Appendix 11.2

Water Quality Assessment

Contents

Tables

Figures

1 Introduction

1.1.1 Potential impacts on surface and groundwater may occur as a result of the Proposed Scheme for Project 7 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 within areas designated for their protected species or habitats (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 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 appropriate 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).

2.1.3 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: Technical Note – 'Side Road and Accommodation Track SUDS'* (AMJV, 2015). Balsporran carpark has been designed as a porous surface parking area and appropriate treatment incorporated in accordance with general SuDS guidance (i.e. SuDS Manual (C753), CIRIA 2015).

2.1.4 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 7 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 drainage networks

Network	1st Level SuDS	2nd Level SuDS	Inclusion of Micro-pool	Outfall Form	Outfall receiving water	Outfall Co-ordinates	
						Easting	Northing
000	Filter Drain	Basin	No	Swale	Allt Chaorach Beag	265634	772530
001	Filter Drain	Basin	Yes	Swale	Unnamed (W7.1)	264686	773114
003	Filter Drain	Basin	Yes	Swale	Unnamed (W7.1)	264686	773114
004	Filter Drain	Basin	Yes	Swale	Allt Coire Mhic-sith (MW7.3)	264561	773260
020	Filter Drain	Basin	Yes	Swale	Allt Fuar Bheann (MW7.6)	263541	774594
042	Filter Drain	Basin	Yes	Swale	Unnamed (W7.101)	262879	776702
060	Filter Drain	Basin	No	Swale	Unnamed (W7.9)	262585	778515
063	Filter Drain	Basin	No	Swale	River Truim	262633	778774
065	Filter Drain	Basin	Yes	Swale	River Truim	262714	778926
Balsporran car park	Porous cellular system filled with single sized stone	Filter Drain	No	Pipe	Unnamed (W7.150)	262806	779192
069	Filter Drain	Basin	No	Swale	Unnamed (W7.15)	262852	779326
077	Filter Drain	Basin	Yes	Swale	River Truim	262986	780161
083	Filter Drain	Basin	No	Swale	Unnamed (W7.19)	263198	780475
092	Filter Drain	Basin	Yes	Swale	Allt Coire Bhotie (MW7.23)	263697	781490
102*	Filter Drain	Tank sewer & vortex separator	No	Swale	Unnamed watercourse	263893	781991

*Note: The tank sewer and vortex separator are included in the Project 7 design as a temporary measure to provide sufficient treatment should Project 7 be constructed prior to Project 8. In actuality, it is likely both will be constructed as one and this section of road will drain north, tying into the Project 8 drainage network, and discharge into Allt Coire nan Cisteachan (MW8.5) via a SuDS basin. However; for assessment purposes, both Project 7 and Project 8 have to be considered independently and sufficient measures to treat runoff provided in each.

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)

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 (now 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. These pollutants are:

- 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 as follows: 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 assessments, 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 input to the tool. 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 Assessment

2.1.20 In line with DMRB HD45/09, cumulative assessments have also been undertaken for multiple discharges to single tributaries of larger watercourses where drainage outfalls are located within 1km along a river reach. 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 weighing 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 of 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 sites 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 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

2.1.31 The risk is initially assessed without any mitigation and subsequently and re-assessed on the basis of embedded mitigation being 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 (P_{EMB}) 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 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.

2.1.32 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 SPAs 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 methodology and criteria described 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. Therefore, filter drains and SuDS basins have been incorporated into the Proposed Scheme 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.

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 **Table 3**.

Table 2: Method A Results Table

Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Embedded 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	
000	Allt Chaorach Beag	0.77	2	Pass	Pass	Pass	No	No	Passes without mitigation – two levels still included in design
	0.001			0.38	1.15		0.16	-	
001	Unnamed Tributary of River Garry	2.29	3/1	Fail	Pass	Fail	No	No	Filter Drain & SuDS Basin
				0.88	1.47		0.23	-	
	0.001		3/2	Pass	Pass	Pass	No	No	Filter Drain & SuDS Basin (with micro pool) (i.e. assessment identified requirement for enhanced treatment)
				0.80	1.42		0.23	-	
003	Unnamed Tributary of River Garry	0.36	2	Pass	Pass	Pass (Alert D/S Structure)	No	No	Passes without mitigation – two levels still included in design
	0.001			0.24	0.72		0.17	-	
004	Allt Coire Mhic-sith	3.77	2	Pass	Pass	Pass (Alert D/S Structure)	No	No	Passes without mitigation – two levels still included in design
	0.055			0.05	0.16		0.28	-	

Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Embedded 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	
020	Allt Fuar Bheann	2.95	3/1	Fail	Pass	Fail	N0	No	Filter Drain & SuDS Basin
				0.63	1.05		0.16	-	
	0.003		3/2	Pass	Pass	Pass	No	No	Filter Drain & Wet Retention Pond (i.e. assessment identified requirement for enhanced treatment)
				0.38	0.90		0.16	-	
042	River Truim	3.73	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.011			0.27	0.84		0.20	-	
060	River Truim	2.62	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.044			0.05	0.15		0.24	-	
063	River Truim	2.04	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.046			0.04	0.12		0.25	-	
065	River Truim	0.96	2	Pass	Pass	Pass (Alert Protected	No	No	Passes without mitigation – two levels still included in design

Network	Receiving Water Course Q_{95} (m^3/s)	Drained Road Area (incl. verges) (ha)	Step	Impact (Average Annual Concentration)					Embedded 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	
	0.046			0.02	0.06	Area)	0.18	-	
069	River Truim	1.94	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.108			0.02	0.05		0.39	-	
077	River Truim	5.136	2	Pass	Pass	Pass (Alert Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
	0.137			0.03	0.08		0.01	53	
083	Unnamed Tributary of Allt Coire Chuirn	1.02	2	Pass	Pass	Pass	No	No	Passes without mitigation – two levels still included in design
	0.001			0.55	1.30		0.20	-	
092	Allt Coire Bhotie	2.36	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – two levels still included in design
	0.0096			0.21	0.64		0.2	-	
102	Unnamed watercourse (W8.1)	1.7	2	Pass	Pass	Pass (Alert Protected Area)	No	No	Passes without mitigation – treatment still included in design
	0.0026			0.25	0.76		0.17	-	

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

Cumulative Network (within 1km)	Distance between outfalls (m)	Receiving Watercourse Q_{95} (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	
001 & 003	1	Unnamed tributary of River Garry 0.0011	2.02	3/1	Fail	Pass	Pass	No	No	Zinc passes with one level of treatment (i.e. filter drain) Copper passes with two levels of treatment if 2nd level is pond
					0.93	1.55		0.31	-	
		0.0011		3/2	Pass	Pass	Pass	No	No	
					0.51	1.27		0.31	-	
060 & 063	345	River Truim	4.66	2	Pass	Pass	Alert (Protected Area)	No	No	Passes without mitigation – two levels still included in design
		0.046			0.08	0.25		0.15	-	
063 & 065	220	River Truim	2.997	2	Pass	Pass	Alert (Protected Area)	Yes	No	Passes without mitigation – two levels still included in design
		0.046			0.05	0.17		0.03	70	

3.1.5 The results in **Table 2** and **Table 3** 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 British Geological Survey (BGS) data and ground investigation (GI) data. The site locations are those proposed for the SuDS basins for each drainage network. The results are summarised in **Table 4**.

Table 4: Method C Results Table

Network	Overall Risk of Impact Score for Filter Drains	Overall Risk of Impact Score for SuDS Basin
000	200 (Medium Risk of Impact)	230 (Medium Risk of Impact)
001	200 (Medium Risk of Impact)	230 (Medium Risk of Impact)
003	200 (Medium Risk of Impact)	215 (Medium Risk of Impact)
004	200 (Medium Risk of Impact)	230 (Medium Risk of Impact)
020	240 (Medium Risk of Impact)	270 (High Risk of Impact)
042	240 (Medium Risk of Impact)	270 (High Risk of Impact)
060	240 (Medium Risk of Impact)	270 (High Risk of Impact)
063	225 (Medium Risk of Impact)	255 (High Risk of Impact)
065	232.5 (Medium Risk of Impact)	262.5 (High Risk of Impact)
069	232.5 (Medium Risk of Impact)	262.5 (High Risk of Impact)
077	240 (Medium Risk of Impact)	270 (High Risk of Impact)
083	212.5 (Medium Risk of Impact)	242.5 (Medium Risk of Impact)
092	240 (Medium Risk of Impact)	270 (High Risk of Impact)
102	202.5 (Medium Risk of Impact)	N/A
Balsporran Carpark	232.5 (Medium Risk of Impact)	N/A

3.1.8 The summary of results in **Table 4** 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 063) and details for the proposed Drumochter junction. The results have been presented (in years) for a system without mitigation and for the final design incorporating SuDS as 'embedded' mitigation. 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 to this Appendix.

Table 5: Method D Results Table

Return period scenario / Road section assessment	Return period without pollution reduction measures (years)	Return Period with Embedded Pollution reduction measures (years)	ASP based on Final Design Incorporating Embedded Mitigation (%)
Longest outfall (surface water spillage)	3112	3890	0.025
Longest outfall (groundwater spillage)	4667	5834	0.017
Junction (surface water spillage)	5896	7370	0.013
Junction (groundwater spillage)	8844	11055	0.009

3.1.10 **Table 5** 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 final design incorporates embedded mitigation as described in **Section 3**.

4.1.2 **Table 6** 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 6: 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 Quality					
000	Allt Chaorach Beag Hydro ID -2, MW7.25	Very High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
001	Unnamed tributary of River Garry Hydro ID 1 W7.1	Very High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
003	Unnamed tributary of River Garry Hydro ID 1, W7.1	Very High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
004	Allt Coire Mhic-sith Hydro ID 2 MW7.3	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
020	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
042	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
060	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
063	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
065	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
069	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
077	River Truim	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
083	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
092	River Truim MW8.1	High	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
102	Unnamed tributary of River Truim W8.1	Low	No routine runoff risk identified by HAWRAT (Method A) ASP <0.5% (Method D)	Negligible	Neutral
Receptor: Groundwater Water Quality					
000	ch. 0,055 to 0,500	Moderate	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
001	ch. -0,022 to -0,880	Moderate	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
003	ch. 0,200 to 0,400	High	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
004	ch. 0,710 to 1,935	Moderate	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
020	ch. 1,940 to 3,010	High	No measurable impact on aquifer due to pathway removal (Method C) ASP <0.5% (Method D)	Negligible	Neutral
042	ch. 3,025 to 4,400	High	No measurable impact on aquifer due to pathway removal (Method C) 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
060	ch. 4,405 to 6,025	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
063	ch. 4,000 to 6,280	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
065	ch. 6,070 to 6,470	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
069	ch. 6,475 to 7,210	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
077	ch. 7,750 to 7,900	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
083	ch. 7,900 to 8,390	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
092	ch. 8,410 to 9,365	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
102	ch. 9,300 to 9,870	Medium	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral
Balsporran carpark	ch. 6,800	High	No measurable impact on aquifer due to pathway removal (Method C) APS <0.5% (Method D)	Negligible	Neutral

5 Conclusion

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 6**, it is considered that there is no likely significant water quality impacts associated with the Proposed Scheme if appropriate mitigation measures are included. 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.

5.1.4 Cumulative impacts assessments have been found to fail at one location (downstream of Hydro ID 1 – the cumulative impact of SuDS 001 and 003 discharging to the same watercourse within approximately 1m vicinity). This impact can be mitigated with enhanced treatment for copper (i.e. pond) but with one level of treatment for zinc (i.e. filter drain). As both networks provide two levels of treatment prior to discharge, the predicted overall impact is negligible.

Annex 1: Calculations

Figure 1: Method A Calculations for SuDS 000

HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Annual Average Concentration	Copper	Zinc	
Step 2	0.38	1.15	ug/l
Step 3	-	-	ug/l

Soluble - Acute Impact: 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	265630	Northing	772532	
OS grid reference of outfall structure (m)	Easting		Northing	772532	
Outfall number	000	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Chaorach Beag				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas Fairhurst CFJV		
Date of assessment	18/11/2016	Version of assessment	01		
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): 0.53365632 Permeable area draining to outfall (ha): 0.23649921

Base Flow Index (BFI): 0.286 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 — Estimated river width (m): 5

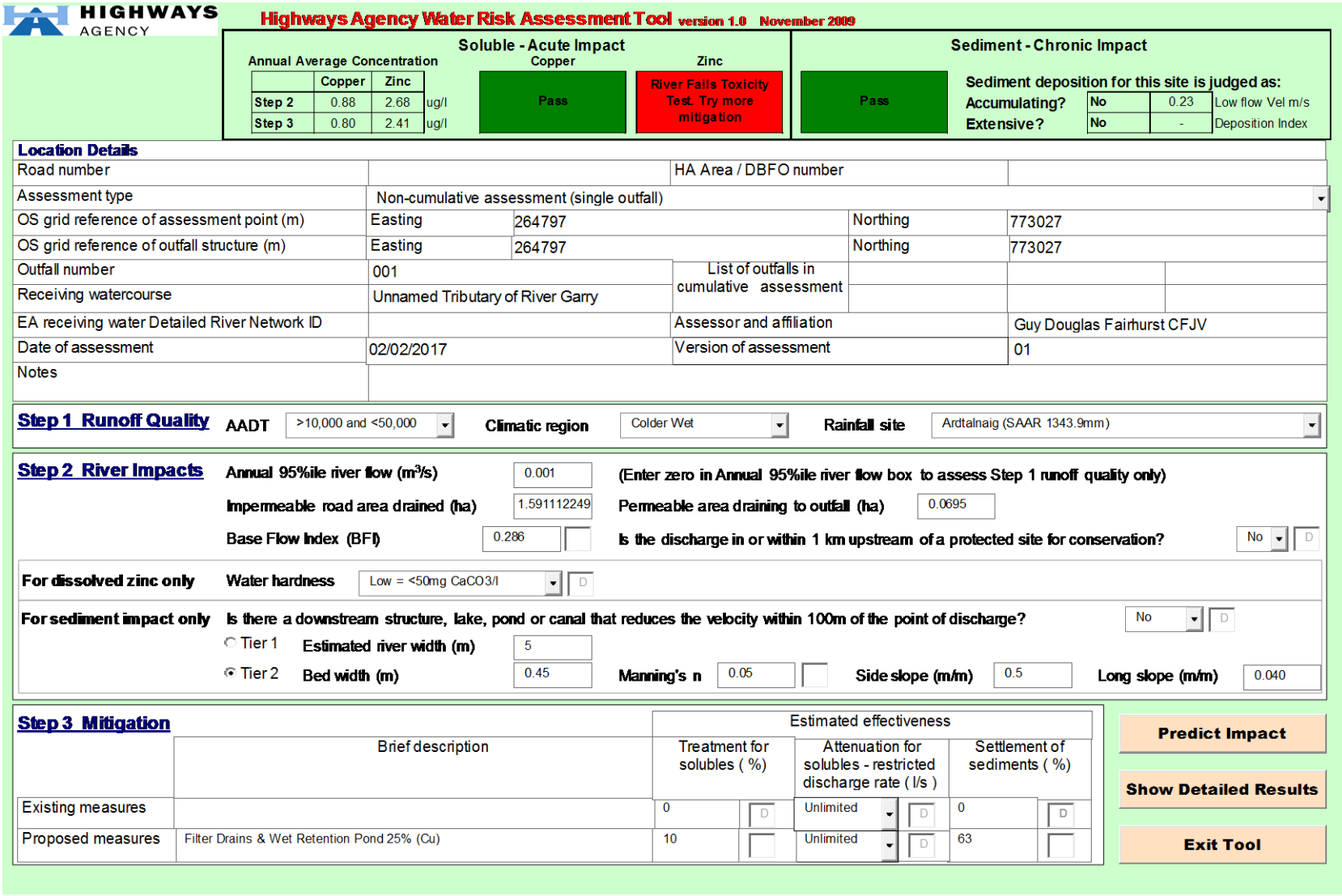
Tier 2 — Bed width (m): 1.7 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.060

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 Calculations for SuDS 001 (copper)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.88	2.68	ug/l
Step 3	0.80	2.41	ug/l

Copper: Pass

Zinc: River Fails Toxicity Test. Try more mitigation

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.23	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	264797	Northing	773027	
OS grid reference of outfall structure (m)	Easting	264797	Northing	773027	
Outfall number	001	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed Tributary of River Garry				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas Fairhurst CFJV		
Date of assessment	02/02/2017	Version of assessment	01		
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): 1.591112249 | Permeable area draining to outfall (ha): 0.0695

Base Flow Index (BFI): 0.286 | 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 — Estimated river width (m): 5

Tier 2 — Bed width (m): 0.45 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.040

Step 3 Mitigation

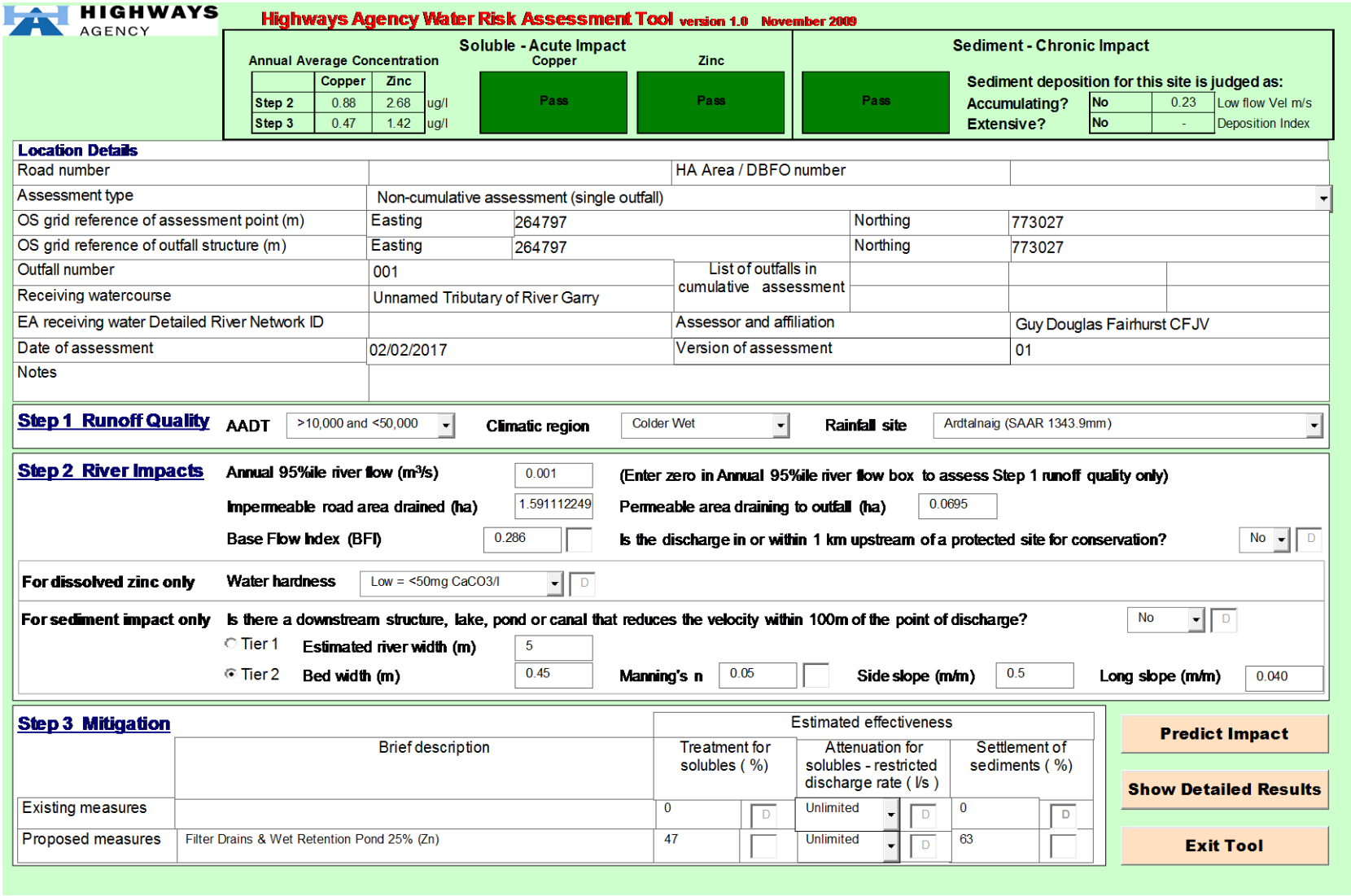
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	Filter Drains & Wet Retention Pond 25% (Cu)	10	Unlimited	63

Predict Impact

Show Detailed Results

Exit Tool

Figure 3: Method A Calculations for SuDS 001 (zinc)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.88	2.68	ug/l
Step 3	0.47	1.42	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.23	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	264797	Northing	773027	
OS grid reference of outfall structure (m)	Easting	264797	Northing	773027	
Outfall number	001	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed Tributary of River Garry				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas Fairhurst CFJV		
Date of assessment	02/02/2017	Version of assessment	01		
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): 1.591112249 | Permeable area draining to outfall (ha): 0.0695

Base Flow Index (BFI): 0.286 | 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 — Estimated river width (m): 5

Tier 2 — Bed width (m): 0.45 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.040

Step 3 Mitigation

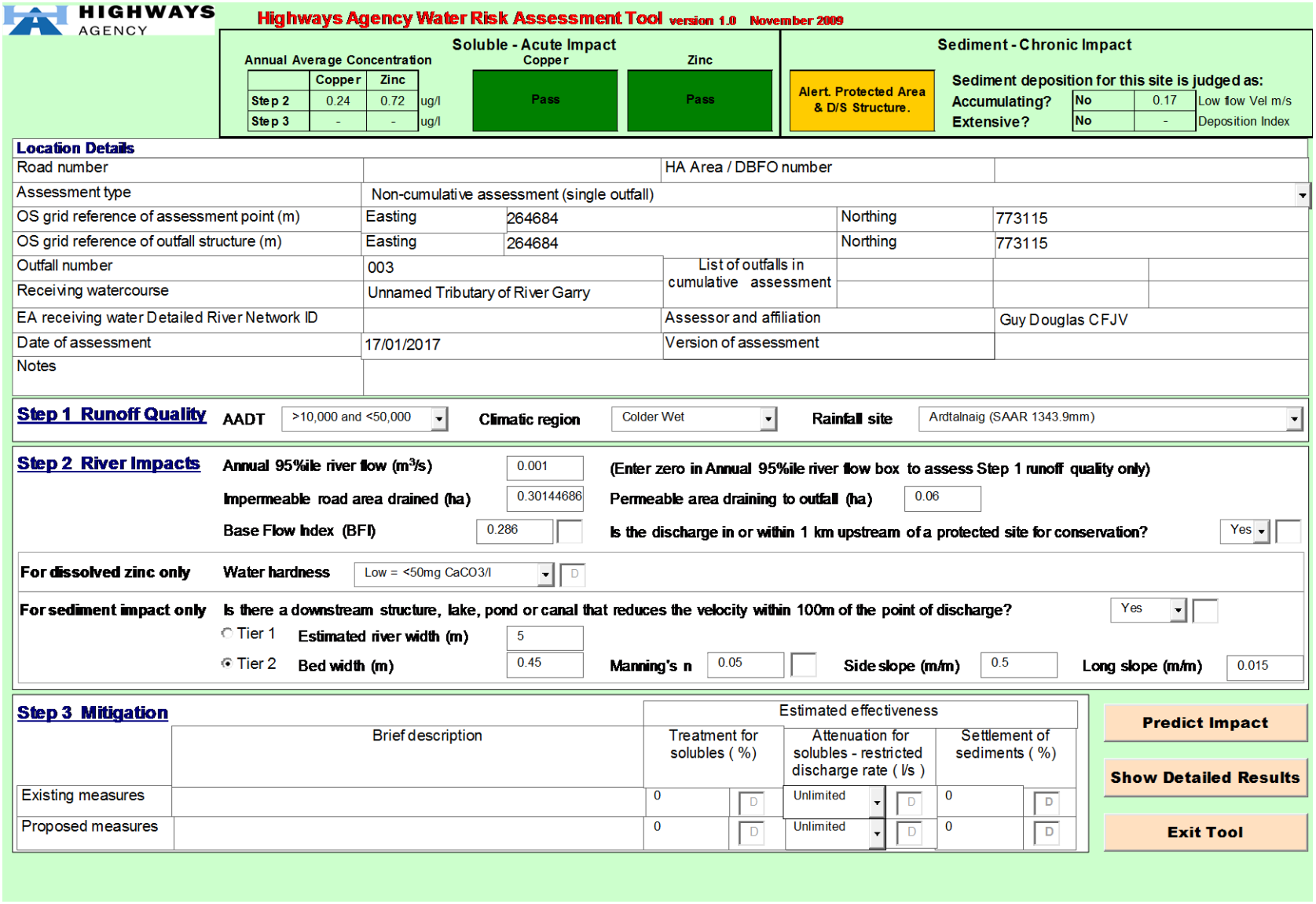
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	Filter Drains & Wet Retention Pond 25% (Zn)	47	Unlimited	63

Predict Impact

Show Detailed Results

Exit Tool

Figure 4: Method A Calculations for SuDS 003



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.24	0.72	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	0.17	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	264684	Northing	773115	
OS grid reference of outfall structure (m)	Easting	264684	Northing	773115	
Outfall number	003	List of outfalls in cumulative assessment			
Receiving watercourse	Unnamed Tributary of River Garry				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas CFJV		
Date of assessment	17/01/2017	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): 0.30144686 Permeable area draining to outfall (ha): 0.06

Base Flow Index (BFI): 0.286 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): 5

Tier 2 Bed width (m): 0.45 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.015

Step 3 Mitigation

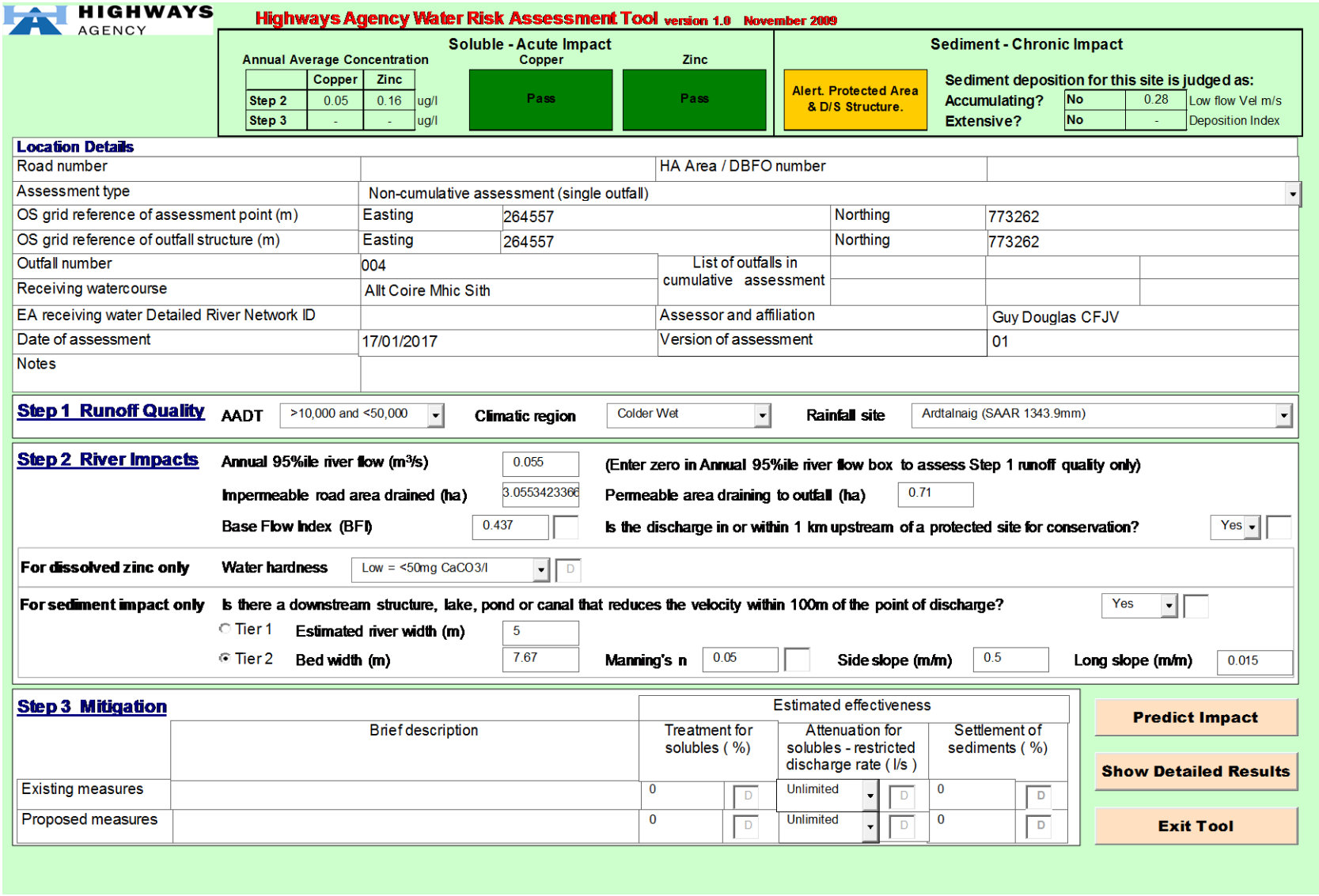
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 5: Method A Calculations for SuDS 004



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.05	0.16	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	0.28	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	264557	Northing	773262	
OS grid reference of outfall structure (m)	Easting	264557	Northing	773262	
Outfall number	004	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Coire Mhic Sith				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas CFJV		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.055 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 3.0553423366 | Permeable area draining to outfall (ha): 0.71

Base Flow Index (BFI): 0.437 | 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): 5

Tier 2 — Bed width (m): 7.67 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.015

Step 3 Mitigation

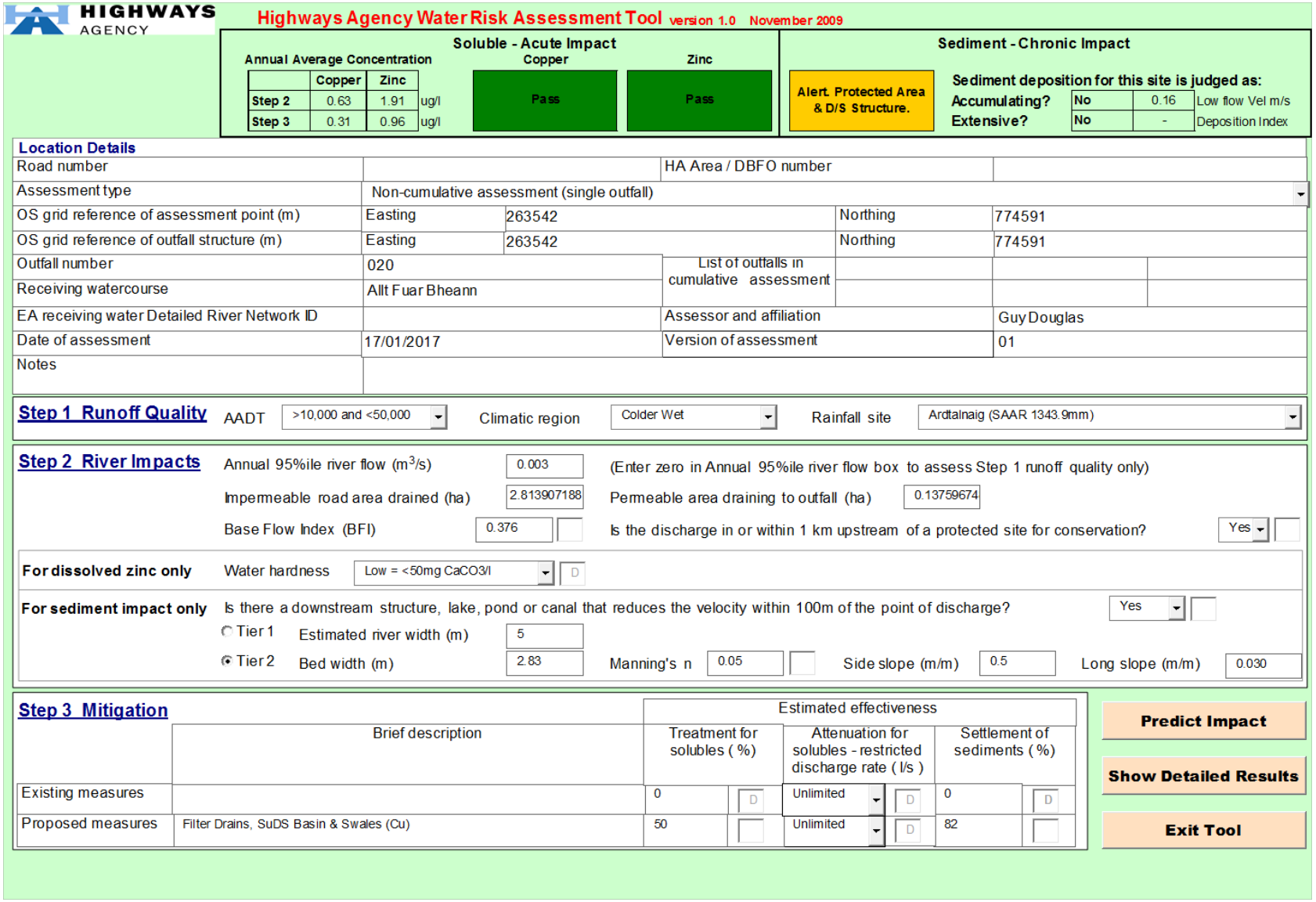
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 6: Method A Calculations for SuDS 020 (dry basin) (copper)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.63	1.91	ug/l
Step 3	0.31	0.96	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	0.16	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	263542	Northing	774591	
OS grid reference of outfall structure (m)	Easting	263542	Northing	774591	
Outfall number	020	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Fuar Bheann				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.003 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.813907188 Permeable area draining to outfall (ha): 0.13759674

Base Flow Index (BFI): 0.376 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): 5

Tier 2 Bed width (m): 2.83 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.030

Step 3 Mitigation

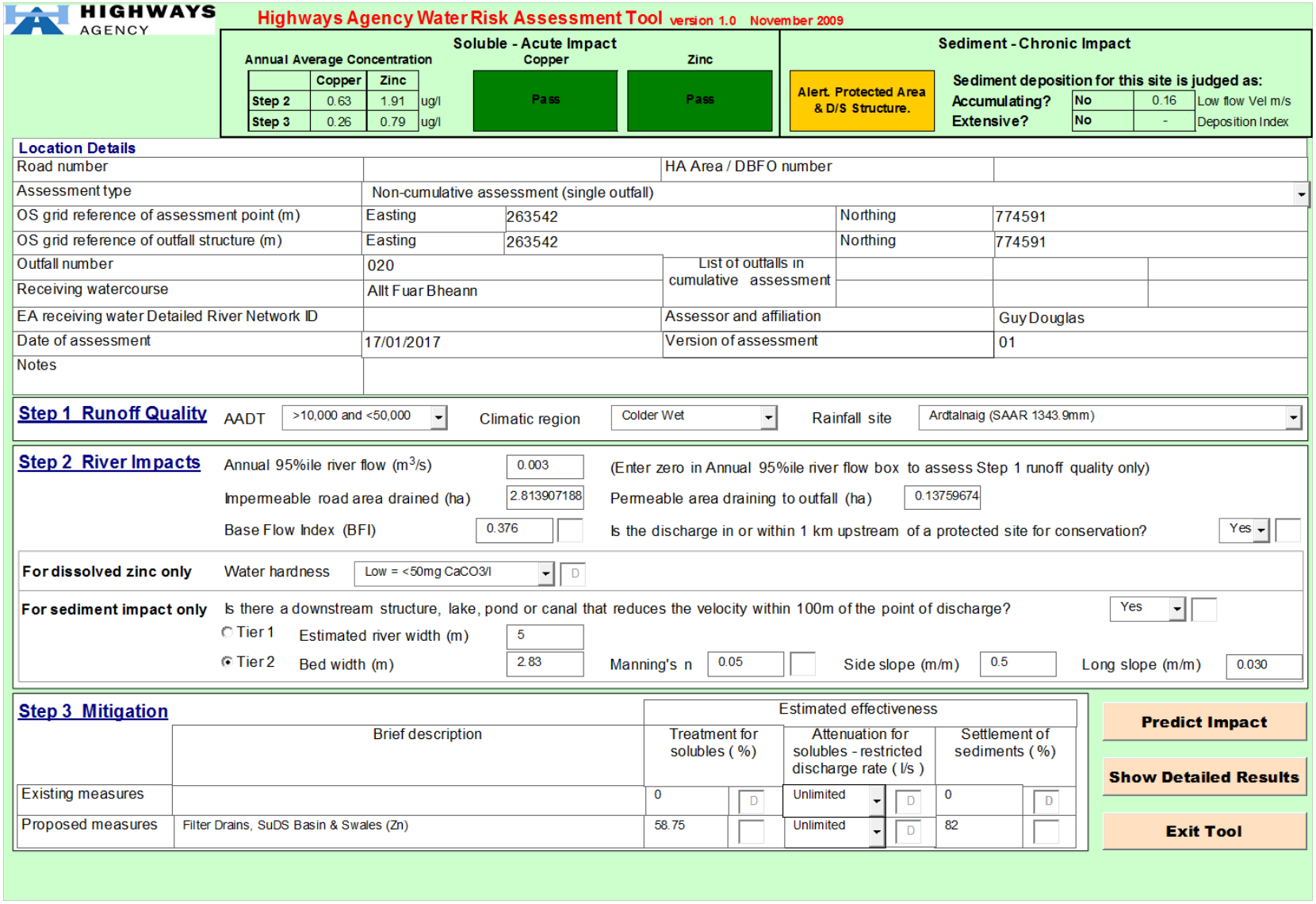
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Filter Drains, SuDS Basin & Swales (Cu)	50	Unlimited D	82

Predict Impact

Show Detailed Results

Exit Tool

Figure 7: Method A Calculations for SuDS 020 (dry basin) (zinc)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.63	1.91	ug/l
Step 3	0.26	0.79	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	0.16	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	263542	Northing	774591	
OS grid reference of outfall structure (m)	Easting	263542	Northing	774591	
Outfall number	020	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Fuar Bheann				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.003 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.813907188 | Permeable area draining to outfall (ha): 0.13759674

Base Flow Index (BFI): 0.376 | 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): 5

Tier 2 — Bed width (m): 2.83 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.030

Step 3 Mitigation

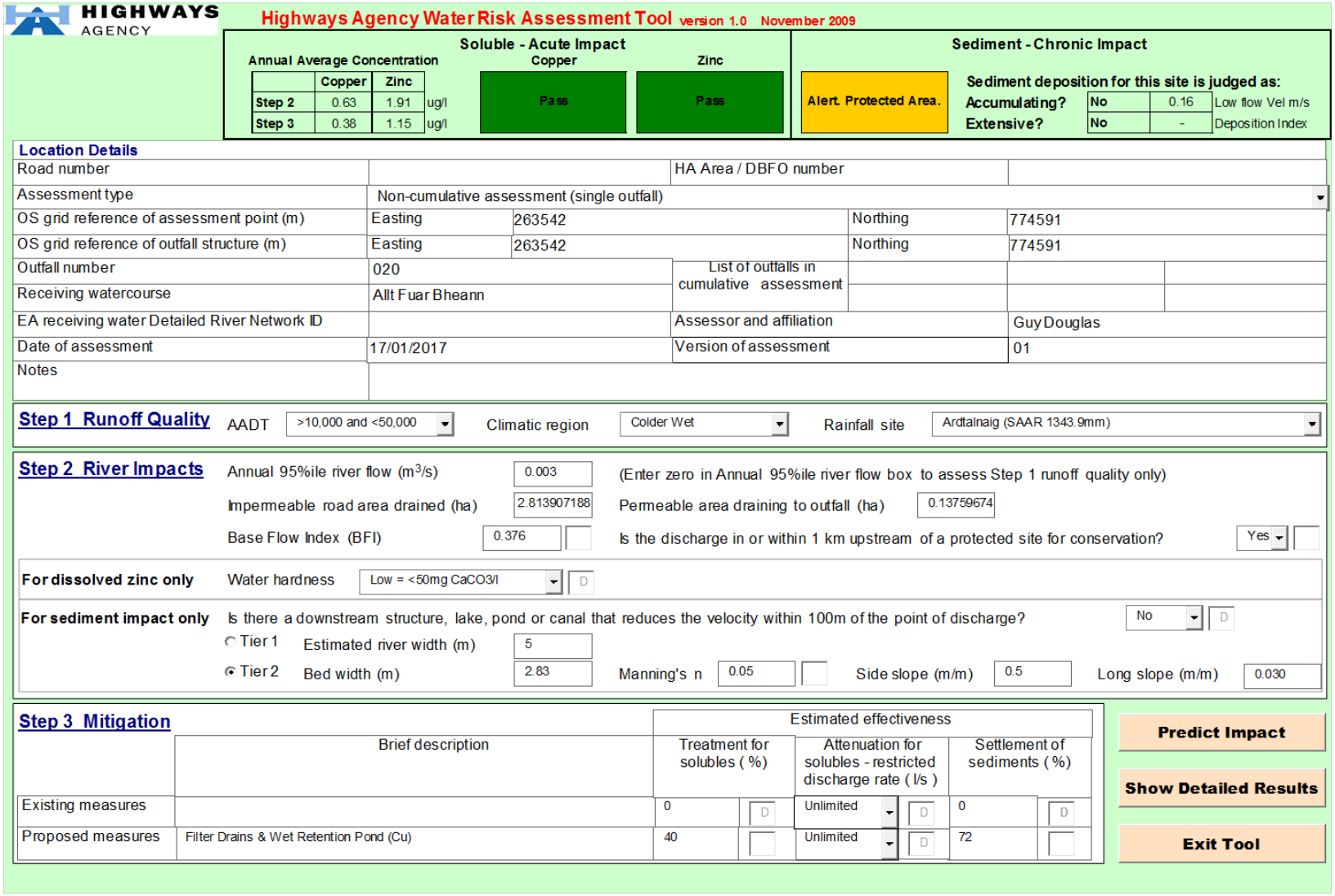
	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures	Filter Drains, SuDS Basin & Swales (Zn)	58.75		Unlimited	D	82	

Predict Impact

Show Detailed Results

Exit Tool

Figure 8: Method A Calculations for SuDS 020 (wet pond) (copper)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.63	1.91	ug/l
Step 3	0.38	1.15	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

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	263542	Northing	774591	
OS grid reference of outfall structure (m)	Easting	263542	Northing	774591	
Outfall number	020	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Fuar Bheann				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.003 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.813907188 | Permeable area draining to outfall (ha): 0.13759674

Base Flow Index (BFI): 0.376 | 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): 5

Tier 2 Bed width (m): 2.83 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.030

Step 3 Mitigation

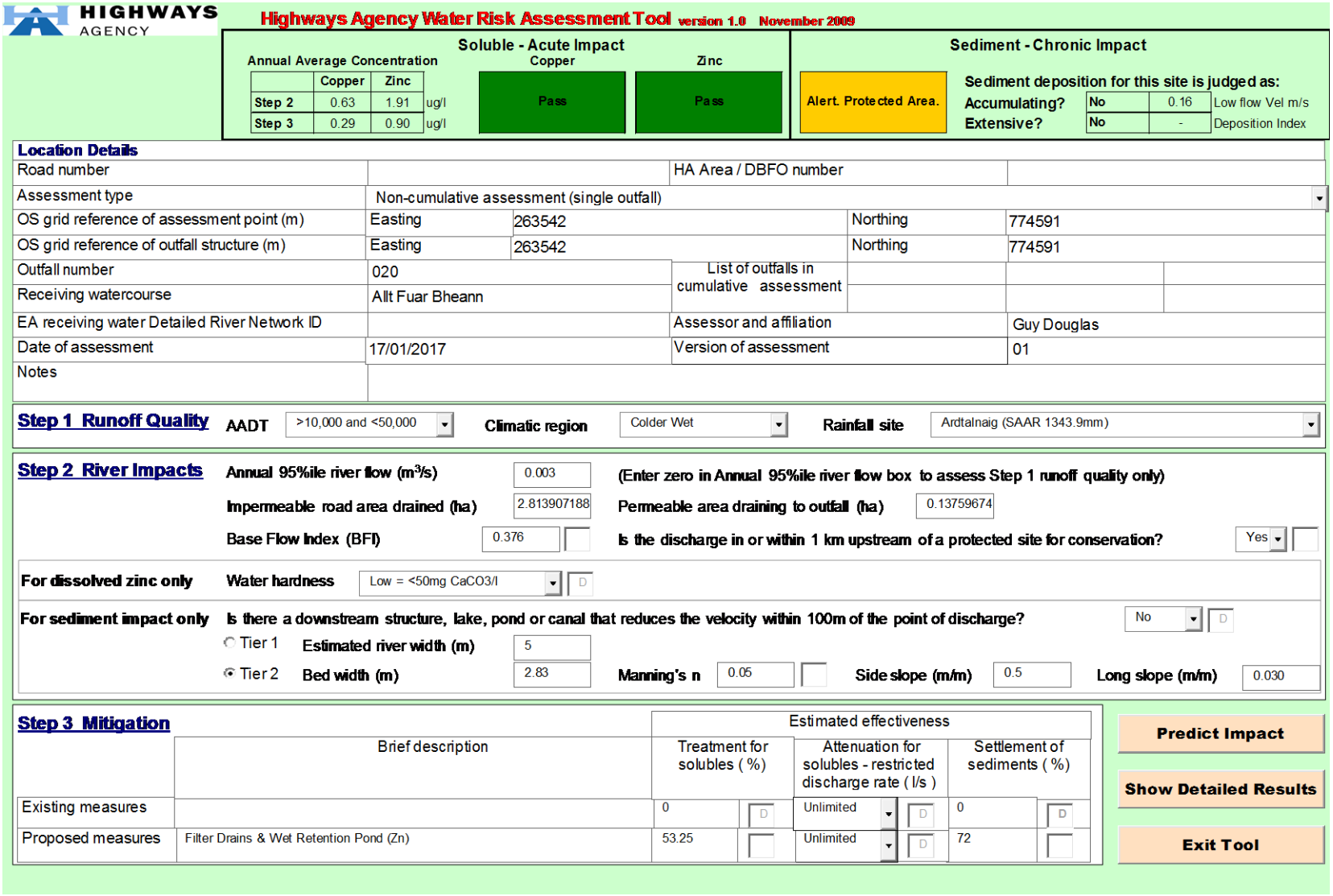
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Filter Drains & Wet Retention Pond (Cu)	40	Unlimited D	72

Predict Impact

Show Detailed Results

Exit Tool

Figure 9: Method A Calculations for SuDS 020 (wet pond) (zinc)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.63	1.91	ug/l
Step 3	0.29	0.90	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Alert. Protected Area.

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	263542	Northing	774591	
OS grid reference of outfall structure (m)	Easting	263542	Northing	774591	
Outfall number	020	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Fuar Bheann				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.003 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.813907188 Permeable area draining to outfall (ha): 0.13759674

Base Flow Index (BFI): 0.376 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): 5

Tier 2 Bed width (m): 2.83 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.030

Step 3 Mitigation

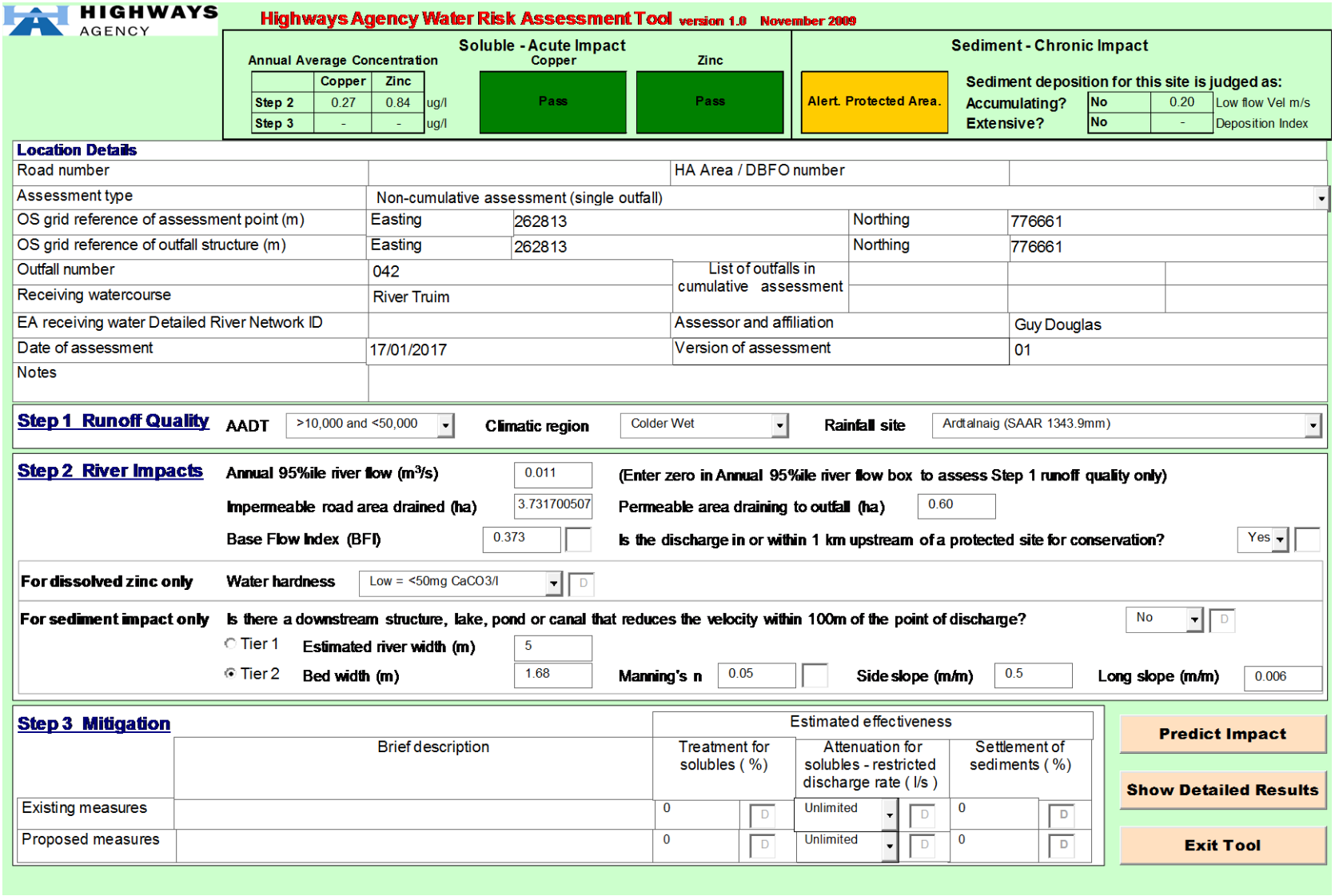
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures	Filter Drains & Wet Retention Pond (Zn)	53.25	Unlimited D	72

Predict Impact

Show Detailed Results

Exit Tool

Figure 10: Method A Calculations for SuDS 042



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.27	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	0.20	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	262813	Northing	776661	
OS grid reference of outfall structure (m)	Easting	262813	Northing	776661	
Outfall number	042	List of outfalls in cumulative assessment			
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas		
Date of assessment	17/01/2017	Version of assessment	01		
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): 3.731700507 Permeable area draining to outfall (ha): 0.60

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): 5

Tier 2 Bed width (m): 1.68 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.006

Step 3 Mitigation

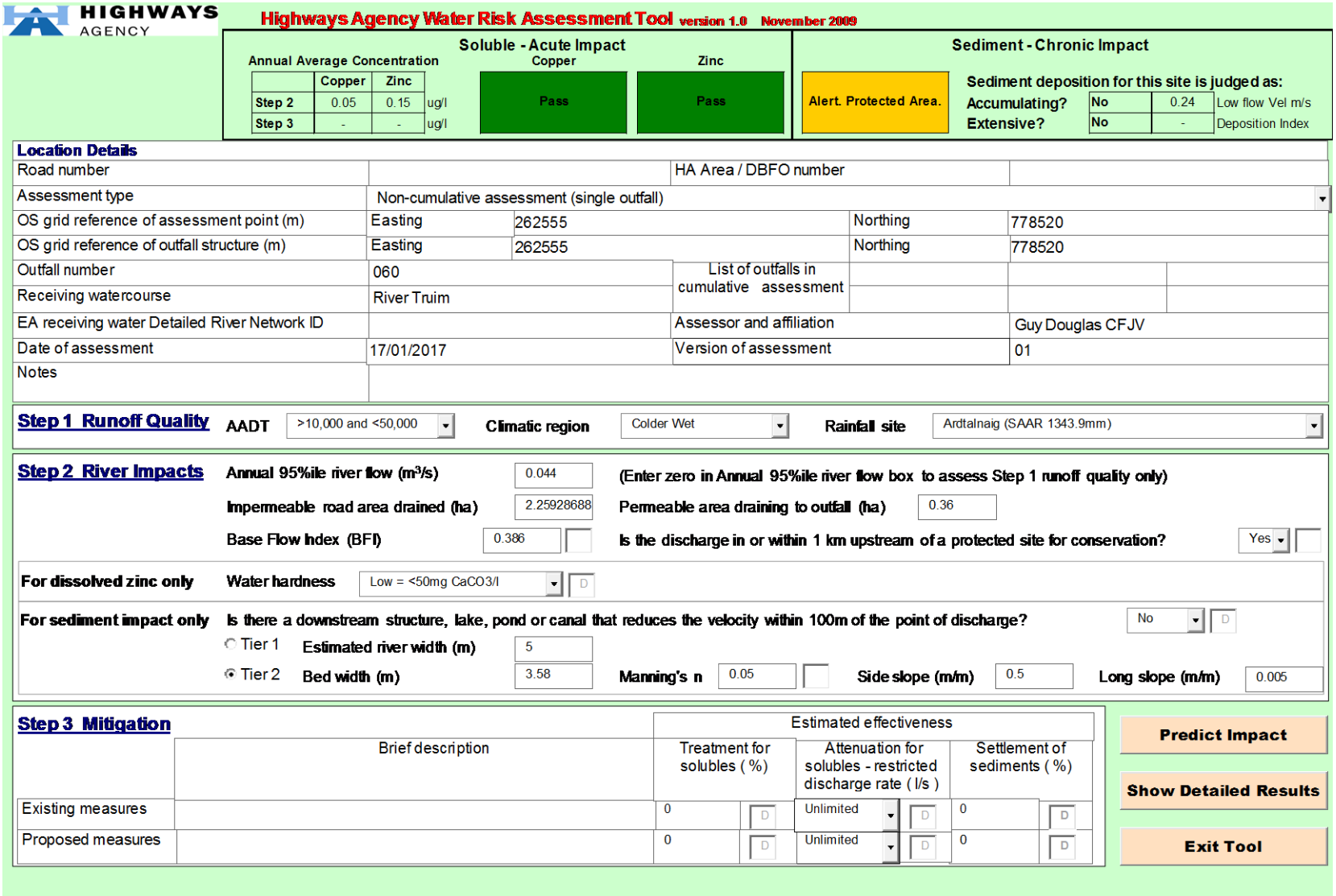
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 11: Method A Calculations for SuDS 060



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.05	0.15	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	262555	Northing	778520	
OS grid reference of outfall structure (m)	Easting	262555	Northing	778520	
Outfall number	060	List of outfalls in cumulative assessment			
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas CFJV		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.044 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.25928688 | Permeable area draining to outfall (ha): 0.36

Base Flow Index (BFI): 0.386 | 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

Tier 2 — Bed width (m): 3.58 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.005

Step 3 Mitigation

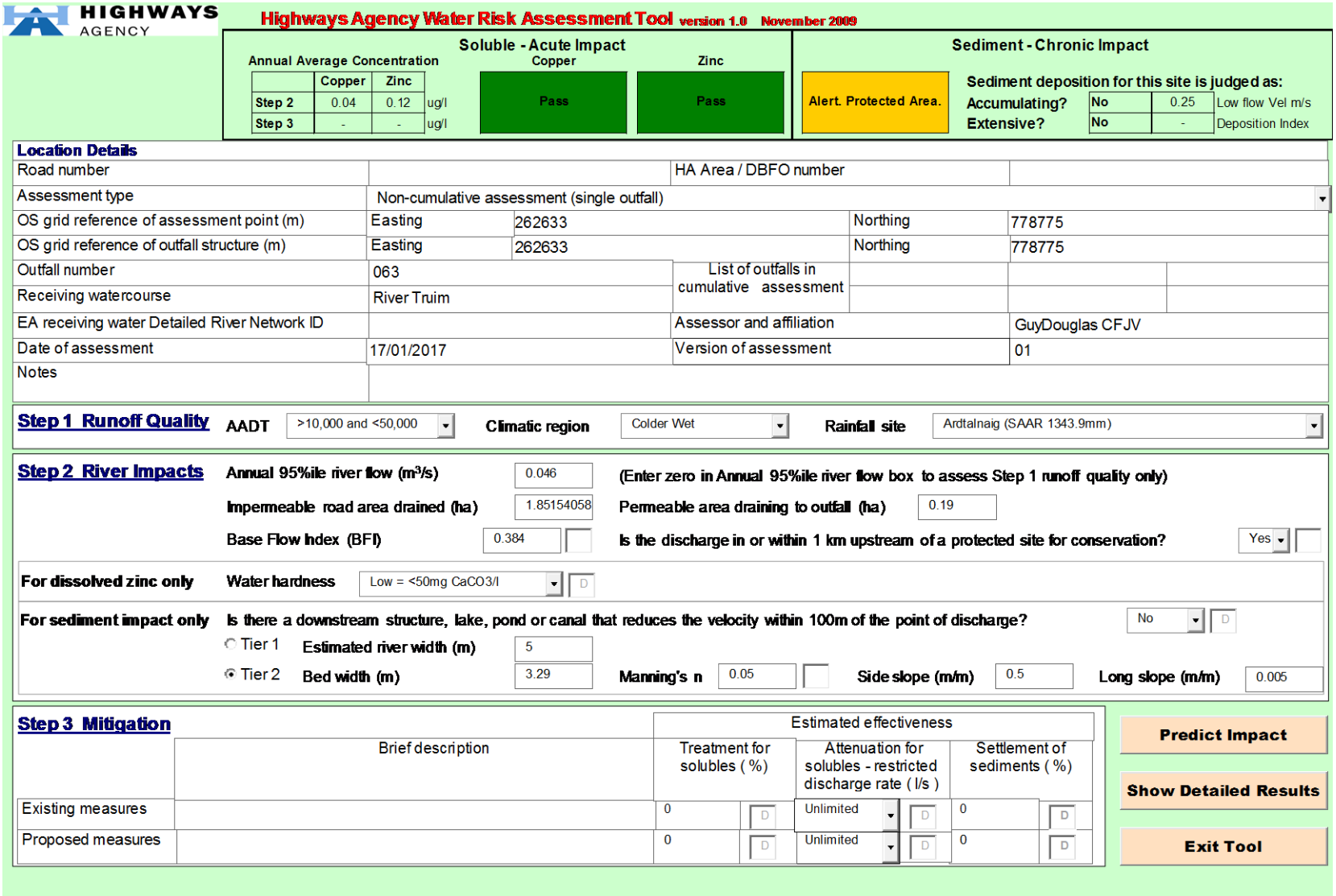
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 12: Method A Calculations for SuDS 063



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.04	0.12	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	0.25	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	262633	Northing	778775	
OS grid reference of outfall structure (m)	Easting	262633	Northing	778775	
Outfall number	063	List of outfalls in cumulative assessment			
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation	GuyDouglas CFJV		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.046 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.85154058 | Permeable area draining to outfall (ha): 0.19

Base Flow Index (BFI): 0.384 | 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

Tier 2 — Bed width (m): 3.29 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.005

Step 3 Mitigation

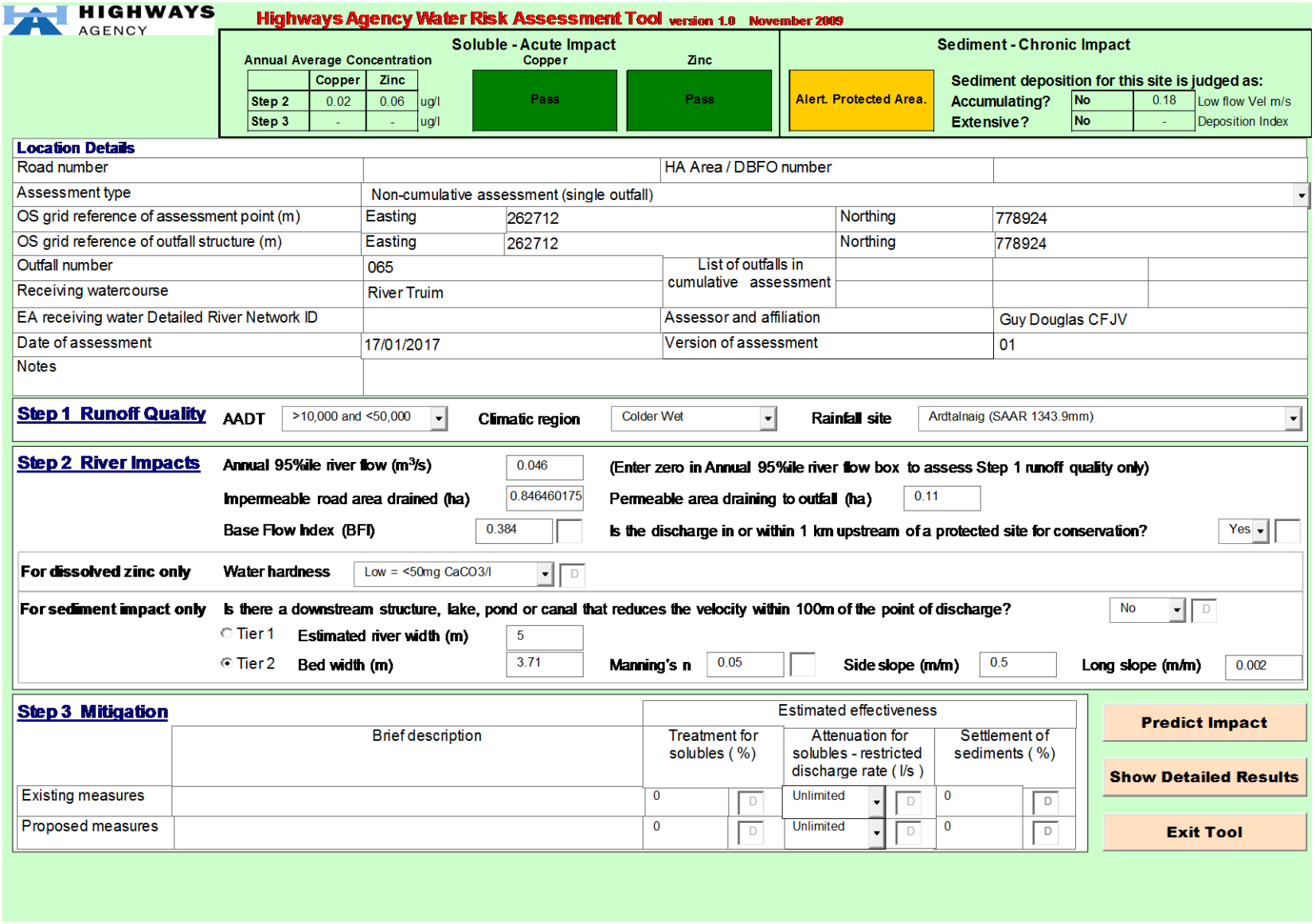
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 13: Method A Calculations for SuDS 065



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

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?	No	0.18	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	262712	Northing	778924	
OS grid reference of outfall structure (m)	Easting	262712	Northing	778924	
Outfall number	065	List of outfalls in cumulative assessment			
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation	Guy Douglas CFJV		
Date of assessment	17/01/2017	Version of assessment	01		
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): 0.046 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 0.846460175 | Permeable area draining to outfall (ha): 0.11

Base Flow Index (BFI): 0.384 | 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

Tier 2 — Bed width (m): 3.71 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.002

Step 3 Mitigation

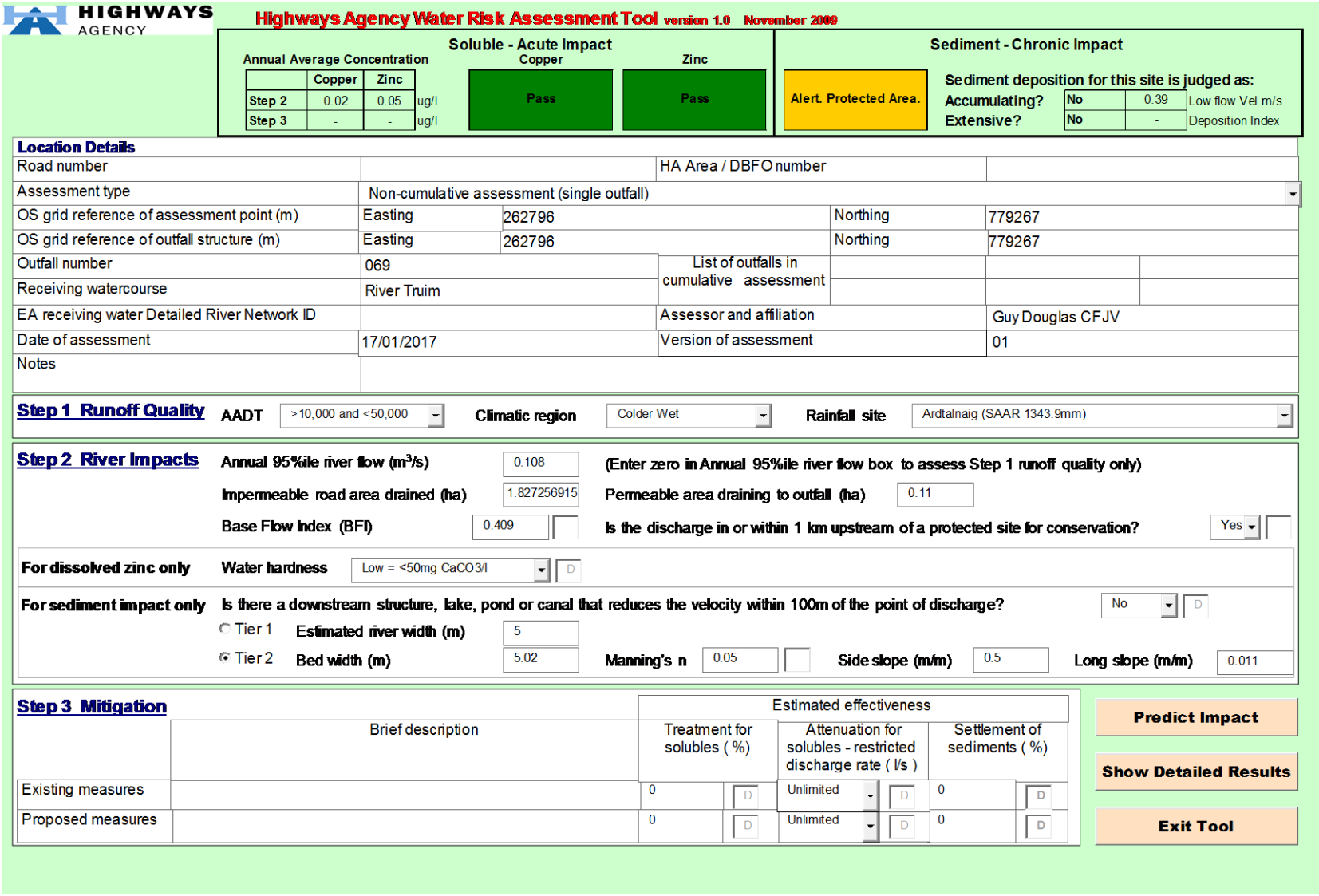
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 14: Method A Calculations for SuDS 069



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.02	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?	No	0.39	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	262796	Northing	779267	
OS grid reference of outfall structure (m)	Easting	262796	Northing	779267	
Outfall number	069	List of outfalls in cumulative assessment			
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation		Guy Douglas CFJV	
Date of assessment	17/01/2017	Version of assessment		01	
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): 0.108 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.827256915 Permeable area draining to outfall (ha): 0.11

Base Flow Index (BFI): 0.409 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): 5

Tier 2 Bed width (m): 5.02 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.011

Step 3 Mitigation

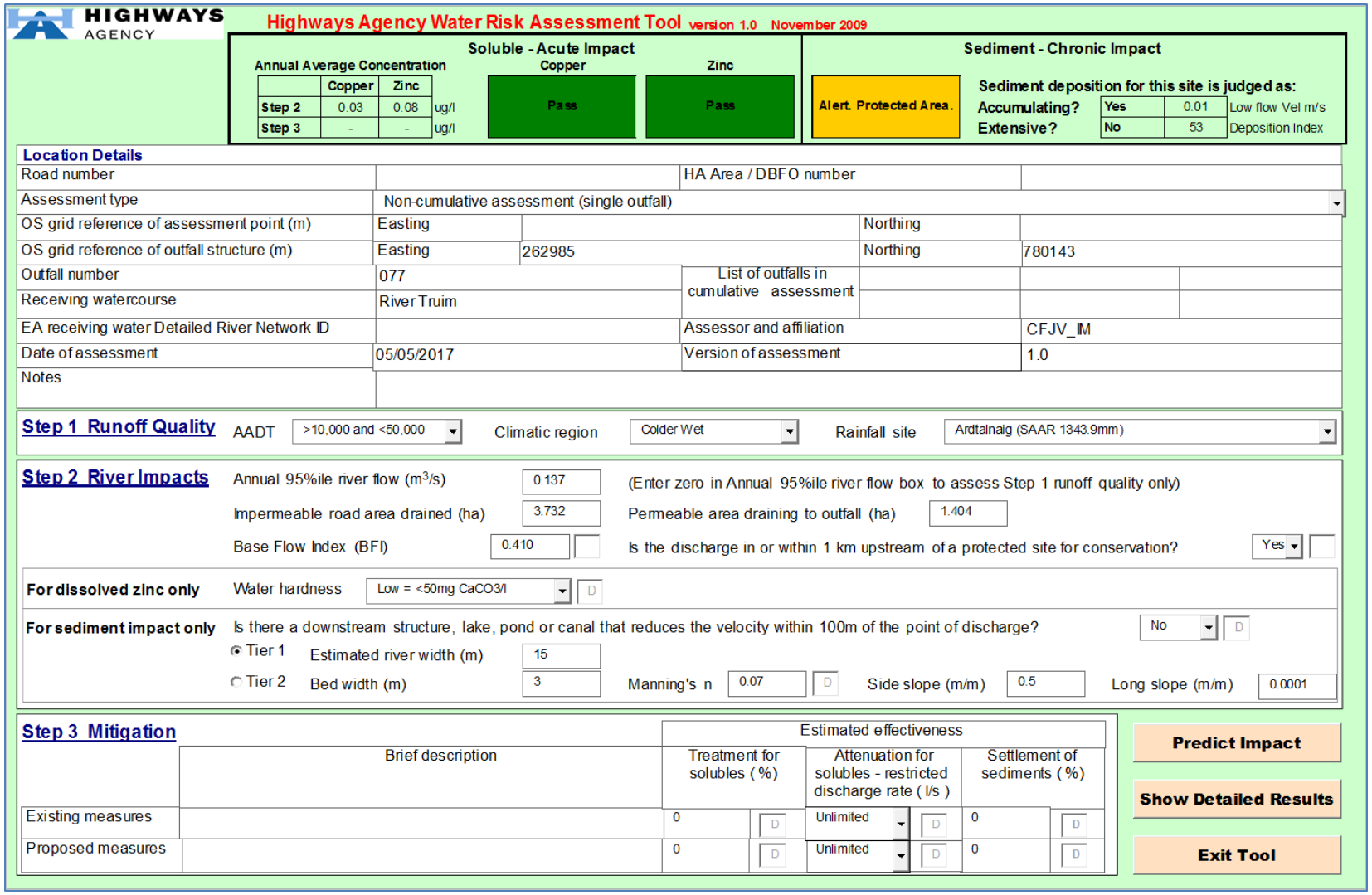
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 15: Method A Calculations for SuDS 077



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.03	0.08	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	53	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		Northing	
OS grid reference of outfall structure (m)	Easting	262985	Northing	780143
Outfall number	077	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	05/05/2017	Version of assessment		1.0
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): 0.137 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 3.732 | Permeable area draining to outfall (ha): 1.404

Base Flow Index (BFI): 0.410 | 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): 15

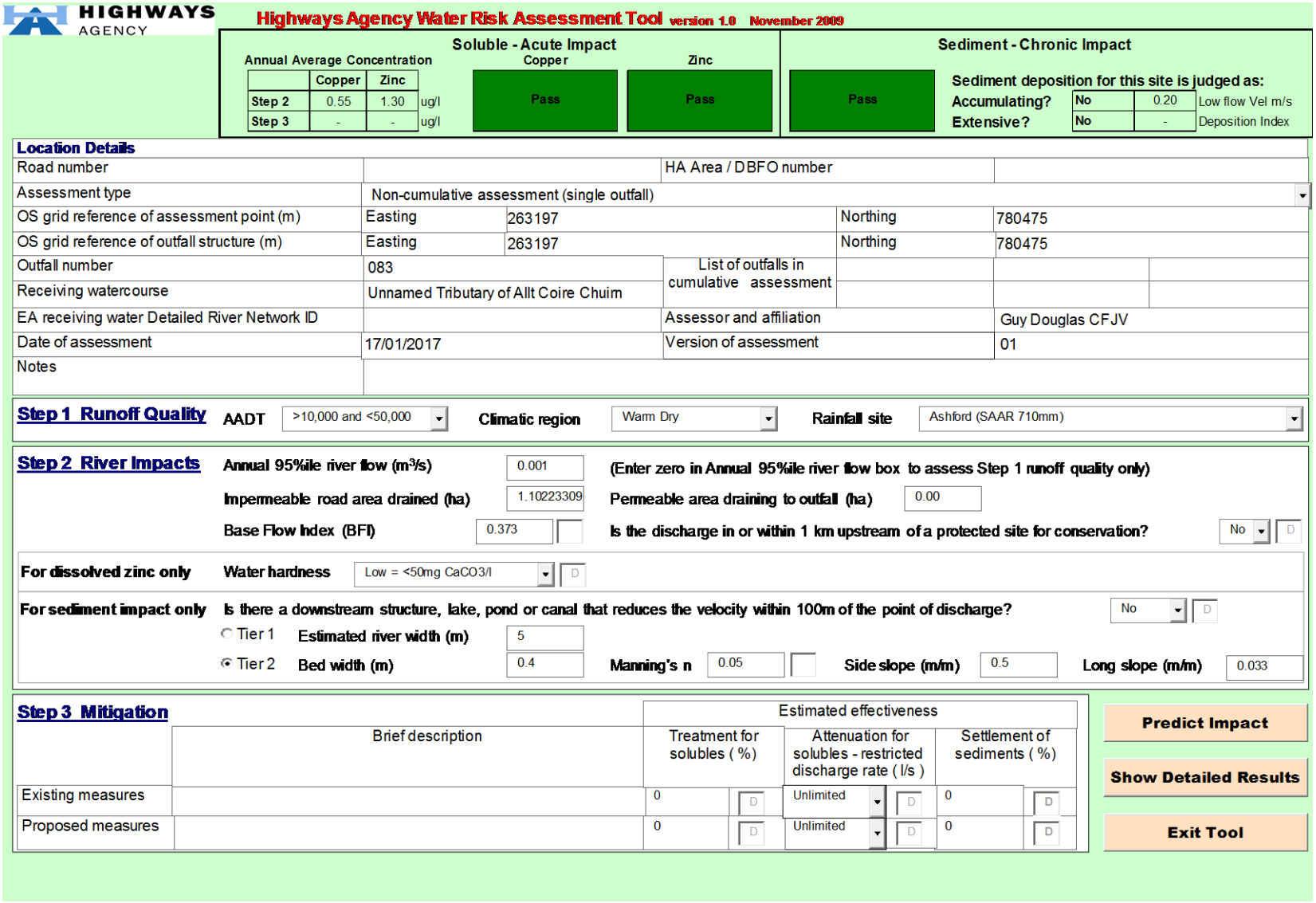
Tier 2 — Bed width (m): 3 | Manning's n: 0.07 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

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 16: Method A Calculations for SuDS 083



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Annual Average Concentration	Copper	Zinc	
Step 2	0.55	1.30	ug/l
Step 3	-	-	ug/l

Soluble - Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.20	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 263197		Northing	780475
OS grid reference of outfall structure (m)	Easting 263197		Northing	780475
Outfall number	083	List of outfalls in cumulative assessment		
Receiving watercourse	Unnamed Tributary of Allt Coire Chuim			
EA receiving water Detailed River Network ID		Assessor and affiliation		Guy Douglas CFJV
Date of assessment	17/01/2017	Version of assessment		01
Notes				

Step 1 Runoff Quality AADT: >10,000 and <50,000 | Climatic region: Warm Dry | Rainfall site: Ashford (SAAR 710mm)

Step 2 River Impacts

Annual 95%ile river flow (m³/s)	0.001	(Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)	
Impermeable road area drained (ha)	1.10223309	Permeable area draining to outfall (ha)	0.00
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

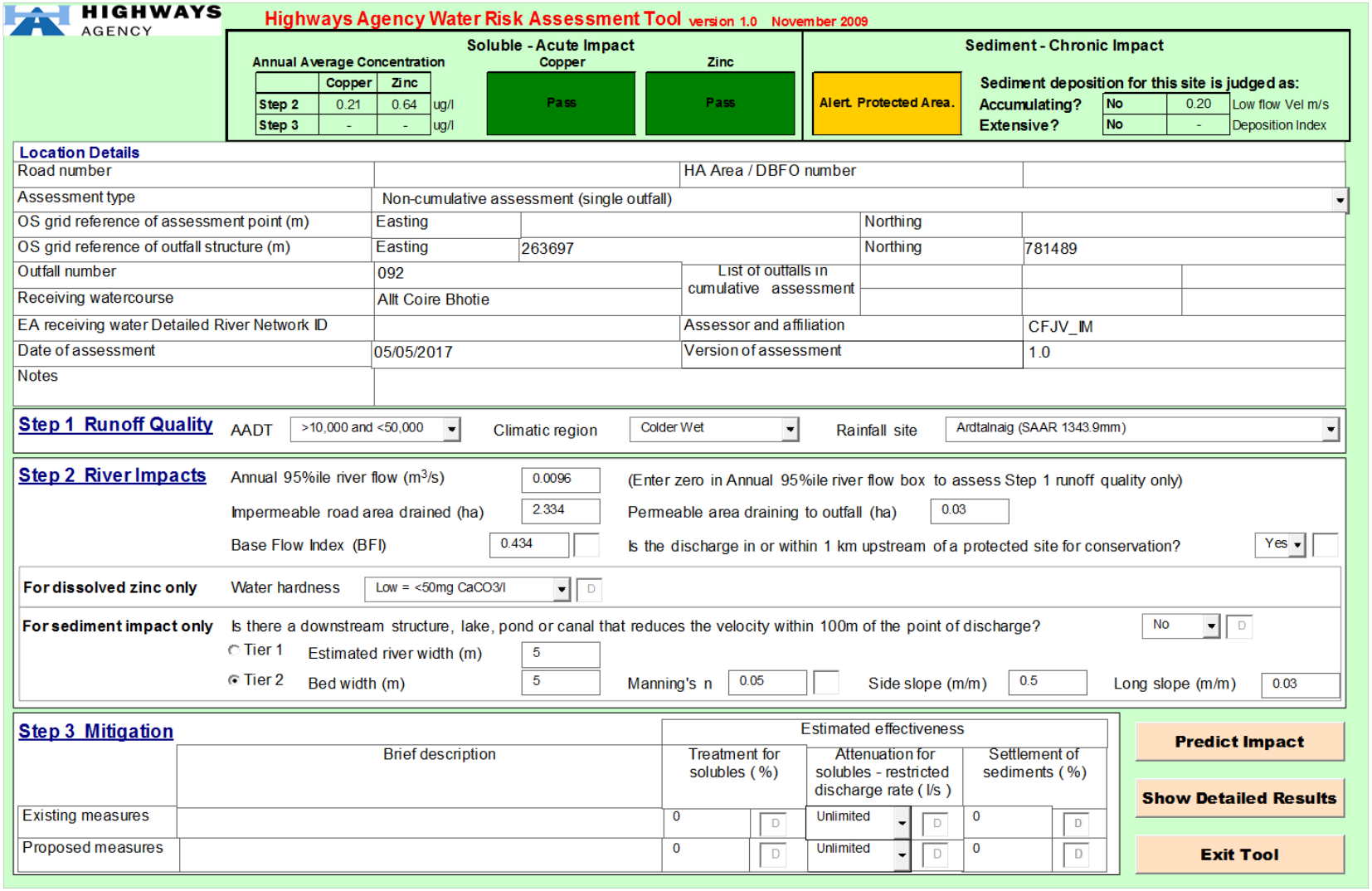
Tier 1	Estimated river width (m)	5					
Tier 2	Bed width (m)	0.4	Manning's n	0.05	Side slope (m/m)	0.5	Long slope (m/m)	0.033

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 17: Method A Calculations for SuDS 092



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.21	0.64	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	0.20	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		Northing		
OS grid reference of outfall structure (m)	Easting	263697	Northing	781489	
Outfall number	092	List of outfalls in cumulative assessment			
Receiving watercourse	Allt Coire Bhotie				
EA receiving water Detailed River Network ID		Assessor and affiliation		CFJV_IM	
Date of assessment	05/05/2017	Version of assessment		1.0	
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): 0.0096 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.334 Permeable area draining to outfall (ha): 0.03

Base Flow Index (BFI): 0.434 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): 5

Tier 2 Bed width (m): 5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.03

Step 3 Mitigation

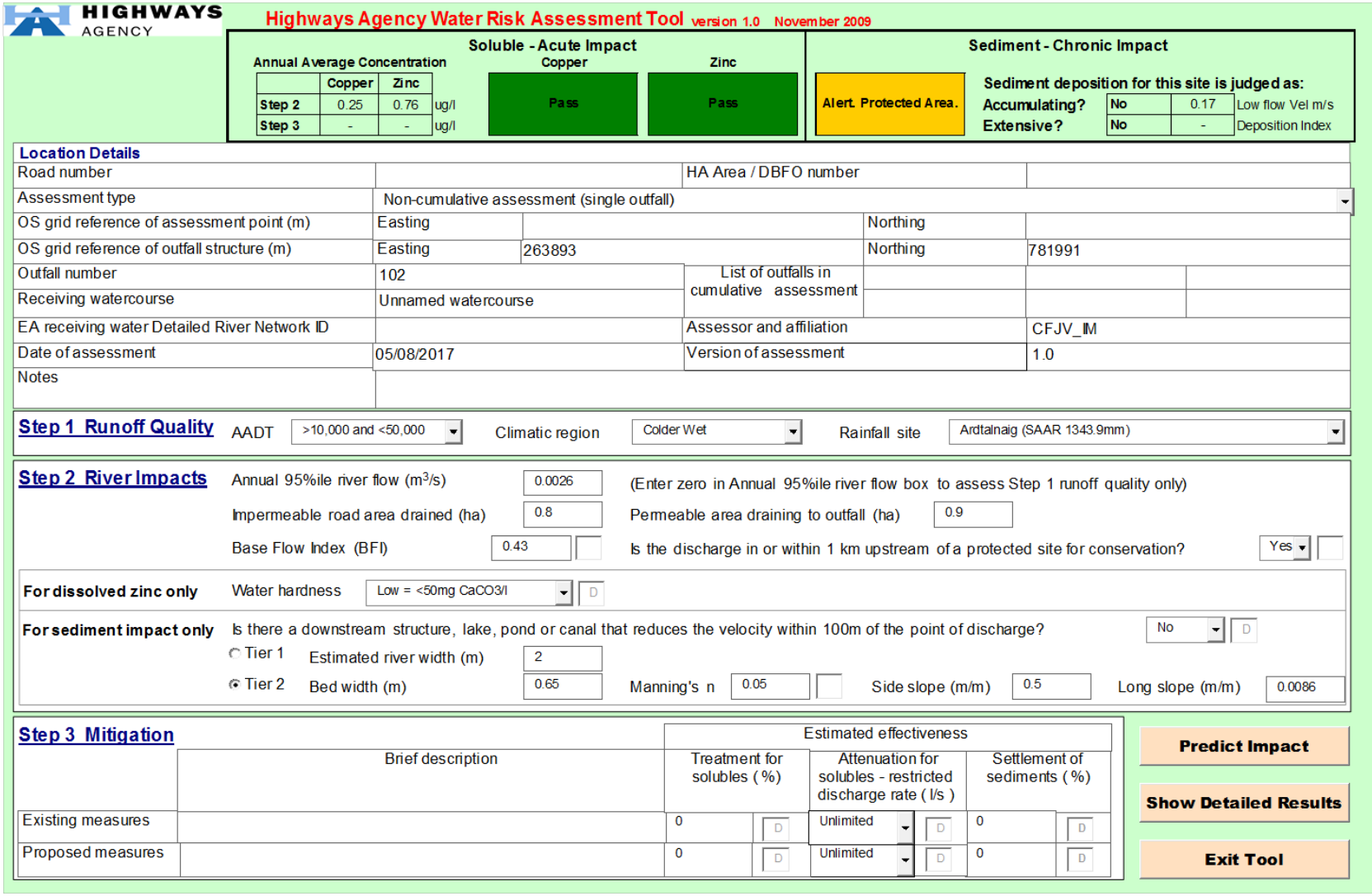
	Brief description	Estimated effectiveness: Treatment for solubles (%)		Attenuation for solubles - restricted discharge rate (l/s)		Settlement of sediments (%)	
Existing measures		0	D	Unlimited	D	0	D
Proposed measures		0	D	Unlimited	D	0	D

Predict Impact

Show Detailed Results

Exit Tool

Figure 18: Method A Calculations for SuDS 102



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.25	0.76	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	0.17	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		Northing
OS grid reference of outfall structure (m)	Easting 263893		Northing 781991
Outfall number	102	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	05/08/2017	Version of assessment	1.0
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) 0.0026 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha) 0.8 Permeable area draining to outfall (ha) 0.9

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) 2

Tier 2 Bed width (m) 0.65 Manning's n 0.05 Side slope (m/m) 0.5 Long slope (m/m) 0.0086

Step 3 Mitigation

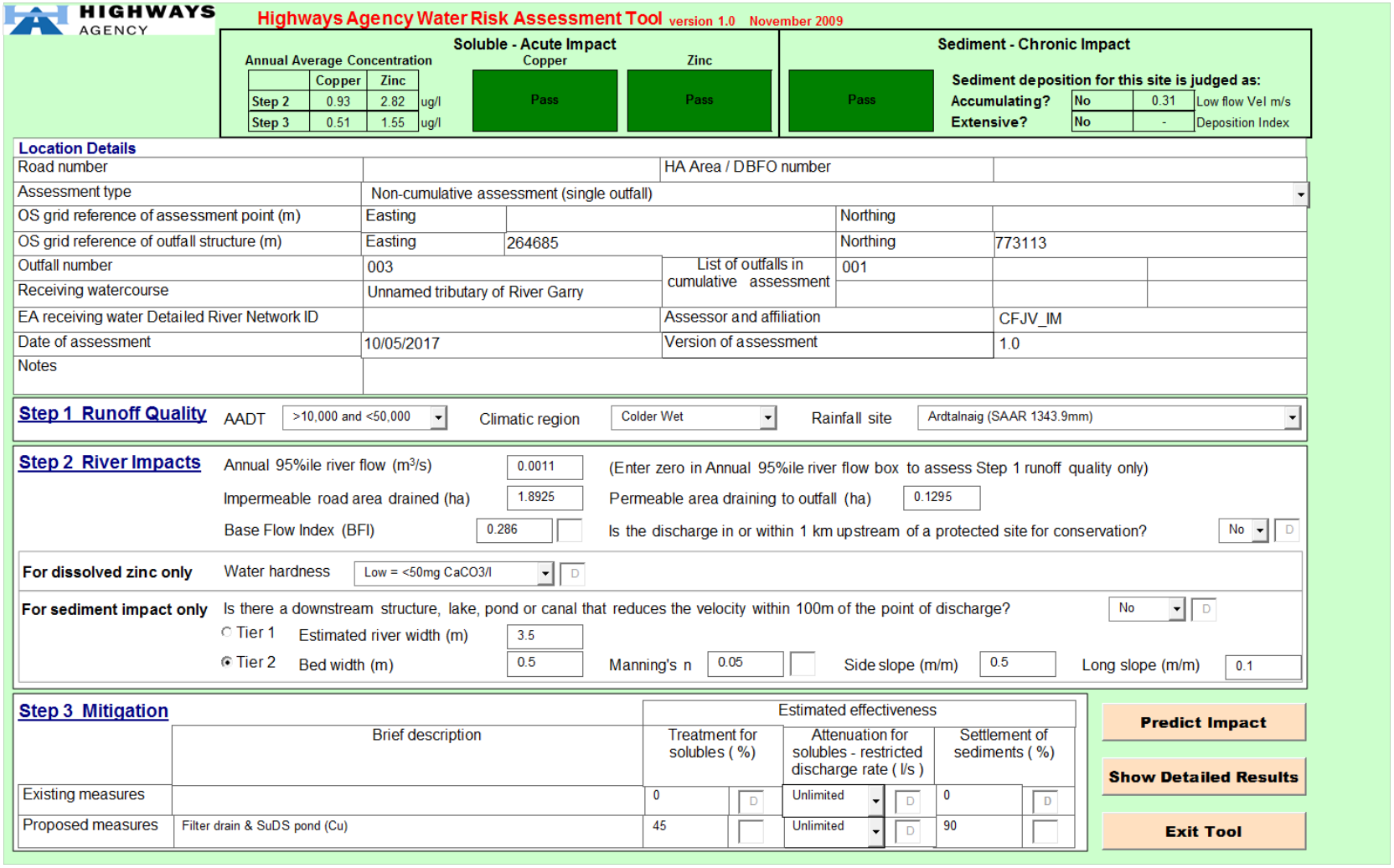
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	Unlimited D	0 D
Proposed measures		0 D	Unlimited D	0 D

Predict Impact

Show Detailed Results

Exit Tool

Figure 19: Method A Calculations for cumulative of SuDS 001 & 003 (copper)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.93	2.82	ug/l
Step 3	0.51	1.55	ug/l

Copper: Pass

Zinc: Pass

Sediment - Chronic Impact

Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.31	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		Northing		
OS grid reference of outfall structure (m)	Easting	264685	Northing	773113	
Outfall number	003	List of outfalls in cumulative assessment	001		
Receiving watercourse	Unnamed tributary of River Garry				
EA receiving water Detailed River Network ID		Assessor and affiliation		CFJV_IM	
Date of assessment	10/05/2017	Version of assessment		1.0	
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): 0.0011 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.8925 Permeable area draining to outfall (ha): 0.1295

Base Flow Index (BFI): 0.286 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 Estimated river width (m): 3.5

Tier 2 Bed width (m): 0.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.1

Step 3 Mitigation

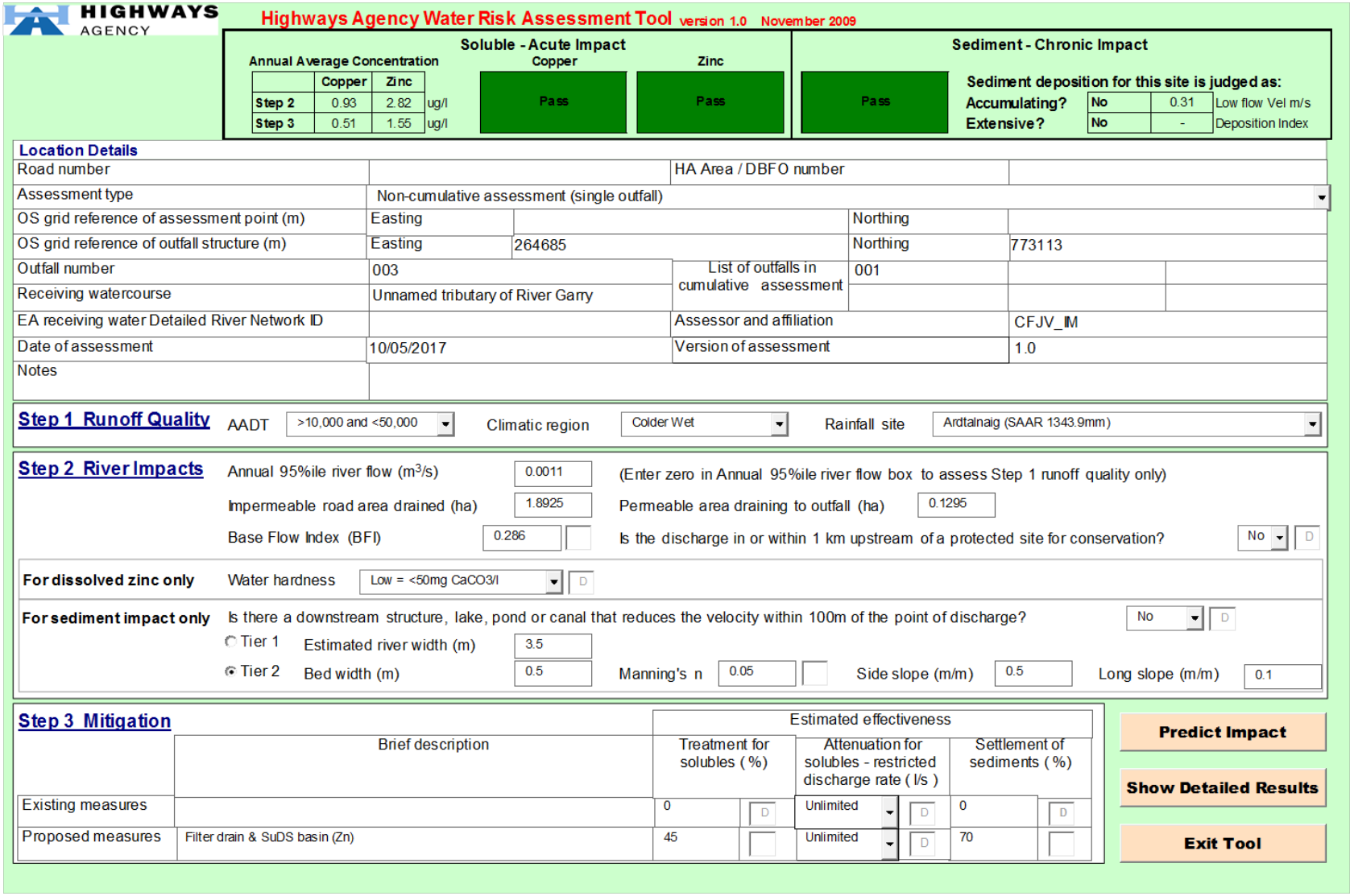
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	Filter drain & SuDS pond (Cu)	45	Unlimited	90

Predict Impact

Show Detailed Results

Exit Tool

Figure 20: Method A Calculations for cumulative of SuDS 001 & 003 (zinc)



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Annual Average Concentration	Copper	Zinc	
Step 2	0.93	2.82	ug/l
Step 3	0.51	1.55	ug/l

Soluble - Acute Impact: Copper: Pass; Zinc: Pass

Sediment - Chronic Impact: Pass

Sediment deposition for this site is judged as:

Accumulating?	No	0.31	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		Northing		
OS grid reference of outfall structure (m)	Easting	264685	Northing	773113	
Outfall number	003	List of outfalls in cumulative assessment	001		
Receiving watercourse	Unnamed tributary of River Garry				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	10/05/2017	Version of assessment	1.0		
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): 0.0011 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 1.8925 Permeable area draining to outfall (ha): 0.1295

Base Flow Index (BFI): 0.286 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 Estimated river width (m): 3.5

Tier 2 Bed width (m): 0.5 Manning's n: 0.05 Side slope (m/m): 0.5 Long slope (m/m): 0.1

Step 3 Mitigation

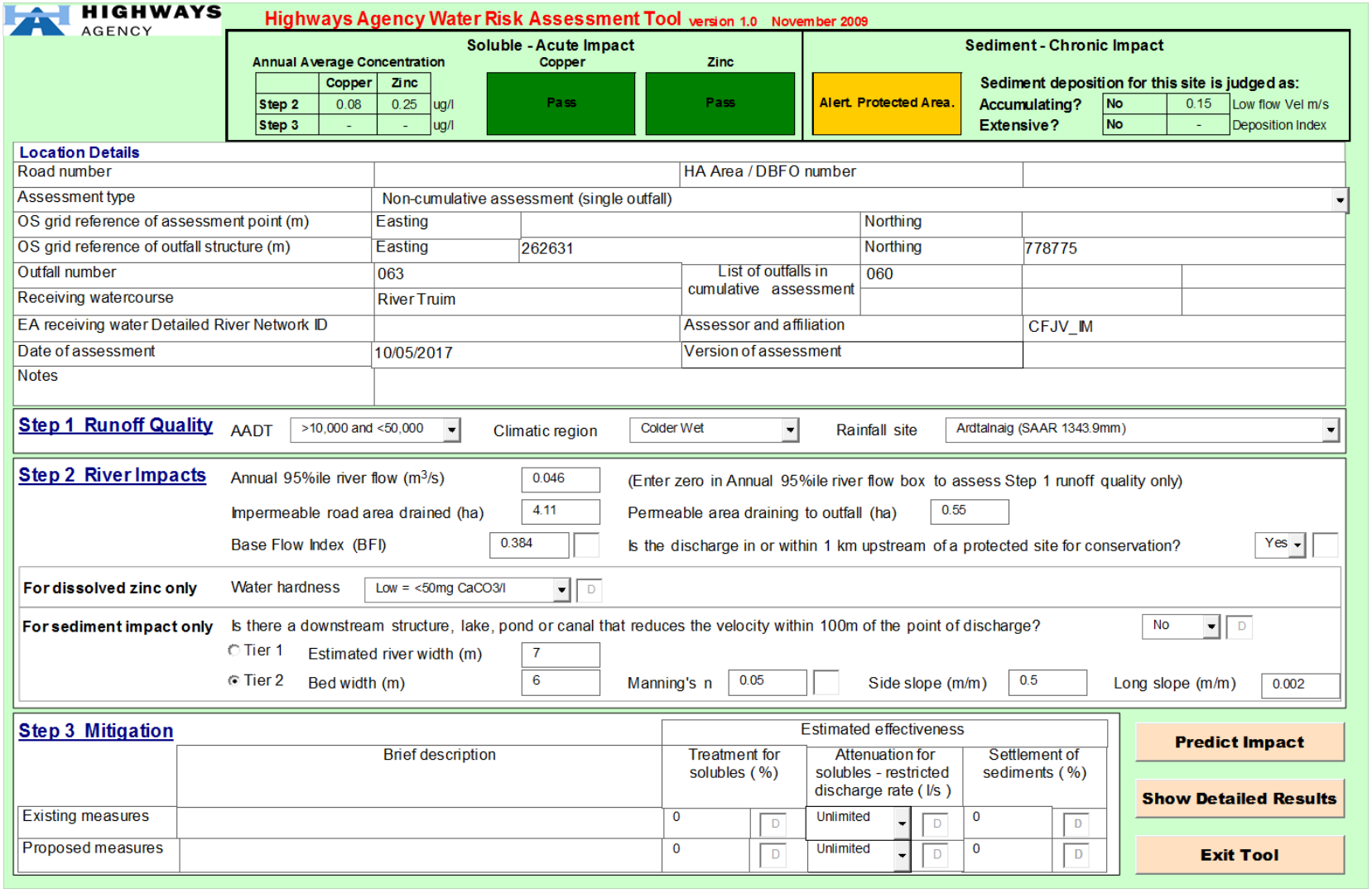
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures	Filter drain & SuDS basin (Zn)	45	Unlimited	70

Predict Impact

Show Detailed Results

Exit Tool

Figure 21: Method A Calculations for cumulative of SuDS 060 & 063



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.08	0.25	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		Northing		
OS grid reference of outfall structure (m)	Easting	262631	Northing	778775	
Outfall number	063	List of outfalls in cumulative assessment	060		
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation	CFJV_IM		
Date of assessment	10/05/2017	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): 0.046 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 4.11 | Permeable area draining to outfall (ha): 0.55

Base Flow Index (BFI): 0.384 | 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): 7

Tier 2 — Bed width (m): 6 | Manning's n: 0.05 | Side slope (m/m): 0.5 | Long slope (m/m): 0.002

Step 3 Mitigation

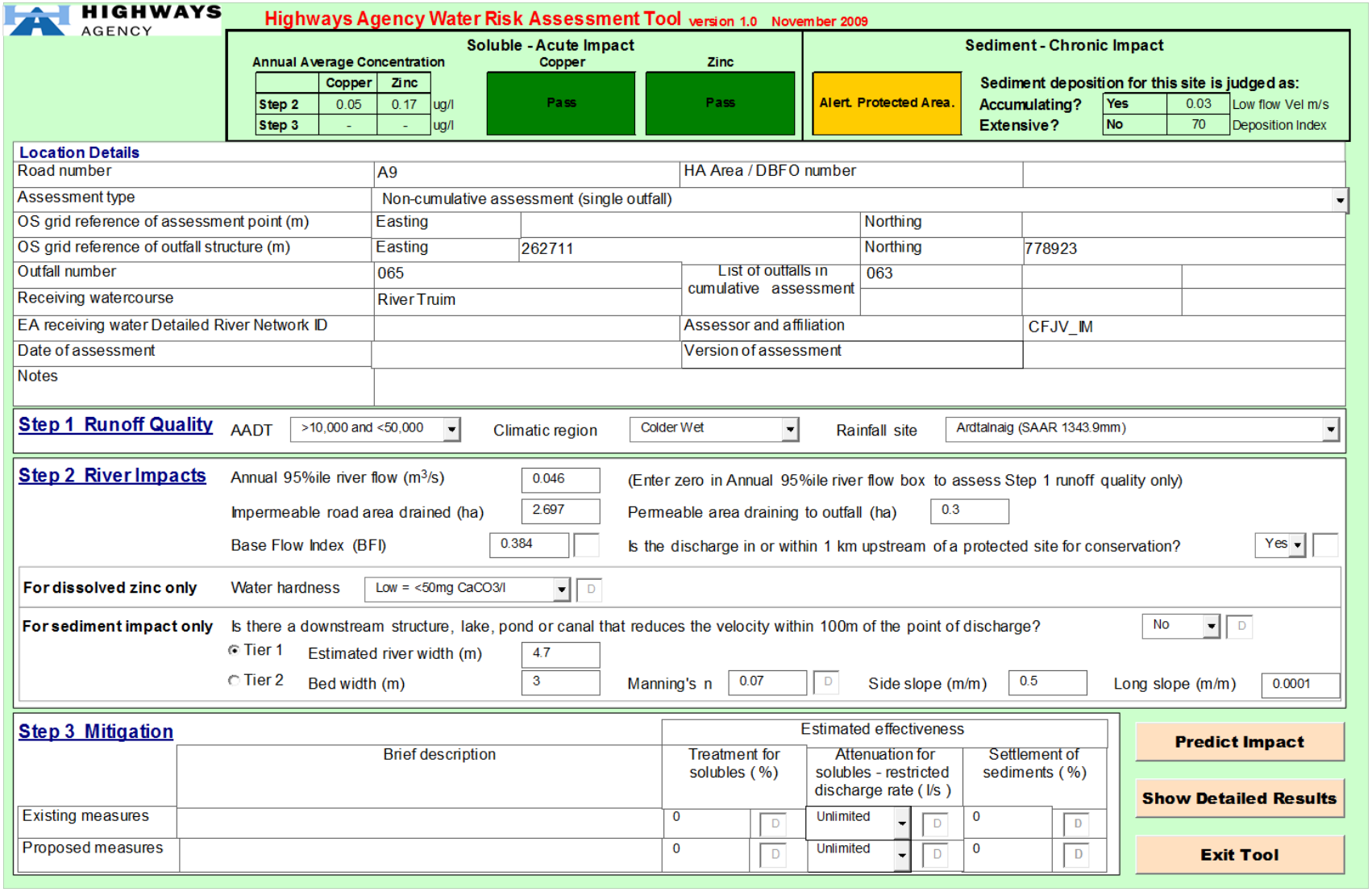
	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	Unlimited	0
Proposed measures		0	Unlimited	0

Predict Impact

Show Detailed Results

Exit Tool

Figure 22: Method A Calculations for cumulative of SuDS 063 & 065



HIGHWAYS AGENCY

Highways Agency Water Risk Assessment Tool version 1.0 November 2009

Soluble - Acute Impact

Annual Average Concentration

	Copper	Zinc	
Step 2	0.05	0.17	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	70	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	262711	Northing	778923	
Outfall number	065	List of outfalls in cumulative assessment	063		
Receiving watercourse	River Truim				
EA receiving water Detailed River Network ID		Assessor and affiliation		CFJV_IM	
Date of assessment		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): 0.046 (Enter zero in Annual 95%ile river flow box to assess Step 1 runoff quality only)

Impermeable road area drained (ha): 2.697 Permeable area draining to outfall (ha): 0.3

Base Flow Index (BFI): 0.384 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): 4.7

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

Table 7: Method C Calculations

SuDS Network 000					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 0.77ha (7,700m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest borehole (BH) to SuDS 000 BH7-004 (located to the east of SuDS earthworks) BH depth = dry at 18.4 mbgl	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	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	High– 3	22.5
Overall Score for Filter Drains					200 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					230 (Medium Risk of Impact)
SuDS Network 001					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 1.66ha (16,600m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 001 BH7-004 (located to the north east of SuDS earthworks) BH depth = dry at 18.4 mbgl	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	SAND AND GRAVEL (hummocky moraine, which contains sand, gravel and boulders)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	High– 3	22.5
Overall Score for Filter Drains					200 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					230 (Medium Risk of Impact)
SuDS Network 003					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall		35 – 39mm	Medium –	

	intensity			2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with medium Road Area 3.66ha ($3,600m^2$)	Low – 1 Medium – 2	15 30
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 003 BH7-004 (located to the west of SuDS earthworks) BH depth = dry at 18.4 mbgl	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	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	High– 3	22.5
Overall Score for Filter Drains					200 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					215 (Medium Risk of Impact)
SuDS Network 004					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 3.76ha ($37,600m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 004 BH7-004 (located to the east of SuDS earthworks) BH depth = dry at 18.4 mbgl	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	SAND AND GRAVEL (assumed based on Hummocky Moundy Glacial Deposits)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	High– 3	22.5
Overall Score for Filter Drains					200 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					230 (Medium Risk of Impact)
SuDS Network 020					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 2.95ha ($29,500m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 020 BH7-007 (located to the north west of SuDS earthworks) BH depth = 2.7 mbgl	High – 3	60
5	Flow type	20	Heavily Consolidated sedimentary deposits, igneous and metamorphic	High – 3	60

			rocks (dominated by fracture porosity)		
6	Effective grain size	7.5	SAND AND GRAVEL (Comprising diamicton, sand and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	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 042

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 4.33ha (43,300m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 042 TP7-019 (located to the north of SuDS Basin) BH depth = 2.3 mbgl	Low – 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	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	High– 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					270 (Medium Risk of Impact)

SuDS Network 060

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 2.61ha (26,100m^2)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 060 BH7-016 (located adjacent to the Basin) BH depth = 2 mbgl	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	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	High– 3	22.5
Overall Score for Filter Drains					240 (Medium Risk of Impact)
Overall Score for SuDS Basin (with high road area)					270 (Medium Risk of Impact)

SuDS Network 063					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1765mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 2.04ha ($2,040m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 063 BH7-017 (located adjacent to SuDS Basin) BH depth = 2.9mbgl	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	VERY FINE SAND	Low – 1	7.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	High– 3	22.5
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 065					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1765mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 0.96ha ($9,600m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 063 BH7-017 (located to the south of the SuDS Basin) BH depth = dry at 2.9 mbgl	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	VERY COARSE SAND (assumed conservative approach based on a mixture of clay, silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (1 – 15% clay minerals)	High– 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 069					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1786mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 1.94ha ($19,400m^2$)	Low – 1 High – 3	15 45

4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 069 TP7-028 (located to the south of SuDS Basin) BH depth = 1.5mbgl	Low – 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	VERY COARSE SAND (based on clay, silt, sand and gravel)	High – 3	22.5
7	Lithology	7.5	(1-15% Clay Minerals)	High– 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 077

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 1.01ha ($10,101m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest TP to SuDS 078 BH7-045 (located to the north of SuDS earthworks) TP depth = 3mbgl	Low – 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	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	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 083

Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 1.10ha ($11,000m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest TP to SuDS 083 BH7-004 (located to the west of SuDS earthworks) BH depth = dry at 3m Assumed water table depth > 5m < 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	7.5	SAND AND GRAVEL	High – 3	22.5

	grain size		(assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)		
7	Lithology	7.5	1 – 15% Clay Minerals	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 092					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1687mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains SuDS Basin associated with High Road Area 2.36ha ($23,600m^2$)	Low – 1 High – 3	15 45
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 092 TP7-048 (located to the south of SuDS earthworks) BH depth = 1.5 mbgl	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	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (<1% clay minerals based on diamicton, sand and gravel)	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)
Network 102					
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	Nearest BH to SuDS 102 TP8-003 (located to the north of SuDS earthworks) BH depth = 3.4 mbgl	High – 3	60
5	Flow type	20	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
6	Effective grain size	7.5	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
7	Lithology	7.5	SAND AND GRAVEL (assumed conservative approach as alluvium contains a mixture of silt, sand, and gravel)	High – 3	22.5
Overall Score for Filter Drain					202.5 (Medium Risk of Impact)
Balsporran Carpark					
Component Number	Property	Weighting Factor	Site Data	Risk Score	Component Score

1	Traffic Density	15	<50,000 (AADT)	Low – 1	15
2	Rainfall volume	15	1786mm	High – 3	45
	Rainfall intensity		35 – 39mm	Medium – 2	
3	Soakaway geometry	15	Filter Drains	Low – 1	15
4	Unsaturated zone (depth to water)	20	Nearest BH to SuDS 069 TP7-028 (located to the south of SuDS Basin) BH depth = 1.5mbgl	Low – 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	VERY COARSE SAND (based on clay, silt, sand and gravel)	High – 3	22.5
7	Lithology	7.5	(1-15% Clay Minerals)	High– 2	15
Overall Score for Filter Drains					232.5 (Medium Risk of Impact)

Figure 23: Method D results for mainline impact on surface water

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)*	2,280							
D3	Road Type *(A-road or Motorway)*	M							
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)	13,641							
D8	% HGV	19							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00063	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.75							
D11	Risk of pollution incident	0.00047	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**							
D13	Return period without pollution reduction measures	0.00047	0.00000	0.00000	0.00000	0.00000	0.00000	0.0005	2132
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction measures	0.00047	0.00000	0.00000	0.00000	0.00000	0.00000	0.0005	2132
D16	Proposed measures factor	0.8							
D17	Residual with proposed Pollution reduction measures	0.00038	0.00000	0.00000	0.00000	0.00000	0.00000	0.0004	2665

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 results for mainline impact on groundwater

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)*	2,280							
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)	13,641							
D8	% HGV	19							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00063	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.50							
D11	Risk of pollution incident	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**							
D13	Return period without pollution reduction measures	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3197
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction measures	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3197
D16	Proposed measures factor	0.8							
D17	Residual with proposed Pollution reduction measures	0.00025	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3997

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

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

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.

Figure 25: Method D results for junction impact on surface water

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)*	781							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Slip road							
D6	Location	> 1 hour							
D7	Traffic flow (AADT two way)	82							
D8	% HGV	4							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.83							
D9	Risk of accidental spillage	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.75							
D11	Risk of pollution incident	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**							
D13	Return period without pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	1722915
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	1722915
D16	Proposed measures factor	0.8							
D17	Residual with proposed Pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	2153644

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.

Figure 26: Method D results for junction impact on groundwater

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)*	781							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Slip road							
D6	Location	> 1 hour							
D7	Traffic flow (AADT two way)	82							
D8	% HGV	4							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.83							
D9	Risk of accidental spillage	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.50							
D11	Risk of pollution incident	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No							
D13	Return period without pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	2584372
D14	Existing measures factor	1							
D15	Return period with existing pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	2584372
D16	Proposed measures factor	0.8							
D17	Residual with proposed Pollution reduction measures	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	3230466

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Table D1

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

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.

Table 8: Change in catchment sizes (existing to proposed)

Existing Hydro ID	Existing Catchment Area (km²)	Proposed Hydro ID	Proposed Catchment Area (km²)	Difference in Area (km²)	Change in Area %	Magnitude of Change	Additional Comment
-03	1.041	-03	1.041	1	0	Negligible	
-02	0.249	-02	0.249	1	0	Negligible	
-01	0.022	-01	0.022	1	0	Negligible	
01	0.208	01	0.208	1	0	Negligible	
02	7.155	02	7.158	0.003	+0.04%	Negligible	
03	0.004	03	0.033	0.029	+725%	Major Adverse	Identified as earthworks drainage only crossings and not crossings of smaller natural watercourses
03a	0.033				-100%		Identified as earthworks drainage only crossings and not crossings of smaller natural watercourses
04	0.057	04	0.058	0.001	+1.75%	Minor Adverse	
05	0.141	05	0.140	0.001	- 0.7%	Negligible	
06	0.045	06	0.045	1	0	Negligible	
07	0.146	07	0.146	1	0	Negligible	
08	0.340	08	0.340	1	0	Negligible	
10	0.125	10	0.125	1	0	Negligible	
12	0.170	12	0.170	1	0	Negligible	
13	0.573	13	0.573	1	0	Negligible	
14	0.071	14	0.071	1	0	Negligible	
15	0.090	15	0.090	1	0	Negligible	
17	0.014				-100%	Major Adverse	
18	0.123				-100%	Major Adverse	
20	0.038				-100%	Major Adverse	
21	0.008	21	0.183	0.175	+2187.5%	Major Adverse	
22	0.093	22	0.093	1	0	Negligible	
23	2.300	23	2.300	1	0	Negligible	
25	0.074	25	0.074	1	0	Negligible	Identified as earthworks drainage only crossings and not crossings of smaller natural watercourses
27	0.149	27	0.149	1	0	Negligible	
28	0.209	28	0.209	1	0	Negligible	
30	0.020	30	0.020	1	0	Negligible	
31	0.823	31	0.823	1	0	Negligible	
32	0.027				-100%	Major Adverse	
33	0.027	33	0.027	1	0	Negligible	
34	0.227	34	0.227	1	0	Negligible	
35	0.099	35	0.099	1	0	Negligible	
36	0.148	36	0.148	1	0	Negligible	
37	0.030	37	0.030	1	0	Negligible	
38	0.044	38	0.044	1	0	Negligible	
39	0.034	39	0.034	1	0	Negligible	

Existing Hydro ID	Existing Catchment Area (km²)	Proposed Hydro ID	Proposed Catchment Area (km²)	Difference in Area (km²)	Change in Area %	Magnitude of Change	Additional Comment
40	0.099	40	0.031	0.068	-68.6%	Major Adverse	
		41a	0.026		+100%		
		41b	0.040		+100%		
42	0.190	42	0.087	0.103	-54%	Major Adverse	
		42a	0.130	0.275	+100%		
43	0.405	43	0.380	-0.025	-27%	Major Adverse	
44	0.091	44	0.091	0.000	0	Negligible	
45	0.175	45	0.175	0.000	0	Negligible	
46	0.039	46	0.039	0.000	+0%	Negligible	
47	0.033	47	0.033	0.000	0	Negligible	
49	0.014	49	0.014	0.000	0	Negligible	
50	0.003	50	0.003	0.000	0	Negligible	
51	0.117	51	0.117	0.000	0	Negligible	
52	3.462	52	3.462	0.000	0	Negligible	
54	0.005	54	0.005	0.000	0	Negligible	Identified as earthworks drainage only crossings and not crossings of smaller natural watercourses
55	0.042	55	0.042	0.000	0	Negligible	Identified as earthworks drainage only crossings and not crossings of smaller natural watercourses
56	0.046	56	0.046	0.000	0	Negligible	
57	0.545	57	0.545	0.000	0	Negligible	
58	0.130	58	0.130	0.000	0	Negligible	
59	3.602	59	3.602	0.000	0	Negligible	
60	0.024	60	0.024	0.000	0	Negligible	Identified as earthworks drainage only crossings and not crossings of smaller natural watercourses
61	0.247	61	0.247	0.000	0	Negligible	
62	0.031	62	0.031	0.000	0	Negligible	Identified as earthworks drainage only crossings and not crossings of smaller natural watercourses
63	0.737	63	0.737	0.000	0	Negligible	
64	1.167	64	1.167	0.000	0	Negligible	

Table 9: Change in catchment sizes (existing to proposed and significance of impact)

Receptor	Chainage (ch.)	Detail of potential impact	Sensitivity	Magnitude	Significance of Impact
Catchment of Hydro ID 4/ W7.43	700 to 890	Change to catchment area +1.75	Low	Minor Adverse	**Neutral**
Catchment of Hydro ID 17/ W7.5	2,450	Change to catchment area -100%	Low	Major Adverse	**Slight Adverse**
Catchment of Hydro ID 18/ W7.70	2,520 to 2,540	Change to catchment area -100%	Low	Major Adverse	**Slight Adverse**
Catchment of Hydro ID 20/ W7.74	2,700 to 2,705	Change to catchment area -100%	Low	Major Adverse	**Slight Adverse**
Catchment of Hydro ID 21/ W7.76	2,350 to 2,830	Change to catchment area +2187.5%	Low	Major Adverse	**Slight Adverse**
Catchment of Hydro ID 40/ W7.109	4,960 to 4,695	Change to catchment area -69%	Low	Major Adverse	**Slight Adverse**
Catchment of Hydro ID 42/ W7.115	4,955 to 4,960	Change to catchment area -54%	Low	Major Adverse	**Slight Adverse**
Catchment of Hydro ID 43/ W7.9	5,500 to 6,150	Change to catchment area -27%	Low	Moderate Adverse	**Slight Adverse**

Annex 2: Technical Note

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