Appendix C: Water Environment - Detailed Baseline and Assessment

6. Water Environment

6.1 Introduction

6.1.1 This chapter presents the Strategic Environmental Assessment (SEA) of the likely significant effects of the project on the following aspects of the water environment:

- Water Quality;
- Hydromorphology;
- Hydrogeology; and
- Flood Risk.

6.1.2 The assessment will be carried out with consideration of the SEA objective and guide questions for the Water Environment, as set out in Chapter 6 (SEA Approach and Methods).

6.2 Methodology

Baseline Conditions

6.2.1 A desk-based assessment has been undertaken to identify water environment receptors in the route corridor assessment, and to provide an understanding of the key issues and potential effects associated with the possible route options (Pink, Brown, Purple, Yellow and Green). The desk-based assessment comprises:

- Identification and mapping of baseline fluvial, surface water and coastal flood risk using SEPA flood mapping (2020) and high-level assessment of the potential flood risk constraints likely to affect / be affected by the project. For any reporting of interaction between the possible route options and flood extents a 50m buffer from the centre line of the Route Option has been applied.
- Identification of Water Framework Directive (WFD) classified water bodies and minor watercourses that may be affected by the project.
- Identification of any designated waters, such as Bathing Waters, Shellfish Water Protected Areas, Active Aquaculture Sites, fish farms (licenced under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR)), Classified Shellfish Harvesting Areas, drinking water protected areas, groundwater, nutrient sensitive areas, and water dependent areas that may be affected by the possible route options.

6.2.2 The desk-based assessment has been considered the following relevant guidance, legislation and regulations:

- Guidance on consideration of water in Strategic Environmental Assessment (LUPS-SEA-GU3) (SEPA 2019a);
- Strategic Flood Risk Assessment: SEPA technical guidance to support development planning (SEPA 2015a);
- LA 113, Revision 1: Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 10, Road Drainage and the Water Environment (Highways England, Transport Scotland, Welsh Government, Department for Infrastructure 2020);
- Water Framework Directive (WFD) (Directive 2000/60/EC) was transposed into Scottish law under the Water Environment Water Services (WEWS) Act 2003 (Scottish Government 2003);
- EU Floods Directive (2007/60/EC) is transposed into Scottish law through the Flood Risk Management (Scotland) Act 2009 (FRMA) (Scottish Government 2009); and
- Scottish Planning Policy (SPP) (Scottish Government 2014).

6.2.3 In addition, the assessment has been informed by the data from the following sources:

- Ordnance Survey (OS) 1: 25,000 mapping;
- National River Flow Archive (CEH 2021);
- SEPA River Basin Management Plan (RBMP) data and classification results available on the SEPA Water Environment Hub (SEPA 2015b) and the SEPA Water Classification Hub (SEPA 2018a);
- British Geological Survey (BGS) GeoIndex Onshore Mapping (BGS 2021); and
- James Hutton Institute Soil Maps of Scotland (James Hutton Institute 2021).

Impact Assessment

6.2.4 Potential effects on the water environment have been assessed using the scoring criteria defined in Table C6.1. The duration of potential effects reported within the assessment is as defined in Chapter 6 (SEA Approach and Methods).

6.2.5 The outputs from the SEA will inform the design development and assessment criteria to assist in future stages of the process (DMRB Stage 2 and 3).

Table C6.1: Assessment Criteria for Potential Effects on the Water Environment

Score	Description	Colour coding and symbol
Minor positive effect	The route corridor has potential for positive environmental effects, for example by providing opportunities for enhancement of the water environment.	+
Minor negative or uncertain effect	The route corridor has potential for a minor negative or uncertain effect on the water environment.	-
Significant negative effect	The route corridor has potential for significant negative environmental effects on the water environment.	--

Limitations to Assessment

6.2.6 Baseline conditions described in Section 6.3 (Detailed Baseline) were informed by desk-based review, outlined in Section 6.2.3, and at this stage no surveys have been undertaken. Therefore, any information presented is reliant on the accuracy and detail of the source information.

6.2.7 This assessment has used the SEPA Flood Maps (SEPA, 2015a) to inform the baseline and assessment for flood risk. These are produced at a strategic level and therefore it is recognised that the maps have limitations in terms of the detail provided, however are considered appropriate at this level of assessment.

6.2.8 The assessment of effects, presented in Section 6.5 (Assessment), has been informed by the alignments for each possible route option within Route corridor 1. At this stage not all of the design elements of the development are included, for example compensatory flood storage areas, drainage systems and SuDS, which would be further developed during DMRB Stage 2.

6.3 Detailed Baseline

Overview

6.3.1 Scotland's Water Environment is essential for all life and activity, ranging from drinking water to maintaining habitats and supporting a significant part of the economy. Scotland has approximately 19,000km of coastline (Scottish Government 2015) and Scotland's rivers and lochs contain 90% of the entire UK's freshwater and cover 2% of the land area (Scotland's Environment 2011). Water is also used for industrial processes such as whisky production, hydroelectricity generation and recreational activities.

6.3.2 Legislation and policies relating to the Water Environment are implemented through European Union legislation, transposed into Scottish Law. The Water Framework Directive (WFD) (Directive 2000/60/EC) was transposed into Scottish law under the Water Environment Water Services (WEWS) Act 2003 (Scottish Government 2003). Under the WFD, new activities within or near to the water environment must not cause deterioration or prevent the achievement of Good Status or Good Ecological Potential (for artificial or heavily modified water bodies). The WEWS Act is delivered through the production of River Basin Management Plans (RBMP), which detail the current condition of water bodies in the Plan area and set objectives for improvement to Good overall status or Good Ecological Potential. Surface water bodies include rivers, lochs, transitional and coastal waters.

6.3.3 The EU Floods Directive (2007/60/EC) is transposed into Scottish law through the Flood Risk Management (Scotland) Act 2009 (FRMA) (Scottish Government 2009). The FRMA sets in place a statutory framework for delivering a sustainable and risk-based approach to the management of flooding, including the preparation of assessments of the likelihood and impacts of flooding, and associated catchment focussed plans. The act places a duty on responsible authorities (Scottish Ministers, SEPA, Scottish Water and local authorities) to manage and reduce flood risk and promote sustainable flood risk management. The main elements of the FRMA, which are relevant to the planning system, are the assessment of flood risks and undertaking structural and non-structural flood management measures.

6.3.4 Through the FRMA, Scottish Planning Policy (SPP) (Scottish Government 2014) requires planning authorities to consider all sources of flooding and their associated risks when preparing development plans. The aims of SPP in relation to flooding are:

- to prevent developments which would be at significant risk of being affected by flooding;
- to prevent developments which would increase the probability of flooding elsewhere; and
- to provide a risk framework from which to identify a site's flood risk category and the related appropriate planning response.

Surface Waterbodies

6.3.5 Within the route corridor there are 30 to 40 water features, which range from main-stem watercourses to minor waterbodies and a small lochan (Figure C6.1). The route corridor falls within the catchment of two watercourses which are monitored by SEPA under WFD (referred to by SEPA as baseline water bodies); Croe Water (ID: 10215) and Kinglas Water (ID: 10217). Croe Water drains into Loch Long, which is downstream of the route corridor. Loch Long is subdivided into two WFD coastal water bodies, Long Long (North) (ID: 200051) and Loch Long (South) (ID: 200045) and it is Loch Long (North), which has the potential to be affected by the project. Table C6.2 provides a summary of the baseline classifications of each WFD attribute as reported in the latest available datasets (2018).

Table C6.2: WFD Waterbody Classification Summary (SEPA 2018a)

Waterbody	Overall Status	Overall Ecology	Overall Hydrology
Croe Water (ID: 10215)	Moderate	Moderate	Good
Kinglas Water (ID: 10217)	Bad ecological potential	Bad	Bad
Loch Long (North) (ID: 200051)	Good	Good	-

6.3.6 Croe Water is approximately 7.7km in length and runs adjacent to the A83 for the majority of the route corridor. Croe Water has a catchment of approximately 18.31km^2 (CEH 2021) upstream of Loch Long (approximately 3km south of the route corridor) and falls within the Cowal/ Clyde Sealochs Coastal catchment of the Scotland river basin district (SEPA 2015b). For the latest classification year under WFD (2018), Croe Water achieved Moderate overall status (Table C6.2). No existing pressures on the quality of the water body are currently noted (SEPA 2018a).

6.3.7 Loch Long is outwith the route corridor, however, may be impacted as it is hydraulically connected to the route corridor by Croe Water. Loch Long (North) is a coastal water body with an area of 10.1 km^2. For the latest classification year under WFD (2018), the water body has achieved Good status (Table C6.2). The coastal water body has known pressures relating to water quality, assessments in 2014 indicated that nutrient levels in the Loch were 'worse than good', although the causes of these issues are not known (SEPA 2015b).

6.3.8 Kinglas Water is approximately 12.6km in length and is located to the north of the route corridor. It is predominantly outwith the route corridor, however it is hydraulically connected to the route corridor by a number of its tributaries within the route corridor, which drain north. The water body has a catchment of approximately 29.51km^2 (CEH 2021), upstream of its confluence with Loch Shira, and falls within the Loch Fyne Coastal catchment of Scotland's river basin district (SEPA 2015b). Kinglas Water is designated as a 'heavily modified waterbody' due to physical alterations as a result of hydroelectric power generation. For the latest classification year under WFD (2018), Kinglas Water achieved overall status of Bad ecological potential (Table C6.2) as a consequence of its heavily modified status.

6.3.9 Based on a review of OS mapping there are approximately 30 to 40 minor unnamed watercourses within the route corridor, which are tributaries of Croe Water and Kinglas Water. Within the route corridor the existing A83 crosses 27 of these minor watercourses, the majority of which are within the Croe Water catchment, however six are within the catchment for Kinglas Water. There is one loch within the route corridor, Loch Restil, located adjacent to the existing A83, at the base of Beinn an Lochain. Loch Restil and the minor watercourses draining into it are part of the Kinglas Water catchment.

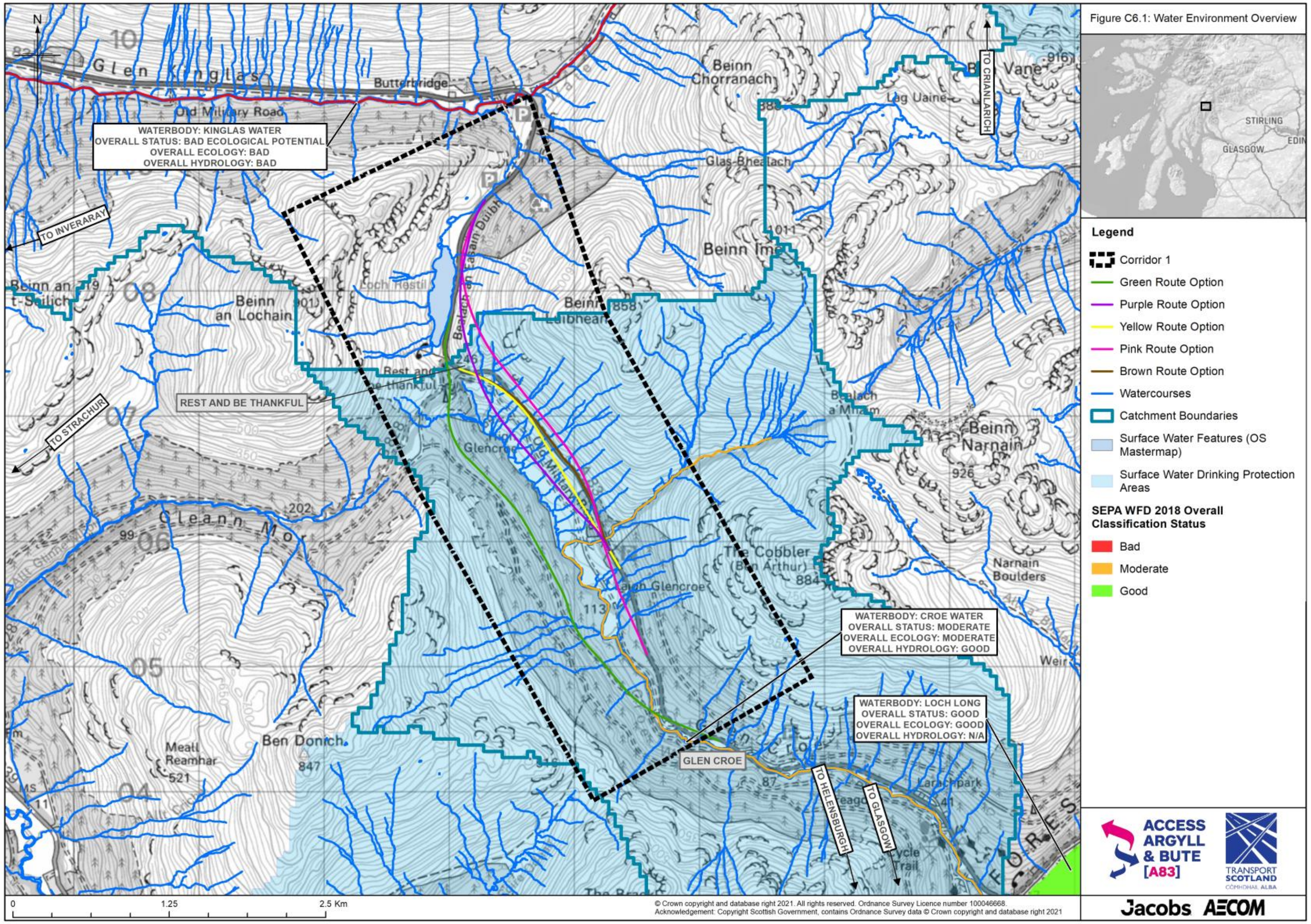

Figure C6.1: Water Environment Overview

Groundwater Bodies

6.3.10 The route corridor is predominantly underlain by bedrock consisting of the Beinn Bheula Schist Formation – Pelite, Semipelite and Psammite and superficial deposits of Till – Diamicton, with sedimentary river deposits along Croe Water (BGS 2021). Soils within the area are typically peaty in nature (The James Hutton Institute 2021). Further details of the soils and underlying geology within the route corridor is provided in Appendix C (Section 7: Soils).

6.3.11 A review of BGS Hydrogeology 1:625,000 scale mapping (BGS 2021) identified a low productivity bedrock aquifer belonging to the Southern Highland Group. This aquifer is described as having small amounts of groundwater in near-surface weathered zones and within secondary fractures.

6.3.12 There are two groundwater body features which are monitored by SEPA under WFD within the route corridor; Cowal and Lomond (ID: 150689) and Oban and Kintyre (ID: 150698). Cowal and Lomond (ID: 150689) is present within the southern extent of the route corridor, south of Loch Restil, and Oban and Kintyre to the north. The Cowal and Lomond groundwater body has an area of 1,163km^2 and the Oban and Kintyre groundwater body has an area of 2,663.1km^2. Both groundwater water bodies achieved Good overall status for the latest classification year under WFD (SEPA 2018a).

6.3.13 National Vegetation Classification (NVC) data identified mire habitats, which may be indicative of Groundwater Dependent Terrestrial Ecosystems (GWDTE) on the east side of the A83 (SNH 2017). Further information on potential GWDTE is presented in Appendix C (Section 5: Biodiversity, Flora and Fauna).

Protected Waters

6.3.14 A number of different types of waters are offered special protection under relevant regulations. A review of protected waters within the route corridor and their associated protection status is presented in Table 6.3. There are no designated sites (SSSIs, SPAs or SACs) protected for water environment interests within the route corridor.

Table C6.3: Summary of Protected Waters

Water Type	Relevant Legislation	Summary
Drinking Water Protection Area	The Water Environment (Drinking Water Protected Areas) Order 2013	The route corridor passes through the Croe Water Drinking Water Protected Area, from the southern-most extent of the route corridor up to Loch Restil
Bathing Waters	The Bathing Waters (Scotland) Amendment Regulations 2012	No Bathing Waters are present within the route corridor.
Shellfish Water Protected Areas	The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013	No Shellfish Water Protected Areas are present within the route corridor, however Loch Long, located downstream of the proposed route corridor, is within a Shellfish Water Protected Area.
Consented Aquaculture	Controlled Activity Regulations (CAR)	No active aquaculture sites or CAR licences fish farms as present within the route corridor.
Classified Shellfish Harvesting Areas	Areas are granted by the Food Standards Agency, based on E. coli levels set out in: • EU Law Regulation (EC) 853/ 2004 • EU Law Regulation (EU) 2019/627	No classified Shellfish Harvesting Areas are present within the route corridor.

Flood Risk

6.3.15 SEPA employs a Land Use Vulnerability Classification, which has five categories (Most Vulnerable Uses, Highly Vulnerable Uses, Least Vulnerable Uses, Essential Infrastructure and Water Compatible Uses) (SEPA 2018b). Based on these classifications, the highest sensitivity receptors within the route corridor are residential properties, of which there are fewer than 10, which are classified as Most Vulnerable Uses and the A83, which is classified as Essential Infrastructure. All other receptors within the route corridor are categorised as 'Water Compatible Uses' and are therefore of low sensitivity.

6.3.16 There is no known history of flooding of the A83 within the route corridor and the area has not been identified as being within a Potentially Vulnerable Area (PVA) (SEPA 2020).

<u>Fluvial</u>

6.3.17 SEPA Flood Maps (SEPA 2020) suggest areas of the existing A83 and Old Military Road may be at risk from fluvial flooding from the Croe Water for the 0.5% Annual Exceedance Probability (AEP) (200-year) (Medium) flood event at the southern extents of the route corridor and at the Croe Water crossing (Figure C6.2). SEPA fluvial flood mapping is only available for watercourses with catchments greater than $3km^2$ and therefore there is additional potential for flooding from minor watercourses not identified by this mapping.

6.3.18 Although SEPA Flood Maps (SEPA 2020) indicated risk to the A83 at the bridge crossing of Croe Water, this is considered unlikely as existing drawings show the bridge to be significantly elevated above the channel. A review undertaken by Jacobs (unpublished) of culvert capacity along a section of the A83, between the Croe Water bridge crossing and south of Loch Restil (National Grid Reference: NN 24182 06207 to NN 23002 07444), indicates that seven of the 18 culverts assessed do not have sufficient capacity for passing flows under a 0.5% (200-year) AEP event plus 55% allowance for climate change (including 600mm freeboard) to account for the allowance for a future increase in peak rainfall intensity (further described in Section 6.4.2).

6.3.19 Further assessment of culvert capacity along a section of the Old Military Road (downstream of the A83), also undertaken by Jacobs (unpublished) indicated 17 of the 21 culverts assessed do not have sufficient capacity for a 0.5% (200-year) AEP event plus 55% allowance for climate change (including freeboard).

<u>Pluvial</u>

6.3.20 SEPA Flood Maps (SEPA 2020) suggest areas of the Old Military Road may be at risk from pluvial (surface water) flooding for the 0.5% AEP (200-year) flood event (Figure C6.2) in localised areas within the southern extents of the route corridor. SEPA flood mapping, however, also indicates the existing A83 is not at risk of pluvial flooding during the 0.5% AEP (200-year) event).

<u>Coastal</u>

6.3.21 The route corridor is located over 3km from the nearest coastal waterbody, Loch Long, and is therefore not at risk from coastal flooding. However, SEPA flood mapping (SEPA 2020) indicates south of the route corridor itself the A83 is at risk of coastal flooding from Loch Long during a 0.5% AEP (200-year) event.

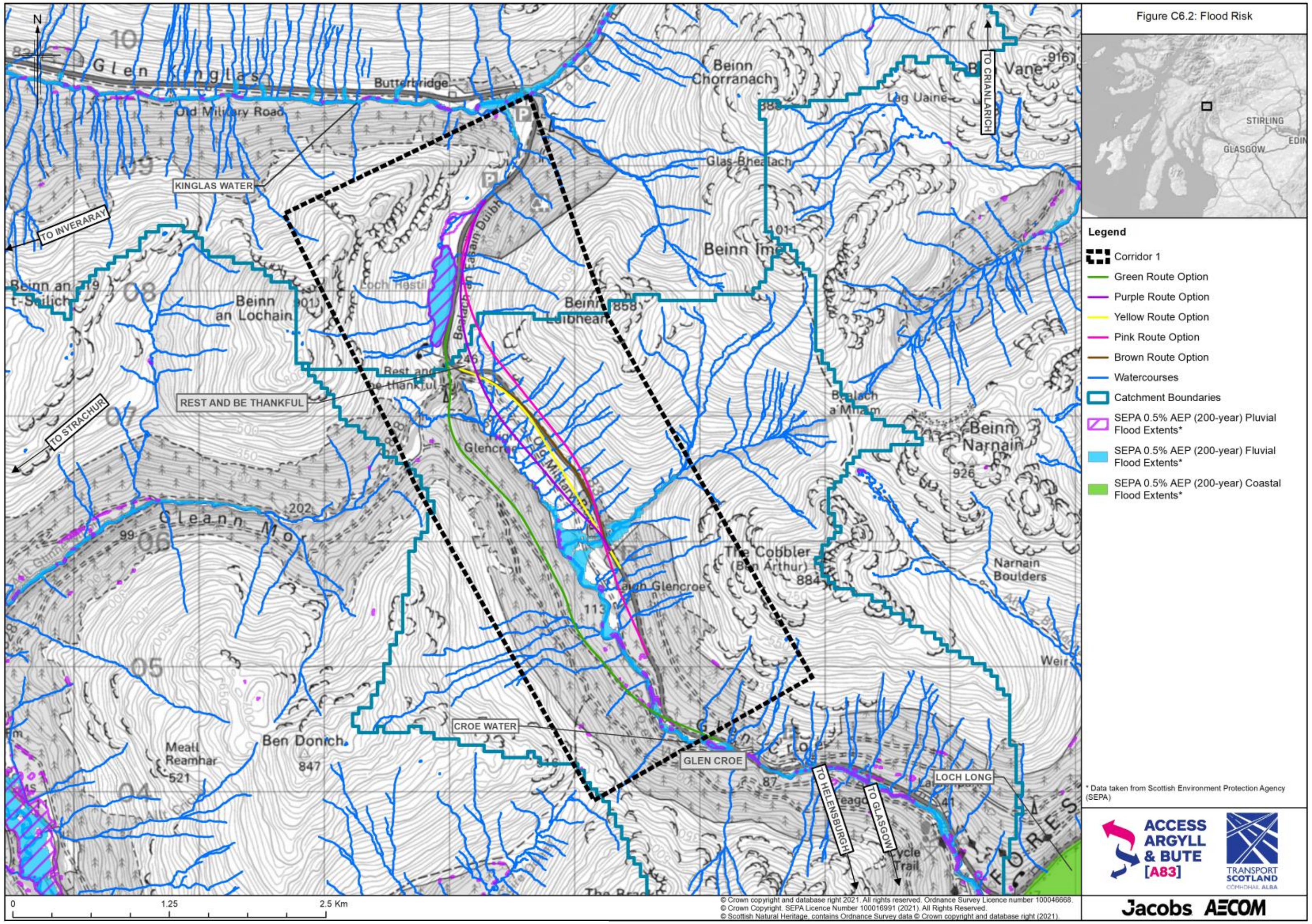

Figure C6.2: Flood Risk

Groundwater

6.3.22 BGS Groundwater Flooding Maps (BGS, 2020) indicate the potential for groundwater flooding within the route corridor is from superficial deposits and typically follows surface topography. The majority of the route corridor located within the Glen Croe Valley, including the existing A83 and Old Military road, is noted to have 'potential for groundwater flooding to occur at surface'. Areas at higher elevations are generally noted as having 'limited potential for groundwater flooding to occur', particularly within the north-easterly section of the route corridor, surrounding Beinn Luibhean. At this stage no information on groundwater levels within the route corridor is available.

6.4 Evolution of Baseline and Trends

6.4.1 Ongoing key pressures on the Scottish surface water environment include urbanisation and intensive agriculture/ aquaculture. Rural and urban diffuse pollution also remains a concern for water quality, particularly in relation to agriculture, forestry, and urban development. SEPA provides future projections of the condition of water bodies classified under WFD for future RBMP cycles. Overall projected conditions for the WFD water bodies within the route corridor for 2021, 2027 and in the long-term are provided in Table C6.4.

Table C6.4: WFD Waterbody Condition Predictions (SEPA 2015b)

Waterbody	Type	2021 Projected Overall Condition	2027 Projected Overall Condition	Long-term Projected Overall Condition
Croe Water (ID: 10215)	Surface Water	Good	Good	Good
Kinglas Water (ID: 10217)	Surface Water	Moderate	Good	Good
Loch Long (North) (ID: 200051)	Surface Water	Moderate	Good	Good
Cowal and Lomond (ID: 150689)	Groundwater	Good	Good	Good
Oban and Kintyre (ID: 150698)	Groundwater	Good	Good	Good

6.4.2 Climate change may exacerbate flood events, with more frequent, high-intensity rainfall. This will increase the risk of flash flooding from surface water or sewers for inland communities. The impact of climate change is likely to vary regionally; as such, SEPA has recently published updated guidance recommending regional climate change allowances (SEPA 2019b). The route corridor falls between the Argyll and Clyde River Basin Regions, and the corresponding regional flow allowances for rivers are provided in Table C6.5. Allowances for peak rainfall intensity are also provided; the allowance for the west of Scotland is 55%. As described in Section **Error! Reference source not found.**, changes to flows as a result of climate change have the potential to affect the capacity of culverts along the A83 and the nearby Old Military Road during a 0.5% (200-year) AEP event, which may result in fluvial flooding of these roads.

Table C6.5: Regional climate change uplift for flow allowances relevant to the route corridor (SEPA 2019b)

Region	Regional flow allowance (Total change to the year 2100)
Argyll	56%
Clyde	44%

6.5 Assessment

6.5.1 This assessment presents likely significant effects on the water environment from the project, in relation to water quality, hydromorphology, hydrogeology and flood risk, and considers whether the following SEA objective with regards to the water environment has been met.

6.5.2 An assessment of the effects of the project on the water environment in relation to the SEA objectives and associated guide questions is presented in Table C6.7.

6.5.3 The type and duration of impacts for all possible route options are likely to be similar, however the significance of effects will vary between the options. All route corridor options are predominantly offline and will therefore introduce new structures and road drainage into the water environment. Potential impacts are dependent on the alignment and design of the project as well as the sensitivity and number of receptors within the respective route corridor options, presented in Table C6.6.

Table C6.6: Water Environment Summary for each Possible Route Option

Possible Route Option	Summary
Green Route Option	▪ One bridge river crossing with a WFD Water body (Croe Water) ▪ Seven minor water body crossings (including one bridge crossing) ▪ Intercepts 1.96ha of 0.5% AEP (200-year) SEPA fluvial flood extents ▪ Intercepts 0.67ha of 0.5% AEP (200-year) SEPA pluvial flood extents ▪ Approximately 4.3km of new impermeable road area (including 0.3km bridge)
Purple Route Option	▪ No WFD water body crossings ▪ 19 minor river water body crossings (including 3 tunnel crossings) ▪ Intercepts 0.84ha of 0.5% AEP (200-year) SEPA fluvial flood extents ▪ Intercepts 0.05ha of 0.5% AEP (200-year) SEPA pluvial flood extents ▪ Approximately 3.2km of new impermeable road area (including 1.2km tunnel)
Yellow Route Option	▪ No WFD water body crossings ▪ 13 minor river water body crossings (including 12 viaduct crossings) ▪ Intercepts 0.84ha of 0.5% AEP (200-year) SEPA fluvial flood extents ▪ Does not intercept 0.5% AEP (200-year) SEPA pluvial flood extents ▪ Approximately 2.1km of new impermeable road area (including 1.8km viaduct)
Pink Route Option	▪ No WFD water body crossings ▪ 25 minor river water body crossings (including 18 tunnel crossings) ▪ Intercepts 0.84ha of 0.5% AEP (200-year) SEPA fluvial flood extents ▪ Intercepts 0.14ha of 0.5% AEP (200-year) SEPA pluvial flood extents ▪ 4.1km of new impermeable road area (including 2.9km tunnel)
Brown Route Option	▪ No WFD water body crossings ▪ 15 minor river water body crossings (including 3 bridge crossings and 11 tunnel crossings) ▪ Intercepts 0.88ha of 0.5% AEP (200-year) SEPA fluvial flood extents ▪ Does not intercept 0.5% AEP (200-year) SEPA pluvial flood extents ▪ 1.9km of new impermeable road area (including 1.3km tunnel and 0.4km bridge)

6.5.4 Effects on water environment receptors are considered within the wider context of impacts for each water environment receptor, rather than in isolation, and therefore no separate inter-disciplinary cumulative effects are reported. The effects of the project on the water environment are also closely linked to, and in some instances interdependent with other topics considered within this SEA. Inter-relationships with other SEA topics are considered in Section 6.6.

6.5.5 A description of potential impacts from the project are described in the sections below and a summary of potential effects of the possible route options is presented in Table C6.9, which provides a score for each possible route options in relation to the topic areas, in accordance with the criteria defined in Table C6.1.

Water Quality

6.5.6 There is potential for the project to result in negative effects on the water environment during both construction and operation. Typically impacts to water quality would be anticipated to increase as the length, extent of earthworks and number of watercourse crossings increase.

6.5.7 Construction of the project, including sections of new carriageway, associated cuttings, embankments, structures and drainage (Sustainable Drainage Systems (SuDS)) could result in temporary decreases in water quality in both surface water bodies and groundwater bodies, including:

- pollution of surface water bodies from site run-off, which may increase the sediment load of the watercourse or has the potential to contain contaminants, in particular adjacent to areas of soil stripping or forestry clearance;
- increased turbidity within surface water bodies through changes to watercourse sediment regimes; and
- pollution of surface water or groundwater bodies due to accidental spillages of contaminants or disturbance of pollution pathways to receptors from contaminated land to surface water or groundwater bodies.

6.5.8 Any potential effects from construction are likely to be short term (less than three years or for the duration of construction), however the effects of large pollution incidents may last into the medium (three to 10 years) or long term (greater than 10 years).

6.5.9 There is also potential for permanent or long-term changes to water quality during operation including:

- decrease in surface water quality due to increases in the volume and/ or frequency of contaminated road run off due to new impermeable areas or spillage events;
- increased turbidity within surface water bodies through changes to watercourse sediment regimes; and
- pollution of surface water or groundwater bodies due to disturbance of pollution pathways to receptors from contaminated land.

6.5.10 The significance of operational effects from road run-off would be dependent on the impermeable area from the new road surface and the type and sensitivity of watercourses which are discharged to. Potential opportunities also exist to improve current surface water quality through improvements to existing road drainage provision which may in some locations be limited (i.e. simple kerb and gully drainage or direct outfall to water courses). The new road would be implemented in line with current standards, including SuDS provision.

6.5.11 Effects of an isolated pollution incident during the operation of the project would be dependent on the scale, extent and duration of the incident, in addition to the number, size of and sensitivity of the water bodies affected. Effects of spillage events are generally short-term in nature, however, have the potential to be medium or longer-term.

Hydromorphology

6.5.12 There is potential for the project to have negative impacts on the hydromorphology of surface water bodies. Typically, effects to surface water hydrology and morphology would be greater where there are a higher number of watercourses within the vicinity of the project, or a larger number of proposed watercourse crossings.

6.5.13 During construction there is potential for negative effects on watercourse hydromorphology through working in water or temporary channel modifications, including:

- alteration of channel morphology due to the construction or demolition of permanent or temporary structures or temporary channel modifications such as channel dewatering, diversions or realignment;
- changes to channel flow velocities and water levels due to temporary channel modifications such as channel dewatering, diversions and realignment or reduction in channel capacity through isolation of in-water working areas;
- destabilisation of watercourse banks as a result of construction works and/or forestry felling; and

- changes to sediment regimes of surface watercourses, resulting in changes to rates of erosion and deposition.

6.5.14 Effects from construction are likely to be short-term, however depending on the nature and extent of the impact there is potential for medium or longer term effects.

6.5.15 Permanent or long-term negative effects on watercourse hydromorphology during operation are similar to those described for construction, through permanent modifications, including:

- permanent alteration to channel flow velocities due to channel realignment/ regrading or changes to channel bank or bedform;
- loss of or long-term changes to channel morphology (bed and/or banks) due to modifications to existing structures, introduction of new structures, such as culverts or bridges, and changes to the riparian route corridor; and
- changes to sediment regimes of watercourses, resulting in changes to rates of erosion and deposition.

6.5.16 Operational effects would be long-term or permanent, and the significance of effects would be dependent on the design of the project. Significant effects on hydromorphology would be most likely due to changes to or introduction of watercourse crossings, where water bodies are more likely to be modified. Therefore, the significance of effects will be dependent on the number and design of crossings as well as the sensitivity of the water body.

6.5.17 From a water environment perspective, bridge crossings are typically considered to be preferable to culverts, which may require more extensive channel modification. Effects of tunnelling are variable dependent on the method of tunnelling, for example a bored tunnel at a reasonable depth from the surface may have minimal to no effects on a watercourse, in comparison to a cut and cover method of tunnelling which may result in substantial vertical or horizontal realignments of watercourses.

6.5.18 There may also be opportunities to provide improvement to water bodies, in particular where water bodies have existing modifications, such as culvert or bridge crossings.

Hydrogeology

6.5.19 There is potential for the project to have negative impacts on the hydrogeology of groundwater bodies. Typically, impacts to groundwater flows and levels would be anticipated to increase with shallower groundwater levels.

6.5.20 During construction, there is potential for temporary negative effects on groundwater aquifers from dewatering for excavations or tunnelling, if required. Potential effects to groundwater quality are as described in paragraph 6.5.9. Any changes to groundwater flow or quality may also affect secondary receptors such as groundwater abstractions, surface water bodies or GWDTEs.

6.5.21 The significance of effects from construction on groundwater aquifers would be dependent on the depth of excavations or extent and method of any tunnelling as well as existing groundwater levels. Effects from dewatering will likely be greater where excavations for subsurface structures are required, e.g. bridge foundations, and have the potential to be particularly extensive where tunnelling is proposed as this could require substantial dewatering activities, depending on the construction method.

6.5.22 Effects on hydrogeology during construction, would likely be short-term, however any substantial dewatering would have the potential for medium or long-term effects on groundwater levels or flows.

6.5.23 Operational permanent or long-term changes to groundwater flow direction or levels may result from the introduction of new subsurface structures, such as bridge foundations or tunnels. The significance of effects would be dependent on the depth and dimensions of subsurface structures and existing groundwater levels, however these would likely be very localised in nature.

Flood Risk

6.5.24 There is potential for the project to have negative impacts on fluvial, pluvial, and groundwater flood risk by creating increased risk of flooding to existing receptors, in addition to potential flood risk to the construction site or operational road. Typically effects from fluvial flood risk would be greater where there are a higher number of watercourses within the vicinity of the project or a larger number of watercourse crossings are proposed.

6.5.25 During construction, potential negative effects due to temporary increases in flood risk to receptors may occur for example through:

- changes to channel flow velocities and water levels due to temporary channel modifications and working-in water;
- temporary loss of floodplain area/ volume; or
- increased run-off to watercourses from intensive forestry clearance.

6.5.26 There is also risk of flooding to the construction site itself, which could result in a pollution incident to nearby surface or groundwater bodies.

6.5.27 The significance of effects would be dependent on construction methodology and location of the project in relation to the floodplain. Effects are likely to be only for the duration of construction, however effects as a result of forestry clearance may be longer-term.

6.5.28 Permanent changes of flood risk to receptors during operation may occur for example through:

- changes to channel hydrology due to channel modifications, resulting in changes in flood levels and/ or the frequency of flooding;
- displacement/ loss of floodplain area or volume;
- introduction of new impermeable areas within surface water catchments, which could potentially increase volume and peak flow to watercourses and/or surface water flood risk; and
- changes to groundwater flows and levels, resulting in changes to groundwater flooding frequency.

6.5.29 The significance of effects on flood risk receptors are likely to be minimal, due to the low number of high value receptors within the route corridor, however the project also has the potential to be at risk of flooding itself, dependent on the design and its location in relation to the floodplain. In addition, potential opportunities may exist to reduce the likelihood of fluvial flood risk through upgrading watercourse crossings with insufficient capacity in line with current design standards.

Assessment of SEA Objectives

6.5.30 An assessment of the potential effects of the project on the water environment in relation to the SEA objective and associated guide questions is presented in Table C6.7.

Table C6.7: Water Environment assessment using SEA Objectives and Guide Questions

Water Environment SEA Objective	SEA Assessment Guide Questions *'Does the Access to Argyll and Bute (A83) route corridor…?'*	Route corridor Assessment
Protect, maintain and improve the quality of water bodies, wetlands and the marine	▪ support and enhance the network of blue and green infrastructure?	There are potential opportunities to improve surface water quality and hydromorphology during operation. Improvements to surface water quality could be implemented through upgrades to drainage systems, in line with current standards, including SuDS provision. Opportunities to improve watercourse hydromorphology may exist where watercourses have existing modifications. However, such improvements have not been considered at the SEA stage.

Water Environment SEA Objective	SEA Assessment Guide Questions *'Does the Access to Argyll and Bute (A83) route corridor…?'*	Route corridor Assessment
environment from any direct or indirect impacts from the project, and protect against the risk of flooding	▪ ensure transport network resilience to climate change and flood risk?	It is anticipated the route corridor will be designed in line with current standards of protection from flooding, including an allowance for climate change, which would be an improvement in comparison to the existing A83. There may also be opportunities to reduce the potential of fluvial flooding through upgrading watercourse crossings with insufficient capacity during a flood events, in line with current design standards. However, improvements to watercourse crossings have not been considered at SEA stage.
	▪ constrain any water bodies from achievement of Good Ecological Status/Good Ecological Potential under the Water Framework Directive (WFD)?	There is potential for the WFD classifications of the three WFD surface water bodies and two groundwater bodies (and associated receptors) in the vicinity of the route corridor to be negatively affected. However, the implementation of appropriate mitigation measures would be anticipated to minimise potential effects and there may also be opportunity to provide improvements, in particular to the Croe Water.
	▪ increase the risk of diffuse pollution from current or increasing traffic volumes?	It is anticipated the increased impermeable area from the new carriageway would increase the risk of diffuse pollution. However, the implementation of appropriate mitigation measures, such as SuDS, would be anticipated to minimise potential effects and there may be opportunities to improve to surface water quality through upgrades to drainage systems, in line with current standards.
	▪ improve the quality of surface water draining from the transport network? (e.g. reducing salt spreading in winter, expanded or improved Sustainable Drainage System network)	It is anticipated the increased impermeable area from the new carriageway would increase the risk of pollution from surface water drainage. However, the implementation of appropriate mitigation measures, such as SuDS, would be anticipated to minimise potential effects and there may be opportunities to improve to surface water quality through upgrades to drainage systems, in line with current standards.
	▪ increase development that physically impacts on a waterbody, watercourse, the coastline or marine environment?	The route corridor would introduce new infrastructure to the water environment, including physical impacts to watercourses such as in-channel structures and outfalls. Dependent on the design development of the route corridor, implementation of best practice is anticipated to minimise negative effects on the water environment, however at this stage it is not possible to determine whether all negative effects can be mitigated.
	▪ promote removal of artificial transport-related structures in water bodies (e.g. bridge piers, concrete slipways)?	The route corridor has potential to promote removal of artificial transport-related structures in waterbodies, however this will vary between the possible route options within the route corridor and subsequent design.
	▪ promote natural flood management techniques?	It is anticipated the route corridor will be designed in line with current standards of protection from flooding, including an allowance for climate change. Where appropriate, there may be opportunities to promote natural flood management techniques, however at this stage it is not possible to determine whether this would be achieved.
	▪ influence the amount of vegetated and forested land-cover that helps reduce erosion risk and surface water runoff and pollution?	There is potential for deforestation or removal of the riparian route corridor to negatively affect watercourse hydromorphology, water quality and flood risk due to increased run-off. Dependent on the design development of the route corridor, implementation of best practice is anticipated to minimise negative effects on the water environment, however at this stage it is not possible to determine whether all negative effects can be mitigated.

6.6 Inter-relationships with other SEA topics

6.6.1 Table C6.8 presents the inter-relationships identified between the water environment and the other SEA topics.

Table C6.8: Inter-related SEA topics

SEA Topic	Potential Interactions
Climate	There is potential for changes to flood risk and hydrology within the route corridor as a result of climate change. These changes may exacerbate any effects reported in this chapter.
Population and human health	Changes to flood risk may impact receptors within the route corridor including population, residential and non-residential buildings and critical and non-critical infrastructure and facilities. Effects are dependent on the extent of the change and could result in positive or negative impacts.
Biodiversity, flora and fauna	Changes to water quality and hydromorphology may impact upon aquatic ecology within the route corridor.
Soils	Soil run-off or transportation of contaminated soils may impact upon water quality within the route corridor.
Cultural heritage	Increases to flood risk may impact cultural heritage assets within the route corridor. Effects are dependent on the extent of the change and could result in positive or negative impacts.
Landscape and visual amenity	Changes to channel morphology, additional structures, channel realignment or changes to hydrology may also result in impacts to their amenity value and have the potential to affect the integrity of a landscape area within the route corridor.

6.7 Conclusions

6.7.1 Potential effects for all possible route options within the route corridor will likely be similar in nature, and all options have the potential for minor negative or significantly negative effects on the water environment. As a result, the project is not considered to fully meet the objective of this SEA to *'Protect, maintain and improve the quality of water bodies, wetlands and the marine environment from any direct or indirect impacts from the project, and protect against the risk of flooding'*.

6.7.2 A summary of the potential effects on the water environment is provided in Table C6.9. Mitigation measures outlined in Table C6.10 should be implemented to avoid or reduce the effects of the project on the water environment, and potential enhancement opportunities should be considered to contribute towards the SEA objective.

6.7.3 It is considered likely that negative effects would reduce following the implementation of the recommendations set out in Table C6.10 and development of additional mitigation measures at subsequent DMRB stages.

Table C6.9: Summary of Effects on Water Environment

Water Environment Subtopic	Potential Effect Description	Effect Duration	Scoring Criteria
Construction			
Water Quality	Decreases in water quality during construction of both surface water bodies and groundwater bodies.	Short-term to Medium-term, temporary.	Minor negative or uncertain effect
Hydromorphology	Changes to watercourse hydromorphology due to working in water or temporary channel modifications during construction.	Short-term to Medium-term, temporary.	Minor negative or uncertain effect
Hydrogeology	Effects on groundwater aquifers or secondary groundwater receptors (such as GWDTEs or groundwater abstractions) from dewatering activities during construction.	Short-term, temporary	Significant negative effect

Water Environment Subtopic	Potential Effect Description	Effect Duration	Scoring Criteria
Flood Risk	Increases in flood risk to receptors (such as properties or agricultural land) during construction.	Short-term, temporary	Minor negative or uncertain effect
	Risk of flooding to construction site.	Short-term, temporary	Minor negative or uncertain effect
Operation			
Water Quality	Decreases to water quality during operation to surface water bodies or groundwater bodies due to road-run-off outfalls.	Long-term, temporary.	Minor negative or uncertain effect
	Decreases to water quality during operation to surface water bodies or groundwater bodies due to accidental spillage or pollution event.	Short-term to medium term, temporary.	Minor negative or uncertain effect
Hydromorphology	Changes to hydromorphology through modifications to watercourse morphology or in-channel structures.	Long-term, permanent	Significant negative effect
Hydrogeology	Effects on groundwater aquifers and secondary groundwater receptors (such as GWDTE and groundwater abstractions) from long-term changes to groundwater flows or levels.	Medium-term to Long-term, permanent (dependent on vertical alignment and design details).	Significant negative effect
Flood Risk	Increases in flood risk to receptors (such as properties or agricultural land) during construction.	Long-term, permanent.	Minor negative or uncertain effect
	Flood risk to operational new carriageway.	Long-term, permanent.	Minor negative or uncertain effect

6.8 Design Development, Mitigation and Enhancement Recommendations

6.8.1 Table C6.10 sets out the SEA recommendations in relation to water environment mitigation and enhancement.

Table C6.10: Potential mitigation, enhancement, and design recommendations in relation to Water Environment

Mitigation / Enhancement/ Monitoring Measure	Stage of Implementation (e.g. DMRB Stage 2, DMRB Stage 3)	Responsible Party for Implementation / Monitoring of Measure	Consultation/ Approvals Required
The design of the project should be undertaken in line with best practice and relevant guidance, considering the requirements of The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) and in consultation with SEPA.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	SEPA Monitoring requirements to be agreed with regulator.
Prevent deterioration of the status of surface water bodies during construction through appropriate pollution control for all potentially polluting activities.	Construction	Contractor	SEPA Monitoring requirements to be agreed with regulator.
Incorporate effective Sustainable Drainage Systems (SuDS) to minimise impacts on water quality, informed by landscape and ecology specialists, such that SuDS features deliver other enhancement benefits where possible.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	SEPA NatureScot Monitoring requirements to be agreed with regulator.
Channel modifications, in-channel works and temporary/ permanent structures should seek to limit effects on channel hydromorphology, where possible and be designed in accordance with appropriate standards and best practice. Where practicable efforts should seek to improve the current situation for surface water bodies with existing morphological pressures.	Throughout the lifecycle of the project	Designer & Contractor To be monitored by Transport Scotland during subsequent DMRB stages and by contractor during design and construction.	SEPA Monitoring requirements to be agreed with regulator.
Hydrogeology and geotechnical surveys should be undertaken to determine groundwater levels within the vicinity of the project. In excavation areas confirmed to intercept groundwater, potential effects should be assessed at later design stages.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	SEPA Monitoring requirements to be agreed with regulator.
Design of tunnels, if relevant, should include a dewatering assessment, to ensure long-term effects on groundwater from dewatering is minimised, where possible.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	SEPA

Mitigation / Enhancement/ Monitoring Measure	Stage of Implementation (e.g. DMRB Stage 2, DMRB Stage 3)	Responsible Party for Implementation / Monitoring of Measure	Consultation/ Approvals Required
Where potential GWDTE have been identified through a review of habitat information in conjunction with ecologists at DMRB Stage 2 and 3, should be undertaken to improve understanding of hydrogeological context of habitats.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	SEPA NatureScot
Site specific flood risk assessments should be undertaken in accordance with DMRB and other relevant guidance, as more localised detail becomes available at each relevant design stage.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	Argyll and Bute Council SEPA Monitoring requirements to be agreed with regulator.
Seek to avoid new infrastructure in the functional floodplain, where possible. Where unavoidable, new infrastructure should be restricted to the shortest practical crossing, avoiding extensive construction within the functional floodplain and providing adequate compensatory flood storage areas where appropriate.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	Argyll and Bute Council SEPA Monitoring requirements to be agreed with regulator.
Design of watercourse crossings should seek to cause no increase in flood risk to sensitive receptors and should improve upon the current situation where culverts have not been identified to have sufficient capacity for the design event, where possible.	DMRB Stage 2, DMRB Stage 3	Designer To be monitored by Transport Scotland during subsequent DMRB stages.	Argyll and Bute Council SEPA Monitoring requirements to be agreed with regulator.
Structures may require ongoing inspection and maintenance to prevent blockages. The design would seek to eliminate the need for operational interventions where possible. Requirements of monitoring to be determined at DMRB Stage 2 and 3.	Operation	BEAR	n/a Monitoring requirements to be agreed with regulator.
Pre and post construction water quality monitoring may be required, where deemed necessary at further design stages. Requirements of monitoring to be determined at DMRB Stage 2 and 3.	Pre-construction, Operation	SEPA	SEPA Threshold triggers to be outlined at later design stages, if monitoring is deemed necessary.
During and post construction geomorphological monitoring may be undertaken where deemed necessary at further design stages. Requirements of monitoring to be determined at DMRB Stage 2 and 3.	Construction, Operation	SEPA	SEPA Monitoring requirements to be agreed with regulator.

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