Llywodraeth Cymru
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A487 New Dyfi Bridge

Environmental Statement - Volume 3: Appendix 15.4

Assessment of Pollution Impacts from Routine Run Off on Groundwater

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Appendix 15.4 Assessment of Pollution Impacts from Routine Runoff on Groundwater

Outfalls to Catchments 2 and 3

Method C Assessment

Table 15.6.1 Overall Risk Score for outfalls to Catchments 2 and 3, which score the same for each component

Component Number		Weighting Factor	Property or Parameter	Site Data	Risk Score	Component Score
1	SOURCE	15	Traffic Density	3,186	Low risk - 1	15
2	SOURCE	15	Rainfall Volume (annual averages)	Annual average from nearest weather station of 1075mm	High risk - 3	45
			Rainfall Intensity	40.3mm	Medium risk - 2	
3	PATHWAY	15	Soakaway Geometry	Continuous linear ditch	Low risk - 1	15
4	PATHWAY	20	Unsaturated Zone	Water table is approximately 1.3m below ground level based on ground investigation	High risk - 3	60
5	PATHWAY	20	Flow Type	Unconsolidated superficial deposits	Low risk - 1	20
6	PATHWAY	7.5	Effective Grain Size	The predominant material is fine sand and below	Low risk -1	7.5
7	PATHWAY	7.5	Lithology	Ground investigation logs indicate silty clay / clayey silt, conservatively assume medium risk score	Medium risk - 2	15
Overall Risk Score						**177.5**

Traffic Density (component 1)

Traffic surveys have been conducted for the existing road in 2015, and the findings have been used to estimate the two way annual average daily traffic (AADT) for 2034. The highest AADT from the 2015 survey and estimated 2034 value has been used – 3,186.

Rainfall Volume (component 2)

The average annual rainfall quantity has been identified from the Met Office average rainfall maps for the period between 1961 and 2010. According to these maps, the average annual rainfall quantity for the site was in the range of 1500 to 2000mm/year. The average annual rainfall for the nearest weather station (Gogerddan) is quoted as 1075mm, for the period between 1981 and 2010.

Rainfall Intensity (component 2)

According to the Flood Estimation Handbook CD-ROM 3, the modelled 1 hour design rainfall for a 1 in 100 year return period has been assessed as 40.3 mm.

Soakaway Geometry (component 3)

The scheme proposals are for road drainage to discharge into a continuous linear ditch.

Unsaturated Zone (component 4)

Historic and preliminary ground investigation information indicates groundwater levels to be at shallow depth throughout the scheme area. Groundwater levels have typically been identified at around 1.4m bgl in the vicinity of the proposed linear ditches into which the drainage water will be discharged.

Flow Type (component 5)

Historic and preliminary ground investigation information indicates that the superficial deposits typically consist of approximately 2m to 3m of cohesive alluvium overlying glacial deposits to depths exceeding 16m bgl. The flow type for infiltrating waters in the unsaturated zone is therefore considered to be dominantly through unconsolidated superficial deposits.

Effective Grain Size (component 6)

Historic and preliminary ground investigation information indicates that the cohesive alluvium that is present from the ground surface in the vicinity of the proposed outfalls predominantly comprises silty clay / clayey silt. Therefore the dominant effective grain size has been categorised fine sand or below.

Lithology (component number 7)

Historic and preliminary ground investigation information indicates that the cohesive alluvium that is present from the ground surface in the vicinity of the proposed outfalls predominantly comprises silty clay / clayey silt. On the basis of the available information, it is not possible to accurately determine the clay content. Therefore, the soils have conservatively been given a medium risk score of between <5% and >1%.

Overall Risk Score

The overall risk score of 177.5 is within the 150 to 250 'medium risk of impact' range. For this 'medium risk of impact', HD 45/09 indicates that mitigation measures should be considered to protect groundwater, although the need for and nature of the mitigation measures should be informed by additional risk assessment.

Additional Risk Assessment

Additional groundwater risk assessment has been carried out using the Environment Agency's P20 Hydrological Risk Assessment for Land Contamination. This is a more detailed computer based model, which takes account of transport and fate properties, aquifer properties and contaminant degradation to identify the extent of any contaminative impact on the groundwater.

The purpose of this additional risk assessment is to demonstrate the level of concern of contamination in relation to specific receptors by determining the distance that a contaminant will reduce in concentration from an initial runoff value to a specific threshold value. Threshold values include UK Drinking Water Standards (UKDWS) or Environmental Quality Standard (EQS) guidelines, whichever is the higher. In this case receptors include water courses with a Q95 flow of greater than $0.001m^3/s$.

The proposed outfalls would facilitate discharge of highway drainage water directly into the ground. The discharged water would penetrate the unsaturated zone before reaching the water table. Any inorganic contamination (e.g. metals) that have migrated as a result of that discharge would also reach the groundwater and would create a plume of contamination migrating with groundwater towards a potential receptor (e.g. a surface water course). The concentrations of the contaminations would however diminish with distance due to dilution and dispersion processes. No biodegradation has been applied within the model, as inorganic contaminants such as metals are unlikely to biodegrade.

The outfalls are likely to be underlain by granular superficial deposits comprising sands and gravels. Parameters describing the aquifer such as bulk density, porosity and hydraulic conductivity have been applied and were characteristic to this type of deposits. The full thickness of these deposits has not been proven and for the purpose of the assessments an aquifer thickness of 30m has been assumed. This represents the greatest proven thickness of saturated ground. The groundwater movement is anticipated to be in the north-eastern direction, towards the Afon Dyfi, where this groundwater is likely to recharge the river. The hydraulic gradient of groundwater has been calculated based on the measured groundwater levels at the outfall locations and the area topography.

The applied parameters are detailed beneath the results tables.

Tables 15.6.2 and 15.6.3 summarise the results of the additional risk assessment for the marker contaminants copper and zinc. The parameters used in the model and the reasoning behind the parameters are also discussed below.

Table 15.6.2 Summary of additional hydrogeological risk assessment for copper at Outfalls 2 and 3.

95%ile Initial Contaminant Concentration (mg/l)	Distance to Compliance Point (m)	Remedial Target Concentration (mg/l)
5.50E-02	10	5.08E-02
5.50E-02	20	1.91E-01
5.50E-02	30	4.26E-01
5.50E-02	40	7.45E-01
5.50E-02	50	1.18

Table 15.6.3 Summary of additional hydrogeological risk assessment for zinc at Outfalls 2 and 3.

95%ile Initial Contaminant Concentration (mg/l)	Distance to Compliance Point (m)	Remedial Target Concentration (mg/l)
1.94E-01	10	9.65E-01
1.94E-01	20	3.64
1.94E-01	30	8.09
1.94E-01	40	14.3
1.94E-01	50	22.3

(grey)	Remedial target greater than initial concentration (no mitigation measures required)
(orange)	Remedial target less than initial concentration (mitigation measures required for receptors within distance)

Applied Parameters

The reasoning behind each parameter used in the model is discussed below.

Target Concentration

- Copper – 1 x 10^{-3} mg/l
- Zinc – 8 x 10^{-3} mg/l

Environmental Quality Standard guidelines.

Initial Contaminant Concentration

- Copper – 5.5 x 10^{-2} mg/l
- Zinc – 1.9 x10^{-1} mg/l

95% ile contaminant concentration from HAWRAT assessment of no flow.

Half Life
9 x 10^{99} days – copper and zinc are soluble and assumed to have little or no degradation.

Width of Plume
2m – Q95 flow less than 0.001m^3/s, therefore assumed to be a point source with a width of approximately 2m.

Length of Plume
2m – Q95 flow less than 0.001m^3/s, therefore assumed to be a point source with a width of approximately 2m.

Plume Thickness
2.12 x 10^{-1} m – in accordance with Level 2 Soil Assessment which takes account of length of plume, aquifer thickness, hydraulic conductivity of aquifer, hydraulic gradient, width of plume and background concentration of contaminant in groundwater.

Saturated Aquifer Thickness
3**0m** – previous investigations encountered at least 30m of granular superficial deposits beneath groundwater level.

Bulk Density of Aquifer Materials
1.9 g/cm^3 – typical bulk density of glacial deposits across the proposed scheme.

Effective Porosity
2.5 x 10^{-1} – Value for sands and gravels from Table 5.1 in RISC4 user manual.

Hydraulic Gradient
1.7 x 10^{-3} – Calculated using groundwater level at each outfall location and topography.

Hydraulic Conductivity of Aquifer
10 m/d – Value for sands and gravels from Table 5.1 in RISC4 user manual.

Partition Coefficient

- Copper – 2.5 l/kg
- Zinc – 75.0 l/kg

Values taken from Table 11.1 in RISC4 user manual.

Receptors

Table 15.6.4 summarises the location of receptors within the proximity of Outfalls 2 and 3.

Table 15.6.4 Summary of receptors within the vicinity of Outfalls 2 and 3.

Receptor	Distance to Receptor
Main groundwater body	0m – present from the ground surface at various times
Afon Dyfi	300m to the north at nearest point, however considering the area topography, groundwater is likely to discharge to the river some 1km to the south-west.