Inverness Airport ACP emissions assessment

Methodology

The estimation of the differences in fuel consumption and CO_2 emissions resulting from the Inverness airspace change was based on the changes in track distance flown for the current and proposed departure and arrival routes.

The changes in track length will occur within the cruise stage of each flight as departure and arrival profiles are assumed to remain the same.

Inverness Airport provided details of the current routes in terms of swathe boundaries. For the purpose of assessment, ERCD created a central track for each swathe to represent the average route flown. Airspace procedure designers *Davidson Ltd* supplied the proposed nominal departure and arrival tracks.

The current and proposed routes are shown in **Figure E1** for Runway 05 and **Figure E2** for Runway 23. The proposed departure and arrival tracks are depicted by the thick blue and red lines respectively. The current departure and arrival swathes (including the central 'average' track) are indicated by the thin purple and orange lines respectively.

The calculated changes in track distance for each route are summarised in **Table E1** below:

Table E1 Changes in track distance resulting from airspace change

Route	Change in track distance (km)
Departure 05 north	+2.1
Departure 05 south	+5.8
Departure 05 west	+1.5
Departure 23 north	+11.6
Departure 23 south	+0.3
Departure 23 west	+4.2
Arrival 05 north	+5.3
Arrival 05 south	-4.9
Arrival 05 west	+3.0
Arrival 23 north	+8.0
Arrival 23 south	+11.0
Arrival 23 west	+9.0
Total	+56.9

It can be seen that the proposed routes are all longer than the current ones with increases of up to 11.6 km, except for arrivals from the south to Runway 05 where there is a 4.9 km decrease associated with the new route.

Inverness Airport also provided 24-hour traffic logs for a typical easterly day (10 July 2013) and a typical westerly day (12 July 2013) to describe the current situation, along with information on the ATS route followed where applicable (i.e. N560D north, N560D south and W6D). For the purpose of modelling, non-ATS movements were allocated to the aforementioned ATS routes on a pro-rata basis (i.e. 13% N560D north, 70% N560D south and 17% W6D). On average there were 83 movements per 24-hour day, comprising 42 departures and 41 arrivals. An average runway modal split of 70% Runway 23 / 30% Runway 05 as confirmed by Inverness ATC was assumed for all the modelled scenarios.

The forecast scenario for 2019 takes into account projected increases in aircraft movements on the new routes. Based on guidance from Inverness Airport, 3% growth per annum has been allowed for scheduled traffic and 10% growth per annum for GA traffic. An average runway modal split of 70% Runway 23 / 30% Runway 05 was also assumed for year 2019.

The difference in fuel consumption is the product of the number of operations of each aircraft type multiplied by the fuel consumption associated with the change in track distance at the cruise stage for the current and proposed routes. (Note: helicopters have not been included in the fuel consumption calculation as it is assumed that their operations and use of airspace will be unchanged).

The fuel consumption at the cruise stage for each aircraft type has been calculated using Eurocontrol's BADA online tool (version 3.11). In BADA, generic cruise speeds are given for each aircraft based on aircraft performance as well as operational data. Fuel consumption for a small number of single-piston engine types which do not feature in the BADA database have been calculated using appropriate substitute aircraft.

The cruise altitudes selected were based on the predominantly short-haul nature of operations to and from Inverness Airport, namely 35,000 ft for jet aircraft, 7,000 ft for the Saab 340 and 5,000 ft for all other aircraft.

The 'nominal' mass, given by BADA for each aircraft type, has been chosen to represent the mass at the cruise stage as it best characterises the mass of aircraft on short-haul operations when actual data are not available.

Fuel flow is given by BADA in kg/s. Using the true airspeed at the cruise stage, the fuel flow was converted to units of kg/nm which was then applied to the difference in route lengths to give the mass of fuel in kg.

Emissions were then calculated by multiplying the fuel consumption by a conversion factor which is dependent on the type of fuel used (i.e. avgas for piston aircraft and jet fuel for jets and turboprops). The changes in fuel consumption were then converted to the annual change in tonnes of CO_2 emitted based on *Annex 1: 2011 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting.*

Results

The calculated changes in annual fuel consumption and annual CO_2 emissions due to implementation of the airspace change for the current (2013) and forecast year 2019 scenarios are summarised below in **Table E2** below:

Table E2 Total annual changes in fuel consumption and CO_2 emissions resulting from airspace change

Scenario	**Total change in annual fuel consumption (t)**	**Total change in annual CO_2 emissions (t)**
With ACP	+122	+387
Forecast 2019	+156	+498

It can be seen that the airspace change is expected to cause a net increase in annual CO_2 emissions of 387 tonnes, which will increase a further 29% to 498 tonnes by 2019.

Figure E1 Inverness Current and Proposed Runway 05 Departure and Arrival Tracks

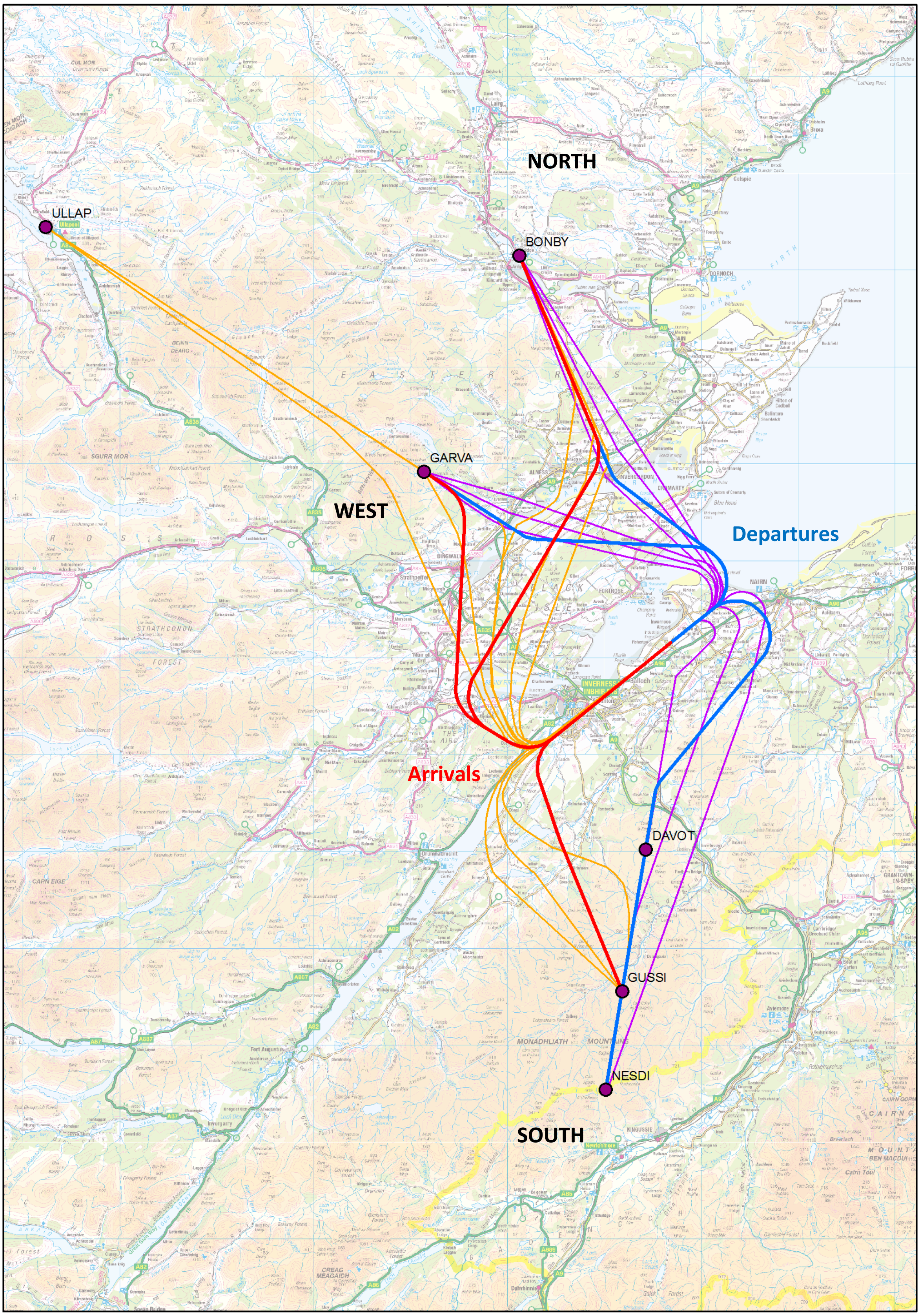

Figure E2 Inverness Current and Proposed Runway 23 Departure and Arrival Tracks