the upper catchment, notably; Bishop Auckland, Spennymoor and Durham.

3.2.4 East of Chester-le-Street the catchment is more urban. The cities and towns of Sunderland, Washington, Chester-le-Street and New Herrington are located within this area.

3.2.5 A number of tributaries discharge to the River Wear, the largest of which are the Browney, Twizell Burn, the Gaunless and Lumley Park Burn.

WFD status

3.2.6 Discharges from The Scheme will potentially impact the River Wear in the downstream section of the watercourse that is a transitional WFD water body. A baseline description of the biological, physico-chemical and hydromorphological quality elements for the River Wear is provided in Table 3.2.

Table 3.2 Baseline description of biological, physico-chemical and hydromorphological quality elements the WEAR transitional water body

Water body ID	GBGB510302402900
Water body name	Wear Transitional water body
Overall Ecological Status	Moderate Ecological Potential
Biological quality elements	
Composition, abundance and biomass of phytoplankton	No data
Composition and abundance of other aquatic flora	
Composition and abundance of fish fauna	
Composition and abundance of fish benthic invertebrate fauna	
Physico-chemical quality elements	
Transparency	EA monitoring is conducted on the River Wear at Chester-le-Street. 151 determinands are taken for the watercourse including pH, temperature, conductivity, ammonia, nitrogen, and dissolved oxygen. The latest measurements (April 2017 – December 2017) taken by EA monitoring for displayed below in the following format: • Determinand (unit) – Range low-Range high (Most recent) • pH – 7.43-8.49 (7.96) • Temperature (°C) – 6.9-17.6 (7.96) • Conductivity (µs/cm) – 472-1032 (655) • Ammonia N (mg/l) - <0.03-0.176 (0.169) • Total Nitrogen (mg/l) – 2.56-6.08 (4.09) • Orthophosphate (mg/l) – 0.083 – 0.185 (0.083) • Dissolved O2 (mg/l) – 8.34-13.7 (11.6) • Turbidity (ntu) – 1.8-8.4 (4.1) It has Moderate physico-chemical quality according to 2016 cycle 2 WFD data and moderate chemical quality.
Thermal conditions	
Oxygenation conditions	
Salinity	
Nutrient conditions	
Specific Pollutants	
Hydromorphological quality elements	
Depth Variation	No Data
Quantity, structure and substrate of the bed	Substrate visible from aerial imagery appeared to consist of silts and sands.
Structure of the intertidal zone	Sands and muds are present within the intertidal zone. Bank reinforcement in the form of rip-rap and concrete walls are present along the majority of both banks from Castletown to the mouth of the river. Small isolated areas

	of mudflats are also present. There are no intertidal marshes obviously visible from aerial imagery.
Freshwater flow	Freshwater flow is provided by the River Wear catchment.
Wave exposure	Aerial imagery suggests that, due to modifications around of the mouth of the River Wear, particularly two large breakwaters, there appears to be little exposure of the water body to waves.

4 WFD ASSESSMENT

4.1 Proposed works

4.1.1 The Scheme provides for the alteration of the existing A19 junction with Downhill Lane and the A1290.

4.1.2 The Scheme involves utilising two existing outfalls (i.e. the locations at which run-off is discharged into a watercourse); the locations of these outfalls are shown on Figure 2.5 in Volume 2 of the Environmental Statement.

- adjacent to the A1290 (Outfall 7), discharging indirectly to the River Wear via the existing drainage system; and
- adjacent to the A19 (connection point to Outfall 8), discharging indirectly to the River Wear via the existing drainage system.

4.1.3 The Scheme also includes changes to the existing outfall arrangement for two of the catchment areas:

- Outfall 6, from Catchment 6, to a tributary of the River Don would be removed as part of the Scheme, and a new Outfall 6 constructed downstream of this location to allow for construction of other features; and
- Outfall 4 to the River Don would be abandoned as part of the Scheme and the drainage system for Catchment 4 would discharge via Outfall 1 (to be constructed as part of the Testo's scheme) in combination with Catchment 1's discharge.

4.1.4 The rate of additional discharge from Catchments 4, 6, 7 and 8 would be restricted to greenfield runoff rates, resulting in a decrease from the existing rates. Therefore, the Scheme would result in marginal benefit to areas downstream during rainfall events more extreme than the greenfield rate.

4.2 Step 1: Potential generic operational impacts of the Scheme on the quality elements

4.2.1 Table 4.1 lists the potential impacts and mitigation measures provided by the UK-Technical Advisory Group (UKTAG) (2008) guidance for a series of generic pressures; those most relevant to the Scheme have been detailed.

Table 4.1 Pressures, potential impacts and associated mitigation measures for works to water bodies (UKTAG 2008 - Annex IV: Flood Risk Management)

Pressure	Potential impacts	Mitigation measure
Bank and bed reinforcement and in-channel structures	Loss of riparian zone/marginal habitat/ loss of lateral connectivity/ loss of sediment input	Removal of hard bank reinforcement / revetment or replacement with soft engineering solution
		Protect and enhance ecological value of marginal aquatic habitat, banks and riparian zone
		Protect and restore historic aquatic habitats
	Loss of sediment continuity (lateral) – build-up of sediment in	Removal of hard bank reinforcement / revetment or replacement with soft engineering solution

Pressure	Potential impacts	Mitigation measure
	the channel	Protect and enhance ecological value of marginal aquatic habitat, banks and riparian zone
		Protect and restore historic aquatic habitats
Pipes, inlets, outlets and off-takes	Hydromorphological alterations of water and sediment inputs through artificial means	Appropriate techniques to align and attenuate flow to limit detrimental effects of these features

4.3 Step 2: Site specific assessment of the Scheme against biological, physico-chemical and hydromorphological quality elements

4.3.1 The utilisation of the existing outfall directly into the River Don is not considered within the assessment with regards to the hydromorphological element of the WFD assessment as the existing river bed and bank would not be compromised. Thus, the assessment here relates to the effect of the new attenuation ponds and discharge issued via outfalls 1 and 6 to the River Don downstream of the A19, and the creation of the new outfall 6 structure. Table 4.2 details the potential operational effects of the Scheme on the River Don.

4.3.2 The utilisation of both existing outfalls that discharge to the River Wear are not considered with regards to the hydromorphological element of the WFD assessment as the existing river bed and bank would not be compromised. Thus, the assessment here relates to the effect of the new attenuation ponds and attenuation ditch and discharges issued via outfalls 7 and 8. Table 4.3 details the potential operational effects of the scheme on the River Wear.

Table 4.2 Operational effects on the biological, physico-chemical and hydromorphological quality elements for the River Don source to Tidal Limit

Water body ID	GB103023075690
Water body name	Don from Source to Tidal Limit
Biological quality elements	
Composition and abundance of aquatic flora	<u>New outfall 6</u> Localised potential effect from marginal habitat loss due to new outfall on a small drainage ditch that flows into the River Don. No macrophytes were identified within the ephemeral ditch at the time of survey, thus no impact would be expected. <u>Discharge</u> No significant additional discharge would be expected to be issued from the Scheme and any additional discharge would be issued at greenfield run-off rates. No impact was anticipated to the water quality of the River Don watercourse. Existing discharge is not attenuated and any soluble or insoluble pollutants are transported via the ephemeral tributary to the River Don. The attenuation of water from outfalls 1 and 6 (via new attenuation ponds) would likely improve the water quality of the discharge from the Scheme possibly resulting in a minor beneficial impact, notably for pollution intolerant macrophyte species.
Composition and abundance of benthic invertebrate fauna	<u>New outfall 6</u> A small portion of the concrete structure could extend into the bed of the channel. This could affect current populations of benthic invertebrate found within the drainage ditch and reduce the immediate availability of benthic habitat. However, the impact was assessed as being negligible due to the overgrown, shaded and ephemeral nature of the channel. <u>Discharge from outfalls 1 and 6</u> No significant additional discharge is expected to be issued from the Scheme and any additional discharge would be at greenfield run-off rates. No impact was anticipated to the water quality of the River Don watercourse. Existing discharge is not attenuated and any soluble or insoluble pollutants are transported via the ephemeral drainage ditch to the River Don. The attenuation of outfalls 1 and 6 (via new attenuation ponds) would likely improve the water quality of the discharge from the Scheme, possibly resulting in a minor beneficial impact. Improved water quality could result in an increase in the composition and abundance of pollution intolerant species.

Composition, abundance and age of structure of fish fauna	New outfall 6 No fish were identified in the tributary that is being discharged to, therefore no impact is expected as a result of the new of the outfall. Discharge from outfalls 1 and 6 No significant additional discharge would be expected to be issued from the Scheme and any additional discharge would be at greenfield run-off rates. No impact was anticipated to the water quality of River Don watercourse. Existing discharge is not attenuated and any soluble or insoluble pollutants are transported via the ephemeral drainage ditch to the River Don. The attenuation of outfalls 1 and 6 (via new attenuation ponds) could improve the water quality of the discharge from the Scheme possibly resulting in a minor beneficial impact.
Physico-chemical quality elements	
Thermal conditions	No temperature measurements were taken during surveys, therefore impacts are based solely on technical judgment. Discharge from Outfalls 1 and 6 The flow from the outfall could potentially have a different temperature to that of the channel and could have a localised impact the ecology of the water body. Impact considered negligible.
Oxygenation conditions	The oxygenation conditions are unknown and the impact cannot therefore be fully assessed. New Outfall Water entering into the watercourse from an elevated height could create very localised oxygenated water. Impact considered negligible.
Salinity	No impact anticipated.
Acidification status	The existing conditions are currently unknown so any statement is based on technical judgment. Discharge from Outfalls 1 and 6 The discharge for both outfalls 1 and 6 would have passed through new attenuation ponds. It is assumed that this would help attenuate any pollutants carried from the road drainage before it enters the water body. The water entering the channel should not impact on the overall acidification or nutrient conditions of the water body.
Nutrient conditions	

Overall water quality	A Highways Agency (now Highways England) Water Risk Assessment Tool (HAWRAT) has been used to investigate the effects of routine runoff on the River Don. The results of this are detailed in Section 14.6 of Chapter 14 of the ES (Road Drainage and Water Environment). The results indicate that outfalls 1 and 6 pass for soluble pollutants. For sediment, pollutants values were assessed to fall within the alert category. This result is due to the proximity of a designated site (within 1km). Subsequently, the Scheme is considered to have achieved a pass under HAWRAT. The outfalls also pass with respect to EQS values. Having both passed against the HAWRAT and EQS no significant effect would be expected with regards to WFD. The attenuation of runoff from outfalls 1 and 6 could provide a minor benefit as run off was previously discharged un-attenuated. Attenuation would allow pollutants and sediments to settle reducing pollutant concentrations in discharged water.
Hydromorphological quality elements	
Quantity and dynamics of water flow	<u>New outfall 6</u> The quantity and dynamics of water flow could be locally impacted by the installation of an outfall on the channel. Local flow patterns are likely to be altered depending on the angle at which the flow would be directed. However, due to the small size and nature of the tributary, this impact was considered to be negligible. The overall flow volume within the tributary of the River Don could also be higher as a result of increased water quantity entering the water body; however, this was anticipated to be minimal and localised. This would be unlikely to have a significant impact on the downstream River Don.
Connection to groundwater bodies	<u>New outfall 6</u> A small portion of the structure would extend into the bed of the tributary. This could have an impact on groundwater connectivity; however, this is unlikely to be significant due to the small portion of bed which would be occupied by the structure and the size of the channel.
River continuity	<u>New outfall 6</u> The outfall headwall would likely have a small impact on lateral connectivity of the water body within the floodplain. However, it is unlikely that this impact would be significant.
River depth and width variation	<u>New outfall 6</u> The outfall headwall might cause a slight variation to the width of the river tributary. Depending on the angle at which the outfall would be directed, the potential increase in water quantity and velocity could create areas of bank and bed erosion which would locally impact on channel depth and width. However, due to the small size and nature of the tributary, this was anticipated to be a negligible impact.

Structure and substrate of the river bed	New outfall 6 Depending on the height of the new outfall from the channel bed and discharge quantity, the possible increase in water velocity and quantity could remove some finer natural bed material locally providing a slight benefit. However, this was anticipated to be a negligible impact
Structure of the riparian zone	New outfall 6 A concrete outfall headwall would locally impact on a portion of the bank and bank top. This would mean a small area of the riparian zone would be permanently removed, affecting vegetation growth in this area.

Table 4.3 Operational effects on the biological, physico-chemical and hydromorphological quality elements for the WEAR

Water body ID	GB510302402900
Water body name	WEAR
Biological quality elements	
Composition and abundance of aquatic flora	No impact anticipated. Discharge from The Scheme would be attenuated and released to the River Wear through existing outfalls. Outfall 7 would be attenuated by a new attenuation ditch with pond to the south-west. Outfall 8 would be attenuated by a new attenuation pond located to the south-east of the Scheme.
Composition and abundance of benthic invertebrate fauna	
Composition, abundance and age of structure of fish fauna	
Physico-chemical quality elements	
Thermal conditions	No impact anticipated. Discharge from the Scheme would be attenuated and released to the River Wear through existing outfalls. Outfall 7 would be attenuated by a new attenuation ditch with pond to the south-west. Outfall 8 would be attenuated by a new attenuation pond located to the south-east of the Scheme.
Oxygenation conditions	
Salinity	
Acidification status	
Nutrient conditions	

Overall water quality	A Highways Agency (now Highways England) Water Risk Assessment Tool (HAWRAT) was used to assess the impact of outfall 8a, a piped section of the watercourse at the request of Sunderland City Council; however to make sure that any effects at the next open channel section are identified, an assessment has also been undertaken downstream at 8b. HAWRAT was used to assess outfalls 7 and 8 at point 8a and 8b, which was assessed to pass for soluble pollutants. For sediment pollutants, values for 7 are assessed to pass and values for 8a and 8b are assessed to fall within the alert category. This result was due to the proximity of a designated site (within 1 km). Subsequently, the Scheme was considered to have achieved a pass under HAWRAT. The attenuation of runoff from outfalls 7 (by a new attenuation ditch and pond) and 8 by a new attenuation ponds could provide a minor benefit as run off was previously discharged un-attenuated. Attenuation would allow pollutants and sediments to settle reducing pollutant concentrations in water discharged from the Scheme to existing drainage.
Hydromorphological quality elements	
Quantity and dynamics of water flow	No impact anticipated. Discharge from the Scheme would be attenuated and would be issued from an existing outfall.
Connection to groundwater bodies	
River continuity	
River depth and width variation	
Structure and substrate of the river bed	
Structure of the riparian zone	

4.4 Step 3: Review of actions to deliver WFD objectives

4.4.1 The specific WFD water body mitigation measures for the Don source to tidal limit HMWB WFD water body for the second reporting cycle (Cycle 2, 2015-2021) were not obtained for the completion of this assessment. However, the potential impacts highlighted in Section 4.3 summarise that the potential impacts were not anticipated to be significant or cause an impact at a water body scale. As a result, it was not anticipated that there would be an impact on the implementation of the specific mitigation measures for the Don source to tidal limit WFD water body, or lead to any change in those measures currently in place. An assessment has been made of the catchment wide mitigation measures for the Northumberland operational catchment. This is outlined below and accounts for the previous Cycle 1 measures.

4.4.2 The actions outlined below have been grouped according to the pressure they are aimed to address/relieve. The following provides a summary of the key pressures that would potentially be impacted by the Scheme.

Priority hazardous substances

4.4.3 As outlined in the Environment Agency and Highways Agency Memorandum of Understanding, highway surface runoff could contain soluble and insoluble pollutants. To address the pressure of priority hazardous substances, priority substances, specific pollutants and non-hazardous pollutants a number of actions have been identified. Amongst these actions it was identified that the SUDS (sustainable drainage systems) Interim Code of Practice should be followed alongside compliance with published advice for operators.

4.4.4 The runoff from the Scheme would initially pass through an attenuation pond prior to being discharged into the River Don. This would be a form of SuDS likely to aid removal of road pollutants from the water (particularly those bound with fine sediment). Therefore, the Scheme would comply with the actions to address priority hazardous substances identified in the RBMP. Pesticides are not relevant in this context.

Physical modification

4.4.5 To address the pressure of physical modification the WFD mitigation measures manual for flood risk management and land drainage activities sets out best practice options for measures to mitigate against the impacts of such activities upon ecology.

4.4.6 The Scheme involves replacement of some natural bank material with artificial material around the new outfall headwall, but does not extensively introduce hard bank reinforcement. Overall, the Scheme would comply with the relevant RBMP actions and does not compromise other RBMP actions to reduce the pressures attributed to physical modifications.

Alien species

4.4.7 To address the pressure of alien invasive species the following action has been identified in the RBMP:

- Establish invasive non-native species forum for the River Basin District to improve communications, identify existing work, share information and best practice, identify key people, coordinate projects and prioritise key species.

4.4.8 The Scheme involves the localised removal of vegetation around the outfall structure. If alien species are identified on site, appropriate mitigation measures would be carried out, following Environment Agency guidelines, so this is addressed sufficiently.

Organic pollutants

4.4.9 To address the pressure of organic pollutants the following RBMP action has been identified:

- Improved or more targeted street and drain cleaning and maintenance of storm water systems.

4.4.10 The runoff from the Scheme would initially pass through an attenuation pond prior to being discharged into the River Don. This would be in the form of SuDS likely to aid removal of road pollutants from the water (particularly those bound with fine

sediment). Therefore, the Scheme would be likely to comply with the actions to address organic pollutants.

4.5 Step 4: Assessment of the Scheme against WFD objectives

4.5.1 This section comprises an analysis of the effects of the Scheme on the River Don's WFD objectives. The analysis is summarised in Tables 4.4 and 4.5.

4.5.2 Article 4.9 of the WFD requires that: "*Member States shall ensure that the application of the new provisions guarantees at least the same level of protection as the existing Community legislation*". The Scheme would not compromise any other EU legislation.

4.5.3 The following mitigation would be considered as part of the drainage design and this is anticipated to minimise impacts on the River Don:

- direct the new outfall downstream to minimise impacts to flow patterns;
- direct the new outfall away from the banks of a river to minimise any potential risk of erosion (particularly on the opposite bank); and
- minimise the size/extent of the outfall headwall where possible to reduce the potential impact on the banks.

Table 4.4 Assessment of proposed options against WFD status objectives

Water body ID	GB103023075690
Water body name	Don from Source to Tidal Limit
Deterioration in the status/potential of the water body	Deterioration is not expected as a result of the works.
Ability of the water body to achieve Good Ecological Status	The water body is currently achieving Moderate Ecological Potential. The Scheme is unlikely to affect the ability of the water body to achieve good ecological status with only very localised impacts anticipated.
Impact on the WFD objectives of other water bodies within the same RBD	It is unlikely that the Tyne estuarine WFD water body (GB510302310200) would be negatively impacted by the Scheme. This water body is located more than 7.5 km from the Scheme and any pollutants or fine sediment would be likely to settle in the attenuation pond and River Don water body prior to the confluence.

Table 4.5 Assessment of proposed options against WFD status objectives

Water body ID	GB510302402900
Water body name	WEAR
Deterioration in the status/potential of the water body	Deterioration is not expected as a result of the works.
Ability of the water body to achieve Good Ecological Status	The water body is currently achieving Moderate Ecological Potential. The Scheme is unlikely to affect the ability of the water body to achieve Good Ecological Status with only very localised impacts anticipated.
Impact on the WFD objectives of other water bodies within the same RBD	It is unlikely that the Tyne and Wear coastal WFD water body (GB650301500002) would be negatively impacted by the Scheme. This water body is located more than 7.5 km from the Scheme and any pollutants or fine sediment would be likely to settle in the attenuation ponds, attenuation ditch or River Wear water body prior to the confluence.

5 WFD ASSESSMENT CONCLUSION

5.1.1 The River Don is identified as a WFD water body by the Environment Agency, thus a WFD assessment is required to assess the impacts of the Scheme. The Scheme would involve utilising three existing outfalls, one discharging to the River Don to be constructed as part of the Testo's scheme (outfall 1) and two discharging indirectly (via existing drainage) to the River Wear (outfall 7 and 8), and the addition of one new outfall on a tributary of the River Don to the east (outfall 6). The rate of additional discharge from Catchments 6 and 8 would be restricted to greenfield runoff rates. The rate of additional discharge from Catchments 4 and 7 would be restricted, resulting in a decrease from the existing rates. Therefore, the Scheme would result in marginal benefit to areas downstream during rainfall events more extreme than the greenfield rate.

5.1.2 Attenuation is also provided by new attenuation ponds for outfalls 1, 6 and 8, plus a new attenuation ditch with pond for outfall 7. Thus, all outfalls from the Scheme would be attenuated. The WFD assessment firstly considered the effects of the Scheme on the biological, physico-chemical and hydromorphological quality elements of the water body.

5.1.3 It was considered that the existing outfalls on both the River Wear and River Don would have a negligible impact as the current river bed and bank would not be compromised and would not include any additional discharge volume.

5.1.4 The headwall of the proposed new outfall would remove a small portion of natural bank and riparian vegetation. It has been assessed that the impact of the outfall structure would be negligible and would be unlikely to affect the River Don source to tidal limit WFD water body.

5.1.5 It is possible that the small overall increase in the range of flows and the local scouring of areas surrounding the outfall could prevent siltation and cause gravels to be cleaned, which could be of local benefit to aquatic fauna.

5.1.6 Pollutant concentrations in sediments discharged from the Scheme to the River Don by outfalls 1 and 6 were assessed to be within the alert category; this is due to the site being within 1 km of a designated site. Consequently, this has been assessed as potentially having a negligible impact to the existing water quality of the River Don. The attenuation pond would be expected to encourage siltation (removing fine sediments derived from the road surfaces) and lead to entrapment of some pollutants (such as those attached to fine sediment). Attenuation of discharge issued from outfalls 1 and 6 could provide a minor benefit to the River Don source to tidal limit WFD water body.

5.1.7 Outfalls 7 and 8 were also assessed as alert due to proximity to a designated site and has been assessed as having a negligible impact upon the River Wear water body. Attenuation of flows from outfalls 7 and 8 was anticipated to improve water quality of run-off from Downhill Lane junction and provide a minor beneficial impact to the River Wear.

5.1.8 This assessment has shown that the proposed A19 Downhill Lane Junction Improvement Scheme would be compliant under the WFD, and that the works are

unlikely to result in the deterioration or prevention of improvements in the overall WFD status of the River Don or any downstream water bodies.

6 REFERENCES

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ANNEX A: ENVIRONMENTAL OBJECTIVES OF THE WFD

Table A-1 presents Article 4 of the WFD (2000/60/EC) for surface waters.

Table A-1 Environmental Objectives of the WFD

Environmental Objectives	Reference
Surface Water	
Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water.	Article 4.1(a)(i)
Member States shall protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015.	Article 4.1(a)(ii)
Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015.	Article 4.1(a)(iii)
Member States shall implement the necessary measures in accordance with Article 16(1) and (8), with the aim of progressively reducing pollution from priority substances and ceasing or phasing out emissions, discharges and losses of priority hazardous substances.	Article 4.1(a)(iv)
Member States will not be in breach of this Directive when: failure to achieve good ecological status or, where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water is the result of new modifications to the physical characteristics of a surface water body; or failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities and the following conditions are met: All practicable steps are taken to mitigate the adverse impact on the status of the body of water; The reasons for those modifications or alterations are specifically set out and explained in the river basin management plan required under Article 13 and the objectives are reviewed every six years; The reasons for those modifications or alteration are of overriding public interest and/ or the benefits to the environment and to society of achieving the objectives set out in paragraph 1 are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development; and The beneficial objectives served by those modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option.	Article 4.7
Other Water Bodies	
Member State shall ensure that the application does not permanently exclude or compromise the achievement of the objectives of this Directive in other bodies of water within the same river basin district and is consistent with the implementation of other Community environmental legislation.	Article 4.8
Other EU Legislation	
Member State shall ensure that the application of the new provisions guarantees at least the same level of protection as the existing Community legislation.	Article 4.9