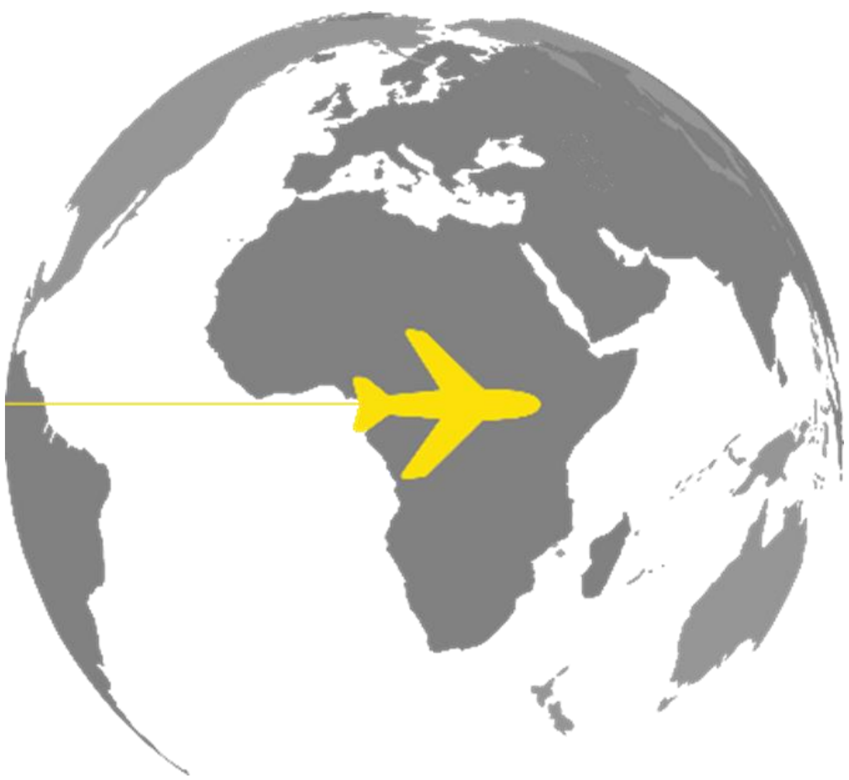
Leeds Bradford
Yorkshire's Airport

# Leeds Bradford Airport Airspace Change Proposal

## Environmental Impact Report



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# Executive Summary

This Report contains a summary of the Environmental Assessments conducted by AMEC Foster Wheeler in support of the Leeds Bradford Airspace Change Proposal which is being submitted under the legacy process CAA Publication (CAP) 725 “Guidance on the Application of the Airspace Change Process”.

The information contained within this report was previously released within the Consultation Document. Additional images have been included that provide clarity about aircraft departure profiles for those departing from Runway 32. The images show the comparison between turbo-prop departures (which are not obliged to follow the Noise Preferential Route (NPR), and A320 or similar aircraft and A330 or similar aircraft.

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# 1 Introduction

## 1.1 Overview

This document is an Enclosure to the Formal Airspace Change Proposal (ACP) submission to the Civil Aviation Authority (CAA) from Leeds Bradford Airport (LBA). The ACP is following the process articulated within the CAA Publication CAP 725 ‘CAA Guidance on the Application of the Airspace Change Process’ [Reference 2]. In accordance with CAP 725, the Economic and Environmental impact of a proposed Airspace Change must be considered. This document has the following sections:

- Section 1, this section, introduces the report;
- Section 2 offers a brief description of the proposed changes to the airspace;
- Section 3 details the Traffic Forecasts;
- Section 4 details assessments of the potential effects of noise;
- Section 5 makes an assessment of the change in fuel burn/$CO_2$;
- Section 6 assesses the effect on local air quality; and
- Section 7 estimates the economic valuation of the environmental impact.

# 2 Description of the Airspace Change

## 2.1 Overview

The LBA Airspace Change Project has taken over 6 years to develop. The full details concerning the final proposal are contained within the LBA ACP Proposal Document that has been submitted to the CAA for consideration. A brief description of the proposed change is contained within this section.

## 2.2 Current Environment

LBA currently has a Class D Control Zone (CTR) and associated Control Areas (CTAs) that provide protection to the existing IFPs and provide connectivity with the en-route airways network. The CTR is quite narrow which means that arrivals are de-conflicted with departures in the only airspace available which lies to the west of the airport. The lack of airspace to manoeuvre aircraft within means that arrival aircraft may be instructed to hold until departures are at a safe distance away, or alternatively, departing aircraft are held on the ground until the arrivals are established on the final approach. This not only affects traffic flows at the airport but also increases planning time and reduces the capacity of the controllers to concentrate on other tasks.

## 2.3 Proposed Airspace

The proposed airspace solution for LBA involves an increase in the volume of Class D Controlled Airspace (CAS) comprising additional CTAs. The consulted option included an increase in the size of the CTR, but in light of the consultation responses, the airspace was modified to maintain the existing CTR by increasing the number of CTAs. This meant that some General Aviation (GA) stakeholders could utilise some elements of the Class G airspace in the same way that they do currently. The modified design still provides containment of the newly proposed Standard Instrument Departure (SIDs) and the new Standard Arrival Routes (STARs), and Instrument Approach Procedures (IAPs). Whilst details of the STARs are included within the environmental assessments, and the Proposal Document submitted to the CAA, the implementation of the STARs will be the subject of a separate application post 2019. The proposed option is detailed in Figure 1 below:

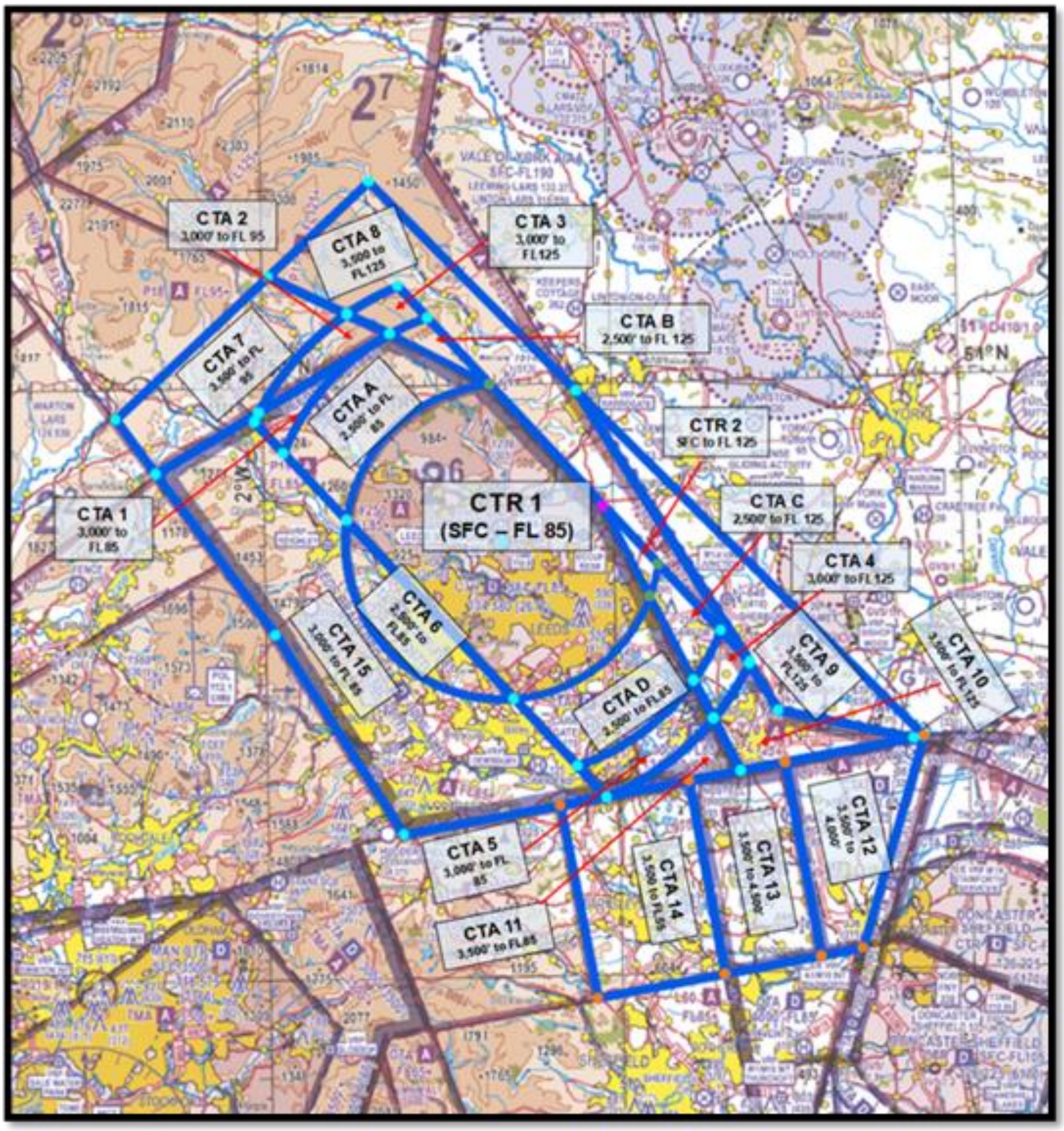


Figure 1 – Proposed LBA Airspace Design

***NB: In order to avoid confusion over the labelling of proposed CTAs from the diagram contained within the Consultation Document, the modified CTR areas have been renamed as CTA A, B C and D.***

| Airspace | Lower Limit | Upper Limit |
|---|---|---|
| CTR | Surface | FL 85 |
| CTA A | 2,500 ft | FL 85 |
| CTA B | 2,500 ft | FL 125 |
| CTA C | 2,500 ft | FL 125 |

| Airspace | Lower Limit | Upper Limit |
|---|---|---|
| CTA D | 2,500 ft | FL 85 |
| CTA 1 | 3,000 ft | FL 85 |
| CTA 2 | 3,000 ft | FL 95 |
| CTA 3 | 3,000 ft | FL 125 |
| CTA 4 | 3,000 ft | FL 125 |
| CTA 5 | 3,000 ft | FL 85 |
| CTA 6 | 2,500 ft | FL 85 |
| CTA 7 | 3,500 ft | FL95 |
| CTA 8 | 3,500 ft | FL125 |
| CTA 9 | 3,500 ft | FL125 |
| CTA 10 | 3,500 ft | FL125 |
| CTA 11 | 3,500 ft | FL85 |
| CTA 12 | 3,500 ft | 4,000 ft |
| CTA 13 | 3,500 ft | 4,500 ft |
| CTA 14 | 3,500 ft | FL55 |
| CTA 15 | 3,000 ft | FL85 |

Table 1 – Vertical Limits of the Proposed Airspace at LBA

## 2.4 Containment of IFPs

The proposed airspace option was designed to ensure that the proposed IFPs would be contained in accordance with ICAO PANS Ops Doc 8168 [Reference 1]. This ensures that aircraft flying the IFPs are provided with the adequate protection as required by the ICAO PANS Ops Doc 8168, and the UK CAA Safety and Airspace Regulation Group (SARG) Policy Statement on Controlled Airspace Containment Policy dated 17th January 2014. The Policy Statement states:

> *"Where established, CAS in the vicinity of aerodromes shall be designed to provide sufficient airspace protection for aircraft established on, or joining, the final approach track (procedurally, or under radar direction), and the integration of aircraft in a radar traffic pattern or carrying out departures (including SIDs where established), or a missed approach. Dimensions for a CTR should be appropriate to meet the requirements of IFPs at the relative aerodrome with relevant distances being measured from the Aerodrome*

*Reference Point; however, another point of reference may be used in order to satisfy local design requirements.*

*The lateral dimensions of Terminal CTAs associated with CTRs (as opposed to en-route CTAs) are to be sufficient to permit the effective integration of flights to and from any adjoining route structure where appropriate or the containment of published terminal, holding and instrument approach procedures where necessary. Containment of such procedures should in the first instance be predicated upon primary obstacle clearance areas used in the design. Where competing airspace requirements preclude containment by primary area, containment of the nominal track defined by the procedure may be less than that afforded by the primary area but shall normally not be less than 3NMs from the edge of CAS. In exceptional circumstances, proposals for procedures resulting in less than 3NMs may be acceptable, but such proposals must be completely justified and supported by a safety case."*

## 2.5 Interaction with Existing En-Route Structures and ANSPs

One of the project constraints was how aircraft departing LBA and arriving at LBA are presented and where they should access and egress the National Airways Structure. The LBA ACP is part of the FASI(N) project and all of the designs, both airspace and IFPs were conducted in collaboration with the FASI (N) project team. This meant that the new proposed SIDs are broadly replicated versions of the existing ones. It was hoped that new STARs could have been included with this submission. However due to delays in the FASI (N) program it would not be possible to implement these at the same time as the airspace and SIDs. Therefore, STARs will be included in a separate submission post 2019. However, the Instrument Approach Procedures (IAPs) are included since these will have no impact on the FASI (N) or Prestwick Centre operations.

# 3 Traffic Forecasts

## 3.1 Overview

The demand for air travel to and from the North Yorkshire region is growing and LBA aims to meet this demand by attracting a greater range of airlines to deliver additional international destinations to meet both business and leisure passengers' requirements. LBA currently has 4 million passengers per year (based on 2017 data) and aims to increase passenger numbers to 7 million per year by 2030.

## 3.2 National Growth

The Department for Transport (DfT) published a report on UK Aviation Forecasts in 2013 and 2016. Since the 2013, the aviation market has undergone some significant changes: passenger demand has grown significantly at UK airports, averaging 4.2% per annum since 2011. In 2016 passenger movements reached an historic high of 267 million at the airports for which the DfT forecast. Aircraft movements (ATMs) have grown nationally by 10%, despite average load factors being higher and airlines using bigger aircraft[1].

| Date | Number of Aircraft Movements | % Change | Number of Passengers | % Change |
|---|---|---|---|---|
| 2014 | 29,873 | - | 3,274,474 | - |
| 2015 | 31,149 | +4% | 3,455,445 | +5.52 |
| 2016 | 31,704 | +1.78 | 3,612,117 | +4.53 |
| 2017 | 34,549 | +8.97 | 4,076,616 | +12.86 |

Table 2 – LBA Statistical Data

Table 2 above shows that the increase in passenger numbers has been achieved by utilisation of larger capacity aircraft. Therefore, growth figures that relate to increases in number of passengers do not directly relate to a commensurate increase in aircraft movements.

## 3.3 Airport Growth

This airspace change was not driven by a desire to increase airport growth. The main driver was to ensure that the airport could continue to publish SID procedures that did not rely upon the ground-based infrastructure that is scheduled for withdrawal. The addition of STARs and IAPs is a natural

[1] Taken from DfT UK Aviation Forecasts published 2017.

progression for airports to develop GNSS based procedures to reduce reliance upon ground-based infrastructure and is in accordance with the UK FAS. The additional volume of CAS is required to contain the new procedures. However, the introduction of new IAPs together with additional airspace, will facilitate more efficient operations which will help to achieve the LBA's aim of 7 million passengers by 2030.

# 4 An Assessment of the Effects of Noise

## 4.1 Overview

Any change to airport operations must be assessed to establish how the change may impact noise exposure. The changes may affect people differently; for example, people living close to the Airport and in locations close to aircraft flight paths, the changes could affect the number and frequency of aircraft that are observed. This will therefore bring associated environmental effects, particularly changes in the locations of where aircraft noise is observed, changes to the amount of aircraft fuel burnt and therefore an effect on both $CO_2$ emissions and local air quality.

It should be noted that the proposed airspace changes do not affect the number of flight movements or proportion of flights along flight paths and therefore this section only considers effects as a result of the route changes. This section includes the following assessments:

- Operational and procedural changes, particularly changes in locations overflown by aircraft and effect of PBN departures;
- Changes in noise and disturbance as a result of the proposed changes;
- Change to local air quality;
- Changes in carbon dioxide ($CO_2$) emissions as a result of fuel burn; and
- Changes for other airspace users.

The effects as a result of the airspace change are assessed against relevant guidance outlined in CAA CAP 725 [Reference 2] and further supporting assessments have been undertaking against relevant supporting guidance and examples of best practice observed during other airspace change proposals.

The proposals have sought to minimise the noise effects of low flying aircraft (below 4,000 ft). Between the height of 4,000 ft and 7,000 ft the objective has been to balance the other environmental effects, namely fuel burn and climate change with noise. At heights above 7,000 ft, and consistent with relevant guidance, it is considered that noise is less significant and therefore fuel burn and climate change are the priority for the proposed changes.

## 4.2 Effects That May be Experienced Locally

This section discusses the potential effects that may be experienced due to the proposed airspace change locally.

### 4.2.1 Operational and Procedural Changes

This section discussing operational changes is focussed on departing aircraft only; the procedural changes for arriving aircraft will seek to formalise the existing arrangements for arriving aircraft and therefore there will be no noticeable change for local residents due to arriving aircraft.

The proposed changes for departing aircraft will affect the locations in which aircraft fly. Furthermore, due to the procedural change as result of PBN operations, the proposed change will also result in aircraft being concentrated along defined flight paths instead of the lateral dispersion of aircraft that is observed today.

Due to the change of locations over which aircraft will fly the operational change assessment therefore considers the following:

- High-level overview of operational changes on a route level;
- Overview of changes to vertical profiles; and
- Effect of PBN and concentrating aircraft along defined flight paths.

### 4.2.2 Overview of Operational Changes

In 2016, of the 44,340 aircraft that operated, 74% of aircraft operated using Runway 32 and 26% using Runway 14. Figure 2 and Figure 6 present an overview of the operational changes on a route level for Runway 32 and Runway 14 respectively. The figures show the current SIDs (presented as green lines) and the proposed PBN routes (presented as blue line). Furthermore, because aircraft do not accurately follow the current departure routes, which results in aircraft laterally dispersed around the nominal SID centreline, a sample of radar data from August-2016 is also presented to show the actual locations of aircraft flight tracks.

For Runway 32 departures, the current SIDs (NELSA and DOPEK/LAMIX) will be replaced with PBN SIDs. However, the waypoints used for the SIDs will not change and therefore the new SIDs will also be called NELSA and DOPEK/LAMIX. Although, there are three Runway 32 SIDs, DOPEK and LAMIX follow the same path up to FL 70 (approximately 7,000 ft) and therefore for simplicity these are considered as being one SID.

Figure 2 shown below, was included within the Consultation Document. This Figure appeared to show that aircraft following the new PBN SID would change their initial turn. This indicated that all aircraft would follow this profile. Upon investigation, it was revealed that the turn depicted was the worst-case scenario, and the image actually reflected the profile of a turbo-prop aircraft (type ATR 72 or similar). These aircraft are not required to follow the NPR and therefore this was confusing. Further analysis was conducted, and the images below reflect separate modelling conducted to show ATR 72 type aircraft, A320 and A330 type aircraft.

Introducing PBN SIDs for Runway 32 (i.e. 74% of the time) will change the location of the initial turns on both of the SIDs and the initial turn will occur earlier than is seen today. It can also be seen from the radar data, that currently aircraft are dispersed across the flight paths, particularly when turning, and this results in aircraft overflying numerous locations in any given month.

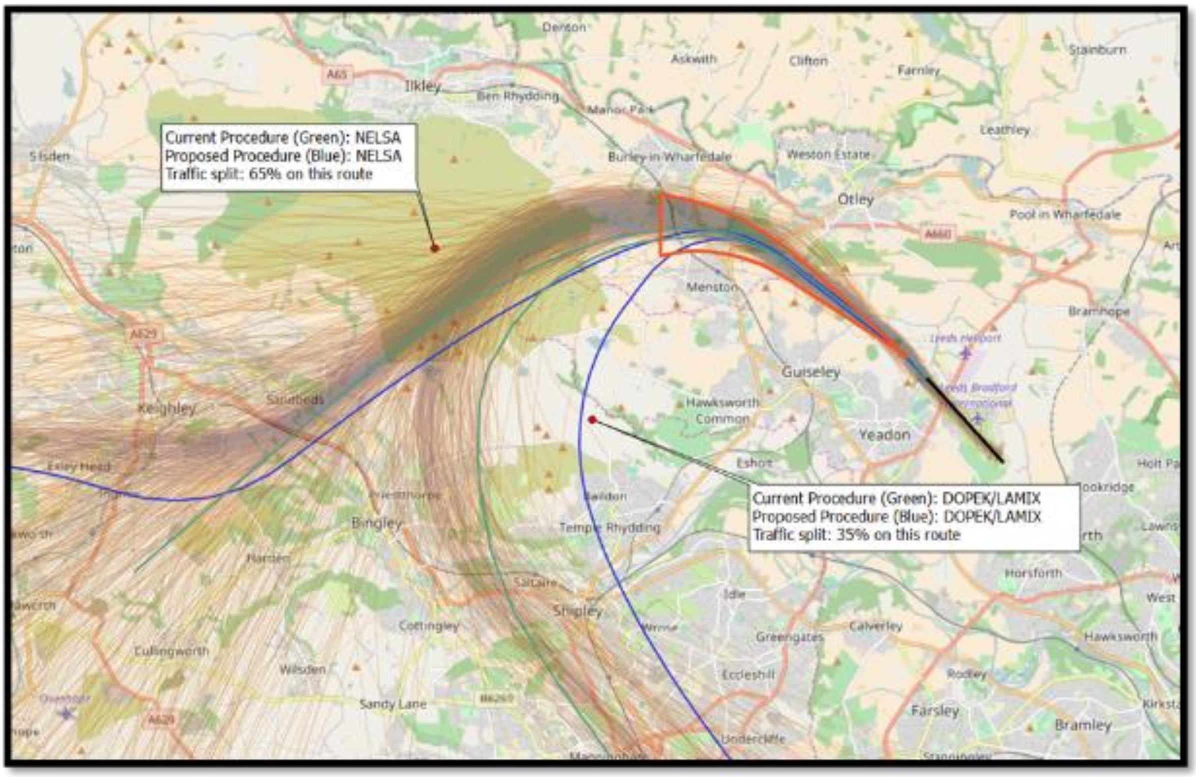


Figure 2. RW 32 Departure SID Routes (Image included within the Consultation Document)

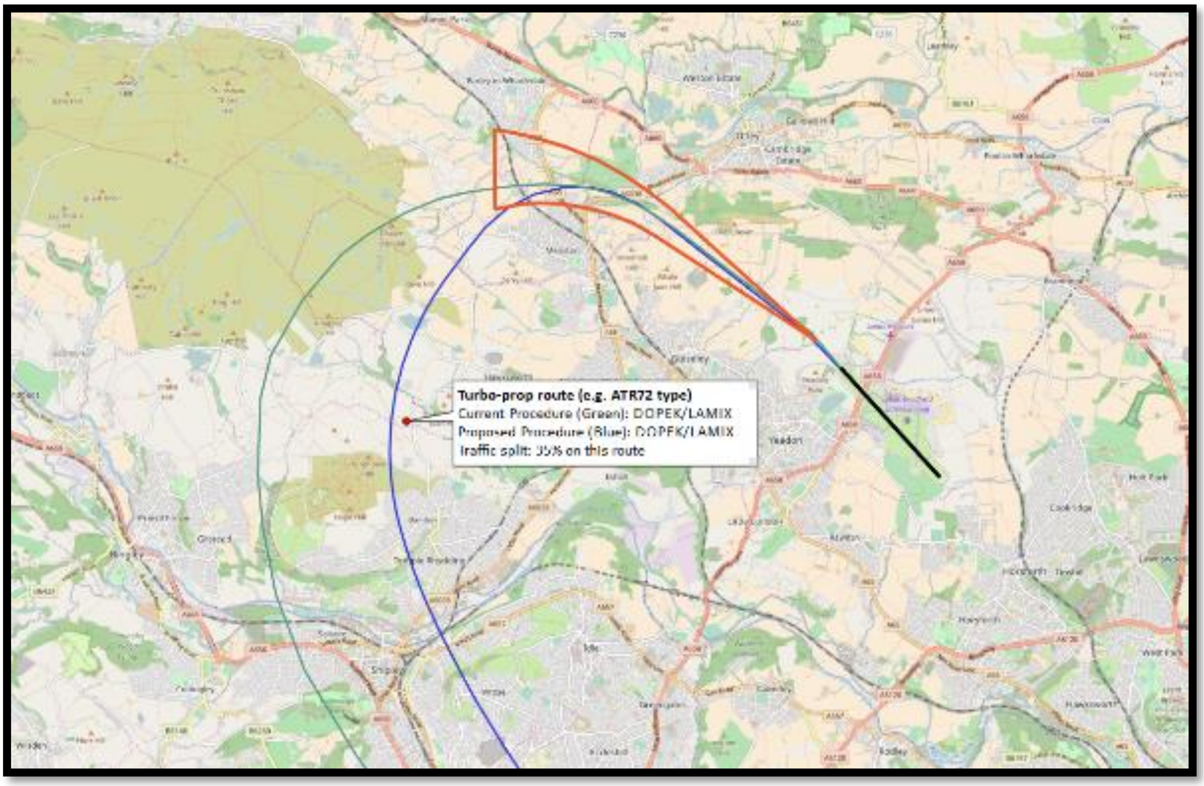


Figure 3. RW 32 Departure SID Route for ATR 72 type aircraft

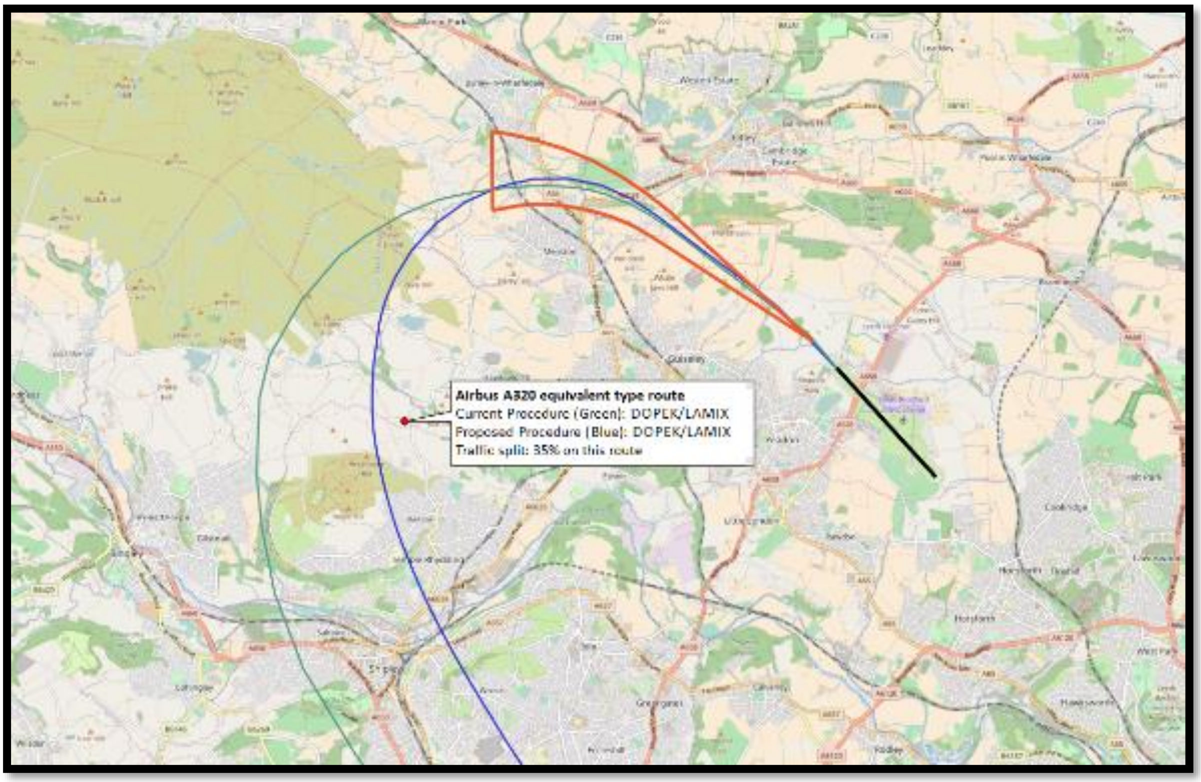


Figure 4. RW 32 Departure SID Route for A 320 Type Aircraft

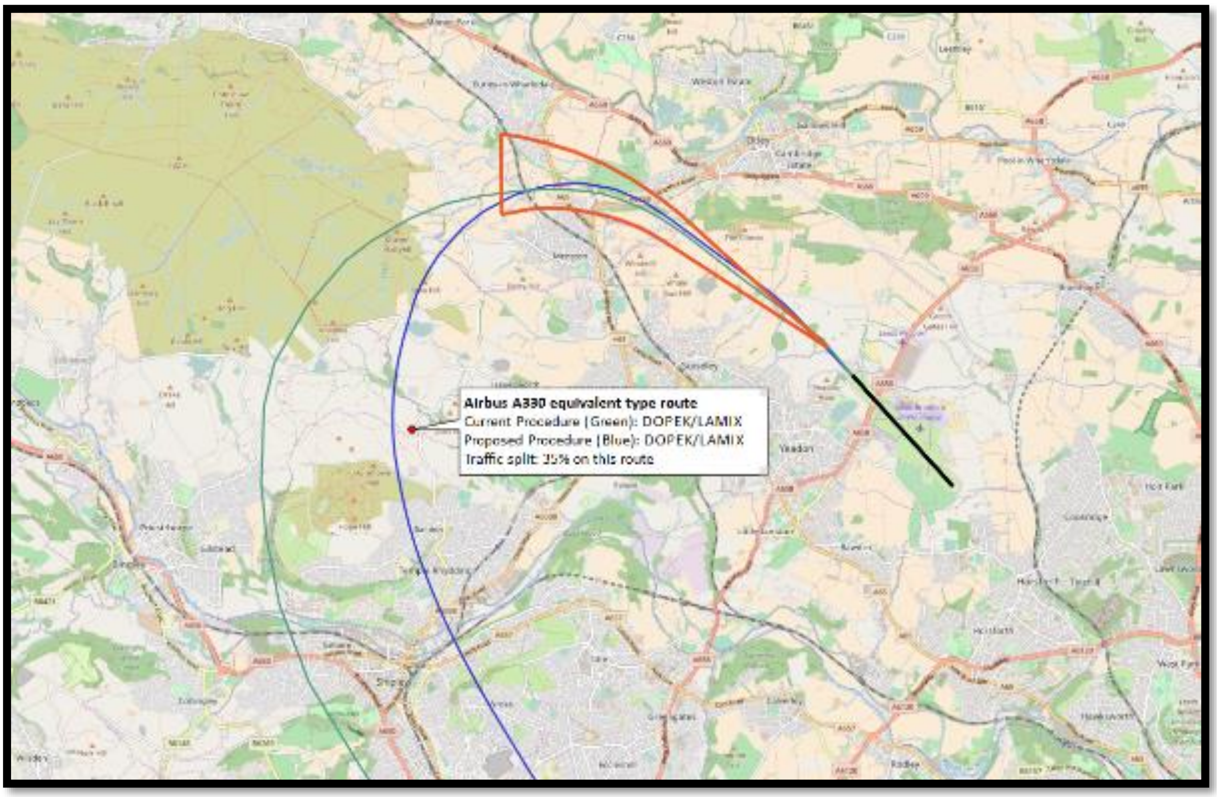


Figure 5. RW 32 Departure SID Route for A 330 Type Aircraft

For Runway 14 departures, the SIDs will be replaced with PBN procedures and the DOPEK/LAMIX SID will remain. However, the current POLEHILL SID, which turns westerly after departure will be replaced with a new SID ELEND which establishes its initial turn later than the current POLEHILL SID.

It can be seen from Figure 6 below that there is little discernible change in the proposed DOPEK/LAMIX route. Furthermore, because there is no turn along the SID after departure, the dispersion of aircraft is much less than is seen on other SIDs.

However, as discussed earlier the current POLEHILL SID, which sees approximately 65% of Runway 14 departures will be changed to become ELEND. The change will not affect the number of departures along the route; however, the initial turn will occur much later than is seen today. This will therefore result in aircraft making the initial turn around Stourton and overflying Rothwell Haigh and Thorpe on the Hill by which time, the aircraft will have climbed higher than when they previously commenced the turn.

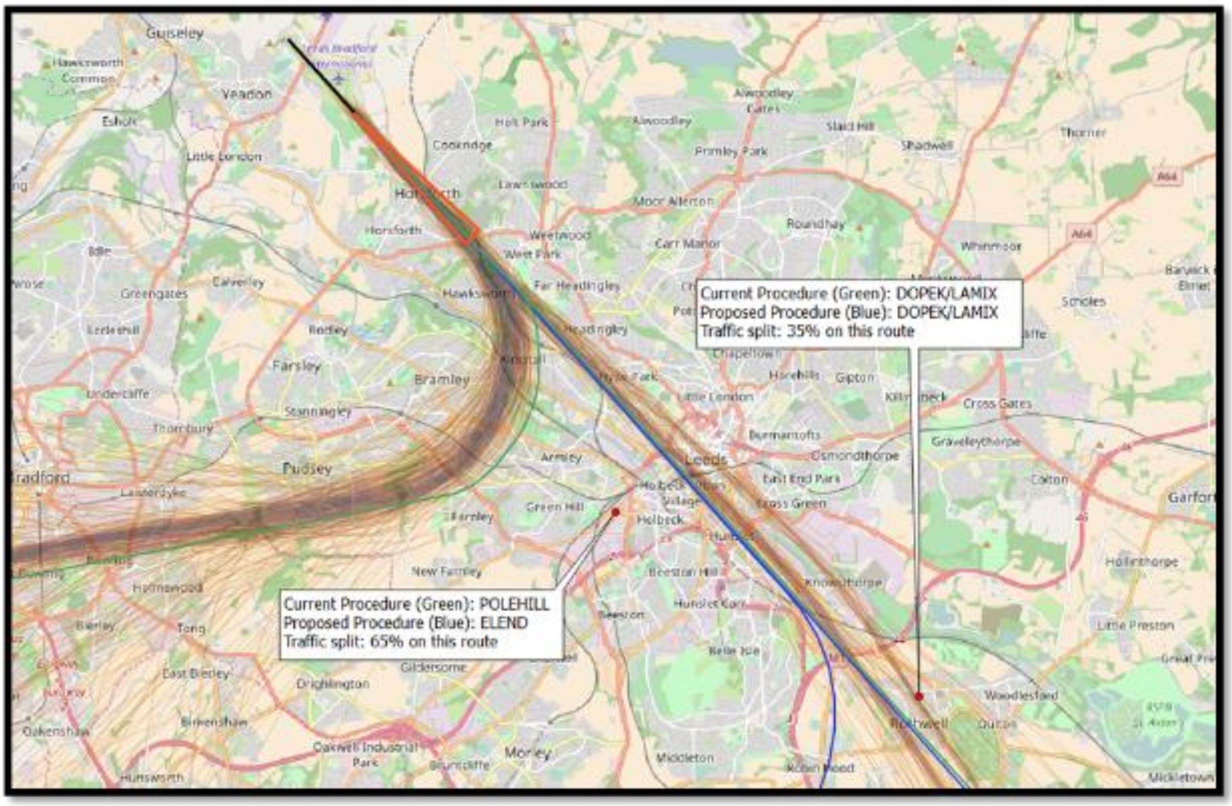


Figure 6. RW 14 Departure SID Routes

## 4.3 Aircraft Vertical Profiles

In addition to affecting the location of aircraft flight paths, an airspace change may also affect the vertical profiles of aircraft, resulting in aircraft being higher or lower over the ground. However, a primary reason for the airspace change is to allow aircraft to make best use of modern performance characteristics, one of which is to allow aircraft almost unrestricted climbs. This will therefore result in aircraft being at a similar height or even higher along the flight track than they are today.

Furthermore, for Runway 32, and due to the climb performance issues associated with Controlled Airspace, an initial climb gradient of at least 8.0% has been stipulated. This is consistent with the current procedures and therefore material changes to climb profiles are not expected.

It should also be noted that for each proposed PBN route it is expected that different sized aircraft will perform slightly differently, with smaller aircraft climbing faster, resulting in the initial turns occurring earlier. The climb performance of aircraft is expected to result in three separate flight paths with the difference in the location of the initial turn around ± 30-metres apart. The aircraft can be broadly categorised into the following grouping:

- Propeller driven passenger aircraft (for example ATR-72);
- Airbus A320 or Boeing 737-800; and
- Airbus A330 or Boeing 767-300.

However, although there is a marginal change in the locations overflown due to aircraft establishing the desired height for turns, this section discussing operational changes, assumes for simplicity that as the changes in locations are negligible, aircraft will be operating along one distinct flight path.

### 4.3.1 Effect of Concentrating Aircraft

As part of the proposed airspace change proposal, the current conventional routes will be replaced with PBN routes, which due to the increased navigational performance of aircraft, will result in aircraft concentrated along defined flight paths which will therefore reduce the extent of areas of overflown.

Furthermore, the effect of concentrating aircraft traffic along flight paths has the effect of increasing the size of aircraft noise exposure contours. Although this is perhaps a little counter intuitive, when aircraft are dispersed, the noise energy is dispersed and there is less noise energy in a specific location to increase the noise into the next noise level category. However, when aircraft are concentrated, a concentration of energy occurs across a smaller area, leading to higher noise levels in that region.

In Figure 7 below, a difference map of the noise energy is shown for the current modelled routes with aircraft dispersed, subtracted from the current modelled routes with aircraft concentrated along flight paths. It should be noted that for Runway 32 departures the noise modelling considered one aircraft track dispersed by 2.5 km which is based on the location of the NPR and an assessment of the average track position of aircraft departures up to 5,000 ft (AMSL) and 7.5 km from Start-of-Roll. The only change between the two scenarios is the concentration of aircraft and it can be seen from Figure 7, that in terms of $LA_{eq}$, more noise energy is concentrated along the centreline but levels are reduced on the periphery.

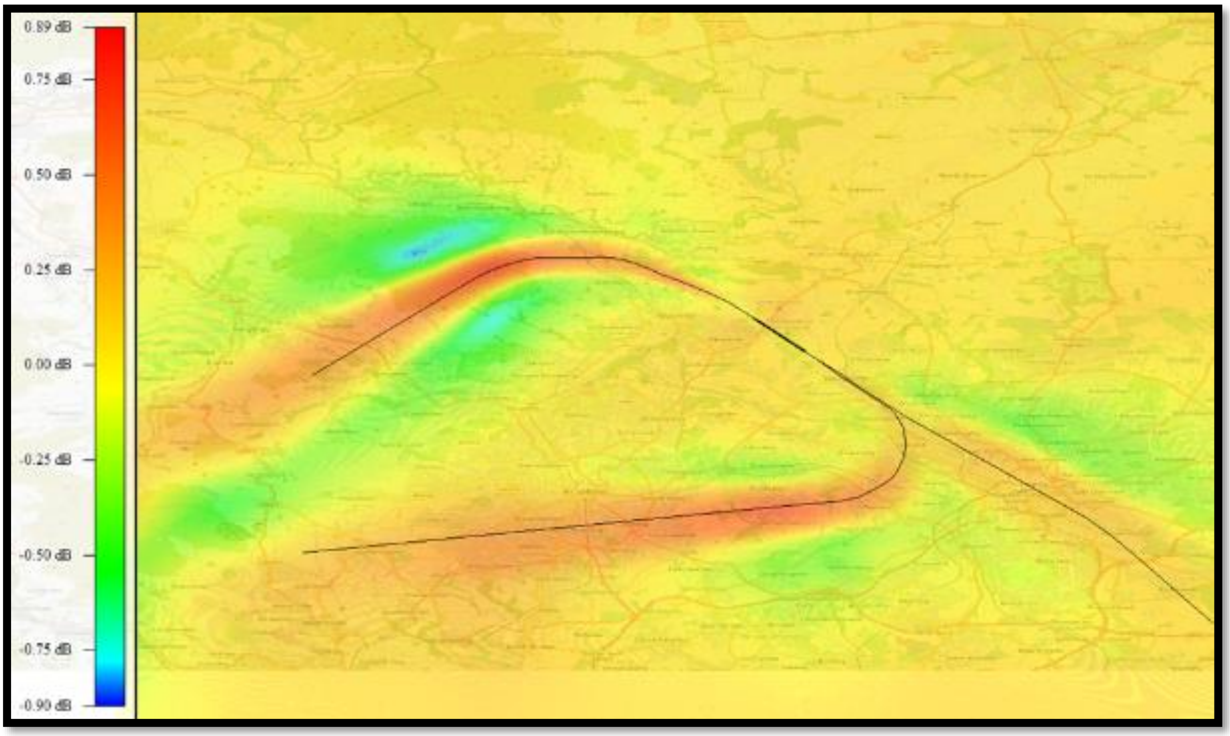


Figure 7. Noise Energy Model for LBA

## 4.4 Noise

Noise exposure can affect the environment and can therefore affect quality of life, health and well-being of individuals, communities and natural resources. For these reasons, noise is often recognised as being an important consideration for those living close to an airport and in locations overflown by aircraft.

The Airport has an overall aim to be "recognised as a pioneering organisation for the management and control of noise among airports of a comparable size, and demographic characteristics" and therefore the airspace change proposal assessments in respect of noise have been undertaken to be consistent with this aim.

### 4.4.1 Noise Indicators

The noise effect of the proposed Airspace Change up to 7,000 feet are presented as:

- Daytime noise exposure contours expressed a $LA_{eq}$, 16hr 92-days. A $LA_{eq}$ contour or equivalent continuous noise contour, is a representation of the 'average' level of noise throughout the period. These contours are typically produced for UK airports to represent the average summers day of operations at the Airport that occurs between 16th June and 15th September from 7am until 11pm, which is considered to represent the busiest time of year for UK airports;
- Maximum sound level footprints for the most frequent and noisiest daytime aircraft, expressed as $LA_{max}$. A $LA_{max}$ contour shows the loudest noise experienced from a single aircraft operation. $LA_{max}$ levels are often used when describing how loud everyday items are; for example, a vacuum cleaner or lawn mower, and
- Noise footprints for the noisiest and most frequent aircraft operating at night, expressed as Sound Exposure Level (SEL). An SEL footprint shows the total noise energy contained in a 1-second burst of the aircraft operation and is often used to measure disturbance as a result of night-time aircraft operations.

### 4.4.2 Noise Assessment Scenarios

For the noise assessment, two scenarios have been considered:

- The current level of noise based upon the situation immediately before airspace change, i.e. baseline (2016); and
- The predicted level of noise immediately after the airspace change, i.e. assuming baseline aircraft operations, but, with the proposed routes and procedures operated.

***It should be noted that the CAA CAP 725 "situation after traffic has increased" has not been considered because whilst traffic levels are expected to increase, that increase is part of the overall growth of the Airport and not as a result of this proposal.***

## 4.5 Noise Modelling

As part the airspace change proposal a noise model has been developed using the US Federal Aviation Administration's (FAA) Integrated Noise Model (INM) version 7.0d. This noise model has been validated against noise and track data from the airport's Noise and Track Monitoring System (NTMS) to represent levels of aircraft noise at the airport. Annexes A1, A2 and A3 provide outputs from the noise modelling methodology.

### 4.5.1 Daytime Noise Exposure ($LA_{eq\ 16hr}$)

The assessment of noise exposure is based on the outputs of noise modelling and compares the baseline level of noise i.e. that which represents the $LA_{eq\ 16hr}$ 92-days for 2016 with the level of noise that is predicted to occur immediately after the airspace change. The situation immediately after assumes the same number and frequency of aircraft operations as the baseline with proposed procedures assumed.

A comparison of the noise contours is presented in Figure 8 and a summary is presented in Table 3 and shows the population encompassed by aircraft noise and the area of the noise contour. It should be noted that consistent with guidance set out in CAA CAP 725 the population is rounded to the nearest one hundred and area to the nearest 0.1 kilometres$^2$. The population dataset used for this study was obtained under license for this project from CACI OS Address Point Dataset. Individual noise exposure contours are presented in Annex A3.

| Contour ($LA_{eq}$, 16hr) | Baseline | | Immediately After | |
|---|---|---|---|---|
| | Population (1,000s) | Area (km$^2$) | Population (1,000s) | Area (km$^2$) |
| 54 dB | 16.1 | 15.6 | 16.5 (+0.4) | 15.8 (+0.2) |
| 57 dB | 5.1 | 8.7 | 5.3 (+0.2) | 8.8 (+0.1) |
| 60 dB | 1.5 | 4.8 | 1.5 (+0) | 4.9 (+0.1) |
| 63 dB | 0.3 | 2.6 | 0.3 (+0) | 2.6 (+0) |
| 66 dB | 0 | 1.4 | 0 (+0) | 1.4 (+0) |
| 69 dB | 0 | 0.8 | 0 (+0) | 0.8 (+0) |

Table 3 - Table of Noise Contours for Current and Proposed Procedures

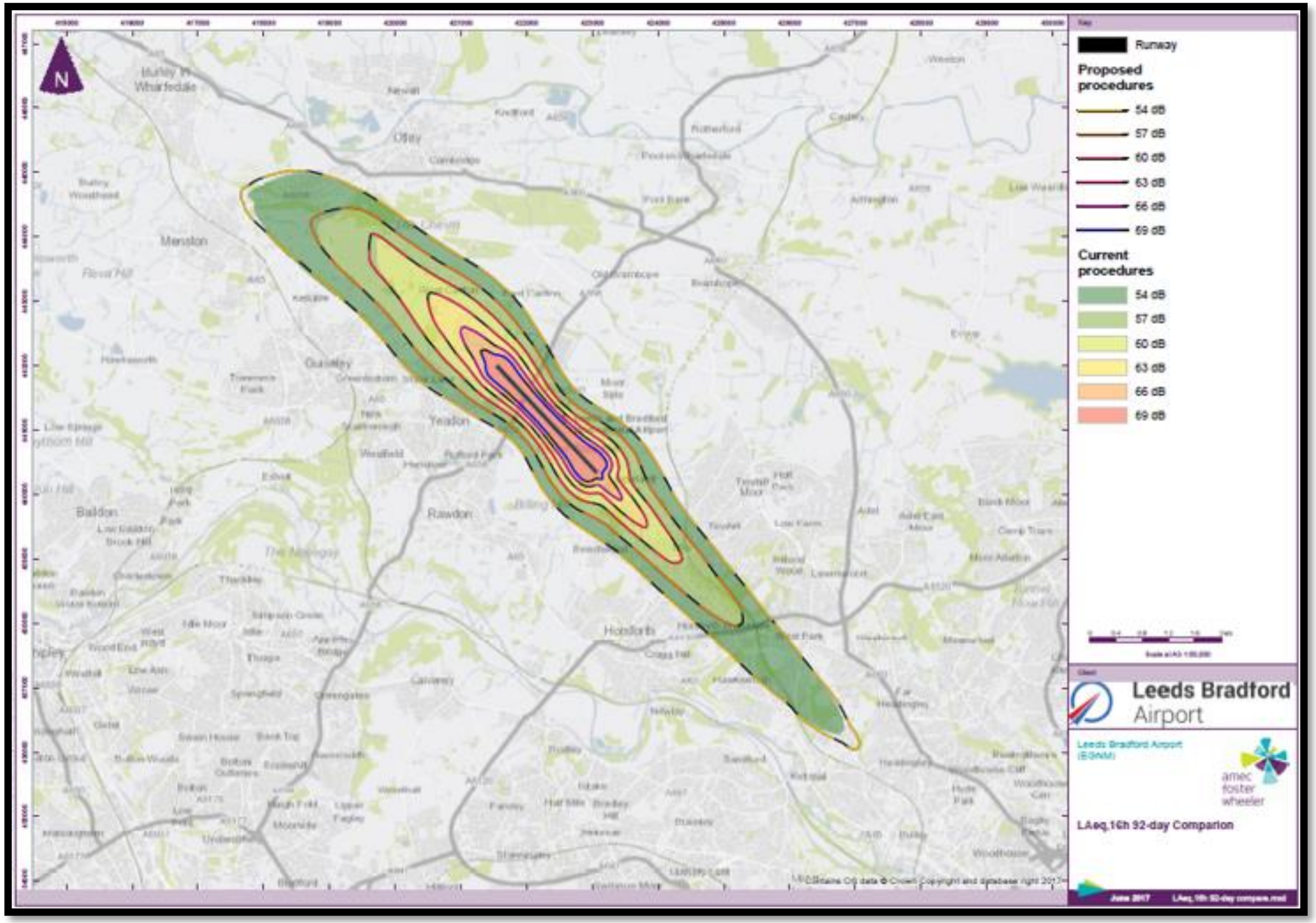


Figure 8 - Noise Exposure Contour Comparison

It can be seen from Table 3 and Figure 8 that there is an increase in the size of the noise exposure contours. This effect is as a result of PBN procedures which concentrates aircraft and is explained within the section entitled "The Effect of Concentrating Aircraft" in section 4.3.1 above. It should however be noted that the FAS requirement to adopt PBN procedures is outside of the scope of this application.

The 54 dB and the 57 dB noise contours are of particular significance to the assessment of noise exposure. The use of the 57 dB noise contour has historically represented the "onset of significant community annoyance" and as such is required by CAA CAP 725.

In summary, it can be seen from Table 3 that there is:

- An increase of 400 people exposed to 54 dB LAeq,16hr; and
- An increase of 200 people exposed to 57 dB LAeq,16hr

Based on the increase in population exposed to levels of noise above 57 dB $LA_{eq,16hr}$ an assessment of noise has been made for new locations exposed to noise of this level. The following postcode locations are therefore now encompassed by the 57 dB $LA_{eq,16hr}$ contour:

- Lambert Terrace, Horsforth, LS18 5DF;
- Springfield Close, Horsforth, LS18 5DG;
- King George Road, Horsforth, LS18 5PY;
- Banksfield Grove, Leeds, LS19 7LN;
- West Chevin Road, Otley, LS21 3DJ; and
- Moor Top, Ilkey, LS29 6RR.

In addition**,** Figure 8 presents noise change contours for the $LA_{eq,16hr}$. The contours show where levels of noise exposure change by:

- ± 1-2 dB;
- ± 2-3 dB;
- ± 3-6 dB;
- ± 6-9 dB; and
- ± >9 dB.

### 4.5.2 Night-time Sound Exposure Level (SEL)

The current night-time restrictions at the Airport were imposed as part of planning permission 29/11/93/FU. This planning permission was granted in 1994 and permitted 24-hour operations at the Airport. As part of the planning permission, night-time was defined as 2300hrs to 0700hrs and several night restrictions were imposed, including:

- The provision of a noise insulation scheme (NIS) for residents defined by the extents of the 90 dB SEL Boeing 737-300 and Boeing 757-200 aircraft;
- The implementation of an improved scheme for the monitoring, reporting and review of:

- Noise Preferential Routes (NPRs) for departing aircraft;
- Departure and landing procedures; and
- Target night-time noise levels.

The airspace change proposal has been designed to operate within the Airport's planning permission permitting 24-hour operations. The current NIS is based upon aircraft following the Airport's NPRs and the airspace change proposals have been designed to remain within the NPRs. As discussed previously, the proposed SIDs operate within the NPR.

# 5 Assessment of the Change in Fuel Burn/$CO_2$

## 5.1 Overview

The proposed changes are expected to result in a net reduction in the emissions of carbon dioxide ($CO_2$). For arriving aircraft, the new arrangements will allow a more predictable approach path, reducing the number of track miles and bursts of acceleration needed on approach. The new approach arrangements will also allow aircraft operators to optimise their fuel load to the actual routing they will follow; small savings in fuel consumption at the end of a flight can result in potentially significant savings in $CO_2$ emissions over the course of the flight, since the weight of the extra fuel does not need to be carried for the whole journey.

## 5.2 Analysis

Regarding departures, the new arrangements will again reduce track miles and increase route predictability, both of which will lead to reductions in $CO_2$ emissions. Under the present arrangements, aircraft heading south and east are expected to follow the DOPEK/LAMIX SIDs which extend to about 50 nm (90 km) from the airport before being handed over to NATS and being routed more directly to their destinations. The new SIDs finish around 40 nm closer to the airport, so the handover to NATS and the subsequent routing occur much sooner, allowing the aircraft to cut off the final part of the SID and head directly towards their destination, saving track miles.

Depending on the destination, this could save several tens of nautical miles. Other SIDs offer greater or lesser potential for reductions in track miles, between nearly none and about 40 nm. Assessments have been conducted by a based airline at the Airport regarding the potential fuel burn that will be achieved by utilising the new procedures. For a Boeing 737-800 aircraft, an estimation of 110 kg per minute of fuel burn was used to compare the new departure routes with the current SIDs. This means that a Boeing 737-800 achieving a reduction of 20 nm would lead to a saving of approximately 500 kg of fuel and 1,500 kg of $CO_2$ per departure. Further, assessments have been conducted assuming a full SID is flown and against the realistic saving against the flight planned route. The potential estimated fuel savings per flight are identified at Table 4:

| Current SID | Proposed SID | Distance reduction / NM | Fuel saving (SID) / kg | Fuel saving (Flight Plan) / kg |
|---|---|---|---|---|
| NELSA 3W | NELSA 1R | 0.5 | 10-15 | 10-15 |
| POL 2X | ELEND 1B | 10 | 275 | 110-220 |
| LAMIX 2W | NMS03 1R | 23 | 500 | 150-200 |
| LAMIX 2X | NME 12R | 37 | 80-1000 | 100-200 |

Table 4 - Potential Fuel Savings Achieved by the New SIDs

There are approximately 10,000 departures per year from the Airport of aircraft in the Boeing 737 (i.e. Code C) size range, so making the cautious estimate that these departures would save on average 10 NM each, this would represent a saving of around 2,000 tonnes of fuel and 7,000 tonnes of $CO_2$ per year. The 5,000 (approximate number) departures per year by smaller aircraft would make additional fuel and $CO_2$ savings.

In practice, under the current arrangements, aircraft are often able (under ATC control) to depart from the SID early, so some of the benefits of reduced track miles compared to the published route are already felt. However, pilots still need to carry sufficient fuel to be able to follow the full SID, even if they end up not doing so and not needing the fuel. The improved predictability from the new arrangements will allow pilots to load only as much fuel as they will actually need, reducing unnecessary weight and saving fuel that way.

Assuming a saving of 200 kg of fuel saved per aircraft, the introduction of the new procedures would reduce $CO_2$ emissions by 1,900 tonnes per year.

# 6 Assessment of the Effect on Local Air Quality

## 6.1 Overview

Proposers of an ACP must produce information on local air quality only where there is a possibility of pollutants breaching legal limits following the implementation of an airspace change. There is no evidence to suggest that this ACP, if successful, will cause a breach to any legal pollutant limits. However, LBA has included some information regarding the assessment of local air quality.

## 6.2 Background to Assessment

When considering air quality, it is normally only the concentrations at ground level (or more precisely, 1.5 m above ground level) that are of concern, since this is the normal human breathing zone. It is customary for airport air quality studies to include the whole aircraft landing and take-off cycle, including operations on the ground and in the air up to 3,000 ft (or 1,000 m) above ground level. However, it is generally considered that emissions from aircraft become negligible, in terms of their effect on air quality, once the aircraft are more than around 100–200 m above the ground. There are two reasons why elevated aircraft emissions are expected to be less significant than ground-level emissions:

- There is a greater degree of mixing and dispersion before the pollutants reach the ground. This is the same reason that large point sources such as industrial installations discharge from tall chimney stacks; and
- As well as being higher, aircraft are more spread out spatially as they follow different routes at elevation, so emissions are more diffuse.

An unpublished study carried out by Amec Foster Wheeler for Heathrow Airport carried out a literature review and dispersion modelling to investigate in detail how aircraft emissions at height affect ground-level concentrations. This study concluded that once departing aircraft are more than 120 m above the ground or arriving aircraft are more than 20 m above the ground, their emissions make a negligible contribution to ground-level concentrations of pollutants. Typically, aircraft below these altitudes are within the airport boundary — when aircraft are flying over the boundary fence, they are high enough to have negligible impact on ground-level concentrations. The impact continues to drop off as heights increase.

Given that the proposed LBA airspace changes are at altitudes substantially greater than these, there is negligible impact from the emissions on local air quality and the changes will have an imperceptible effect on local air quality.

Under the national arrangements for improving air quality, local authorities have a duty to declare an Air Quality Management Area (AQMA) in locations where there is a risk of exceeding legal limits. The nearest AQMA to the Airport is approximately 6 km southeast of the airport, in a location where local road traffic conditions are the primary cause of poor air quality. At this distance, the contribution from the Airport, and especially from the aircraft at the height of the airspace changes under consultation here, will be exceedingly small and immaterial.

# 7 References

| Reference | Name | Origin |
|---|---|---|
| 1 | ICAO PANS-OPS Document 8168 Vol II Construction of Visual and Instrument Flight Procedures Sixth Edition 2014 | ICAO |
| 2 | CAP 725 CAA Guidance on the Application of the Airspace Change Process Fourth Edition March 2016 | CAA |

Table 5 – Table of References

# A1 SEL 90dB Noise Contours

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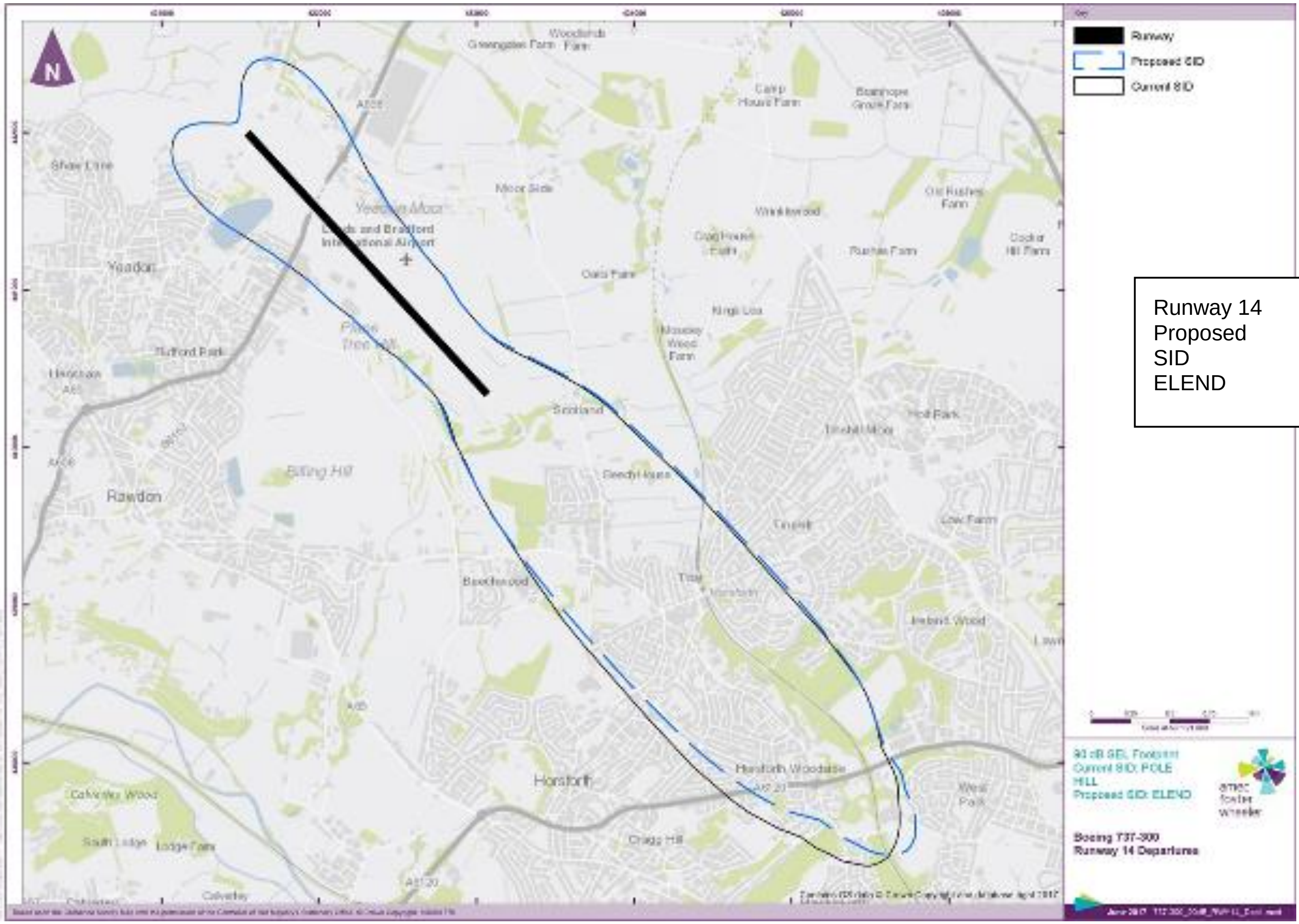
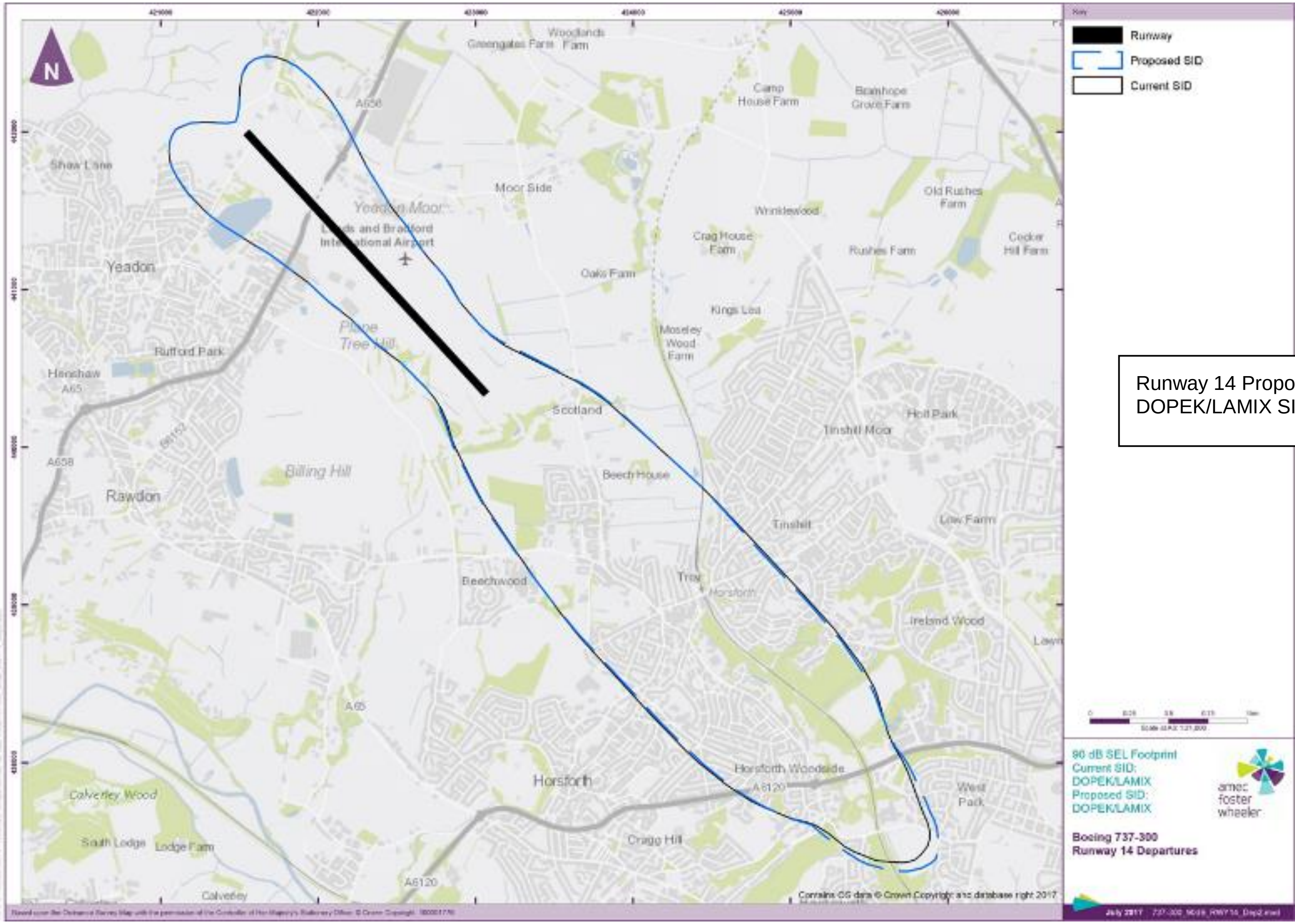
Yorkshire's Airport

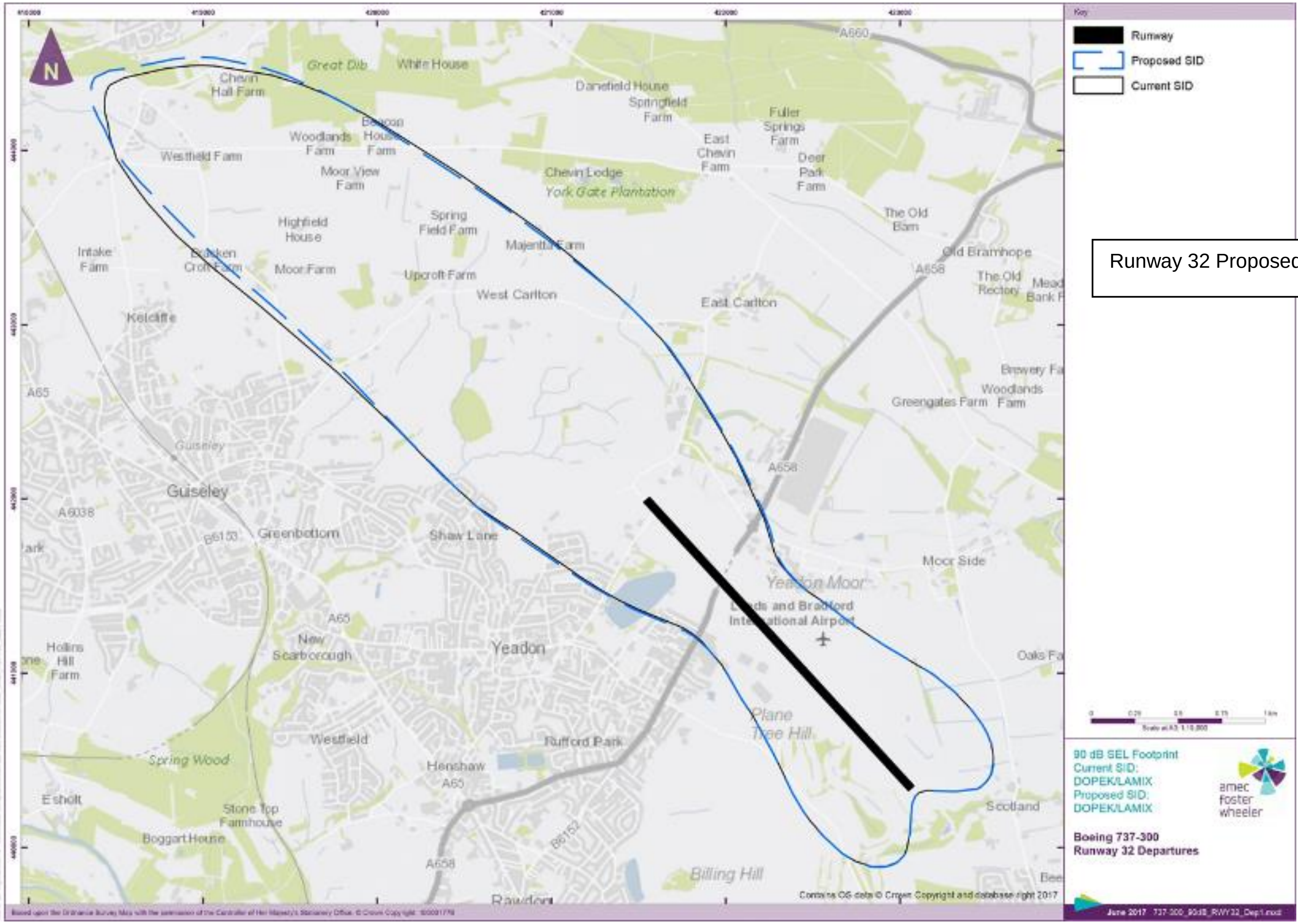
## A1.1 B737-300




Runway 14
Proposed
SID
ELEND

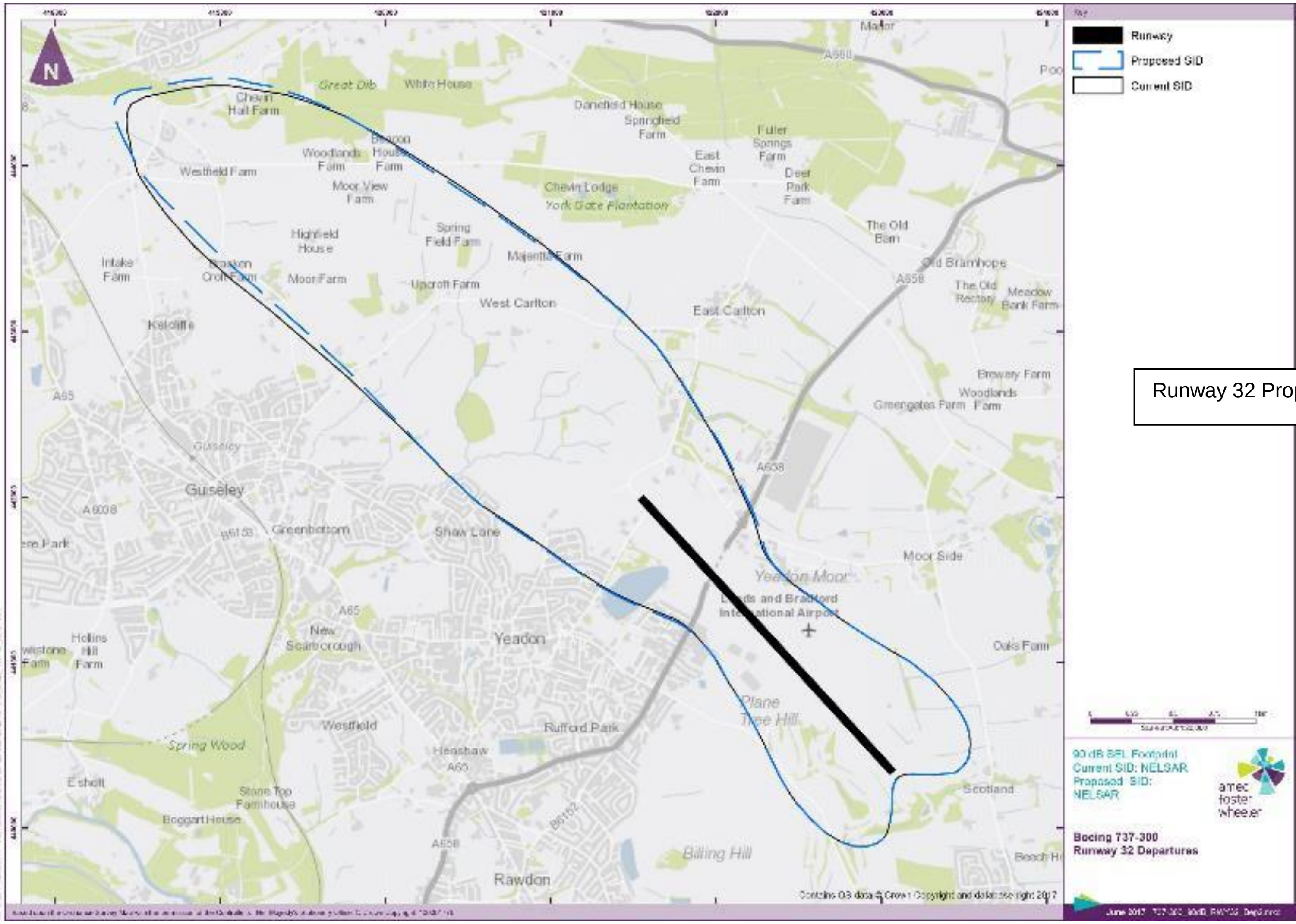



Runway 14 Proposed DOPEK/LAMIX SID



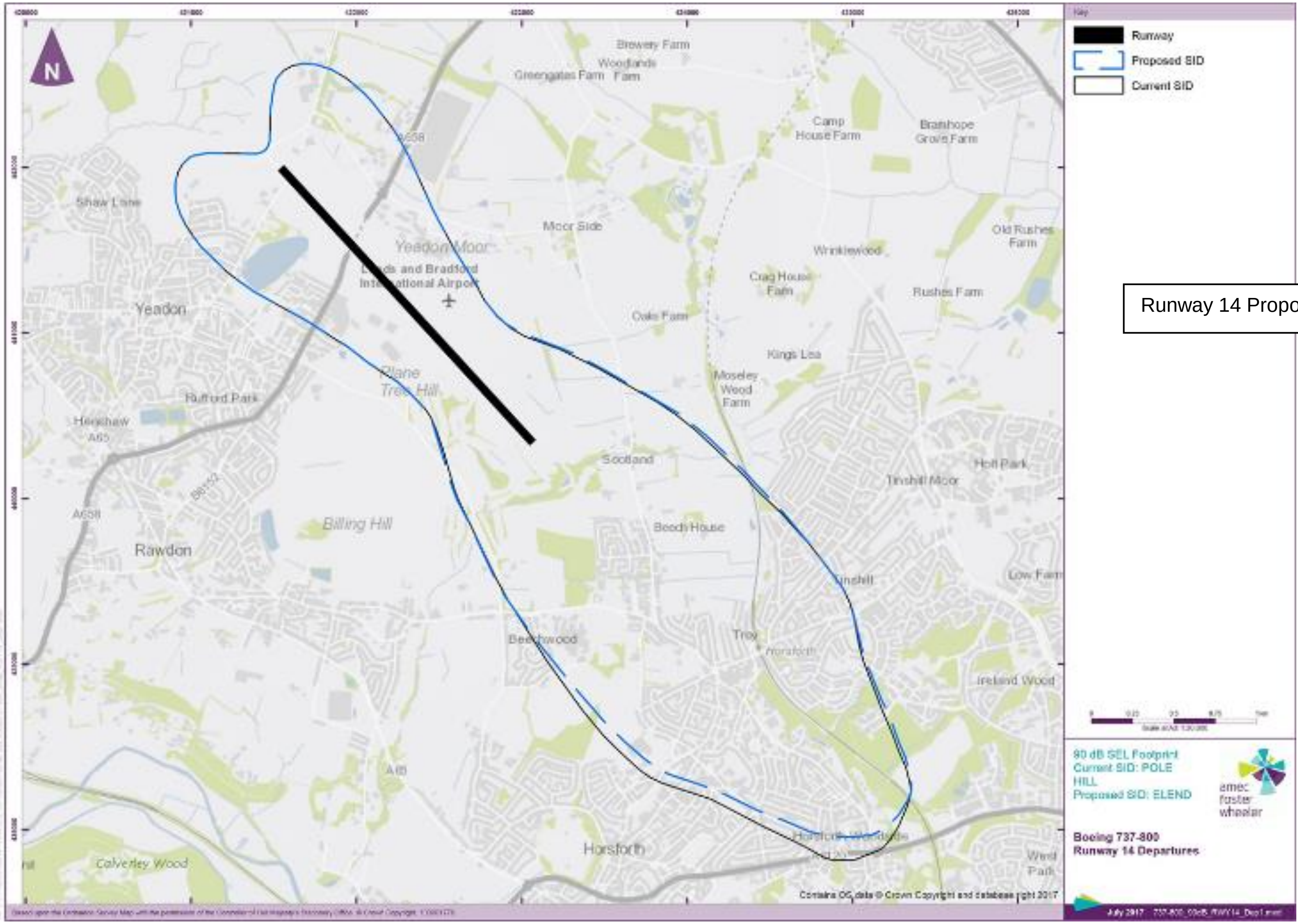

Runway 32 Proposed DOPEK/LAMIX SID

Leeds Bradford
Yorkshire's Airport



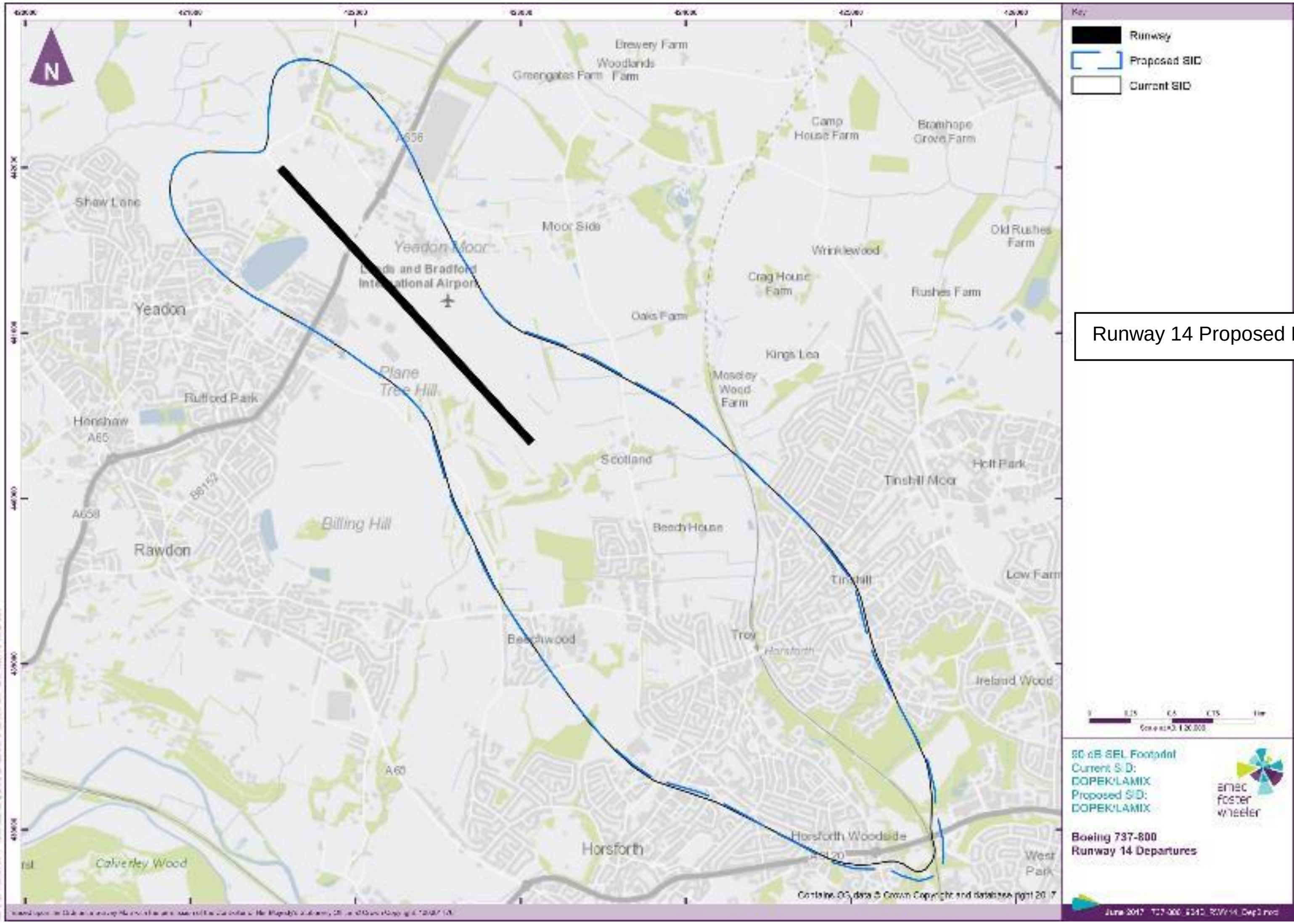

Runway 32 Proposed NELSA SID

## A1.2 B737-800




Runway 14 Proposed ELEND SID

Leeds Bradford
Yorkshire's Airport

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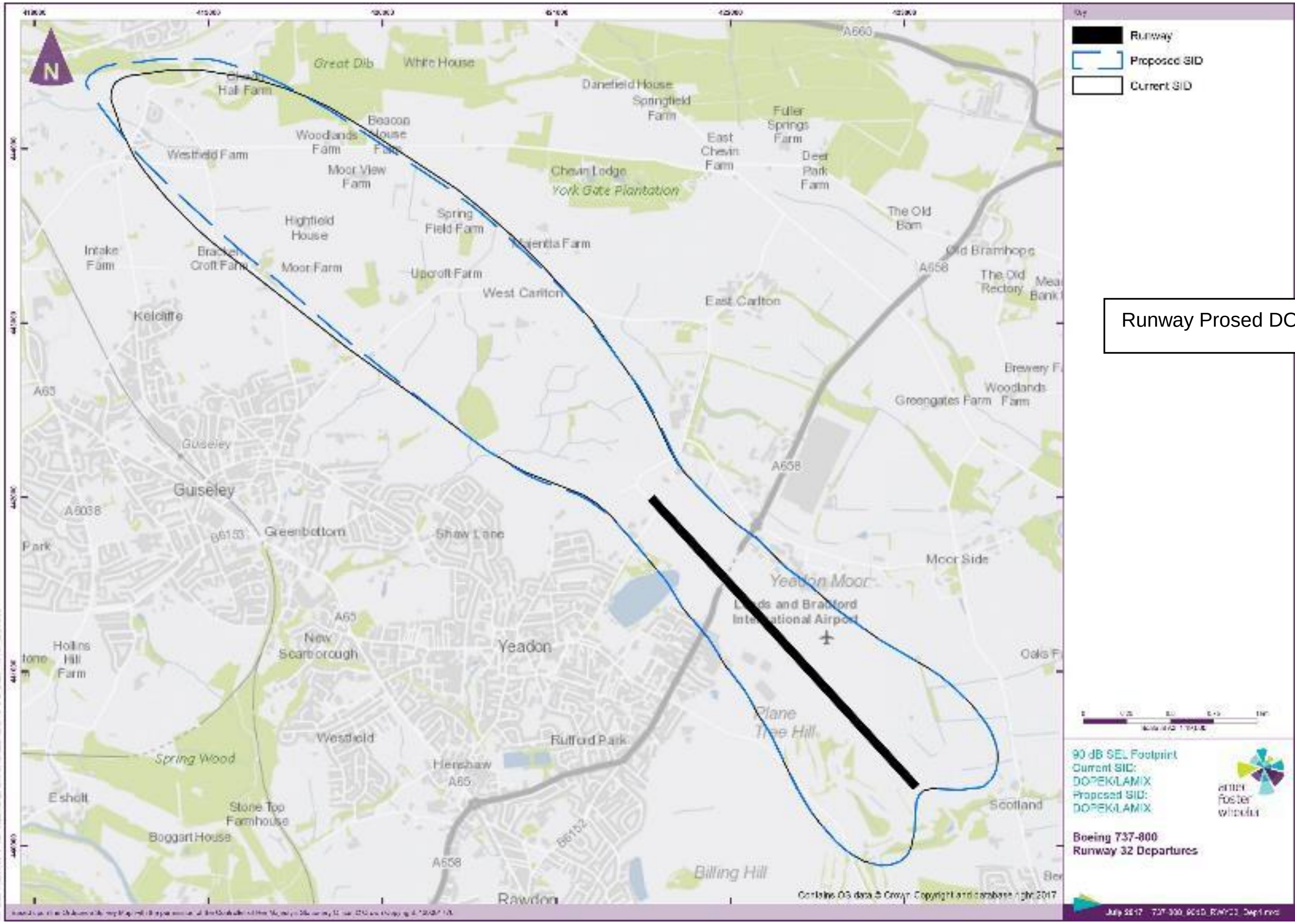
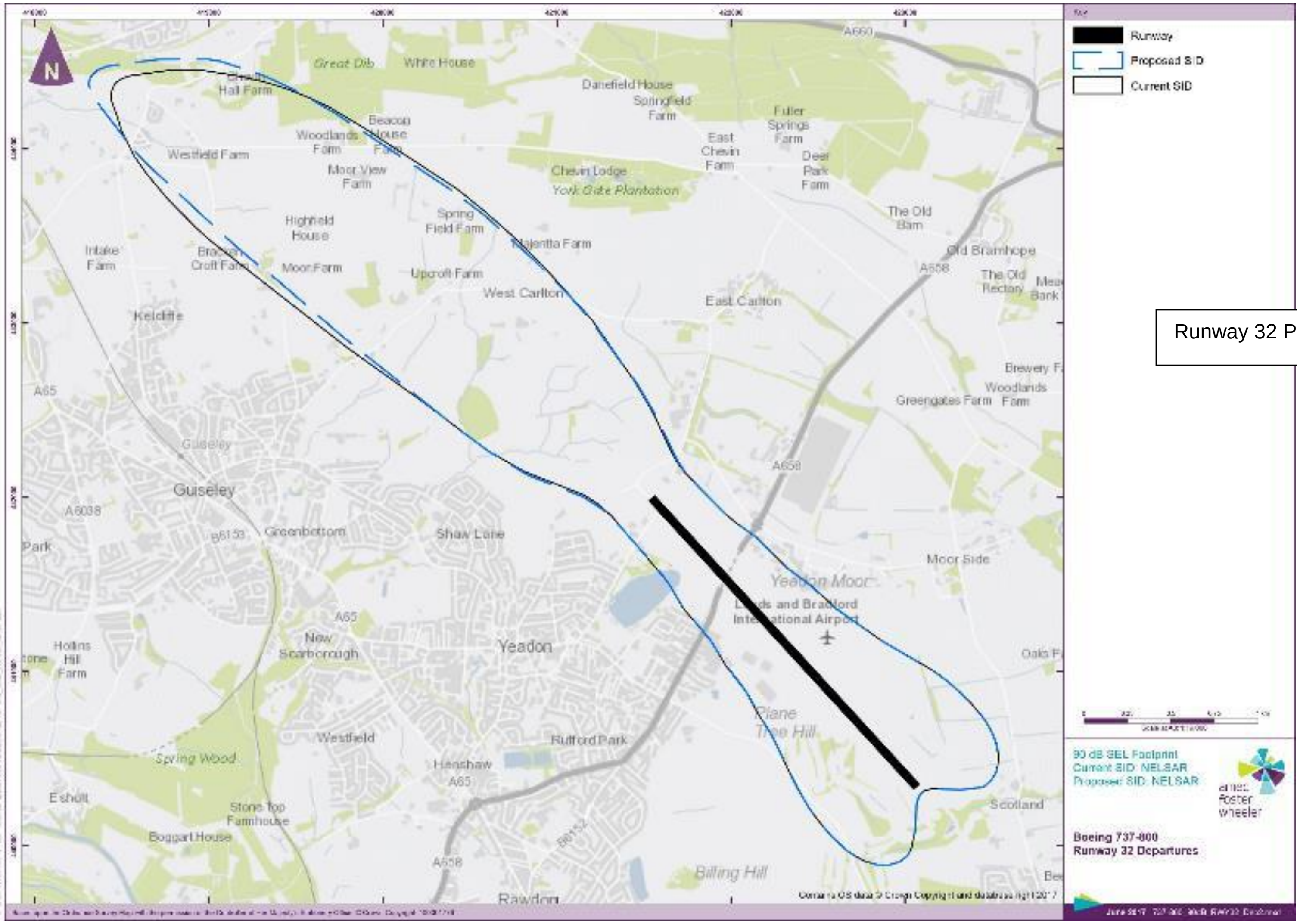


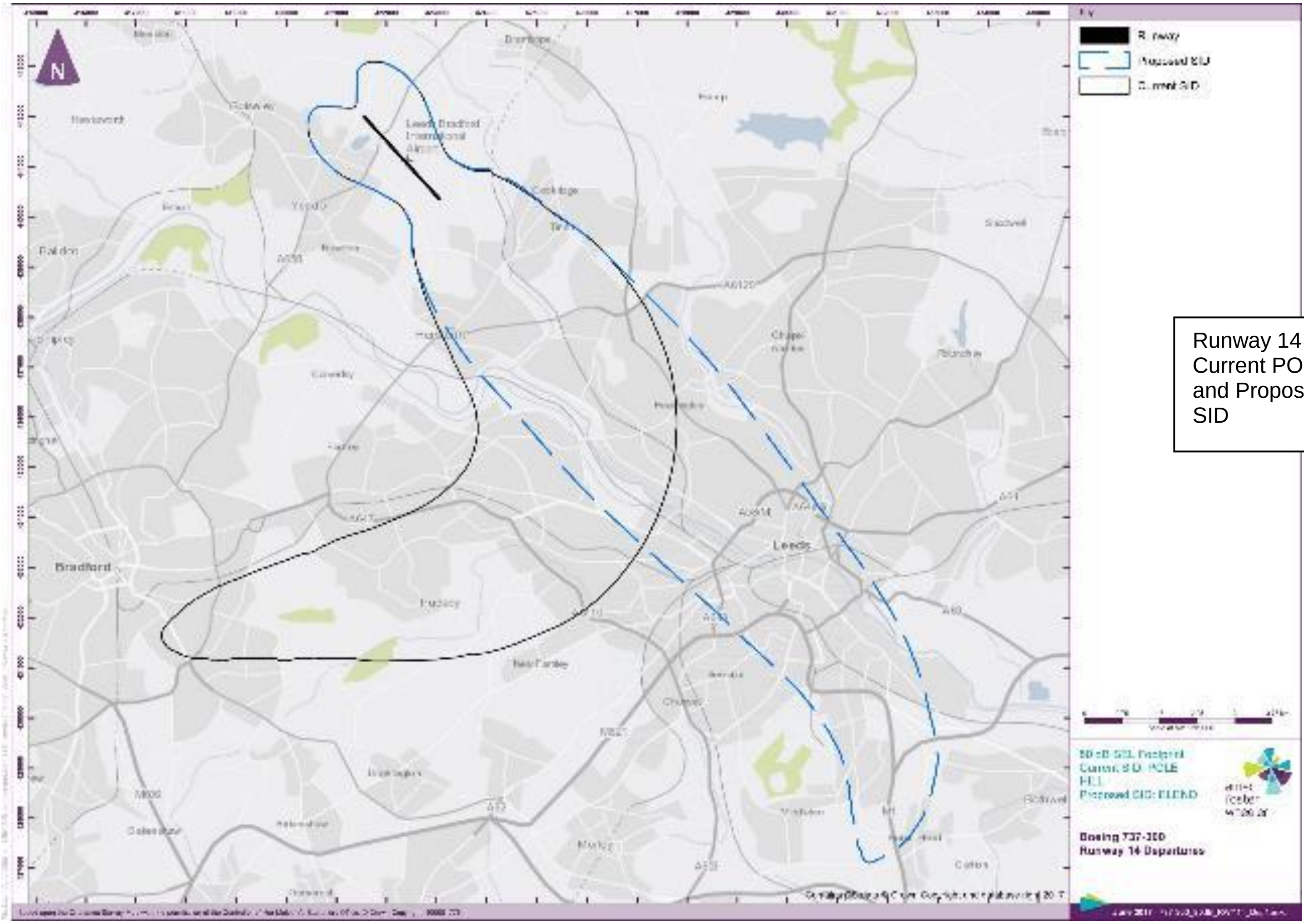

Runway Prosed DOPEK/LAMIX SID



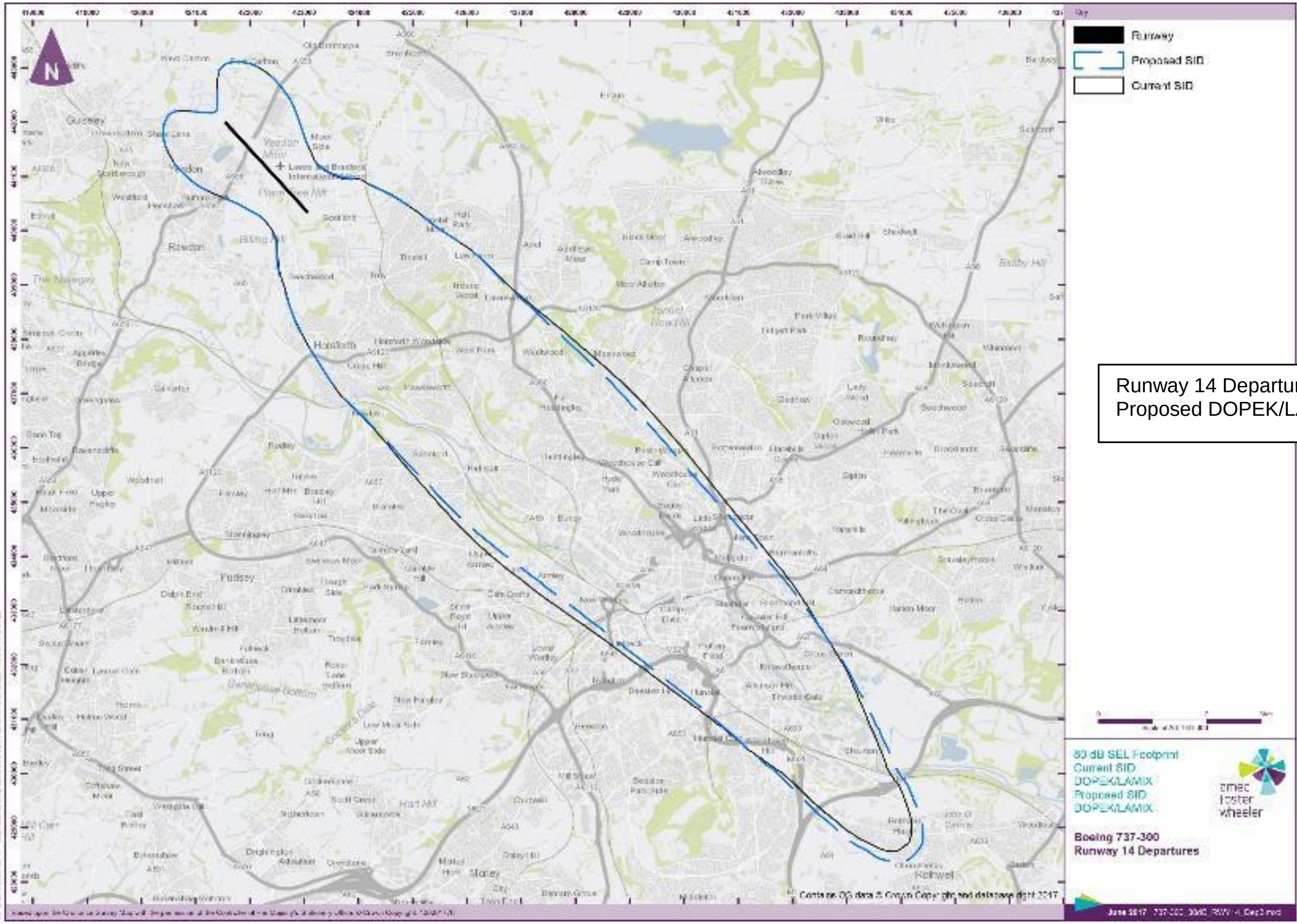

Runway 32 Proposed NELSA SID

# A2 80dB SEL Noise Contours

## A2.1 B737-300

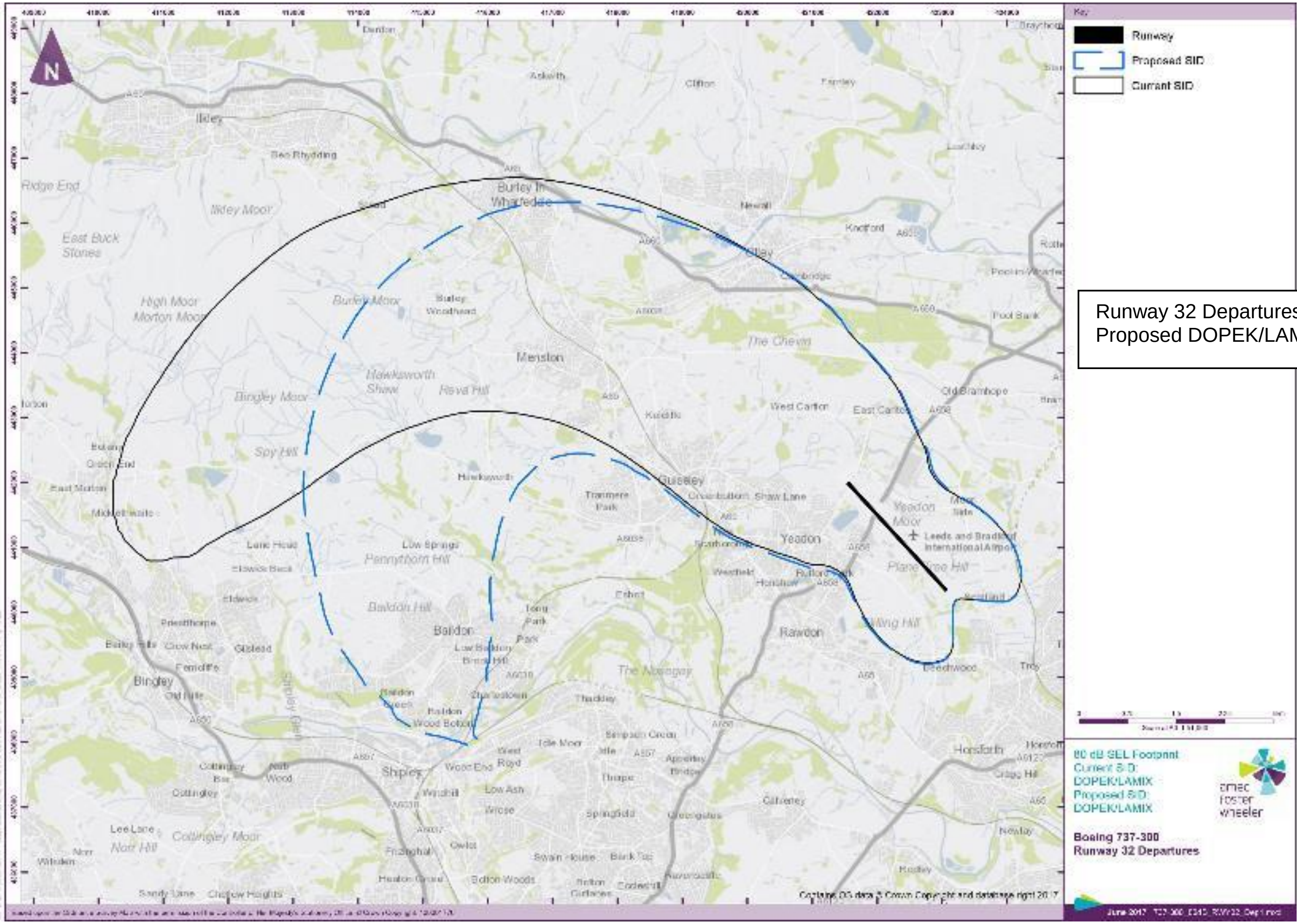


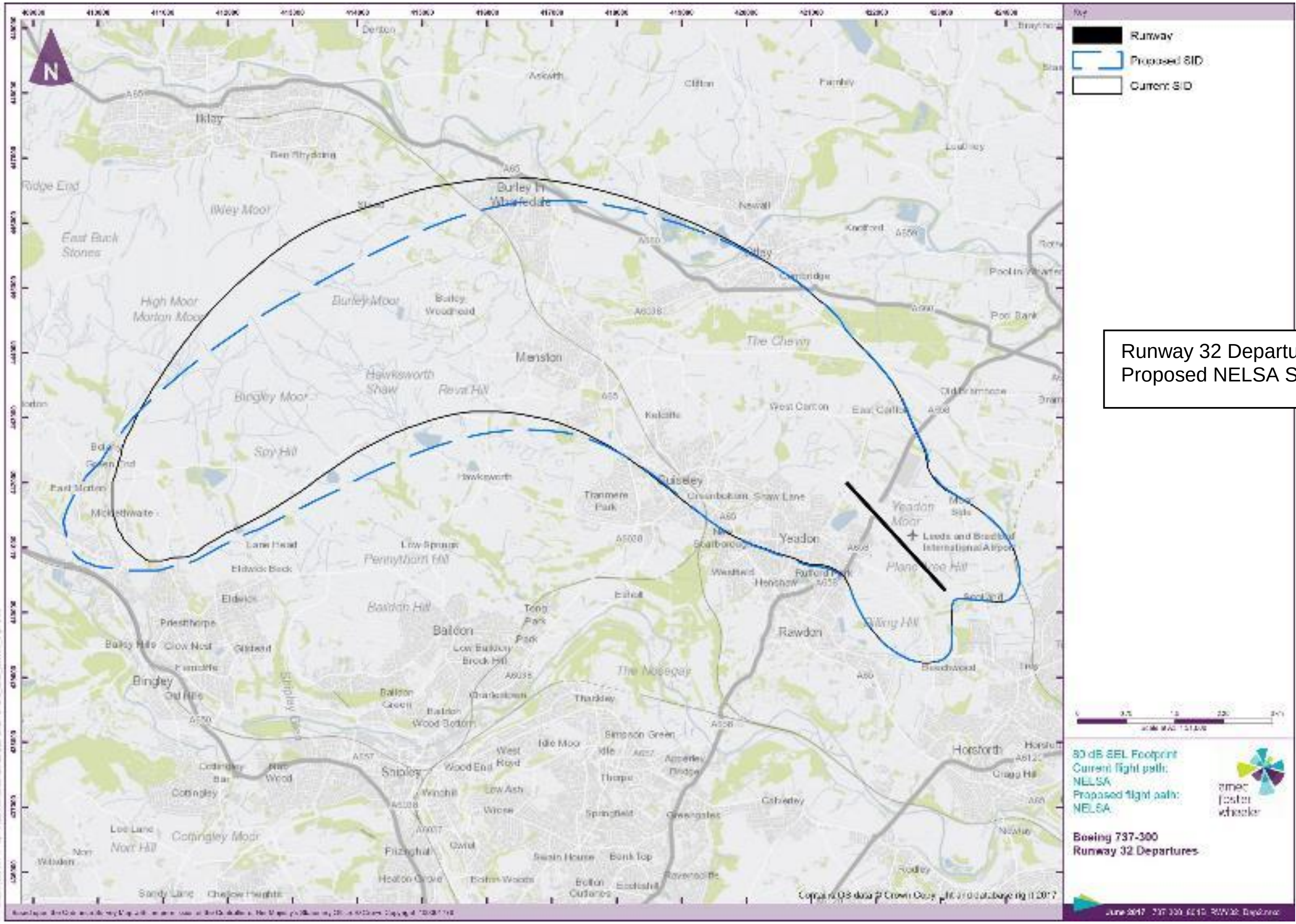

Runway 14 Departures Current POLEHILL SID and Proposed ELEND SID




Runway 14 Departures Current and Proposed DOPEK/LAMIX SIDS

Runway 32 Departures Current and Proposed DOPEK/LAMIX SIDS






Runway 32 Departures Current and Proposed NELSA SIDS

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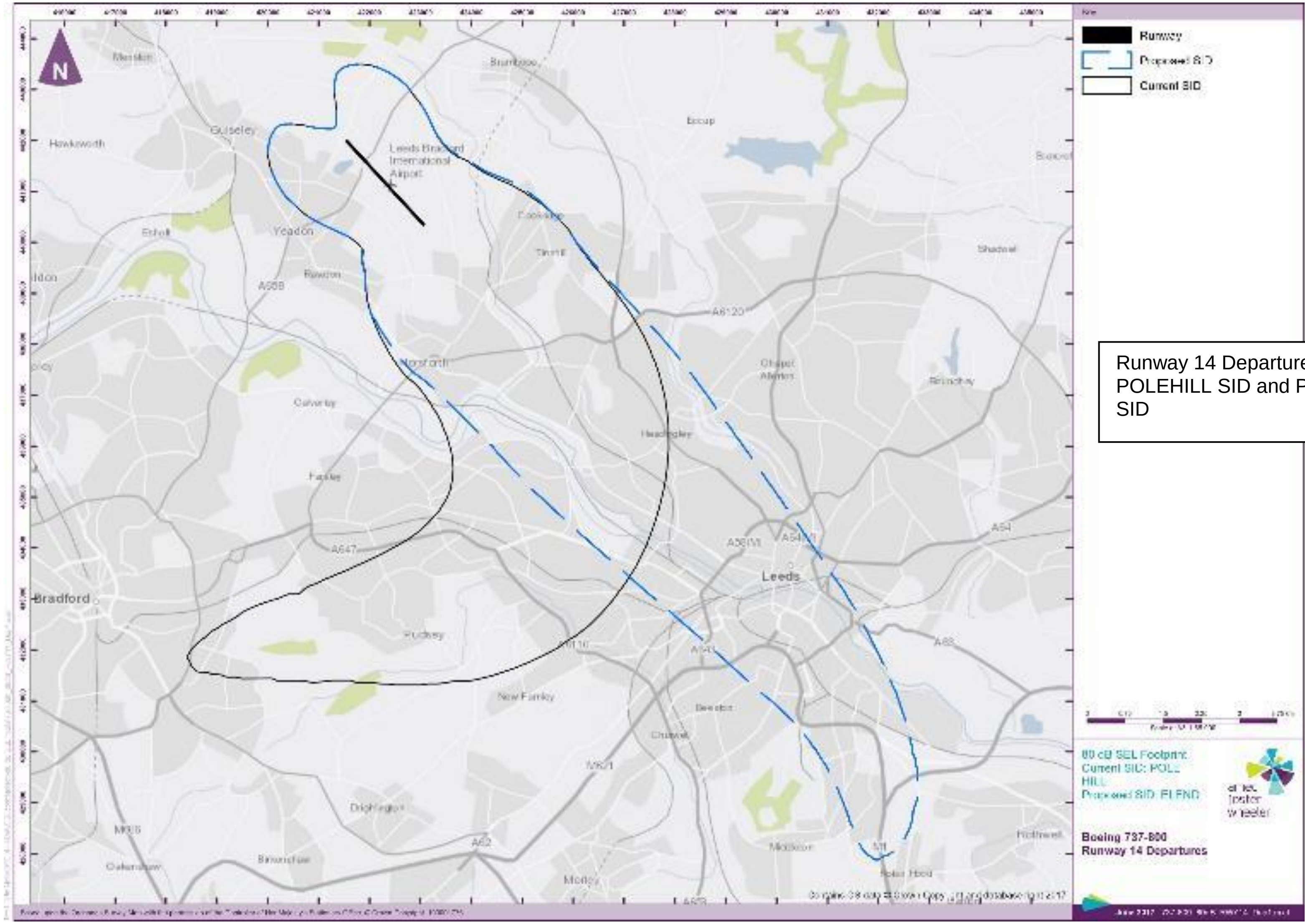
## A2.2 B737-800




Runway 14 Departures Current POLEHILL SID and Proposed ELEND SID

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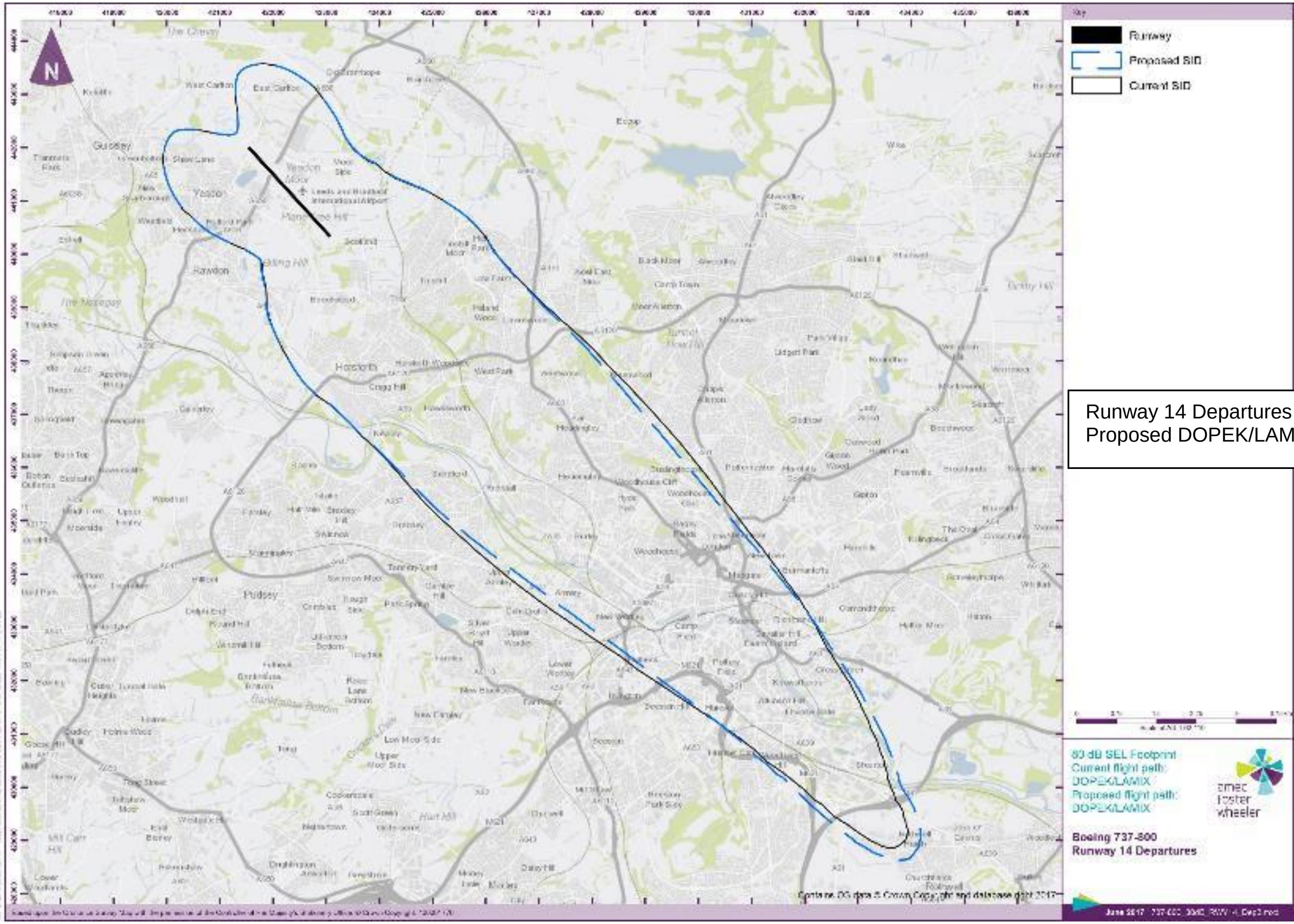
Runway 14 Departures Current and Proposed DOPEK/LAMIX SIDs



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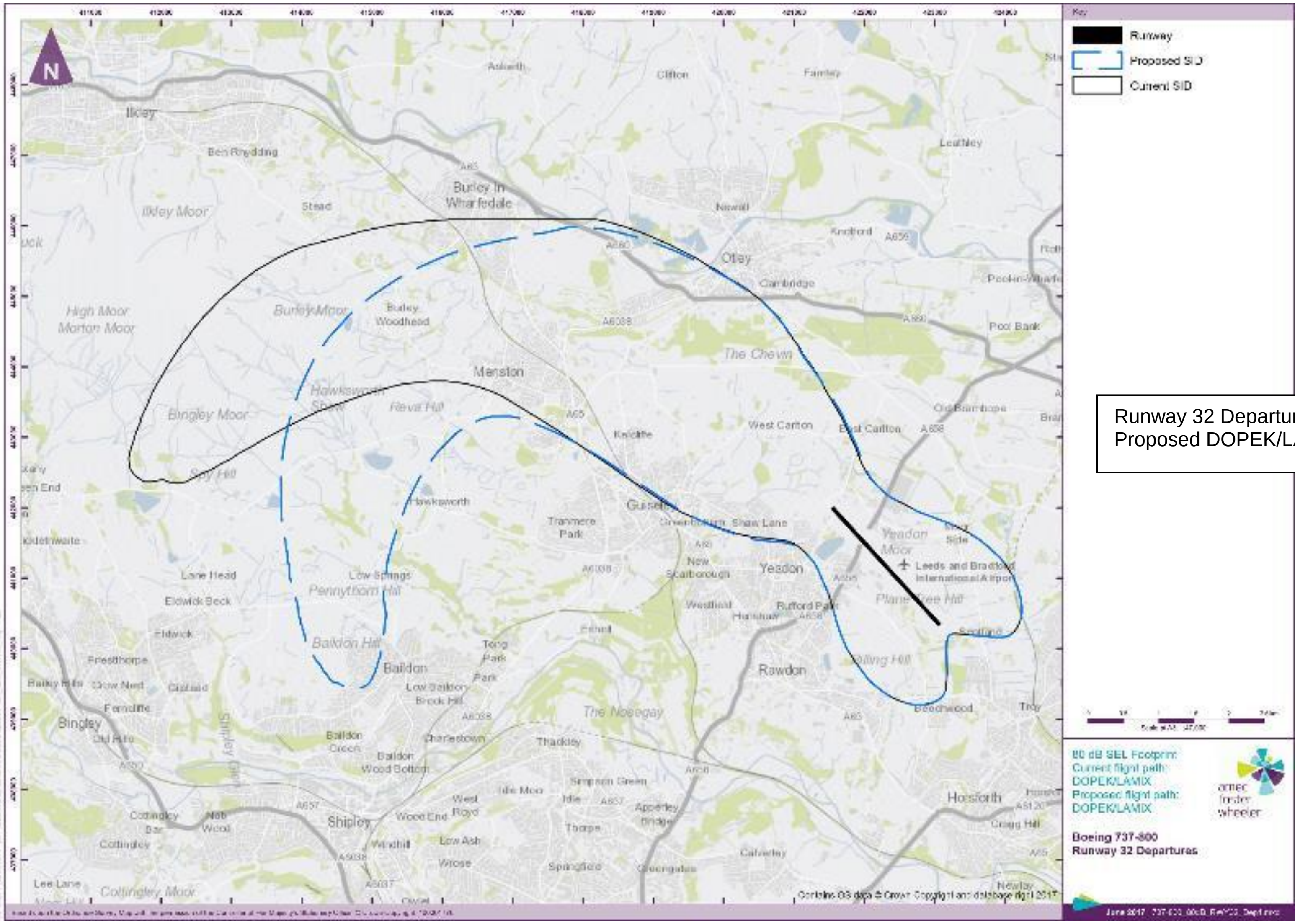
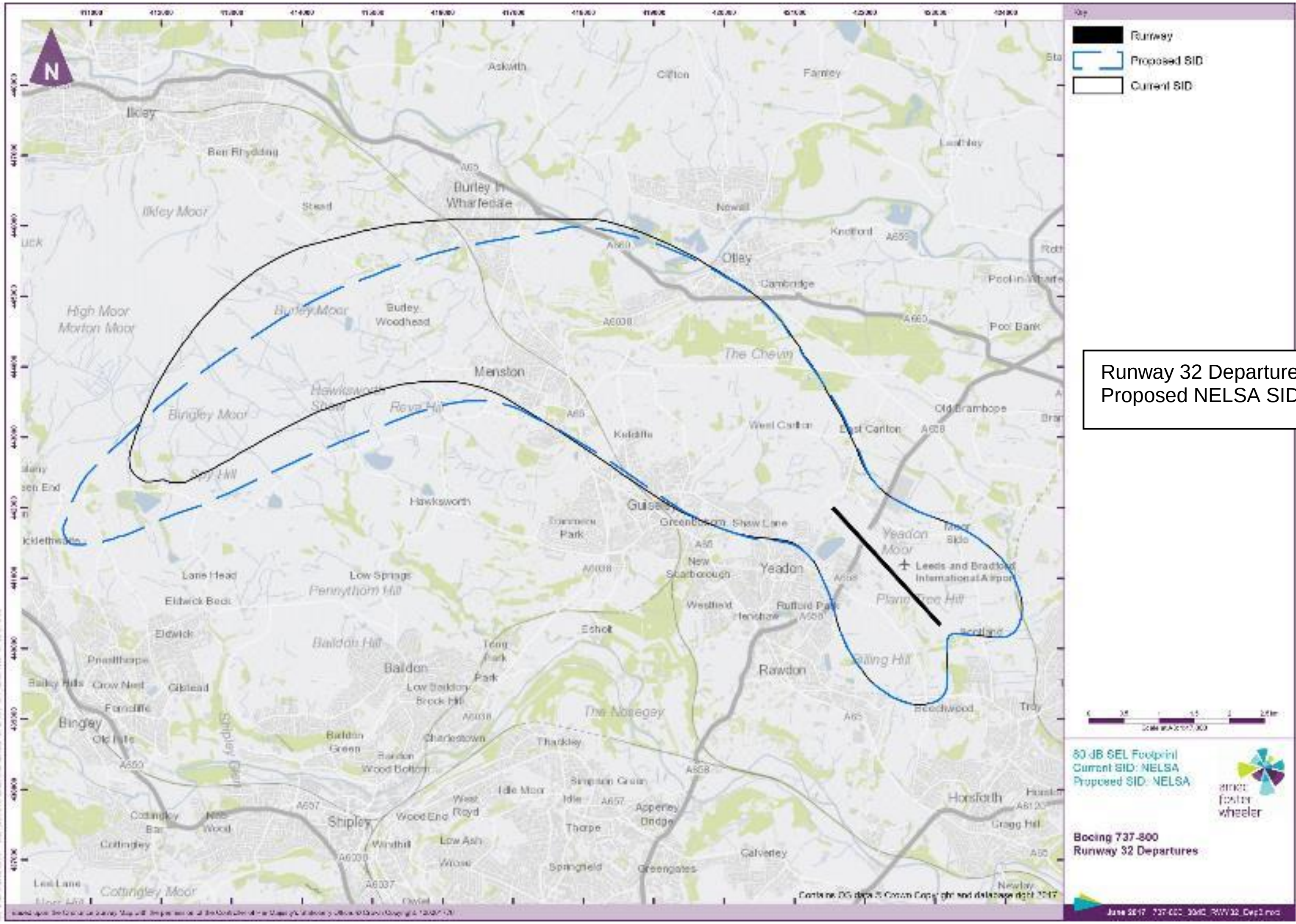



Runway 32 Departures Current and Proposed DOPEK/LAMIX SIDs




Runway 32 Departures Current and Proposed NELSA SIDs

# A3 16hr $LA_{eq\ 16hr}$Contours

Section 4 of this document depicts a combined image of the $LA_{eq\ 16hr}$ noise contours. This Annex shows the two separate noise contour images that were produced to provide the combined image.

## A3.1 Current Noise Contours

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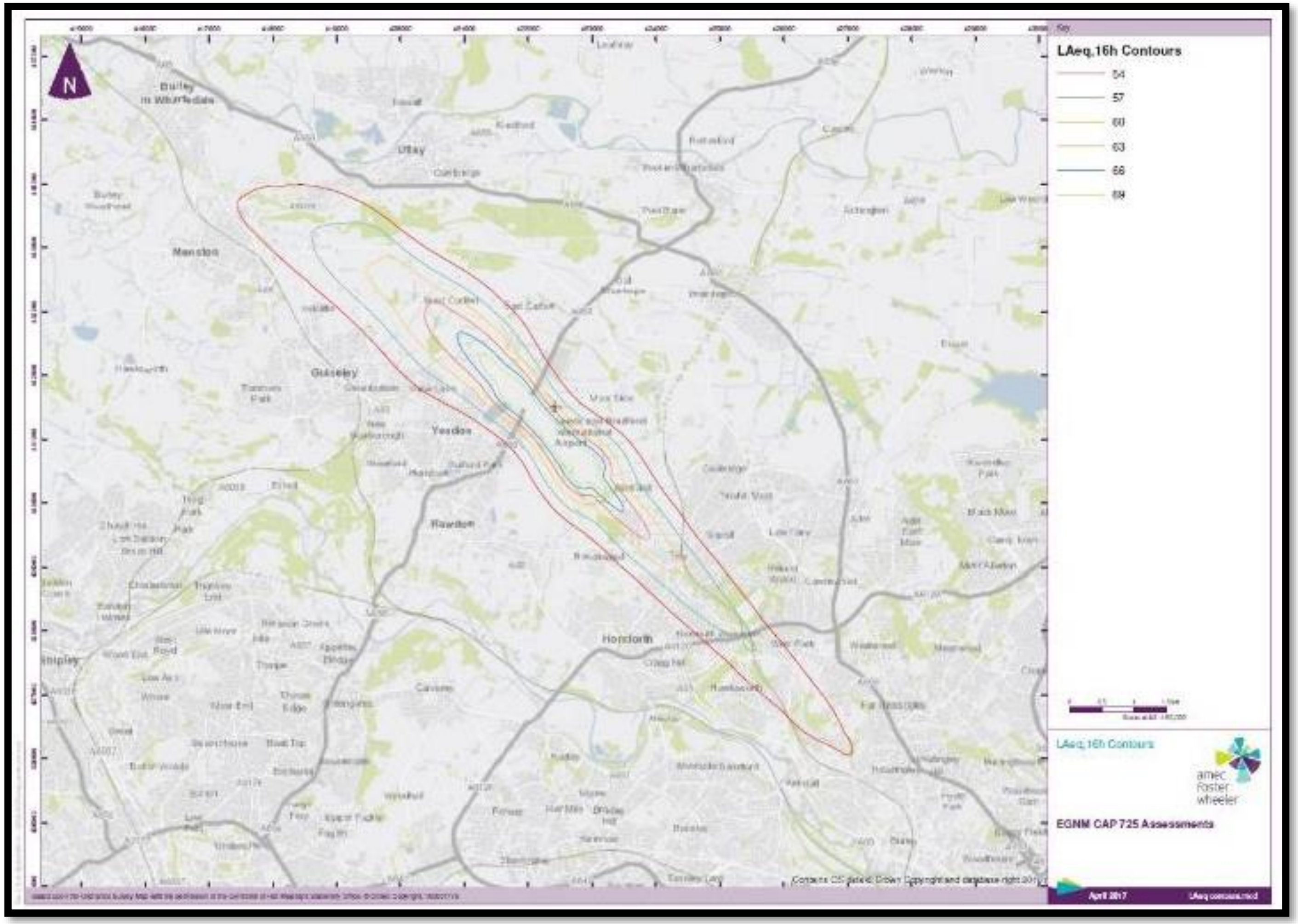

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## A3.2 Following the Proposed Changes