Report

Access to Argyll & Bute [A83]

DMRB Stage 2 Scheme Assessment Report

Volume 1- Part 4 Traffic and Economic Assessment

Transport Scotland

May 2023

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Notice

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Client signoff

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Project	Access to Argyll & Bute [A83]

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1. Overview

This section of the DMRB Stage 2 Report for Access to Argyll and Bute (A83) describes the existing local traffic conditions, potential changes to the network and the traffic modelling undertaken to assess the impact of the Scheme Options. This includes how the data was used to support the economic assessment of the Scheme Options.

It should be noted that the economic analysis described in this section has been undertaken to assess which of the Scheme Options performs best from a traffic and economic perspective. This report is not intended to underpin the financial justification for the scheme. Further details regarding the wider economic benefits of the scheme which are considered applicable to all Scheme Options are presented in section 6.

2. Existing Transport Situation

2.1.1. Current traffic conditions

At the time of writing BEAR Scotland is the Operating Company for the North West unit, appointed by Transport Scotland and is currently undertaking engineering works in the local area, including catch pits, debris flow fences and barricades at problem areas to alleviate the impact of a landslide. BEAR Scotland also operate the traffic management convoy along the A83 and the OMR which runs parallel to the affected A83 Rest and Be Thankful site but is deeper in the Glen.

The convoy operation along the A83 is used as the 1st stage of pre-emptive safety measures when the soil saturation reaches a certain threshold and to allow engineering works of the road or minor clean-up operations following an event. This convoy operates for a 0.95km stretch and the typical wait time for users in the convoy is approximately 3 minutes depending on the volume of traffic.

If there is considered to be a risk of landslide, or if a landslide occurs, the 2nd stage of measures is introduced which includes the traffic management convoy and diversion to the OMR local diversion.

The OMR is a single lane, low-capacity paved private road, which when built was not intended to be used by large traffic volumes nor large vehicles such as HGVs. As a

consequence of this, when the convoy was first in operation along the OMR, HGVs on occasions became stuck at some of the tight turns and steep gradients experienced on parts of the route. Recovery vehicles from BEAR Scotland would then rescue the affected HGVs, but ultimately, this led to delays for vehicles stuck behind the affected HGV and for vehicles waiting to use the diversion route. In response to this, measures have already been implemented to resolve many of the issues associated with HGVs using the OMR, such as road widening at tight turns, and installation of high friction surfacing. Overall, this has helped to reduce the delays associated with travelling along the OMR when in use as the local diversion, with most of the remaining delays to travellers being associated with waiting at the convoy markers whilst the current convoy is moving. This can amount to average standing delays of around 15 minutes, however if the driver arrives just as the convoy leaves, the waiting time could increase to around 25 minutes and would likely lead to increased driver frustration. To clarify the travel time along the OMR is approximately 7 minutes, amounting to a total journey time of 32 minutes in the worst case.

Recognising the issue, in March 2021, Transport Scotland committed to delivering a programme of further improvements to the OMR as part of a Medium-Term Solution (MTS) to the issues at the Rest and Be Thankful. The purpose of the MTS is to deliver a safe, proportionate and more resilient diversion route to the A83 while it is closed. These improvements will significantly reduce journey times through increasing the length of two-way operation and thereby reducing the length of convoy and improving the safety and resilience of the OMR by including landslide protection measures such as bunds and fences. These works are anticipated to start in 2023 and will be completed before the start of construction of the permanent, long-term solution.

In the event of a significant event whereby the OMR local diversion may not operate, or the OMR may be unsafe to use due to risk of a significant landslide. Instead, the operating company will apply the 3rd stage of protection which includes a diversion via the wider trunk road network; A82/A819 northern route through Dalmally, shown in Figure 2-1. However, this diversion adds around 41km to the journey length, and 32 minutes on average to the journey time for a regular commuter and around 37 minutes for a HGV for a journey between Inverary to Tarbet. In the event the OMR was in use, a road user's decision to use this trunk road diversion would be based on their origin and destination, and whether they have prior knowledge of the road closures at the A83 Rest and Be Thankful site. Although this trunk road diversion is more reliable than the local OMR diversion, this extra time and

length adds significant costs to the journey, particularly once the MTS is in place for the local diversion.

An alternative diversion, again depending on the user's origin and destination, is to use the ferry from Rothesay to Wemyss Bay to cross the River Clyde. This is the fastest route from the South of Argyll and Bute into Central Scotland to cities such as Glasgow, but costs £12.45 per journey per car at the time of writing. Larger commercial vehicles are charged at a higher commercial rate, making it more expensive for businesses to transport goods into and out of the region if the A83 Rest and Be Thankful is closed.

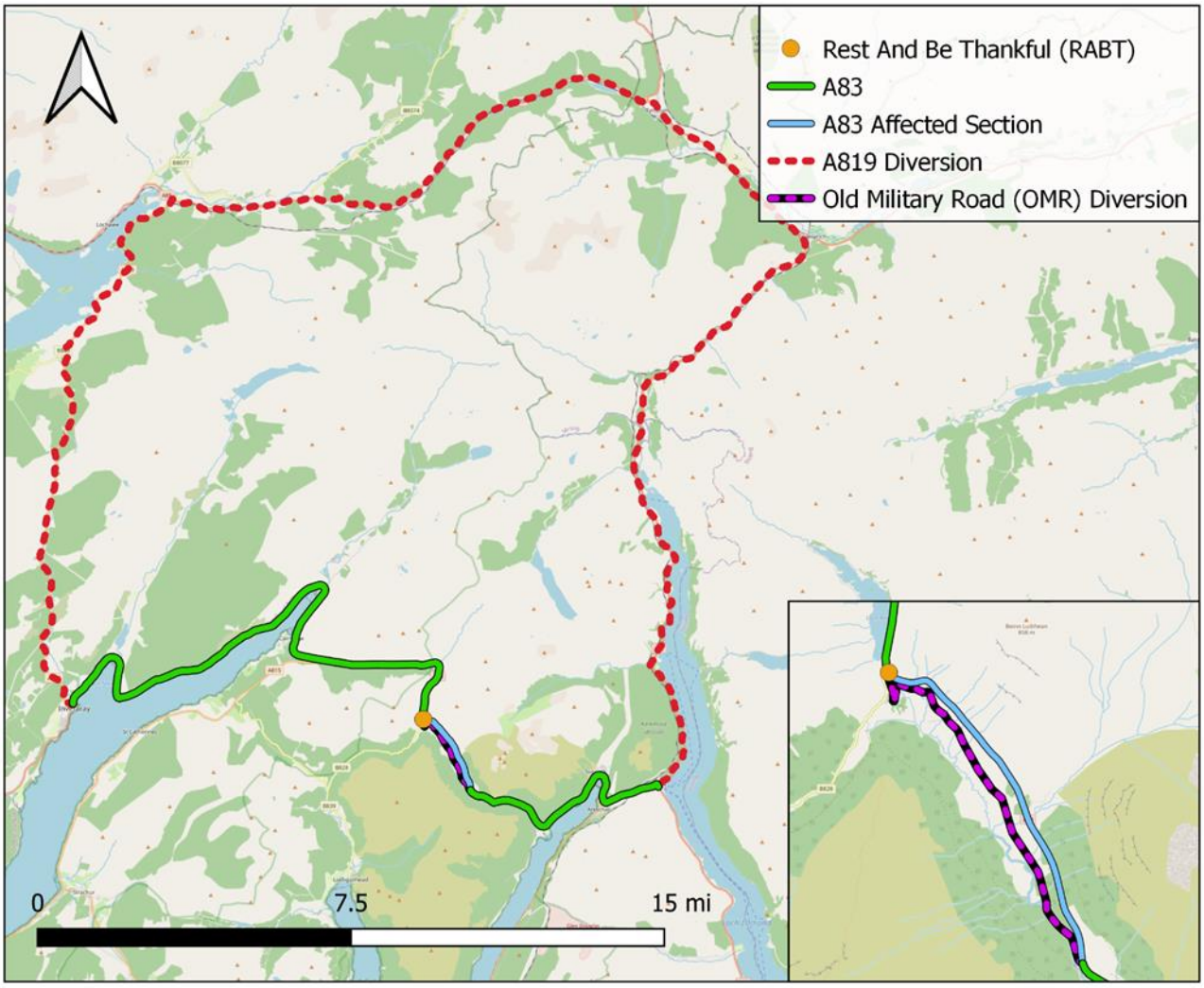

Figure 2-1 - Routes from Inverary to Tarbet

2.2. Context

2.2.1. 2020 Landslip

Prior to 2020, closures of the Rest and Be Thankful section of the A83 were occasional; around once per year and would last for on average 5 days. With the ever-accelerating rate of climate change, 2020 was subject to the two worst landslides experienced in the area in terms of their impact on the operation of the A83.

The first landslide occurred in August 2020 and split into two channels, one which was caught by the catch fences implemented by BEAR Scotland and the other moved onto the A83. This also washed down onto the OMR which caused the local OMR diversion to be predominantly closed.

The second landslide occurred in September and caused further closures of the A83 and OMR. In total in 2020, the A83 was closed for 130 days and 193 nights, and the OMR was closed for 16.5 days and 44.5 nights. This also led into 2021, with the A83 closed for 23 days and nights, and 2 days and nights where the OMR was also closed. When both the A83 and OMR were closed, the full diversion via the A82/A819 was required, adding extensive costs and delays to the regular user. It is likely that some users didn't make their usual journeys during this time with the uncertainty of the A83 closures or with the additional costs associated with the longer diversion. This may also have had an impact on tourism to the local area as the summer holiday season came to an end, although this was likely minimal as holidaymakers would usually continue with their plans despite delays.

2.2.2. Population and Employment

The Wider Economic Impact Report (WEIR) conducted in DMRB Stage 1 highlighted the rapid decline in population in the study area. This may be partly due to the connectivity issues from the West of Scotland to major central cities such as Glasgow arising from the road closures at Rest and Be Thankful. The decline in the number of young people and families exacerbates the decline in population due to the lack of babies born in the area.

Some of this decline has been subsidised by an increase in the number of people over 65 years old. However, generally people of this age will be retired and will not be commuting to work or for education via the A83, therefore road closures are expected to have less of an impact on this age group.

The WEIR also showed that the average wage of the population of Argyll and Bute was approximately 7% lower than the Scottish average in 2019. To clarify this refers to those who live in Argyll and Bute regardless of where their place of work is located. However, the wage of those that both live and work within Argyll and Bute was around 17% lower than the Scottish average. Due to the population decline in the area, businesses may be forced to shut due to the lack of workers, putting a greater strain on those continuing to live there to find another job which may feasibly only be accessible via the A83 Rest and Be Thankful.

2.2.3. Current situation

Since the 2020 landslides, the A83 has been predominantly operating under signal control, and by convoy. Even with the engineering works to improve safety along the A83, closures are still not uncommon. During some of the wetter and colder months where the risk of landslide increases, the road is occasionally pre-emptively closed, and traffic is diverted onto the OMR which represents the local diversion, however use of the longer diversion via Dalmally is rarely used. As rainfall increases year on year due to climate change, both with respect to duration and intensity, landslides at Rest and Be Thankful may become more common, posing a greater threat to the connectivity that the Rest and Be Thankful site provides, as well as property and lives.

2.2.4. Proposed interventions

Eleven route corridors, plus 4 additional corridors suggested by members of the public, were considered through DMRB Stage 1 by Jacobs AECOM to improve the connectivity between Argyll and Bute and Central Scotland. Following the corridor assessment at the end of Stage 1, the preferred route corridor was announced as the existing A83 Glen Croe corridor in March 21. Since then, work has been done to understand how best to implement a permanent, long term solution to the A83 within the existing corridor of Glen Croe.

The permanent, long term solution would follow along the existing length of the A83 and will ultimately be one of five Scheme Options as described in Part 2. The Scheme Options range from different combinations of viaduct, tunnel, and debris flow shelter. The difference in journey times from each of the Scheme Options will be negligible but all will greatly improve the safety, operation and resilience of the trunk road.

3. Data Collation

3.1. Traffic data

3.1.1. National Traffic Data System (NTDS) Traffic Counts

Access to the NTDS database has been provided to AWJV to aid in the traffic appraisal. There is only one active traffic counter located on the A83 in the immediate study area, which is to the South-East of the Rest and Be Thankful site. This counter was also highlighted in the Traffic Technical Note 002 in DMRB Stage 1. The counter has been used to verify average monthly vehicle counts during the 2019-2022 period, which is shown in Figure 3-1.

During the 2020 period, the COVID-19 lockdowns had a pronounced effect on travel patterns, reducing vehicle counts on the A83 by almost 66% from March to April. The number of vehicles increased as lockdowns were lifted but then drops greatly after the two landslides at the Rest and Be Thankful site in August and September. This affected travel until the A83 re-opened in April 2021. The remainder of 2021 and 2022 approximately follow the trend of the available data from 2019, showing that the expected longer-term effects of COVID-19 in terms of hybrid working and online shopping, have had little impact on this trunk road specifically. This further emphasises the importance of this road, as many local users of the A83 are required to use this corridor to access workplaces, education, and services.

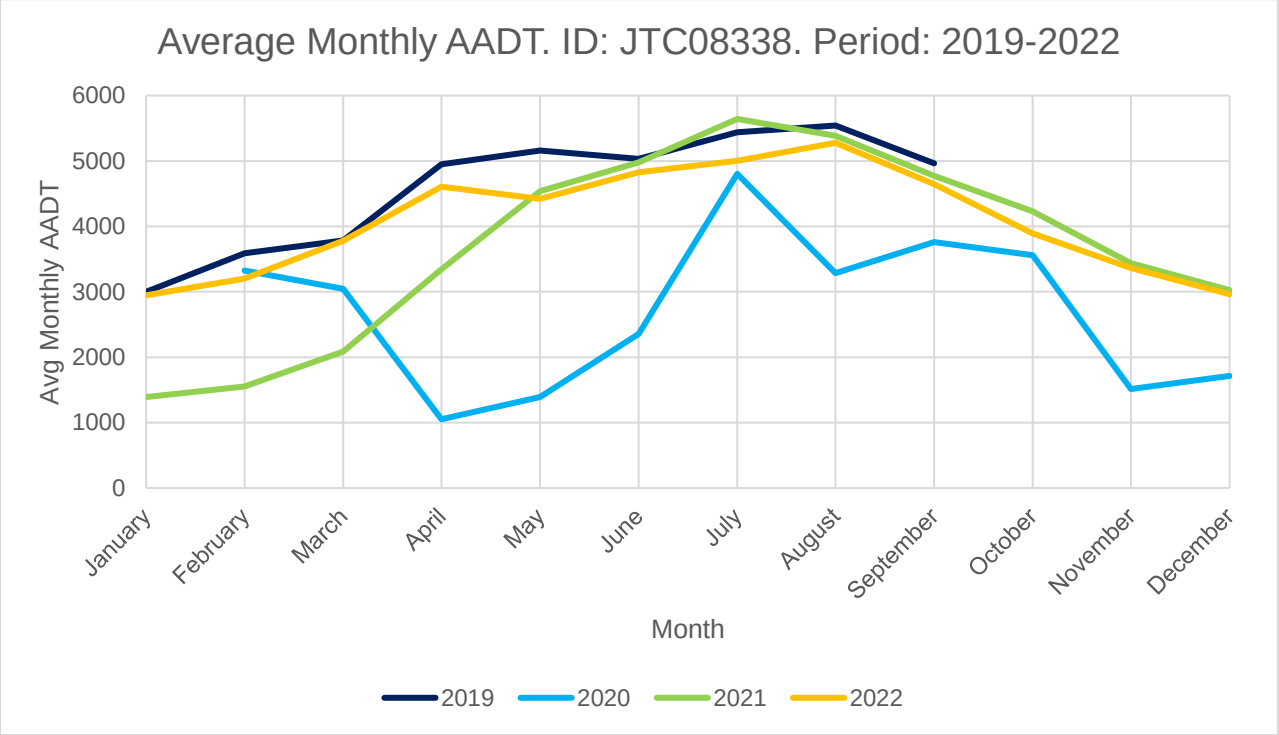

Figure 3-1 - NDTS average vehicle counts 2019-2022

3.1.2. INRIX Database

AWJV has also been given access to the INRIX database which allows for a select link analysis on certain parts of the Scottish road network. Our main goal was to examine the journey time of vehicles using the OMR diversion during an A83 closure. It was found that by using INRIX and examining the A83 Rest and Be Thankful, that journey times are either reported incorrectly or missing entirely during periods where the A83 was closed due to a landslide. A hypothesis for this is that whilst the vehicles are stationary and waiting for the convoy, the INRIX database counts the trip as complete and then does not record the additional time spent waiting at the convoy. Furthermore, we have been unable to complete a select link analysis on the OMR itself as the feature is not available on this road.

3.1.3. Transport Model for Scotland (TMfS)

The TMfS was used in DMRB Stage 1 to forecast traffic flows in two scenarios. This is detailed in Section 4.4. The TMfS was not used as part of the DMRB Stage 2 assessment, but it is noted this would not have influenced the findings in this report as it is a comparative

assessment of options. The TMfS will be considered further to support the Stage 3 assessment where relevant.

3.2. Convoy data

A register of operations from BEAR Scotland in the period August 2020 to January 2023 has been provided to AWJV for analysis and to inform the appraisal. This register contains dates and times in which the A83 traffic lights, A83 convoy, OMR convoy and full A819/A82 diversion were deployed. This has been particularly useful to highlight the disruption caused by each of the traffic management measures and to use in calculating total operating costs per day of the traffic measures in the appraisal.

4. Traffic model

4.1. Overview

A spreadsheet model to perform an economic appraisal of the transport costs has been developed by Transport and Economic Appraisal team. This has been built in accordance with Scottish Transport Appraisal Guidance (STAG) given in Section 9 and the economic parameter data book. Journey time costs and vehicle operating costs have been calculated to obtain a detailed picture of the economic impact that the road closures have on transport within the region.

4.2. Base Year

Figure 3-1 shows the traffic trends between 2019 to 2022. This shows the impact of landslides on traffic flows in 2020 in addition to the impacts of COVID-19. It was decided that 2019 provides the traffic flow data that predates both of these major events and provides the most appropriate baseline from which to forecast traffic growth from. Therefore, 2019 has been chosen as the model base year.

4.3. Model development

The development of the model has been undertaken within a spreadsheet as this was deemed proportionate considering the location of the scheme and the levels of traffic that use the A83. The model applies the changes in travel time to the number of trips predicted to use the A83. The model represents an average day across the whole year. The changes

in journey times from the Scheme Options are then applied to the number of trips in order to derive journey time benefits and vehicle operating costs for the economic appraisal. The changes in journey times were generated using a python simulation described in Section 4.3.1.

4.3.1. Convoy simulation

A simple simulation of the convoy procedure has been developed in python, a general-purpose programming language. This has been used due to the lack of journey time data at Rest and Be Thankful on OMR diversion days but has also been used to inform the wait time at the A83 convoy. Simple equations show us that the longest time that a vehicle could wait to cross the diversion route would be if the vehicle arrived just after the convoy had left, say vehicle A. This vehicle must wait for the convoy to travel the length of the OMR, for those vehicles to depart, the convoy to pick up vehicles travelling in the opposite direction, for those vehicles to depart, the convoy to pick up the next vehicles including vehicle A, and then to travel along the OMR. The wait time of the average user is approximately 15 minutes but can increase to around 25 minutes if the vehicle arrives just as the convoy leaves. This has been modelled over a 4-hour period with a random number of vehicles arriving from the east and west up to a target number of vehicles per hour such that the results from the simulation are related to the traffic flow scenario. The simulation was run for different parameters and numbers of vehicles, so that the number of vehicles using the OMR could be scaled in-line with the traffic flow forecasts provided in DMRB Stage 1.

A number of assumptions and parameters were used in the creation of the python script, which are given below:

- One-way section length: 2000m, 3000m or 4000m
- One-way section vehicle speed: 10mph
- Vehicles per hour: 181, 229, 255 or 338
- Maximum convoy length: 35 vehicles (which includes the convoy vehicle)
- Vehicles have instantaneous speed
- No route choice has been incorporated into this simple model

Results from this simulation were consistent with the average travel time along the current OMR diversion of 23 minutes including the wait time.

4.4. Traffic flow forecasts

4.4.1. Annual average daily traffic flows

The forecast traffic flows given in DMRB Stage 1 have been used as the baseline for the economic appraisal. The 'With Policy Ambition' traffic flow forecast, called 'Low Motorised Traffic/Emissions Scenario' in DMRB Stage 1, makes the following assumptions:

- Phase out the need for new petrol and diesel cars and vans by 2030.
- Car ownership constrained in all cities to number in 2020.
- Decline in trip rates: -25% commute, -66% business, all others – extrapolate decline.
- No connected and autonomous vehicles (CAV's) by 2050.
- Car generalised cost increase to achieve 20% reduction in car vehicle kms by 2030.

The 'Without Policy Ambition' traffic flow forecast, called 'High Motorised Traffic/Emissions Scenario' in DMRB Stage 1, makes the following assumptions:

- Existing electric vehicle growth with no further interventions promoting uptake.
- Car ownership will only be constrained in city centres where there are existing parking constraints.
- Decline in trip rates: -15% commute, -33% business, all others – stable.
- A 40% update of connected and autonomous vehicles (CAV's) by 2050 with the first CAV's appearing in the mid 2020's.
- No change in fuel cost.

It was also noted in DMRB Stage 1 that 'Both scenarios incorporate enhancements to explicitly represent the longer-term effects of the COVID-19 pandemic, such as increased home working and increased levels of digital substitution.'

The traffic flow forecasts use the 2019 AADT counts presented in Section 3.1.1 as a baseline and are then calculated up to 2045, after which it has assumed that there is no change in the traffic flow for each scenario as shown in Figure 4-1.

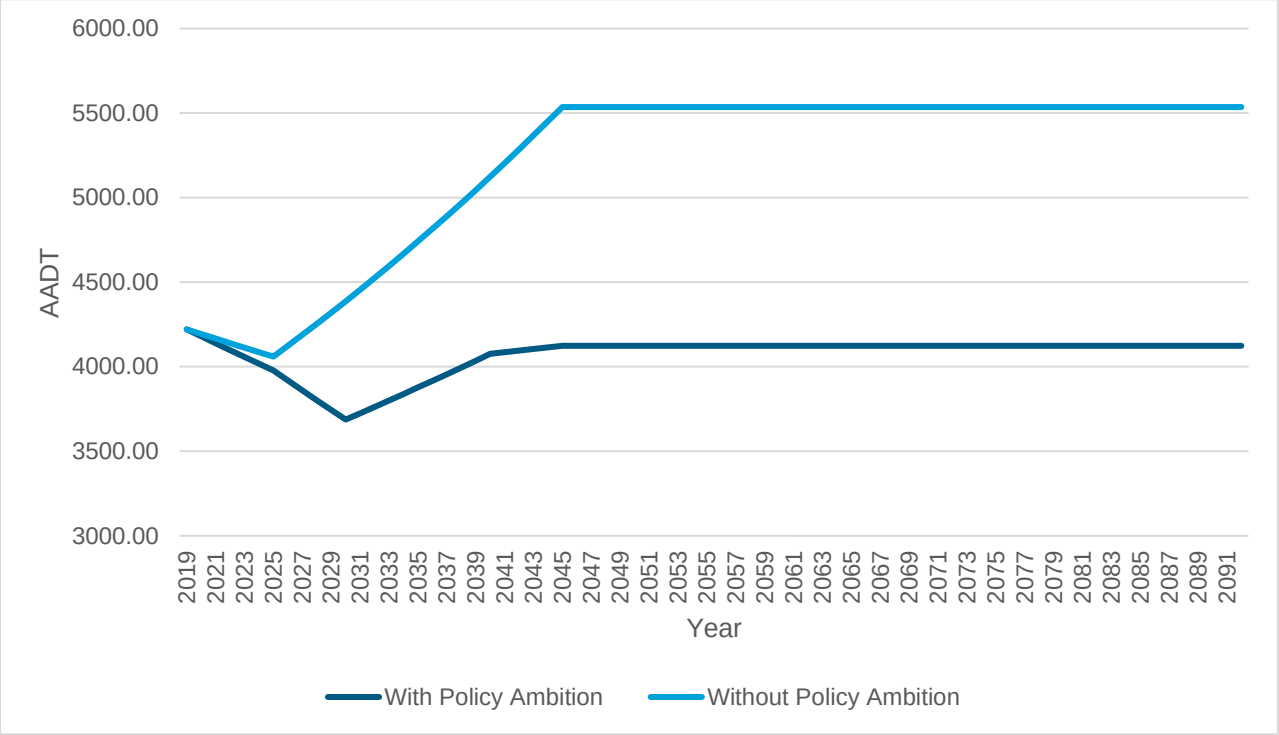

Figure 4-1 - AADT Forecasts

4.4.2. Journey purpose

Journey purposes using the A83 were extracted from the DMRB Stage 1 WEIR and are shown in Table 4-1. The 'Non home based' journeys have been split into two types using the assumption from the WEIR that there are around 200 HGV's using the A83 trunk road per day in each direction. A conversion from occupants to vehicles is obtained by dividing the number of occupants by the STAG value of the number of occupants per vehicle. The proportions of each journey type have been used in combination with the projected traffic flow forecasts from Section 4.4.1. Weekdays, weekends and bank holiday flows have not been treated separately and the total number of vehicles per day in Table 4-1 represents an average of 365 days in 2019.

Table 4-1 - Journey purposes

Journey purpose	Total occupants	Total vehicles	Proportion of travellers
Home based: Work	1244	1058	20%
Home based: Education	258	150	4%
Home based: Other	3244	1874	53%
Non home based: Business cars and LGV's	964	739	16%
Non home based: HGV's	400	400	7%
Total	6110	4221	100%

4.5. Model scenarios

4.5.1. Do Minimum – Medium Term Solution

As part of the Do Minimum, the MTS has been included which has been committed to by Scottish Ministers. This MTS provides an upgrade to the OMR which aims to reduce travel times along the corridor when the A83 Rest and Be Thankful is closed. The MTS upgrades sections of the OMR to allow for two-way traffic and therefore shortens the length of road where the convoy operates. When compared to the current travel time along the OMR, this should reduce the journey time by around 12 minutes. Table 4-2 details the changes to be made to the OMR as part of the MTS. Due to the gradient at the northern section of the OMR, it is not practicable to completely upgrade the OMR to entirely two-way without a major reconstruction of the road and hillside equivalent to that of the long term, permanent solution.

Table 4-2 - Breakdown of the OMR route

OMR	Section type	Section length (km)	Section speed (mph)
Current road	One-way	2.7	10
	Two-way	1.1	15
MTS upgrade	One-way	1.3	10
	Two-way	2.5	20

4.5.2. Do Something – Long-Term Solution

The LTS forms the Do Something in the economic appraisal. Five Scheme Options for the LTS have developed by AWJV. The five options are based on the Pink, Green, Yellow, Purple and Brown Options identified in the DMRB 1 Report and vary between different combinations of debris flow shelter, viaduct, and tunnel. Full details of the Scheme Options are contained in Part 2. All Scheme Options are similar in length to the current A83 and will continue to have a national speed limit. For the purposes of assessment, a 50mph 85th percentile speed has been used**.** Figure 4-2 indicates the location of each of the options.

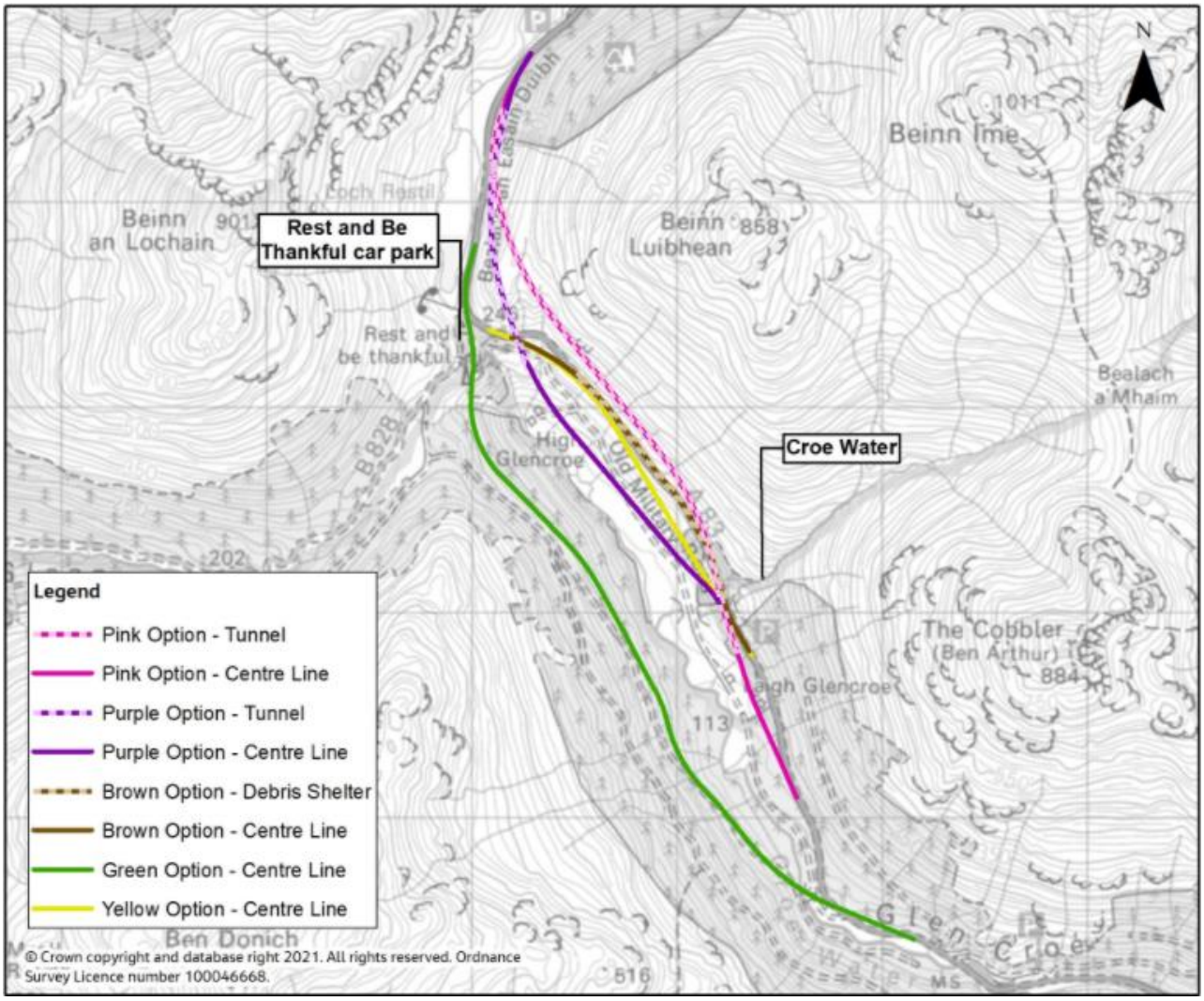

Figure 4-2 - LTS Option Alignments

4.6. Projected closures of the A83

To define the future scenario a number of assumptions have been made to produce a projection of the number of closures of the A83 defined as the appraisal baseline. The closures have had different severities applied to them in order to define how road users will travel through the A83. Table 4-3 provides a summary of these assumptions. It is predicted that a similar event to the landslide in 2020 was a 1 in 50-year event. Therefore, it is assumed that a similar magnitude landslide would occur in 2070 and would cause a similar level of disruption to the A83 Rest and Be Thankful section. During this time, it is assumed

all traffic would be diverted via the OMR convoy and there would be no additional use of the A819/A82 northern diversion.

Table 4-3 - Projected closures on A83

Travel scenario	Number of days per typical year	Number of days during a major event (2070)
Old Military Road	40	220

To provide context of the likely impact of road closures across the varying scenarios, the projected impact on journey times for road users travelling through the study area has been presented in Table 4-4. This analysis involved creating two scenarios:

- 2020 scenario using dataset of number of A83 closures
- Appraisal baseline – projected number of closures over appraisal period with MTS (Do minimum)

The aim of this analysis is to provide an indicative impact across an entire year. These are based on the assumptions on projected road closures detailed in Table 4-3 above.

Table 4-4 also summarises the journey time changes for a typical journey from Inverary to Tarbet relative to the existing A83 with no traffic management measures.

Table 4-4 - A83 Journey time probability

Route	Route probability (2020 scenario)	Route probability (appraisal baseline)	Variation to typical journey time (Inverary to Tarbet)
Existing A83 with no traffic management measures	59%	89%	0
Existing A83 with traffic lights/convoy	8%	0%	+ 3 mins

Route	Route probability (2020 scenario)	Route probability (appraisal baseline)	Variation to typical journey time (Inverary to Tarbet)
Existing OMR with convoy	24%	0%	+ 20 mins
Full diversion via A819/A82 diversion	9%	0%	+ 32 mins
Upgraded OMR with convoy (MTS)	-	11%	+ 8 mins

This table shows that the impact on a regular user of the A83 during the 2020 with 41% of their journeys being impacted by either pre-emptive closures or a landslide event. The appraisal baseline shows that 19% of journeys are likely to encounter delay to their journey either having to use the convoy along the A83 or on the upgraded OMR.

5. Traffic and Economics Appraisal

5.1. Overview

This section details the Transport Economic Efficiency (TEE) analysis and Cost Benefit Analysis (CBA) of the 5 Scheme Options for the LTS. This will capture the main impacts of the Scheme Options in terms of economic welfare, predominantly represented by the main costs and benefits of users and operators of the transport system.

5.2. Appraisal scenarios

The Do Minimum and Do Something are structured to accurately capture the objectives of the appraisal. As the LTS is currently anticipated to open in 2030, the Do Minimum consists of the MTS being subject to staged implementation starting in 2023 and finishing before the start of construciton of the LTS and then a 60-year appraisal from 2030 to 2090. The Do Something is also a 60-year appraisal across the same period but using the open LTS for all

Scheme Options with the exception of the Green Option, which has an appraisal period of 2032-2092 due its longer construction duration.

A separate appraisal is calculated for the construction period of the LTS.

5.3. Exclusions

5.3.1. Public Transport and Active Mode Appraisal

This appraisal has not included any impact on public transport and active mode due to the negligible impact within the economic appraisal.

5.3.2. Safety Benefit Analysis

No accident benefit analysis has been undertaken at this stage. The scheme does not change the standard of road from a traffic speed point of view and is unlikely to show a significant change in the number of accidents occurring on this section of the A83.

5.3.3. Environmental Impact Appraisal

For the purposes of the DMRB Stage 2 assessment, the Environmental Impact has been qualitatively undertaken. The methodology for each impact is summarised within each relevant section of this report.

5.4. User benefits and vehicle operating costs

5.4.1. Journey time benefits

To calculate the journey time benefits, the average journey time for each user was taken from the spreadsheet model across the 60 year appraisal period. The number of vehicles projected for each year was then expanded into users by applying the occupancy. The value of time has been applied to the decreases/increases in travel time for each option to provide a total benefit/disbenefit. The model represents a single day and therefore to annualise to represent a whole year this was expanded by 365 days.

For each scenario, the traffic flows were split into journey purpose. This allowed the application to place a cost on the time for each diversion relative to the journey time of an ‘open as usual’ A83. In accordance with STAG, this has been appropriately calculated with parameter values from the STAG economic data book and discounted.

It is important to note here that the appraisal makes use of the assumption that HGV's travel 15% slower than light vehicles. This is due to the fact that HGV's in the convoy will slow trailing vehicles so that all vehicles travel at the slower HGV speed.

5.4.2. Vehicle operating costs

Vehicle operating costs were calculated in a similar way as journey time costs whilst making use of the relevant STAG data book information and AADT flows used throughout this report. Vehicle occupancies are not used in this calculation.

5.4.3. User benefits during construction and maintenance

A separate assessment has been undertaken for the construction period. The Brown Option is the only online option that requires the A83 to be closed for extended periods during construction. For the purposes of this assessment, it is estimated that the A83 will be closed, and traffic diverted to the MTS (OMR local diversion) on average for around 10 months of each year of the construction period. The remaining options are estimated to have varying closure periods of the A83 with traffic diverted to the MTS (OMR local diversion) and are presented in Table 5-1.

Table 5-1 - Construction periods and diversions for LTS options

Option	Construction length (years)	Number of A83 convoy days	Number of OMR diversion days
Pink	4	30	50
Green	6	30	50
Yellow	4	70	50
Purple	4	30	50
Brown	4	0	297

The Pink and Purple Options are the only options which contain tunnel sections, meaning that they are subject to more frequent maintenance than other types of roads. Table 5-2 details the typical closures experienced by most road tunnel systems in the UK, which has been incorporated into the appraisal. It has been assumed that during these closures all

traffic would use the longer A819/A82 diversion through Dalmally during these short periods. This is consistent with the official diversion during the 2020 landslide which closed both the A83 and OMR.

Table 5-2 - Tunnel closure frequency

Event	Duration of closure	Frequency	Comments
Routine planned maintenance	8 hours	Quarterly	Most UK Road tunnels close 4 times per year for 2-3 nights dependent on level of cleaning and system maintenance.
General inspection	1-2 overnight closures	Yearly	Required by DMRB CS 452 Inspection and Records for Road Tunnel Systems
Principal inspection	4-5 overnight closures	Every 4 years	Required by DMRB CS 452 Inspection and Records for Road Tunnel Systems
Emergency exercise	8 hours	Every 4 years	Required by DMRB CS 452 Inspection and Records for Road Tunnel Systems

5.4.4. Present value benefits

The final discounted totals per year are then collected and summed over the 60-year appraisal period appropriate to the LTS option. The number of closure days and the number of days requiring each diversion are then incorporated to develop a detailed model of the economic impact of disruption to transport should no changes be made to the A83 Rest and Be Thankful site.

Table 5-3 - Present Value Benefits (2010 prices)

Option	With Policy Ambition PVB	Without Policy Ambition PVB
Pink	£ 9,208k	£ 16,527k
Green	£ 9,954k	£ 17,336k
Yellow	£ 9,827k	£ 17,152k
Purple	£ 8,554k	£ 15,647k
Brown	£ 6,933k	£ 13,743k

5.5. Present value costs

The whole life base costs for each scheme are summarised in Table 5-4. These costs include risk and optimism bias, and the maintenance costs are shown in Q1 2023 prices.

Table 5-4 - Scheme base costs

Option	Description	Location to existing A83	Construction period	Cost excluding maintenance (£k 2023 Prices)	Maintenance costs (whole life) (£k 2023 price)
Pink	Tunnel	Offline	2026-2030	£ 1,337,882k	£ 117,517k
Green	Flow shelter and viaduct	Offline	2026-2032	£ 877,111k	£ 63,002k
Yellow	Viaduct	Offline	2026-2030	£ 554,280k	£ 35,444k
Purple	Tunnel and viaduct	Offline	2026-2030	£ 1,048,449k	£ 138,826k
Brown	Flow shelter	Online	2026-2030	£ 432,749k	£ 24,619k

Each option has been profiled equally over their respective construction period. The treatment of costs has been applied in accordance with TAG Unit A1.2. It has been assumed to be equally spread over the construction period and then had inflation applied. The inflation rate applied is the GDP deflator plus 2.1%. These costs have then been discounted from 2010 with discount rate of 3.5% per year and then rebased to 2010 prices using the GDP deflator to calculate the Present Value Costs (PVC) in 2010 prices. The maintenance costs have been treated in the same manner over the whole appraisal period and are shown in 2010 prices.

The cost of the projected A83 closures within the Do Minimum scenario and have been offset against the LTS investment and maintenance costs within the final PVC. The cost per day for traffic management and OMR rental are displayed in Table 5-5.

Table 5-5 - Traffic management costs (2022 prices)

Traffic management costs	Cost per day
Traffic management and land access	£ 11,892

By applying the assumptions on the number of forecast closures, a total cost was derived for the whole appraisal period and then included within the PVC calculation. The PVC for each option is shown in Table 5-6.

Table 5-6 - Present Value Costs (2010 prices)

Option	Description	Present Value Costs (£ 2010 Prices)
Pink	Tunnel	-£ 598,770k
Green	Forestry track - Flow shelter and viaduct	-£ 377,551k
Yellow	Viaduct	-£ 243,964k
Purple	Tunnel and viaduct	-£ 461,914k
Brown	Flow shelter	-£ 197,373k

5.6. Benefit to Cost Ratios

The ratio between the PVB and PVC for each option are presented as the Benefit to Cost Ratio (BCR) and are given in Table 5-7.

Table 5-7 - LTS option BCR's

Option	With Policy Ambition BCR	Without Policy Ambition BCR
Pink	0.02	0.03
Green	0.03	0.05
Yellow	0.04	0.07
Purple	0.02	0.03
Brown	0.04	0.07

5.7. Sensitivity tests

There is a high degree of uncertainty when attempting to predict the number of A83 closures. Therefore, additional scenarios have been included to cover a range of scenarios and the subsequent impact on the present value benefits.

The first test compares the Do Minimum to the Do Something for a catastrophic landslide occurring in 2030. There are three simple scenarios which have different lengths of time where the A83 corridor is completely closed due to the road being destroyed. This has been compared to the Yellow Option in the Do Something as this option does not have a significant impact during the construction period and has an appraisal period consistent with 3 of the other 4 options. Table 5-8 shows the Present Value Benefits for a landslide closure of the A83 for 2, 5 and 10 years from 2030 for both traffic flow scenarios. An assumption has been made that in the Do Minimum after a catastrophic landslide event, there would be no A83 pre-emptive or actual closures due to landslides upon re-opening.

Table 5-8 - PVB for major landslide sensitivity test (2010 prices)

A83 full closure period	With Policy Ambition PVB	Without Policy Ambition PVB
2030-2032	£ 21,397k	£ 25,218k
2030-2035	£ 48,934k	£ 57,685k
2030-2040	£ 92,408k	£ 110,644k

Another test which is important to examine is how the number of OMR convoy days may vary into the future. There is a scenario where the remediation measures to the hillside reduce the number of OMR convoy days per year by reducing the number of pre-emptive closures. This is represented by a reduction in OMR convoy days from 40 to 10. There is also an argument to be made that the number of OMR convoy days may increase as the amount of rainfall increases year on year due to the effects of climate change. These scenarios are represented by increases in the number of OMR convoy days from 40 to 70, 100 and 130, where 130 is the number of days the OMR convoy operated during the landslide events of 2020. Similarly, to the previous test, this has been compared to the Do Something where the Yellow Option has been used as the testing baseline. Table 5-9 shows the PVB for each of the discussed scenarios in both of the traffic flow scenarios.

Table 5-9 - PVB for varying number of OMR convoy days sensitivity test (2010 prices)

OMR convoy days per year	With Policy Ambition PVB	Without Policy Ambition PVB
10 days	£ 4,683k	£ 7,588k
40 days	£ 9,827k	£ 17,152k
70 days	£ 14,970k	£ 26,716k
100 days	£ 20,114k	£ 36,280k
130 days	£ 25,258k	£ 45,844k

5.8. Conclusions

To conclude the traffic appraisal, all the Scheme Options have a very low BCR. Traffic flows along the A83 corridor are generally low across the year with fluctuations in the Winter and Summer periods. All the Scheme Options marginally improve the journey length and thus the journey time between Inverary and Tarbet and are comparable in that aspect.

Although the Brown and Yellow Options have very similar BCR values, the Brown Option gives the lowest value of user benefits in comparison to all other options. This is due to the major disruption during the construction period where all traffic is assumed to use the medium-term solution (OMR local diversion) for a significant proportion of the year during the construction period. The Purple and Pink Options give the lowest BCR's and both contain tunnel sections, highlighting that tunnelling in this area is a very high cost process.

6. Wider Economic Impacts

6.1. Overview

This section summarises findings from a Wider Economic Impacts (WEI) assessment undertaken for the proposed A83 Access to Argyll and Bute scheme. It follows a three-step approach to:

- Collate evidence to establish a narrative
- Examine forecast changes from the proposed intervention
- Confirm the scope of WEI and undertake assessment

A review of the trips and activities that are supported by the A83 was conducted at first, along with assessing possible changes that may be brought by the proposed scheme in terms of travel time and reliability. Findings from the initial review helped to relate the anticipated outcomes from the scheme to potential economic impacts in the current appraisal framework, in order to ascertain the scope of the WEI assessment. A range of qualitative and quantitative analysis was subsequently undertaken in accordance with the identified scope, with their findings captured in this chapter.

It is noted that these benefits are largely associated with all Scheme Options opposed to being a differentiator as part of the comparative assessment of options.

6.2. Economic Narrative

Trips and Activities supported by the A83

Located to the southern half of Argyll and Bute, the A83 Trunk Road through Rest and Be Thankful carries over 4,400 vehicle trips per day, with these serving a variety of purposes to a variety of destinations including Campbelltown, Lochgilphead, Inverary and Rothesay/Dunoon, as shown in

Figure 6-1.

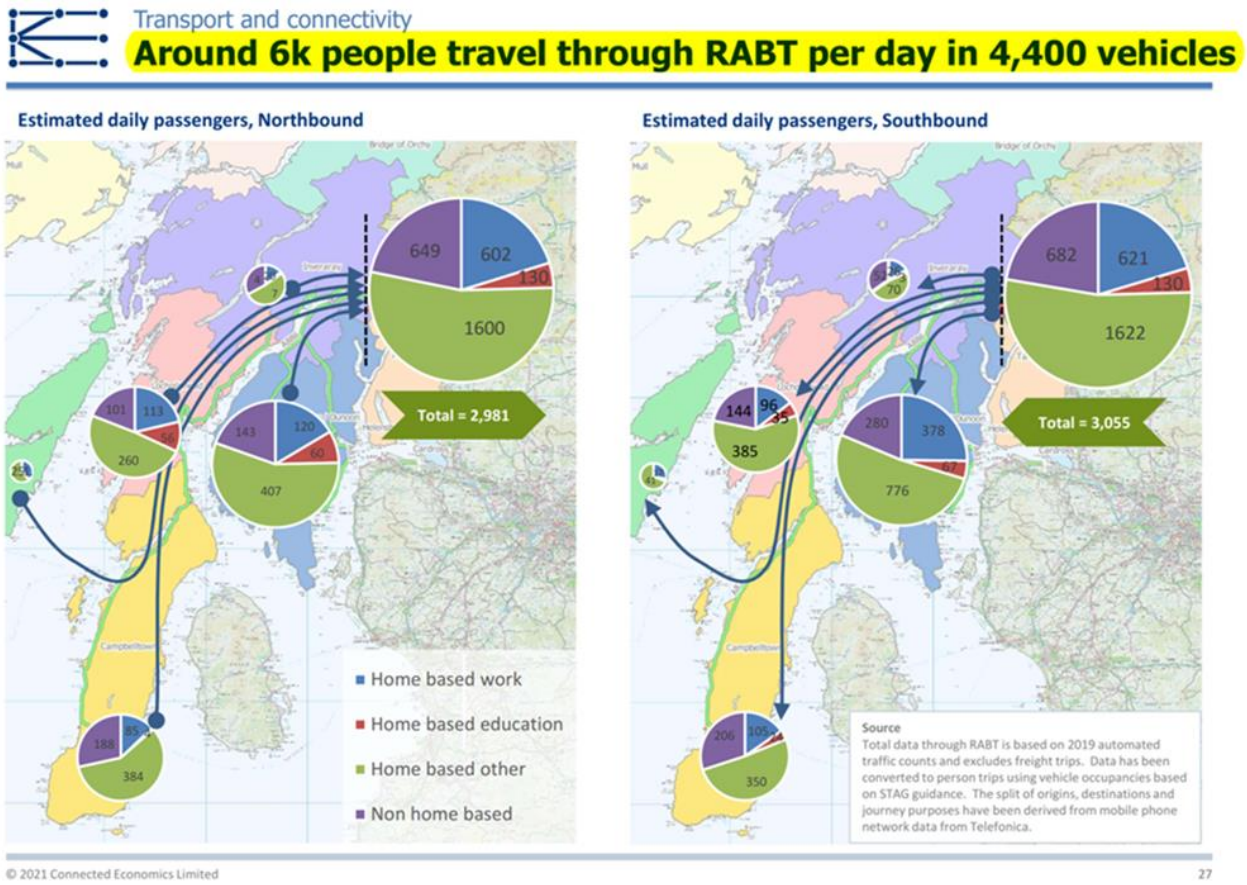

Figure 6-1 - Trip Purpose Overview (Source: Access to Argyll and Bute Wider Economic Impacts: Preliminary Assessment of Route Corridors, Jacobs/Aecom/Transport Scotland, April 2021)

Social and Economic Functions of the A83

A83 is one of the only two east-west strategic routes from Argyll & Bute to Central Belt, which covers approximately 70% of Scottish population. Based on information from Figure 6-1, the A83 near Rest and Be Thankful covers about 20% commuting trips, 4% for Education and 75% for other home and non-home based purposes (Table 6-1). Overall, these statistics are broadly consistent with the proportion of trips by purpose at a national level, with data from Transport Scotland (Source: Table TD3: [Purpose] Percentage of journeys made by purpose of travel: 2012-2019 | Transport Scotland), indicating that in 2019, commuting accounting for 23.3% of total trips made, 5.6% for Education and 71% for other purposes.

Table 6-1 - Breakdown of A83 trips by direction and purpose near Rest and Be Thankful

Purpose \ Direction of Travel	Northbound	South bound	Total	%
Work	602	621	1,223	20%
Education	130	130	260	4%
Home-based other	1,600	1,622	3,222	53%
Non-home based	649	682	1,331	22%
Total	2,981	3,055	6,036	100%

A significant proportion of the home-based work trips, approximately 20% in both the northbound and southbound direction, are coming from places further afield. This suggests one function of the A83 is to provide connectivity for residents from more remote places to employment opportunities and clusters to the south of Argyll and Bute. These areas are particularly evident at Rothesay/Dunoon, Lochgilphead, which is the destination of the largest employment site within the area, and Campbelltown.

Out of the total trips through the A83 Rest and Be Thankful, approximately 4% are made for education purposes in both the northbound and southbound direction. As demonstrated in Figure 6-1, these trips are predominantly to/from Campbeltown, Dunoon, Lochgilphead and

Rothesay, and are likely to be for further and higher education purposes. The University of Highlands and Islands (UHI) (Source: Our centres - UHI Argyll) is Argyll's largest provider of further and higher education, with nine campuses throughout Argyll and Bute, including at the aforementioned locations. With nearly 31,000 students studying per year, it is estimated to contribute £560 million annually to the region, indirectly supporting 6,200 jobs (Source: UHI Strategic Plan, 2021 – 2025). As such, maintaining transport connectivity through the A83 is therefore critical in supporting access to these educational opportunities and the economic value that it generates across Argyll and Bute.

When comparing the proportion of trips for education purposes to a national level, trips through the A83 Rest and Be Thankful are slightly below what is observed. In 2019, trips for education purposes nationally represented 5.6% of total trips, compared to 4% locally. This differential could possibly reflect the more rural and remote locations through the identified study area, particularly along the scheme area itself, with relatively limited public transport provision compared to urban centres such as Edinburgh and Glasgow.

Overall, the data and statistics revealed suggests that A83 is a critical infrastructure for residents, visitors and investors to enjoy the high quality of life, benefits of the scenic location, built heritage, and the increasingly diverse rural economy in Argyll & Bute.

The Rural Growth Deal (Source: Rural Growth Deal (argyll-bute.gov.uk)), announced by Argyll & Bute Council in 2022, includes a £70 million package of investment that aims to transform the areas natural resources and business innovation into a thriving local economy. The A83 plays an important role in supporting these aspirations by:

- connecting high value business sectors with national and international markets
- attracting skills, visitors and businesses, and also enabling training and learning opportunities.
- making more of the natural and built resources in the region.

The location of the healthcare and education facilities, alongside the Rural Growth Deal priorities, in relation to the A83 Rest and Be Thankful, are shown in Figure 6-2 below. It is clear that in addition to its role as transport infrastructure, it is also an integral part of a wider system that support aspired outcomes in economic prosperity, planning (population and development growth), environmental sustainability and carbon reduction.

The A83 offers significant value to those who live and work alongside the corridor:

- Connecting rural communities, landowners and businesses with employment clusters, investment and growth opportunities in sectors including but not limited to tourism and hospitality, aquaculture and fisheries, forestry and wood processing, creative industries, energy and renewables.
- Access to healthcare and social services, such as hospitals for emergency, inpatient care and outpatient clinics, GP, dental and community health services, and care homes.
- Access to schools, outdoor education, further education and higher education, such as the University of Highlands and Islands (with nine campuses throughout Argyll and Bute).
- Overall, a key infrastructure necessary to support day to day activities in Argyll and Bute, connecting businesses and communities, facilitating access to essential services, and supporting jobs and activities in industries such as healthcare, education, aquaculture, forestry, tourism, energy and renewables.

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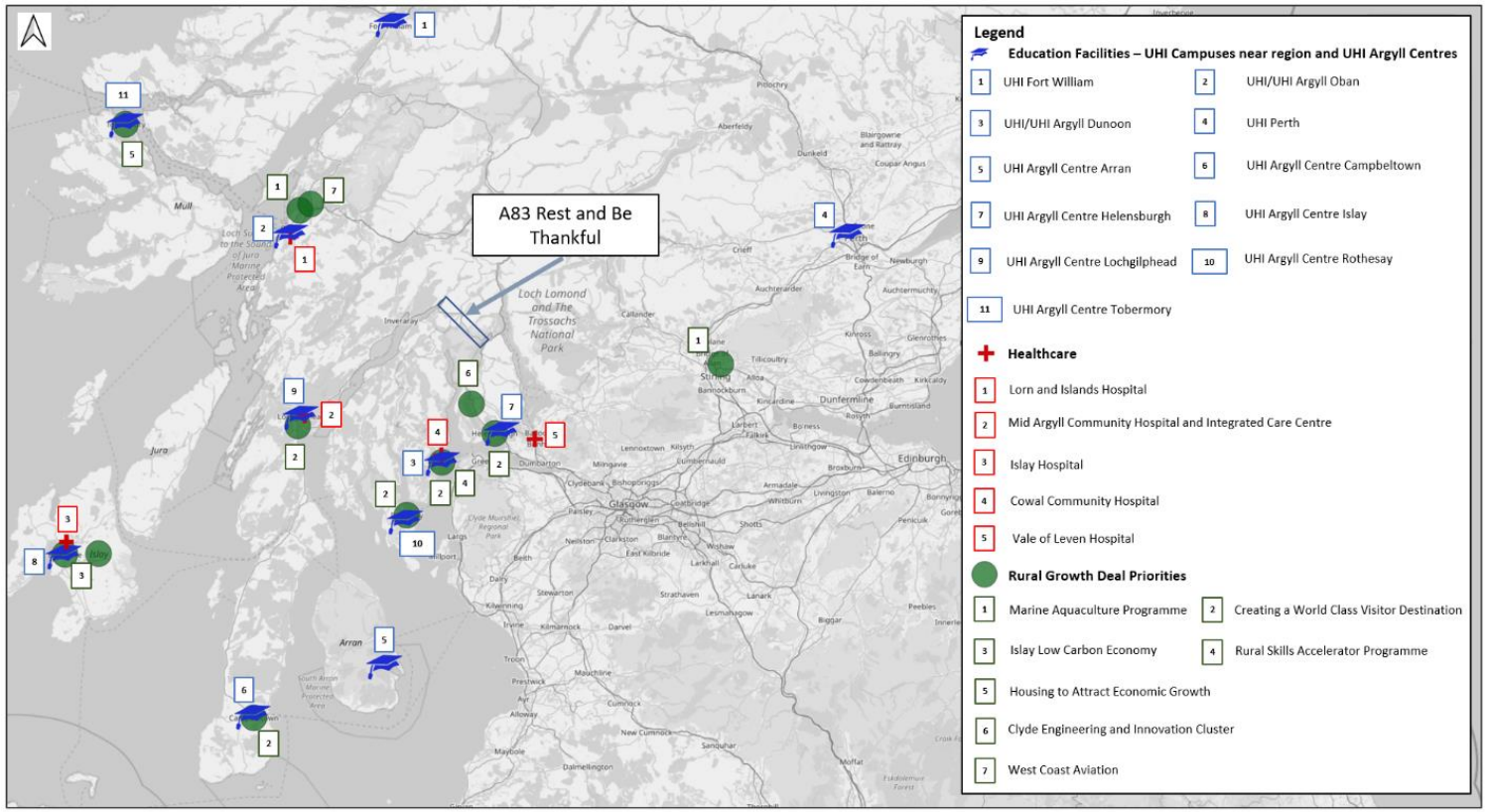
Figure 6-2 - Scheme Location relative to Education and Healthcare Facilities, alongside Rural Growth Deal priorities



6.3. Scope of Impacts Informed by Forecast Changes from the Intervention

As previously discussed, a key change brought about by the scheme, and which drives the majority of the quantified benefits regardless of option, is to improve journey times and reliability for users of the A83 through Glen Croe.

From a national perspective, this will result in a faster and more reliable east-west strategic route connecting Argyll and Bute with Central Belt. The access of Argyll and Bute business sectors to labour/skills, visitors and markets further afield through the year will also be maintained. This will benefit sectors including but not limited to tourism and hospitality, aquaculture and fisheries, forestry and wood processing, creative industries, energy and renewables.

Assessing these impacts from a local level, the scheme will result in safer, more relaxed and reliable journeys to jobs and essential services such as healthcare, education and other day-to-day activities. An overview of the changes brought about by the intervention is shown in Table 6-2 below. It is noted that this overview is based on high-level assessment of all Scheme Options opposed to a comparative assessment to differentiate Scheme Options.

Table 6-2 - Scope of economic impacts from changes brought by the scheme

Benefit Streams	Impacts from changes brought by the proposed scheme
User impacts	Real time savings and welfare benefits for transport users from improved journey experience from reduced delay, better journey planning and improved reliability
Productivity impacts	Reduced travel time will reduce the costs for commuting and business journeys within Argyll and Bute, and to markets and suppliers in the central belt, the rest of Scotland and Great Britain. The reduced travel costs will enhance the Access to Economy Mass for Argyll and Bute, which in turn leads to uplift in productivity for local firms and workers.

Benefit Streams	Impacts from changes brought by the proposed scheme
Employment effects	Reduced costs (due to decreased journey time) for commuting may encourage higher labour participation from the economic active population and increase potential labour pool for businesses in areas that are forecast to receive material journey time benefits
	Faster journeys on the A83 without disruption also present opportunities that may lead to relocation of workers / jobs, attract inward investment and development growth, due to variations in productivity between regions, skill levels/occupational mix, specialisation, stock of knowledge and market access.
Induced investment	This may include but not limited to workers, firms and investors exploiting differences in factor endowments such as environment and natural resources for tourism, mining and renewables, and the thriving creative industry in Argyll and Bute for opportunities in traditional arts (visual, performing, music, literature and crafts) and digital industry. Outcomes from the changes may include increases in jobs, GVA and land value uplift, although the realisation of such growth or benefits is likely to required concerted investment across different sectors including but not limited to the transport sector alone.

These benefit streams identified were assessed qualitatively and quantitatively. Findings from the assessment are reported in the section that follows.

6.4. Findings from the Assessment

The scope of the wider economic impact assessment for the Access to Argyll and Bute A83 scheme has been identified following the narrative on its economic function and forecast changes as described previously, in accordance with the wider economic impact framework in TAG Unit A2.1 (Source: TAG unit A2.1 wider economic impacts appraisal, May 2018 (publishing.service.gov.uk)). An overview of the findings from the assessment is presented in Table 6-3.

Table 6-3 - Overview of the Findings from the Wider Economic Impact Assessment

Benefit Streams	Welfare Impacts	GDP Impacts	Assessment
User impacts	User time and travel cost benefits from business, commuting and leisure trips	Business user benefits only	Quantified in the PVB from the transport user impacts appraisal that supported the option assessment. Impact is positive but the scale of benefit is likely to be modest compared with the cost due to the low level of demand.
Productivity impacts	Uplift in productivity as a result of enhanced agglomeration (access to economic mass)		Positive but modest impact – Quantification is only possible until relevant data is made available.
Employment effects	40% of the GDP impacts (to the right) to represent the tax revenue income from more people working	Increase in GVA when there are more people working	Positive but modest impact – Quantification is only possible until relevant data is made available.
	30% of the GDP impacts (to the right) to represent the tax revenue income	Net increase in GVA when workers / jobs relocate	Likely to be positive for all but the scale of benefits can only be significant when the intervention is appraised as part of a holistic package that brings step changes.

Benefit Streams	Welfare Impacts	GDP Impacts	Assessment
Induced investment	Increased economic output in imperfect competitive market (10% of business user benefits)		Quantification is not recommended for employment effects associated with job relocation due to the significant efforts required for Land Use and Transport Interaction modelling and the uncertainty in other complementary measures in order to make a sizeable impact.
	Land Value Uplift from developments unlocked by the A83 scheme	Additionality applied	Similarly for induced investment, quantification is only appropriate with clarity on specific development opportunities and strong evidence for dependency (without the A83 Rest and Be Thankful scheme, the development cannot be delivered).

Specific benefit streams in the table above were explored in more depth during the assessment. This includes productivity impact and induced investment.

Productivity Impacts

Individuals and firms derive productivity benefits from locating in close proximity to other individuals and firms. These benefits arise because of individuals and firms interacting with one another and are an important factor in the formation of clusters; also known as agglomeration. Agglomeration economies arise from improved labour market interactions,

knowledge spill-overs and linkages between intermediate and final goods suppliers, which can occur within an industry and/or across industries.

Due to the absence of data, the exact scale of productivity uplifts from the scheme could not be quantified at this stage, and such impacts will be driven by assumptions in the Reference Case on the frequency of closure and diversion as the design progresses.

In the absence of quantified forecast in accordance with the relevant guidance, a high-level analysis has been undertaken to assess the potential of productivity uplift from the scheme. Table 6-4 presents the total GVA by sector in Argyll and Bute along with the sectoral average productivity compared to the national average. It can be seen that consumer services and productor services are the two weakest sectors in Argyll and Bute in terms of the average productivity. However, judging by the size of the relevant economic activities as measured by their combined GVA (over £900m), these two sectors account for approximately 70% of the GVA in Argyll and Bute. A marginal 1% uplift in the average productivity of these two sectors, assumed as the potential outcome from transport investment represented by enhanced agglomeration, represents a potential £9 million increase in the GVA from the region per annum.

Table 6-4 - An Overview of Divergence in Productivity by Sector

Sector	Total GVA by Sector in Argyll and Bute	Total GVA by Sector in Argyll and Bute as %	Productivity in Argyll and Bute	Productivity in Scotland	Difference in Productivity with National Average
Manufacturing	£252,222,161	19%	£98,933	£99,743	-1%
Construction	£166,494,004	12%	£55,086	£59,408	-7%
Consumer services	£657,801,616	49%	£37,968	£49,333	-23%
Producer services	£254,926,422	19%	£41,234	£62,220	-34%

Induced Investment

Induced investment refers to changes in the productive capacity of the economy as a result of a transport investment. In appraisal practice it may be two-fold. On one hand, it refers to additional output from the businesses which benefit from the enhanced connectivity with increase in their output higher than the changes in the marginal cost, under imperfect competition. On the other hand, changes in transport connectivity and productive capacity of the economy may affect the level and location of economic activity, and as a result output, employment and productivity. However, the scale of such changes can only be significant when any transport intervention is delivered as a part of a holistic package that alters the use of land.

For increased output under imperfectly competitive market, improved accessibility and/or reductions in generalised travel costs as a result of the scheme will lower the costs of production for businesses. The corresponding increase in output from these firms is greater than the time savings captured in the conventional appraisal of business user benefits under imperfect competition. This additional benefit can be captured as a wider economic impact, as advised in TAG Unit A2.4, by applying a 10% uplift factor to the business users' transport impacts (part of the total PVB presented in Table 5-3 of this report). It can be seen from Table 5-3 that 10% of the forecast user benefits (as a proxy for output increase under imperfect competition) is very modest when considering the significant cost of each of the individual options.

For induced investment relating to more significant changes to the level and location of economic activity, whilst a positive impact is expected, these impacts have not been quantified due to the absence of specific development opportunities (or their dependence on the proposed scheme) to inform robust Land Use and Transport Interaction modelling and / or Land Value Uplift assessment.