NATS – Case study

ICAO
Template for good practice examples of environmental assessment (Draft V1.0)

Note: The italicized text is for guidance only and merely indicates the kind of information that is likely to be of value for users of the ICAO assessment guidance. You do not need to cover all points if some are not applicable to your case study.

Organisation/Company*: (The name of the body that undertook or sponsored this assessment)*

NATS

Project Title: *(The title of the project being assessed)*	Date of Assessment:
London Airspace Management Project (LAMP) Phase 1A	

ASBU Module Code(s)[1]:	States' Action Plan[2]:

Project Description: *(Briefly describe the project or proposed operational change to be assessed for its environmental implications; Please when possible, use schematics for illustration.)*

LAMP Phase 1A is the first phase of the London Airspace Management Project which will implement PBN and modernise the airspace structures supporting airports in South East England. Phase 1A scope was primarily focussed on changes to routes for London City and Gatwick airports.

In the UK, airspace regulation, en-route service provision and airport service provision are the responsibility of different organisations (the CAA, NATS and airport companies respectively).

Therefore it was necessary for the design, assessment, consultation and execution of these changes to be a collaboration between the airports and NATS, while the CAA has overseen the development as the independent regulator.

The change is predicated on the following points:

- Modernise airspace structures in line with the UK CAA mandates and expected European legislation
- Improve the operational efficiency of the airspace providing capacity for the future and thereby minimising future delay
- Improve the environmental performance of the airspace, reducing average CO_2 per flight and reducing the incidence of low-level over-flight of populated areas.

[1] **APTA-**Approach procedures including vertical guidance; **WAKE-**Wake vortex; **RSEQ-**AMAN / DMAN; **SURF-**A-SMGCS, ASDE-X; **ACDM-**Airport CDM; **FICE-**Increased efficiency through ground - ground integration; **DAIM-**Digital AIM; **AMET-**Meteorological information supporting enhanced operational efficiency; **FRTO-**En route Flexible Use of Airspace and Flexible routes; **NOPS-**Air Traffic Flow Management; **ASUR-**ADS-B satellite based and ground based surveillance; **ASEP-**Air Traffic Situational awareness; **OPFL-**In-Trail procedures (ADS-B); **ACAS-**ACAS improvements; **SNET-**Ground based safety nets; **CDO-**Continuous Descent Operations, PBN STARs; **TBO-**Data link en-route; **CCO-**Continuous Climb Operations

[2] http://www.icao.int/environmental-protection/Pages/action-plan.aspx

Specifically the project sought to introduce PBN point merge structures for managing arrivals at Gatwick and London City alongside complementary introduction of PBN SIDs.

In the UK the Government's Department for Transport (DfT) provides guidance for airspace change (link to DfT guidance here: link). This defines height based altitude priorities which leads to a model for demarcation of responsibility for airspace change, which broadly means that:

- Changes at 4000ft and below, in the vicinity of the airports, were managed and financed by the airports as noise and local airport capacity are the priorities
- Changes at 7000ft and above were managed and financed by NATS as they primarily relate to network efficiency in terms of the operation and fuel/CO_2.
- Between 4,00ft and 7,000ft changes were managed and financed jointly.

As the en-route ANSP, NATS has the lead role in coordinating the LAMP airspace change, bringing together all the affected airports and being the focal point for the regulator.

Reason for the environmental assessment: *(Explain why the environmental assessment was undertaken and if applicable include any specific regulation, policy, or rule that requires the assessment to be undertaken)*

Changes are undertaken in line with guidelines set out in CAA Publication CAP725 with additional guidance in CAP724. These give very clear environmental guidelines and assessments which should be undertaken (link). The CAP724/725 guidance relates to the need for the UK Civil Aviation Authority, in exercising its air navigation functions, to give priority to maintaining a high standard of safety in the provision of air traffic services in accordance with its statutory duties set out in Section 70(1) of the Transport Act 2000 (ISBN 0 10 543800 6). Specifically, the CAA must exercise its air navigation functions in the manner it thinks best to take account of the Civil Aviation Authority (Air Navigation) Directions 2001 and the Civil Aviation Authority (Air Navigation) (Variation) Direction 2004, these include the following references to environmental protection:

- The Government's policy on sustainable development;
- The Government's policy on reducing, controlling and mitigating the impacts of civil aviation on the environment; and
- The need to reduce, control and mitigate as far as possible the environmental impacts of civil aircraft operations; in particular the annoyance and disturbance caused to the general public arising from aircraft noise and vibration, and emissions from aircraft engines.

The final project submission, taking account of the CAP724/725 guidance is an Airspace Change Proposal (ACP) submitted to the CAA for their approval. This specifies which assessments have been applied, details the results and gives reasons why an environmental assessment may have been omitted. For instance in the case of a replication of existing tracks, the CAA do not require fuel and noise analysis (this is discussed below).

Client or competent Authority: *(Explain which body the assessment will be submitted to for their approval or decision making. Was the assessment internal or public? What audiences is it intended to inform?)*

The CAA formally assesses the environmental output of any change proposal. However, a substantial part of the process is ensuring that the likely impacts are made available to the public during the consultation in order to elicit as much participation and feedback as possible. This ensures that issues can be raised and appropriate design decisions can be made before submission of the final proposal.

Assessment Approach: *(This section asks for a brief description of your application of the ICAO guidance for each main assessment step. If a step was not undertaken give a brief explanation of why the step was omitted or is not applicable to this assessment example. Please complete each section individually. In this box you can explain why the ICAO approach to assessment was chosen. If you did not apply the ICAO methodology please explain how your methodology differed from the ICAO approach.)*

The methodology followed was as specified in CAA publication CAP725 document referenced above. This is the UK guidance for airspace change.

In summary LAMP Phase 1A included two generic types of change:

- PBN Replication: this is replacing conventional route structures with PBN replications. They are designed to match the existing procedures as closely as possible and therefore the CAA has agreed no quantitative environmental analysis is required (this is recorded in a CAA policy document found here: link). Analysis is therefore qualitative only, consisting of a pictorial comparison of pre and post change procedures and track distributions. Replication was the basis of all the London City changes below 4,000ft.
- PBN redesign: where the introduction of PBN leads to realigned routes it is necessary to undertake a full environmental analysis including 57DbA (Leq 16hours), 90dBA SEL and CO_2 assessments as specified in the CAA guidance (see box below). The proposed changes for London City at higher levels, and all the proposed changes for Gatwick were categorised as 'redesigns'.

The LAMP utilised the consultation process to discern areas of public environmental interest, reasoning that local residents will have a strong understanding and opinion of how aircraft noise, emissions and visual intrusion are likely to impact their local environment. Therefore routes which were not a direct replication of existing flight paths were consulted on using 'swathes'. In essence, rather than detailing the centre tracks over the ground of each new route, a broad area within which aircraft could be placed was illustrated and feedback from local residents was sought on where best to locate the flight paths within these swathes, to reduce the likely impacts (an example is provided later).

Because the swathe consultation was not reliant on mature designs, it could be undertaken early in the design process when there was scope for making significant change to the design. Airports undertook a second phase of consultation later in the design process on the specific route centrelines below 4,000ft.

The project also included analysis on the likely fuel savings for operators, which were converted to a CO_2 saving; the approach is covered in detail later.

As part of the change process a detailed Post Implementation Review will be undertaken roughly 12 months after planned implementation to ascertain how accurately these predictions have been realised.

Preparatory Work: *(Briefly explain the relevant background activities that have been undertaken to prepare for the assessment. This may include decisions or processes such as, deciding that an environmental assessment is required, identifying the assessment client, gathering base data, deciding on years to be assessed, deciding on assessment methods or standards to be applied. There is no need to cover all possible information, simply provide a sufficient explanation of the reasons why the assessment steps and approach were selected. How did you establish which rules, regulations, or standards applied to the assessment?)*

Comprehensive guidance is given in the CAA publication CAP725 and is agreed at the Framework

briefing with the regulator.

Describe the proposed [operational] change, its purpose and alternatives: *(Explain what will change as a result of the proposal to be assessed – this may repeat the information in the earlier project description. Explain why this project is required and what purpose it serves, and what alternatives have been considered. Information on why these alternatives were rejected is useful but not essential)*

The operational change is described in the project description section. During the design phase there were a number of design iterations, these were assessed for their operational impact and also for their impact on fuel efficiency. Following consultation, design options were also considered against the areas identified as being particularly environmentally sensitive (these were generally any populated area, or areas designated for their natural beauty).

For the London City Airport replications, a number of different methods were tested to identify which would result in the least change to the pattern of over-flight over London.

Describe the scope and extent of the assessment: *(How was it decided that this assessment was needed – "screening". Describe the impacts to be assessed, for example, aircraft noise, CO_2 or NOx emissions, climate impacts or air quality impacts. Explain the decision making process that determined this scope and the level of detail to be used in the assessment – "scoping". Also describe any formal processes to consult upon or agree on the scope, for example, via a nominated competent authority if applicable. Explain for example if the scope was set using expert judgement or a pre-assessment checks or information gathering. Also describe how the decision to undertake a more detailed assessment, or not, was taken. How were the base-case and proposed case(s) determined, why were particular years chosen.)*

Noise

'Swathe' operations diagrams were used in the consultation to illustrate the potential position and heights of aircraft following the changes. Diagrams were also included which showed where aircraft fly today so that the public could make an informed decision as to the potential change in impacts.

For any given location the swathe diagrams could be used to identify whether a new route may go overhead, what height the aircraft might be, how many aircraft there could be per hour and the potential noise impact. The noise impact was described using Lmax values along with a table detailing comparative noise, ie a busy road at 1 meters distance. An example swathe operations diagram and extracted text is included below. This is taken from the NATS consultation material relating to approaches into Gatwick airport.

Videos were also made available (produced by NATS) which illustrated various aircraft types on departure and approach and with a decibel meter (recorded separately but at the same time) superimposed onto the aircraft footage. These were uploaded to our website and referenced in all consultation material. Background noise ensured that users didn't have volume settings up too high on their computers, but even so this method was very unscientific in terms of portraying aircraft noise. However, it was effective at demonstrating what an aircraft at a given height actually looks like in the sky; this was useful because residents tended to assume a worse impact (ie the aircraft would be much lower and loom larger in the sky than they would in reality).

All of the consultation material is available at:
http://www.londonairspaceconsultation.co.uk/?s=select

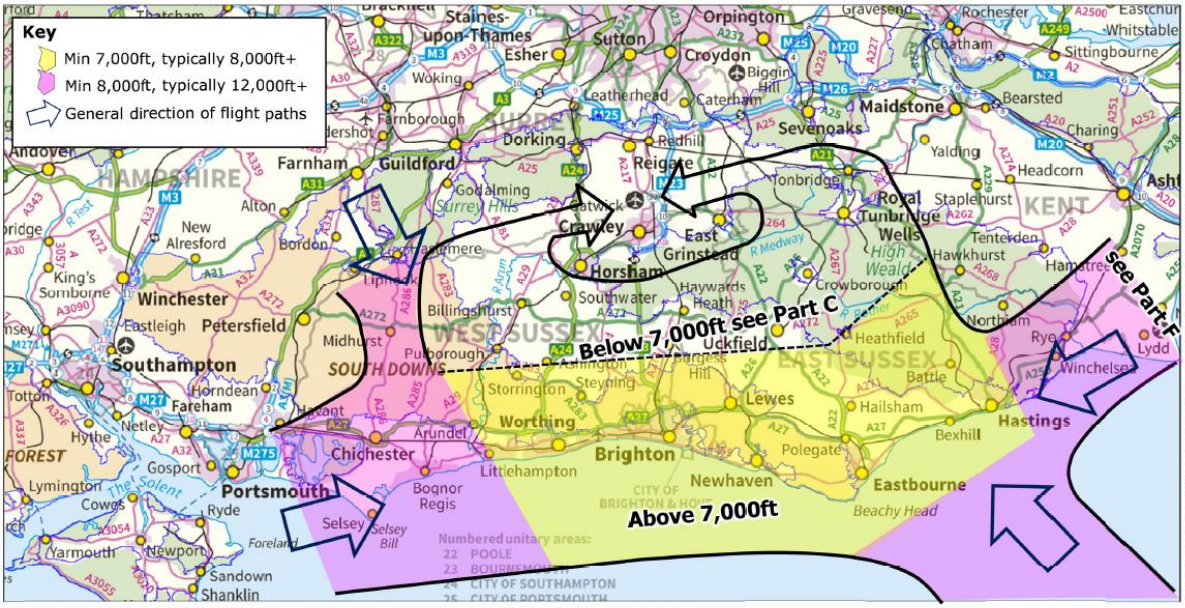

Figure D7: Consultation swathes for Gatwick Airport Arrival Routes above 7,000ft

Notes for Figure D7

The coloured shading on Figure D7 defines the consultation swathe for positioning the Gatwick Airport Point Merge route system above 7,000ft.

The final positions of the routes within these areas will be determined after consultation feedback has been analysed. The position of the routes will determine how areas within the shaded regions are impacted; areas beneath the final routes would expect more overflights than today, and areas away from the routes would expect fewer.

Table D1 shows the potential number of flights that could pass directly overhead if the route was positioned overhead. This is a pessimistic prediction as the numbers shown are for the busiest individual route and it assumes all aircraft are kept on the route in question rather than being vectored off it by air traffic control; which in reality would occur some of the time. A detailed traffic breakdown is provided in Appendix G.

Route	2016	2020	2025
Arrival daytime (0700-2300)	20	21	23
Arrival night time (2300-0700)	4	4	5

Table D1: Forecast for route usage (all Gatwick air traffic) – numbers are hourly averages - for a detailed traffic breakdown see Appendix G

Table D2 provides L_{max} noise information for the typical and noisiest aircraft regularly flying to/from Gatwick. More noise information can be found in Appendix J. Lmax is the maximum noise at ground level from an aircraft flying directly overhead. The L_{max} values may be compared to Table D3 for everyday equivalents. Additional overflight videos are provided on the webpage to help stakeholders understand what aircraft at various altitudes may look and sound like.

Aircraft type	%	7,000-8,000ft	11,000–12,000ft	15,000-16,000ft
Typical Arrival A320/B737 series[24]	72.2%	55 - 56 dBA	<55dBA	<55dBA
Noisiest Arrival B747-400	1.5%	57 - 59 dBA	<55dBA	<55dBA

Table D2: Typical Noise (L_{max}) at various heights[25]

Noise	Noise level (dBA)
Chainsaw, 1m distance	110
Disco, 1m from speaker	100
Diesel truck pass-by, 10m away	90
Kerbside of busy road, 5m away	80
Vacuum cleaner, distance 1m	70
Conversational speech, 1m	60
Quiet office	50
Room in quiet, suburban area	40
Quiet library	30

Table D3: Tables of L_{max} Equivalents
Source: Airports Commission, based substantially on www.sengpielaudio.com/TableOfSoundPressureLevels.htm

[24] Includes the following aircraft types: Airbus A318/319/320/321, Boeing 737-600/700/800/900 (Ancon category, 125-180 seat single-aisle 2-eng jet)
[25] This table shows L_{max} at a height above ground level. Local elevation should be taken into account. See footnote 21

Leq and SEL

Detailed designs were developed on the basis of the swathe consultation feedback. The detailed design options for Gatwick below 4,000ft were analysed for effects on the Leq (16hours) and 90DbA SEL footprints. Population counts were undertaken to determine population differences within contours and footprints as a result of the various options.

The detailed designs and environmental analyses were subject to a further consultation. The Gatwick consultation material, below 4000ft is available here: link.

For London City Airport, the changes below 4,000ft were limited to replication; therefore while London City also undertook a subsequent consultation it did not include specific noise analysis, instead focussing on comparisons of proposed tracks against existing traffic distributions. This material is available here: link

Emissions

The project performed a system wide CO_2 analysis to determine the overall effect on CO_2. In addition local air quality gaseous emissions are included in the analysis. This analysis was repeated throughout the design process to enable comparisons between iterations of the design. It was completed in January 2015 and was based on real time simulation modelling, taking into account the final proposed design both in terms of routes and procedural levels.

The project estimated that in 2016 the change would result in enabled fuel savings of 15,600 tonnes, rising to 18,200 tonnes by 2020. This is an 'enabled' fuel benefit, which is a measure of the difference that the proposal will make to the trip fuel that airlines will plan for. As such this provides a measure of the financial benefit to airlines when considering the efficiency of a particular planned route.

In the current operation aircraft are tactically vectored for reasons of safety and efficiency. This occurs in today's airspace and would also occur in the future. This vectoring means that not all trip fuel that airlines load onto a flight is spent, because the distance actually flown is usually less than that planned for. As CO_2 is only generated from fuel which is burnt, this can mean that the enabled fuel benefit may overestimate the CO_2 benefit if a straight conversion from the enabled fuel is undertaken. Therefore whilst the enabled fuel benefit may be an appropriate basis for reporting a financial benefit to airlines, the project applied a method for adjusting the results to avoid, as far as is practicable, overestimating actual fuel burn and therefore CO_2.

While NATS has world leading fuel/CO_2 assessment tools in the AirTOp fast time model and KERMIT fuel-burn/emissions assessment software, we recognise that there are elements of the fuel and CO_2 assessment methodologies that remain subject to assumptions, in particular when translating enabled fuel reduction into actual CO_2 reduction. We have taken account of these factors as far as possible, and therefore reduced the CO_2 benefits on the basis of a comparison of modelled and actual fuel for today's traffic.

The adjusted CO_2 estimate was a 39,400 tonne saving in 2016; rising to 46,000 by 2020 (this is adjusted down by 21% from the equivalent 'enabled' benefit).

However, the dynamic nature of the air traffic environment both in terms of day-to-day operation and the long-term effects of increasing traffic and technological advancement, mean that a degree of uncertainty remained. To account for this uncertainty we applied a range to the reported results in the ACP (to meet CAP725 requirements).

Declared CO_2 saving for 2016: 19,000 – 40,000 tonne pa
Declared CO_2 saving for 2020: 23,000 – 46,000 tonne pa

The lower end of the range has not been scientifically derived; it was simply 50% of the calculated value. However, it was the opinion of our operational and analytical experts that, as the calculated value represents as close an approximation to the required adjustment as can be achieved, then the lower end of the range more than covers the remaining uncertainty, and presents a sufficient benefit contributing to the overall justification for change.

It should also be noted that within the overall result there are some specific routes for which there was a negative fuel/CO_2 impact. However, because these are the less-frequently-used routes, the net negative CO_2 impact is negligible when taken in the context of the overall system benefit.

For all noise, fuel and CO_2 analysis two sample years were used for comparative purposes; 2016 as the first year of implementation and 2020 as a future scenario. Forecasts beyond 2020 were not undertaken because it was recognised that further phases of LAMP, and potential runway development in the London area would significantly reduce the confidence in forecasts beyond that timescale.

Describe the assessment itself: *(Describe any standards or mandatory requirements for the assessment to be undertaken together with the methodology, monitoring or model used to determine the extent of the environmental impacts for the proposal. Give an indication of the extent or time-horizons that were chosen (if not already described earlier). Was quality management applied? For example, was there a process to ensure that the input data for the environmental assessment was consistent with other parallel assessments? Were interdependencies encountered and how did you address any trade-off issues[3]? Was the expertise for this assessment available from internal resources or procured externally?)*

See section '**Scope and extent of the assessment'**

Describe the results and how they were communicated: *(Explain in general terms what the results of the assessment were, how this was used, for example to what extent it informed decision making or approval for the project. Was it produced as a draft for consultation or simply as a final report? Were the results validated or verified in any way – for example were the assessment processes or quality management processes independently audited? Did the results feed into a wider process, for example, a business case assessment?)*

See section '**Scope and extent of the assessment'** for communication through consultation.

Feedback reports were also provided following each consultation; these can be found on the consultation websites.

The results from the consultation, including any changes as a result of consultation feedback and the results of the final environmental analysis, were packaged into the Airspace Change Proposal and passed to the CAA for approval prior to implementation. At the time of writing the CAA are considering the submitted documentation.

Lessons learned: (*Explain here what worked well, what could be improved, what you would do differently next time –If applicable please explain if you think the ICAO assessment guidance could be improved and in what way. If you did not use the ICAO methodology can you identify aspects of your methodology that could provide benefits to future iterations of the ICAO guidance? What aspects of the ICAO guidance would you apply to your own methodology for future assessments?)*

Swathe consultation

Even though the early 'swathe' consultation was criticized for lack of final detail, it was an effective approach in terms of getting a wide body of opinion across a swathe of potential options. It was therefore a cost effective approach for the changes above 4,000ft.

[3] For definitions and examples of interdependencies and trade-offs, please refer to Chapter 4 of ICAO Doc 10031, Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes.

At lower levels the follow up consultations presented more difficulty and therefore the swathe approach may not be as useful for airport led consultations.

Noise and low level consultation

LAMP Phase 1A was subject to significant local opposition during and after the consultation phases, which has led to the Gatwick point-merge and associated low level changes being removed from scope. These will be considered in later LAMP Phases.

Despite extensive consultation, public reaction was dominated by discussion around the negative effects of change, rather than a balanced view of the pros and cons of PBN. The tendency of NATS and the airports was to focus resource on those parties objecting to the proposal in an attempt to win them over. With hindsight many of these parties were fundamentally against **any** change, and were not interested in rational arguments. A better approach would have been to concentrate more on those community's that would benefit from the change and to ensure that they mobilized their thoughts and opinions so that there was more balance to the discussion.

Fuel and CO_2 analysis

Fuel and CO_2 analysis has been undertaken using fast time simulation to generate aircraft profiles. These are necessarily based around the defined procedures and flight plans rather than tactical intervention. Whilst the resultant measure gives airlines a reasonable indication of the potential impact on trip fuel, it does not necessarily translate into a reliable measure for actual fuel spent and therefore CO_2; this is because it cannot take into account the tactical variations. Tactical variation of tracks is extensive in the busy TMA areas, and while PBN is expected to reduce this to a degree, through increased systemization, tactical variation will still be required in a PBN environment for some years, if local capacity is to be maintained.

We have attempted to account for this by adjusting the modeling results based on observed differences between todays procedural and tactical performance, but further work to refine the method is recommended.

Comments*: (Optional - Offer here any other advice or hints that may be of value to others using ICAO environmental assessment guidance*)