A83 Rest and Be Thankful

LTS EIAR VOLUME 4, APPENDIX 19.2 - ROAD DRAINAGE AND THE WATER ENVIRONMENT METHODOLOGY

Transport Scotland

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A19-2. Road Drainage and the Water Environment Methodology

A19-2.1. Introduction

A19-2.1.1. Three inter-linked sub-topics are associated with Road Drainage and Water Environment (RDWE); surface water quality, hydromorphology (which encompasses fluvial geomorphology) and flood risk. Appropriately qualified specialists have been directly involved in the assessments and reporting associated with each of these topics.

A19-2.1.2. Recognising challenges for water management, consultation has been carried out with Argyll and Bute Council, Scottish Environment Protection Agency (SEPA), NatureScot and other relevant authorities. Consultation has informed the design, assessment methods and Environmental Impact Assessment (EIA) reporting strategy throughout the respective Design Manual for Roads and Bridges (DMRB) stages of assessment and reporting. Regular A83 Environmental Steering Groups (ESG) meetings have provided a forum to present and discuss progress and to align expectations and requirements to comply with the European Union (EU) Water Framework Directive (WFD) and seek a proportionate approach to EIA delivery.

A19-2.1.3. The following sections describe the methodology used in the assessment of potential effects of the Proposed Scheme on the RDWE, including assumptions and limitations of the approach.

A19-2.1.4. The assessments follow the principles outlined in DMRB LA 113 Road Drainage and the Water Environment, with details of key guidance documents applied included in Volume 4, Appendix 19.1: Road Drainage and Water Environment - Legislation, Policy and Guidance.

A19-2.1.5. Note that groundwater related effects are assessed within Chapter 12: Geology, Soils and Groundwater, with interactions across chapters identified in

each. Drainage design details are set out in Chapter 4: The Proposed Scheme, with interactions between the technical teams leading to the development of an appropriate drainage strategy to meet various criteria, including water quality and flood risk.

A19-2.2. Sources of Information

A19-2.2.1. The sources of information used for the purpose of this assessment consist of a combination of online sources and findings from various site visits since December 2022. The assessments have been informed by the following software, datasets, guidance, surveys and other sources of information:

- Flood Estimation Handbook (FEH)
- National River Flow Archive (NFRA) Peak Flow Dataset v12.1
- The River Basin Management Plan for Scotland 2021 – 2027
- SEPA Water Classification Hub
- SEPA Water Environment Hub
- SEPA rainfall data
- historical flood data from SEPA and the Local Authority
- Ordnance Survey (OS) 1:25,000 and 1:50,000 scale mapping
- topographical surveys
- DMRB Stage 2 modelled flows, depths, velocity, and flood plain extents
- previous flood risk modelling / studies
- Site walkover findings, observations and photos
- LiDAR (20cm) digital elevation model provided by Transport Scotland
- aerial photographs and AWJV drone photogrammetry
- DMRB Stage 2 Scheme Assessment Report
- DMRB CD 501 – Design of highway drainage systems
- DMRB CD 521 – Hydraulic design of road edge surface water channels and outlets
- DMRB CD 522 – Drainage of runoff from natural catchments

- DMRB CD 529 – Design of outfall and culvert details
- DMRB CD 532 – Vegetated drainage systems for highway runoff
- CIRIA SuDS Manual
- CIRIA Control of Water Pollution from Linear Construction Sites, Technical Guidance
- Technical Flood Risk Guidance for Stakeholders – SEPA requirements for undertaking a Flood Risk Assessment
- Argyll and Bute Council Flood Risk Management Policy
- Argyll and Bute Council information of private water supplies (PWS) – received 21 March 2023.
- SEPA Guidance for Transport Infrastructure Projects - WAT-SG-93
- SEPA Regulation of Engineering Activities – WAT-RM-02
- SEPA Culverting of Watercourses - WAT-PS-06-02
- SEPA Sediment Management Authorisation - WAT-SG-78
- Transport Scotland structures database (pre stage 2 data provided by Jacobs).

A19-2.3. Baseline Conditions

A19-2.3.1. Baseline conditions have been informed by desk-based assessments cognisant of the sources of information listed (Section A19-2.2) as well as site walkovers. Baseline conditions are described in Volume 4, Appendix 19.3: Road Drainage and the Water Environment - Baseline.

A19-2.3.2. The Study Area incorporates the hydrological catchments that drain towards the Proposed Scheme and associated floodplains; and includes the catchments of the Croe Water, Kinglas Water as well as the standing body of water, Loch Restil. Further Study Area information, specific to individual assessments is provided in sections below.

A19-2.3.3. Major watercourses are defined in the SEPA CAR licensing guidance as those shown on the OS 1:50,000 scale mapping, with minor watercourses shown on

OS 1:25,000 scale mapping. Study Area watercourses have been further categorised using the definition system provided in Table A19-2.1.

A19-2.3.4. Where the 1:25,000 mapping does not show a watercourse and a crossing (culvert or bridge) has been identified at that location, the assumption has been made that a minor watercourse exists.

A19-2.4. Assessment Methodology

A19-2.4.1. The assessment methodologies outlined are aligned with DMRB LA 113 which describes methods for assessing impacts of road schemes on the water environment; furthermore, the methods are also aligned with those identified in the earlier DMRB Stage 3 Scoping Report.

A19-2.4.2. Assessments has been summarised within Chapter 19 – Road Drainage and the Water Environment, with full details provided within each of the associated Volume 4 appendices, including:

- Appendix 19.4: Hydromorphology Assessment
- Appendix 19.5: Water Quality Assessment and
- Appendix 19.6: Flood Risk Assessment.

A19-2.4.3. The sensitivity and importance of receptors has been evaluated, as has the magnitude of impact on each, as further detailed below. Furthermore, cumulative and indirect impacts have been identified and assessed with respect to WFD compliance.

Table A19-2.1: Criteria for Watercourse Definition

Category	Description	Details
Major	On OS 1:50,000 scale map	Supply of water and sediment from a measurable, permanent catchment area maintains a clearly defined channel. Flow may be perennial or ephemeral resulting from groundwater flow, tributary input, springs and storm event run-off. Flow direction is perpendicular to contours and follows topographic depressions. Watercourse would have existed prior to human modification of the landscape. Minor B watercourses assessed on a site-by-site basis for ecological potential and morphological functioning.
Minor A	On OS 1:25,000 scale map and perennial	As above for “major”
Minor B	Not on OS 1:25,000 scale map or ephemeral	As above for “major”
Minor C	Land drains	No measurable or permanent catchment area. Channel artificially constrained or poorly defined with flow resulting from storm-fed spring-lines and overland flow. Flow direction may be parallel or oblique to contours. Defined watercourse would not have existed prior to human modification of the landscape, particularly on lower topographic elevations.
PED	For pre-earthworks drainage only	As above for “Minor C”.

Hydromorphology Assessment

A19-2.4.4. The hydromorphology assessment includes all main watercourses hydrologically linked within 1km of the Proposed Scheme and has been carried out in accordance DMRB LA 113 Appendix E – Hydromorphological Assessment and the Scotland National Application Annex, within.

A19-2.4.5. DMRB LA 113 does not specify a prescriptive method for undertaking a hydromorphological assessment; rather it states that the approach should be tailored to the project and the affected watercourses but should consider the effects of the Proposed Scheme on the form and function of watercourses and the connectivity with the wider landscape.

A19-2.4.6. Baseline information has been used to inform the design of the Proposed Scheme to maximise resilience from erosion, scour and sedimentation over its operational lifetime; whilst at the same time minimising potential impacts on the hydromorphological form and function of affected watercourses.

A19-2.4.7. Specific hydromorphological sensitivity and impact magnitude criteria have been developed based on guidance provided in the DEFRA/EA R&D Report FD1914 Guidebook of Fluvial Geomorphology.

A19-2.4.8. The hydromorphological assessment includes both desk-based investigations and field surveys to provide an understanding of watercourse character, dominant processes and likely impact. The desk-based assessment has applied available digital data, geographical information system (GIS) analysis, including detailed digital terrain model (DTM) data (derived from an Unmanned Aerial Vehicle (UAV) flown quarterly), to characterise the hydromorphological form and function of the affected watercourses and any recent channel change.

A19-2.4.9. Where it was considered safe to do so, field surveys were carried out on affected watercourses (identified from the OS 1:25,000 mapping) to assess channel dimensions, potential sources, types and size of sediment available for erosion and transportation. Information obtained during these surveys has also been used to identify - specifically in relation the wider Croe and Kinglas water bodies - opportunities for enhancement and restoration of the water

environment off-site; to offset the on-site impacts but also maximise the opportunities for wider natural capital benefits.

A19-2.4.10. Conceptual models have been developed for each of the watercourses to illustrate the respective flow and sediment characters. Hydraulic modelling outputs (see also, Appendix 19.6 – Flood Risk Assessment) have also been analysed and sensitivity tests conducted to better understand the likely flow depths, velocities and sediment entrainment capabilities and the magnitude of potential impact on channel form.

A19-2.4.11. These data have informed the design of the Proposed Scheme incorporating embedded mitigation to maximise the sustainability (and natural functioning) of the watercourses and resilience to erosion/scour and sedimentation over its operational lifetime. Where residual impacts are identified, specific mitigation measures are recommended.

A19-2.4.12. Liaison with the river engineers, geotechnical and structures team has been carried out to develop the most viable options for the Proposed Scheme, as regards watercourse crossings. Regular consultation with the ecology and Biodiversity Net Gain (BNG) team has sought to identify opportunities for enhancement and restoration within the Croe Water valley to maximise wider natural capital benefits.

Water Quality Assessment

A19-2.4.13. The assessment of potential effects on water quality (including those on private water supplies) has been carried out cognisant of effects during construction and operation of the Proposed Scheme; and has been informed by the drainage design and traffic data to identify operational treatment requirements in accordance with DMRB LA 113 criteria for routine runoff and accidental spillage.

Construction Pollution

A19-2.4.14. Evaluation of the potential for pollution of surface waters arising from accidental spillage and of the release of pollutants including sediments into watercourses or water bodies has involved a review of areas where construction would be

required within or in proximity of (i.e. within 50m) of watercourses and water bodies.

A19-2.4.15. Information on private water supplies was provided by Argyll and Bute Council and SEPA. The data provided was then reviewed using a geographic information system (GIS) mapping software to establish receptor locations within the Study Area and potential for connectivity / interactions with the Proposed Scheme.

Pollution from Routine Runoff

A19-2.4.16. DMRB LA 113 specifies procedures for the assessment of pollution impacts from routine runoff on surface waters, this comprises two separate elements:

- Highways England Water Risk Assessment Tool (HEWRAT) Assessment: HEWRAT is a Microsoft Excel application designed to assess the short-term risks related to the intermittent nature of road runoff. It assesses the acute and chronic pollution impacts on aquatic ecology associated with soluble and sediment bound pollutants, respectively.
- Environmental Quality Standards (EQS) Assessment: EQS are the maximum permissible annual average concentrations of potentially hazardous chemicals, as defined under the WFD. The long-term risks over the period of one year are assessed through comparison of the annual average concentration of pollutants discharged with the published EQS for those pollutants.

A19-2.4.17. To fully carry out these assessments a variety of baseline and drainage design information is required, including:

- traffic volumes
- areas of impermeable and permeable road surfaces to be drained
- receiving watercourse dimensions and flow data
- water hardness
- presence of sensitive sites (considered as international/national designated conservation sites)

- in-stream structures or features which influence the flow and
- the Proposed Scheme Sustainable Drainage System (SuDS) treatment train features.

A19-2.4.18. HEWRAT and EQS assessments have been carried out for each road drainage network's outfall, taking account of dilution from receiving water and water quality treatment proposed within the mainline drainage design, with the objective to achieve a 'pass' for all drainage networks.

Pollution from Accidental Spillage

A19-2.4.19. DMRB LA 113 specifies procedures for the assessment of pollution impacts from accidental spillage within Appendix D. A summary of the methodology is provided below, with full details provided in DMRB LA 113.

A19-2.4.20. The assessment takes the form of a risk assessment, where the risk is expressed as the annual probability of a serious pollution incident occurring. This risk is the product of two probabilities:

- the probability that an accident will occur, resulting in a serious spillage of a polluting substance on the carriageway and
- the probability that, if such a spillage did occur, the polluting substance would reach the receiving water body and cause a serious pollution incident.

A19-2.4.21. The probability of a serious spillage occurring is dependent on a variety of factors; traffic volumes, percentage of heavy goods vehicles in the traffic volumes, whether the road is motorway, rural or urban trunk road, the road type categories within the road drainage catchment under assessment i.e. 'no junction', 'slip road', 'crossroad' or 'roundabout' and the length of each road type within the catchment.

A19-2.4.22. The probability of a serious spillage subsequently causing a serious pollution incident is dependent on the receiving surface water body and the response time of the emergency services, i.e. less than 20 minutes, less than one hour, or greater than one hour.

A19-2.4.23. Typically, an annual probability of 1% (i.e. a 1 in 100 chance of a serious pollution incident occurring in any one year) is considered by DMRB as an acceptable risk. However, where a road drainage outfall discharges within 1km of a sensitive receptor, (such as a nationally designated conservation site), a higher level of protection is required, such that the risk has no greater annual probability than 0.5% (i.e. a 1 in 200 chance of occurring in any one year).

A19-2.4.24. Evaluation of the predicted effects has been undertaken for all proposed mainline drainage networks in accordance with the guidance provided in LA 113 and outlined in the Impact Assessment Criteria section below.

A19-2.4.25. The accidental spillage water quality assessment has been summarised within Chapter 19: Road Drainage and the Water Environment with full details provided within Volume 4, Appendix 19.5 Water Quality Assessment.

Flood Risk Assessment

A19-2.4.26. DMRB LA 113 specifies that flood risk assessment should be undertaken in accordance with the overseeing organisations specific requirements on flood risk (therefore for the Proposed Scheme SEPA/ government and Local Authority requirements). However, it does note the 4 principles that a Proposed Scheme should be designed around:

- remain operational and safe for all users in times of flood
- result in no net loss of flood plain storage
- not impede water flows and
- not increase flood risk elsewhere.

A19-2.4.27. To assess the flood risk initially, all of the watercourses located within the Proposed Scheme extents were identified. These pass below the existing A83 via mainline watercourse crossings, with flow from these watercourses continuing down the steep slope and then crossed by the Old Military Road (OMR) before entering the ‘High Glen Croe’ watercourse, an unnamed upstream tributary of the Croe Water which flows south along the valley floor of upper Glen Croe.

A19-2.4.28. The flood risk assessment (FRA) examines the flood risk to and from the Proposed Scheme. Flood risk to the Proposed Scheme was collated from sources such as SEPA flood maps and historical flood event records.

A19-2.4.29. Given the complexity and nature of the environment it was not possible quantify the potential magnitude of impact from the Proposed Scheme relative to the baseline using accurate and precise numerical modelling techniques. Therefore, professional judgment has been used based on knowledge of the study area, experience in applying flood risk guidance and a sound understanding of the limitations of numerical models Specifically, professional judgement has been based on:

- a sound knowledge of the baseline study area based on site visit and assessment of available data
- an assessment of the potential impacts of the scheme on flow paths;
- a hydraulic assessment of the watercourses with culverts on watercourses with a range of gradients across the scheme l being modelled pre and post scheme to understand the hydraulics and controlling factors for the watercourses
- sensitivity testing to understand the limitations of the quantitative assessment and associated assumptions and
- our knowledge and experience of best modelling practice and in particular SEPA Flood Modelling Guidance for Responsible Authorities.

A19-2.4.30. The magnitude and significance/ importance of these impacts has been assessed for the 0.5% AEP plus climate change.

A19-2.5. Assessment Criteria

A19-2.5.1. The predicted significance of impacts has been based on an evaluation of the importance/sensitivity of the receptor/feature; the magnitude of the potential impact on the receptor/feature and the significance of the potential effect on the receptor/feature – arising from Proposed Scheme during construction and operation. Importance/Sensitivity, Magnitude and Significance criteria are set out in the sections below.

Importance/Sensitivity

A19-2.5.2. The importance/sensitivity has been evaluated considering their quality, rarity, scale and substitutability of hydromorphological, water quality and flood risk sensitive receptors and their features. The typical criteria provided in DMRB LA 113 with additional criteria in accordance with the cited guidance and examples therein are detailed in Table A19-2.2.

Table A19-2.2: Typical Importance Criteria for Road Drainage and the Water Environment Receptors (derived from DMRB LA 113, Table 3.70)

Importance/ Sensitivity	Criteria
Very high	Surface Water Quality and Biodiversity Watercourse classified under Water Framework Directive, with low flow (Q_{95}) value of 1m^3/s or greater. Sites protected under EU wildlife legislation (Special Area of Conservation (SAC), Special Protection Areas (SPA) and Ramsar) Watercourses supporting a wide range of significant species and habitats sensitive to changes in suspended sediment concentrations and turbidity such as salmon or freshwater pearl mussels. Water dependent ecosystems of international/national biodiversity value Water Supplies Watercourse supporting major/critical public water supplies. Public water supply or large private water supply serving >10 properties Hydromorphology A watercourse exhibiting a range of natural morphological features, such as pools and riffles, active gravel bars, and varied river bank types. This morphological variability supports a range of habitats which is a primary determinant of ecological diversity. Minimal signs of artificial modification. Flood Risk Essential infrastructure or highly vulnerable development Watercourses or floodplains, with direct or indirect flood risk to adjacent populated areas and/or presence of essential infrastructure such as schools, hospitals and isolated dwellings in sparsely populated areas, which are highly sensitive to increased flood risk by the possible increase in water levels.

Importance/ Sensitivity	Criteria
High	Surface Water Quality and Biodiversity Watercourse classified under Water Framework Directive, with low flow (Q_{95}) value of 0.001m^3/s to 1m^3/s. Sites protected under UK wildlife legislation (Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR)). Water dependent ecosystems of regional/county biodiversity value. Watercourses supporting some species and habitats sensitive to changes in suspended sediment concentrations and turbidity. Water Supplies Watercourses supporting minor/non-critical public drinking water supplies. Private water supply serving 2-10 properties. Hydromorphology A watercourse exhibiting a range of morphological features with very little evidence of artificial modification. Flood Risk More vulnerable development. Watercourses or floodplains, with a possibility of direct or indirect flood risk to less populated areas without essential infrastructure, which are sensitive to increased flood risk by the possible increase in water levels.

Importance/ Sensitivity	Criteria
Medium	Surface Water Quality and Biodiversity No Water Framework Directive classification, low flow (Q_{95}) value of 0.001m^3/s or greater. Water dependent ecosystems of county/district biodiversity value. Watercourses supporting limited species and habitats sensitive to changes in suspended sediment concentrations and turbidity. Water Supplies Watercourses supporting private drinking water supplies or for agricultural/industrial use. Private water supply serving a single property. Hydromorphology A watercourse exhibiting some signs of artificial modifications and indications of recovery to a natural equilibrium. Limited natural morphological features and a limited range of associated natural fluvial processes. Flood Risk Less vulnerable development. Watercourses or floodplains, with direct or indirect flood risk to agricultural or recreational land and/or affecting <10 industrial premises and high value agriculture (e.g. arable pastures, complex cultivation patterns and agro-forestry), which are sensitive to increased flood risk by the possible increase in water levels.

Importance/ Sensitivity	Criteria
Low	Surface Water Quality and Biodiversity No Water Framework Directive classification, with low flow (Q95) value of less than 0.001m3/s. Water dependent ecosystems of local/less than local biodiversity value. Watercourses which do not support any significant species and habitats sensitive to changes in suspended sediment concentrations and turbidity. Water Supplies. Watercourses not supporting water abstractions. Hydromorphology A watercourse exhibiting minimal morphological diversity; flow is uniform, homogenous channel bed with gravel bars absent and bank type's uniform and stable, with no evidence of active fluvial processes. Such watercourses may have been subject to past modification such as straightening, bank protection. and culverting, or other anthropogenic pressures. Flood Risk Water compatible development. Watercourses or floodplains with a possibility of direct or indirect flood risk to low value agricultural areas, such as rough grazing, which are less sensitive to increased flood risk by the possible increase in water levels.

Magnitude of Impact

A19-2.5.3. The magnitude of the various impacts is evaluated considering the extent of loss and effects on integrity of the relevant water body attributes. The criteria used in determining the magnitude of impact are detailed in Table A19-2.3.

Table A19-2.3: Criteria Used to Estimate the Magnitude of Impacts on Receptors

Magnitude	Criteria
Major Adverse	Surface Water Quality and Biodiversity High risk of pollution to surface water during construction, significant temporary or long-term change in water quality, resulting in a permanent change in WFD status. Failure of both soluble and sediment bound pollutants in HEWRAT and EQS routine runoff compliance failure. Water Supplies Permanent loss of surface water supply. Hydromorphology Results in loss of feature(s) and failure of hydromorphological elements (morphology, quantity, and dynamics of flow) resulting from the works, e.g., significant physical modification. Significant/extensive alteration to channel planform and/or cross section, including modification to bank profiles or the replacement of a natural bed. Loss or damage to existing habitats linked to morphological form. Flood Risk Results in loss of or significant alteration to the 0.5% AEP plus climate change event flood plain. Significant increase in downstream peak flows due to upsizing of watercourse crossings to the 0.5% plus climate change AEP. Significant changes in surface water flow paths leading to increased peak flows.

Magnitude	Criteria
Moderate Adverse	Surface Water Quality and Biodiversity Moderate risk of pollution to surface water during construction, moderate temporary change in water quality, resulting in a temporary change of WFD status or preventing attainment of target overall status of 'Good'. Failure of both soluble and sediment bound pollutants in HEWRAT routine runoff but compliance with EQS limits. Water Supplies Temporary loss of water supply. Hydromorphology Results in adverse impact on integrity of feature(s) or loss of part of feature/moderate shift away from baseline conditions. Failure of one or more hydromorphological elements (morphology, quantity and dynamics of flow) resulting from the works e.g., potential impacts on sediment transport and morphology. Some alteration to channel planform and/or cross section, including modification to bank profiles or the replacement of a natural bed. Some damage or loss to habitat due to the modifications. Flood Risk Results in loss of or significant alteration to the 0.5% AEP plus climate change event flood plain. Increase in downstream peak flows due to upsizing of watercourse crossings to the 0.5% plus climate change AEP. Changes in surface water flow paths leading to increased peak flows.

Magnitude	Criteria
Minor Adverse	Surface Water Quality and Biodiversity Minor risk of pollution during construction to surface water, relatively minor temporary changes in water quality such that ecology is temporarily affected. Equivalent to a temporary minor, but measurable, change within WFD status class. Failure of either soluble or sediment bound pollutants in HEWRAT routine runoff but compliance with EQS limits. Water Supplies Temporarily reduced quality of water supply Hydromorphology Potential failure in one of hydromorphological elements (morphology, quantity and dynamics of flow) resulting from the works. Minimal shift away from baseline conditions or partial loss or damage to habitat due to modifications. Flood Risk Changes to existing culvert hydraulic capacity leading to the potential for minor changes in downstream peak flow. Floodplain impacts which result in small increases in peak flood level (of the order of >10mm) for the 0.5% plus climate change AEP.

Magnitude	Criteria
Negligible	Surface Water Quality and Biodiversity Negligible risk of pollution to surface water during construction, very slight temporary change in water quality with no discernible effect on watercourse ecology or water supply. All elements of HEWRAT and EQS routine runoff assessments passed. Water Supplies No anticipated effect on water supply. Hydromorphology No alteration to hydromorphological elements. Some impact on feature(s), but of insufficient magnitude to affect the use/integrity and habitat potential, approximating to a 'no change' situation. Flood Risk No alteration to downstream peak flows at existing culvert crossings for the 0.5% plus climate change AEP. No detectable potential effects on floodplain (0.5% plus climate change AEP) <10mm.

Magnitude	Criteria
Minor Beneficial	Surface Water Quality and Biodiversity Minor permanent improvement over baseline conditions or larger temporary improvement, with the potential to facilitate a slight increase in the capacity to dilute pollutants or waste products. Water Supplies Temporarily improved quality of water supply. Hydromorphology Partial improvement to sediment processes at the reach scale, including reduction in siltation and localised recovery of sediment transport processes. Partial improvements include enhancements to in-channel habitat, riparian zone and morphological diversity of the bed and/or banks. Slight improvement on baseline conditions with potential to improve flow processes at the reach scale. Slight beneficial impacts at the reach scale, which may cause partial habitat enhancement. Impacts have limited potential to improve hydromorphological-related parameters in WFD classification. Flood Risk Moderate improvement over baseline conditions involving a reduction in 0.5% AEP peak flood level >10mm.

Magnitude	Criteria
Moderate Beneficial	Surface Water Quality and Biodiversity A moderate permanent improvement over baseline conditions with the potential to facilitate an upgrade in individual WFD quality elements and/or moderate increase in the capacity to dilute pollutants or waste products. Removal or reduction of a polluting discharge which has limited baseline effect or removing the likelihood of polluting discharges occurring to a watercourse. Water Supplies Permanent moderate improvement of water supply, in terms of quality or yield to an existing resource. Hydromorphology Reduction in siltation and recovery of sediment transport processes at the reach or multiple reach scale. Partial creation of both in-channel and vegetated riparian habitat. Improvement in morphological diversity of the bed and/or banks at the reach or multiple reach scale. Includes partial or complete removal of structures and/or artificial materials. Notable improvements on baseline conditions and recovery of fluvial processes at the reach or multiple reach scale, with potential to improve one hydromorphological-related parameter in WFD classification. Flood Risk Moderate improvement over baseline conditions involving a reduction in 0.5% AEP peak flood level >50mm.

Magnitude	Criteria
Major Beneficial	Surface Water Quality and Biodiversity Major permanent improvement over baseline conditions with the potential to facilitate an upgrade in WFD overall status and/or a substantial increase in the capacity to dilute pollutants or waste products. Removal of a polluting discharge with baseline effect or removing the likelihood of polluting discharges occurring to a watercourse. Water Supplies Permanent major improvement of water supply, in terms of quality or yield or enabling access to new resource. Hydromorphology Improvement to sediment processes at the catchment scale, including recovery of sediment supply and transport processes. Extensive creation of both in-channel habitat and riparian zone. Morphological diversity of the bed and/or banks restoration, such as natural planform, varied natural cross-sectional profiles, recovery of fluvial features (e.g. cascades, pools, riffles, bars) expected for river type. Removal of modifications, structures, and artificial materials anticipated to lead to improved status of at least one hydromorphological-related parameter in WFD classification. Flood Risk Large improvement over baseline conditions involving a reduction in 0.5% AEP peak flood level >100mm.

Effect Significance

A19-2.5.4. The estimation of the significance of potential effects has been arrived at by combining the estimated sensitivity of the affected water bodies and the magnitude of the impacts as indicated in Table A19-2.4 prior to consideration of any potential mitigation, following guidance provided in DMRB LA 104.

A19-2.5.5. Where the significance of potential effects (i.e. the consequence of impacts) is shown as being one of two alternatives; a single description may be provided based upon reasoned judgement, if sufficient information available to do so.

Table A19-2.4: Criteria Used to Estimate the Significance of Potential Effects (DMRB LA 104, Table 3.8.1)

Environmental Value (Sensitivity)	Magnitude of Impact - Major	Magnitude of Impact - Moderate	Magnitude of Impact - Minor	Magnitude of Impact - Negligible	Magnitude of Impact - No Change
Very High	Very Large	Large / Very Large	Moderate / Large	Slight	Neutral
High	Large / Very Large	Moderate / Large	Slight / Moderate	Slight	Neutral
Medium	Moderate / Large	Moderate	Slight	Neutral / Slight	Neutral
Low	Slight	Slight	Neutral / Slight	Neutral / Slight	Neutral
Negligible	Slight	Neutral / Slight	Neutral / Slight	Neutral	Neutral

A19-2.6. Limitations and Assumptions

A19-2.6.1. The assessment has relied upon the accuracy and level of detail of the documented sources of information. For instance, the identification of water bodies and current characteristics has made reference to the SEPA data sources for RBMPs and associated WFD water body information; where datasets have been updated annually with latest available year being 2022.

Hydromorphology

A19-2.6.2. The results of the hydromorphology assessment are based on both a desk-based and field-based approach using all available data, which includes notes and photos taken during site walkovers by other disciplines; however, it was not possible to survey the full length of watercourses impacted due to topographical and access constraints. Where it was safe to make access, watercourses upstream and downstream of the OMR and immediately downstream of the A83 were surveyed.

A19-2.6.3. The Ground Investigation works are ongoing and there are still uncertainties regarding the ground conditions. The downslope structures, located downstream of the proposed A83 culverts are in design development, with recognition that the innovative protection proposed is not tested in this steep environment, with a precautionary approach applies at this stage of design. It should also be appreciated that the Beinn Luibhean hillside is a dynamic system which response to fluvial flows, debris flows and landslide events. These events in terms of magnitude and frequency are difficult to predict, and therefore design for.

A19-2.6.4. However cognisant of these factors, it is not considered that these limitations affect the outcomes of the assessments carried out as the transition between the A83 culverts and the natural watercourses would need to be managed using an engineered solution that can be designed within the parameters used for the assessment (length and width of watercourse affected).

Water Resource and Water Quality

A19-2.6.5. Information on abstractions and private water supplies has been provided by SEPA and Argyll and Bute Council, respectively. It is recognised that data may not have been accurately registered for all local properties, with limited associated information relating to current use, source type and source locations. With the limited number of properties and developments identified in the Study Area and following consultation and visits to local landowners, there is a high confidence in the associated data applied.

A19-2.6.6. The assessments are partially reliant on desk-based data sources. The watercourse crossing information has been confirmed through site visits and watercourse delineation.

A19-2.6.7. With regards to the routine runoff assessment, the use of HEWRAT presents several limitations. Firstly, a rainfall site must be selected from an embedded list of 21 sites across the UK, with only three located in Scotland. The closest and most geographically similar rainfall site is Ardtalnaig (near Aberfeldy). The annual average rainfall at Ardtalnaig is reported as being 1344mm, compared to the higher annual average rainfall within the Study Area of approximately 2847mm (based on the Falloch at Glen Falloch NRFA catchment). Therefore, there is potential for underestimation of flows (and associated dilution potential) within the receiving watercourses and from the road drainage networks in the Study Area. The process assumes flowing water, therefore flows of small input tributaries to Loch Restil have been used as indicators of loch throughput for outfalls to this standing waterbody.

A19-2.6.8. Precipitation within the Debris Flow Shelter will be lower than naturally occurs at this location due to roof structure; with 30% of natural precipitation input predicted for Drainage Network 1. There is no guidance within DMRB of the method for such structures, therefore a pragmatic approach has been adopted, applying a rainfall station featuring approximately 30% of local rainfall levels (selected as the site at Keighley, with an average annual rainfall value of 1000mm) for the calculations for this unusual drainage network.

A19-2.6.9. Additionally, HEWRAT uses two-way Annual Average Daily Traffic (AADT) volumes in the estimation of pollutant build-up on the road, where AADT data is entered in broad bands of 10,000 to 50,000, 50,000 to 100,000, and >100,000. Given that the volumes of traffic estimated for the Proposed Scheme are approximately 4,000, substantially below 10,000, it is likely that there is overestimation of the pollutant concentrations in the road runoff, this is considered to present a precautionary HEWRAT outcome.

A19-2.6.10. HEWRAT is designed for predicting the potential effect of runoff on receiving rivers and streams for soluble pollutants (acute impacts) and sediment related pollutants (chronic impacts) and requires input of specific watercourse dimensions to assess the impact of the sediment related pollutants. However, one outfall discharges to Loch Restil, therefore, the parameters of representative tributaries have been used to establish a reasonable Loch Restil throughput flow rate.

A19-2.6.11. In addition to the limitations associated with HEWRAT as outlined above, it should be noted that there is no direct linkage between the results and current or targeted WFD objectives. In order to be certain of the direction of impact (adverse/beneficial) it would be necessary to carry out a baseline HEWRAT assessment of the existing drainage system and compare the existing and Proposed Scheme scenarios; however, there is no formal drainage treatment prior to outfalls identified along the existing A83 trunk road. Notwithstanding this, the fact that the existing drainage system provides no formal treatment, and the fact that the Proposed Scheme has been designed to provide treatment on each drainage network, the Proposed Scheme will have an associated beneficial impact on drainage discharges.

A19-2.6.12. Detailed topographic survey data and walkover information has been used where available used to inform HEWRAT assessments e.g. long-slope and channel roughness; whilst reasonable assumptions have otherwise been made based on the proximity and similarity of nearby watercourses.

Flood Risk

A19-2.6.13. The accuracy of the hydraulic models used in this assessment is influenced by the quality of available hydrological and topographical data. While the models provide valuable insights, it's important to note that their limitations stem from factors such as data resolution, survey accuracy, and the inherent assumptions of the modelling software. For further details on the specific limitations and uncertainties associated with the models, please refer to the annexes (B, C, D, and E).

A19-2.6.14. All the Proposed Scheme crossings drain small steep catchments, which are not accurately defined by the Flood Estimation Handbook website. Catchment boundaries have therefore been defined using topographic data and observations made during site visits. Freeboard allowances and model sensitivity have been used to include allowance for this uncertainty in the culvert design.

A19-2.6.15. Due to the rural and extreme nature of the watercourse terrain, no records of past flooding which would be of any value to calibrate the 1D and 1D/2D models are available.

A19-2.6.16. The current proposed design has made assumptions that are based on the most accurate data available at the time of writing. Only historic Ground Investigation (GI) has been completed at the time of writing this assessment however it is not expected that the results of the updated GI will have a large impact on these assumptions.

A19-2.6.17. Furthermore, there is a lack of available data to calibrate hydrology or modelling. These factors have been considered throughout the flood risk assessment process, adopting a pragmatic and precautionary approach, including methodology discussions with SEPA, to understand the potential impact from the Proposed Scheme.

A19-2.6.18. The above limitations are not considered to impair the assessment process, with sufficient data available and conservative assumptions applied for a robust and proportionate assessment.