4. The Proposed Scheme

4.1. Introduction

4.1.1. This chapter describes the key components and construction activities associated with the Proposed Scheme. This includes:

- mainline alignment
- junctions
- public roads
- improvements to the Old Military Road (OMR)
- structures
- culverts
- active travel provisions
- lay-bys
- traffic signs and lighting
- drainage
- watercourse crossings
- earthworks
- fencing and environmental barriers
- road surfacing
- land required for the Proposed Scheme and
- anticipated construction methodology and programme.

4.1.2. The information provided is based on the design of the Proposed Scheme at Design Manual for Roads and Bridges (DMRB) Stage 3.

4.1.3. As outlined in Volume 2, Chapter 1: Introduction, the Proposed Scheme aims to develop a resilient and sustainable road to connect Argyll and Bute to the central belt of Scotland in response to a recommendation from the Strategic Transport Projects Review 2 (STPR2) and major landslide events within the Proposed Scheme extents in 2020. The STPR2 identified the importance of the A83 as a key transport corridor in urgent need for a solution to the recurring landslide issues.

4.1.4. Also outlined in Volume 2, Chapter 2: Need for the Proposed Scheme, the Proposed Scheme objectives, as defined in the Access to Argyll and Bute (A83) DMRB Stage 1 Assessment Report (Strategic Environmental Assessment (SEA) and Preliminary Engineering Services (PES)) are as follows:

- Resilience – Reduce the impact of disruption for travel to, from and between key towns within Argyll and Bute, and for communities accessed via the strategic road network.
- Safety – Positively contribute towards the Scottish Government's Vision Zero road safety target by reducing accidents on the road network and their severity.
- Economy – Reduce geographic and economic inequalities within Argyll & Bute through improved connectivity and resilience.
- Sustainable Travel – Encourage sustainable travel to, from and within Argyll & Bute through facilitating bus, active travel and sustainable travel choices.
- Environment – Protect the environment, including the benefits local communities and visitors obtain from the natural environment, by enhancing natural capital assets and ecosystem service provision through delivery of sustainable transport infrastructure.

4.1.5. The Proposed Scheme is expected to be procured by means of a Design & Build (D&B) type contract. For this form of contract, the Appointed Contractor will undertake both the detailed design and construction of the Proposed Scheme. Responsibility for operating and maintaining the trunk road following completion of the Proposed Scheme including any maintenance period would remain with the Scottish Government. Responsibility for operating and maintaining side roads would remain with Argyll and Bute Council on completion of the Proposed Scheme.

4.1.6. Under a D&B type contract, a specimen (outline) design is prepared for the Proposed Scheme, which the Appointed Contractor may optimise at the detailed design stage. Such optimisation must comply with the Employer's Requirements and be within the constraints imposed by the Environmental Impact Assessment (EIA) Report.

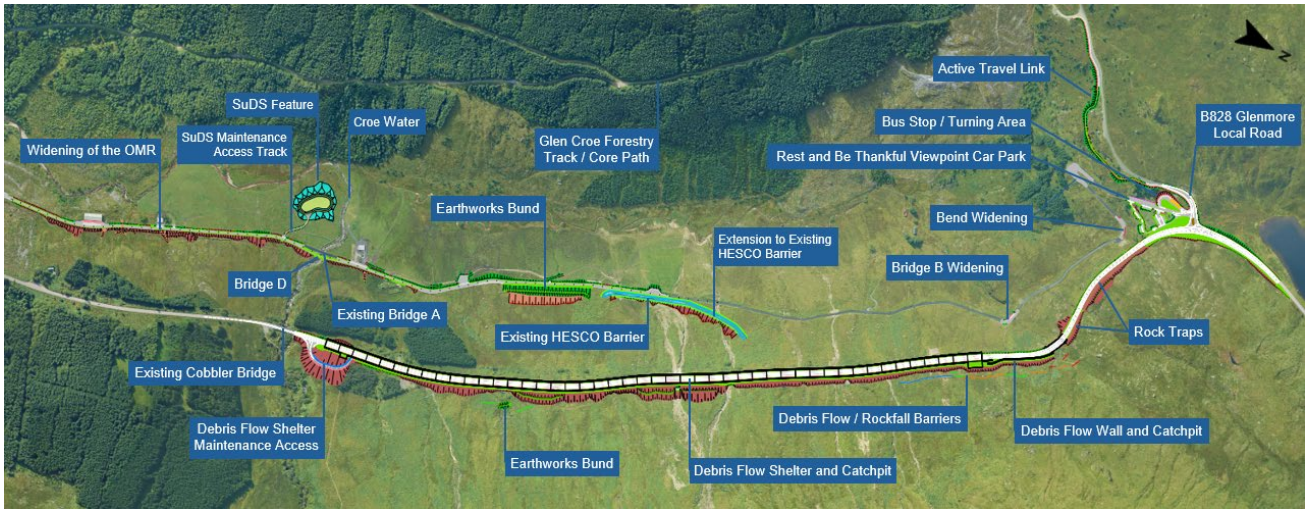
4.1.7. Optimisation of the Proposed Scheme design will still be deemed to comply with this EIA Report provided that any design changes have been subject to environmental review to ensure that the residual impacts would not be greater than those reported in this EIA Report, and subject to Transport Scotland's acceptance of the findings of any such review. Further detail on any future design modifications including associated environmental review can be found in Volume 2, Chapter 5: Overview of the Assessment Process.

4.2. Description of Proposed Scheme

Proposed Scheme Overview

4.2.1. The Proposed Scheme is predominantly online and is therefore on or very close to the line and level of the existing A83, with an overall length of 2.25km, starting immediately north of the Croe Water (Cobbler Bridge) and extending to a point north of the junction to the B828 Glenmore local road, adjacent to Loch Restil. An overview of the Proposed Scheme layout is shown in Plate 4.1 (Proposed Scheme Layout) and included in Volume 3, Figure 4.1 Scheme Layout Overview.

Plate 4.1 – Aerial view of Glen Croe including an overview of the Proposed Scheme layout



4.2.2. Landslide, debris flow and boulder protection are achieved through the inclusion of a Debris Flow Shelter (DFS) combined with a catchpit for approximately 1.4km in length, with an additional 146m of catchpit and Debris Flow Protection Wall (DFW) to the north. It is proposed that maintenance of the catchpit, which sits on the uphill side of the DFS and DFW, will be achieved via the roof of the DFS with access taken directly from the A83 via a new direct access, as shown in Plate 4.2. An engineering plan and profile drawing of the DFS Maintenance Track is included in Volume 3, Figure 4.2b.

Plate 4.2 – Debris Flow Shelter and associated maintenance access (Visualisation)

4.2.3. The Proposed Scheme also includes improvements to the B828 Glenmore local road junction and Rest and Be Thankful Viewpoint car park and bus stop / turning area. Extending from the Rest and Be Thankful Viewpoint car park and bus stop / turning area, to the Core Path on the lower slopes of Ben Donich, the Proposed Scheme includes an Active Travel Link which closely follows the B828 in the southern verge. Detailed General Arrangement drawings for the B828 Glenmore local road, Rest and Be Thankful Viewpoint car park and bus stop / turning area and the Active Travel Link are included in Volume 3, Figure 4.2b.

4.2.4. There are several other key structures as part of the scheme including 16 No. culverts (12 within the extents of the DFS and a further four to the north of the DFS) and a 30m bridge structure. Indicative designs for key structures are shown in Volume 3, Figure 4.3 Debris Flow Shelter, Figure 4.4 Debris Flow Wall, Figure 4.5a LTS Watercourse Realignments and Figure 4.5b B02 Burn Bridge. Landscape proposals and environmental mitigation are shown in Volume 3, Figure 9.3 Landscape and Ecological Mitigation.

4.2.5. To support the construction of the Proposed Scheme and provide a suitable, resilient diversion route for A83 Trunk Road traffic, a series of Improvements to the OMR are proposed as follows:

- widening of the OMR over a length of approximately 1.4km to accommodate two-way traffic including a new proprietary bridge structure that will carry southbound traffic
- localised widening at three existing sharp bends at the northern end of Glen Croe to assist HGVs in navigating the narrow carriageway when using the OMR as the diversion route
- an approximately 150m long debris flow protection earthwork bund to protect the OMR during debris flow and rock fall events
- extension of the existing HESCO barrier by approximately 150m to protect the OMR during debris flow and rock fall events and
- installation of debris flow and rock fall fences above the A83 Trunk Road to increase resilience of the OMR. New fences are proposed where there are currently no geotechnical interventions.

4.2.6. Principal components of the Proposed Scheme are listed below with further details and description provided in this section.

- Proposed Alignment
- Proposed Junctions and Accesses
- Proposed Walking, Cycling and Horse-Riding User Provisions
- Proposed Earthworks
- Proposed Structures and Culverts
- Proposed Lay-bys
- Proposed Traffic Signs and Road Markings
- Proposed Lighting
- Proposed Drainage
- Proposed Watercourse Crossings
- Proposed Fencing and Environmental Barriers

- Proposed Road Surfacing
- Maintenance Proposals and
- Proposed Construction Methodology and Programme.

Iterative Design Development

4.2.7. The design of the Proposed Scheme has been developed in an iterative manner which has involved successive refinement to mitigate issues arising through the collation of new information on constraints or engineering problems as the Proposed Scheme has progressed. Each design iteration has resulted in incremental changes that provide solutions until an optimum DMRB Stage 3 design is reached, taking cognisance of the overall scheme objectives throughout.

4.2.8. For the Proposed Scheme, the iterative design process has included the following:

- multi-disciplinary design coordination meetings;
- development and use of an environmental constraints mapping tool, capturing information held by stakeholders and survey data;
- a series of design refreshes; and,
- stakeholder engagement.

4.2.9. Design coordination meetings were held at regular intervals to provide environmental (and other) disciplines a forum to provide feedback on any constraints and an opportunity to address potential impacts associated with design proposals and refinements. This informed and influenced the development of the Proposed Scheme design.

4.2.10. In order to collate and share environmental and design information across the project team a web-based GIS tool, known as WebGIS, was developed. WebGIS is accessible to all project team members, providing easy access to a wide range of information including environmental constraints (protected species, habitats, cultural heritage features etc), geotechnical and topographical mapping, aerial imagery and design information. Information was regularly updated to capture site surveys, desk studies, stakeholder information and design refreshes. WebGIS allowed the developing design to be overlain with known constraint information to understand any impacts associated with the Proposed Scheme.

4.2.11. The iterative design process has also included stakeholder engagement, primarily via the bi-monthly meetings of the A83 Environmental Steering Group (ESG), as described in Volume 2, Chapter 6: Consultation and Scoping.

4.2.12. The key developments to the Proposed Scheme during DMRB Stage 3 include:

- OMR Interventions now included as part of the Proposed Scheme works.
- Maintenance access to the roof of the DFS moved north of the Croe Water to avoid a further watercourse crossing.
- Alignment and cross-section amended to provide a reduced cross-section (more akin to existing), and therefore reduced earthworks, north of the DFS.
- Earthworks slopes further developed to include berms (where appropriate) at estimated rock / soil interface.
- B828 Glenmore local road junction refined to provide a compliant ghost-island and a reduced junction bellmouth footprint, reducing impact on the adjacent Benn an Lochain Site of Special Scientific Interest (SSSI).
- RaBT Viewpoint car park proposals developed with environmentally led design in consultation with key stakeholders (public, A83 Task Force, A83 ESG, Argyll and Bute Council, TS directorates etc).
- Active Travel Link included between the RaBT Viewpoint car park and the Glen Croe Forestry Track / Core Path on opposite side of Glen adjacent to and south of the B828 Glenmore local road.

- Drainage design refined – now only one SuDS feature at southern end of Proposed Scheme. Northern SuDS feature within Beinn an Lochain SSSI removed with agreement from NatureScot and SEPA.
- DFS design refined to accommodate fire and smoke modelling. DFS now 5.3m (minimum) headroom with a 4-degree incline on the soffit with an external emergency walkway, accessed via gaps in a concrete vehicle restraint system (VRS).
- DFS design refined to better accommodate the proposed culvert at Ch. 1,400 resulting in a corresponding reduction to the length of DFW.
- Debris Flow Wall (DFW) design north of the DFS refined to accommodate future maintenance access.
- ITS / Systems rooms included at either end of the DFS to manage and maintain critical systems infrastructure within the DFS. At the southern end of the DFS this is included, as a buried structure, under the DFS maintenance access and at the northern end it is below the DFS turning area.
- A new bridge structure (B02 Burn Bridge) included at northern end of the Proposed Scheme to allow debris flow, landslide and boulder fall material to pass below the A83.
- Watercourse design developed to include suitable mitigation measures (aprons, cascades etc) on the downstream side of the A83.
- Natural Capital and Biodiversity Net Gain mitigation sites developed and included, refer to Section 4.5 below.

Alignment

Proposed Scheme Alignment

4.2.13. The proposed design speed for the A83 mainline, based on design speed calculations undertaken in line with DMRB CD 109 'Highway Link Design' and supported by speed surveys undertaken on site in October / November 2023 and January / February 2024, is 100kph (band 100B).

4.2.14. The proposed mainline alignment consists of a 7.3m wide carriageway with 1m wide hard strips and 2.5m wide verges within the extents of the DFS, in line with the requirements for Rural Single Carriageways as set out in DMRB CD 127 'Cross-Sections and Headrooms'. Outwith the DFS, lane widths have been reduced from the required 3.65m to 3.35m and hard strips have been reduced from the required 1m to 0.3m due to horizontal geometry constraints including steep sidelong ground on both sides of the road and the presence of the Rest and Be Thankful Viewpoint car park. Verges have been widened locally where practicable for improved visibility.

4.2.15. Cuttings and earthworks are required along the length of the proposed A83 trunk road with the height and extent of these varying depending on local topography and any stability requirements. The design has been developed to minimise the need for earthworks on the lower slopes of Beinn Luibhean, between the A83 and OMR. However, there are significant cuttings required above the A83 in order to accommodate the works proposed for the DFS and adjacent catchpit.

4.2.16. Engineering plan and profile drawings for the A83 mainline (Volume 3, Figure 4.2a Mainline Plan and Profile) detail the horizontal alignment and vertical profile.

Proposed OMR Improvements Alignment

4.2.17. The Proposed Scheme introduces widening of the OMR to allow two-way traffic over a length of approximately 1.4km from the end of the existing two-way carriageway at Ch. 1,085m, to the existing HESCO barrier at approximately Ch. 2,450m. At this point, the road tapers back to tie into existing single file traffic.

4.2.18. The Proposed Scheme will widen the overall cross-section of the OMR, where the existing carriageway width of between 3m to 3.5m is increased to 6.5m with a varying verge between 1m to 1.5m on either side. An exception to this is at the location of the proposed Bridge D, discussed further below, which will only carry southbound traffic where the carriageway width is 4m with 1m verge either side. Northbound traffic will use the existing Bridge A, which is a three span reinforced concrete structure, that carries the OMR over the Croe Water.

4.2.19. Beyond Ch. 2,450m, localised widening based on vehicle tracking, is proposed at three existing sharp bends to assist HGVs and larger vehicles in navigating the narrow carriageway when using the diversion route.

Proposed Scheme Junctions and Accesses

Proposed B828 Glenmore Local Road Junction

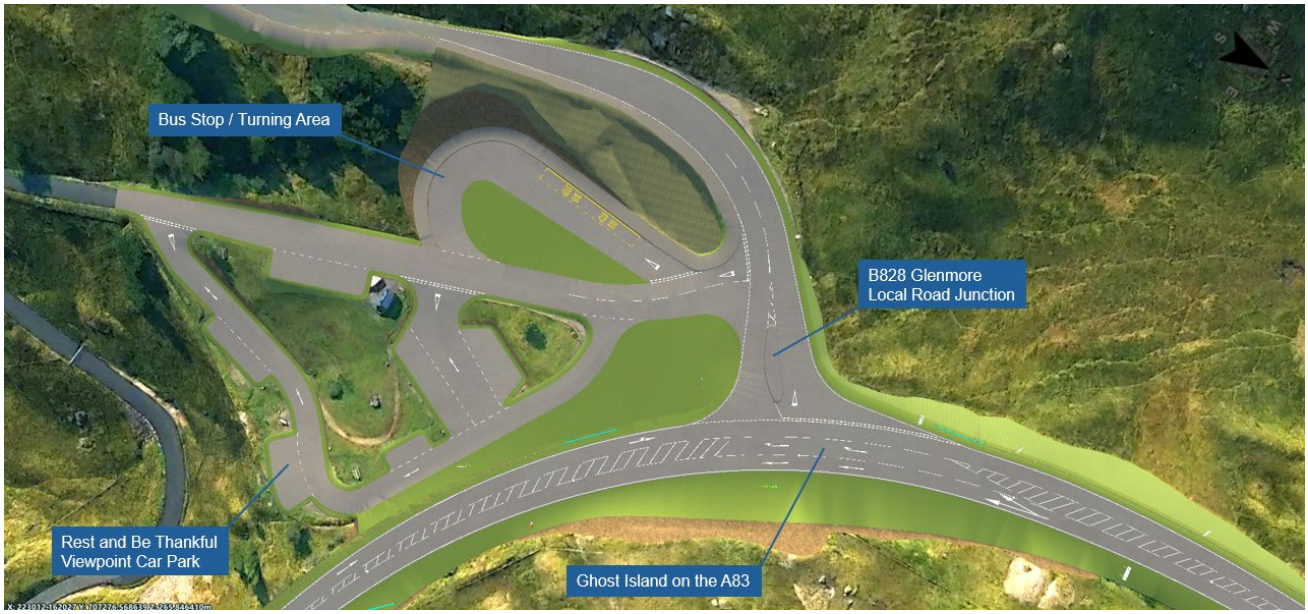
4.2.20. At the existing simple priority junction connecting the A83 and B828 Glenmore local road, it is proposed that the junction design be upgraded to a ghost island junction, see Plate 4.3 below.

4.2.21. Traffic data collected in October / November 2023 and February / March 2024, indicates an annual average daily traffic (AADT) count of 4,400 vehicles for the A83 and 300 vehicles for the B828 in this location. This data used in accordance with Figure 2.3.1 of DMRB CD 123 'Geometric Design of At-Grade Priority and Signal-Controlled Junctions' determines a suitable junction form based on traffic volumes, in this case a ghost island junction.

4.2.22. It is proposed that the ghost island will provide a compliant length right-turn lane of increased width (4.0m) to cater for the increased width of an articulated vehicle as it slows on a 5% crossfall, as gusts and crosswinds can widen the envelope of articulated vehicles. It will also cater for the rear overhang of trailer's that can often swing into the nearside lane during sharp turns.

4.2.23. A traffic island is proposed in the B828 junction bellmouth to channelise right turning traffic, reducing cornering speed and the likelihood of HGV's overturning. The island also provides a useful location for flag-type direction signs that would otherwise be located in the opposite verge where they could cause an obstruction to Stopping Sight Distance (SSD) for southbound traffic on the A83.

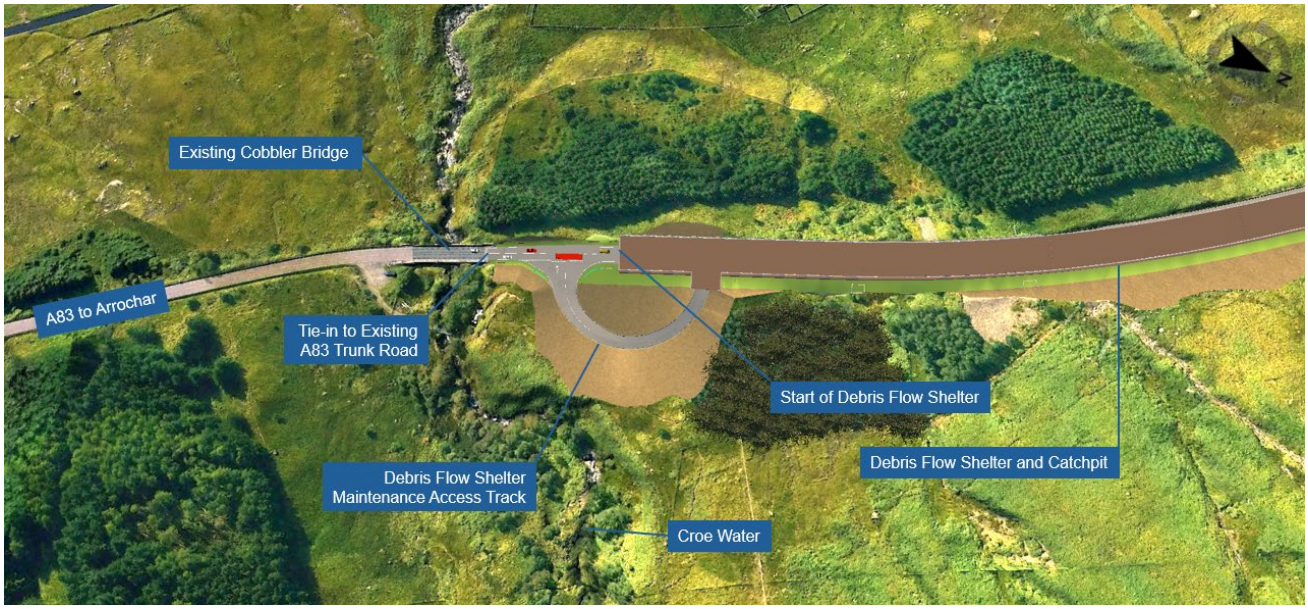
Plate 4.3 – Plan view of the proposed junction between the A83 and B828 Glenmore local road including the ghost island on the A83 and the channelising island on the B828



Proposed Maintenance Track Provision

4.2.24. Located midway between the existing Cobbler Bridge and the start of the DFS, it is proposed that a direct access be constructed to connect the roof of the DFS to the A83 via a maintenance access track. This is to allow maintenance vehicles to access the roof directly to conduct inspections and clear the proposed catchpit of any debris after debris flow or landslide events on the Beinn Luibhean hillside. A plan view of the direct access and maintenance track is presented in Plate 4.4 and Figure 4.2b.

Plate 4.4 – Plan view of the proposed direct access and maintenance track located immediately north of the Croe Water (Cobbler Bridge) providing maintenance access directly to the roof of the DFS



Proposed Rest and Be Thankful Viewpoint Car Park and Bus Stop / Turning Area

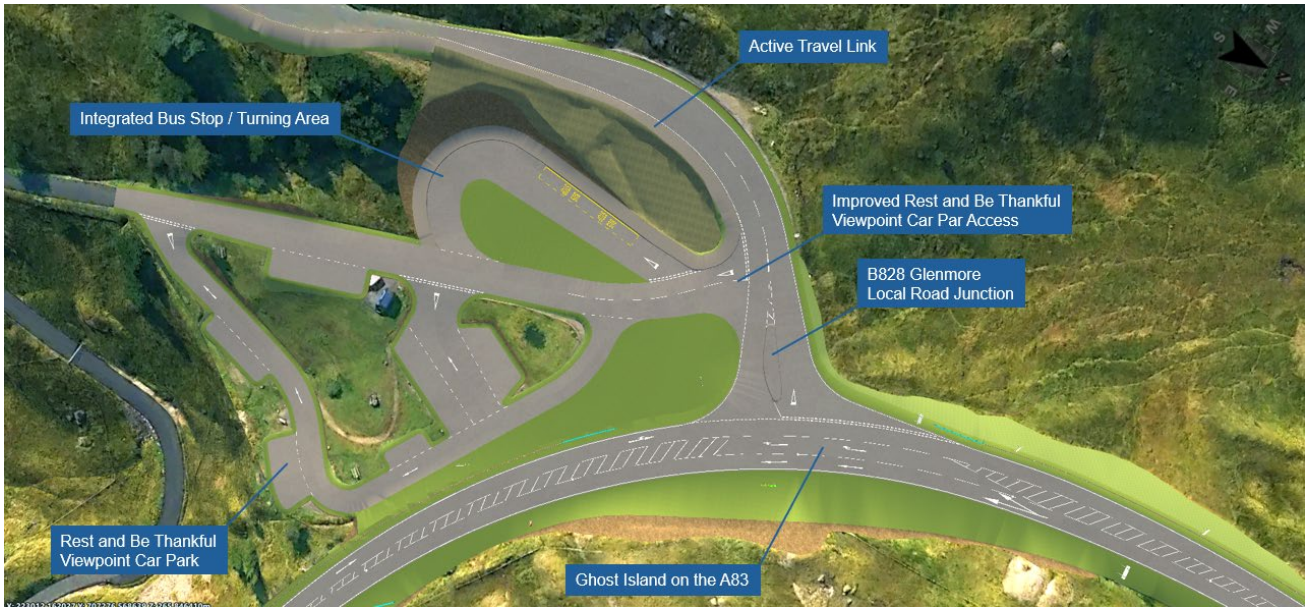
4.2.25. The Proposed Scheme includes improvements to the Rest and Be Thankful Viewpoint car park and bus stop / turning area, see Plate 4.5. The Proposed Scheme layout has been developed to rationalise the current junctions and accesses to the Rest and Be Thankful Viewpoint car park and bus stop / turning area and reduce the number of conflict points on the B828 Glenmore local road.

4.2.26. As such, the Proposed Scheme layout incorporates a single junction between the OMR and the B828 – the existing layout has three junctions, all situated within 100m of the junction between the A83 and B828. The proposed junction to the Rest and Be Thankful Viewpoint car park and bus stop / turning area provides greater separation between the B828 junction with the A83 and the access to the Rest and Be Thankful Viewpoint car park. With the amalgamation of the bus turning area and the Rest and Be Thankful Viewpoint car park the proposed design only requires one junction onto the B828, as opposed to three in the existing scenario.

4.2.27. With the removal of the bus turning area junctions the singular proposed junction can be relocated, further away from the junction between the A83 and B828, further along the B828. This relocation increases the distance between the A83 / B828 and car park junctions from 17m to 36m, measured from the centre of the car park junctions to the centreline of the A83 carriageway. This reduces the risk of rear end shunts and queuing back onto the A83 caused by vehicles leaving the A83 and turning directly into the Rest and Be Thankful Viewpoint car park.

4.2.28. Additionally, the proposed Rest and Be Thankful Viewpoint car park junction meets the B828 at 85 degrees, whist the existing arrangement produces and 80-degree angle. The proposed angle presents an improvement over existing conditions and affords road users better visibility left along the B828 when exiting the car park junction. The proposed junction will have corner radii of 8m on both sides, which is an improvement on the existing provision, further facilitating easier and safer manoeuvres for vehicles using the junction to enter or exit the car park and bus turning provisions.

Plate 4.5 – Plan view of the proposed Rest and Be Thankful Viewpoint car park improvements with a single junction providing access to the car park and an integrated bus stop / turning area



4.2.29. The proposed car park layout largely retains the existing arrangement, whereby the public parking facility consists of a large loop that is bisected by a road that creates a second smaller loop closely mirroring that of the existing layout. In the proposed layout it is envisaged that the larger loop will be used by smaller passenger vehicles owing to the steeper gradients encountered (see Section 4.2.29, below) and the smaller loop will be utilised by larger commercial vehicles (coaches, HGV's etc). The proposed layout provides an equal number of parking bays situated within the car park, albeit in a slightly different arrangement to existing owing to the proposed landscape enhancements. To reduce congestion and reduce driver confusion when navigating the car park, a one-way clockwise system is proposed. This system will be indicated to road users via road markings and traffic signs as appropriate.

4.2.30. As the proposed car park shares much of the arrangement of the existing car park it also shares much the same geometry. The smaller loop represents the 'top' of the car park with this area sitting at, or close to, the level of the existing A83 on a relatively flat plane with gradients generally less than 4%. The southern end, or 'bottom' of the car park, makes up the larger loop and contains the steepest vertical gradients at 10.8% for approximately 20m. The vertical geometry over much of this southern section, adjacent to the Viewpoint at the head of Glen Croe, is steep and in excess of 8%. In combination with the steep gradients the southern section also includes restrained horizontal geometry with the tightest radius of 8m located at the southeast corner next to the Viewpoint at the head of Glen Croe. The proposed horizontal and vertical geometry can be seen on the Rest and Be Thankful Viewpoint car park plan and profile drawings included in Volume 3, Figure 4.2b.

4.2.31. Contrary to the existing layout, the proposed layout incorporates the bus stop / turning area within the car park extents. This provision will be situated in a similar footprint to the existing bus stop / turning area. However, in order to increase the spacing between A83 / B828 junction and the car park access, the turning area will share a single access with the Rest and Be Thankful Viewpoint car park onto the B828.

4.2.32. The proposed arrangement of the bus turning area connects it to the through road of the Rest and Be Thankful car park (extension of the OMR), at two points. The proposed amendments to the bus turning area will incorporate a one-way system and only for local and regional buses, road markings and signage shall be used to indicate this.

4.2.33. The design of the car park has been developed taking cognisance of the environmental considerations around the history, culture, landscape character and visual amenity of Glen Croe. The concept design, as shown in Plate 4.6, includes materiality and design details of some of the key proposals including stone retaining walls (1), Rest and Be Thankful Commemorative Stone seating area (2), social picnic benches (3) and motorsport heritage interpretation (4).

4.2.34. The concept design will be developed further during the specimen design stage through consultation with the ESG and other key stakeholders.

Plate 4.6 – Concept design of Rest and Be Thankful Viewpoint car park improvements

Proposed OMR Improvements Direct and Private Accesses

4.2.35. New direct accesses will be created with the adjacent land plots following Compulsory Purchase of the OMR. It is estimated at this time that 40 No. direct accesses will be required from the OMR to adjacent land parcels.

Walking, Cycling and Horse-Riding User Provisions

4.2.36. The Proposed Scheme has been developed to incorporate sustainable travel facilities including bus, walking, cycling, wheeling and horse-riding facilities, wherever possible. A DMRB GG 142 Walking, Cycling and Horse-Riding Assessment and Review has been completed and identified opportunities and whether these have been incorporated into the Proposed Scheme.

4.2.37. One such opportunity is the provision of an Active Travel Link from the Rest and Be Thankful Viewpoint car park and bus stop / turning area to the Core Path / forestry tracks on the lower slopes of Ben Donich, to the west of the OMR. The Active Travel Link, as shown in Plate 4.7 and Volume 3, Figure 4.2b, consists of a 2.75m wide paved surface and 0.5m (min.) wide verges and runs parallel to the B828 Glenmore local road for a length of approximately 505m.

Plate 4.7 – Plan view of the proposed Active Travel Link adjacent to the B828 Glenmore local road connecting the Rest and Be Thankful Viewpoint car park to the Glen Croe Forestry Track / Core Path

4.2.38. The design of the Active Travel Link has evolved to avoid impact on important cultural heritage assets that form the remains of a Home Guard Stop Defence from World War Two (WWII). The ruins are composed of a group of WWII assets, including a spigot mortar emplacement and a Nissen hut, located in and around a natural depression adjacent to, and south of, the B828. A picture of the spigot mortar emplacement is included in Plate 4.8, below.

Plate 4.8 – Photograph of a spigot mortar emplacement adjacent to the B828 Glenmore Local Road with the A83, OMR, Beinn Luibhean and The Cobbler in the background

4.2.39. In addition, the paths to the east of the A83 which access the Arrochar Alps from the existing informal access to the south of the Croe Water (Cobbler Bridge) will be retained and the Proposed Scheme will ensure no barriers are put in place which limits access provision for existing routes.

Earthworks

Proposed Scheme Earthworks

4.2.40. Approximate bulk earthworks volumes for the permanent works associated with the Proposed Scheme (A83, B828, DFS Maintenance Access, Rest and Be Thankful Viewpoint Car Park, Active Travel Link and SuDS Basin plus access) are included in Table 4.1, below.

Table 4.1 – Earthworks Summary for the Proposed Scheme

Quantity / details	A83 Mainline	B828 Junction and RaBT Car Park	Side Roads / Access Tracks / SuDS	Total
1. Cut (Acceptable)	99,161 m^3	913 m^3	24,695 m^3	124,769 m^3
2. Cut (Unacceptable)	104,747 m^3	2,991 m^3	6,464 m^3	114,202 m^3
3. Cut (Bulked Rock)	162,624 m^3	1,497 m^3	40,500 m^3	204,621 m^3
4. Cut (Bulked Soil)	125,696 m^3	3,589 m^3	7,757 m^3	137,042 m^3
5. Engineering Fill	2,382 m^3	778 m^3	1,368 m^3	4,528 m^3
Approx. Surplus / Deficit Volume (3+4-5)	285,938 m^3 Surplus	4,309 m^3 Surplus	46,889 m^3 Surplus	337,136 m^3 Surplus

Notes:

1. Bulked rock figures are based on a rock bulking factor of 1.64.
2. Bulked soil figures are based on a soil bulking factor of 1.20.

4.2.41. The earthworks design identifies 1V:1.5H slopes to approximate Ch. 20m with slope heights up to 5.8m adjacent to the southbound carriageway. Between Ch. 20m and Ch.120m, the excavation adjacent to the southbound carriageway widens and steepens for the DFS maintenance access track.

4.2.42. Along the full extents of the DFS and DFW, the cross section features a catchpit, which requires cuttings in soil and rock on the uphill side of the A83. The alignment of the debris flow shelter has been designed such that it removes the need for earthworks or retaining structures on the downhill side of the A83. This is to minimise construction on potentially unstable existing debris flow deposits that are a prominent feature on the lower slopes of Beinn Luibhean between the A83 and OMR.

4.2.43. The design for the catchpit has 60° slopes, which is a similar gradient to the slopes of the existing catchpits. Where significant thicknesses of superficial deposits are anticipated the cut slope profile has been amended to include a berm with 45° slopes above. The maximum height of the cut slopes is approximately 35m at Ch. 860m. The base width of the catchpit is a minimum of 6m.

4.2.44. Stabilisation measures, such as soil nails, with either flexible or sprayed concrete facing will be required for cut slopes in superficial deposits. Slopes in bedrock are anticipated to be largely stable at the proposed slope angle. However, rock dowls / bolting, dentition or other stabilisation measures will be required to address localised areas of instability.

4.2.45. Where channels carrying surface water flows or surface water run-off interface with the cut slope of the catchpit additional detailing will be required to ensure long term stability. Local to the crest of the cutting, the channel will be excavated to rockhead to minimise potential erosion and the side slopes will be stabilised, as required.

4.2.46. For all cuttings, slope drainage measures will be required, which may include raking drains, weepholes and berm drainage, as appropriate.

4.2.47. Beyond the extents of the DFS and DFW the Proposed Scheme includes 60° cut slopes adjacent to the southbound carriageway, with maximum slope heights of approximately 28m at Ch. 1,740m. Superficial deposits are expected to be thin or absent across this area of the scheme, with the majority of excavation in bedrock. There is an allowance for rock traps where the verge is of insufficient width to retain typical rock falls and a berm is included at mid height where the cut slopes exceed approximately 12m.

4.2.48. There are no significant embankments required for construction of the Proposed Scheme. Minor upfill is required for widening to provide additional verge width at the northern tie-in. At this location the embankment shoulders are up to approximately 4.8m height with slopes of 1V:1.5H.

4.2.49. Earthworks associated with the upgrades to the B828 Glenmore local road and the Rest and Be Thankful Viewpoint car park are generally minimal given the design proposals look to retain the existing as far as practicable.

4.2.50. Earthworks associated with the proposed bus stop and turning area result in cut slopes with a maximum height of approximately 5m based on slopes of 1V:1.5H. Extending from the bus stop / turning area to the core path / forestry track on the lower slopes of Ben Donich, the Active Travel Link requires minor upfill to allow for its inclusion adjacent to the B828. At this location the embankment shoulders are up to approximately 6m height with slopes of 1V:1.5H.

Proposed OMR Improvements Earthworks

4.2.51. The widening of the OMR will require various low height soil cuttings and embankments. The proposed cut slopes are generally 1V:3H, with a maximum height of approximately 7.5m at Ch. 1,228m. The proposed widening on embankment has side slopes of 1V:2H, with a maximum height of 5m at Ch. 2,110m.

4.2.52. Two debris flow protection earthwork bunds are required to protect the A83 Trunk Road and the OMR during debris flow and rock fall events. The preliminary design for the bunds has slopes of 1V:1.5H and a crest width of 3m. It is anticipated that the bunds will be constructed using a high friction granular fill. Geogrid reinforcement may be incorporated in the design to provide additional stability.

4.2.53. The proposed earthwork bund adjacent to the OMR begins at Ch. 2,150m and continues parallel to the OMR until Ch. 2,300m where it ties into a rise in the existing topography. The bund has a height of approximately 6m from crest to toe on the OMR facing side and is offset 2m from the edge of the carriageway. The height from crest to toe of the rear face of the bund, which will define the retention capacity of the bund, has a maximum height of 4m at Ch. 2,270m. The rear height varies throughout the bund as the toe ties in with the natural topography of the slope behind the bund and a drainage ditch is then cut in to the existing slope at the bund toe. Two existing culverts (Culvert OMR_17 and Culvert OMR_18) will be extended below the bund to ensure continuity of the existing watercourses and enable adequate slope drainage.

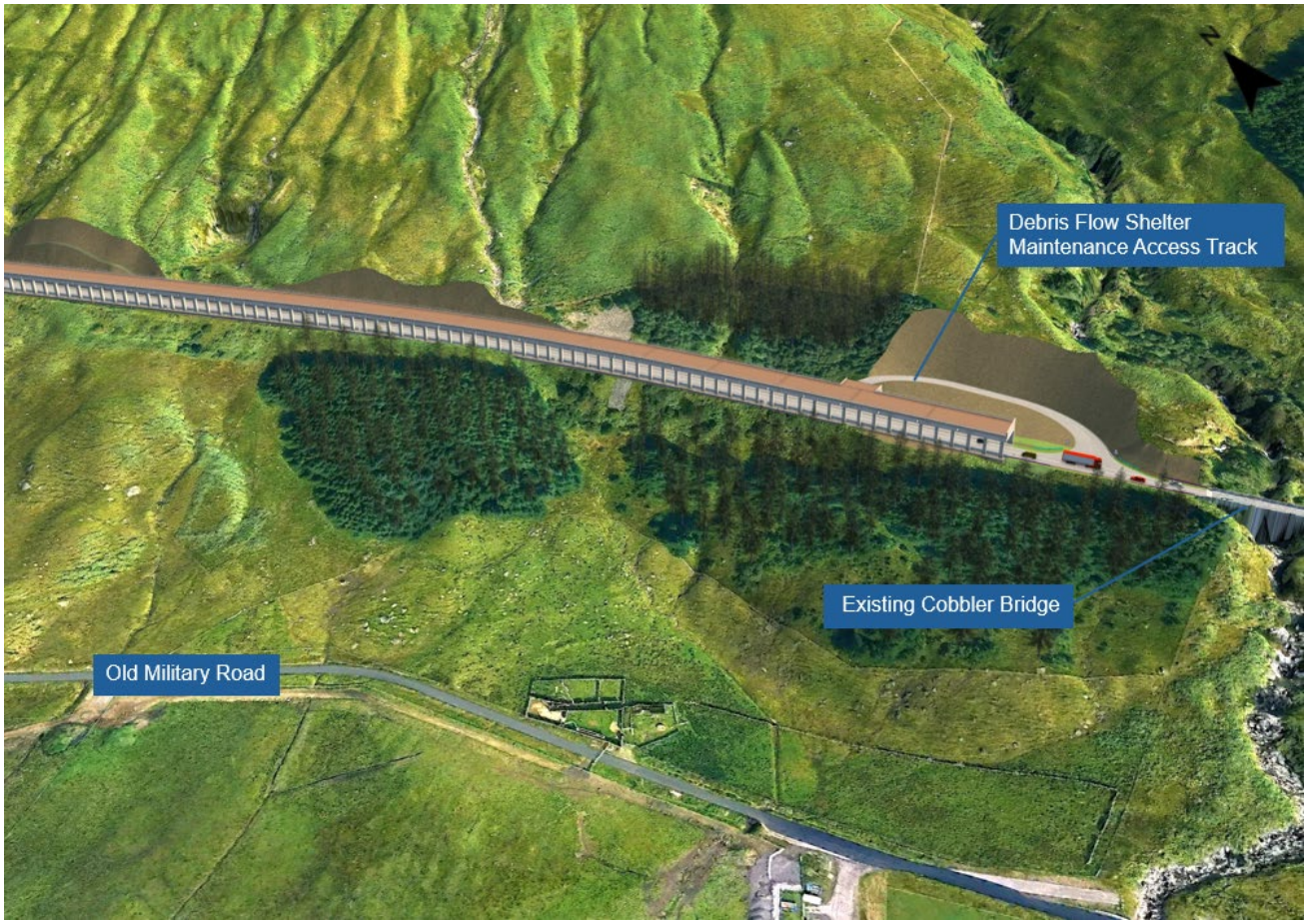
4.2.54. A second earthwork bund is proposed at the entrance to the disused quarry above the A83 Trunk Road. The bund has a height of approximately 3m from crest to toe on the A83 facing side and will tie-in to the steep quarry walls at both ends. A new culvert will be required below the bund to ensure that flows from the quarry reach the existing culvert intake at the A83. Minor earthworks will also be required to improve the existing open channel between the quarry and the A83 Trunk Road.

Structures and Culverts

Debris Flow Shelter

4.2.55. The DFS is the primary structure within the Proposed Scheme, see Plate 4.9 below. The DFS is intended to act as a rigid barrier to protect the A83 from debris flow, landslide and rockfall events. An approximately 6m wide catchpit (width will have minor variation along its length based on the existing ground profile) is present at the rear of the structure to provide additional debris and rockfall collection capacity and to convey watercourses from the slopes of Beinn Luibhean above, into culverts below the A83. The proposed superstructure comprises a monolithic portal frame with a solid reinforced concrete wall on one side, regularly spaced reinforced concrete columns on the other and a solid reinforced concrete roof slab. A minimum internal width of 14.3m and minimum internal height of 5.3m at the inside face of the hillside wall will be provided.

Plate 4.9 – Computer generated image of the DFS at the southern end of the Proposed Scheme



4.2.56. Due to the variable rockhead profile along the length of the A83, it is envisaged that the substructure will vary along the length of the DFS, with either an embedded wall or twin piles on one side and a single row of piles on the other. A 4-degree slope on the soffit of the roof slab will be provided in order to allow smoke to dissipate out of the structure on the open side in the event of a fire.

4.2.57. The DFS will accommodate a 3.65m single lane in each direction with a 1m hard strip and 2.5m verge on either side. An emergency evacuation and maintenance walkway with a minimum clear width of 1.5m is proposed on the valley side of the structure and will be formed in the valley side pilecap. A 1m high pedestrian parapet will be provided along the length of this walkway. A concrete barrier will be provided in the northbound verge with discrete breaks to facilitate emergency exit of the DFS.

4.2.58. The DFS will carry a maintenance access track on its roof to allow clearance of the catchpit and roof from the roof of the structure. Access to the roof of the DFS will be provided at the southern end via a direct access and maintenance track for the A83 over an access bridge above the catchpit. A turning area will be provided at the northern end of the structure. A minimum 1m depth of fill will be provided on the roof to dissipate energy from boulders as part of rockfall events. It is proposed that the fill material is planted with suitable low-lying, wildflower and grass mix to create a green roof. A 1m thick layer of gabions will also be provided at the rear of the hillside wall to dissipate energy from lateral boulder load as part of rockfall and debris flow events. A 1m high pedestrian fence is proposed along the perimeter of the roof of the DFS with the exception of the ends of the structure where a solid reinforced concrete upstand is proposed.

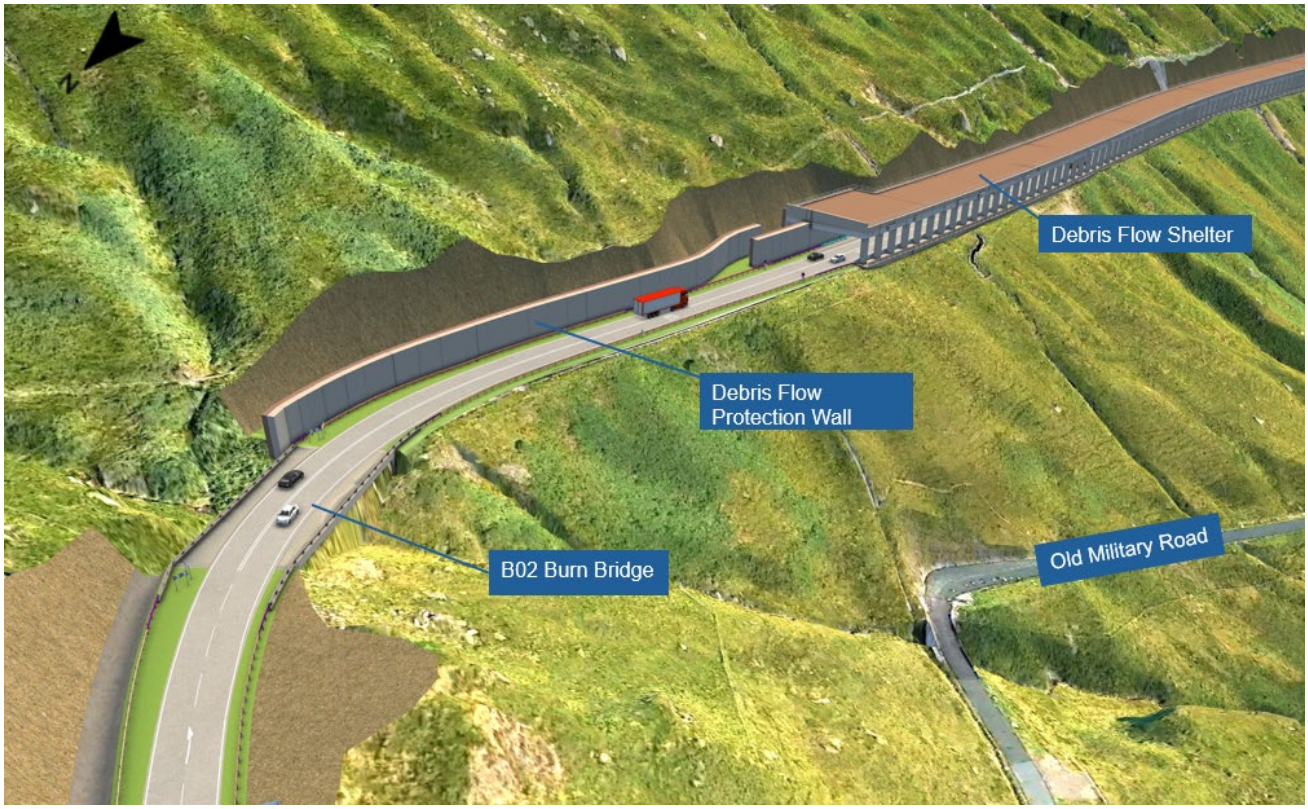
4.2.59. At either end of the DFS there is a requirement for equipment rooms which will be arranged into service buildings. At the southern end it is proposed to include the service building to the rear of the DFS embedded below the DFS maintenance access track to minimise visual impact and avoid the need for greater landtake. At the northern end it is proposed to include the service building below the turning area on the roof of the DFS, utilising a combined maintenance access to the catchpit for access.

4.2.60. Welfare facilities will be included in both service buildings with foul drainage contained in a septic tank.

Debris Flow Protection Wall

4.2.61. Two Debris Flow Protection Walls (DFWs), with a staggered arrangement, are proposed to the north of the DFS in the southbound verge, see Plate 4.10 below. The first DFW extends from the end of the DFS (Ch. 1,445m) for approximately 21m at a constant offset of 2.5m from the edge of the proposed A83 Trunk Road. The second DFW commences at Ch. 1,456m behind the first DFW with a 10m overlap, and extends north for approximately 135m terminating adjacent to B02 Burn Bridge (see below). The DFWs will provide a similar function to the DFS where the wall acts as a rigid barrier to debris and rockfall events with the adjacent catchpit to provide additional debris collection capacity. The structures are proposed to comprise a reinforced concrete wall embedded into rockhead along their length. Access will be provided to the catchpit behind the DFW at its northern end for maintenance and operation activities.

Plate 4.10 – Computer generated image of the DFW at the northern end of the Proposed Scheme

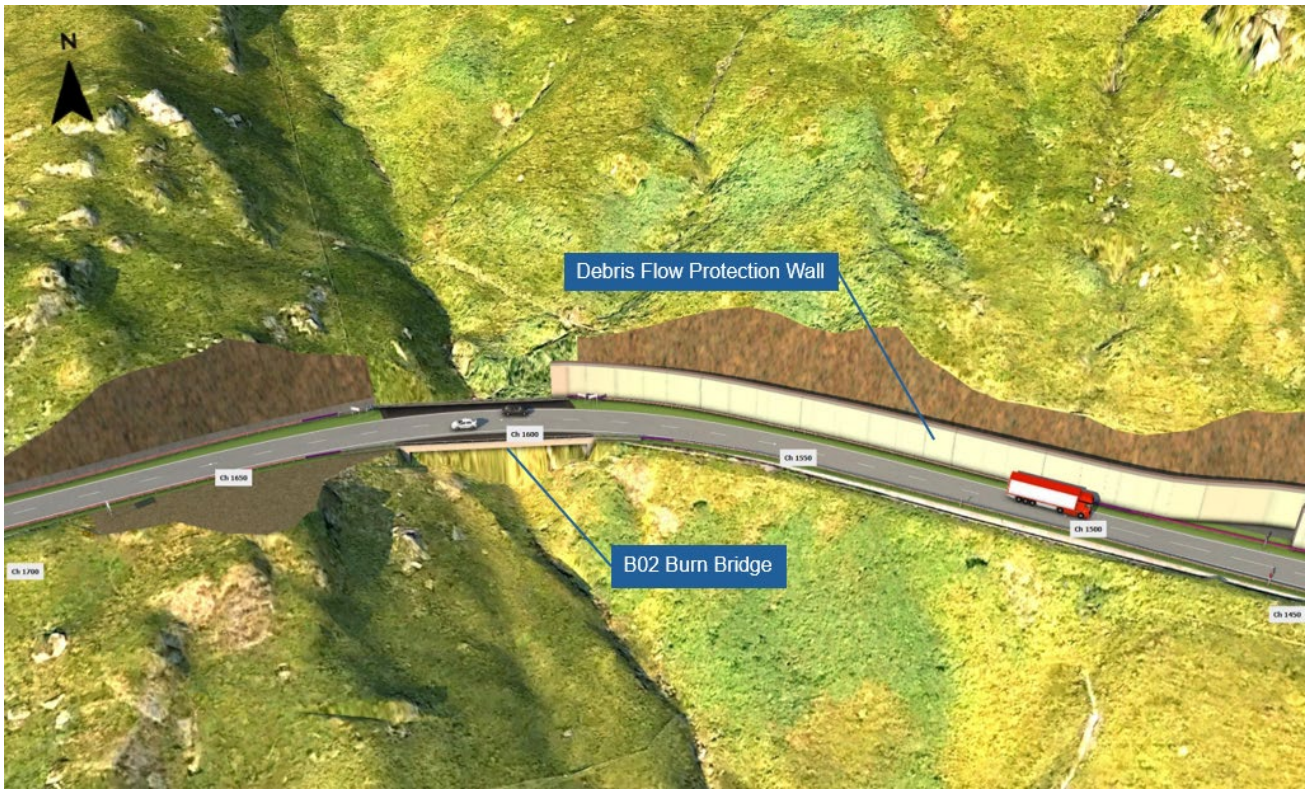


B02 Burn Bridge

4.2.62. A new watercourse crossing carrying the A83 over an unnamed watercourse is proposed to the north of the DFW, see Plate 4.11 below. The A83 is curved on plan with a variable radius at this location. The structure comprises a 30m single span, precast, prestressed beam bridge skewed at 12-degrees to the A83. The primary function of this bridge is to convey debris flow and landslide material under the A83 at this location and into the base of the valley.

4.2.63. The structure carries a 3.35m wide lane in each direction with 0.3m hard strips and 2.5m (minimum) verges on either side. Normal containment parapets of 1m height will be provided at either edge of the bridge. This will transition into a vehicle restraint system (VRS) which will allow access to be provided behind the DFW.

Plate 4.11 – Computer generated image of B02 Burn Bridge at the northern end of the Proposed Scheme



Proposed Structures – OMR Improvements

4.2.64. To facilitate the OMR Improvements, namely the increase in width to accommodate two-way traffic, additional structures and some modification to existing structures, will be required. There is a new proprietary structure, Bridge D, required alongside the existing Bridge A and Bridge B shall be widened using a precast arch solution.

4.2.65. It is also proposed to extend the existing HESCO Barrier by approximately 150m and introduce debris flow fences behind the existing quarry adjacent to the A83 Trunk Road.

Bridge D – Proprietary Bridge

4.2.66. There is a requirement to install a proprietary bridge structure adjacent to Bridge A, at approximate Ch. 1,740m. This structure will carry the southbound traffic, whilst the existing Bridge A will carry the northbound traffic. The proprietary bridge will span the Croe Water downstream of the existing Cobbler Bridge.

4.2.67. The proprietary bridge will be provided by a specialist manufacturer and is anticipated to be constructed of structural steel with a proposed single span of 12 metres. It is assumed that the structure will be supported on reinforced concrete abutments and spread foundations.

4.2.68. The structure will be simply supported, and is likely to be a modular, bailey bridge type structure.

4.2.69. Alternatives considered to the proposed proprietary bridge at Bridge D included:

- Widening of the existing structure. Discounted, as although possible, widening the existing structure to cater for two-way vehicle movements would be technically challenging, requiring the bridge to be closed for the duration of the works which could introduce wider resilience issues in Glen Croe.

- Provision for a permanent one-way structure parallel to the existing structure (Bridge A). Although similar to the preferred option, this was discounted as it would introduce a range of additional engineering, environmental and economic impacts.
- Demolition of the existing structure and provision of a two-way structure at the same location as the existing (Bridge A). Discounted as it was deemed to have the most significant impacts of all options considered with the demolition of a structure which is approximately 10 years old with significant works required in the watercourse.

Bridge B – Localised Widening

4.2.70. Planned realignment of the OMR requires localised widening of Bridge B, at approximate Ch. 3,215m. The downstream parapet will be demolished to extend the width of the structure by 1.5m to facilitate traffic in both directions.

4.2.71. A proprietary arch will be provided by a specialist manufacturer and is anticipated to be an unreinforced concrete arch with a clear span of 4.4m. The arch will be supported on newly constructed reinforced concrete abutments and spread foundations. The arch will span square to the abutments and therefore have no skew.

4.2.72. Spandrel walls will be precast sections, clad with locally sourced masonry, in keeping with the aesthetics of the existing bridge. The wingwalls will be reinforced concrete L-shaped walls, also faced in locally sourced masonry.

4.2.73. The carriageway width between kerbs is approximately 4.7m. The new downstream parapet will be constructed of masonry and have a height of 1.15m, in line with DMRB CD 377 ‘Requirements for Road Restraint Systems’. It will include a curve at the western end, where the parapet end protection cannot be provided. This is in line with Department for Transport Guidance on the Design, Assessment and Strengthening of Masonry Parapets on Highway Structures.

HESCO Barrier

4.2.74. The preliminary design for the proposed extension to the HESCO barrier is a continuation north from the existing barrier, for approximately 150m, terminating at Ch. 2,630m.

4.2.75. The front face of the barrier will be approximately 6m in height, allowing for embedment of the HESCO MIL units. The rear height will vary, as required, to provide deflection of debris flows to the low point behind the existing barrier. The alignment of the barrier will be at a skew to the OMR to take advantage of the change in gradient and maximise the potential capacity of the barrier. The form of the barrier will be optimised to reduce the excavation into the hillside as far as possible.

4.2.76. A new culvert, (ref. OMR_20), will be provided below the HESCO barrier extension to enable continuity of the existing watercourse.

4.2.77. Alternatives considered to the extension of the HESCO barrier included:

- Removal of the existing HESCO barrier and provision of an earth bund. Discounted as there is insufficient space between the OMR and A83 to provide an earthworks bund of sufficient size and scale to mitigate the geohazard / landslide risk.
- Removal of the existing HESCO barrier and provision of a reinforced earth structure. Discounted as it generally does not provide any significant benefits in comparison to extending the existing HESCO barrier.
- Removal of the existing HESCO barrier and provision of a reinforced concrete retaining wall (e.g. similar to the DFW included adjacent to the A83). Discounted as it is a significant engineering solution which brings potentially significant impacts across a range of engineering, environment and economic criteria.

Debris Flow Fencing

4.2.78. Debris flow and rock fall fences are proposed above the A83 Trunk Road to increase the resilience of the OMR, in advance of the construction of the Proposed Scheme. New fences are proposed where there are currently no geotechnical interventions in place above the A83 Trunk Road, this includes the slopes either side of the old quarry. The slope angles here are generally steep and often exceeding 30°.

4.2.79. The two proposed fences are 30m and 35m in length and require a minimum height of 3.5m. The fences typically include steel posts attached to concrete foundations. The posts are anchored upslope with upslope anchor ropes including integrated braking elements. A primary net is attached to upper and lower support ropes. Secondary meshes may be incorporated into the design for retaining the fine material.

Proposed Scheme Culverts

4.2.80. There are a total of 13 No. culverts passing under the DFS and DFW (A83_16 to A83_30, respectively), refer to Table 4.2. These culverts are intended to convey watercourses, passing from the hillside into the catchpit and through the culverts under the A83. The culverts are oversized for normal flow conditions, with internal dimensions of 1.9m wide x 1.9m high and are sized to provide adequate capacity in debris flow conditions. Debris screens at the inlet of the culverts will be provided to limit the size of the material entering the culvert to liquid and small stones and debris material. There are also a further four culverts to the north of the DFS and DFW (A83_32 to A83_35, respectively).

4.2.81. The culverts are proposed on either Major or Minor A watercourses and will replace any existing culverts under the A83. Realignment of some watercourses will be required and energy dissipation measures will be required downstream of some culverts. A general arrangement of the typical watercourse crossing is included in Volume 3, Figure 4.5a LTS Watercourse Realignments.

Table 4.2 – Proposed A83 Culverts

Culvert Name	Chainage (m)	Description
A83_16	190	1.9m x 1.9m Box Culvert with downstream cascade
A83_17	270	1.9m x 1.9m Box Culvert with downstream scour apron
A83_18	430	1.9m x 1.9m Box Culvert with downstream cascade
A83_19	570	1.9m x 1.9m Box Culvert with downstream cascade
A83_20	635	1.9m x 1.9m Box Culvert with downstream cascade
A83_23	810	1.9m x 1.9m Box Culvert with downstream cascade
A83_24	920	1.9m x 1.9m Box Culvert with downstream cascade
A83_25	1,065	1.9m x 1.9m Box Culvert with downstream cascade
A83_26	1,135	1.9m x 1.9m Box Culvert with downstream scour apron
A83_27	1,265	1.9m x 1.9m Box Culvert with downstream scour apron
A83_28	1,315	1.9m x 1.9m Box Culvert with downstream cascade
A83_29	1,400	1.9m x 1.9m Box Culvert with downstream scour apron
A83_30	1,500	1.9m x 1.9m Box Culvert with downstream cascade
A83_32	1,690	2.7m x 2.7m Box Culvert
A83_33	1,860	1.2m x 1.2m Box Culvert
A83_34	2,045	1.2m x 1.2m Box Culvert
A83_35	2,230	1.2m x 1.2m Box Culvert

Proposed OMR Improvement Culverts

4.2.82. There are 14 No. new culverts, and 3 No. culvert extensions proposed as part of the OMR Improvements. Details are set out in Table 4.3.

Table 4.3 – Proposed Culverts on OMR

Culvert Name	New or Extension	Chainage (m)	Description
OMR_08	Extension	1,198	Extension length 3.108m: 1 No. 375mm dia. pipe
OMR_09	New	1,320	Length 15.30m: 2No. 900mm dia. plastic pipes
OMR_10	Extension	1,410	Extension length 6.114m: 1No. 900mm dia. plastic pipe
OMR_11	New	1,451	Length 13.50m: 2No. 600mm dia. plastic pipes
OMR_12	New	1,608	Length 15.05m: 1No. 600mm dia. plastic pipe
OMR_14	New	1,840	Length 21.10m: 2No. 900mm dia. plastic pipes
OMR_15	Extension	1,992	Extension length 14.346m: 1No. 600mm dia. plastic pipe
OMR_16	New	2,066	Length 16.30m: 2No. 800mm dia. plastic pipes
OMR_17	New	2,170	Length 34m: 1No. 700mm dia. plastic pipes
OMR_19	New	2,255	Length 35m: 1No. 800mm dia. plastic pipe
OMR_20	New	2,488	Length 24.0m: 1No. 700mm dia. plastic pipe
OMR_21	New	2,581	Length 7.91m: 2No. 900mm dia. plastic pipes

Culvert Name	New or Extension	Chainage (m)	Description
OMR_26	New	2, 896	Length 9.92m: 2No. 500mm dia. plastic pipes
OMR_27	New	2,940	Length 6.32m: 2No. 900mm dia. plastic pipes
OMR_29	New	3,118	Length 6.26m: 2No. 600mm dia. plastic pipes
OMR_34	New	3,507	Length 10.59m: 1No. 600mm dia. plastic pipe
OMR_35	New	3,527	Length 8.9m: 1No. 600mm dia. plastic pipe

Proposed Scheme Lay-Bys

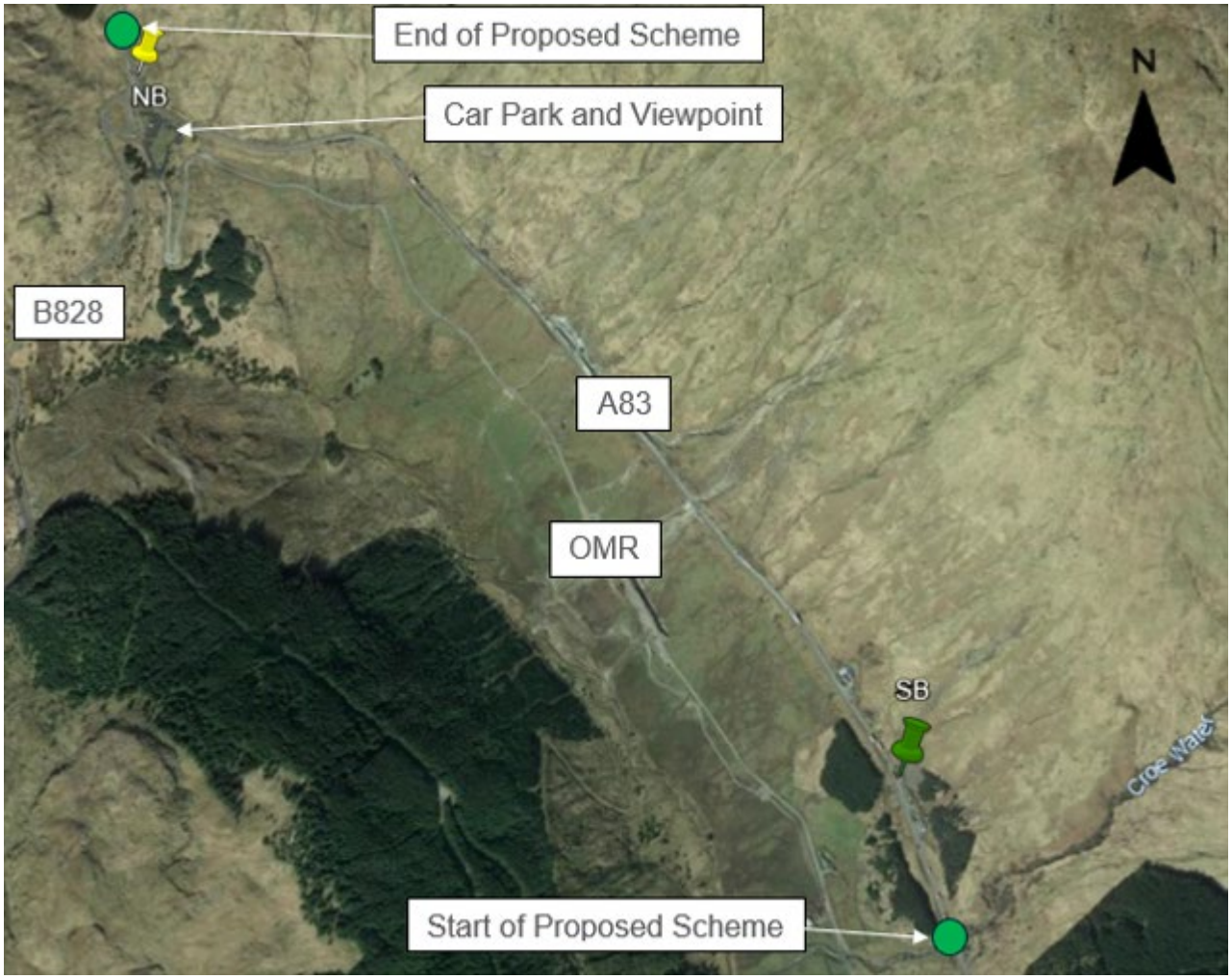
4.2.83. Throughout the DMRB Stage 3 design and assessment process a review has been conducted of the lay-by and non-emergency stopping provisions between Arrochar and Cairndow, which encompasses the section within the extents of the Proposed Scheme.

4.2.84. There are two existing lay-bys within the Proposed Scheme extents, one northbound in the vicinity of the B828 Glenmore local road junction and one southbound approximately 250m north of the Cobbler Bridge, see Plate 4.12 below.

4.2.85. As the existing northbound lay-by is currently incorporated into the B828 Glenmore local road junction merge layout and given the proposals to make improvements to the junction, the removal of the lay-by to accommodate a compliant merge layout is required.

4.2.86. On the basis that the Rest and Be Thankful Viewpoint car park is immediately adjacent to the A83 and will be accessed via the improved B828 Glenmore local road junction the removal of this lay-by is not considered to have a significant impact on the non-emergency stopping provision.

Plate 4.12 – Aerial imagery of two existing lay-bys within the Proposed Scheme extents



4.2.87. The existing southbound lay-by will fall within the proposed DFS extents. Inclusion of a lay-by within the DFS would require significant localised widening of the structure wall which would have implications on the catchpit and subsequently result in significant increased earthworks cut material. As such it is proposed that this lay-by is removed as part of the Proposed Scheme.

4.2.88. This approach aligns with the outcomes of the ongoing operational assessment of the Proposed Scheme. A lay-by located within the proposed DFS could encourage unnecessary stops from road users resulting in unnecessary risk to the Proposed Scheme.

4.2.89. The conclusion of the lay-by and non-emergency stopping provisions review was that while there will be two lay-bys removed from the A83 within the Proposed Scheme extents, the overall lay-by provision is sufficient and still meets the requirements of DMRB CD 169 'The Design of Lay-bys, Maintenance Hardstandings, Rest areas, Service Areas and Observation Platforms.

4.2.90. Therefore, the two lay-bys removed as a result of the Proposed Scheme will not be replaced.

Proposed Scheme Traffic Signs and Road Markings

4.2.91. Traffic Sign and Road Marking requirements and detailing have been developed based on relevant design standards and taking cognisance of the existing provision within the Proposed Scheme extents. This will be further developed at specimen and detailed design stages and the Appointed Contractor will be required to consult with Transport Scotland and Argyll and Bute Council.

4.2.92. A Traffic Sign and Road Marking strategy has been developed for the Proposed Scheme. As part of detailed design, this will be further developed by the Appointed Contractor, taking cognisance of the environmental impact of signage, particularly in terms of landscape and visual intrusion.

4.2.93. Whilst it is proposed to retain the existing traffic signs, these will be relocated to allow siting in accordance with the Traffic Signs Manual (TSM), ensuring drivers have sufficient time to react to hazards and changes in road layout. It is also proposed that any additional traffic signs required, over and above the existing, be designed to match existing sign face sizes (in accordance with the existing x-heights used, as set out in Appendix A: Directional Signs in Local Transport Note 1/94 – The Design and Use of Directional Informatory Signs) to ensure continuity within the Proposed Scheme extents. The x-height is used to define the size of text on a traffic sign face based on the height of the lower-case letter 'x' and the unit of measurement when designing a sign is the stroke width which is one quarter of the x-height.

4.2.94. The traffic sign layout for the Proposed Scheme will also look to reduce sign clutter to improve forward visibility for all road users.

4.2.95. In addition to replacing existing traffic signs, as part of the Proposed Scheme there is a requirement to ensure the free flow of traffic within the DFS. This will be achieved through the inclusion of a 24-hour clearway order which will prohibit stopping on the main carriageway and as such will need to be adequately signed.

4.2.96. The existing road marking provision on the A83 within the extents of the Proposed Scheme are generally in compliance with TSM Chapter 5 'Road Markings' and as such much of the existing road markings are to be maintained in the Proposed Scheme design. However, within the Proposed Scheme extents it is proposed to make two amendments to the road markings on the A83.

4.2.97. The first of the amendments is the inclusion of double white lines along the centre of the A83 within, and on the approach to, the DFS extents to prohibit drivers from encroaching on the opposite lane used by opposing flows of traffic. Whilst overtaking is prohibited by the inclusion of white lines, the regulations allow vehicles to overtake stationary vehicles and slow moving (less than 10mph) cyclists.

4.2.98. The second amendment, to improve safety for road users and aid the free flow of traffic on the A83, is the targeted improvements of the B828 Glenmore local road junction as part of the Proposed Scheme which will include updated markings in relation to the inclusion of the ghost island.

Proposed Traffic Signs and Road Markings – OMR Improvements

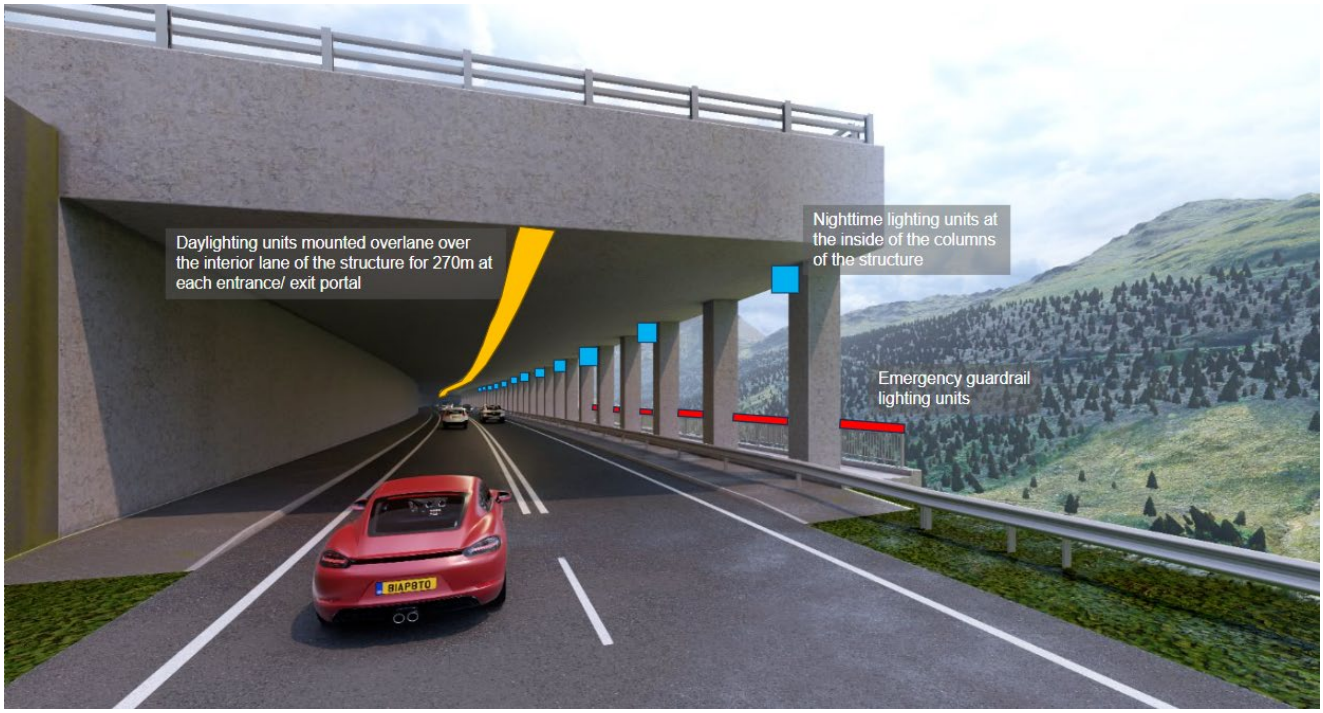
4.2.99. To support the use of the OMR as the local diversion route during construction of the A83 mainline (including B828 Glenmore local road junction and DFS maintenance access) additional signage, speed cushions, marker posts and gates will be required.

4.2.100. Similar to the main works, the detailed design of all signage and road furniture for the OMR Improvements will be part of the Appointed Contractor's responsibilities and will be undertaken in accordance with relevant design standards and the Proposed Scheme contract documentation. Consultation will be required to be undertaken with Transport Scotland and Argyll and Bute Council.

Proposed Lighting (relating to the DFS)

4.2.101. The proposed lighting design includes a combination of daylighting luminaires (located over the southbound lane), structure mounted night-time luminaires, along with some combination of emergency provisions, as shown in Plate 4.13.

Plate 4.13 – Computer generated image of the DFS northern portal with the various lighting proposals illustrated



4.2.102. Where possible, reflective surfaces, including road markings, reflective strips, and brighter surface materials will be used throughout the DFS to enhance visibility and spatial orientation. Reflective road markings have been included as part of the DMRB Stage 3 design. However, the use of brighter surface colours for both the road surfacing and concrete materials within the DFS will continue to be considered and developed as part of specimen design with final commitments included in contract documents.

4.2.103. A system of controls will be implemented that enable lighting to be switched off (or taken to a low level) when not in use.

4.2.104. The proposed daytime lighting is based on:

- artificial lighting provided for a length of 540m through the DFS (in 2 x 270m sections beginning at each portal)
- the potential to integrate control mechanisms such as photometers which will add efficiencies and
- the potential to include measures for surface finishes to aid the lighting, including the use of lighter materials in the interior walls and carriageway, and darker in the areas covering the approach to the structure.

4.2.105. The proposed night-time lighting provision is based on the following which take account of the safety systems that are used for the DFS as well as environmental and visual impacts given the rural and remote location of the Proposed Scheme:

- lighting to be provided to the carriageway for the full length of the DFS in accordance with BS EN 13201 class M6. This would typically be achieved by cornice mounted or overhead tunnel lighting units
- lighting to be provided for any potential pedestrian routes, derived from road lighting standards or from evacuation lighting standards, supporting safe egress in an emergency
- all artificial lighting will use warm colour temperature sources (amber lighting) to mitigate environmental impact
- highly reflective road markings to be used and
- surface finishes to be as light and reflective as possible, as for daytime considerations.

4.2.106. The proposed approach for emergency lighting is subject to change, depending upon the safety systems that are implemented for the DFS. The proposed provisions include:

- use of handrail mounted luminaires for the length of the walkway located on the open, valley side of the DFS, in combination with any illuminated signage proposed by the safety strategy

- use of daytime and / or night-time luminaires as standby lighting in the event of an interruption to the power supply and
- reflective surfaces to be placed along pertinent walls and other structural elements to enhance wayfinding and orientation.

Proposed Scheme Road Drainage

4.2.107. The road drainage strategy for the Proposed Scheme has been developed and assessed as part of the DMRB Stage 3 Assessment process. The drainage strategy has considered three sections of alignment:

- Ch. 0m to Ch. 1,430m (A83 Southern Tie-In to DFS Northern Portal) – Network 1
- DFS roof drainage
- Ch. 1,430m to Ch. 1,945m (DFS Northern Portal to High-Point adjacent to the Rest and Be Thankful Viewpoint car park) – Networks 2A and 2B
- Ch. 1,945m to Ch. 2,245m (High-Point adjacent to the Rest and Be Thankful Viewpoint car park to A83 Northern Tie-In) – Networks 3A, 3B and 3C and
- B828 Local Road & Active Travel Link – Networks 4A to 4G.

4.2.108. Network 1 proposes a kerb and gully collection system under the DFS, filter drains to drain the road catchment south of the DFS, and combined drainage kerbs to drain the access track to the roof of the DFS. The network extends downslope via a ‘stepped’ pipe and chamber arrangement, crosses the Croe Water with a pipe bridge at the OMR, and extends to a detention basin for attenuation and additional treatment prior to discharging to the Croe Water. The detention basin has an access track connection from the OMR which is also drained by filter drains. Typical details for the detention basin are included in Volume 3, Figure 4.6 Typical SuDS Basin Details.

4.2.109. The DFS roof will have a layer of granular fill to act as a cushioning material and provide protection during debris flow and landslide events should the catchpit be overtopped. The drainage strategy is to include filter drains along the eastern edge of the roof that will discharge at regular intervals to the adjacent catchpit where the runoff will be allowed to enter one of the 13 culverts below the DFS.

4.2.110. Networks 2A and 2B have similar drainage strategies, with proposals for filter drains to drain the road, and oversized pipes specified to provide attenuation. The networks shall outfall to existing ditches/channels, between the A83 and OMR, which drain towards Croe Water.

4.2.111. Networks 3A, 3B and 3C have similar drainage strategies, with proposals for filter drains to drain the road, and oversized pipes specified to provide attenuation. The networks shall outfall to existing culverts which drain towards Loch Restil. Networks 3A, 3B and 3C were originally proposed to outfall to a swale situated within the Beinn an Lochain Site of Special Scientific Interest (SSSI). However, it was acknowledged that the swale and the access required for its construction and future maintenance would adversely impact the SSSI. It was therefore agreed through discussions with NatureScot and SEPA that the swale, providing a second level of treatment, could be removed noting the drainage proposals (without the swale) provided an improvement over the existing arrangement.

4.2.112. Networks 1, 2A, 2B, 3A, 3B and 3C will be adopted and maintained by Transport Scotland and therefore are designed in accordance with DMRB standards, ensuring no flooding of the carriageway during the 1 in 5 year plus 46% Climate Change (CC) event. All networks discharge at estimated greenfield Qbar rates.

4.2.113. Networks 4A to 4G, covering the full extents of the Active Travel Link, incorporate either a kerb and gully system or a linear drainage channel, with some of the existing and proposed widened B828 carriageway catchment also being captured. These elements connect into the networks via tail connections to chambers or carrier drains via junctions. All gullies are positioned on the westbound kerb line. A hydraulic calculation, in line with DMRB CD 526 'Spacing of Road Gullies', was conducted which estimates a spacing for draining the road catchment from a hydraulics perspective based on 100% Percentage Impervious value for each catchment along the B828 Road. Where the Active Travel Link alignment veers around existing features, drainage networks will have a linear channel drain to collect surface water and connect into a network via a sump unit to a chamber. There are no proposed treatment features on the basis that the B828 is not treated in the existing scenario, and the Active Travel Link is not to be trafficked.

4.2.114. The B828 Glenmore local road and Active Travel Link will be adopted by Argyll and Bute Council and therefore are designed in accordance with Local Flooding Authority (LFA) standards, ensuring no flooding of the carriageway during the 1 in 30 year plus 46%CC event. All networks shall discharge at estimated greenfield Qbar rates.

Proposed Cut-Off Drainage

4.2.115. Generally, existing cut-off drainage throughout the Proposed Scheme is to be retained where it is not impacted by the works.

4.2.116. Along the extents of the DFS catchpit and proposed rock traps these will act as cut-off drainage, diverting overland runoff from the natural catchment into watercourses and existing ditches / channels prior to draining onto the highway alignment and associated highway drainage networks.

4.2.117. Where required, proposed cut-off drainage features (ditches and filter drains) have been proposed to divert natural catchment runoff towards watercourses and existing ditches / channels. In accordance with DMRB, these have been modelled to ensure no flooding of the features during the 1 in 100 year plus 46%CC event.

Attenuation SuDS

4.2.118. Network 1 utilises a detention basin for treatment and attenuation and was confirmed as appropriate in accordance with early-stage Highways England Water Risk Assessment Tool (HEWRAT). Key details of the detention basin include:

- base invert level – 120.000mAOD which proposes the basin in fill above ground level to mitigate the risk of groundwater encroachment / contamination
- 1:3 internal side slopes up to a level of 121.000mAOD (1.0m deep)
- 3.0m wide access track with a 1:40 crossfall towards the basin
- 1:3 external side slopes (fill) to tie back into existing topography
- vehicular junction and access track extending from the OMR with a proposed filter drain in the southern verge
- Vortex Flow Control restricting the discharge rate to 16.0l/s during the 200yr+46%CC event (in accordance with Qbar Greenfield Runoff calculations) with an estimated freeboard of ~250mm
- the detention basin has been proposed at a minimum 15m offset from the Croe Water edge of bank
- the detention basin has been positioned outwith the Glen Croe 200yr flood event extents
- Network 1 outfalls to Croe Water via a precast headwall structure and
- proposed carrier drains near to the basin are proposed to either be concrete material or with a Type Z concrete surround bedding to counteract flotation of pipes due to high groundwater.

Proposed OMR Improvements Drainage

4.2.119. Generally, the proposed road drainage philosophy is to maintain the existing drainage scenario or formalise drainage elements along the OMR, where feasible. Existing drainage has been assessed to determine the suitability and the potential to retain. Where proposed works are expected to impact the existing drainage, new formal drainage has been included in the design.

4.2.120. Where new drainage is proposed, the design includes filter drains (acting as combined surface and sub-surface drains), carrier drains, gullies, cut-off ditches / filter drains, locations of outfalls, chambers and catchpits.

4.2.121. Surface water runoff from the OMR drainage system derives from the road cross-section, including the carriageway and verges, together with the associated earthworks. Additional surface flow from natural catchment runoff draining towards the OMR Improvements outside the verge to verge cross-section would be kept separate from the carriageway drainage system where practicable by cut-off drainage.

4.2.122. The cut-off drainage will be used throughout the OMR Improvements to capture surface water run-off from embankments, cuttings and where existing ground profiles require control of run-off. The proposed cut-off drainage will replace existing drainage, where required, and divert runoff to local watercourses and channels.

4.2.123. In relation to water quality treatment, the drainage proposals aim to provide betterment and formalisation of drainage when compared to the current arrangement.

4.2.124. With regard to flood risk, a zero-detriment approach in comparison to the existing scenario has been adopted for the OMR Improvements. This aligns with the requirements set out for flood management by Argyll and Bute Council who are in a local plan district with The Highland Council, with the latter being the Lead Local Authority. In line with Section 6.13 of 'The Highland Council's Flood Risk and Drainage Impact – Supplementary Guidance', allowable discharge rates and volumes draining to a receiving watercourse / waterbody shall not exceed the existing runoff rates for Brownfield sites, or the Greenfield runoff rate for previously undeveloped sites. A climate change allowance of 46% has also been applied in line with SEPA Document 'LUPS-CC1: Climate change allowances for flood risk assessment in land use planning'.

4.2.125. Where drainage networks are controlled to allowable discharge rates (based on a zero-detriment approach pre and post development assessment), the restriction of flow is achieved through the installation of flow controls such as vortex flow controls and orifice plates.

4.2.126. Attenuation of runoff is achieved through the use of oversized pipes, expected to be up to 500mm in diameter, avoiding the need for attenuation features such as ponds and basins.

Watercourse Crossings

Proposed Scheme Watercourse Crossings and Realignment

4.2.127. Watercourses have been categorised using the definition provided in Table 4.4 and are identified Volume 3, Figure 19.3 The Proposed Scheme and Watercourses.

Table 4.4 – Watercourse categories and descriptions

Category	Descriptions
Major	On OS 1:50,000 scale map
Minor A	On OS 1:25,000 scale map and perennial
Minor B	Not on OS 1:25,000 scale map or ephemeral

4.2.128. With reference to Table 4.4, it is noted that the supply of water and sediment from a measurable, permanent catchment area maintains a clearly defined channel. Flows may be perennial or ephemeral resulting from groundwater flow, tributary input, springs and storm event run-off. Flow direction is typically perpendicular to contours and follows topographic depressions. Watercourses would have existed prior to human modification of the landscape. Minor B watercourses have been assessed on a site-by-site basis for ecological potential and morphological functioning.

4.2.129. Of the 22 existing watercourse crossings affected by the Proposed Scheme, 14 are situated underneath the DFS and DFW of which 12 new culverts will be constructed (flow from two Minor B watercourses will be incorporated into the neighbouring culverts). Each of these structures consists of a grated horizontal entrance that will be situated level with the catchpit bed (approximately 6m wide) and positioned over the upstream end of the proposed A83 culverts. Flow from the upstream watercourses will spill into the catchpit and be directed towards the grated entrance by means of a 5% longitudinal and horizontal gradient. The watercourse will flow into the grated opening (100mm spacing) to allow transfer of gravels and small cobbles downstream.

4.2.130. Once the flow passes through the grate it will enter a drop structure which comprises angled sides and an angled step to dissipate energy and direct flow and sediment into the culvert. Each of the proposed culverts that pass under the A83 DFS are currently 1.9m x 1.9m box culverts with a proposed 5% gradient. These structures have been oversized for the flows that are expected and have been sized principally to satisfy Construction Design and Management (CDM) Regulations and ease of maintenance. A low flow channel has been designed within the culvert bed to accommodate lower flows whilst maintaining sediment continuity.

4.2.131. The current design includes a section of open channel (2.5% gradient) after the flow exits the culvert. This open channel includes engineering measures (e.g. baffles) to reduce the exit velocity of the flow from the culvert. The open channel section is also wider than the base diameter of the culvert to further dissipate the energy from the culverted flow.

4.2.132. Downslope dissipation and protection measures will comprise a combination of bank reprofiling, natural rock and / or reinforced concrete cascade features and / or geo-engineered stabilisation measures.

4.2.133. There will be minor realignments to the planforms upstream (to accommodate the catch pit) and downstream of the crossings to ensure a smooth tie-in to the existing ground. Realignments have been minimised and in the majority of watercourses aligns with the existing channel downslope of the A83.

4.2.134. Along the A83, within the extents of the Proposed Scheme, there are six other crossings (A83_ML_030 - A83_ML_035) beyond the extents of the approximately 1.6km that has a planned retaining feature (DFS / DFW). A83_ML_031 is a bedrock channel and will be a free span bridge. The other crossings will be sized to accommodate the Q200+CC (0.5% Annual Exceedance Probability (AEP)) flow and have an appropriate allowance for freeboard. Headwall arrangements will be included in the design. The bridges over the Croe Water will be retained. The potential interaction with wildlife has been assessed, and mammal passage or ledges have been confirmed at the northern end of the Proposed Scheme at B02 Burn Bridge (A83_ML_031) and the culvert immediately to the north of this (A83_ML_032). At the southern end of the Proposed Scheme mammal passage will be retained through the existing Cobbler Bridge.

4.2.135. There are also three watercourses that are crossed on the other side of the glen as part of the Active Travel Link, adjacent to the B828 (B828_001 – B828_003). These will be extended beneath the Active Travel Link.

Proposed Fencing and Environmental Barriers

4.2.136. Temporary fencing will be erected where required prior to the commencement of construction to secure the area and will be determined by the Appointed Contractor.

4.2.137. The design of environmental barriers will be incorporated to provide mitigation to protect mammals (for example otter fencing), this will be further considered and detailed as part of specimen and detailed designs.

Proposed Road Surfacing

4.2.138. The road surfacing involves building up of the pavement in layers. The bottom layer (sub-base) which consists of a crushed rock aggregate would be delivered to the site from local quarries. The upper pavement layers would be specified in accordance with the requirements of the contract and would involve transport of material to the site either from local sources or from a batching plant on site.

Maintenance Proposals

Road Maintenance

4.2.139. As the Proposed Scheme forms part of the Trunk Road Network, upon completion it shall be returned to the appointed regional Operating Company to be maintained. The maintenance of the proposed carriageway and associated road assets will therefore naturally integrate into the Operating Company's cyclic inspection and maintenance programmes.

Catchpit Clearance

4.2.140. A safe process of works will require to be developed by the Operating Company to clear debris following debris flow events that result in the catchpit behind the DFS and DFW having a build-up of detritus. To negate the need for work in a confined space the maintenance track provides access to the DFS roof for operatives and machinery to clear debris from the adjacent catchpit.

4.2.141. It is assumed that long-reach excavators will be brought onto the DFS roof to reach into the catchpit and remove the debris, they will then load the debris into the back of waiting multi-axle lorries. The lorries will be able to drive the entire length of the DFS roof, to prevent the need for them to complete a potentially dangerous reversing manoeuvre to exit the roof. To facilitate the turning of lorries on the roof there is a turning area incorporated at the northern extent of the roof.

Structural Inspections

4.2.142. A programme of routine inspections of structural elements will be required on existing and proposed structures within the Proposed Scheme extents. These will likely be integrated into the Operating Company's existing cyclic inspection programme. Safe access provision to inspect and perform maintenance on structures will be devised during the detailed design stage.

Embedded Mitigation

4.2.143. As the design of the project has evolved, measures have been incorporated into the project design in order to avoid or prevent adverse environmental effects. These measures are referred to as 'embedded mitigation' and are taken into account in this EIA Report before determining potential impacts. Table 4.5 collates and summarises the embedded mitigation measures included in the design and.

Table 4.5 - Embedded mitigation measures

Ref	Description
CH-Embed 1	The new active travel route at the north of the Proposed Scheme has been designed to retain the World War II assets (A11 and A64 – 67) adjacent to the B828 Glenmore.
ECO-Embed1	The Proposed Scheme design has evolved to minimise impacts on: Beinn an Lochain SSSI with the removal of a proposed Sustainable Drainage System (SuDS) within the SSSI in consultation with SEPA and NatureScot, (who also confirmed that the use of filter drains would be an improvement over the current scenario): habitats; trees (including riparian trees); and protected and notable species. Efforts to reduce losses further will continue during detailed design.
ECO-Embed 2	A sensitive lighting approach has been incorporated into the design of the Proposed Scheme that considers impacts to wildlife whilst also ensuring public safety and reduced visual impacts. The lighting designers worked closely with ecologists and landscape architects in creating the design, and this collaborative approach will continue during detailed design. The design team applied their professional experience and took account of 'Bats and Artificial Lighting in the UK' Guidance Note GN 08/23 (https://theilp.org.uk/publication/guidance-note-8-bats-and-artificial-lighting/). If night time work is required, any temporary lighting will be directed towards works areas and cowling will be used to minimise light spill on sensitive receptors such as watercourses.

Ref	Description
ECO-Embed 3	Information on watercourse realignment and aquatic mitigation of culverting is provided in Volume 2, Chapter 19 Road Drainage and the Water Environment. Sensitive ecological watercourse realignment and crossing design has been included wherever possible, whilst acknowledging the significant constraints and risks the water environment poses within the vicinity of the Proposed Scheme and the need for some hard engineering. Watercourse crossing lengths and riparian habitat loss has been minimised as far as practically possible. New or extended watercourse crossings, including culvert inlets and outlets, will be sensitively designed and constructed with reference to SEPA's Good Practice Guides (Engineering guidance | Scottish Environment Protection Agency (SEPA)). The drainage designers worked closely with ecologists and hydrologists in creating the design, taking survey data, habitat suitability for key species and professional judgement into account. This collaborative approach will continue during detailed design. Detailed designs will also ultimately be subject to SEPA authorisation for works affecting watercourses under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR). Culverts will be appropriately designed to maintain in-channel habitat (i.e. sediment and flow) continuity wherever possible in line with good hydromorphological design practices (see Volume 2, Chapter 19 Road Drainage and the Water Environment). Detailed design will also incorporate safe passage for mammals where required.
ECO-Embed 4	Volume 2, Chapter 19 Road Drainage and the Water Environment sets out measures including measures to reduce flow at outfalls. Design options are being considered to slow flow rate of water leaving the catchpit towards the Croe Water. Slowing the flow will reduce sedimentation loads and scouring when the Headwaters enter the Croe Water. This will mitigate adverse impacts on aquatic species and habitats.

Ref	Description
ECO-Embed 5	The detention basin to the south of the Proposed Scheme will remove pollutants and sediments from run-off from the Proposed Scheme prior to entering surrounding habitats and watercourses (Croe Water). Pollutants will naturally dilute out of run-off within the detention basin prior to entering any main watercourse (Croe Water). The detention basin will also provide attenuation up to the 200-year event with flows restricted to Qbar greenfield rates which will reduce flood risk associated with the Proposed Scheme. Marginal and landscape planting around this feature will benefit a range of invertebrates, enhancing the site for foraging bats and other mammals.
ECO-Embed 6	The road drainage provides water quality treatment via the specification of filter drains and catchpit sumps prior to basin or watercourse outfalls. Their detailed design will include measures to reduce risks to animals.

Ref	Description
ECO-Embed 7	Temporary fencing and / or barriers will be erected to secure the working area(s) and prevent animals, including otter and badger, that rely on existing mammal pathways to navigate (for example waterways / culverts) entering the main roads during construction. Wildlife warning reflectors will also be installed along the OMR and maintained while it is used as a diversion route. Permanent wildlife fencing (if and where appropriate) will be installed to direct animals to safer crossing points. Locations will be finalised at detailed design but it is anticipated that design will include a requirement near the burn bridge to the north of the DFS, at Bridge B on the OMR and retention of mammal passage at the Croe Water culvert. Indicative key locations are shown in Volume 3, Figure 9.3: Landscape and Ecological Mitigation Plan, which should be read with the mitigation described in this chapter, the landscape chapter and the OLEMMP (Volume 4 Appendix 11.15). Fencing and / or landscape planting would also be designed and installed in areas near the entrances to the DFS so that species including deer, badger and pine marten are discouraged from entering the DFS (if appropriate). Fencing will be installed to stop wildlife accessing the top of the DFS, if required. The detailed design would be determined taking account of ecological professional judgement, based on the survey data that informed this EIAR, combined with any subsequent update survey data and also taking account of detailed design and ground conditions.
ECO-Embed 8	Two Receptor sites have been included in the Proposed Scheme. Receptor 1 will be used for installation of bat boxes (compensation under licence and for wider loss of roosting opportunities) and bird boxes. Receptor 2 will be enhanced to increase carrying capacity for reptiles and may also be used for additional bird and bat boxes depending on requirements identified during detailed design and update surveys.

Ref	Description
LV-Embed-1	Debris Flow Shelter: • The Debris Flow Shelter has been designed to include a green roof to help blend the DFS to the landscape and Through further design development at the next stage, and with engagement with the LLTNPA, Transport Scotland will design and, where necessary, specify measures for the Appointed Contractor to improve the aesthetics of the DFS (such as slanted piers)
LV-Embed-2	Bund slope gradients have been designed to be varied to make the SuDS features as natural as possible and will be agreed with the Environmental Clerk of Works.
LV-Embed-3	• Conceptual design has been developed to retain open views for users of the A83 and • Conceptual design has been developed to maintain local landscape character.
LV-Embed 4	The HESCO barrier extension will match the colour of the existing HESCO barrier as far as possible.
GSG-Embed1	The footprint of the existing OMR has been utilised as much as possible, which minimises both the land take required and cuttings into the hillside, hence reducing the potential impact on soils (including carbon rich soils such as peat) and groundwater receptors.

Ref	Description
GSG-Embed2	Between CH160 to CH1090 and CH2480 to CH3836, it is proposed to retain the existing ditches, which would provide a Surface Water Pollution Mitigation Index of SS 0.5, M 0.6, and H 0.6. This suggests only 0.2 below the target Suspended Solids (SS) score, and satisfactory treatment for Metals (M) and Hydrocarbons (H) in comparison to the OMR Road Pollution Hazard Indices. Although these mitigation indices fall below compliance with the Simple Index Approach (SIA), they do provide treatment and existing features look in good condition. The proposal to retain was agreed in principle with SEPA during the A83 ESG January 2024 consultation meeting, to minimise engineering interventions as a proportionate approach for the OMR to be used as a temporary route.
GSG-Embed3	Between CH1090 to CH2480, filter drains are proposed along most of the extents to drain the road as well as draining the earthworks and verges. These filter drains would provide a Surface Water Pollution Mitigation Index of SS 0.4, M 0.4 and H 0.4. Although these mitigation indices fall below compliance with the Simple Index Approach (SIA), they do provide treatment and existing features look in good condition. The proposal to retain was agreed in principle with SEPA during the A83 ESG January 2024 consultation meeting, to minimise engineering interventions as a proportionate approach for the OMR to be used as a temporary route.
GSG-Embed4	The LTS follows the footprint of the existing A83 corridor, which minimises both the land take required and cuttings into the hillside, hence reducing the potential impact on geology, soils and groundwater receptors.

Ref	Description
GSG-Embed5	The following has been included within the drainage design: • Sustainable drainage system (SuDS) in Network 1, is a detention basin, allowing storage of runoff, attenuation and treatment, before discharging to the Croe Water. The basin's height above ground level varies from 0.21m to 1.26m agl (above ground level). The maximum groundwater level at the basin is recorded as 0.15m bgl (below ground level) (AAB-BH1049), hence the base of the feature is designed to be ~0.35m above the maximum groundwater level to mitigate the risk of groundwater contamination. • The detention basin will be vegetated, with the soil layer absorbing a proportion of the runoff, in addition to sediment and pollutant removal. • Carrier drains, aligned throughout most of the LTS area, comprise unperforated pipes, without infiltration (due to slope stability concern). • Carrier drains close to the basin are proposed to either be concrete material or with a concrete surround bedding to counteract the potential flotation of pipes due to high groundwater levels. • Filter drains carrying road runoff as part of the SuDS for Networks 2 and 3 will be lined with an impermeable material, to prevent infiltration increasing risk of slope instability and will protect groundwater from any contaminants. • Crest drains that intercept overland flow are expected to also be lined, particularly in upper sections, preventing infiltration of water onto unstable slopes. • Ditches designed to receive overland flow with no road runoff input

Ref	Description
MW-Embed 1	The cut and fill balance has been estimated as a cut of 350,176m3 and a fill requirement of 26,926m3. This equates to a surplus of approximately 323,250m3. Therefore, earthworks is forecast to comprise the largest proportion of waste generated by the Proposed Scheme. Although ground investigations are yet to be completed, it is expected a proportion of earthworks will be diverted from inert and / or non-hazardous waste landfill. The suitability of fill / site-won materials intended for reuse will be checked prior to use through sampling and chemical analysis. The reuse of site arisings on the Proposed Scheme would be subject to investigation (and potentially treatment) and would be managed as part of a Materials Management Plan.
PHH-EMB-1	Use of the alternative bus stop at / adjacent to the Rest and Be Thankful Car Park / Viewpoint during construction period noting that this alternative bus stop is already in use during periods where the A83 is closed.
PHH-EMB-2	With respect to paths (informal or formal), these will be realigned as close to their original alignment as practical to avoid extending WCH routes, where possible.
PHH-EMB-3	Where the Proposed Scheme would affect existing paths, replacement network provision would be made to ensure routes remain open by providing suitable crossing points or diversions.
PHH-EMB-4	Where new paths are required, they would be designed to be as fully accessible as possible. Of note, a new Active Travel Link is included in the Proposed Scheme and will link the Rest and Be Thankful Car Park / Viewpoint to forest trails and core path to the west of the OMR.
EC-Embed 1	Where aggregates for earthworks, drainage and pavement need to be imported, the current commitment is to procure these from sources local to the Proposed Scheme, such as authorised quarries.

Ref	Description
EC-Embed 2	A surplus earthworks balance of approximately 323,250m^3 is forecast. This material will be reused where practicable, both onsite and offsite.
CV-Embed 1	The alignment of the DFS has been designed such that it removes the need for earthworks or retaining structures on the downhill side of the A83. This is to minimise construction on potentially unstable existing debris flow deposits. To facilitate excavation into the hillside, protective measures in the form of rock/debris fall fences and mesh will be applied upslope of the excavation. The excavation works will be undertaken in a phased manner following erection of sufficient sections of protective measures as required to reduce safety risk to As Low As Reasonably Practical (ALARP). Additional mitigation to address this is set out in CV1.

Ref	Description
CV-Embed 2	A number of measures are proposed to be in place for protection of the major structure of the project, the Debris Flow Shelter (DFS) and Debris Flow Wall (DFW): • A catchpit up to 6m wide with a protection wall between the road and catchpit of up to around 7.5m in height. • Stabilisation measures such as soil nails in superficial deposits, and rock dowls/bolting in localised areas of bedrock instability will be used. • A minimum 1m depth of fill will be provided on the roof to dissipate energy from boulders as part of rockfall events. • A 1m thick layer of gabions (or other suitable protection measures) will also be provided at the rear of the hillside wall to dissipate energy from lateral boulder load as part of rockfall and debris flow events. • Two Debris Flow Protection Walls, in a staggered arrangement, and adjacent catchpit are proposed to the north of the DFS. These provide the necessary protection to the A83 from potential debris and rockfall events between the DFS and B02 Burn Bridge Where the alignment is not protected by the DFS, stabilisation measures such as soil nails in superficial deposits, and rock dowls/bolting in localised areas of bedrock instability will be used. The B02 Burn Bridge comprises of a 30m single span bridge skewed at 12-degrees to the A83. The primary function of this bridge is to convey debris flows under the A83 at this location and into the base of the glen.
CV-Embed 3	The design will ensure assets can adapt to expected future variations in temperature. For example, the Eurocodes used for bridges in the Proposed Scheme stipulate design to a temperature range which is adjusted to take account of altitude, material type and depth of surfacing thickness, etc. As part of Transport Scotland's on-going maintenance of the trunk road network, the Proposed Scheme structures will be monitored throughout the life of the Proposed Scheme.

Ref	Description
CV-Embed 4	Risk will be managed by best practice design and construction. The geotechnical design will be in accordance with BS EN 1997-1:2004 Eurocode 7 Geotechnical Design Part 1 General rules. For example, • undertaking appropriate ground investigations and • collecting appropriate groundwater level data • cuttings and embankment works will be designed based on slope-stability analysis using site specific soil parameters • stability assessments will be completed as part of design. Including analysis and modelling to predict maximum and permittable magnitude of settlement • where foundations extend below the existing groundwater table or could extend below the future groundwater level, they are designed in accordance with industry standards • high friction, free draining materials will be specified for embankment construction to mitigate the risk of collapse To avoid waterlogging around embankments appropriate drainage will be included so that carriageway runoff is collected and stored and natural catchment runoff is collected and conveyed before being released to local watercourses after a rainfall event, see DMRB, CG 501 - Design of highway drainage systems and DMRB, CD 522 – Drainage of runoff from natural catchments. The geotechnical construction will be in line with Standards for Highways (MCHW Series 0600 - Earthworks). Soil stability risks will be controlled, for example, by providing appropriate soil compaction. The Proposed Scheme will have an operational maintenance plan which will include regular inspection of vulnerable assets in the study area to assess movements for the lifetime of the Proposed Scheme.

Ref	Description
CV-Embed 5	The proposed landscape design will futureproof the Proposed Scheme in terms of climate change as well as in terms of pests/diseases (which can be exacerbated with climate change) by adhering to best practice. This will include diversifying planting species as much as possible, whilst still having regard to the local character, and generally planting only native species, which will mitigate impacts from soil moisture deficits. It will also adhere to best ecological practice.
CV-Embed 6	There is no landscaping in areas where the Proposed Scheme is designed to contain and/or direct boulder rock falls, gravel, slurry and water movements. See embedded mitigation in CV-Embed 2 for further details.
CV-Embed 7	The Proposed Scheme is 2.4km long and the road carriageway has a 1m hard strip where it passes through the DFS.. The Rest and Be Thankful viewpoint car park is immediately adjacent to the A83 and will be accessed via the improved B828 Glen Mhor local road junction. The overall lay-by provision still meets the requirements of DMRB CD 169 'The Design of Lay-bys, Maintenance Hardstandings, Rest areas, Service Areas and Observation Platforms. The DFS will be open so there is no need for ventilation, e.g. to dissipate smoke or car exhaust fumes. CCTV and emergency telephones will be within and outside the DFS. An external walkway for maintenance and emergency egress is also included to limit potential consequences of an event.
CV-Embed 8	Roads will be salted and ploughed as needed, based on forecasts and road conditions, in line with the Transport Scotland winter service procedures. The Proposed Scheme design will include drip checks, which ensure that no water flows into the DFS that could result in icicle formation. Microclimate models are being developed to understand the risk from driven rain/snow coming into the DFS and any identified adverse risk would be addressed at a later design stage.

Ref	Description
CV-Embed 9	The Proposed Scheme design reduces the risk of landslides impacting the road. See embedded mitigation in CV-Embed 2 for further details.
CV-Embed 10	A maintenance track is to be constructed to allow maintenance vehicles to access the roof directly to conduct inspections and safely clear the proposed catchpit or roof of any debris after a debris flow or landslide event. Crews should therefore not need to enter the catchpit. A 1m high pedestrian fence is proposed along the perimeter of the roof of the DFS with the exception of the ends of the structure where a solid reinforced concrete upstand is proposed.
MAD-Embed 1	The design of the Proposed Scheme includes a Debris Flow Shelter combined with a catchpit and a Debris Flow Wall to reduce the vulnerability of the Proposed Scheme to landslides. The design also includes measures to reduce the vulnerability of the Proposed Scheme to fluvial and pluvial flooding including the installation of culverts to convey watercourses under the A83. Embedded mitigation measures also include a programme of hazard studies (such as road safety audits) to produce an inherently safe design and to ensure residual risks are managed to be ALARP

Ref	Description
RDWE-EMB-01	To ensure the continuity of hydrological and sediment flows from upstream to downstream of the A83 as well as the long-term resilience of the downstream watercourses, the following measures have been incorporated into the design of the catch pit and associated culverts and downstream watercourses: • catch pit to have longitudinal and lateral gradient (both 5%); • culvert inlet of the A83 crossing positioned away from the back face of the rock cut to minimise blockage and damage; • culvert inlet grate to allow sediment <100mm to be transferred downstream; • culvert drop-chamber to be angled to reduce deposition/accumulation of sediment; • low flow channel within the culvert to promote movement of sediment through the structure and reduce the need for maintenance; • dissipation measures within the open channel to slow the flow; • transition structures to accommodate vertical misalignments; • dissipation pools and bank and bed protection at the transition to minimise scour; • bank reprofiling to promote (geotechnical) stability; and • fencing to prevent livestock and encourage hillside vegetation growth.
RDWE-EMB-02	Small informal catch pit upstream of OMR crossings where sediment deposition and potential blockage assessed as a higher risk.

Ref	Description
RDWE-EMB-03	The Appointed Contractor will comply with the requirements of the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (also known as the CAR Regulations) in relation to water features which require engineering work and construction activities, particularly in relation to sediment management and fuel/hydrocarbon control. The Appointed Contractor shall develop designs and detailed method statements for planned work activities and installations including bank reinforcement, outfalls, watercourse crossing structures, in-channel works, concrete application, watercourse diversions/realignments and SuDS (also see GSG-Embed-02/03/05 in relation to SuDS design). Any disposal to sewer will require approval from Scottish Water. These shall incorporate mitigation measures in accordance with good practice including from SEPA WAT-RM-08 / WAT-SG-29 / WAT-SG-75 / general pollution guidance / pollution prevention guidelines and CIRIA C532. The Appointed Contractor will be encouraged to minimise environmental effects and seek opportunities for enhancement, plus undertaking prompt remedial actions, as applicable. These methods shall be subject to pre-construction approval from SEPA and development of such will be a contractual requirement, including obtaining necessary consent for construction water runoff (SEPA Application - Form N). Appropriate specialists, including drainage engineers and hydromorphologists, should be involved in design and site supervision to optimise these key activities.
RDWE-EMB-03 (cont)	Works within or adjacent to water features may require a CAR licence, registration or compliance with the General Binding Rules (GBR). Where required, a CAR application would be made to SEPA and this would include detailed information on the proposed activity, the potential impacts to the water environment, mitigation measures included in the design and a detailed construction methodology for all engineering activities.

Ref	Description
RDWE-EMB-04	In relation to flood risk, the Appointed Contractor will develop a Flood Response Plan (as part of the CEMP) including measures to be implemented when working within the functional floodplain (defined here as the 0.5 % AEP (200-year) flood extent. This shall include weather forecast reviews, preventative actions, remedial actions and temporary drainage strategies.
RDWE-EMB-05	In relation to service diversions and to avoid damage to existing services from excavations and ground penetration, including temporary severance of private water supplies through damage to infrastructure, the Appointed Contractor will: • locate and map all private water supply assets and other service infrastructure prior to construction; • take measures to prevent damage to services and to avoid pollution during service diversions, excavations and ground works; and • provide a temporary alternative water supply (e.g. bottled or tankered) if services are to be disrupted or diverted by the works.
RDWE-EMB-06	For works within areas identified as potentially containing contaminated land following further GI or during construction, the Appointed Contractor will reduce the risk of surface water pollution to an acceptably low level through further site investigation to determine the level of contamination prior to proceeding. They shall also install temporary treatment facilities or other methods to avoid polluting the water environment. Potential contamination shall be raised with SEPA at earliest opportunity, with further actions agreed.

4.3. Land Required for the Proposed Scheme

General Summary

4.3.1. The overall Proposed Scheme requires the purchase of land to allow its construction, future operation and maintenance. Land required for the Proposed Scheme, in excess of that already owned by Scottish Ministers, will be acquired through the Compulsory Purchase Order (CPO) process.

4.3.2. It may be desirable for the successful Contractor to acquire additional areas of land for locating the construction site compound and any storage areas. Such additional areas will not be included within the Land Made Available (LMA) by the Employer for the Works and will be required to be obtained by the Contractor through negotiation with adjacent Landowners, and subject to a separate planning process as appropriate.

Land Take Required for the A83 Improvements

4.3.3. The total land take for the Proposed Scheme is approximately 31.15ha, excluding the areas required for BNG and Natural Capital enhancement sites. This includes 10.85ha (34.85%) of land currently owned by The Scottish Ministers. This land does not include the existing A83 Trunk Road carriageway but includes land adjacent to the carriageway on the slopes of Beinn Luibhean. The areas of land included in the compulsory purchase orders (CPO) is approximately 20.29ha, (65.15%).

4.3.4. The majority of the CPO land is acquired from private landowners (12.01ha).

4.3.5. Land to be acquired from Argyll and Bute Council accounts for 0.38ha.

4.3.6. A large portion of land, including the existing A83 carriageway and sections of the B828 Glenmore local road carriageway does not have a registered title or otherwise does not have confirmed land ownership (“unknown” plots). These areas account for 7.9ha.

Land Take Required for the OMR Improvements

4.3.7. The total land take necessary for the Proposed Scheme is approximately 10.47ha, excluding the areas required for BNG and Natural Capital enhancement sites. This includes 2.4ha (22.96%) of land currently owned by The Scottish Ministers. The areas of land included in the compulsory purchase orders (CPO) is approximately 8.06ha, (77.04%).

4.3.8. The majority of the CPO land is acquired from a private landowner (7.29ha).

4.3.9. Land to be acquired from Argyll and Bute Council accounts for 0.03ha.

4.3.10. A portion of land does not have a registered title or otherwise does not have confirmed land ownership (“unknown” plots). These areas account 0.7ha.

4.4. Construction

4.4.1. The Proposed Scheme has undergone significant design development, driven in part by an assessment of construction, operation, and maintenance. The following sections set out a suggested construction approach, methodology and site-specific activities for the Proposed Scheme. However, the Appointed Contractor may vary from the information provided in this outline methodology.

4.4.2. This section also details the resultant overall construction duration estimates and anticipated construction programme.

Construction Period

4.4.3. The EIA assumes that construction will have an estimated four-to-five-year duration following appointment of a Contractor, based on a continuous working approach. This is based on the construction of the OMR Improvements taking a single year (in advance of the Proposed Scheme) and the construction of the Proposed Scheme taking three to four years. However, this will be subject to potential interruptions as follows:

- landslide or debris flow events on the Beinn Luibhean hillside ceasing construction activities

- the OMR being used as a diversion route when the A83 Trunk Road is or has the potential to be, as identified through regular monitoring, impacted by a landslide or debris flow event and
- inclement weather ceasing construction activities

Construction Programme

4.4.4. The Appointed Contractor will be required to provide a detailed construction programme prior to the commencement of the works. This will set out:

- the overall period of construction
- programming of the key elements and phases of construction and
- the duration of each element and phase

4.4.5. The Appointed Contractor will be required to regularly update the programme to reflect any changes in programmed activities and will provide the basis for notification to landowners and local communities where sensitive activities or non-routine events would likely result in temporary disruption to access.

4.4.6. The construction programme, in relation to the OMR Improvements, is complicated by the fact that the OMR may need to be used by trunk road traffic with relatively short notice during times of elevated debris flow risk which will be determined through continual monitoring. At present, monitoring includes weather forecasts, hillside conditions and level of water saturation.

4.4.7. Additionally, the Appointed Contractor will be restricted by environmental constraints (e.g. seasonal ecology constraints).

Typical Construction Activities

4.4.8. Both the Proposed Scheme and Improvements to the OMR will be constructed in linear, narrow existing road corridors with access taken from either end of construction site.

4.4.9. Key construction activities associated with the Proposed Scheme are indicated in Table 4.6, below.

Table 4.6 – Indicative Construction Activities associated with the Proposed Scheme

Section	Activities
Construction of the OMR Improvements – required in advance of works to the A83	Widening of the OMR over a length of approx. 1.38km to accommodate two-way traffic including a new proprietary bridge structure that will carry southbound traffic. Localised widening at three existing sharp bends at the northern end of Glen Croe to assist HGVs in navigating the narrow carriageway when using the OMR as the diversion route. An approximately 150m long debris flow protection earthwork bund to protect the OMR during debris flow and rock fall events. Extension to the existing HESCO barrier by approximately 150m to protect the OMR during debris flow and rock fall events. Installation of debris flow and rock fall fences above the A83 Trunk Road to increase resilience of the OMR. New fences are proposed where there are currently no geotechnical interventions.

Section	Activities
Potential Advanced Works	Establishment of a site compound(s) including relevant power and water supplies Installation of Debris Fences / Barriers on the Beinn Luibhean hillside above the A83 Trunk Road – to be delivered in advance of works to the A83 Utilities – required for the operation of the DFS

Section	Activities
DFS construction	Installation of Debris Fences / Barriers on the Beinn Luibhean hillside above the A83 Trunk Road Diversion of watercourses Excavation and rock cutting to form the base of the catchpit with existing ground (on the A83 corridor) cut and filled to form access for site traffic. Installation of reinforced concrete piles in both verges, a single row on the northbound (valley) side and a twin pile / spread footing arrangement on the southbound (hill) side. Pour (insitu) or place and stitch (pre-cast) concrete column elements on the southbound (valley) side and concrete wall elements on the northbound (hill) side. Pour (insitu) or place and stitch (pre-cast) concrete roof elements. Pour (insitu) or place and stich (pre-cast) concrete upstands Apply waterproofing to the back and top faces of the DFS Place and compact granular fill on the roof. Installation of gabion baskets to the rear of the wall on the northbound (hill) side. Finishes, including any mechanical and electrical equipment required, within the DFS.

Section	Activities
DFW construction	Installation of Debris Fences / Barriers on the Beinn Luibhean hillside above the A83 Trunk Road Diversion of watercourses Excavation and rock cutting to form the base of the catchpit with existing ground (on the A83 corridor) cut and filled to form access for site traffic. Excavation for DFW foundation Cast (insitu) DFW foundation Pour (insitu) or place and stitch (pre-cast) concrete wall elements on the northbound (hill) side Apply waterproofing to the back face of the DFW Installation of gabion baskets to the rear of the wall on the northbound (hill) side.
B02 Burn Bridge construction	Secant piled wall installed at each abutment to rock level Excavation of rock and superficial material to form widened / deeper channel Demolition of existing culvert Cast (insitu) bankseat abutments Place precast concrete beam elements Cast (insitu) deck Install back of wall drainage Apply waterproofing to the back face of abutment and deck Backfill and compact bankseat abutments Install parapets Surfacing and finishes

Section	Activities
Culvert construction	Diversion of the watercourse (upstream) Excavation to foundation level in two parts – northbound carriageway followed by southbound carriageway Temporary bridge placed over open excavation whilst other half of excavation is dug Construct outfall consisting of reinforced concrete cascade and protective rock mattresses Placing and stitching of precast box culvert elements switching the temporary bridge between lanes as required Culvert will then be backfilled and compacted in stages Hillside wall of DFS and inlet structure constructed separately at a later point and tied-in with precast section of culvert

Section	Activities
Roadworks	Site establishment and plant compounds at strategic locations Permanent fencing including accommodation works fencing Site clearance and demolition Temporary and permanent surface water outfalls Utility Apparatus / Service diversions (if not taken forward as advanced works) Temporary pre-earthworks drainage and permanent cut-off drainage Earthworks (cuttings and embankments) Earthworks Bunds Landscaping Drainage, service ducts and chambers Topsoil spreading, seeding and turfing Pavement construction Roadwork finishes including traffic signs, road markings and vehicle restraint systems Accommodation works
Environmental	Landscape and ecological mitigation planting Permanent diversion of watercourses
Temporary Works	Temporary Traffic Management Temporary diversion of watercourses to facilitate culvert construction Temporary outfalls Temporary fencing to facilitate construction

Section	Activities
Maintenance	Landscape maintenance Remedial works as a result of landslides or debris flow events during construction Other routine maintenance and defect repair works

Working Hours

4.4.10. Normal working hours are expected to take place between 07:00 – 19:00 Monday to Friday and 07:00 – 13:00 Saturday. No Sunday working is currently anticipated.

4.4.11. The Appointed Contractor may wish to carry out certain operations outside of the expected working hours. For example, oversize deliveries, junction tie-ins or for traffic management reasons. These hours may need to be restricted and considered on a case-by-case basis.

4.4.12. Furthermore, the Appointed Contractor may seek to extend working hours in the summer months to take advantage of the better weather conditions and longer daylight hours given the inherent debris flow risk which is heightened by high rainfall. Due to traffic management restrictions, safety and operational constraints, some operations may need to be carried out at night.

4.4.13. Such extensions beyond normal working hours would be dependent on the Appointed Contractor's proposed methods of construction, and subject to agreement with the Trunk Road Operating Company, Transport Scotland and Argyll and Bute Council. Liaison with the local community, businesses, and other key stakeholders, such as Loch Lomond and the Trossachs National Park Authority and Police Scotland, will also be required.

Land Requirements

4.4.14. Most construction work will take place within the limits of the land made available (LMA) to the Appointed Contractor as defined within the contract documents. The LMA has informed the land take and habitat loss calculations undertaken for this EIA Report. This includes land for all the permanent works and implementation of the Biodiversity Net Gain and Natural Capital areas. Land for earthworks storage has not been identified within the LMA as this will be a matter for the Appointed Contractor to determine based on their construction methodology and the mitigation principles set out in the EIA Report. The final LMA would include land acquired under Compulsory Purchase Order (CPO), land to which the Scottish Ministers already have ownership of or access to, and other areas the Appointed Contractor has acquired by agreement to facilitate construction.

4.4.15. The land to be acquired includes land necessary to construct, operate and maintain the Proposed Scheme and associated infrastructure and to undertake essential environmental mitigation measures. However, the Appointed Contractor may (depending on the phasing and execution of works) determine the need for additional areas of land such as for site compounds, topsoil storage areas and other areas required for construction. Should land be required outside of the land made available, this would be secured through separate agreement / planning permission by the Appointed Contractor. As the requirement and potential location of such areas is currently unknown, it has not been possible to assess the impact of these within the EIA Report.

Construction Site Compounds

4.4.16. The location of site compounds for the Proposed Scheme has not been determined nor assessed within this EIA Report as these will be identified and decided by the Appointed Contractor. The Appointed Contractor will be required to negotiate with the relevant landowner should land be required outwith the land identified for the Proposed Scheme itself and the Contractor's proposals shall be subject to appropriate planning permission.

Construction Environmental Management Plans

4.4.17. The environmental performance of the Appointed Contractor throughout the works will be defined and controlled through an overarching Construction Environmental Management Plan (CEMP), which shall be developed by the Appointed Contractor. The CEMP will comply with current legislation, regulations and industry best practice, and require consultation with statutory consultees where relevant.

4.4.18. The CEMP will outline the measures to minimise and mitigate the construction impacts of the Proposed Scheme in accordance with the EIA Report. The CEMP will be developed to:

- define how the Appointed Contractor and any associated parties shall implement the committed environmental mitigation measures (as defined in Chapter 21 Schedule of Environmental Commitments) to minimise any adverse impacts to the environment
- document how the detailed design process, materials selection, construction techniques, and operational methods shall minimise adverse impacts to the environment
- establish and maintain high environmental standards
- avoid environmental accidents and pollution
- encourage reduced consumption of resources, and restrict the production of waste and
- promote good relationships with the relevant authorities and other key stakeholders including affected landowners.

4.4.19. Commitments made regarding mitigation measures, their implementation and subsequent monitoring shall be recorded by the Appointed Contractor. The mitigation measures recorded in Chapter 21: Schedule of Environmental Commitments and Volume 4, Appendix 11.1 Report to Inform Habitats Regulations Appraisal shall be included and considered as ‘Compliance Obligations’.

4.4.20. Notwithstanding any other commitments the CEMP shall:

- document and demonstrate how the proposed methods of construction shall restrict impacts to the best practicable environmental option
- set out contingency plans and emergency procedures
- include liaison with the local community and landowners and
- include environmental training for all site personnel, including sub-contractors and suppliers, including specific environmental inductions and 'toolbox talks'.

4.4.21. The Appointed Contractor will ensure that environmental considerations are included in risk assessments, method statements, work instructions and field control sheets and will ensure these are communicated to those undertaking the work. No work will commence on site before method statements and risk assessments have been approved by the appropriate person. The Appointed Contractor's Environmental Manager / Clerk of Works will be responsible for co-ordinating and managing all environmental activities during the construction phase, supported as appropriate by the Appointed Contractor's Ecological Clerk of Works.

4.4.22. The Appointed Contractor will develop and maintain a CEMP that shall include, numerous plans related to the protection of environmental receptors during the construction period as detailed in Chapter 21: Schedule of Environmental Commitments. Volume 4, Appendix 4.2 First Iteration Environmental Management Plan has been produced in accordance with DMRB LA 120 Environmental management plans and sets the framework for the Appointed Contractor to further develop their CEMP.

4.4.23. All activities on site will be reviewed against the requirements of the CEMP via an integrated risk assessment and method statements procedure. The Appointed Contractor will review environmental risks associated with the construction process and appropriate control measures included in method statements and field control sheets.

4.4.24. Regular audits will be completed by the Appointed Contractor to verify that the project is compliant with the established CEMP, contractual requirements and legislation.

4.4.25. The Appointed Contractor's Environmental Manager/Clerk of Works will carry out regular assessments of the project's environmental performance.

Traffic Management

4.4.26. The Appointed Contractor will be required to develop and agree a Traffic Management Plan (TMP) with Transport Scotland and the Trunk Road Operating Company, Police Scotland, and Argyll and Bute Council and other directly affected stakeholders for the duration of the contract. The plan will identify proposals for the principal phases of the works and individual construction activities which will potentially involve disruption to existing vehicular, pedestrian, cyclist and horse-riding access in specific locations along the construction corridor.

4.4.27. The majority of the works for the Proposed Scheme are on the line of the existing A83. Therefore, once the construction of the OMR Improvements is completed, traffic management will be put in place to divert traffic onto the OMR as a temporary diversion route, as required.

4.4.28. Notwithstanding the above, the TMP will need to account for a scenario where trunk road traffic is diverted onto the OMR, during the construction of the OMR Improvements, as a result of a closure of the A83 Trunk Road which may require public traffic running adjacent to the works. The Appointed Contractor should be prepared for quick cessation of any live works and traffic management set up.

4.4.29. It is likely that the TMP will require to be regularly reviewed and updated as the programme progresses.

Earthworks Balance and Materials Requirements

4.4.30. The Proposed Scheme requires extensive earthworks. While it has been designed to minimise the impact on the surrounding topography, the earthworks predominantly consist of cuttings which are of significant size, with limited embankment construction. Therefore, there is a notable imbalance in the cut / fill ratio.

4.4.31. A significant quantity of made ground will be excavated, generally related to existing road construction and Rest and Be Thankful Viewpoint car park. It is expected that the majority of the existing A83 road construction will be removed over the full length of the Proposed Scheme and that existing road materials could be re-used, subject to appropriate classification and assessment. An exception to this would be the presence of coal tars within the asphalt.

4.4.32. At this stage of assessment, no contaminated materials have been identified for disposal. A review of historical mapping has not identified any significant potentially contaminative developments / land uses within the Proposed Scheme extents or identified any specific point sources of land contamination. However, there is the possibility of localised or diffuse contamination / spills associated with agriculture or commercial forestry activity or anthropogenic materials within the existing road infrastructure construction materials, including the potential for asphalt to contain coal tar binders. In addition, there may be contaminated ground associated with the disused quarry.

4.4.33. Available ground investigation data indicates that the topsoil encountered on site is generally very thin. In addition, the presence of boulders and irregular topography will cause significant difficulties in separating the topsoil from the underlying superficial deposits. Therefore, only a limited quantity of topsoil is expected to be available for re-use from areas of proposed excavation.

4.4.34. Existing information also suggests that natural superficial deposits that will be excavated in areas of proposed cut can be relatively wet and contain relict soil layers. As indicated above, separating the topsoil layer will also be difficult due to the undulating, irregular topography and this may lead to further entrainment of organic materials. As such, as-dug superficial materials may not comply with the requirements of Class 1 or 2 General Fill for re-use in the works.

4.4.35. As more ground investigation data becomes available, there will be greater certainty over the quality of the natural superficial deposits, and it may be possible to permit processing for re-use. In particular, granular superficial deposits could be screened and graded to provide fill suitable for use as cushioning material on the roof of the DFS.

4.4.36. Bedrock at the site generally comprises interbedded sequences of metamorphic rock identified as psammites, pelites and semi-pelites with occasional phyllites. Igneous intrusions, recorded as dolerites and occasional diorite have been identified toward the southern extent of the Proposed Scheme including the disused quarry.

4.4.37. It is anticipated that the majority of the excavated metamorphic rock can be processed for re-use as SHW Class 1 engineered fill. Argillaceous rock types including pelites and phyllites are permitted constituents of Class 1 fills. However, they are precluded from re-use as Class 6 fills. As the psammites are interbedded with argillaceous units it is unlikely that these strata could be processed separately.

4.4.38. While the available testing indicates that the metamorphic rock should be durable in the long term, it is noted that recent experience of re-using excavated rock from the A83 catchpits to construct bunds in Glen Kinglas suggests that this material can be prone to disintegration during processing and handling, or over-compaction.

4.4.39. Class 6 fill materials such as capping, backfill to structures and gabion fill for the DFS may be derived from the igneous bedrock, subject to rock composition and grading requirements being met. Further ground investigation is planned to determine the extent on the igneous intrusions and whether it is viable to process this material separately during the excavation works.

Disposal and Import of Materials

4.4.40. The identification of approved receptor sites for the disposal of any excess materials associated with earthworks that is unsuitable for re-use and the import of bulk materials required to make up design levels will be the responsibility of the Appointed Contactor. The Appointed Contractor will be required to meet all legal obligations relating to licensing and planning approvals.

4.4.41. Where such import and export of materials is required, haulage routes will be subject to agreement under the required project Traffic Management Plan. Specific consideration will be given to the potential sensitivity of communities located along potential haul routes.

Piling

4.4.42. Piling will be required for the DFS and B02 Burn Bridge. It is assumed that piles will be circular reinforced concrete and embedded circa 3m into rockhead.

4.4.43. Pile construction on the valley side must take cognisance of the potential instability of the slope beneath the carriageway (between the A83 and the OMR). There is recent and historic evidence of instability and localised failure on this slope, with a presence of emergency repairs in the form of soil nails and anchored retaining walls in some locations. Construction methodology chosen by the Contractor must contain reasonable mitigation and careful consideration in technique selection, temporary works and real time monitoring of the slope adjacent to the work zone.

4.4.44. Pile construction on the hill side will be subject to the risks associated with piling into rock. Pilot holes are therefore recommended. It is assumed that rotary bored piles are favourable as this would place less energy into the superficial material during construction relative to down the hole hammer (DTH) drilling. Furthermore, existing GI records show the presence of boulders within the superficial material, which poses a risk to the auguring tool's penetration and verticality. As such, the use of core barrels to advance the borehole could be applied where sufficiently sized are encountered, although at a lower penetration rate.

Construction Phase SuDS

4.4.45. Construction Phase SuDS has not been assessed as part of this EIA Report.

4.4.46. Erosion and sediment control methods will be detailed within the CEMP as part of the Appointed Contractor's temporary works to suit their proposed construction phasing and works programme. The Appointed Contractor will be required to consult with SEPA and obtain the Construction Site Licence.

4.4.47. It is assumed that some or all of the following measures will be carried out as part of a comprehensive erosion and sediment control plan during construction:

- Clearly defined responsibilities and roles to manage erosion and sediment on site, including out-of-hours support and regulatory contacts.
- Agreed expectations of thresholds for total suspended solids (TSS) as a maximum sediment level allowable for discharge to surface waters. Furthermore, consideration of threshold levels for in-channel sediment levels taking account of baseline conditions (i.e. sediment uplift from the development).
- Construction of pre-earthworks diversion drains / ditches and potentially damming and over-pumping of upslope watercourses to minimise water ingress from both hillslope and channels onto mid-slope construction zones.
- Construction of collection drains (downslope of or within disturbed areas), bunds and slope drains where required, to convey runoff, by gravity or via pumping, to sediment basins or other storage locations or devices.

- Construction of settlement basins where topography allows, to provide for temporary retention of runoff from disturbed areas, these shall not be positioned within areas susceptible to flood risk and maximise distance from watercourses shown on OS 1:25,000 scale mapping (at least 10 m, with larger offsets difficult to achieve due to frequency of channels along the Proposed Scheme extents).
- Where settlement requirements are unlikely to be achieved by standard settlement basins, such as within the limited space of the catchpit, alternative techniques shall be employed which may include individual, or a series of, mechanical settlement devices to enable local discharge. These devices are portable and would be re-deployed at appropriate locations to manage construction sedimentation risk as the construction programme progresses.
- Construction of other source control methods, such as sediment fences and straw bale filters (downslope of disturbed areas and stockpiles), as required.
- Consideration of filter strips of retained vegetation between discharge points and entry into receiving watercourses.
- Flocculant additives may be necessary, to augment settlement performance of settlement basins and/or mechanical devices (or other methods). The specific additive(s), methodology and circumstances for application shall be pre-agreed with SEPA and other regulators, to minimise delay and adverse environmental effects where pre-requisite circumstances are met.
- Consideration shall also be given to collection and transfer off-site of sediment-laden runoff that cannot be adequately treated and discharged to local channels. In such circumstances, receptor sites for further treatment or discharge would be pre-agreed with regulators including SEPA.

4.5. Biodiversity Net Gain and Natural Capital

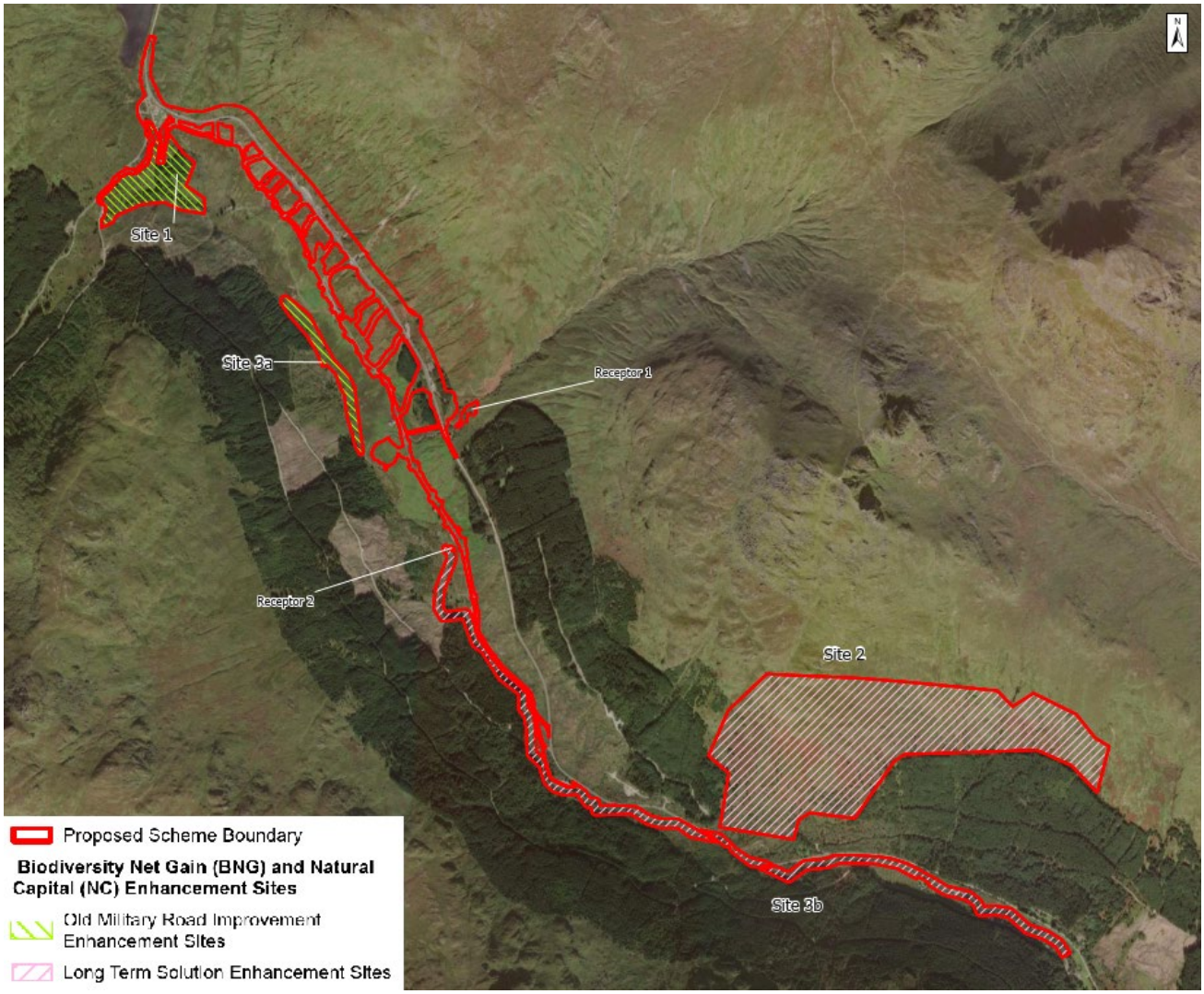
Introduction

4.5.1. To deliver on the National Planning Framework 4 (NPF4) biodiversity and natural capital policy requirements and the strategic 'environment' objective for the Proposed Scheme (as detailed in full in Appendix A4.1), four enhancement sites have been identified within Glen Croe, where habitat creation and enhancements will be undertaken.

Enhancement sites

4.5.2. The sites for both Proposed Scheme components are detailed here, for the purpose of completeness. The sites are apportioned accordingly, Sites 1 and 3a are attributed to the OMR improvements, whilst Sites 2 and 3b are attributed to the Proposed Scheme. See Plate 4.14 and Volume 3, Figure 4.7 Biodiversity Net Gain (BNG) and Natural Capital (NC) Enhancement Sites.

Plate 4.14 – Aerial image of Glen Croe containing the Proposed Scheme boundary and associated Biodiversity Net Gain and Natural Capital Enhancement Sites



Site 1

4.5.3. Site 1 is approximately 8.0 hectares (ha), located immediately south-west of the Rest and Be Thankful Viewpoint car park and comprises a mosaic of habitats, with areas of purple moor-grass and rush pasture, upland heath and coniferous woodland (non-native Sitka spruce). This non-native habitat is influencing the other habitats present within Site 1, with young spruce saplings and trees starting to establish.

4.5.4. Site 1 includes 0.7km of watercourse habitat which as per the River Condition Assessment (RCA) is in fairly good condition, on account of the indicator scores for a number of criteria, including physical characteristics of the bank top, bank face and channel bed – on account of its natural planform, riverbed and riverbank. Moderate levels of grazing from livestock and poor / non-native bank top vegetation cover limit the condition of the watercourse.

4.5.5. For Site 1 it is proposed that all Sitka spruce plantation including young regenerating woodland, existing stumps and needle litter and brash, is removed and an open mosaic of broadleaved woodland will be created, covering approximately 3ha.

4.5.6. For the mosaic of purple moor grass and fens, the presumption is that enhancement of the habitat condition would be achievable through the removal of Sitka spruce, which is likely to result in local changes to the water table. Additionally, the removal of regenerating Sitka saplings and young trees, stumps, needles and brash will permit the regeneration of the wetland habitats with a reduction in shade and smothering by needle litter and brash.

4.5.7. Similarly, the removal of the Sitka plantation and regenerating Sitka woodland would remove shading of the upland heathland habitats. Deer fencing may also be installed (where feasible) which will permit the recovery of previously suppressed heather and bilberry.

4.5.8. Given the natural planform of the watercourse, aquatic habitat enhancements are restricted to land use change within the riparian corridor (up to 10m from bank top) to improve bank top vegetation cover and richness. Proposed terrestrial habitat interventions will be undertaken up to and including the bank top.

Site 2

4.5.9. Site 2 is a 66ha site on the northern slopes of the Glen Croe Valley above the Honeymoon Bridge structure. Site 2 is currently dominated by an upland grassland-bracken mosaic with scattered inland rock and scree habitats throughout and scattered areas of purple moor grass and rush pasture, heathland and upland birchwood. Within the grassland-bracken mosaic, ancient woodland indicators were recorded throughout, including bluebell, and wood anemone.

4.5.10. Planting of a broadleaved woodland mix is proposed targeting upland birch woodland, as the woodland in the surrounding area indicates that this is the natural climax community here. The presence of woodland ground flora demonstrates that a woodland seedbank is still present, and thus increases the likelihood of successful woodland creation. In total approximately 36ha of woodland would be created.

4.5.11. To improve the condition of all habitats within Site 2, the removal of invasive non-native species (INNS) would be targeted to improve the condition of the habitats. Some areas of grassland would be retained, to create open glades and to provide habitats for invertebrates and reptiles.

4.5.12. The areas of heath and purple moor grass rush pasture would be retained. It is considered likely that a change in condition could be achieved if fencing to reduce deer browsing pressure could be installed, but at the time of reporting this has not been agreed, so no change to condition is presumed at this time.

Site 3a

4.5.13. Site 3a represents a roughly 20m buffer of FLS land either side of an approximately 1km reach of the Croe Water toward the northern end of Glen Croe. The habitats within the buffer zone currently comprise purple moor grass and rush pasture, fens, and neutral grassland, as well as a small area of coniferous woodland.

4.5.14. Site 3a provdes 0.9km of watercourse habitat in fairly good condition. The watercourse displays a semi sinuous planform with a high degree of morphological feature diversity. However, bank top/ face vegetaion cover and richness are low and modifed riparian landuse (plantation and agriculture) limits the condition.

4.5.15. The proposed interventions for the site include the removal of all non-native conifer plantation woodland and any regenerating Sitka, with planting of a broadleaved woodland mix across 3.1ha, to create wooded riparian corridor. The high distinctiveness habitats within Site 3a would be retained, to create a mosaic of habitats with the new broadleaved woodland. Removal of any non-native rhododendron shall also be undertaken within this Site.

4.5.16. Given the natural planform of the watercourse, aquatic habitat enhancements are restricted to land use change within the riparian corridor to improve bank top vegetation cover and richness. Proposed terrestrial habitat interventions would be undertaken up to and including the bank top.

Site 3b

4.5.17. Site 3b represents a roughly 20m buffer of FLS land either side of an approximately 4km reach of the Croe Water toward the more southern end of Glen Croe, with the Honeymoon Bridge structure approximately halfway along its length.

4.5.18. The habitats within the buffer zone currently comprise purple moor grass and rush pasture, fens, and neutral grassland, as well as a small area of coniferous woodland and wet woodland.

4.5.19. Site 3b includes approximately 2.6km of watercourse habitat in fairly good condition and 1.3km of watercourse habitat in moderate condition, all on the Croe Water. Differences in artificial bank top ground cover are the main reason the watercourse displays different condition classes throughout Site 3b. Where plantation woodland or footpaths / roads are present within the riparian corridor, condition of the watercourse is generally restricted to moderate.

4.5.20. Proposals for this site include broadleaf planting and removal of INNS (e.g. rhododendron) in areas up to and including the bank top.