Appendix 11.2

Water Quality Assessment

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1 Introduction

1.1.1 Potential impacts on surface and groundwater may occur as a result of the Proposed Scheme for Project 8 (Dalwhinnie to Crubenmore) during both construction and operational phases. Impacts may occur, for example, from pollution from site runoff (construction) or accidental spillage (operation). Further details on potential impacts are provided in **Chapter 11**. Pollutants from runoff, such as heavy metals (copper and zinc), suspended solids, and hydrocarbons can enter watercourses and detrimentally impact sensitive species, and/ or infiltrate the groundwater table and affect potable water supplies.

1.1.2 The Proposed Scheme is located in the vicinity of areas designated for their protected species (i.e. Special Areas of Conservation (SAC), Special Protection Areas (SPA), and Sites of Special Scientific Interest (SSSIs); therefore, road runoff is required to be treated before discharging to watercourses in order to satisfy the requirements of statutory bodies such as the Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH). Further detail on protected species and habitats is provided in **Chapter 12**.

1.1.3 The Proposed Scheme design has been developed through an environmentally-led iterative process. Details of the initial assessments undertaken in a pre-mitigation scenario are provided in this appendix. These findings informed the design development by identifying potential impacts of a preliminary design on the water environment (as well as adverse impacts to the Proposed Scheme by the water environment), from which necessary mitigation requirements were established and 'embedded' into the design that is assessed in **Chapter 11**.

2 Approach and Methods

2.1.1 Water quality has been assessed in line with Design Manual for Roads and Bridges (DMRB) HD45/09 guidance. Methods outlined in DMRB are used to determine potential pollution impacts from:

- Routine Runoff to Surface Waters (Method 'A')
- Detailed Assessment of Pollution Impacts from Routine Runoff to Surface Waters (Method 'B')
- Assessment of Pollution Impacts from Routine Runoff on Groundwater (Method 'C')
- Assessment of Pollution Impacts from Spillages (Method 'D')

2.1.2 The assessment focuses on outfalls from the A9 mainline and local or side roads which have been identified in Scottish Planning Policy (SPP) as sources of pollution to rivers and streams requiring appropriate treatment in the form of Sustainable Drainage Systems (SuDS). Outfalls from accommodation tracks and NMUs (surfaced or unsurfaced) will not be assessed individually but will normally require a basic single level of treatment. Guidance on the appropriate treatment for tracks and NMUs has been followed as per Annex 2 – *'Side Road and Accommodation Track SUDS'* (AMJV, 2015).

2.1.3 SEPA has been consulted on the design approach for SuDS; this has also been discussed on a scheme-wide basis at Environmental Steering Group meetings. Proposed treatment for the Project 8 drainage networks has been confirmed through discussions with the design teams and is outlined in **Table 1**.

Table 1: Summary of proposed SuDS features for outfalls

SuDS ID	1st Level SuDS	2nd Level SuDS	Inclusion of Micro-pool	Outfall Form	Outfall receiving water	Outfall Co-ordinates	
						Easting	Northing
207	Filter Drain	Basin	No	Swale	Allt Coire Cisteachan	263953	782359
213	Filter Drain	Basin	No	Swale	Unnamed (W8.4)	263937	782969
214	Filter Drain	Basin	No	Swale	Unnamed (W8.4)	263916	783003
222	Filter Drain	Basin	No	Pipe	Allt Coire Bhathaich (MW8.8)	264026	783821
DW1	Filter Drain	Swale	No	Swale	River Truim (MW8.1)	263760	784072
DW2	Filter Drain	Swale	No	Swale	River Truim (MW8.1)	263729	784170
DW3	Filter Drain	N/A	No	Pipe	River Truim (MW8.1)	263717	784258
225	Filter Drain	Basin	No	Swale	River Truim (MW8.1)	263743	784179
233	Filter Drain	Basin	No	Swale	Unnamed (MW8.9)	264252	784879
254	Filter Drain	Basin	Yes	Swale	River Truim (MW8.1)	265085	786776
258	Filter Drain	Basin	No	Swale	Allt Cuaich (MW8.14)	265715	787008
259	Filter Drain	Basin	No	Swale	Allt Cuaich (MW8.14)	265715	787008
277	Filter Drain	Basin	Yes	Swale	Unnamed (W8.22)	266626	788456
282	Filter Drain	Basin	Yes	Swale	Unnamed (MW8.19)	266984	788755
286	Filter Drain	Basin	Yes	Swale	Unnamed (MW8.19)	267319	789265
293	Filter Drain	Basin	Yes	Pipe	Unnamed (W8.167)	267583	789795
306	Filter Drain	Basin	No	Swale	Allt na Ceardaich (MW8.22)	267723	791074
309	Filter Drain	Tank Sewer & Vortex separator	No	Pipe	Existing Culvert	267723	791285
310	Filter Drain	N/A	No	Pipe	River Truim (MW8.1)	267757	791433

2.1.4 A sheep hardstanding area is also being constructed as part of the Proposed Scheme, located to the east of the A9 at chainage 22,050. Hardstanding has the potential to increase surface runoff;

therefore, a Constructed Farm Wetland (CFW[1]), or similar, should be incorporated into the design to ensure sufficient treatment is provided in line with good practice. This will be independent from the Scheme drainage networks.

HAWRAT

2.1.5 Potential impacts from routine runoff and accidental spillage risk (Method 'A' and Method 'C') to watercourses have been assessed using the Highways Agency (now Highways England) Water Risk Assessment Tool (HAWRAT); HAWRAT is an integral part of HD45/09 which is also applicable to trunk roads in Scotland. HAWRAT is a Microsoft Excel tool designed to evaluate risks related to the intermittent nature of routine road runoff. It assesses the acute pollution impacts on aquatic ecology associated with soluble pollutants, and the chronic impacts associated with sediment bound pollutants. This is undertaken using the parameters outlined below.

Runoff Pollutant Models

2.1.6 The HAWRAT assessment uses statistically based models for predicting the runoff quality for each pollutant. The models use traffic density, climate region and event rainfall characteristics to predict runoff quality in terms of Event Mean Concentrations (EMCs) and Event Mean Sediment Concentrations (EMSCs). Using long-term rainfall data, the models generate distributions of runoff quality.

Impact Model

2.1.7 The tool also uses models to predict the impact of runoff on receiving rivers. For soluble pollutants (that cause acute impacts), the assessment involves a simple mass balance approach accounting for river flows. For sediment-related pollutants, the model considers both the likelihood and extent of sediment accumulation.

Threshold analysis

2.1.8 The tool holds a number of ecologically based thresholds with which it compares the predicted impacts to evaluate the toxicity risks:

Assessment Thresholds

- Soluble (Acute) – Look-up tables show Runoff Specific Thresholds (RSTs) for dissolved copper and zinc and the allowable number of exceedances of these thresholds
- Sediments (Chronic) – Look-up tables show Threshold Effect levels (TELs) and Probable Effect Levels (PELs)

[1] A CFW is defined as 'one or more shallow, free surface flow constructed cells containing emergent vegetation, which is designed to receive and treat lightly contaminated surface water runoff from farm steadings, in such a manner that any discharge from the wetland will not pollute the water environment'. – *Constructed Farm Wetlands (CFW) – Design Manual for Scotland and Northern Ireland (2008)*

Method A – Simple Assessment of Pollution Impacts from Routine Runoff to Surface Waters

2.1.9 Method 'A' uses HAWRAT to assess the short-term and long-term risks to the receiving watercourses based on the impacts from soluble pollutants and sediment-bound pollutants. The assessment is first carried out for individual outfalls, thereafter, when more than one outfall discharges into the same stretch of watercourse, the combined effects are also assessed.

2.1.10 HAWRAT tests for a suite of pollutants identified through the Highways Agency (Highways England) and Environment Agency research programme as the key contaminants in road runoff either because of their abundance and/ or they are the most harmful in terms of species sensitivity in the water environment:

- Soluble pollutants associated with acute pollution impacts, expressed as EMCs (µg/l) for dissolved copper (Cu) and zinc (Zn)
- Sediment related pollutants associated with chronic pollution impacts, expressed as EMSCs (mg/kg) for total copper, zinc, cadmium, and (in µg/kg) for pyrene, fluoranthene, anthracene, phenanthrene and total PAH (Polycyclic Aromatic Hydrocarbons)

2.1.11 HAWRAT allows the user to assess the potential effects of short-term risks on water quality related to the intermittent nature of road runoff, as well as the effectiveness of any recommended mitigation measures. It does so by predicting road runoff pollutant loading at each step of the assessment and comparing it against runoff specific thresholds, for example Environmental Quality Standards (EQSs), based on annual average concentrations.

2.1.12 For the assessment of potential impacts from routine runoff to surface waters, HAWRAT uses three steps: Quality of Runoff; In-River Impacts; and Mitigation. A 'pass' result at one step negates the requirement of a subsequent step.

Step 1 – Quality of runoff

2.1.13 This is an initial first step to assess the quality of the direct road runoff against toxicity thresholds prior to treatment and discharge to the water body. Toxicity thresholds based on Environmental Quality Standards (EQS) for the protection of freshwater aquatic life have been derived from SEPA's Supporting Guidance (WAT-SG-53) (2014). The relevant EQSs for the protection of freshwater aquatic life are given as 1.0µg/l for copper and 11.9µg/l for zinc.

2.1.14 HAWRAT displays a 'pass' or 'fail' and the corresponding concentrations. If the toxicity levels yield a 'pass' then no further assessment is required. The parameters used in Step 1 are:

- The design traffic flow of the road (two-way Annual Average Daily Traffic) (AADT)
- The climatic region of the site
- The nearest rainfall site within that climatic region

Step 2 – In River Impacts

2.1.15 If Step 1 yields a 'fail', the assessment continues to Step 2. Step 2 takes account of the acute impacts of soluble pollutants and the chronic impacts of sediment pollutants after dilution and dispersion in the watercourse prior to mitigation.

2.1.16 For sediment-bound pollutants, Step 2 provides two tiers of assessment; the first is a desk based assessment; the second is a more detailed assessment allowing the entry of estimated or measured dimensions of a watercourse. Passing the first tier avoids a second tier assessment. The parameters used in Step 2 are:

- The annual 95%ile river flow (m^3/s)
- Base Flow Index (BFI)
- The impermeable road area which drains to the outfall (ha)
- Any permeable (non-road surface) area which also drains to the outfall (ha)
- The hardness of the receiving water (mg $CaCO_3/l$)
- Whether the discharge is likely to impact on a protected site for conservation
- Whether there is a downstream structure, lake or pond that reduces the river velocity near the point of discharge
- For Tier 1 assessment, an estimate of the river width
- For Tier 2 assessment details of channel dimensions, side slope, long slope and an estimation of Manning's *n*

Step 3 – Mitigation

2.1.17 If the outfall point fails Step 2 after discharge to the water body, the assessment continues to Step 3. This requires the input of any existing and proposed mitigation measures in order to assess whether the mitigation will be sufficient to reasonably treat the runoff. A brief description of the existing and proposed measures, and their associated estimated removal capability (expressed as a percentage), is required. Estimated removal capacity is required for:

- Treatment of soluble pollutants
- Settlement of sediments

2.1.18 Information on estimates of pollutant removal capability for various Sustainable Drainage Systems (SuDS) management systems is derived from DMRB HD33/16 (Table 8.1).

2.1.19 If a combined approach is proposed, the mitigation techniques are combined to determine the total removal capacity. The procedure to calculate the removal capacity is carried out in line with SuDS Manual (C753). The efficiency value of the first level of treatment is calculated as 100% effective; thereafter, secondary and tertiary (where applicable) levels are assumed to perform at 50% effectiveness due to already reduced inflow concentrations. If the outfall point fails Step 3, HAWRAT can provide an indication of the scale of additional mitigation required.

Cumulative Effects

2.1.20 In line with DMRB HD45/09, assessments of cumulative effects have also been undertaken for multiple discharges to single tributaries of larger watercourses where drainage outfalls are located within 1km along a river reach for soluble pollutants, and 100m for sediment-bound pollutants. In the context of this assessment, a reach is defined as a length of watercourse between two confluences. HD45/09 states *"the reason for this is that the available dilution and stream velocity will naturally change at confluences and influence the assessment"*. The three-stage process described above is also followed for the cumulative assessment. Long-term concentrations are also calculated using the HD45/09 procedure.

Method B – Detailed Assessment of Pollution Impacts from Routine Runoff to Surface Waters

2.1.21 If the in-river annual average concentrations of soluble pollutants exceed the EQS values (i.e. a failure at Step 2), and appropriate mitigation is not being provided in the form of SuDS, the

bioavailability of the soluble pollutants can be reassessed using a Biotic Ligand Model (BLM). The three steps outlined in the Simple Assessment are also followed for the Detailed Assessment.

2.1.22 The BLM refines the EQS on a site specific basis and then compares the copper and zinc concentrations predicted by HAWRAT to the BLM derived 'Probable Non-Effect Concentration' (PNEC). If the annual average concentrations exceed the EQS, it is highly likely that the Runoff Specific Thresholds (RSTs) are also being exceeded.

2.1.23 As mitigation (Step 3) is employed to treat the pollutants in order for them to meet the RSTs, this results in a reduction in annual average concentrations, which in turn may result in compliance with the EQS.

Method C – Assessment of Pollution Impacts from Routine Runoff on Groundwater

2.1.24 Method 'C' assesses the pollution impacts from routine runoff on groundwater. This involves assessing the overall risk to groundwater quality posed by the disposal of road runoff to the ground, either by direct discharge or through infiltrations.

2.1.25 The assessment is based on an examination of the 'Source-Pathway-Receptor protocol' (S-P-R). The principle applied in this assessment is that all components of the S-P-R linkage have to be present to create a pollutant linkage. The receptor in the assessment is groundwater. The presence of the pollutant in itself does not pose a threat to groundwater if there is no identifiable pathway. Further details of groundwater are provided in **Chapter 10**.

2.1.26 Each component is identified and given a weighting factor. This is to recognise that each may have a greater or lesser influence on the magnitude of the risk to groundwater. Each component is given a risk score (low, medium or high) and multiplied by the weighting factor. The overall cumulative assessment of risk score is obtained and classed using suggested ratings from HD45/09:

- Overall risk score <150 = Low Risk of Impact
- Overall risk score 150-250 = Medium Risk Impact
- Overall risk score >250 = High Risk Impact

Method D – Assessment of Pollution Impacts from Spillages

2.1.27 Method 'D' assesses the impact of accidental spillages on the road network and is carried out using HAWRAT. It estimates the risk of a collision (involving spillage) occurring and the risk, that if a spillage has occurred, of the pollutant reaching and impacting onto the receiving waterbodies.

2.1.28 It is initially assessed without any mitigation and the risk is expressed as the probability of an incident in any one year. If the results show that mitigation is required, the risk is reduced using a pollution risk reduction factor for each mitigation measure. The following information is required for assessing the risk:

- Road and junction type and urban/ rural setting
- The length of road draining to an outfall in each category
- The Annualised Average Daily Traffic (AADT) two way flow for each vehicle category
- The percentage of AADT flow that comprises Heavy Good Vehicles (HGVs)
- The probability of a serious pollution incident occurring as a result of a serious spillage (expressed as a factor based on the response time to the site)

Spillage factor

2.1.29 The normal acceptable risk of a serious pollution risk occurring is anywhere the annual probability is predicted to be less than 1%. In areas where road discharges are within close proximity to a natural wetland, designated wetland, SSSI, SAC, SPA, Ramsar site or where important drinking water supplies and abstraction, the acceptable spillage risk threshold is much lower at 0.5% annual probability (i.e. 1 in 200 years).

2.1.30 To determine the spillage risk associated with a section of road, DMRB requires information regarding predicted annual average daily traffic flow on the proposed road (AADT), the percentage of traffic with a Heavy Goods Vehicle (HGV) Classification, the road length and the type of junction, and takes into account the time it would take the emergency services to respond to an emergency situation.

2.1.31 The probability of a serious accidental spillage is calculated as follows:

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

Where:

P_{SPL} = annual probability of a spillage with the potential to cause a serious pollution incident

RL = road length, within each drainage catchment draining to each watercourse

SS = Serious spillage rate, based on the type of junction and the road setting

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

Where:

P_{INC} = the probability of a spillage with an associated risk of a serious pollution incident occurring

P_{POL} = the probability, given a spillage, that a serious pollution incident will take place. This takes into account a risk reduction factor, dependent upon emergency response times and the type of watercourse.

2.1.32 The risk was initially assessed for the system without any mitigation, and subsequently re-assessed to include embedded mitigation incorporated into the Proposed Scheme design. The initial risk without mitigation was found to be P, and the risk of the final design with embedded mitigation (PEMB) was calculated as:

$$P_{EMB} = P \times R_F$$

Where:

R_F is the reduction factor based on assumptions about the type of SuDS system incorporated as embedded mitigation within the final design. Based on DMRB HD33/16 guidance, a prescribed reduction factor of 0.8 was used, as this is considered a conservative estimate of a 20% reduction in pollutants which may be achieved by a short length of filter drain.

2.1.33 The acceptable risk of a serious pollution incident will be where the annual probability is predicted to be less than 0.5%. This suggested threshold level is referenced within DMRB as being applicable for proposed schemes where road runoff discharges in close proximity (<1km) to designated SSSIs and SACs.

3 Results of Potential Impacts

3.1.1 The assessment results presented below assume pre-mitigation conditions to determine worst-case scenarios and inform mitigation requirements to the Proposed Scheme.

3.1.2 Within each of the assessment subheadings, details of the assessments are first presented; thereafter, the potential magnitude and significance of impacts are given for all those deemed to be greater than Neutral based on the criteria and methodology outlined in **Chapter 11**.

Pre-mitigation Routine Runoff to Surface Waters (Method 'A')

3.1.3 The assessment for routine runoff to surface waters has been undertaken using the three step HAWRAT process. As detailed in **Section 2**, if the toxicity levels yield a 'pass' at any stage of the process, no further assessment is required. In Scotland, however, it is a statutory requirement to provide two levels of SuDS to control and treat surface water runoff from trunk roads. Therefore, filter drains and SuDS basins have been incorporated into the Proposed Scheme mainline drainage design as 'embedded mitigation' for each drainage network, including those which predicted a 'pass' at Step 2. In cases where a 'fail' has been predicted at Step 2, Step 3 has been applied i.e. with embedded mitigation.

3.1.4 Step 3 is repeated with 'enhanced' treatment until all failures are eliminated. HAWRAT spreadsheet outputs are provided in **Section 11.4** of this Appendix. Results of the assessment are summarised in **Table 2** and cumulative impacts summarised in **Tables 3** and **4**.

Table 2: Method A Results Table

Drainage Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
				Average Annual Concentration Soluble Soluble – Acute Impact		Sediment – Chronic Impact			
				HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
				Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
207	Allt Coire nan Cisteachan	3.0	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.011			0.18	0.55		0.30	-	
213	Unnamed	1.54	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
	0.008			0.14	0.43		0.01	95	
214	Unnamed	0.17	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
	0.008			0.02	0.06		0.01	12	

Drainage Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
				Average Annual Concentration Soluble Soluble – Acute Impact		Sediment – Chronic Impact			
				HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
				Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
222	Allt Coire Bhathaich	1.65	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
	0.021			0.07	0.22		0.00	52	
DW1	River Truim	0.333	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – appropriate level of treatment for access track still included in design as per Scheme-wide design approach[2]
	0.252			0.00	0.00		0.05	2	
DW2	River Truim	0.161	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – appropriate level of treatment for access track still included in design as per Scheme-wide design approach (see above)
	0.252			0.00	0.00		0.03	1	

[2] Treatment levels for tracks have been informed by *'Side Road and Accommodation Track SUDS' – Technical Note, AMJV (2015)*, A9P0N-AMJ-HDG-Z_ZZZZZ_XX-TN-DE-0001. SEPA has been consulted on the design approach for SuDS as this been discussed on a scheme-wide basis at Environmental Steering Group meetings.

Drainage Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
				Average Annual Concentration Soluble Soluble – Acute Impact		Sediment – Chronic Impact			
				HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
				Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
DW3	River Truim	0.056	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – appropriate level of treatment for access track still included in design as per Scheme-wide design approach (see above)
	0.252			0.00	0.00		0.03	1	
225	River Truim	3.9	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
	0.252			0.01	0.03		0.03	24	
233	Unnamed	0.89	3	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes with Filter drain and SuDS basin (SEPA minimum recommended SuDS for trunk roads)
	0.002			0.34	0.58		0.15	-	
254	River Truim	7.66	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
	0.335			0.01	0.05		0.06	20	
258	Allt Cuaich	1.57	2	Pass	Pass	Pass (Alert Protected Area & D/S Structure)	Yes	No	Passes without mitigation – two levels still included in design
	0.168			0.01	0.03		0.01	16	
259	Allt Cuaich	0.45	2	Pass	Pass	Pass (Alert Protected Area & D/S Structure)	Yes	No	Passes without mitigation – two levels still included in design
	0.168			0.00	0.01		0.01	5	

Drainage Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
				Average Annual Concentration Soluble Soluble – Acute Impact		Sediment – Chronic Impact			
				HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
				Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
277	Unnamed	7.02	3	Pass	Pass	Pass (Alert Protected Area & D/S Structure)	Yes	No	Filter drain, pond, swale (i.e. assessment identified requirement for enhanced treatment)
	0.001			0.85	2.00		0.07	58	
282	Unnamed	1.76	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.004			0.34	1.16		0.13	-	
286	Unnamed	1.53	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.0046			0.25	84		0.15	-	
293	Unnamed	0.83	2	Pass	Pass	Pass (Alert Protected Area & D/S Structure)	Yes	No	Passes without mitigation – two levels still included in design

Drainage Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
				Average Annual Concentration Soluble Soluble – Acute Impact		Sediment – Chronic Impact			
				HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
				Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
	0.001			0.43	1.47		0.00	77	
306	Allt na Ceardaich	4.1	2	Pass	Pass	Pass (Alert Protected Area & D/S Structure)	No	No	Passes without mitigation – two levels still included in design
	0.0128			0.18	0.61		0.34	-	
309	Unnamed	0.601	2	Pass	Pass	Pass (Alert Protected Area & D/S Structure)	Yes	No	Passes without mitigation[3]
	0.001			0.40	1.35		0.00	59	

[3] Due to spatial constraints, Network 309 has one stage of treatment through filter drains and potential to be retained within a 1200mm dia. tank sewer before discharging upstream of Hydro ID 132

Drainage Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
				Average Annual Concentration Soluble Soluble – Acute Impact		Sediment – Chronic Impact			
				HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
				Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
310	Unnamed	0.33	2	Pass	Pass	Pass (Alert Protected Area & D/S Structure)	Yes	No	Passes without mitigation[4]
	0.001			0.26	0.79		0.00	52	

[4] Network 310 is approx. 150m of filter drain in the central reserve and again in the southbound verge, both are proposed to connect in to the existing drainage network. However, a sensitivity check using the smallest watercourse in the vicinity of the network (watercourse at Hydro ID 132) was carried out to ensure a 'Pass' result was predicted pre-mitigation

Table 3: Method A cumulative assessments results (Soluble Pollutants – outfalls within 1km)

Cumulative Network (within 1km)	Distance between outfalls (m)	Receiving Watercourse Q95 (m^3/s)	Combined Drained Road Area (incl. verges) (ha.)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
					Average Annual Concentration Soluble-Soluble – Acute Impact		Sediment – Chronic Impact			
					HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
					Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
213, 214	45	Unnamed	1.71 (1.42 + 0.29)	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
		0.008			0.15	0.48		0.24	-	
DW2, DW3 & 225	16 (DW2 & 225) 88 (DW2 & DW3)	River Truim	4.458 (3.208 + 1.25)	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
		0.252			0.01	0.04		0.03	30	
282, 286	640	Unnamed	3.29 (3.03 + 0.26)	2	Pass	Pass	Pass	No	No	Passes without mitigation – two levels still included in design
		0.0046			0.48	1.46		0.16	-	

Table 4: Method A cumulative assessments results (Sediment-bound Pollutants – outfalls within 100m)

Cumulative Network (within 100m)	Distance between outfalls (m)	Receiving Watercourse Q95 (m^3/s)	Drained Road Area (incl. verges) (ha.)	Step	Impact (Average Annual Concentration)					Proposed Mitigation (incl. minimum two levels requested by SEPA)
					Average Annual Concentration Soluble-Soluble – Acute Impact		Sediment – Chronic Impact			
					HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	HAWRAT Threshold Pass/Fail	Sediment Accumulating? Yes/No	Extensive? Yes/No	
					Copper concentration (µg/l)	Zinc concentration (µg/l)		Low flow velocity (m/s)	Deposition Index	
213 ,214	45	Unnamed	1.71 (1.42 + 0.29)	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
		0.008			0.15	0.48		0.24	-	
DW2, DW3 & 225	16 (DW2 & 225) 88 (DW2 & DW3)	River Truim	4.458 (3.208 + 1.25)	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
		0.252			0.01	0.04		0.03	30	
258, 259	0 (same outfall)	Allt Cuaich	1.95 (1.95 + 0.00)	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
		0.169			0.01	0.03		0.01	21	

3.1.5 The results in **Tables 2** to **4** highlight that, where necessary, incorporation of appropriate levels of mitigation reduces risk from routine runoff on receiving watercourses. The resulting magnitude of impact from routine runoff on each receiving watercourse is, therefore, predicted to be **Negligible**.

Detailed Assessment from Routine Runoff to Surface Waters (Method 'B')

3.1.6 This is no requirement for a detailed assessment as the Proposed Scheme incorporates SuDS (typically two treatment levels) on all networks and outfalls. SuDS provision will be in line with national and local planning policy and SEPA 'best-practice' guidance for trunk road drainage.

Assessment of Pollution Impacts from Routine Runoff on Groundwater (Method 'C')

3.1.7 Assessments of potential impacts to groundwater were undertaken for both embedded mitigation techniques that are incorporated into the design (i.e. filter drains and SuDS basins). Details of ground conditions were obtained using information outlined in **Chapter 10**, along with BGS data and ground investigation (GI) data. The site locations are those proposed for the SuDS basins for each drainage network. Results are summarised in **Table 5**.

Table 5: Method C Results Table

Network	Overall Risk of Impact Score for Filter Drains	Overall Risk of Impact Score for SuDS Basin/ Swale
207	212.5 (Medium Risk of Impact)	242.5 (Medium Risk of Impact)
213	240 (Medium Risk of Impact)	270 (High Risk of Impact)
214	240 (Medium Risk of Impact)	270 (High Risk of Impact)
222	240 (Medium Risk of Impact)	270 (High Risk of Impact)
DW1	212.5 (Medium Risk of Impact)	242.5 (Medium Risk of Impact)
DW2	212.5 (Medium Risk of Impact)	242.5 (Medium Risk of Impact)
DW3	212.5 (Medium Risk of Impact)	N/A
225	212.5 (Medium Risk of Impact)	242.5 (Medium Risk of Impact)
233	240 (Medium Risk of Impact)	270 (High Risk of Impact)
254	192.5 (Medium Risk of Impact)	232.5 (Medium Risk of Impact)
258	240 (Medium Risk of Impact)	270 (High Risk of Impact)
259	240 (Medium Risk of Impact)	255 (High Risk of Impact)
277	232.5 (Medium Risk of Impact)	262.5 (High Risk of Impact)
282	225 (Medium Risk of Impact)	255 (High Risk of Impact)
286	232.5 (Medium Risk of Impact)	262.5 (High Risk of Impact)
293	212.5 (Medium Risk of Impact)	242.5 (Medium Risk of Impact)
306	212.5 (Medium Risk of Impact)	242.5 (Medium Risk of Impact)

3.1.8 The summary of results in **Table 5** supported by detailed results in Annex 1, show that the risk for potential impacts to groundwater is **Medium** to **High** due to the presence of higher permeable

soil conditions within the Proposed Scheme extents thus SuDS should be lined to prevent or control infiltration.

Assessment of Pollution Impacts from Spillages (Method 'D')

3.1.9 Assessments of potential pollution impacts from spillages impacts to groundwater were undertaken using a conservative approach; the calculations are based on the longest road drainage catchment area of the Proposed Scheme (Network 254) and details for the proposed junction at Dalwhinnie. The calculated results have been presented (in years) for a system without mitigation measures, and for the final design incorporating SuDS as 'embedded' mitigation (**Table 6**). The Annual Spillage Probability (ASP) has been presented as a percentage (%) output on the basis of the final design. Results from the HAWRAT excel spreadsheet are provided in **Annex 1** of this Appendix.

Table 6: Method D Results Table

Return period scenario / Road section assessment	Return Period with Embedded Pollution reduction measures (years)	Residual with proposed Pollution reduction measures (years)	ASP based on Final Design Incorporating Embedded Mitigation (%)
Longest outfall (surface water spillage)	2588	3235	0.031
Longest outfall (groundwater spillage)	3881	4852	0.02
Junction (surface water spillage)	4411	5514	0.018
Junction (groundwater spillage)	6617	8271	0.012

3.1.10 **Table 11-2-6** indicates that calculated ASP for the Proposed Scheme is considerably less than the accepted 0.5% value for serious pollution incident for protected areas. The magnitude of risk from accidental spillages on surface water and groundwater is predicted to be negligible, but given that the sensitivity of the receiving watercourses, spillage containment has been provided as 'embedded' mitigation (shut-off valves) within the Proposed Scheme design.

4 Potential Impact Assessment

4.1.1 This section provides an overview of the potential impacts on water quality that may arise as a result of the Proposed Scheme. The potential impact assessment has been carried out on the assumption that the design will incorporate SuDS as 'embedded mitigation' as described in **Section 3**.

4.1.2 **Table 7** presents a summary of the potential water quality impacts for a range of water features which were identified for surface water and groundwater receptors. Note that each water feature has been assigned a sensitivity classification on the basis of the baseline information presented in **Appendix 11.1**. In accordance with the approach outlined in Section **11.2** of **Chapter 11**, the assessment applies the sensitivity classification along with the predicted magnitude of change to produce an overall significance of impact for each water feature.

Table 7: Potential Water Quality Impacts

Drainage Network	Water Feature Location	Receptor Water Quality Sensitivity	HAWRAT Water Quality Results Based on Final Drainage Design Inc. Embedded Mitigation	Magnitude	Significance of Impact
Receptor: Surface Water					
207	ch. 20,750	Medium	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
213	ch. 21,300	Medium	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
214	ch. 21,400	Medium	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
222	ch. 22,200	Medium	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
DW1	ch. 22,400	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
DW2	ch. 22,500	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
DW3	ch. 22,700	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
225	ch. 22,250	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
233	ch. 22,300	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
254	ch. 25,400	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
258	ch. 25,800	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
259	ch. 25,900	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral

Drainage Network	Water Feature Location	Receptor Water Quality Sensitivity	HAWRAT Water Quality Results Based on Final Drainage Design Inc. Embedded Mitigation	Magnitude	Significance of Impact
277	ch. 27,700	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
282	ch. 28,200	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
286	ch. 28,650	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
293	ch. 29,300	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
306	ch. 30,600	Medium	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
309	ch. 30,900	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
310	ch. 30,100	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
Receptor: Groundwater Water					
207	ch. 20,750	Medium	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
213	ch. 21,300	Medium	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
214	ch. 21,400	Medium	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
222	ch. 22,200	Very High	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
DW1	ch. 22,400	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral

Drainage Network	Water Feature Location	Receptor Water Quality Sensitivity	HAWRAT Water Quality Results Based on Final Drainage Design Inc. Embedded Mitigation	Magnitude	Significance of Impact
DW2	ch. 22,500	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
DW3	ch. 22,700	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
225	ch. 22,250	High	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
233	ch. 22,300	Medium	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
254	ch. 25,400	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
258	ch. 25,800	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
259	ch. 25,900	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
277	ch. 27,700	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
282	ch. 28,200	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
286	ch. 28,650	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
293	ch. 29,300	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
306	ch. 30,600	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral

4.1.3 The sheep hardstanding area being constructed at chainage 22,050 has the potential to increase surface runoff; therefore, a Constructed Farm Wetland (CFW), or similar, should be incorporated into the design to ensure sufficient treatment is provided in line with good practice. This will be independent from the Scheme drainage networks and not discharge directly to a surface watercourse. At present the site is already utilised to herd several thousand sheep twice a year before transportation; therefore, the inclusion of a CFW or similar will ensure an overall **Neutral** or **Beneficial** impact comparative to existing conditions.

5 Conclusions

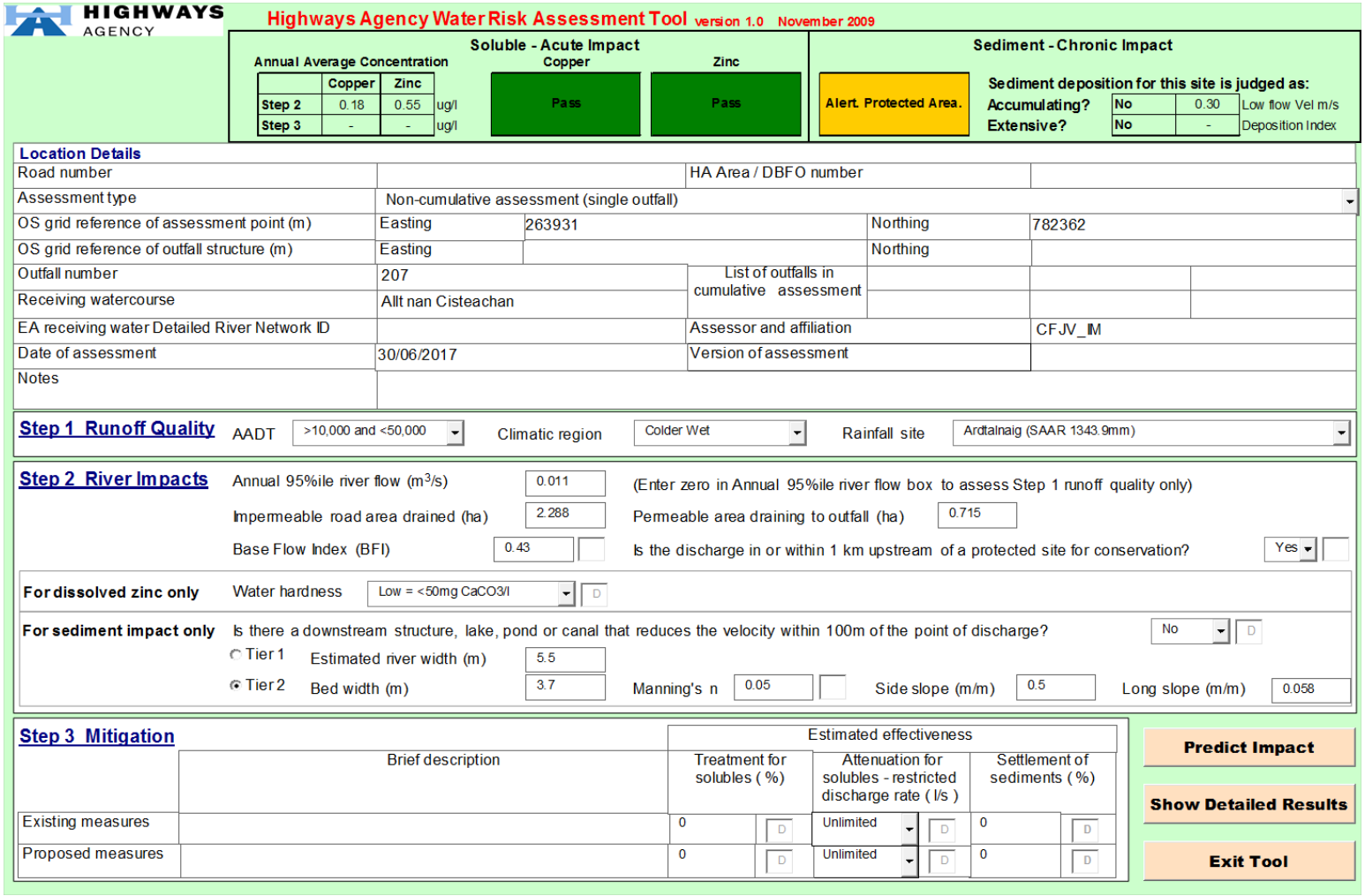
5.1.1 This appendix has presented further information on the water quality assessments undertaken during the EIA to support the findings reported in **Chapter 11**.

5.1.2 As outlined in **Table 7**, it is considered that there is no likely significant water quality impacts associated with the Proposed Scheme if appropriate mitigation measures are included, as set out in **Section 11.5** of **Chapter 11**. This information has been further presented in an evaluation of effects for each of the receptors within **Chapter 11**.

5.1.3 Impacts/ failures of water quality assessments can be appropriately mitigated using typically two levels of treatment for road surface water runoff. Impacts on groundwater should be mitigated by lining SuDS to prevent infiltration risk where Medium or High values have been recorded.

Annex 1: Calculations

Figure 1: Method A HAWRAT output for SuDS network 207



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Soluble - Acute Impact

Annual Average Concentration	Copper	Zinc		Copper	Zinc
Step 2	0.18	0.55	ug/l	Pass	Pass
Step 3	-	-	ug/l		

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.30	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	263931	Northing	782362	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	207	List of outfalls in cumulative assessment			
Receiving watercourse	Allt nan Cisteachan				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.011 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.288 | Permeable area draining to outfall (ha): 0.715

Base Flow Index (BFI): 0.43 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

Tier 1 Estimated river width (m): 5.5

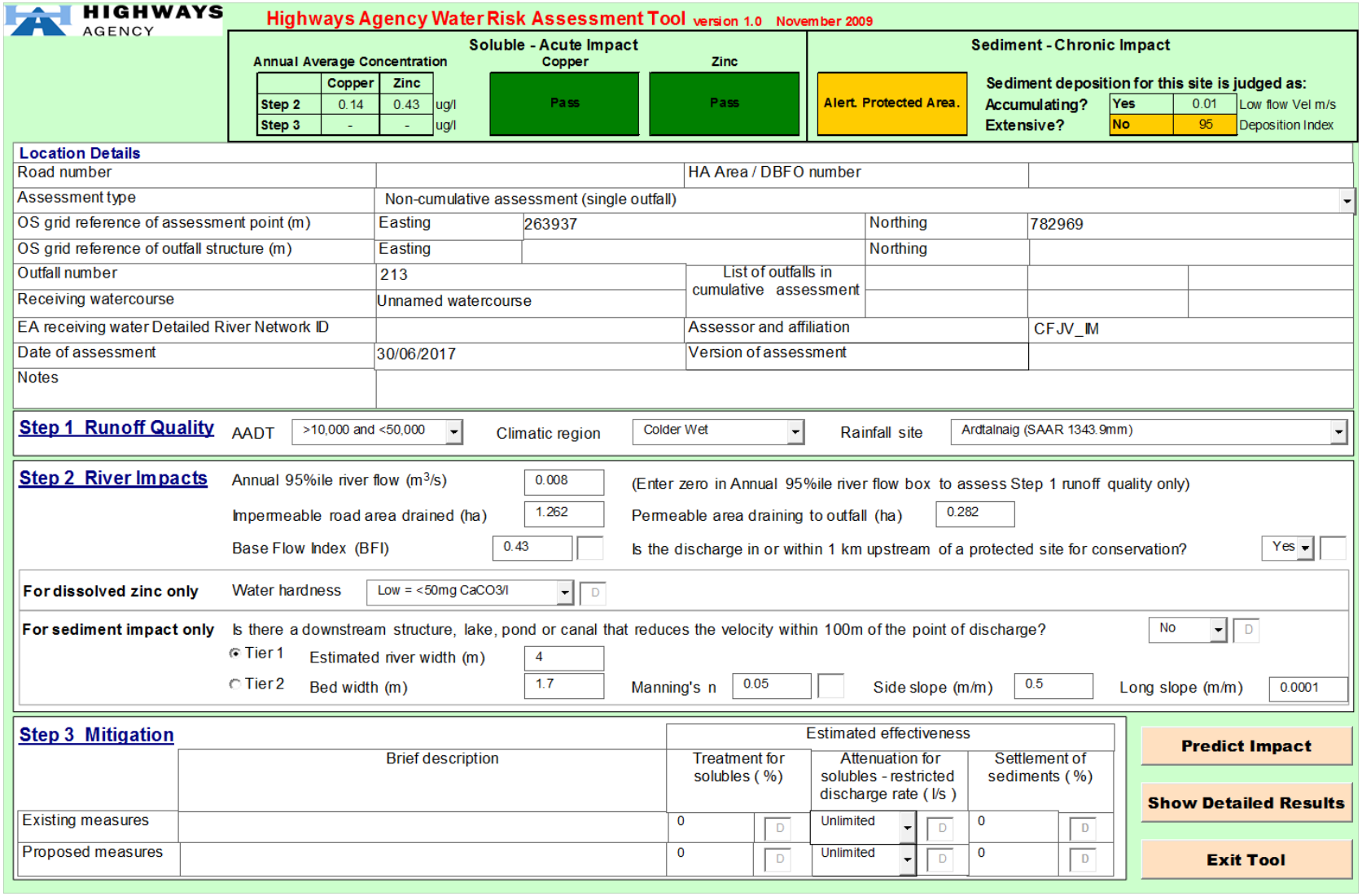
Tier 2 Bed width (m): 3.7 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.058

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact | Show Detailed Results | Exit Tool

Figure 2: Method A HAWRAT output for SuDS network 213



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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.14	0.43	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.01	Low flow Vel m/s
Extensive?	No	95	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	263937	Northing	782969	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	213	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.008 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.262 Permeable area draining to outfall (ha): 0.282

Base Flow Index (BFI): 0.43 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

Tier 1 Estimated river width (m): 4

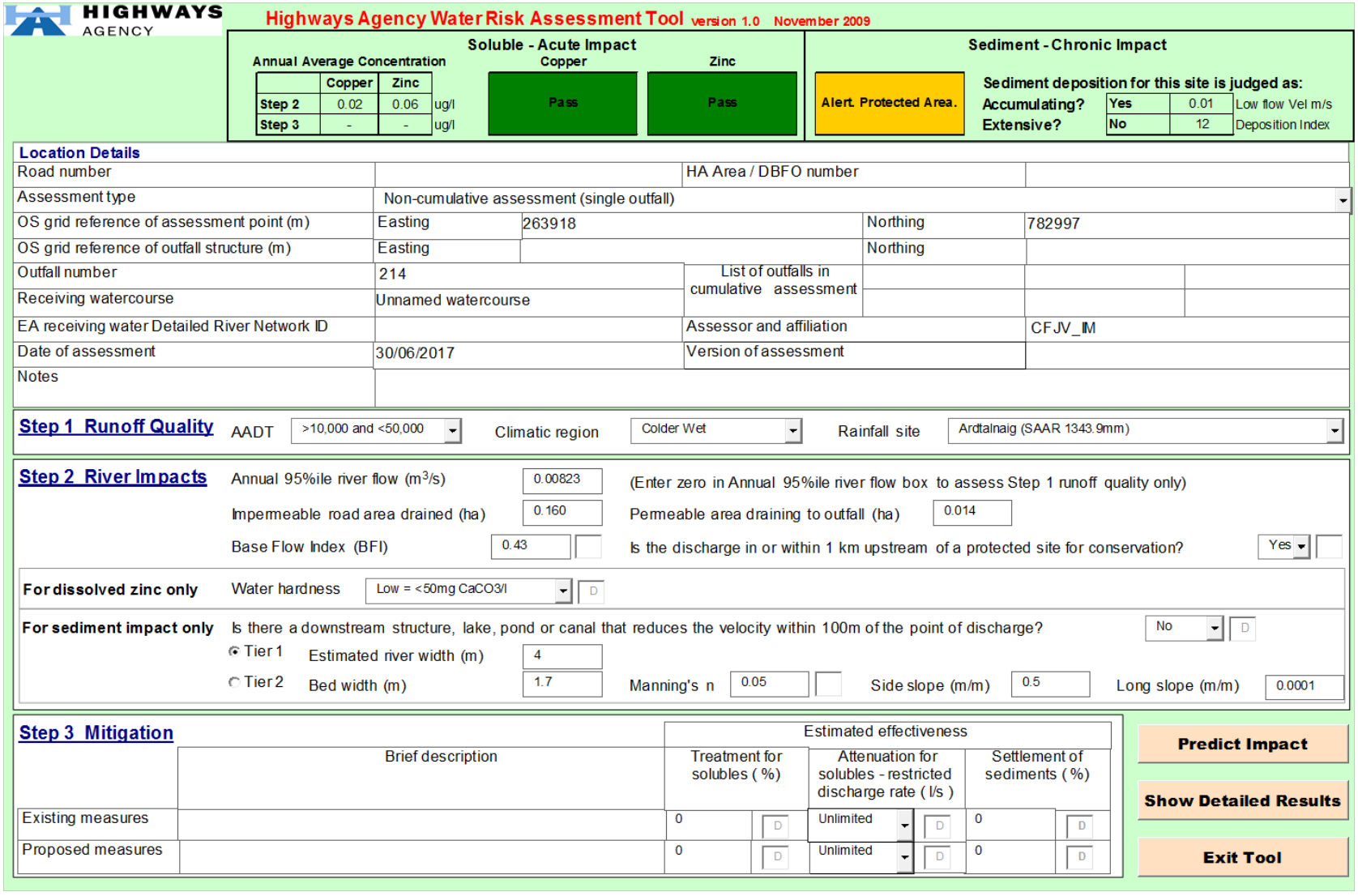
Tier 2 Bed width (m): 1.7 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact | Show Detailed Results | Exit Tool

Figure 3: Method A HAWRAT output for SuDS network 214



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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.02	0.06	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating? Yes 0.01 Low flow Vel m/s

Extensive? No 12 Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	263918	Northing	782997	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	214	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT >10,000 and <50,000 Climatic region Colder Wet Rainfall site Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s) 0.00823 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha) 0.160 Permeable area draining to outfall (ha) 0.014

Base Flow Index (BFI) 0.43 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness Low = <50mg CaCO3/l D

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

Tier 1 Estimated river width (m) 4

Tier 2 Bed width (m) 1.7 Manning's n 0.05 Side slope (m/m) 0.5 Long slope (m/m) 0.0001

Step 3 Mitigation

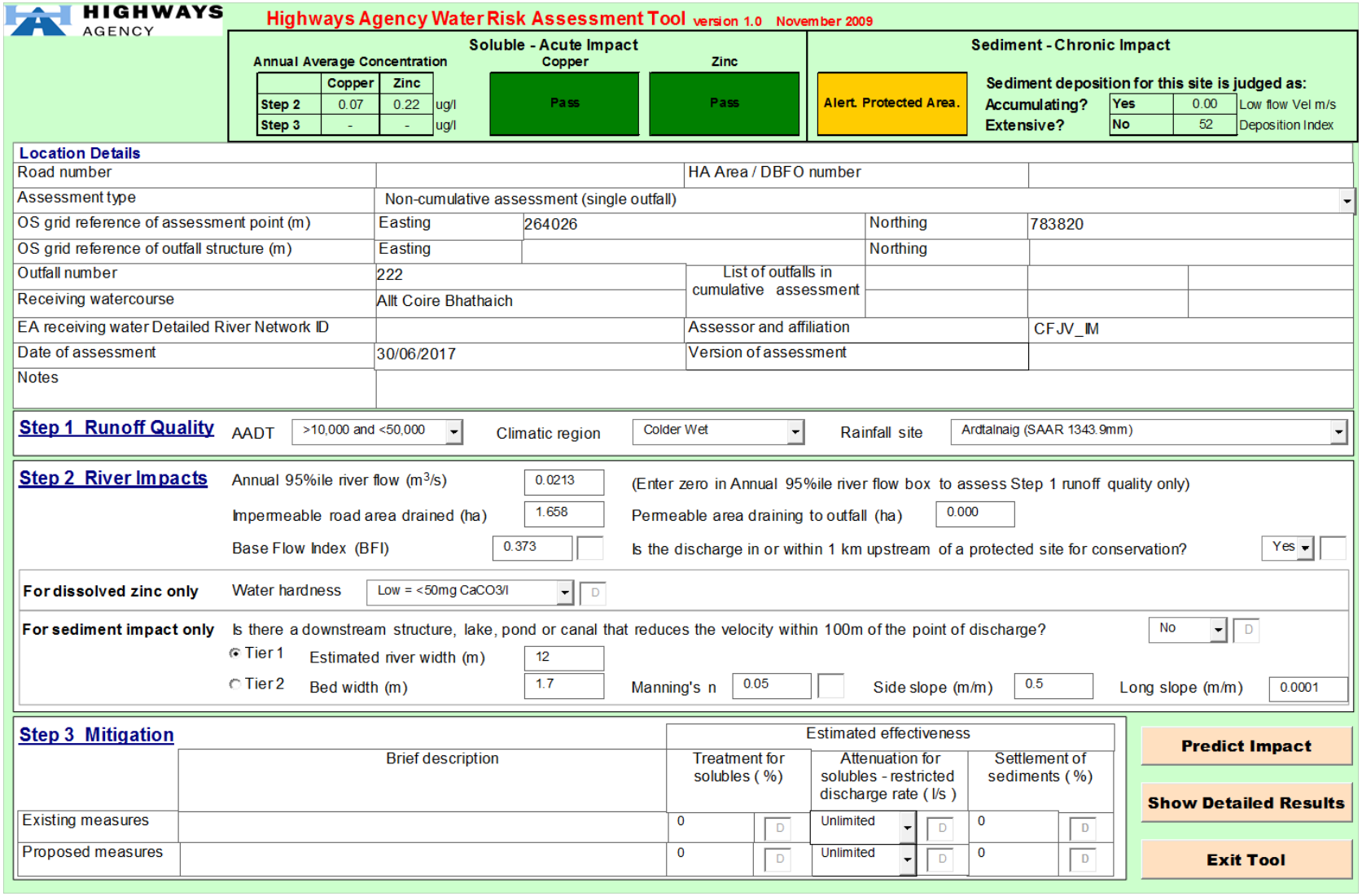
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 4: Method A HAWRAT output for SuDS network 222



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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.07	0.22	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating? Yes 0.00 Low flow Vel m/s

Extensive? No 52 Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	264026	Northing	783820	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	222	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Coire Bhathaich				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0213 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.658 Permeable area draining to outfall (ha): 0.000

Base Flow Index (BFI): 0.373 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

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

Tier 1 Estimated river width (m): 12

Tier 2 Bed width (m): 1.7 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0001

Step 3 Mitigation

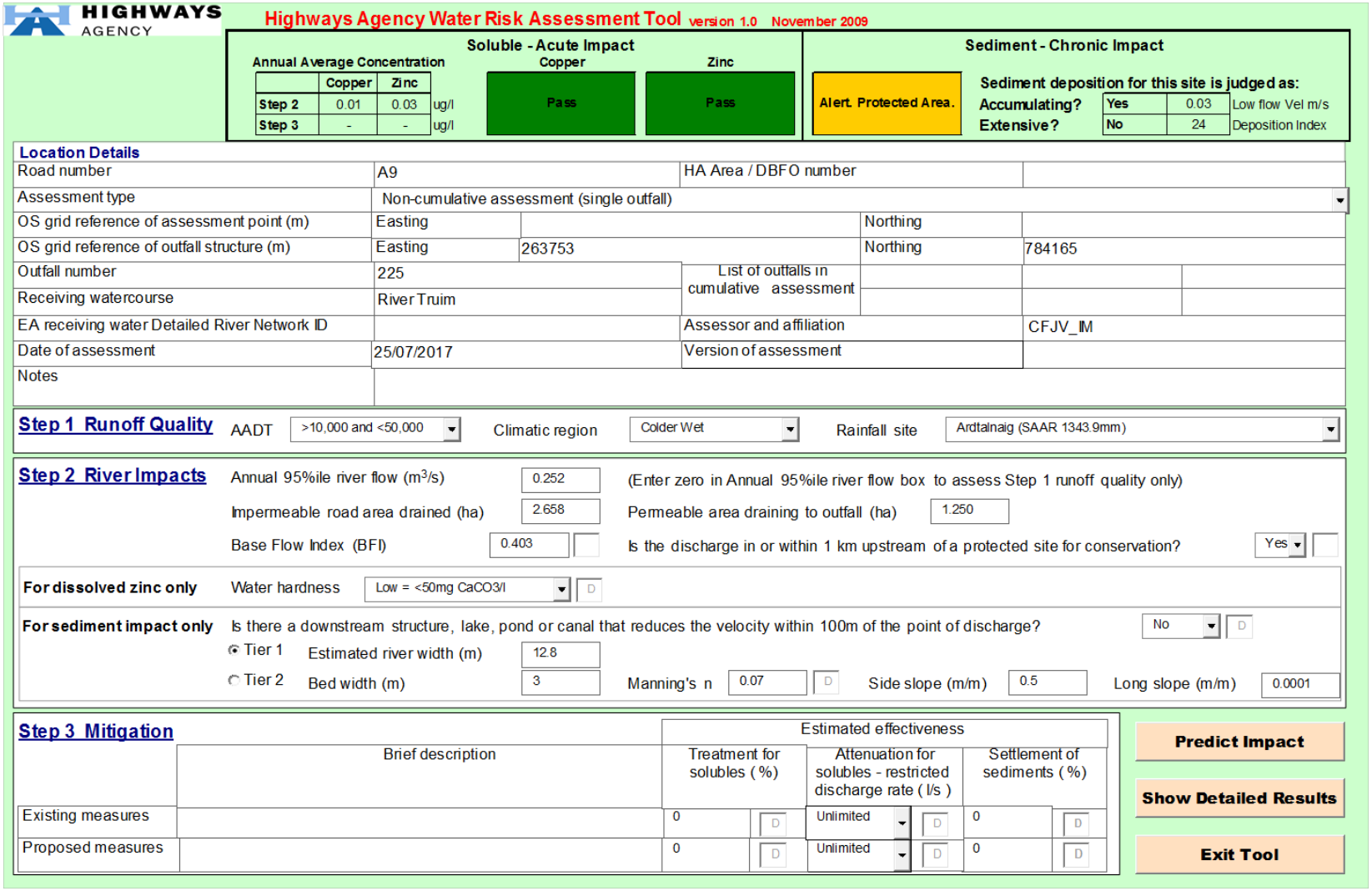
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 5: Method A HAWRAT output for SuDS network 225



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Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.01	0.03	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating? Yes 0.03 Low flow Vel m/s

Extensive? No 24 Deposition Index

Location Details

Road number	A9	HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	Northing	
OS grid reference of outfall structure (m)	Easting 263753	Northing	784165
Outfall number	225	List of outfalls in cumulative assessment	
Receiving watercourse	River Truim		
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM
Date of assessment	25/07/2017	Version of assessment	
Notes			

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.252 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.658 Permeable area draining to outfall (ha): 1.250

Base Flow Index (BFI): 0.403 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

Tier 1 Estimated river width (m): 12.8

Tier 2 Bed width (m): 3 Manning's n: 0.07 Side slope (m/m): 0.5 Long slope (m/m): 0.0001

Step 3 Mitigation

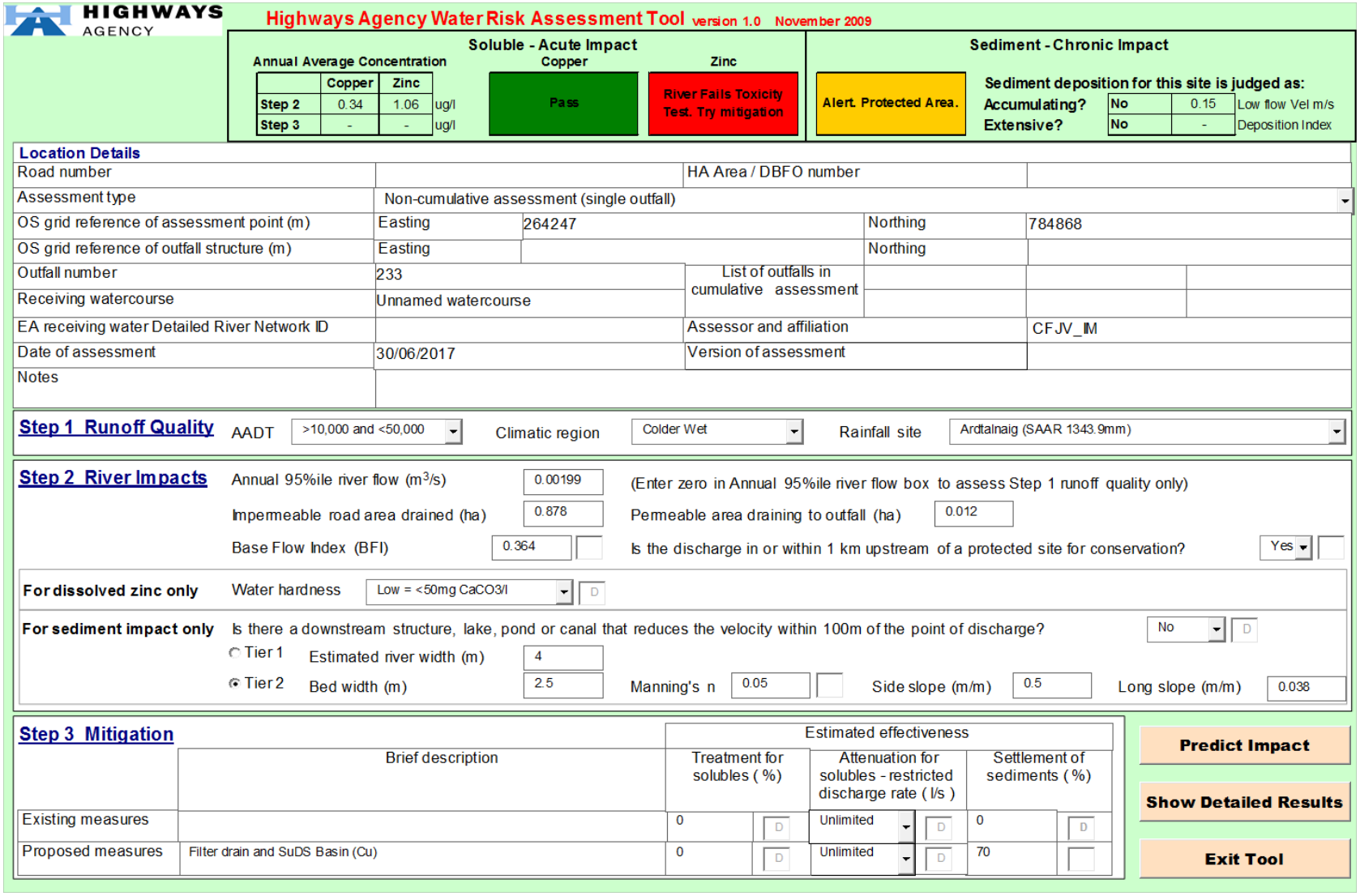
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 6: Method A HAWRAT output for SuDS network 233 (copper)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.34	1.06	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: River Fails Toxicity Test. Try mitigation

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.15	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	264247	Northing	784868	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	233	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00199 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.878 Permeable area draining to outfall (ha): 0.012

Base Flow Index (BFI): 0.364 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

Tier 1 Estimated river width (m): 4

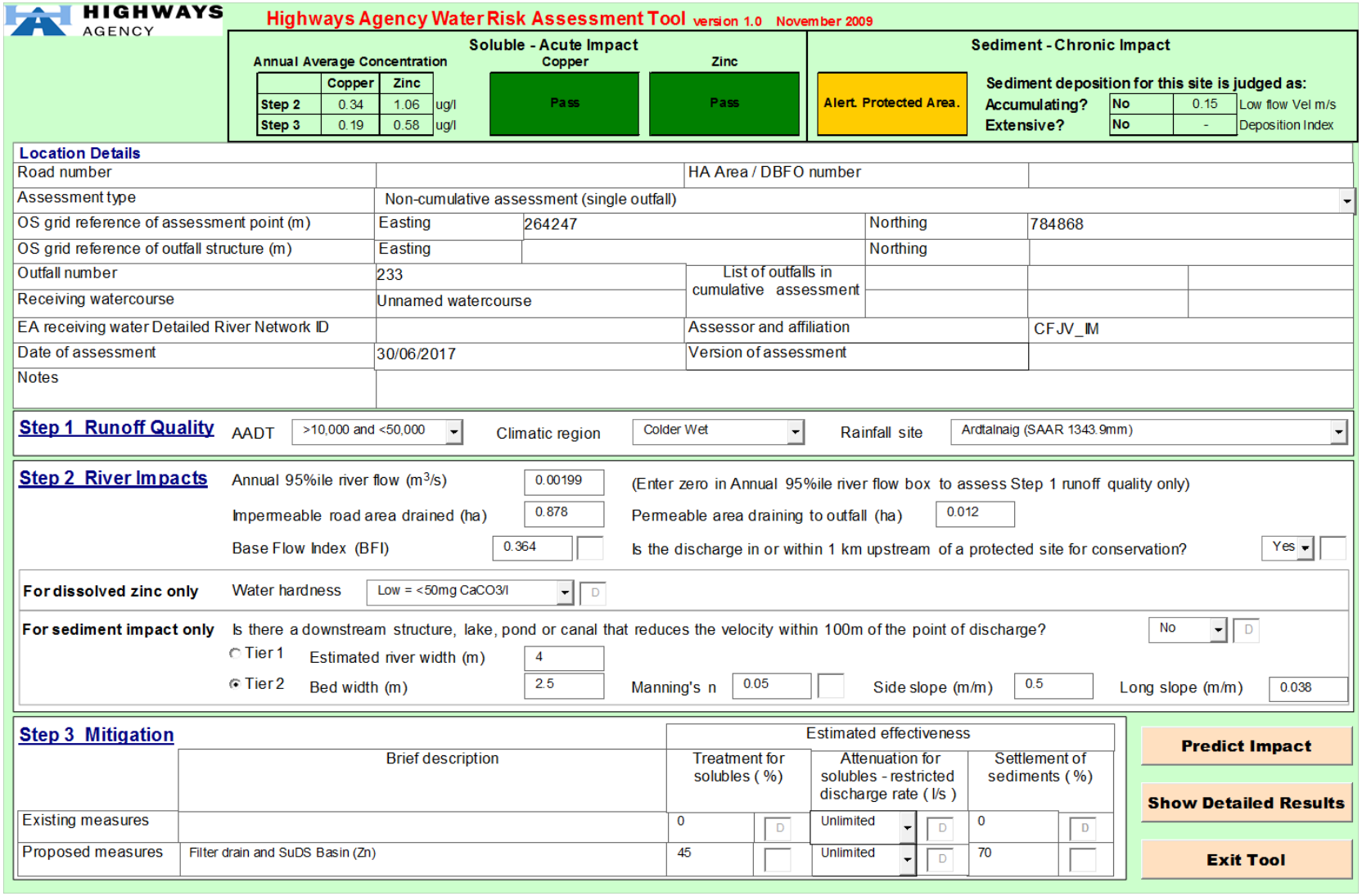
Tier 2 Bed width (m): 2.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.038

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	Filter drain and SuDS Basin (Cu)	0	Unlimited	70

Predict Impact | Show Detailed Results | Exit Tool

Figure 7: Method A HAWRAT output for SuDS network 233 (zinc)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.34	1.06	ug/l
Step 3	0.19	0.58	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.15	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 264247	Northing	784868
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	233	List of outfalls in cumulative assessment	
Receiving watercourse	Unnamed watercourse		
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM
Date of assessment	30/06/2017	Version of assessment	
Notes			

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.00199 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.878 | Permeable area draining to outfall (ha): 0.012

Base Flow Index (BFI): 0.364 | Is the discharge in or within 1 km upstream of a protected site for conservation?: Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

Tier 1 Estimated river width (m): 4

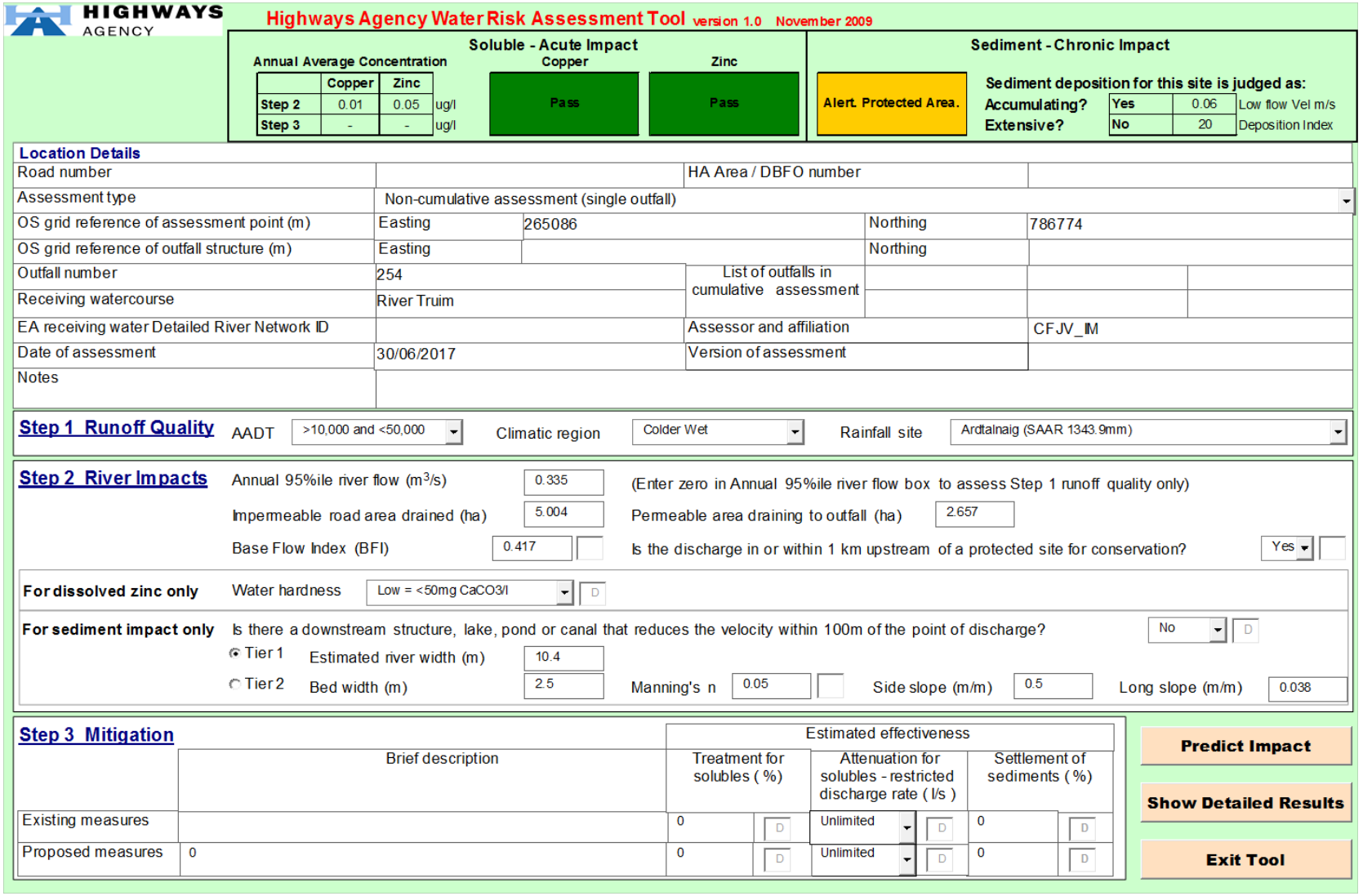
Tier 2 Bed width (m): 2.5 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.038

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	Filter drain and SuDS Basin (Zn)	45	Unlimited	70

Predict Impact | Show Detailed Results | Exit Tool

Figure 8: Method A HAWRAT output for SuDS network 254



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.01	0.05	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating? Yes 0.06 Low flow Vel m/s

Extensive? No 20 Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	265086	Northing	786774	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	254	List of outfalls in cumulative assessment			
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.335 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 5.004 Permeable area draining to outfall (ha): 2.657

Base Flow Index (BFI): 0.417 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

Tier 1 Estimated river width (m): 10.4

Tier 2 Bed width (m): 2.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.038

Step 3 Mitigation

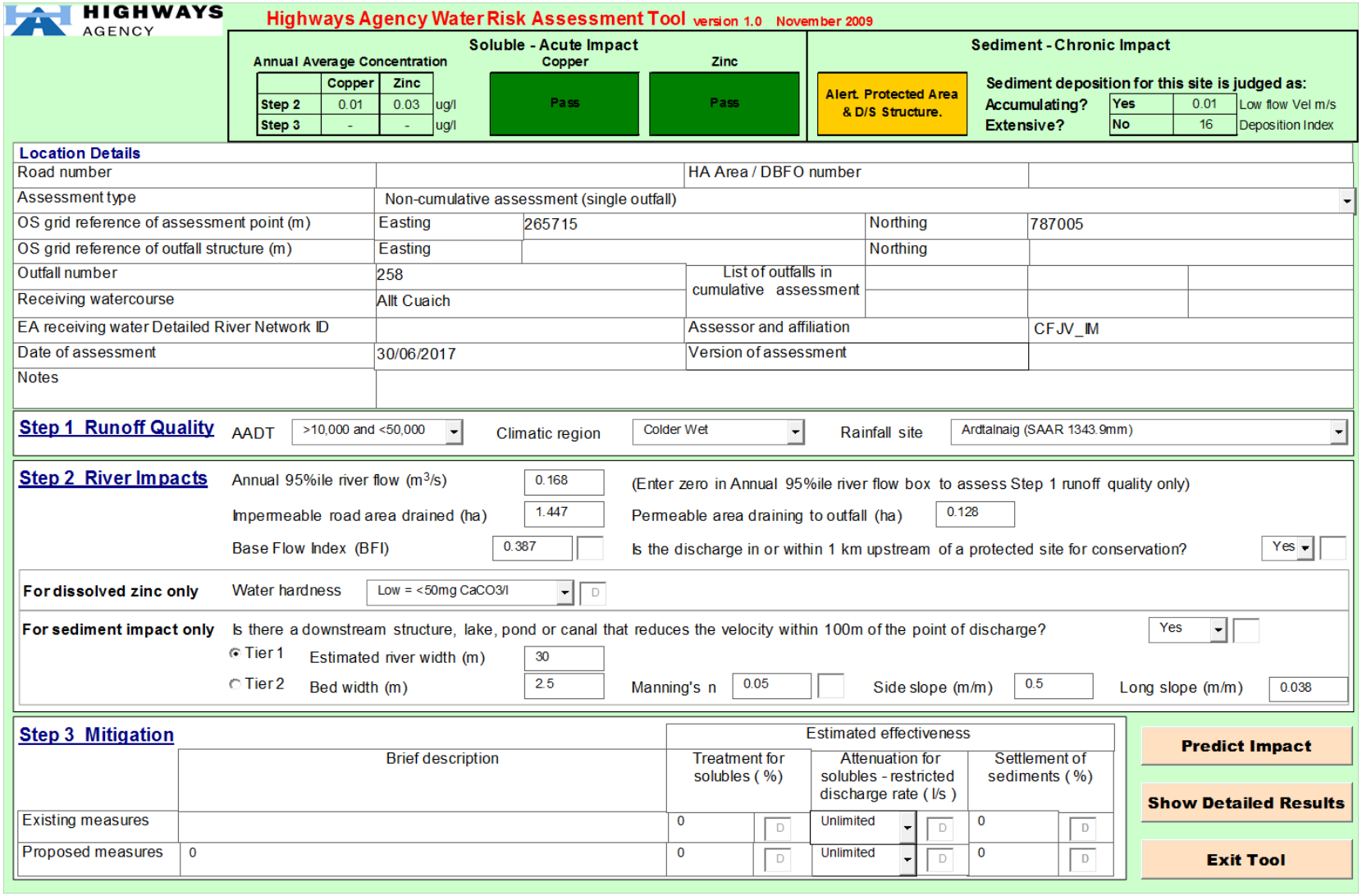
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	0	0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 9: Method A HAWRAT output for SuDS network 258



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.01	0.03	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.01	Low flow Vel m/s
Extensive?	No	16	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	265715	Northing	787005	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	258	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Cuaich				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.168 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.447 Permeable area draining to outfall (ha): 0.128

Base Flow Index (BFI): 0.387 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 30

Tier 2 Bed width (m): 2.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.038

Step 3 Mitigation

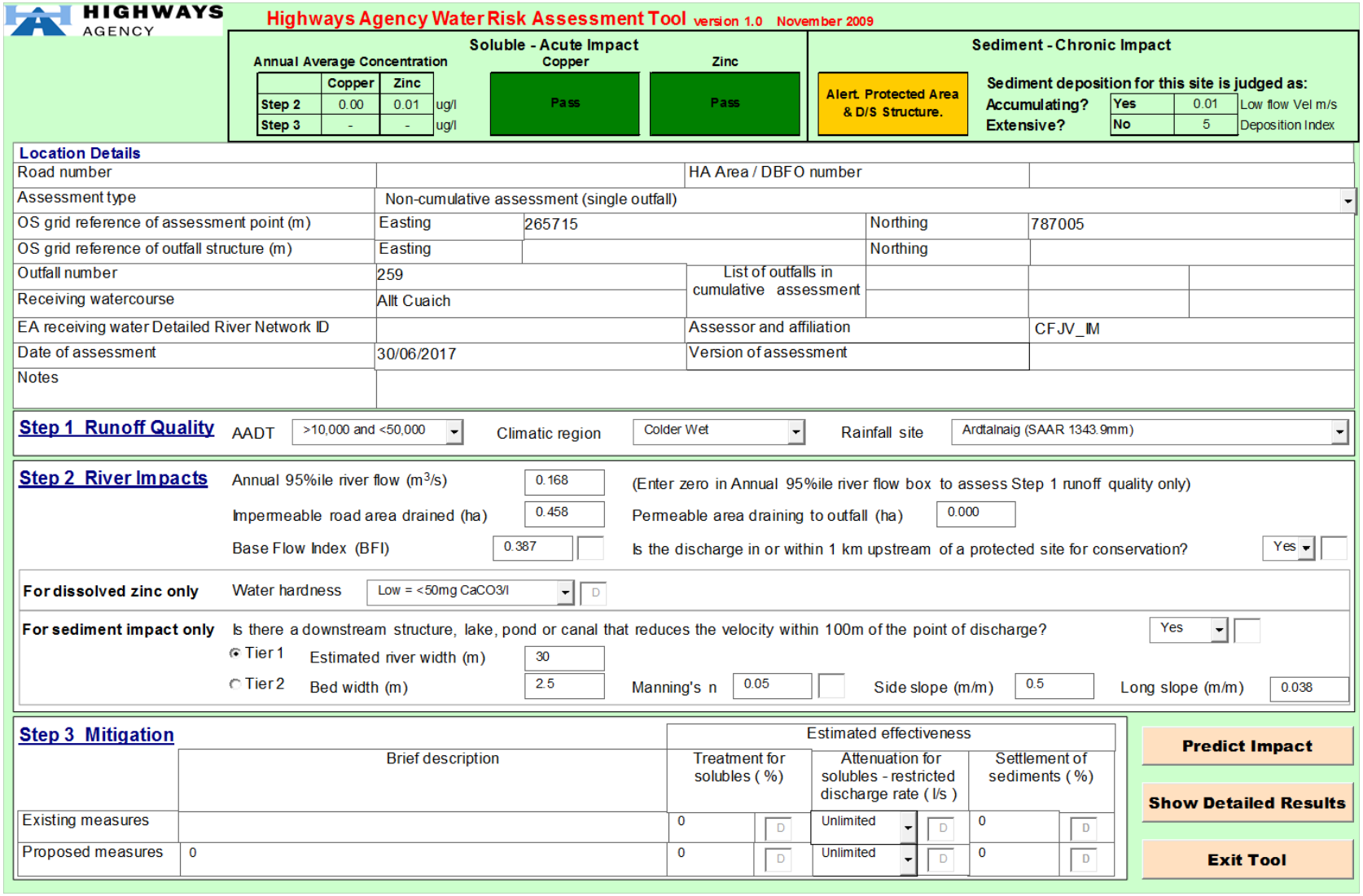
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	0	0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 10: Method A HAWRAT output for SuDS network 259



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.00	0.01	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.01	Low flow Vel m/s
Extensive?	No	5	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	265715	Northing	787005	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	259	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Cuaich				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.168 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.458 Permeable area draining to outfall (ha): 0.000

Base Flow Index (BFI): 0.387 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 30

Tier 2 Bed width (m): 2.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.038

Step 3 Mitigation

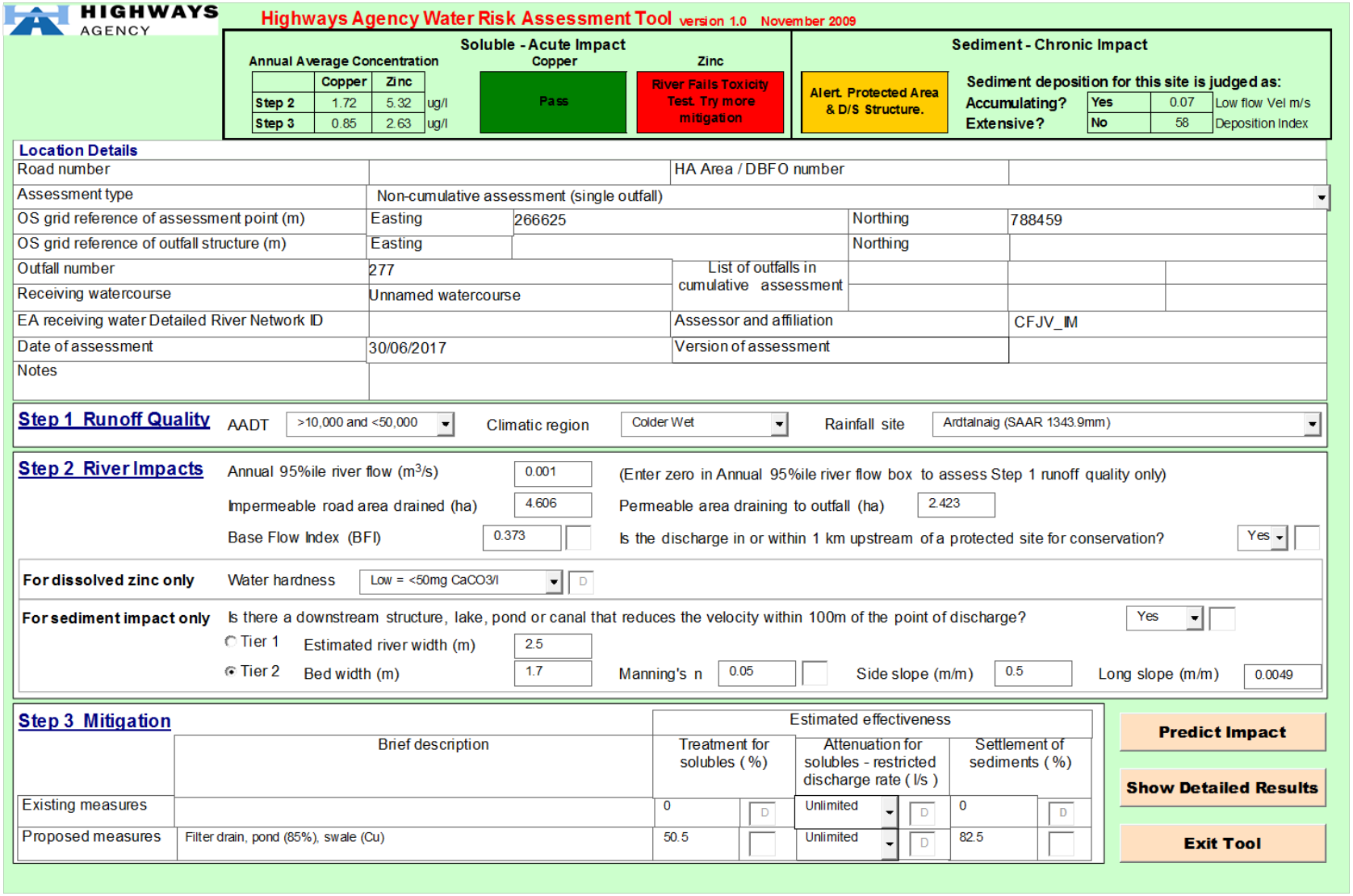
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	0	0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 11: Method A HAWRAT output for SuDS network 277 (copper)



HIGHWAYS AGENCY

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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	1.72	5.32	ug/l
Step 3	0.85	2.63	ug/l

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.07	Low flow Vel m/s
Extensive?	No	58	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	266625	Northing	788459	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	277	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.606 Permeable area draining to outfall (ha): 2.423

Base Flow Index (BFI): 0.373 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 2.5

Tier 2 Bed width (m): 1.7 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0049

Step 3 Mitigation

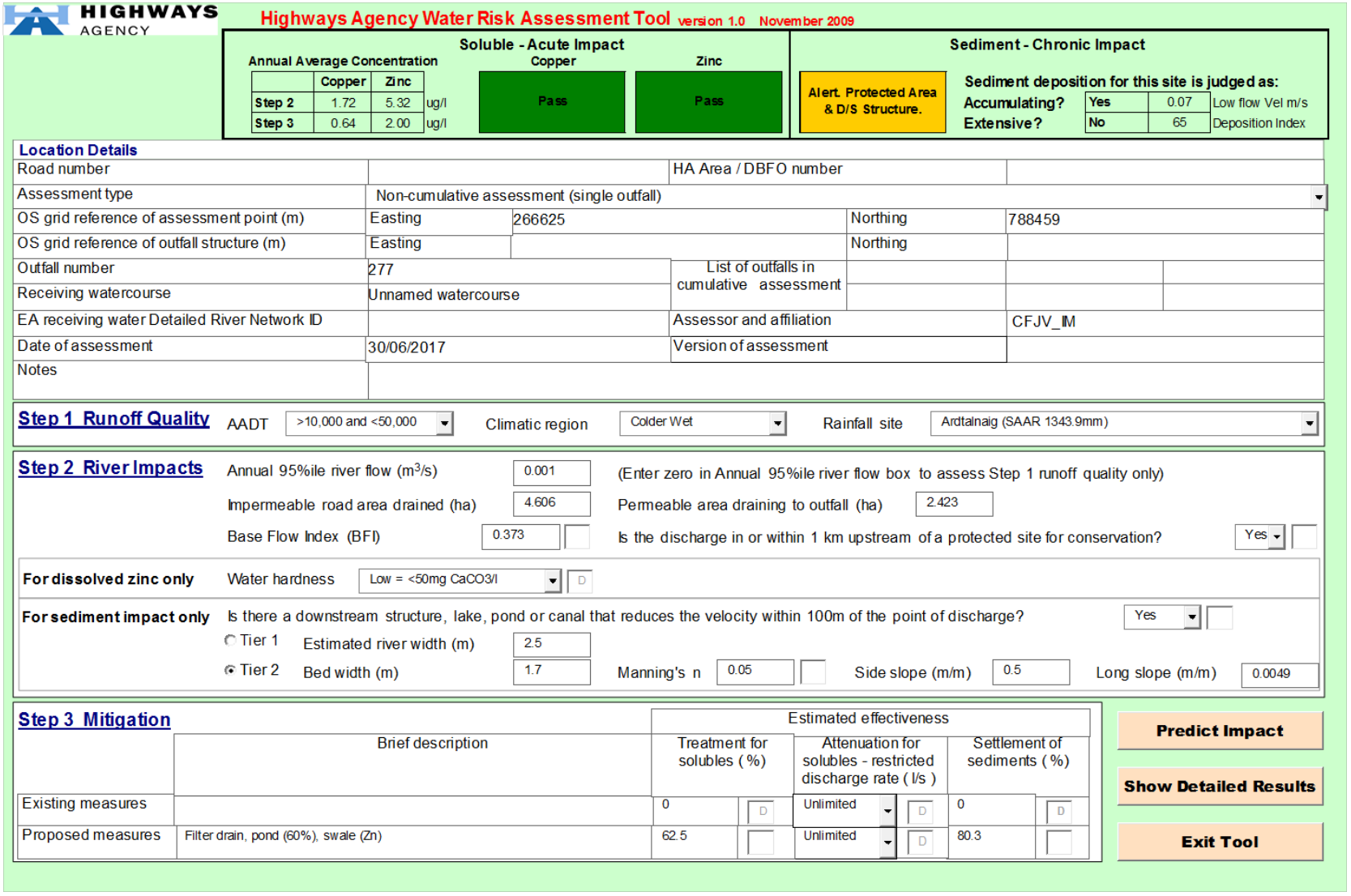
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Filter drain, pond (85%), swale (Cu)	50.5	Unlimited D	82.5

Predict Impact

Show Detailed Results

Exit Tool

Figure 12: Method A HAWRAT output for SuDS network 277 (zinc)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	1.72	5.32	ug/l
Step 3	0.64	2.00	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.07	Low flow Vel m/s
Extensive?	No	65	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	266625	Northing	788459	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	277	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	30/06/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.606 Permeable area draining to outfall (ha): 2.423

Base Flow Index (BFI): 0.373 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 2.5

Tier 2 Bed width (m): 1.7 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0049

Step 3 Mitigation

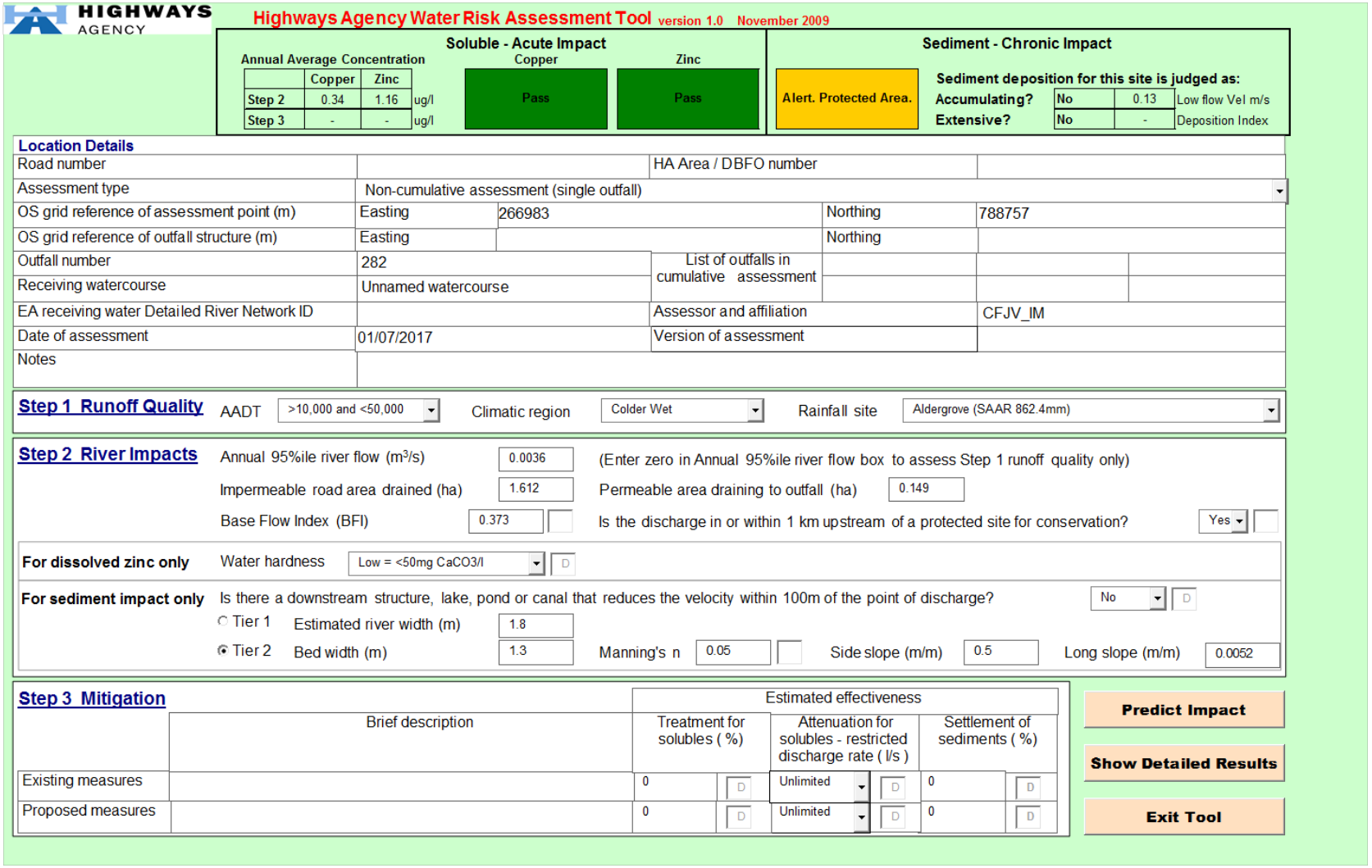
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Filter drain, pond (60%), swale (Zn)	62.5	Unlimited D	80.3

Predict Impact

Show Detailed Results

Exit Tool

Figure 13: Method A HAWRAT output for SuDS network 282 (copper)



HIGHWAYS AGENCY

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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.34	1.16	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.13	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	266983	Northing	788757	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	282	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation		CFJV_IM	
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 Climatic region: Colder Wet Rainfall site: Aldergrove (SAAR 862.4mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0036 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.612 Permeable area draining to outfall (ha): 0.149

Base Flow Index (BFI): 0.373 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

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

Tier 1 Estimated river width (m): 1.8

Tier 2 Bed width (m): 1.3 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0052

Step 3 Mitigation

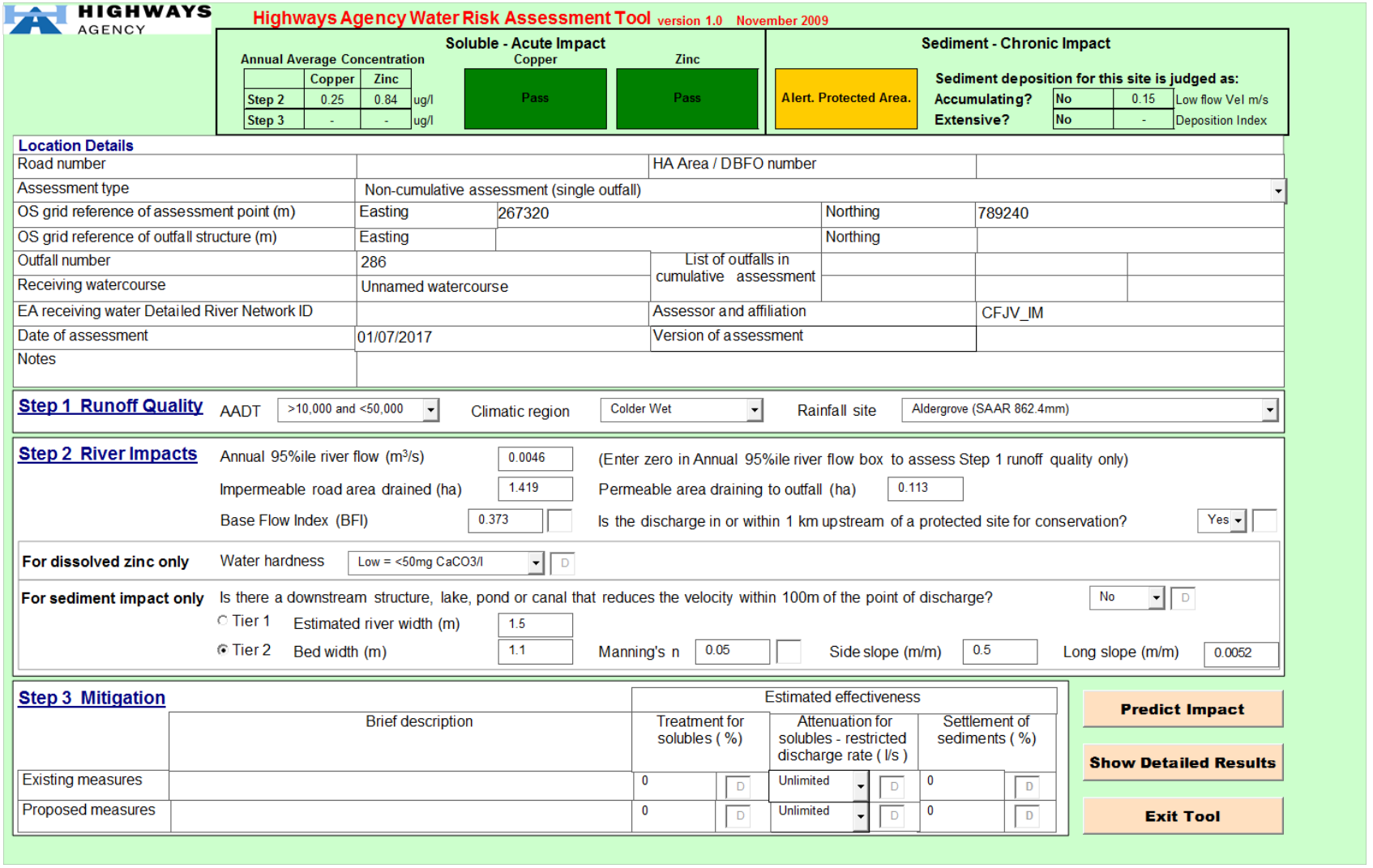
	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures		0	D	Unlimited	D	0	D

Predict Impact

Show Detailed Results

Exit Tool

Figure 14: Method A HAWRAT output for SuDS network 286



HIGHWAYS AGENCY

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Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.25	0.84	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.15	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	267320	Northing	789240	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	286	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation		CFJV_IM	
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Aldergrove (SAAR 862.4mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0046 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.419 | Permeable area draining to outfall (ha): 0.113

Base Flow Index (BFI): 0.373 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Low = <50mg CaCO3/l

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

Tier 1 — Estimated river width (m): 1.5

Tier 2 — Bed width (m): 1.1 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0052

Step 3 Mitigation

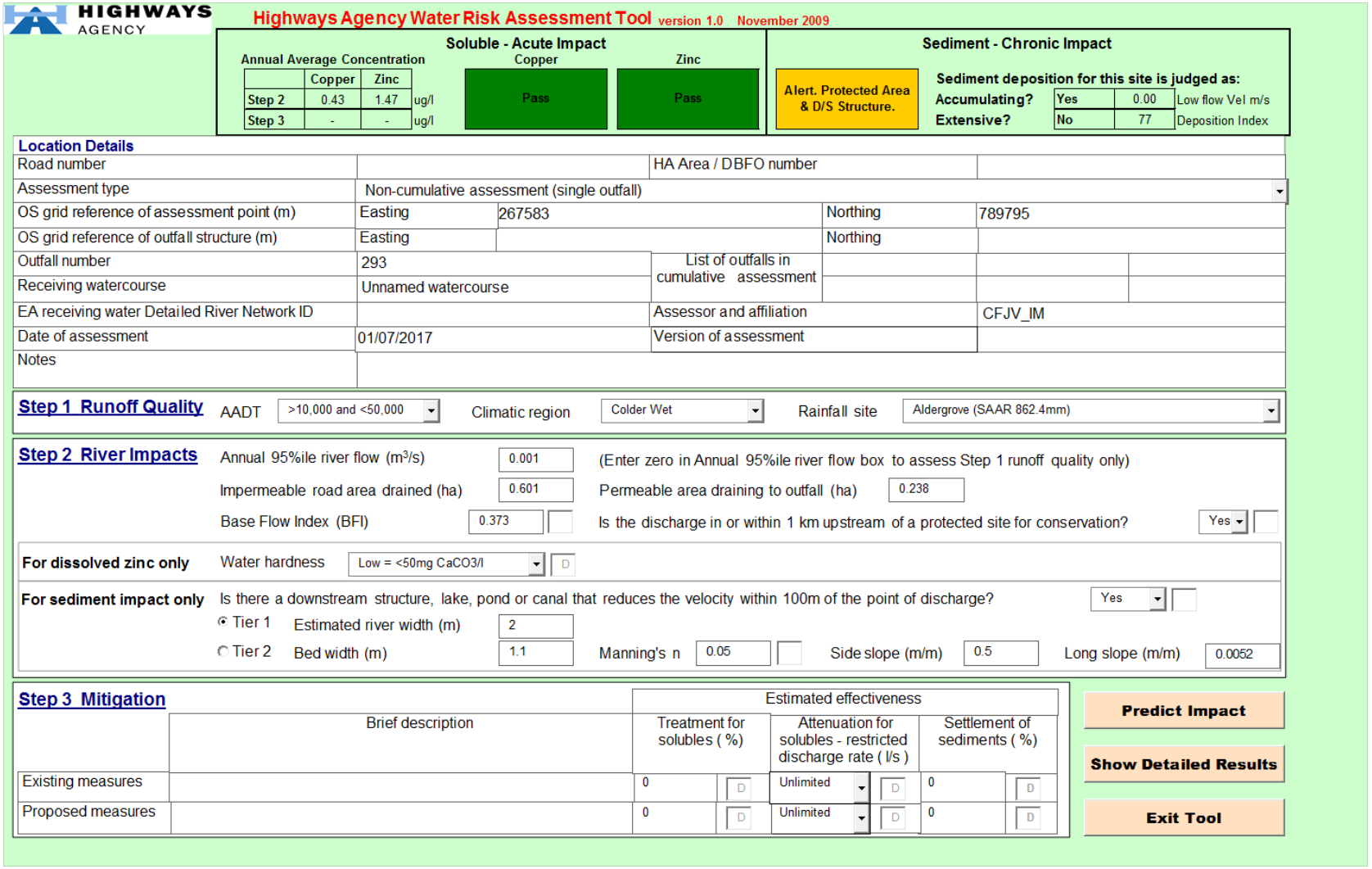
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 15: Method A HAWRAT output for SuDS network 293



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.43	1.47	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	No	77	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	267583	Northing	789795	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	293	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Aldergrove (SAAR 862.4mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.601 Permeable area draining to outfall (ha): 0.238

Base Flow Index (BFI): 0.373 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 2

Tier 2 Bed width (m): 1.1 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.0052

Step 3 Mitigation

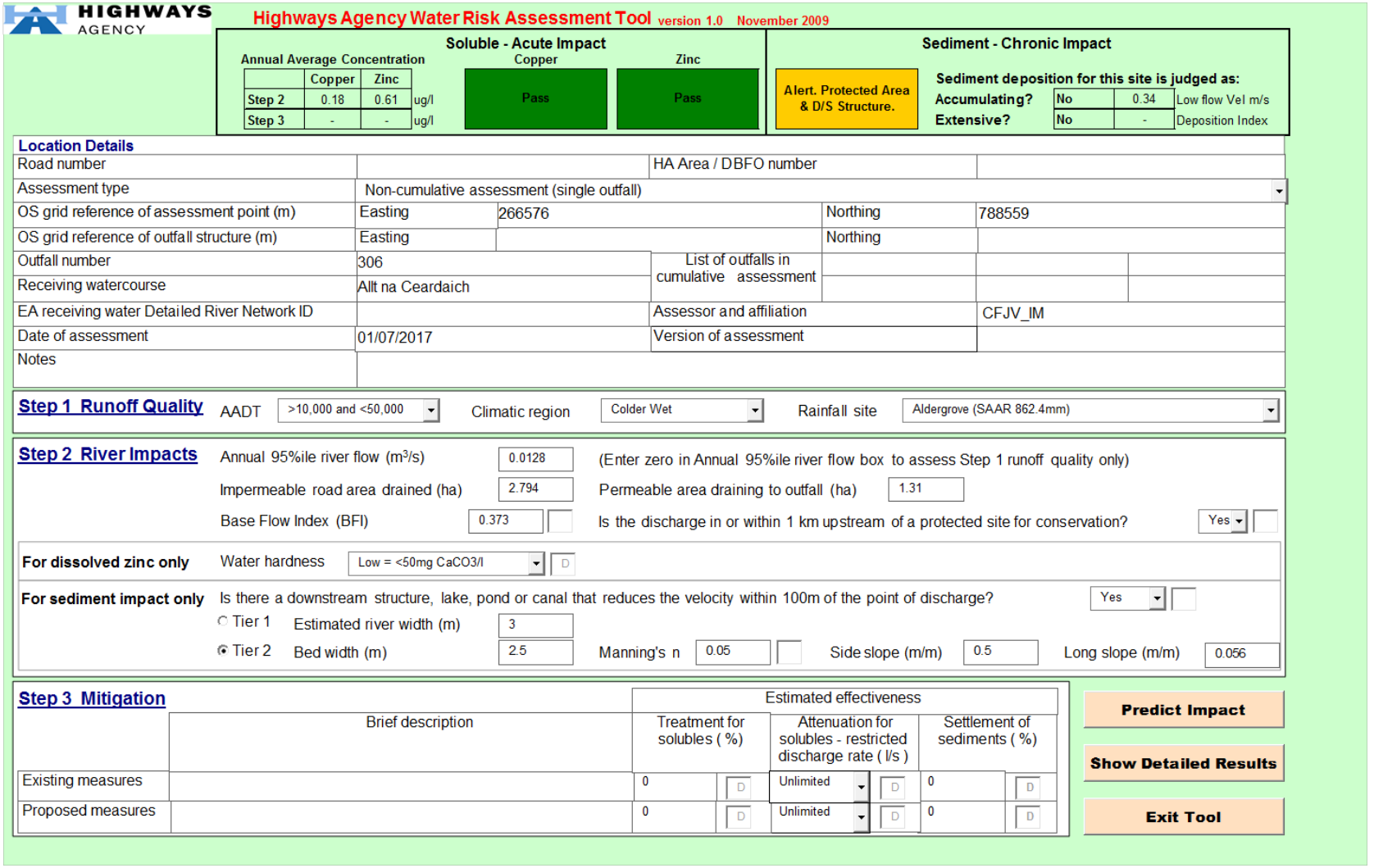
	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures		0	D	Unlimited	D	0	D

Predict Impact

Show Detailed Results

Exit Tool

Figure 16: Method A HAWRAT output for SuDS network 306



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.18	0.61	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	No	0.34	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	266576	Northing	788559	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	306	List of outfalls in cumulative assessment			
Receiving watercourse	Allt na Ceardaich				
EA receiving water Detailed River Network ID		Assessor and affiliation		CFJV_IM	
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 Climatic region: Colder Wet Rainfall site: Aldergrove (SAAR 862.4mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0128 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.794 Permeable area draining to outfall (ha): 1.31

Base Flow Index (BFI): 0.373 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 3

Tier 2 Bed width (m): 2.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.056

Step 3 Mitigation

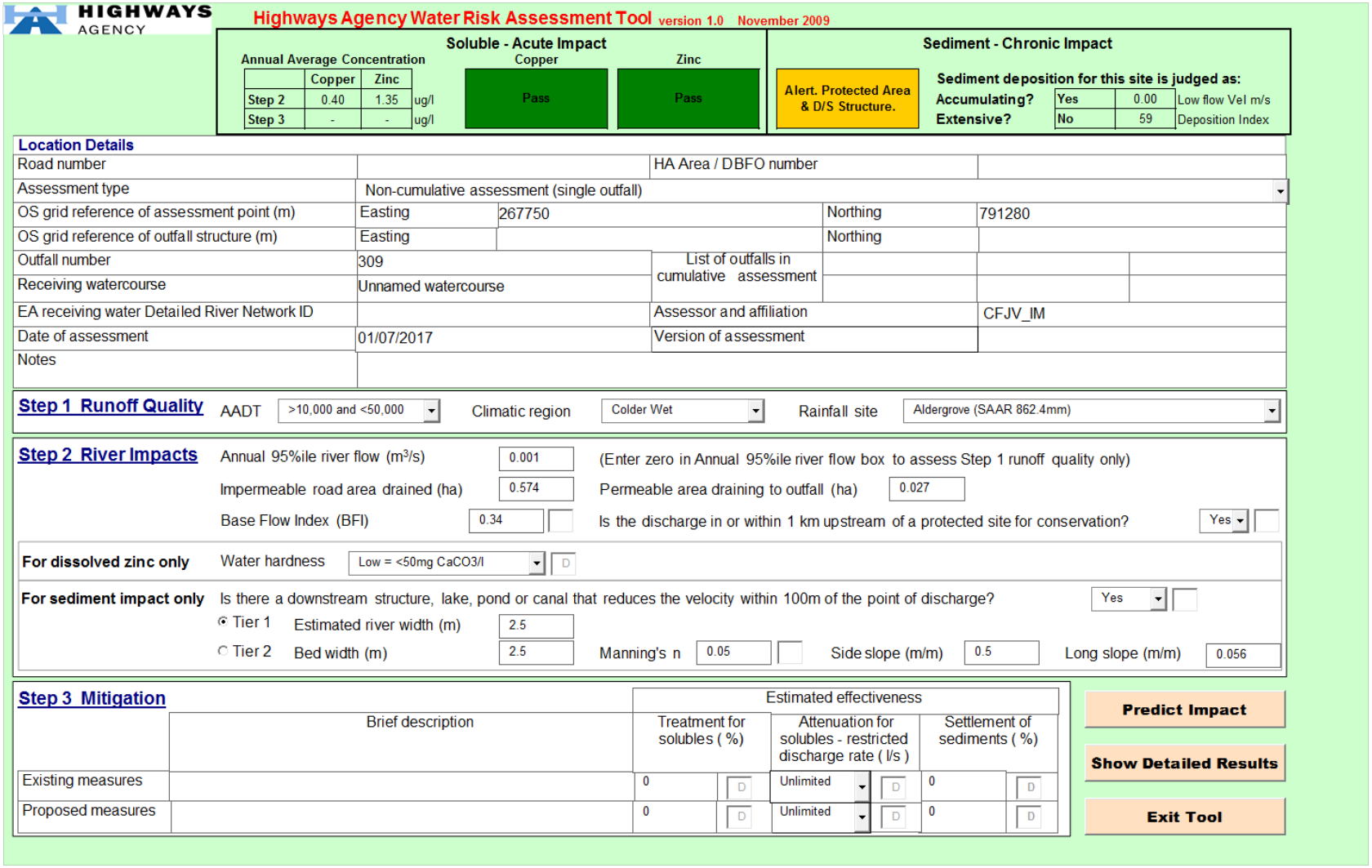
	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures		0	D	Unlimited	D	0	D

Predict Impact

Show Detailed Results

Exit Tool

Figure 17: Method A HAWRAT output for SuDS network 309



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.40	1.35	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	No	59	Deposition Index

Location Details

Road number		HA Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting 267750	Northing	791280
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number	309	List of outfalls in cumulative assessment	
Receiving watercourse	Unnamed watercourse		
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM
Date of assessment	01/07/2017	Version of assessment	
Notes			

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Aldergrove (SAAR 862.4mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.574 Permeable area draining to outfall (ha): 0.027

Base Flow Index (BFI): 0.34 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 2.5

Tier 2 Bed width (m): 2.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.056

Step 3 Mitigation

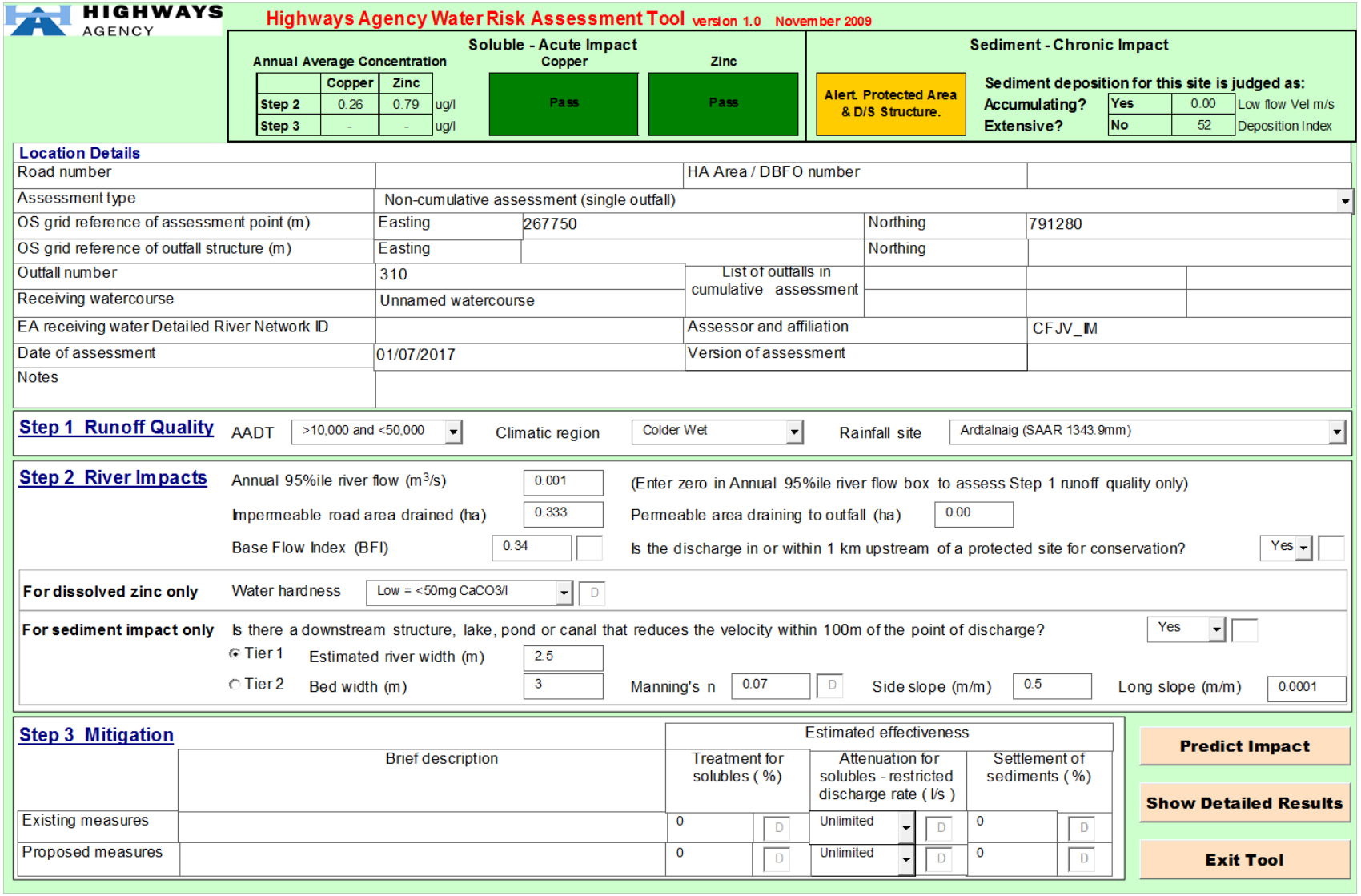
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 18: Method A HAWRAT output for SuDS network 310



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.26	0.79	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area & D/S Structure.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.00	Low flow Vel m/s
Extensive?	No	52	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	267750	Northing	791280	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	310	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed watercourse				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.001 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.333 Permeable area draining to outfall (ha): 0.00

Base Flow Index (BFI): 0.34 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? Yes

Tier 1 Estimated river width (m): 2.5

Tier 2 Bed width (m): 3 Manning's n: 0.07 D Side slope (m/m): 0.5 Long slope (m/m): 0.0001

Step 3 Mitigation

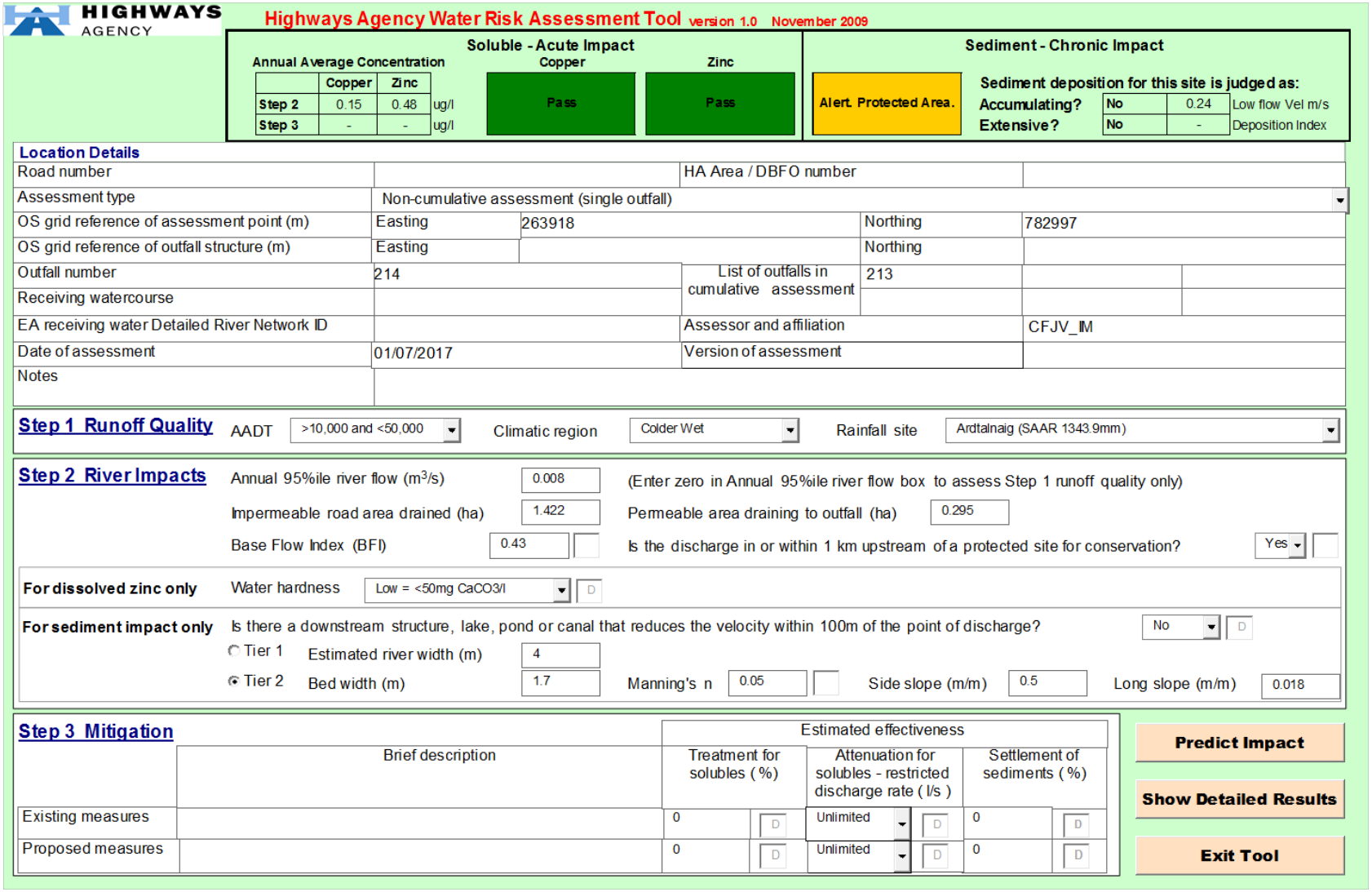
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 19: Method A HAWRAT output for SuDS 213 & 214 cumulative assessment



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.15	0.48	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.24	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	263918	Northing	782997	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	214	List of outfalls in cumulative assessment	213		
Receiving watercourse					
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.008 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.422 Permeable area draining to outfall (ha): 0.295

Base Flow Index (BFI): 0.43 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l D

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

Tier 1 Estimated river width (m): 4

Tier 2 Bed width (m): 1.7 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.018

Step 3 Mitigation

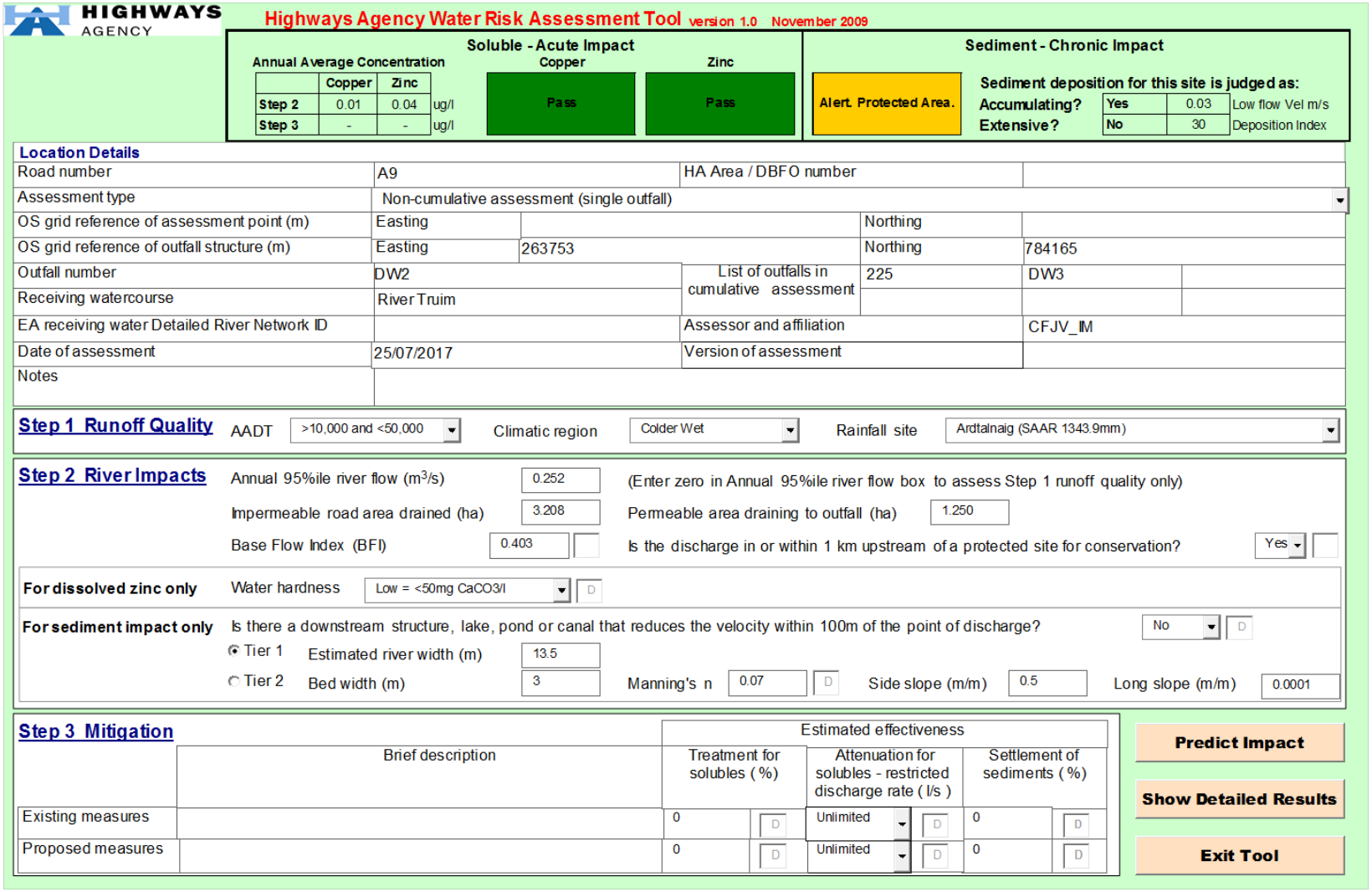
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 20: Method A HAWRAT output for SuDS DW2, 225 and DW3 cumulative assessment



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.01	0.04	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating? Yes 0.03 Low flow Vel m/s

Extensive? No 30 Deposition Index

Location Details

Road number	A9	HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting	263753	Northing	784165	
Outfall number	DW2	List of outfalls in cumulative assessment	225	DW3	
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation		CFJV_IM	
Date of assessment	25/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.252 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 3.208 Permeable area draining to outfall (ha): 1.250

Base Flow Index (BFI): 0.403 Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only

Water hardness: Low = <50mg CaCO3/l D

For sediment impact only

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

Tier 1 Estimated river width (m): 13.5

Tier 2 Bed width (m): 3 Manning's n: 0.07 D Side slope (m/m): 0.5 Long slope (m/m): 0.0001

Step 3 Mitigation

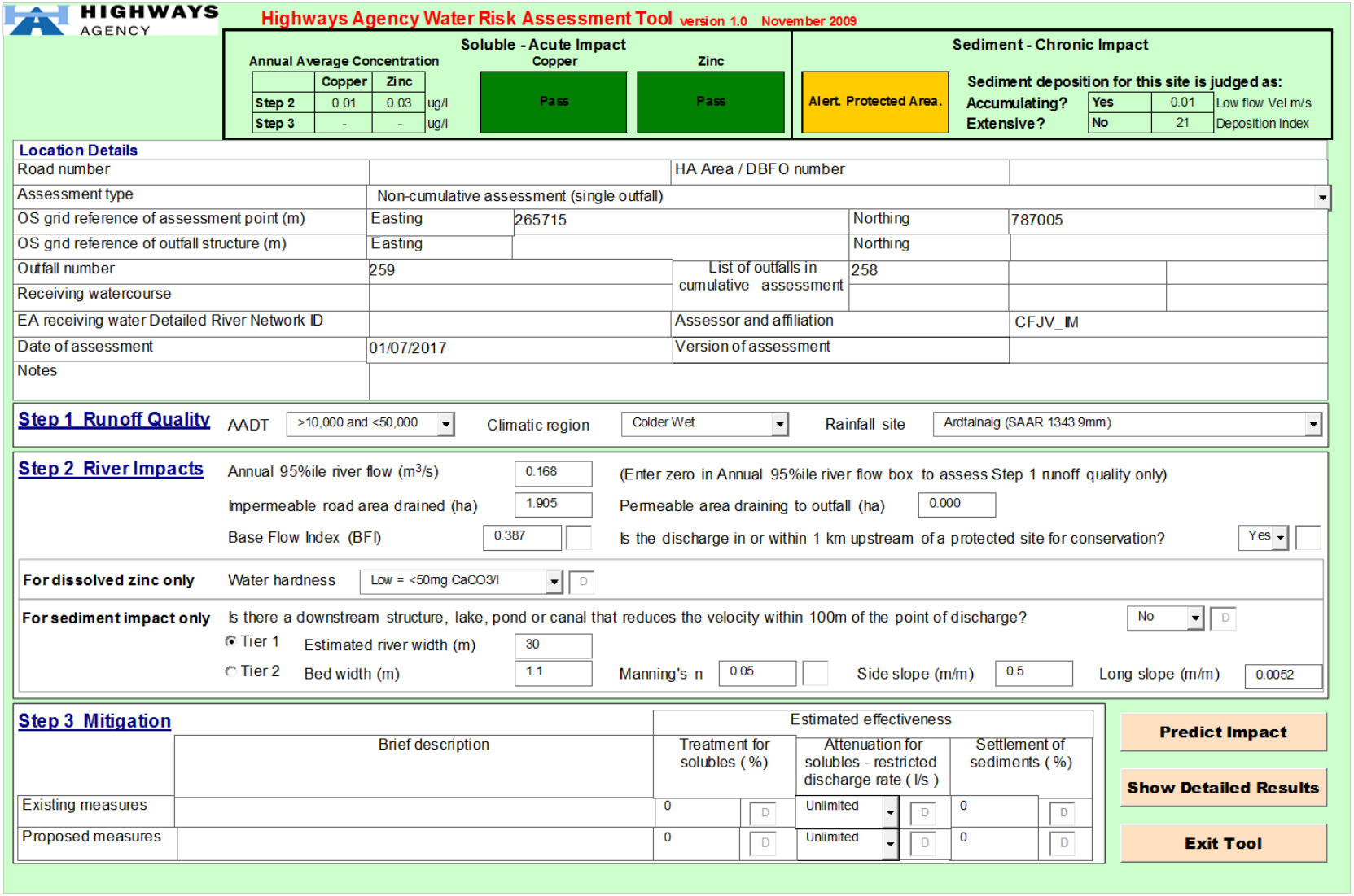
	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures		0	D	Unlimited	D	0	D

Predict Impact

Show Detailed Results

Exit Tool

Figure 21: Method A HAWRAT output for SuDS 258 & 259 cumulative assessment



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.01	0.03	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	Yes	0.01	Low flow Vel m/s
Extensive?	No	21	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	265715	Northing	787005	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	259	List of outfalls in cumulative assessment	258		
Receiving watercourse					
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.168 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.905 | Permeable area draining to outfall (ha): 0.000

Base Flow Index (BFI): 0.387 | Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

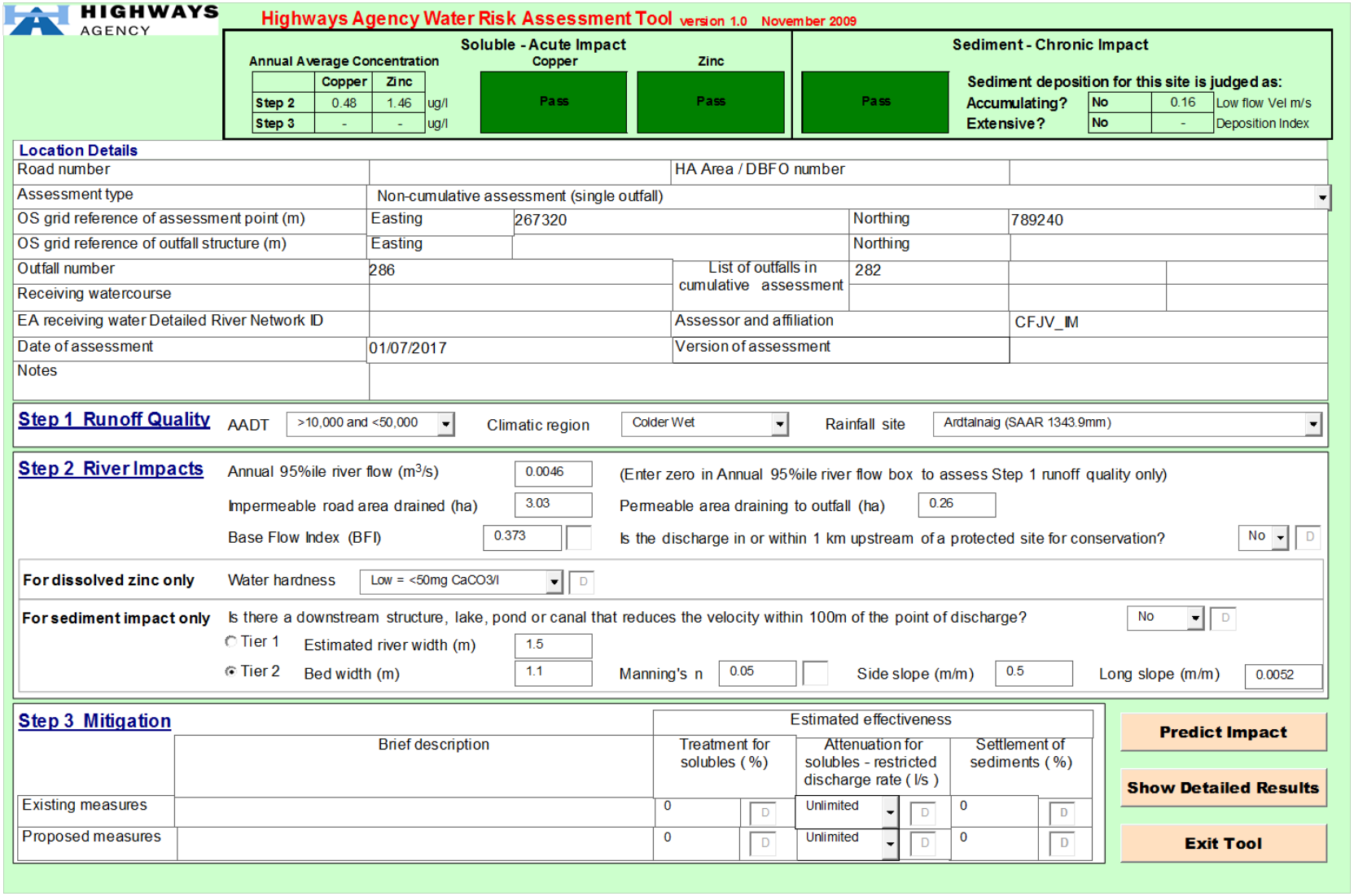
Tier 1 / Tier 2: Estimated river width (m): 30 | Bed width (m): 1.1 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0052

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact | Show Detailed Results | Exit Tool

Figure 22: Method A HAWRAT output for SuDS 282 & 286 cumulative assessment



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.48	1.46	ug/l
Step 3	-	-	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.16	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Location Details

Road number		HA Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting	267320	Northing	789240	
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number	286	List of outfalls in cumulative assessment	282		
Receiving watercourse					
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	01/07/2017	Version of assessment			
Notes					

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Colder Wet | Rainfall site: Ardtalnaig (SAAR 1343.9mm)

Step 2 River Impacts

Annual 95%ile river flow (m^3/s): 0.0046 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 3.03 | Permeable area draining to outfall (ha): 0.26

Base Flow Index (BFI): 0.373 | Is the discharge in or within 1 km upstream of a protected site for conservation? No

For dissolved zinc only Water hardness: Low = <50mg CaCO3/l

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

Tier 1 / Tier 2: Estimated river width (m): 1.5 | Bed width (m): 1.1 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0052

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Table 8: Method C Assessment Table

SuDS Network 207					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	13568 (AADT)	Low – 1	15
2	Rainfall volume	15	1669mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 2.64ha (26,438m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 207 BH8-003 (located under north-eastern edge of SuDS earthworks) Depth to water = 5.1m BH depth = 8.7m bgl	Medium – 2	40
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-003 SAND AND GRAVEL Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
7	Lithology	7.5	BH8-003 SAND AND GRAVEL Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	Medium – 2	15
Overall Score for Filter Drains					212.5 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					242.5 (Medium Risk of Impact)
SuDS Network 213					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	13574 (AADT)	Low – 1	15
2	Rainfall volume	15	1669mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	

3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 1.70ha (16,972m²)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 213 TP8-006 (located under southern edge of SuDS earthworks) Depth to water = 2.1m BH depth = 3m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	TP8-006 = GRAVEL Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
7	Lithology	7.5	TP8-006 = GRAVEL Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					270 (High Risk of Impact)

SuDS Network 214

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	13576 (AADT)	Low – 1	15
2	Rainfall volume	15	1706mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 2.64ha (26,438m²)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BHs to SuDS 214 TP8-006 (located c.130m south of SuDS 214 earthworks) Depth to water = 2.1m BH depth = 3m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60

6	Effective grain size	7.5	TP8-006 = GRAVEL Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
7	Lithology	7.5	TP8-006 = GRAVEL Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					270 (High Risk of Impact)

SuDS Network 222

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	13578 (AADT)	Low – 1	15
2	Rainfall volume	15	1496mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 2.13ha 21,304m^2	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 222 BH8-030A (located c.160m north of SuDS 222 earthworks) Depth to water = 1.60m BH depth = 13.55m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-030A = GRAVEL Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5

7	Lithology	7.5	BH8-030A = GRAVEL Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					270 (High Risk of Impact)

SuDS Network 225

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12547 (AADT)	Low – 1	15
2	Rainfall volume	15	1665mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 3.93ha ($39,273m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 225 BH8-033 (located c.70m south of SuDS 225 earthworks) Depth to water = dry BH depth = 8m	Medium – 2	40
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3 Assumption based on Chapter 10 info in lieu of BH data	22.5
7	Lithology	7.5	Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	Medium – 2	15
Overall Score for Filter Drains					212.5 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					242.5 (Medium Risk of Impact)

SuDS Network 233

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12740 (AADT)	Low – 1	15

2	Rainfall volume	15	1285mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 0.84ha (8384m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 225 BH8-028 (located c.47m north of SuDS 233 earthworks) Depth to water = 4.60m BH depth = 17.3m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-028 = COBBLES Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
7	Lithology	7.5	BH8-028 = COBBLES Till: Geological characteristic - Clayey silty sandy fine to coarse gravel and sandy gravelly silt. - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					270 (High Risk of Impact)

SuDS Network 254

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12741 (AADT)	Low – 1	15
2	Rainfall volume	15	1170mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	5.42ha (54,240m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 254 BH8-014 (located c.150m north-east of SuDS 254 earthworks) Depth to water = dry BH depth = 19m	Low – 1	20
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60

6	Effective grain size	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
7	Lithology	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates.	Medium – 2	15
Overall Score for Filter Drains					192.5 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					232.5 (Medium Risk of Impact)

SuDS Network 258

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12742 (AADT)	Low – 1	15
2	Rainfall volume	15	1170mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin Associated with High Road Area1.61ha (16,059m²)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 258 BH8-015 (located c.10m west of SuDS 258 earthworks) Depth to water = 2.5m BH depth = 13m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-015 = GRAVEL Alluvial Fan Deposits; - Sandy gravelly silt and silty fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
7	Lithology	7.5	BH8-015 = GRAVEL Alluvial Fan Deposits; - Sandy gravelly silt and silty fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)

Overall Score for SuDS Basin (with high road area)					270 (High Risk of Impact)
SuDS Network 259					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12742 (AADT)	Low – 1	15
2	Rainfall volume	15	1170mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 0.34ha (3,395m²)	Low – 1 Medium – 2	15 30
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 259 BH8-015 (located c.60m south-west of SuDS 259 earthworks) Depth to water = 2.5m BH depth = 13m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-015 = GRAVEL Alluvial Fan Deposits; - Sandy gravelly silt and silty fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
7	Lithology	7.5	BH8-015 = GRAVEL Alluvial Fan Deposits; - Sandy gravelly silt and silty fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					255 (High Risk of Impact)
SuDS Network 277					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12744 (AADT)	Low – 1	15
2	Rainfall volume	15	1163mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	

3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 4.78ha (47,7540m²)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 277 BH8-020 (located at proposed eastern edge of SuDS 277 earthworks) Depth to water = 1m BH depth = 13m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-020 = SAND AND GRAVEL Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
7	Lithology	7.5	BH8-020 = SAND AND GRAVEL Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	Medium – 2	15
Overall Score for Filter Drains					232.5 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					262.5 (High Risk of Impact)

SuDS Network 282

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12745 (AADT)	Low – 1	15
2	Rainfall volume	15	1163mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 1.61ha (16,073m²)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 282 BH8-021 (located c.180m north-east of SuDS 282 earthworks) Depth to water = 'damp' BH depth = 2m	High – 3	60

5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	Medium – 2	15
7	Lithology	7.5	Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	Medium – 2	15
Overall Score for Filter Drains					225 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					255 (High Risk of Impact)

SuDS Network 286

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12745 (AADT)	Low – 1	15
2	Rainfall volume	15	1163mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 1.40ha (14,001m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 286 BH8-023A (located c.45m south-east of SuDS 286 earthworks) Depth to water = 3.4m BH depth = 6.85m	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-023A SCHIST Sand Gravel and Boulders Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5

7	Lithology	7.5	BH8-023A SCHIST Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	Medium – 2	15
Overall Score for Filter Drains					232.5 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					262.5, High Risk of Impact

SuDS Network 293

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12745 (AADT)	Low – 1	15
2	Rainfall volume	15	1215mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	- Filter Drains - SuDS Basin associated with High Road Area 0.56ha ($5,616m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 286 BH8-025 (located c.170m north-east of SuDS 286 earthworks) Depth to water = 8m BH depth = 13m	Medium – 2	40
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	BH8-025 SAND AND GRAVEL Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
7	Lithology	7.5	BH8-025 SAND AND GRAVEL Alluvium: - Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	Medium – 2	15

Overall Score for Filter Drains	212.5 Medium Risk of Impact
Overall Score for SuDS Basin (with high road area)	242.5 Medium Risk of Impact

SuDS Network 306

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	12746 (AADT)	Low – 1	15
2	Rainfall volume	15	1147mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	- Filter Drain - SuDS Basin associated with high road area 3.14ha (31,446m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	TP8-047 (located c.130m south east of SuDS 306 Depth to water = dry BH depth = 1.2m, assumed ground water level >5m and < 15m	Medium – 2	40
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	River terrace deposits: Sand and Gravel -- Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	High – 3	22.5
7	Lithology	7.5	River terrace deposits: Sand and Gravel --Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel -Moderate to high or high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers and Truim Valley sand and gravel aquifer	Medium – 2	15
Overall Score for Filter Drain					212.5 Medium Risk of Impact (150 -250)
Overall Score for SuDS Basin (with high road area)					242.5 Medium Risk of Impact (150 -250)

Network DW1

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	1223 (AADT)	Low – 1	15
2	Rainfall volume	15	1665mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	

3	Soakaway geometry	15	- Filter Drain - Swale	Low – 1 Low – 1	15
4	Unsaturated zone (depth to water)	20	TP8-032 (located at the site of DW1 swale) Depth to water = dry BH depth = 8.5m, assumed ground water level >5m and < 15m	Medium – 2	40
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
7	Lithology	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates.	Medium – 2	15
Overall Score for Filter Drain & Swale					212.5 Medium Risk of Impact (150 -250)

Network DW2

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	1223 (AADT)	Low – 1	15
2	Rainfall volume	15	1665mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	- Filter Drain - Swale	Low – 1 Low – 1	15
4	Unsaturated zone (depth to water)	20	TP8-032 (located at the site of DW1 swale) Depth to water = dry BH depth = 8.5m, assumed ground water level >5m and < 15m	Medium – 2	40
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
7	Lithology	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates.	Medium – 2	15

Overall Score for Filter Drain & Swale					212.5 Medium Risk of Impact (150 -250)
Network DW3					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	1223 (AADT)	Low – 1	15
2	Rainfall volume	15	1665mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	- Filter Drain	Low – 1	15
4	Unsaturated zone (depth to water)	20	TP8-032 (located at the site of DW1 swale) Depth to water = dry BH depth = 8.5m, assumed ground water level >5m and < 15m	Medium – 2	40
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic rocks (dominated by fracture porosity)	High – 3	60
6	Effective grain size	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates.	High – 3	22.5
7	Lithology	7.5	HUMMOCKY (MOUNDY) GLACIAL DEPOSITS: -Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand - Predominantly granular with moderate to high permeability estimates	Medium – 2	15
Overall Score for Filter Drain					212.5 Medium Risk of Impact (150 -250)

Figure 23: Method D HAWRAT output for Surface Water (Mainline)

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	1,900							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	No junction							
D6	Location	> 1 hour							
D7	Traffic flow (AADT two way)	12,547							
D8	% HGV	20.42							
D8	Spillage factor *(no/10^8 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00052	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.75							
D11	Risk of pollution incident	0.00039	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No	No						
D13	Return period without pollution reduction measures	0.00039	0.00000	0.00000	0.00000	0.00000	0.00000	0.0004	2588
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction measures	0.00039	0.00000	0.00000	0.00000	0.00000	0.00000	0.0004	2588
D16	Proposed measures factor	0.8	1						
D17	Residual with proposed Pollution reduction measures	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3235

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

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

Table 7.1

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

The worksheet should be read in conjunction with DMRB 11.3.10.

HAWRAT_Version 1_0Spillage Risk

Figure 24: Method D HAWRAT output for Groundwater (Mainline)

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Groundwater							
D2	Length of road draining to outfall *(m)*	1,900							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	No junction							
D6	Location	> 1 hour							
D7	Traffic flow (AADT two way)	12,547							
D8	% HGV	20.42							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00052	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.50							
D11	Risk of pollution incident	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**						
D13	Return period without pollution reduction measures	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3881
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction measures	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3881
D16	Proposed measures factor	0.8	1						
D17	Residual with proposed Pollution reduction measures	0.00021	0.00000	0.00000	0.00000	0.00000	0.00000	0.0002	4852

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

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

Table 7.1

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

The worksheet should be read in conjunction with DMRB 11.3.10.

HAWRAT_Version 1_0Spillage Risk

Figure 25: Method D HAWRAT output for Surface Water (Junction)

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse	Surface watercourse						
D2	Length of road draining to outfall *(m)*	750	1,022						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Rural	Rural						
D5	Junction type	No junction	Cross road						
D6	Location	> 1 hour	> 1 hour						
D7	Traffic flow (AADT two way)	12,547	1,222						
D8	% HGV	20.2	15.6						
D8	Spillage factor *(no/10^8 HGVkm/year)*	0.29	0.88						
D9	Risk of accidental spillage	0.00020	0.00006	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.75	0.75						
D11	Risk of pollution incident	0.00015	0.00005	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No	No						
D13	Return period without pollution reduction measures	0.00015	0.00005	0.00000	0.00000	0.00000	0.00000	0.0002	5055
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction measures	0.00015	0.00005	0.00000	0.00000	0.00000	0.00000	0.0002	5055
D16	Proposed measures factor	0.8	0.8						
D17	Residual with proposed Pollution reduction measures	0.00012	0.00004	0.00000	0.00000	0.00000	0.00000	0.0002	6318

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

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

Table 7.1

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

The worksheet should be read in conjunction with DMRB 11.3.10.

HAWRAT_Version 1_0Spillage Risk

Figure 26: Method D HAWRAT output for Groundwater (Junction)

HIGHWAYS AGENCY

View Spillage Assessment Parameters | Reset | Go To Runoff Risk Assessment Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Groundwater	Groundwater						
D2	Length of road draining to outfall *(m)*	750	1,022						
D3	Road Type *(A-road or Motorway)*	A	A						
D4	If A road, is site urban or rural?	Rural	Rural						
D5	Junction type	No junction	Cross road						
D6	Location	> 1 hour	> 1 hour						
D7	Traffic flow (AADT two way)	12,547	1,222						
D8	% HGV	20.2	15.6						
D8	Spillage factor *(no/10⁸ HGVkm/year)*	0.29	0.88						
D9	Risk of accidental spillage	0.00020	0.00006	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.50	0.50						
D11	Risk of pollution incident	0.00010	0.00003	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No	No						
D13	Return period without pollution reduction measures	0.00010	0.00003	0.00000	0.00000	0.00000	0.00000	0.0001	7582
D14	Existing measures factor	1	1						
D15	Return period with existing pollution reduction measures	0.00010	0.00003	0.00000	0.00000	0.00000	0.00000	0.0001	7582
D16	Proposed measures factor	0.8	0.8						
D17	Residual with proposed Pollution reduction measures	0.00008	0.00003	0.00000	0.00000	0.00000	0.00000	0.0001	9477

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

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

Table 7.1

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

The worksheet should be read in conjunction with DMRB 11.3.10.

HAWRAT_Version 1_0Spillage Risk

Annex 2: Technical Note

'Side Road and Accommodation Track SUDS' – Technical Note, AMJV (2015), A9P0N-AMJ-HDG-Z_ZZZZZ_XX-TN-DE-0001

Project:	A9 Dualling	**Originated**	PG
Subject:	Side Road and Accommodation Track SUDS	**Checked**	DP
Date:	August 2015	**Reviewed**	RMcE
Document Reference	A9P0N-AMJ-HDG-Z_ZZZZZ_XX-TN-DE-0001	**Authorised**	SB
Suitability	For Review & Comment	**Version**	P3.0

1. SUDS on Side Roads, Accommodation and NMU Tracks

Section 4.1 of Chapter 3 'Water and Flooding' of the A9 Dualling Programme Environmental Design Guide [1] states that 'All runoff from newly dualled A9 carriageway will be collected and treated via, as a minimum, two levels of sustainable drainage systems (SUDS), prior to discharge.
Dualling of the A9 involves interaction with existing side roads, requiring diversions and realignments as well as creation of accommodation tracks and non-motorised user (NMU) tracks. This Technical Note outlines the proposed approach to SUDS on these side roads and tracks.

1.1 Current Guidance on SUDS use with Roads

There is limited guidance on how to approach the SUDS assessment and design for the type of roads and tracks that are beyond the A9 mainline or junctions. Below are extracts from a number of relevant guidance documents referencing SUDS use with roads:

- 'SUDS for Roads' [2] section 2.1 acknowledges the different categories of roads below Trunk Roads, including a number of categories of distributor and access roads. The guidance on the number of SUDS levels for roads in section 2.4.1 states 'It is generally accepted that roads typically require two levels of treatment, although for smaller developments residential roads may require only one level'
- Guidance in SEPA 'Regulatory Method (WAT-RM-08) Sustainable Urban Drainage Systems (SUDS or SUDS systems) [3]. Section 7.7 states that 'Levels of treatment required will depend on the volume of traffic using the road; 'One level is appropriate for lightly trafficked and minor roads, two levels of treatment are normally required for all other roads, except motorways which normally require three levels.'
- Highland Council guidance, sections 6.25 to 6.29 'Drainage of the Road' of Flood Risk & Drainage Impact Assessment: Supplementary Guidance [4], refers to individual elements of SUDS for use on roads, but references SUDS for Roads for further guidance (section 6.29).

Perth and Kinross Council guidance, 'Flood Risk and Flood Risk Assessments' [5] does not make any specific reference to SUDS use with roads.

1.2 Side Road and Track Classifications

SUDS for Roads (Figures 2.1 and 2.2) classify roads in three broad categories; trunk, distributor and access roads.
'A9 Dualling: Preliminary Engineering Support Services' [6] (PES) report classifies side roads into three tiers for the purposes of the junction strategy: Tier 1; A and B roads, Tier 2; C and unclassified roads and Tier 3; Private and Agricultural access roads. Section 4.10.1 of the PES report identifies that B roads with Annual Average Daily Traffic (AADT) or less than 500 should be considered separately to those with a greater AADT.

Taking both of the above classifications into consideration, it is proposed to group the side roads and tracks in the following classifications. This is so that the most appropriate method of SUDS assessment, selection and guidance can be applied to each group.

- Tier 0: Trunk Road (side road to A9) under the jurisdiction of Transport Scotland.
- Tier 1.1: A and B roads (local roads) with an AADT of over 500.
- Tier 1.2: A and B roads (local roads) with an AADT of under 500.
- Tier 2: C and unclassified roads.
- Tier 3: Private and Agricultural Access Roads (Accommodation Tracks).
- Tier 4: NMU tracks.

1.3 Guidance Relevant to each Side Road and Track Classification

- Tier 0 side roads are those under the jurisdiction of Transport Scotland, therefore design standards and advice in the Design Manual for Roads and Bridges (DMRB) [7] applies, as it does for the mainline A9.

- Tier 1 and 2 are local authority roads, therefore guidance on SUDS assessment in the DMRB may not be appropriate. HD45/09 Road Drainage and the Water Environment [8] is the applicable section of guidance in the DMRB. The methods in here, such as Method A (HAWRAT) (HD45/09 Annex 1) for assessing the runoff from roads on receiving watercourses, are aimed at roads with a traffic flow (AADT) of over 10,000 per day. On parts of the A9 mainline the AADT is below this, and on the side roads likely to be lower again, often lower than 10% (1000 AADT) of this. Therefore, more appropriate guidance on SUDS assessment and selection is in SUDS for Roads.

  Guidance in SUDS for Roads is applicable to all types of roads from trunk roads to minor access links (section 1.1.1).
  Section 2.6 of SUDS for Roads sets out a procedure to select the appropriate SUDS features for a road, taking into consideration aspects such as topography, space available and environmental factors. It is proposed to use this procedure to assist in selecting the SUDS for Tier 1 and 2 side roads.

  Tier 1 roads have been sub-divided into two categories, based on the PES Report AADT of 500 as the limit of a lightly trafficked road. The use of 500 AADT as a basis for lightly trafficked roads originates from DMRB TD41/94 [9] as a road with such low traffic flows as to allow an uncontrolled direct access off the trunk road. SEPA guidance 'WAT-RM-08' will be considered in the case of lightly trafficked roads with an AADT of under 500.

  Tier 1.1 A and B roads with an AADT of over 500
  Tier 1.2: A and B roads with an AADT of under 500

- Tier 3 accommodation tracks and access roads vary depending on the use and requirements and the majority will be private. These have been sub-divided into five categories on the basis of applying the most appropriate SUDS guidance to each one.

  Tier 3.1: Agricultural / forestry with an AADT of under 100
  Tier 3.2 Agricultural with an AADT of under 50
  Tier 3.3 Residential with an AADT of under 100
  Tier 3.4 Residential with an AADT of under 10
  Tier 3.5 Road feature maintenance track with and AADT of under 10

  Table 1.1 below shows potential variants within the Tiers. As most tracks will be designed to meet the requirements of the landowner, the tracks can vary between resembling minor roads (Tier 3.1 impermeably surfaced) to less formal accesses (Tier 3.4 permeably paved). Use of permeably paved accesses will be subject to suitability of ground conditions and intended usage.

In addition to guidance in SUDS for Roads and WAT-RM-08, other drainage design guidance specifically for tracks may also be considered. SNH guidance 'Constructed Tracks in the Scottish Uplands' [10] contains guidance on the design and construction of tracks in a rural upland setting, including drainage (section 4.9), which may also be appropriate for some track types.

Tier	Typical Width*	Surface	Typical Vehicle	AADT	Purpose (dwelling, business, agricultural)
3.1	6m	Impermeable surfacing	HGV 6 (or more)-axle articulated	<100	Agricultural /forestry
		Permeable paving	HGV 6 (or more)-axle articulated	<100	Agricultural/forestry
3.2	4m with passing places	Impermeable surfacing	Car /LGV	<50	Agricultural
			HGV 6 (or more)-axle articulated		
		Permeable paving	Car /LGV	<50	Agricultural
			HGV 6 (or more)-axle articulated		
3.3	4m with passing places	Impermeable surfacing	Car /LGV	<100	Residential (multiple properties)
			HGV (3 axle rigid) – service vehicle		
		Permeable paving	Car /LGV	<100	Residential (multiple properties)
			HGV (3 axle rigid) – service vehicle		
3.4	3m with passing places	Impermeable surfacing	Car / LGV	<10	Residential (single property)
		Permeable paving	Car / LGV	<10	Residential (single property)
3.5	3m with passing places	Permeable paving	LGV	<10	SUDS maintenance track

***** *Actual dimensions will be subject to change following consultation with local authority or the affected landowners*

Table 1.1 Private and Agricultural Access Roads

- Tier 4 NMU tracks will also vary depending on the use and requirements. They are likely to be a mix of private and local authority tracks. They have been subdivided into two categories in order to apply the most appropriate SUDS guidance to each one:

  Tier 4.1: Impermeably surfaced NMU tracks
  Tier 4.2: Permeably paved NMU tracks

1.3 Water Quality, SUDS, Guidance and Legislation

The drainage of the side roads, accommodation track and NMU track provision will consider the requirements of The Water Environment (Controlled Activities) (Scotland) Regulations 2011 [11] (CAR).

Within the CAR Practical Guide [12], pollution control from surface water discharge is covered by both 'Point Source' (section 3.1) and 'Diffuse Pollution' (section 3.2), for the protection of the water environment.

Point source pollution includes 'surface water from urban areas' and diffuse pollution includes 'discharge of surface water run-off.' Further guidance on SEPA's website [13] identifies run-off from roads as diffuse pollution and should have SUDS applied, in accordance with SUDS for Roads. Roads are identified within the diffuse pollution in urban area, although applicable to rural and urban situations where roads are proposed.

SEPA guidance 'Diffuse Pollution General Biding Rules: Forestry' [14] references rural diffuse pollution, surface runoff:

- Water should be discharged in a way that minimises the risk of polluting the water environment.
- No discharge from drainage should result in the destabilisation of the banks or bed of the receiving water.

SNH 'Constructed Tracks in the Scottish Uplands' (section 4.9 – Drainage) references the CAR practical guide and acknowledges the potential impact of surface water runoff from these tracks on the receiving watercourses.

Point source and diffuse pollution, urban and rural are covered by General Binding Rules (GBR) 10 and 21, which cover surface water drainage, except where a simple licence is required.

- GBR10 addresses discharges relating to construction sites, buildings, roads, yards and other built up areas and requires provision of SUDS.
- GBR21 addresses the discharge of water run-off via a surface water drainage system to the water environment (rural land activities) and requires that run-off must be discharged in a manner that minimises the risk of pollution to any river, burn, ditch or wetland and must not result in the destabilisation of the banks or bed of the receiving river, burn, ditch or wetland. GBR 21 does not specify the requirement for SUDS.

Section c) of GBR10 states 'All reasonable steps must be taken to ensure that the discharge will not result in pollution of the water environment.' Therefore the provision of SUDS for each side road or track will contribute to achieving this.

Section 2, below, identifies the steps to be taken for each Tier of side road or track in order to best meet the requirements of GBR10 and 21.

2. Proposed Assessment Procedures

2.1 Side Roads (Tier 0)

- Tier 0 roads; where other Transport Scotland trunk roads join the A9 mainline, these shall be assessed in accordance with DMRB guidance and two levels of SUDS as a minimum will generally be proposed.

2.2 Side Roads (Tiers 1.1, 1.2 and 2)

All side roads will be reviewed on a case-by-case basis in line with an assessment and selection process based on that outlined in section 2.6 of SUDS for Roads. This includes consideration of location, traffic usage and position relative to any designated environmental sites. To ensure a proportional and risk-based solution, the SUDS approach for each category of side road is as follows:

- Tier 1.1 roads; these will be reviewed in accordance with an assessment based on section 2.6 of SUDS for Roads. It is proposed that two levels of SUDS shall be used, however each road will be reviewed on a case-by-case basis to ensure this is appropriate. Where physical or other site constraints exist that prevent the application of two levels, one level of SUDS may be proposed. If one level of SUDS is proposed, the type of SUDS will be considered to maximise pollutant capture and treatment, and the relevant stakeholders will be consulted.

- Tier 1.2 roads; these will be assessed in the same manner as Tier 1.1 roads. However, consideration will be given to the advice in WAT-RM-08 for roads that are lightly trafficked. Therefore, it is proposed to have one level of SUDS unless they are located in, or discharge to, an aquatic part of a Natura2000 site – Special Protection Area (SPA) or Special Areas of Conservation (SAC) designated under the Birds Directive (79/409/EEC) [15] or the Habitats Directive (92/43/EEC) [16] respectively, whereby use of two levels will generally be proposed.

  Where one level of SUDS is used, the most appropriate type of SUDS should be considered with the aims of maximising pollutant capture and treatment with due regard to ease of maintenance.

- Tier 2 roads; these will be assessed using the same approach as for Tier 1.2 roads.

3. Accommodation Tracks (Tier 3)

Each accommodation track in Tiers (Tier 3.1 to 3.5) has an AADT of under 100. Therefore it is appropriate to consider the advice given in WAT-RM-08. The traffic figures are low enough for one level of SUDS generally to be sufficient to give adequate and proportionate protection to the receiving watercourse. The type of SUDS will be considered to maximise pollutant capture and treatment.

However, Table 1.1 indicates that the type of vehicle use may vary significantly, and Tier 3.1 and 3.2 may carry types of industrial vehicle which have a higher risk of generating pollution.

Each track will be assessed on a case-by-case basis, using a process based on that outlined in section 2.6 of SUDS for Roads. It will generally be proposed that one level of SUDS is sufficient; however, where higher risk vehicles are identified as using the tracks, two levels of SUDS may be proposed. Likewise, where the tracks are located in or upstream of a Natura 2000 site (SAC or SPA), an additional level of SUDS may be required to give sufficient protection to the receiving watercourse.

Advice in SNH guidance ‘Constructed Tracks in the Scottish Uplands’ will be considered where applicable. Where permeable paving is used, particularly for Tiers 3.4 and 3.5, and where site conditions allow, the permeable paving may be considered as one level of SUDS.

4. NMU Tracks (Tier 4)

NMU tracks will generally not be used by vehicles, and so no vehicle based pollutants will be generated and washed into the run-off. Therefore, specific SUDS features to protect the quality of the receiving watercourses will not generally be provided. Where the tracks are paved, the runoff rates will be assessed and one level of SUDS may be proposed, principally as a conveyance and flood mitigation feature. Where the NMU tracks are constructed with permeable paving, this may be considered as one SUDS level in certain circumstances, depending on paving type, track use and local ground conditions. Otherwise they shall be treated in the same manner as paved NMU tracks.

5. References

1. Chapter 3 'Water and Flooding' of the A9 Dualling Programme Environmental Design Guide (CH2M Hill, 2015).
2. SUDS for Roads (WSP, 2009).
3. Regulatory Method (WAT-RM-08) Sustainable Urban Drainage Systems (SUDS or SUDS systems) (SEPA, 2014).
4. Flood Risk & Drainage Impact Assessment: Supplementary Guidance (The Highland Council, 2013)
5. 'Flood Risk and Flood Risk Assessments (Developers Guidance Note on Flooding and Drainage) (Perth and Kinross Council, 2014)
6. A9 Dualling: Preliminary Engineering Support Services' DMRB Stage 1 Assessment (Jacobs, 2014)
7. Design Manual for Roads and Bridges (DMRB) (Highways England) www.standardforhighways.co.uk
8. HD45/09 'Road Drainage and the Water Environment' Volume 11, Section 3, Part 10 (DMRB, 2009)
9. TD41/95 'Vehicular Access to All Purpose Trunk Roads' Volume 6, Section 1, Part 7 (DMRB 1995)
10. Constructed Tracks in the Scottish Uplands (SNH, 2013)
11. The Water Environment (Controlled Activities) (Scotland) Regulations 2011
12. The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended). A Practical Guide Version 7.2 (SEPA, 2015)
13. http://www.sepa.org.uk/regulations/water/diffuse-pollution/diffuse-pollution-in-the-urban-environment/
14. Reducing the Risk of Water Pollution: Diffuse Pollution General Biding Rules: Forestry (SEPA, 2006)
15. Birds Directive (79/409/EEC) as amended. European Parliament (1979)
16. Habitats Directive (92/43/EEC) as amended. European Parliament (1992)