Appendix F: Predicted concentrations of dissolved copper and total zinc in waterbodies receiving road runoff

Table F1: Western routes water quality assessment

Route	Estimated Drainage Network	Assumed Outfall *	Predicted Concentration of Copper (ppb)	EQS for Copper (ppb)	Predicted Concentration of zinc (ppb)	EQS for zinc (ppb)	Return Period of Pollution Incident (no. of Years), for emergency response < or > 20 mins	
							< 20 mins	> 20 mins
Red	A	River Tud	10	112	49	500	2231	1339
	B	groundwater	351	2000	1462	5000	4029	4029
	C	groundwater	351	2000	1462	5000	6043	6043
	D	River Wensum	3.6	112	23	500	815	489
	E	River Wensum					738	443
	F	groundwater	117	2000	585	5000	1978	1978
	G	groundwater	351	2000	1462	5000	9271	9271
	H	groundwater	351	2000	1462	5000	5418	5418
Blue	A	River Tud	9.5	112	47	500	2222	1333
	B	River Wensum	4.5	112	26	500	600	360
	C	River Wensum					709	425
	D	groundwater	117	2000	585	5000	1833	1833
	E	groundwater	351	2000	1462	5000	9081	9081
	F	groundwater	351	2000	1462	5000	5307	5307
Orange	A1	River Tud	9.1	112	45	500	2142	1285
	B1	River Wensum					2298	1379
	C	River Wensum	4.4	112	26	500	798	479
	D	River Wensum					690	414
	E	groundwater	117	2000	585	5000	1791	1791
	F	groundwater	351	2000	1462	5000	9112	9112
	G	groundwater	351	2000	1462	5000	5326	5326
Green	A	River Tud	17	112	78	500	800	480
	B	River Wensum	3.3	112	21	500	993	596
	C	groundwater	351	2000	1462	5000	1741	1741
	D	groundwater	351	2000	1462	5000	12042	12042
	E	groundwater	351	2000	1462	5000	4856	4856
Purple	A	River Tud	5.8	112	34	500	7873	4724
	B	River Tud					3368	2021
	C	groundwater	117	2000	585	5000	4066	4066
	D2	groundwater	117	2000	585	5000	1166	1166
	E2	groundwater	117	2000	585	5000	1008	1008
	F	groundwater	117	2000	585	5000	2244	2244
	G	groundwater	351	2000	1462	5000	7416	7416

Route	Estimated Drainage Network	Assumed Outfall *	Predicted Concentration of Copper (ppb)	EQS for Copper (ppb)	Predicted Concentration of zinc (ppb)	EQS for zinc (ppb)	Return Period of Pollution Incident (no. of Years), for emergency response < or > 20 mins	
							< 20 mins	> 20 mins
	H	groundwater	351	2000	1462	5000	5358	5358
Brown	A	River Tud	7.0	112	40	500	2520	1512
	B	River Tud					6456	3874
	C	groundwater	117	2000	585	5000	3289	3289
	D2	groundwater	117	2000	585	5000	1166	1166
	E2	groundwater	117	2000	585	5000	1008	1008
	F	groundwater	117	2000	585	5000	2296	2296
	G	groundwater	351	2000	1462	5000	7520	7520
	H	groundwater	351	2000	1462	5000	5433	5433
Purple Variation	A	River Tud	5.8	112	34	500	7873	4724
	B	River Tud					3368	2021
	C	groundwater	117	2000	585	5000	4066	4066
	D1	River Wensum	3.5	112	22.7	500	584	350
	E1	River Wensum					861	517
	F	groundwater	117	2000	585	5000	2244	2244
	G	groundwater	351	2000	1462	5000	7416	7416
	H	groundwater	351	2000	1462	5000	5358	5358
Brown Variation	A	River Tud	7.0	112	40	500	2520	1512
	B	River Tud					6456	3874
	C	groundwater	117	2000	585	5000	3289	3289
	D1	River Wensum	3.5	112	23	500	586	352
	E1	River Wensum					869	521
	F	groundwater	117	2000	585	5000	2296	2296
	G	groundwater	351	2000	1462	5000	7520	7520
	H	groundwater	351	2000	1462	5000	5433	5433

* The fundamental principle for water quality and drainage is wherever possible SuDs would be proposed with an outfall to groundwater, rather than outfall into either the River Tud or Wensum, however for this section the outfalls have been consider for both.

Environmental Quality Standards (EQS) are derived from the EU Dangerous Substances Directive and are also applied to the EA River Ecosystem Classification. Standards applied in this study are taken from class RE1 (assumed for Rivers Wensum and Tud). As Environmental Quality Standards (EQS) are not available for drinking water, Drinking Water Inspectorate (DWI) Standards for Copper (2000) and Total Zinc (1989) have been applied to screen groundwater contamination.

95 percentile flow (Q95) data for Rivers Wensum and Tud have been obtained from the Centre for Ecology and Hydrology, BGS Wallingford, Hydrological data UK Hydrometric Register and Statistics 1991 - 1996 at:

- River Wensum gauging station 034004: Costessy Mill, NGR 617700 312800
- River Tud gauging station 034005: Costessy Park, NGR 617000 311300

Precise road areas, drainage networks and outfall points will be used in calculations when full detailed road and drainage designs are available. Current calculations are based on projected drainage networks, estimated from topography/vertical route alignments. Outfall locations have been assumed depending on water features located at low points in the vertical alignments.

If dewatering of the ground is required for a tunnel structure (if the base of tunnel lies beneath groundwater levels), this abstracted water will have to be discharged at a distant location. Also the abstraction may draw in local groundwater, which will continue the problem of the presence of groundwater, may disrupt local abstractions and may disrupt the drainage plans of nearby road drainage networks, e.g. may draw in poor quality water to the tunnel vicinity from soakaways and balancing ponds. This may disrupt the residence requirements of runoff water for mitigation of contaminants, thus rendering such measures less effective.

Table F2: Eastern routes water quality assessment

Route	Estimated Drainage Network	Assumed Outfall	Predicted Concentration of Copper (ppb)	EQS for Copper (ppb)	Predicted Concentration of zinc (ppb)	EQS for zinc (ppb)	Return Period of Pollution Incident (no. of Years), for emergency response < or > 20 mins	
							< 20 mins	> 20 mins
Blue	A1	groundwater	117	2000	585	5000	6938	6938
	B1	groundwater	233	2000	1020	5000	1688	1688
	C	groundwater	351	2000	1462	5000	4580	4580
	D	groundwater	351	2000	1462	5000	4466	4466
	E	groundwater	351	2000	1462	5000	2566	2566
	F	groundwater	351	2000	1462	5000	5953	5953
Yellow	A	groundwater	351	2000	1462	5000	6544	6544
	B	groundwater	287	2000	1224	5000	1575	1575
	C	groundwater	351	2000	1462	5000	3637	3637
	D	groundwater	351	2000	1462	5000	2913	2913
	E	groundwater	351	2000	1462	5000	5792	5792
Pink	A	groundwater	351	2000	1462	5000	6295	6295
	B	groundwater	351	2000	1462	5000	1204	1204
	C	groundwater	351	2000	1462	5000	3809	3809
	D	groundwater	351	2000	1462	5000	4037	4037

Environmental Quality Standards (EQS) are derived from the EU Dangerous Substances Directive and are also applied to the EA River Ecosystem Classification. Standards applied in this study are taken from class RE1 (assumed for Rivers Wensum and Tud). As Environmental Quality Standards (EQS) are not available for drinking water, Drinking Water Inspectorate (DWI) Standards for Copper (2000) and Total Zinc (1989) have been applied to screen groundwater contamination.