London City Airport RNAV Replications

Stakeholder Consultation Document

Issue 1.0

Publication history

Issue	Month/Year	Change Requests in this issue
Issue 1	September 2014	Not used prior to base-lining

Referenced documents

List of documents referenced in this publication:

(1) CAP 725, CAA Guidance On The Application Of The Airspace Change Process, March 2007, CAA Directorate of Airspace Policy
http://www.caa.co.uk/docs/33/CAP725.PDF

(2) CAP 724, CAA Airspace Charter which defines the authorities, responsibilities and principles by which the CAA Director of Airspace policy conducts the planning or airspace and related arrangements in the UK.
http://www.caa.co.uk/docs/33/CAP724.PDF

(3) Cabinet Office Code of Practice on Consultation
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/255180/Consultation-Principles-Oct-2013.pdf

(4) Guidance to the Civil Aviation Authority on Environmental Objectives Relating to the Exercise of its Air Navigation Functions
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/269527/air-navigation-guidance.pdf

(5) HM Government – Aviation Policy Framework, 2013
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/2739/draft-aviation-policy-framework.pdf

(6) Civil Aviation Authority, Future Airspace Strategy for the United Kingdom 2011 to 2030
www.caa.co.uk/FAS

(7) Civil Aviation Authority, Policy Statement, Guidance On PBN SID Replication For Conventional SID Replacement, August 2013.

(8) Policy for the Application of Performance Based Navigation in UK/Irish Airspace 2011
http://www.caa.co.uk/docs

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Note: Appendices are attached as a separate document

1 Foreword

Dear Stakeholder

London City Airport is a key strategic airport in terms of passengers and aircraft movements serving the London area. In 2013 it handled around 3.3 million passengers. The airport provides regular flights to over 40 destinations which help to link central London's businesses with the world, creating connectivity which drives business investment in the heart of the capital.

Throughout what has been a successful journey over the last decade and more, London City Airport is committed to its local area and has fostered positive, constructive relationships across communities.

This consultation continues our commitment as we respond to upcoming legislation from Europe that will require us, and all London's main airports, to upgrade their routes to take advantage of modern navigation technology. This will change the way aircraft navigate, not just here at London City Airport but in airspace across London and the rest of Europe.

Specifically, this consultation is about our proposal to enhance the arrival and departure routes to and from London City Airport so that they are based on Area Navigation (usually known as RNAV). RNAV is an established technology which uses satellite navigation and ground based systems to ensure more reliable, repeatable and predictable flight paths. This technology gives the potential to streamline air traffic routes, which as part of a whole network of changes at London City and across the South East will deliver reduced delay, reduced emissions and an improved noise environment for the majority of people in the area.

Our consultation is focused on the routes in the vicinity of the airport, generally below 4,000ft. The "new" RNAV routes that we are proposing here have been designed to replicate as closely as is possible, the existing routes. This document provides the details of the case for this plan, and explains the routes involved.

Note that other proposals at higher altitudes beyond this are being progressed by NATS who are a separate company that provides the air traffic control service between airports.

Thank you for taking the time to participate in this consultation.

2 Introduction

This consultation concerns modernisation of the existing arrival and departure routes to London City Airport.

The existing routes used by aircraft (termed "conventional" routes) rely on the 1950s technology of ground based radio beacons[1]. A well established and much more accurate form of navigation is a**R**ea **NAV**igation (RNAV) which uses a combination of satellite and ground-based navigation technology to permit aircraft to follow a precisely defined path over the ground with far greater accuracy than is possible with conventional routes. This in turn enables pilots to fly pre-determined, predictable arrival and departure profiles.

Aircraft today already use RNAV extensively to fly in our airspace, even though the existing conventional routes have not been specifically designed for its use.

Processes are underway at a European level to make modernisation of the route system a legal requirement for the UK and other European states by 2020[2]. This will require all member states, including the UK, to upgrade routes to the RNAV standards. This legislation will be enacted by UK mandates to be introduced by the Civil Aviation Authority. The CAA is planning to mandate that all operators will have to be RNAV 1 approved by November 2017, and then require RNAV routes to be introduced by winter 2019.

Modernising our conventional routes is therefore mandatory and inevitable; this consultation concerns how we intend to achieve this at London City Airport with minimal impact to our stakeholders.

2.1 Our Proposal

This proposal is sponsored by London City Airport Limited. We are seeking to upgrade our departure and arrival routes[3] to take advantage of the improved navigational capabilities of RNAV.

This proposal is being progressed to coordinate with Phase 1 of the London Airspace Management Programme (LAMP) which is a related project being run by NATS, the UK's main air traffic control provider.

LAMP is focussed on implementing improvements across the network of routes that join airports to one another and to the airspace of neighbouring states. As such the LAMP is considering, and has already consulted upon, changes to much of the airspace used by London City departures above 4,000ft (see www.londonairspaceconsultation.com for details of LAMP plans above 4,000ft).

Our proposal, which is presented in this consultation, focuses on local routes below 4,000ft, which will feed into the LAMP network.

Modernising our routes is being driven by European legal requirements. Our intention is to meet these requirements with the minimum impact to stakeholders; hence we are seeking to replicate all the existing conventional routes with equivalent RNAV routes rather than designing new ones. The aim of replication is to match the existing conventional routes as closely as possible in line with regulatory guidance and within the rules of what is allowed for RNAV routes.

[1] These are VORs and NDB, respectively **V**HF (very High Frequency) **O**mni-directional **R**adio Range, and **N**on-**D**irection radio **B**eacon which are ground-based navigation facilities.
[2] Eurocontrol explain the requirement and planned timescales for modernisation here: www.eurocontrol.int/articles/performance-based-navigation-pbn-mandate
[3] Note that the flight paths followed by aircraft are defined by formal routes listed in the UK Aeronautical Information Publication (AIP section AD 2-EGLC lists London City arrival departure routes; ENR 3.1 details Low level Routes) and in local air traffic control routes and practices.

As we are seeking to replicate rather than redesign our existing routes, we expect that flights will still be seen in the same areas as today. The main difference would be that aircraft will follow the routes more consistently than they do today. This is due to the improved track-keeping ability of RNAV. Improved track keeping means that there will be less dispersion of aircraft either side of each of the routes; this would mean a reduction in the overall area regularly overflown, but an increase in the concentration of over-flights in some areas.

Many airlines are already equipped with RNAV technology and prefer to use it where they can (since it is more precise). As a result many aircraft currently flying from London City already use RNAV versions of conventional arrival and departure routes, so called "RNAV overlays". This proposal seeks to formalise the use of RNAV by superseding these overlays with officially certified RNAV routes.

Approximately 70% of aircraft flying from London City are equipped to fly RNAV routes; the remainder still rely on conventional navigation. We therefore propose to keep the conventional routes for use alongside the proposed RNAV replications, until such time as RNAV is fully adopted, after which the conventional routes will be removed. The CAA is planning to mandate that all operators will have to be RNAV 1 approved by November 2017, and airports in the London area must replace conventional procedures by November 2019. After the implementation of the RNAV routes at London City (planned for December 2015) the majority of those aircraft which are approved for RNAV1 will use the new routes. There will then be a transitional period to 2017 where the remaining airlines progressively transition to full RNAV1 operations. The conventional procedures will then be withdrawn by November 2019.

The proposed RNAV routes represent a technical change to the published routes for pilots. For this reason London City Airport has a duty, as prescribed by the Civil Aviation Authority, Safety and Airspace Regulation Group[4] (CAA, SARG), to consult on the implementation of the proposed RNAV routes.

2.2 The Consultation

This proposal seeks to replicate a total of 10 Standard Instrument Departure routes (referred to as SIDs) and 2 arrival routes.

The focus of this consultation is primarily replication of all London City departure and arrival routes up to 4,000ft.

The redesign of all arrival routes and departure routes to the south above 4,000ft are being progressed separately by NATS (see www.londonairspaceconsultation.com). However, we are covering replication of departure routes to the north & north east above 4,000ft in this consultation because these routes are outside the area currently being considered by NATS.

Replication of the departure routes to the north and north east above 4,000ft is required to complement our replication below 4,000ft. However, for these routes above 4,000ft the replication will have little impact on where aircraft fly; this is because the way in which air traffic control handle the flights will not change. Above 4,000ft the replication of these particular departure routes is therefore principally a technical matter which we cover in this consultation for completeness. (Note that Figures 3 and 4 later in this document give an indication of aircraft altitude profiles along the departure and arrival routes).

Arrivals to London Biggin Hill airport share the same arrival routes as London City Airport up to a point. There are relatively few Biggin Hill arrivals compared to London City. To avoid having two consultations on the same route we are therefore covering the London Biggin Hill arrivals where they are coincident with London City arrival routes. However we are not consulting on Biggin Hill departure routes or the arrivals in the immediate vicinity of Biggin Hill airport. Any questions regarding these routes should be directed to Biggin Hill airport directly.

Appendix C shows the charts (as are currently used by the pilots) for the conventional routes we are seeking to replicate.

Airspace change proposals must follow the CAA guidance (ref. 1 & 7). This involves liaison with the CAA to determine the appropriate level and form of consultation.

[4] The CAA is the UKs independent airspace regulator.

By replicating today's routes, the majority of flights will fly over the same areas that they do today. As this change is being driven by European legislation, and is designed to replicate the existing route system as far as possible, the CAA has advised that consultation with the Airport Consultative Committee and airspace users groups is appropriate.

Airspace design has an effect on where aircraft fly and therefore is a highly complex subject area. Matters relating to navigation and airspace arrangements are inevitably technical in nature. It is, however, assumed that the stakeholder groups mentioned above have a broad understanding of Air Traffic Control (ATC) issues and terminology, and that they require a level of technical detail to enable them to consider the consultation. A glossary of terms is provided at Appendix A.

This consultation documentation is available via our website at

http://www.londoncityairport.com/londonairspacemanagement.

The consultation will begin on 4th September 2014 and end on 27th November 2014, a period of 12 weeks.

It would be appreciated if consultees could provide comments as early in the process as possible.

3 The Consultation: What is it about, why is it needed and what will it consist of?

This section provides background information concerning RNAV and our proposal.

3.1 What is this consultation about?

This consultation concerns amendments proposed to the navigation systems which define the standard arrival and departure routes to London City Airport. The existing routes (termed "conventional" routes) rely on the 1950s technology of VOR & NDB[1] radio beacons. More modern navigation systems can now provide area navigation (RNAV) which uses a combination of satellite and ground-based navigation technology to permit aircraft to follow a precisely defined path over the ground with far greater accuracy than is possible with conventional routes.

The benefits of RNAV are well documented (Ref 6 & 8), and the replacement of conventional routes with equivalent RNAV routes is in accordance with Government and international (ICAO/Eurocontrol) guidelines[5].

This proposal seeks to replicate the existing conventional routes with equivalent RNAV routes. The new RNAV routes have been designed to replicate the conventional routes as closely as possible (within the rules of what is allowed for RNAV routes). Comparisons of how aircraft fly today with how we anticipate they will follow the proposed RNAV routes are given in section 6.

This consultation primarily concerns changes which affect aircraft profiles below 4000ft above mean sea level. Technical details regarding exactly which parts of each route are included in this consultation are given in Appendix C. The higher altitude changes are the responsibility of NATS who are making changes to the higher level route network as part of the LAMP programme.

The purpose of this consultation exercise is to allow stakeholders to consider the proposal and provide London City Airport with feedback. We ask that you consider the impact of the proposed move from conventional navigation to RNAV routes, and what impact, if any, it would have on you or your organisation.

At the end of the consultation London City Airport must demonstrate to the CAA that the best balance possible has been achieved.

3.1.1 What is RNAV?

RNAV is a highly accurate method of aircraft navigation. RNAV is not new, it has been in use since the 1970s, however the accuracy achievable has improved over the years and as a result there are several different specifications which determine the accuracy that can be achieved. For example RNAV5 has accuracy to ±5nm, RNAV1 has accuracy to ±1nm (note: these are minimum standards, in practice the performance is typically better, i.e. most aircraft are able to follow the defined centreline of a straight segment to within ±0.1nm although more variation is seen around turns). RNAV1 utilises existing ground based infrastructure and satellite navigation to enable aircraft to navigate from point to point with a high degree of accuracy. The routes proposed herein are all designed to the RNAV1 specification.

When RNAV equipped aircraft fly known routes, the on-board flight management computers can assist the pilots by predicting accurate arrival times, and create optimised descent profiles from the top of the decent to the runway.

Predictable aircraft behaviour benefits both pilots and air traffic control, and helps deliver improved operational and environmental efficiency, safety, and resilience through the systemisation of operations.

[5] CAA Future Airspace Strategy (www.caa.co.uk/FAS)

These benefits will derive from changes to the whole route network above London and the South East of which the routes we are consulting on here are only a small part. This wider redesign of the route network is being progressed separately by NATS as part of the London Airspace management Programme (see www.londonairspaceconsultation.com for details).

Whilst our proposal to replicate London City Airport routes is a small part of this overall development, none of the benefits will be achieved without modernisation of the routes at London City Airport (as well as at all other main airports). This interdependency is the reason behind the European legislation that requires modernisation throughout the system, as the full benefit can only realised by ensuring that all key parts of the system are modernised.

3.1.2 Is London City Alone in This Concept?

London City is not alone in moving to use RNAV routes, the change is being made in accordance with national and international initiatives to improve navigational performance. The UK Future Airspace Strategy (FAS) is an aviation industry and governmental initiative to improve the efficiency of airspace and ensure that all parties are prepared for the legislative requirements to modernise. The FAS supports the introduction of RNAV routes as an enabler to the achievement of future benefits. The FAS strategic vision for 2030 is to establish,

> "Safe, efficient airspace, that has the capacity to meet reasonable demand, balances the needs of all users and mitigates the impact of aviation on the environment."

To this end, the three FAS drivers of continuous improvement in Safety, Capacity and the Environment are aligned with London City Airport's own vision for the future, in which the introduction of new technology, including RNAV routes, is a part.

Similarly the Single European Skies ATM Research (SESAR) project, a multi-billion Euro, pan-European collaborative effort is developing many Performance Based Navigation threads (of which RNAV is a part) with a view to ensuring that many of these are available for use, across Europe within the 2020 time frame.

The benefits of RNAV are generated throughout the airspace Network. The LAMP airspace change proposal being led by NATS seeks to achieve these benefits in the airspace over London at levels of 4,000ft and above.

The aim of our proposal is to build upon these UK and international initiatives, and to make London City Airport's routes compatible with the latest navigation technology available. Many other UK airports are introducing RNAV routes e.g. Gatwick Airport RNAV replication of SID was introduced in November 2013.

3.2 Why is the consultation required?

This proposal will introduce 10 RNAV SIDs and 2 RNAV arrival transitions. These have been designed to replicate the existing conventional routes as closely as possible commensurate with RNAV design criteria. In accordance with the CAA's Airspace Change Process (Ref 1) and the CAA Policy on RNAV replication of conventional procedures (Ref 7) formal consultation focussed through the consultative committee is required to ensure the needs of all stakeholders are considered.

3.3 What is this consultation not about?

This consultation only concerns aircraft arriving to/departing from London City Airport. It is not related to air traffic growth in general nor changes to the ground-based infrastructure at London City Airport.

3.4 Implementation Date

If the proposal is approved by the CAA, implementation of the proposal will occur at an appropriate opportunity but, in any event not before 10th December 2015.

3.5 Who are the stakeholders in the consultation?

The proposals herein seek to replicate the existing patterns of aircraft arriving at London City Airport today. The introduction of RNAV routes should not introduce additional residents to aircraft noise, and will have no impact on the volume of air traffic. In light of this it has been agreed with the CAA that the consultation specifically engage with the following:

(i) The London City Airport Consultative Committee (LCACC) which includes representatives of Local Authorities, community representatives and other organisations that have expressed an interest in the activities of the airport.

(ii) Members of the National Air Traffic Management Committee (NATMAC) which includes representatives of all types of airspace users.

(iii) Airlines that operate from London City Airport.

(note: a full list of all stakeholders and constituent members of the Airport Consultative Committee and NATMAC is provided at Appendix A)

The consultation is also open to any other interested party to respond.

3.6 How long will the consultation period last?

The consultation will begin on 4th September 2014 and end on 27th November 2014, a period of 12 weeks.

It would be appreciated if consultees could provide comments as early in the process as possible. This will allow London City Airport to respond in good time.

4 Overview of Current Operations at London City Airport

London City Airport is serviced by two runways utilising either end of the same tarmac landing strip. These are named runway 27 and runway 09 as per convention corresponding to the magnetic direction of the runway (approximately 274° and 94° respectively for Runway 27 and runway 09). This section details how each runway operates, including the routes and levels which departing and arriving aircraft will take when landing and taking off in each direction.

The main routes which aircraft take to/from each runway can be seen as red in the flight path density plots of Figures 1 to 4; these show todays distribution of over flights. Other yellow, blue and grey areas indicate a reduced number of aircraft over-flying those locations and demonstrate how tactical intervention by Air Traffic Control (ATC) often results in variation in the flight paths actually flown.

4.1 Current Aircraft Flight Paths

Figures 1 and 2[6] illustrate the arrival and departure routes to/from runway 09 and 27 respectively. These plots are generated from radar data and show the density of flight paths. Red areas indicate the highest concentration of flight paths, with yellow/green less so and grey areas show where there are only occasional flights.

The pattern of traffic on any particular day depends on the direction of the wind, since this determines which runway is used. Aircraft always take-off and land into the wind. The prevailing wind in the UK is from the south west, hence on average runway 27 is used, 73% of the time and runway 09, is used 27% of the time.

Figure 1 shows today's traffic patterns on days when the wind was predominantly from the east, which results in runway 09 being used.

Figure 2 shows today's traffic patterns on days when the wind was predominantly from the west, which results in runway 27 being used.

The current traffic patterns at London City Airport are influenced by several external factors. The most significant of these is the presence of Heathrow Airport to the west. A large area of airspace to the west of Battersea is reserved for use by Heathrow flights, keeping the Heathrow and London City flights separate is an essential safety measure in this congested area and so this effectively prevents aircraft from approaching London City from west of Battersea. Hence arrivals to runway 09 approach from the east and usually fly south of the airport before turning right onto 'final approach' (final approach is the last part of a flight where they line up with the airport runway and land).

London City Airport does not currently have any published arrival routes at low altitudes. Currently aircraft are given instructions by Air Traffic Control (ATC) to join the final approach. Even though there is no formal route it can be seen from Figure 1 that there is high degree of consistency in the instructions given. This is demonstrated by 09 arrivals in Figure 1 which shows a clear concentration of flight paths passing south of the airport before returning north and then east to land.

Figure 1 also shows a relatively small number of flights heading south east from Sidcup. These are flights to Biggin Hill Airport that share the same flight path as London City arrivals up to Sidcup. Our proposals cover Biggin Hill arrivals where they are coincident with our own - up to Sidcup but not covering any areas to the South.

[6] The traffic samples used in these and all subsequent plots are from June 2013 to show typical flight path patterns over each area.

4.2 Current Aircraft Altitudes

The minimum altitudes at points on the current day flight paths are indicated on Figure 3 and 4, these have been determined from analysis of the flight path density plots[7]. ATC will always seek to get departures to higher altitudes early and also not to descend arrivals early; this is better for noise levels, emissions reduction and CO_2 levels. This means that aircraft will usually be higher than these minimum levels. However, Air Traffic Control (ATC) has to keep flights safely separated, which often constrains the altitudes they can achieve. It is not expected that the altitudes of aircraft will change significantly by the change to RNAV replications of the existing routes.

Note these maps are high resolution so that if you zoom in, individual streets can be identified.

[7] Note that the formal definitions of the routes published in the UK Aeronautical Information publication has some lower levels defined – these are levels for safety related procedures to be used only when aircraft radio systems fail, which happens very rarely (there have been no such incidents at London City in recent years).

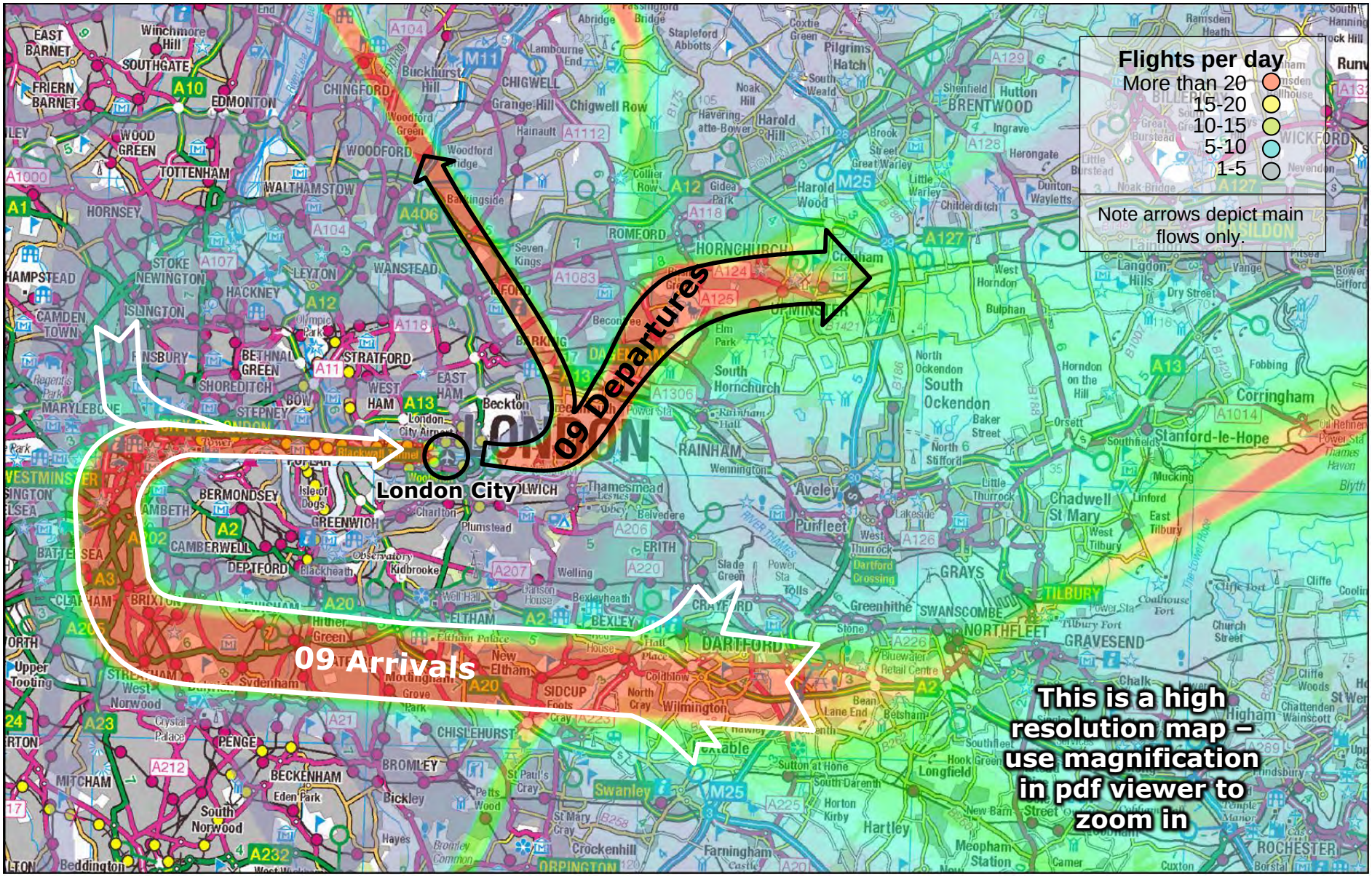


Figure 1: Current Flight Paths, Runway 09 (Easterly Operations)

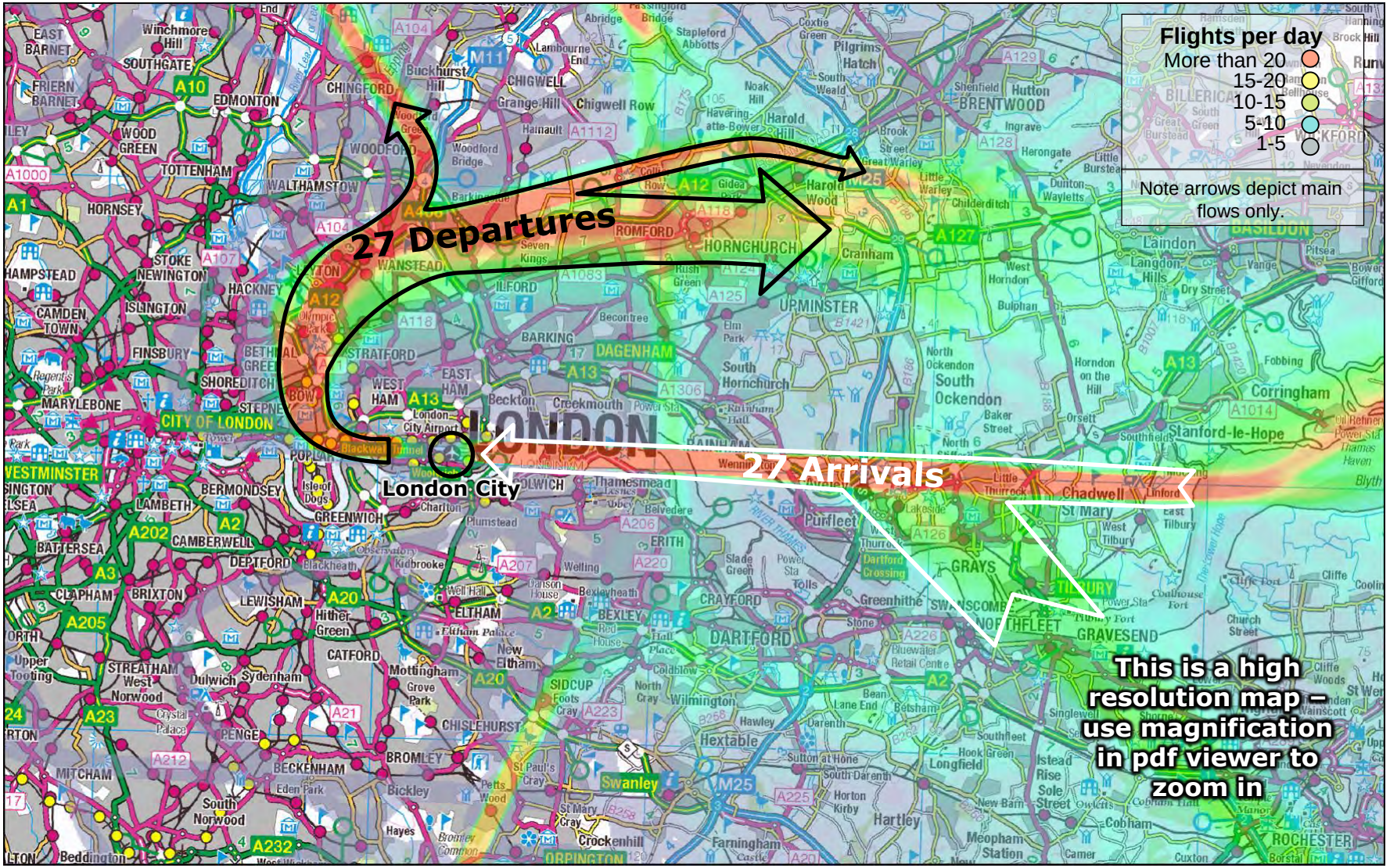


Figure 2: Current Flight Paths, Runway 27 (Westerly Operations)

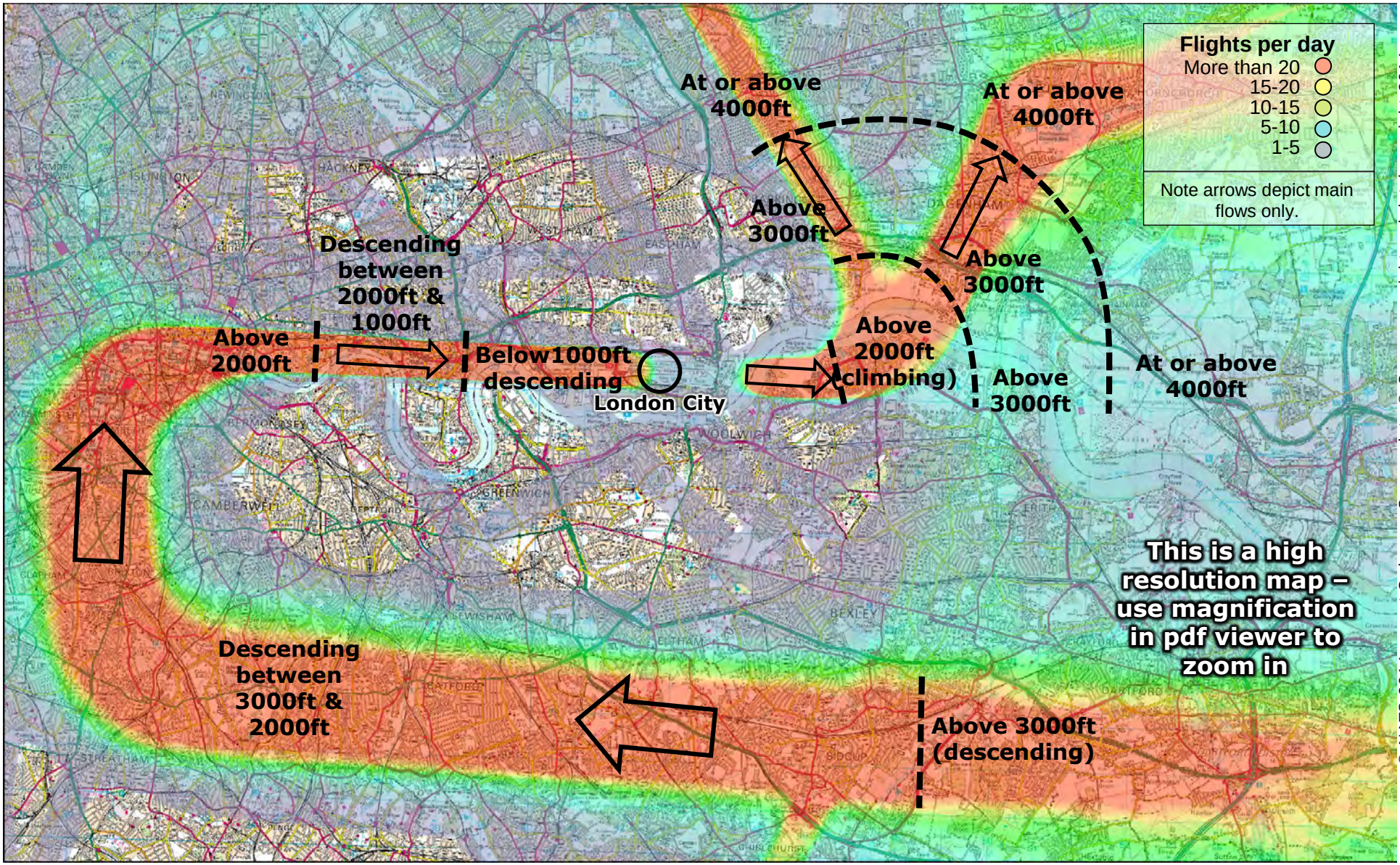


Figure 3: Indicative Aircraft Heights for Runway 09

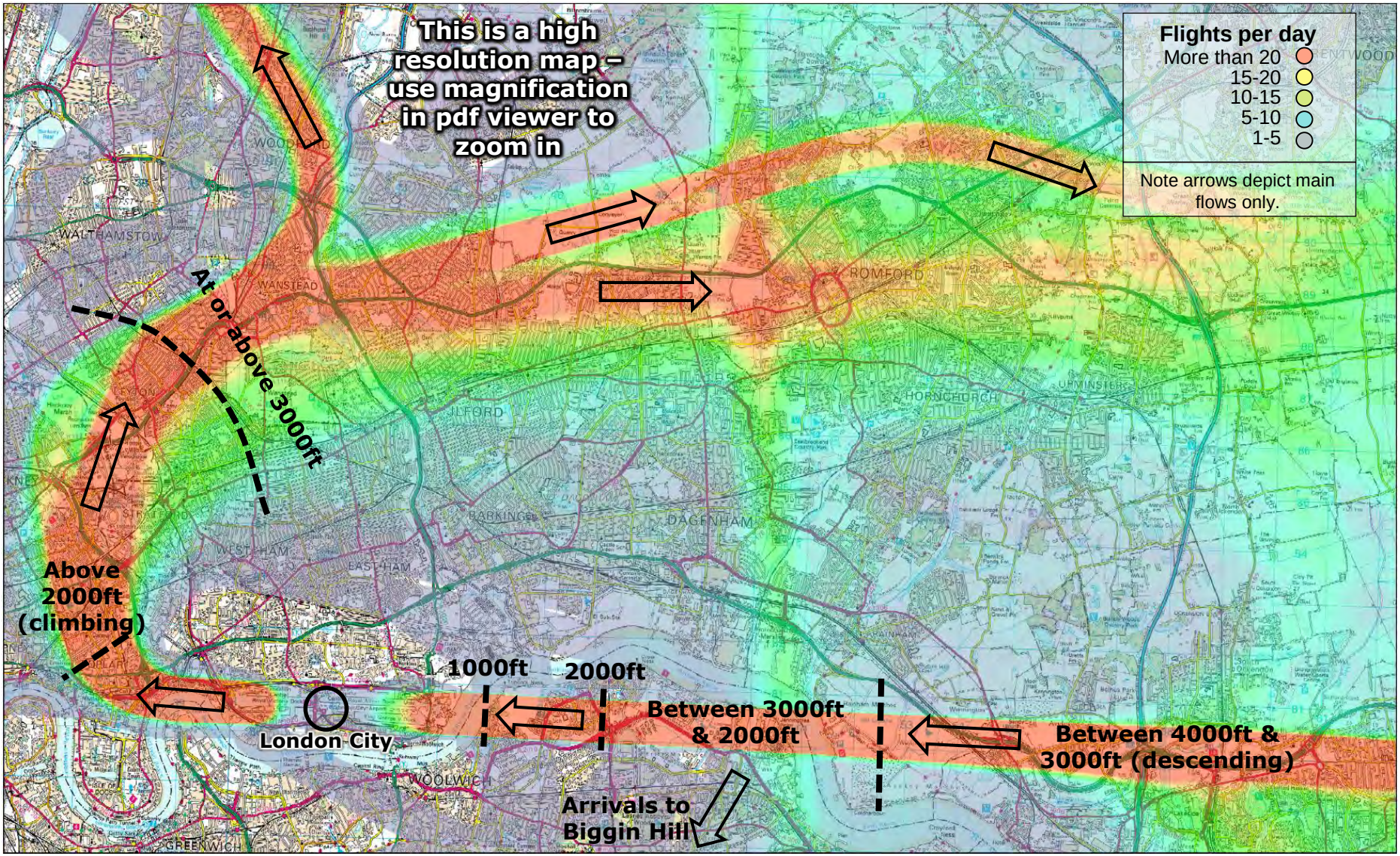


Figure 4: Indicative Aircraft Heights for Runway 27

5 Design Options

The guidelines for design of RNAV routes allow a variety of different options for RNAV replication of conventional routes to be developed. London City Airport has strived to progress only those options which match the existing flight paths as closely as is possible. Hence it is the objective that the proposed designs will result in only a barely perceptible difference to stakeholders on the ground.

5.1 What Does an RNAV Route Design Consist of?

RNAV routes are made up of waypoints which are precisely defined points in space. These waypoints are given certain attributes which determine how the aircraft interpret the route. Different aircraft will fly routes in different ways; along a straight segment all aircraft will follow the same "centreline" closely (the centreline is a term describing the track that the route follows). However where routes turn, there is more variation. For instance slower aircraft tend to turn in a tighter radius than faster ones; hence they will follow different flight paths around the turn.

The RNAV routes have an associated "nominal track". This is the track flown by the least manoeuvrable aircraft likely to fly the route, leading to the widest turns. This is necessary to calculate as it is the performance of the least manoeuvrable aircraft that tend to limit what can be achieved in the design of a route, for example waypoints around a turn must be positioned such that the least manoeuvrable aircraft can fly between them, which may not be possible if they are too close together. Nominal tracks are the worst case scenario and it is rare that an aircraft will follow the path of the nominal centreline over the ground. Because of safety requirements the CAA use nominal centrelines in their assessments of replicated routes (see section 5.3). However they do not represent the range of tracks that you are likely to see following a route, nor do they represent the average track.

Waypoints are defined as either 'fly-over' whereby the aircraft flies directly over the top of the point and then turns to intercept a new course, or they are 'fly-by' waypoints in which case the aircraft anticipates the turn and the flight management system calculates the turn, (inside of the waypoint) to smoothly intercept the outbound course.

The aim of RNAV is to give consistency and commonality to the routes. This allows pilots to plan their descent profiles to best effect by knowing, ahead of schedule, the distance to touchdown and any level or speed restrictions that are in place.

5.2 Do Nothing

The option to "do nothing" and maintain the current operation would continue to work in the short term. However this would not meet the requirements of the upcoming European Legislation and not allow the wider improvement in aircraft operations (see Section 3.1.1).

For these reasons doing nothing is not an option.

5.3 RNAV Replication of the Conventional Routes

The CAA defines RNAV replication of conventional departure routes as follows (ref 7):

"The design of an RNAV or RNP (Required Navigation Performance) route that follows the path over the ground of the nominal track of the existing conventional route as closely as possible. Note: it is the path over the ground of the designed conventional route and not the nominal centreline of the associated NPR or the current traffic concentration."

Hence the CAA's emphasis for replication is on reproducing the design of the conventional route. With careful design it is possible to do this and to *also* match closely the current trajectories flown by the majority of flights; this is what we have sought to do for departures.

The following section presents maps showing today's traffic patterns and for comparison, computer simulations showing how we expect aircraft to fly the replicated routes. For completeness we also provide comparisons of the theoretical nominal tracks for the departure route replications in Appendix B to demonstrate how they meet the CAA's requirements.

For arrivals there is currently no formal route to replicate. We have therefore agreed with the CAA that a replication is an RNAV defined route that matches the current concentration of flights seen in today's airspace. Appendix B also shows the nominal tracks for arrivals.

5.4 Replications of Existing Track Concentrations

The following figures are intended to help you understand the current day spread of flight paths, and to see where the flight paths resulting from the use of the proposed RNAV routes would occur.

In the following pages where two figures are side by side, the figures on the left (e.g. Figure 5) show density plots of flight paths[8] so that the current number of flights over any given location in a typical day can be gauged. These figures give a good indication of where the main concentrations of flights currently occur. The dotted line is superimposed to show the typical flight path, around which we would expect the flight paths for aircraft following the proposed RNAV routes to be concentrated (a tighter concentration than today).

We have depicted these as wide dotted lines so that areas beneath can be viewed, and to signify both that there will still be some variation in tracks and that you do not have to be directly beneath a flight path to see or hear the aircraft.

The dotted line shown in each of the figures on the left are derived from the predicted flight paths as shown in the figures on the right. The figures on the right (e.g. Figure 6) show the outputs from computer simulations[9] of how different aircraft types would follow the proposed RNAV1 routes.

Seven aircraft types, representative of those operating from London City Airport, were used in the simulations. The different coloured lines in these figures represent different aircraft types. Often the tracks for several types will be very close together in which case they are difficult to separate. Note that no simulations have been run for arrivals because all arriving flights are required to adhere to speed restrictions that mean that flight path characteristic vary less than for departures.

Where there is a spread of trajectories, this is a result of the different speeds and performance of the various aircraft types. In general, slower aircraft (e.g. turbo props) will turn with tighter radii, while faster jet aircraft (e.g. Airbus A318) will turn with wider radii. There can also be some variation due to wind.

Please note the flight path density plots and predicted flight paths shown in Figures 1-19 differ from the nominal centrelines shown in Appendix B, as the nominal tracks are used to define the extremes, and so are not always representative of where the majority of aircraft will fly.

For reference the current conventional SIDs are included in Appendix C.

Although there may be a slight beneficial change to vertical profiles as described in section 7, it is difficult to notice small altitude differences from the ground, and hence stakeholders should assume that the vertical profiles will be the same as they are today.

Data of RNAV track-keeping conformance from a study of procedures trialled at Gatwick Airport[10] indicates that aircraft of comparable type to those using London City (A320), navigating using RNAV1 had an average track deviation from the simulated track, of 0.1nm, and the 95% were within 0.2nm (a sample of 594 aircraft, on 2 SIDs). The dots of the dotted lines on the right hand figures are 0.2nm radius, to correspond with this 95% value.

Once above 4,000ft aircraft are often tactically vectored by ATC. This means that they are instructed by ATC to leave the SID, and hence above 4,000ft the flight paths may be more dispersed; this is particularly the case for routes to the North East (Figure 11 and 14). For the other departure routes and the arrival routes we expect the application of RNAV to mean that aircraft will generally conform to the RNAV routes.

Table 1 below shows the average usage for the routes depicted in Figures 5 - 22.

[8] These are derived from radar data. Two different 5 day samples are required to illustrate operations for each runway, these are taken from June 2013.
[9] Using Eurocontrol RNAV Validation Tool
[10] Statistical Comparison of RVT & Radar Tracks for RNAV Flights. May 2014

Route (T=27, U=09)	%	Average flights per day 2013 (note 1 & 2)	Average flights per day 2016 (note 1 & 2)	Average flights per day 2021 (note 1 &2)
To the south (Figures 5-8) DVR 5T/5U	32%	32	41	48
To the south (Figures 5-8) LYD 5T/5U	22%	22	28	33
To the north east (Figures 9-14) CLN 7T/7U	22%	22	28	33
To the north (Figures 15-19) CPT 6T/6U	1%	1	1	2
To the north (Figures 15-19) BPK 5T/5U	23%	23	29	35
Departure Total	100%	101	127	151
Arrivals (Figures 21-22)	100%	101	127	151

Table 1 Daily route usage

Note 1: route usage data for 2016 and 2021 based on 2013 data grown in line with master plan forecast.

Note 2: runway 27 is used 73% of the time, and runway 09 27% of the time. This means that for each route shown in table 1 the average flights per day would apply to the runway 27 routes for 266 days per year and runway 09 for the remaining 99 days per year.

5.4.1 RWY27 Departure routes to the South: DVR 5T, LYD 5T (average 69-81 flights per day for 266 days per year)

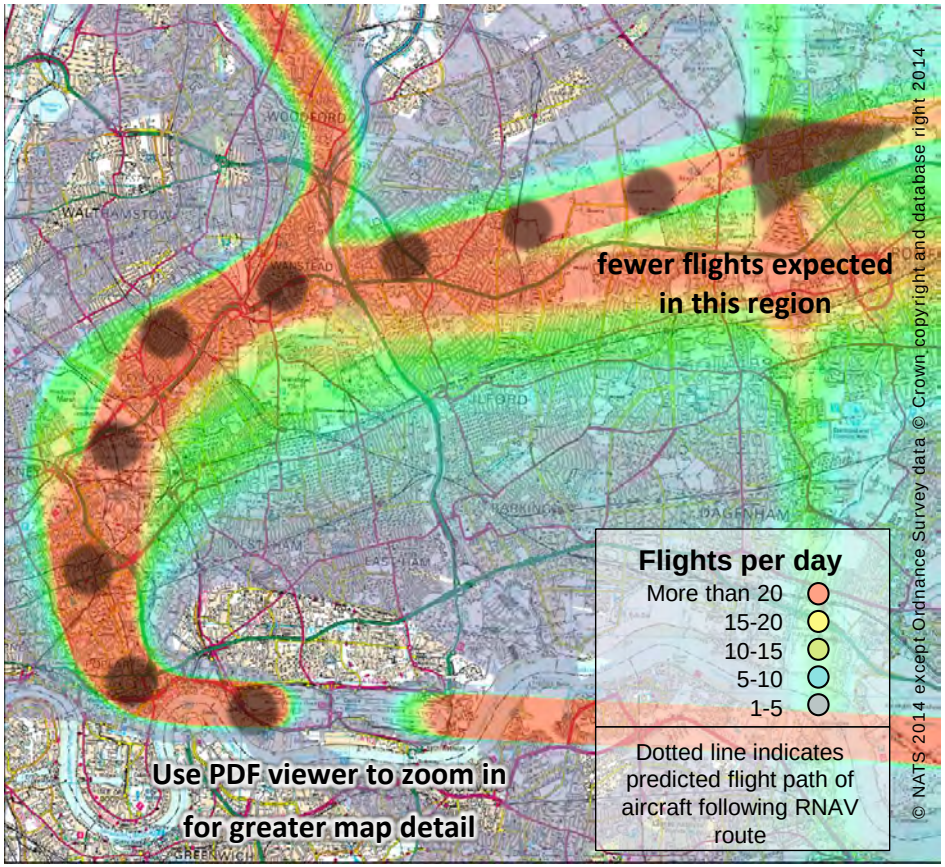


Figure 5: DVR 5T, LYD 5T Current day flight paths with indication of placement of RNAV route
(Dotted line shows the area where most flights would be concentrated)

Figure 6 RNAV simulator flight paths

5.4.2 RWY09 Departure routes to the South: DVR 5U, LYD 5U (average 69-81 flights per day for 99 days per year)

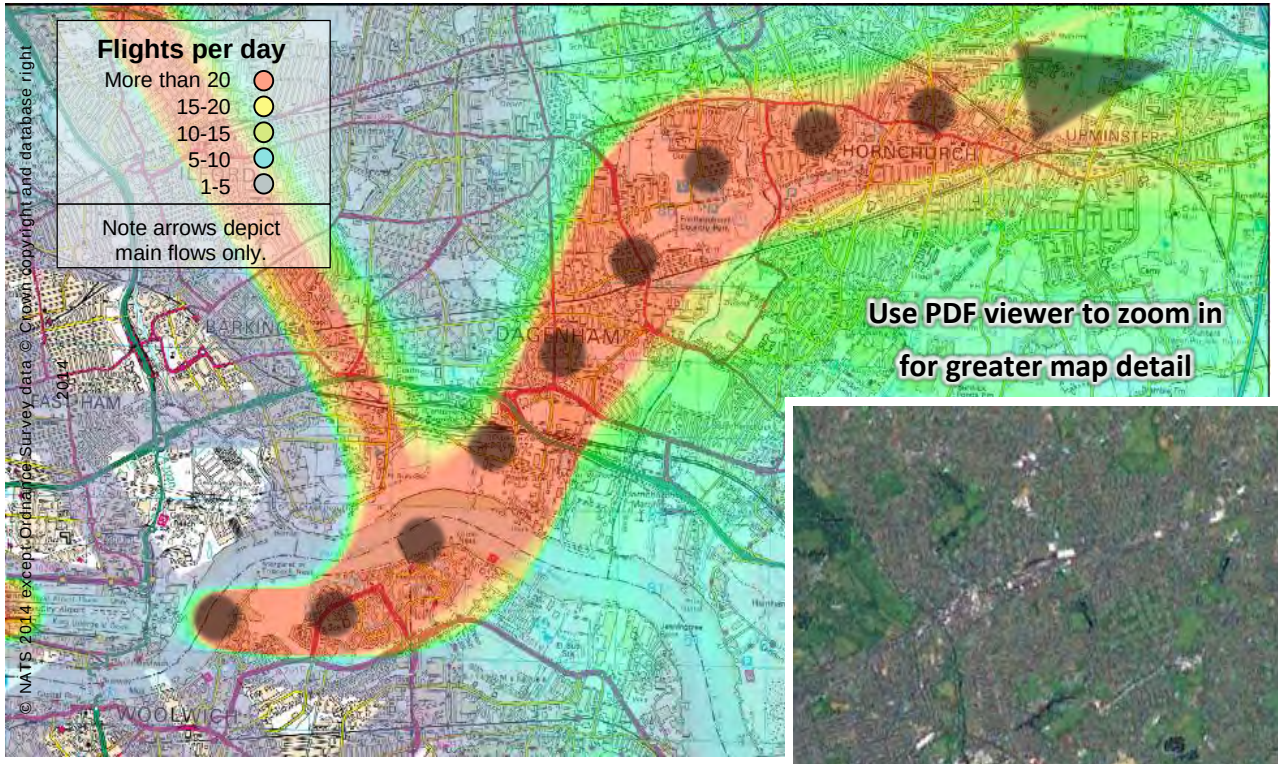


Figure 7: (Left) DVR 5U, LYD 5U Current day flight paths with indication of placement of RNAV route (Dotted line shows the area where most flights would be concentrated)

Figure 8: (Right) RNAV simulator flight paths

5.4.3 RWY09 Departure routes to the East: CLN 7U (average usage 28-33 flights per day for 99 days per year)

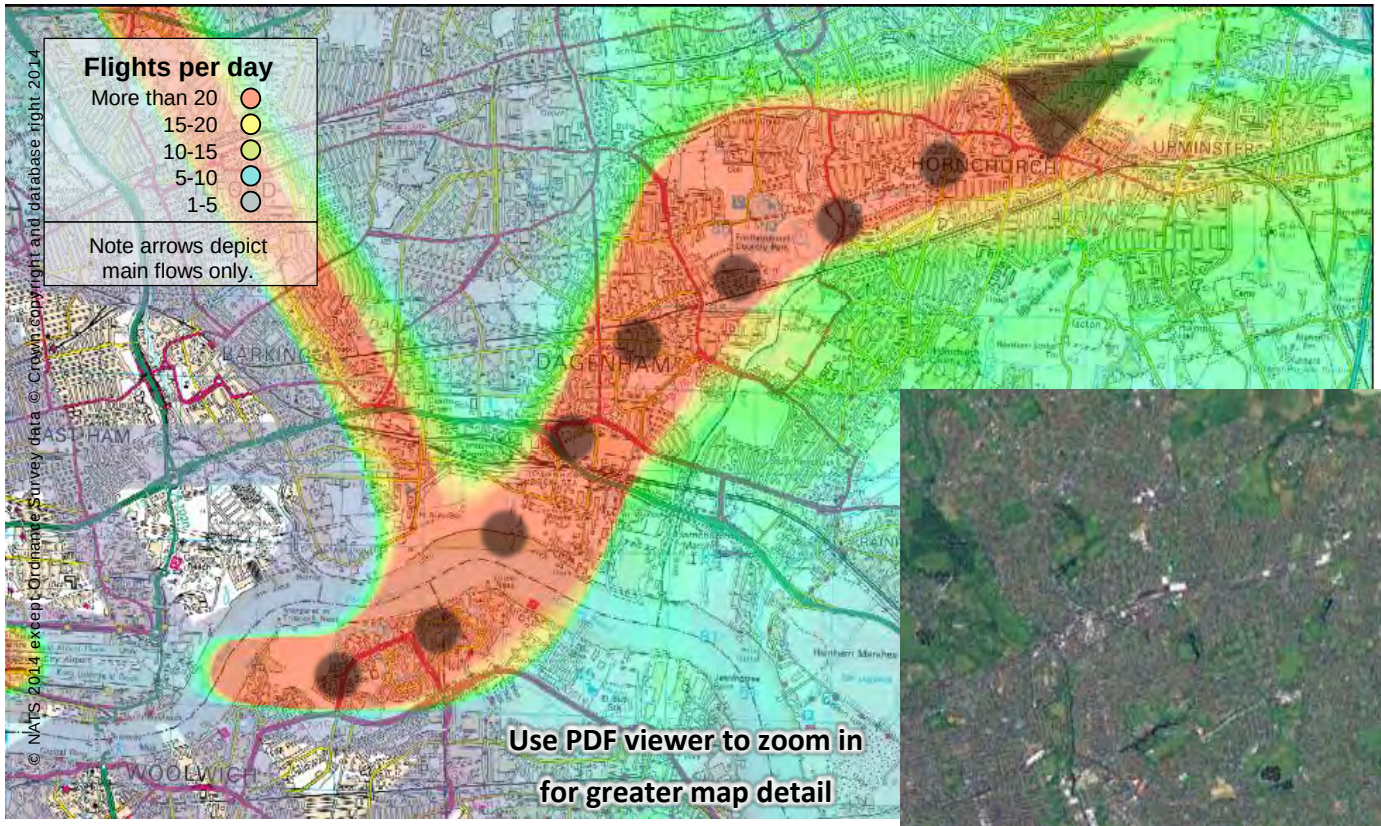
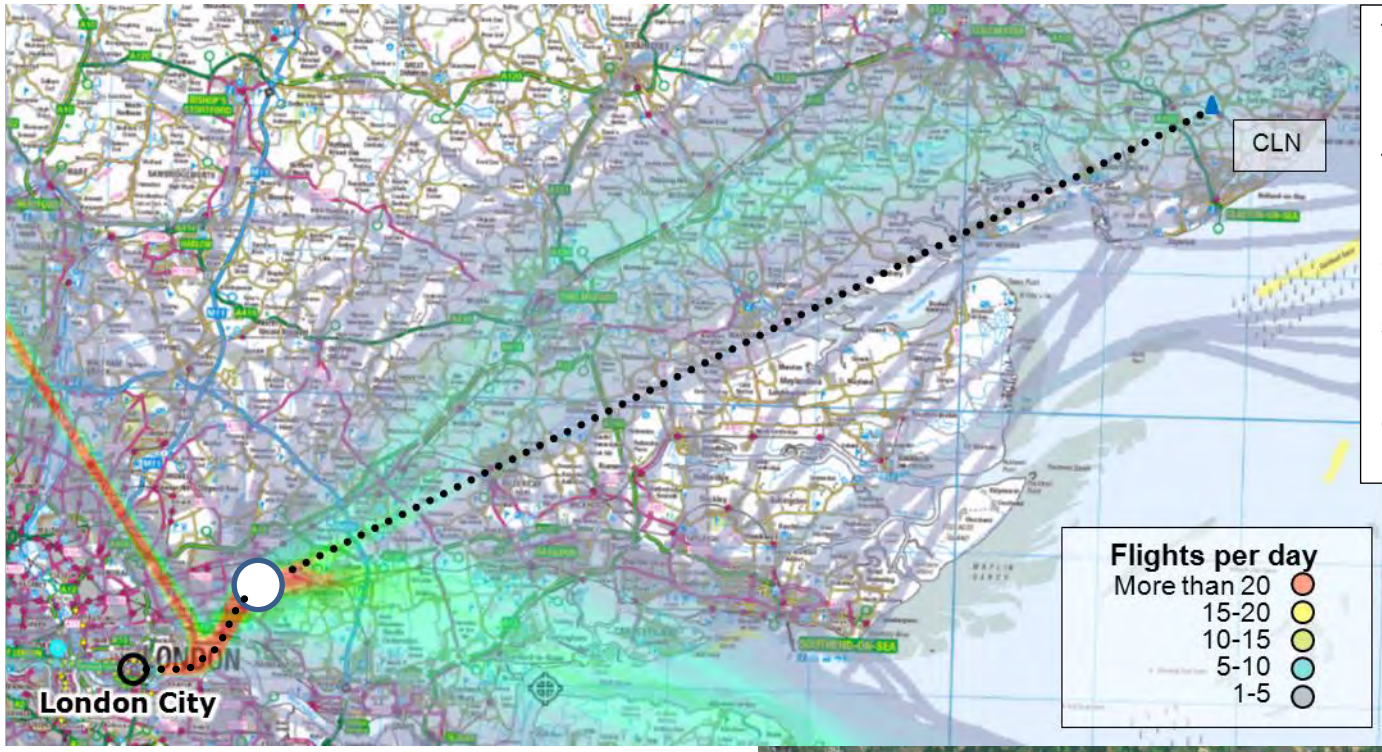


Figure 9: CLN7U Current day flight paths with indication of placement of RNAV route (Dotted line shows the area where most flights would be concentrated)

Figure 10: (Right) RNAV simulator flight paths



The portion of the route from the white dot to the north east is above 4,000ft. However, all flights in this area are taken off this route in the vicinity of the white dot. They do this to enable the London City departures to climb (e.g. up to ~10,000ft) otherwise they would be held down (at 4,000ft) beneath Heathrow arrivals and Stansted departures that pass through the same airspace. As a consequence the replication from the white dot to the routes in the vicinity of Clacton is a technical exercise and will have no impact on where aircraft actually fly.

Figure 11: CLN7U Current day flight paths with indication of placement of RNAV route (zoomed out view – same route as Figure 9 & 10)

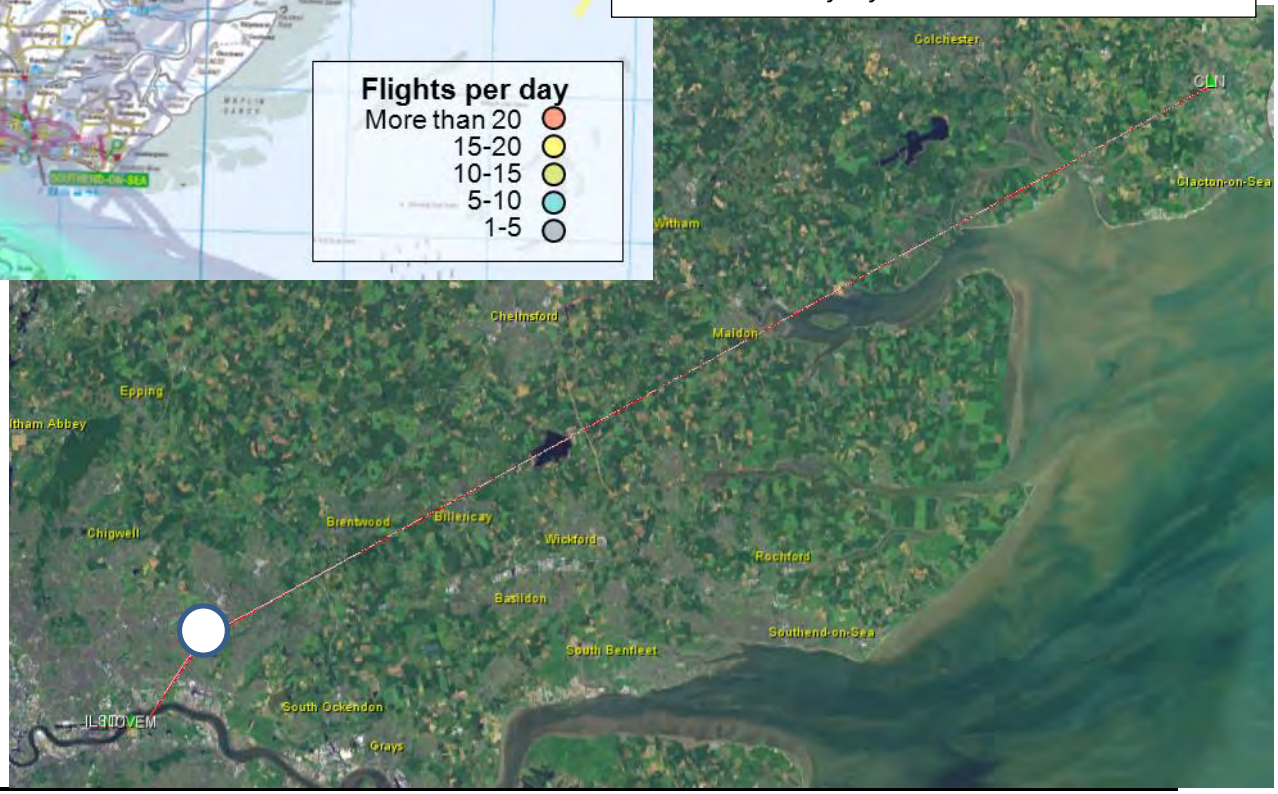


Figure 12: (Right) CLN7U RNAV simulator flight paths for the full route to Clacton.

5.4.4 RWY27 Departure routes to the East: CLN 7T (average usage 28-33 flights per day for 266 days per year)

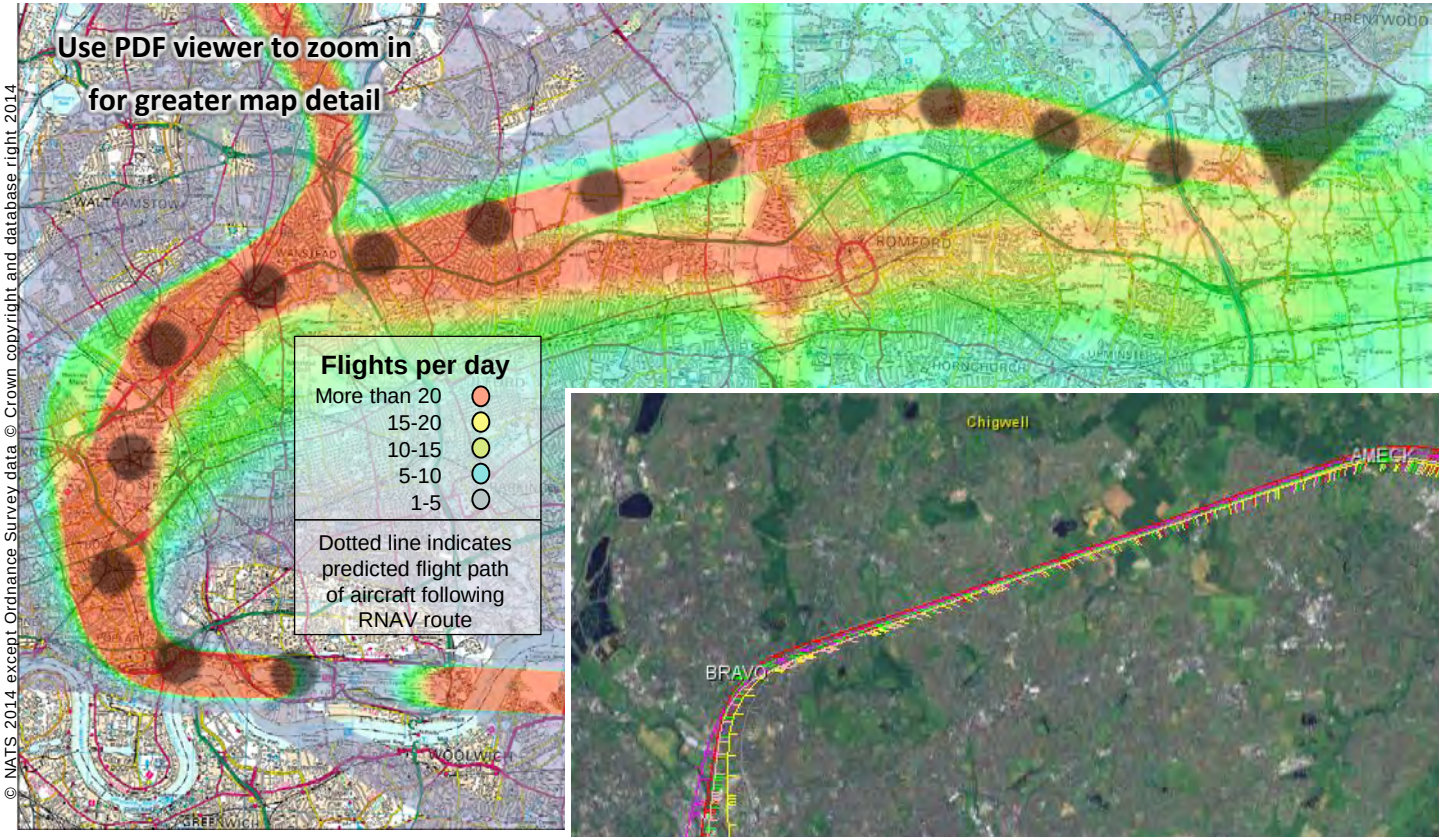


Figure 13: CLN7T Current day flight paths with indication of placement of RNAV route (Dotted line shows the area where most flights would be concentrated)

Figure 14: (Right) RNAV simulator flight paths

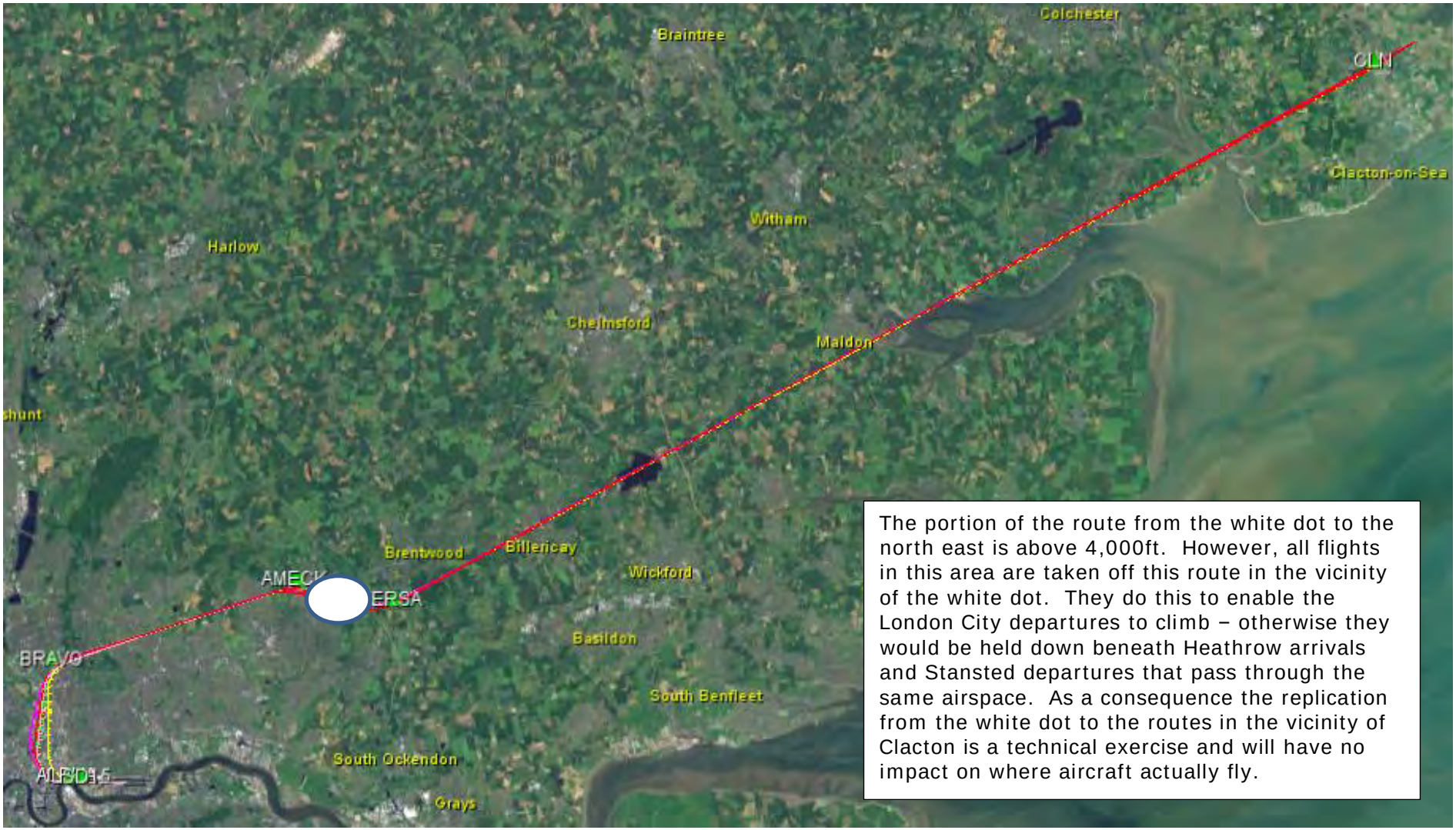
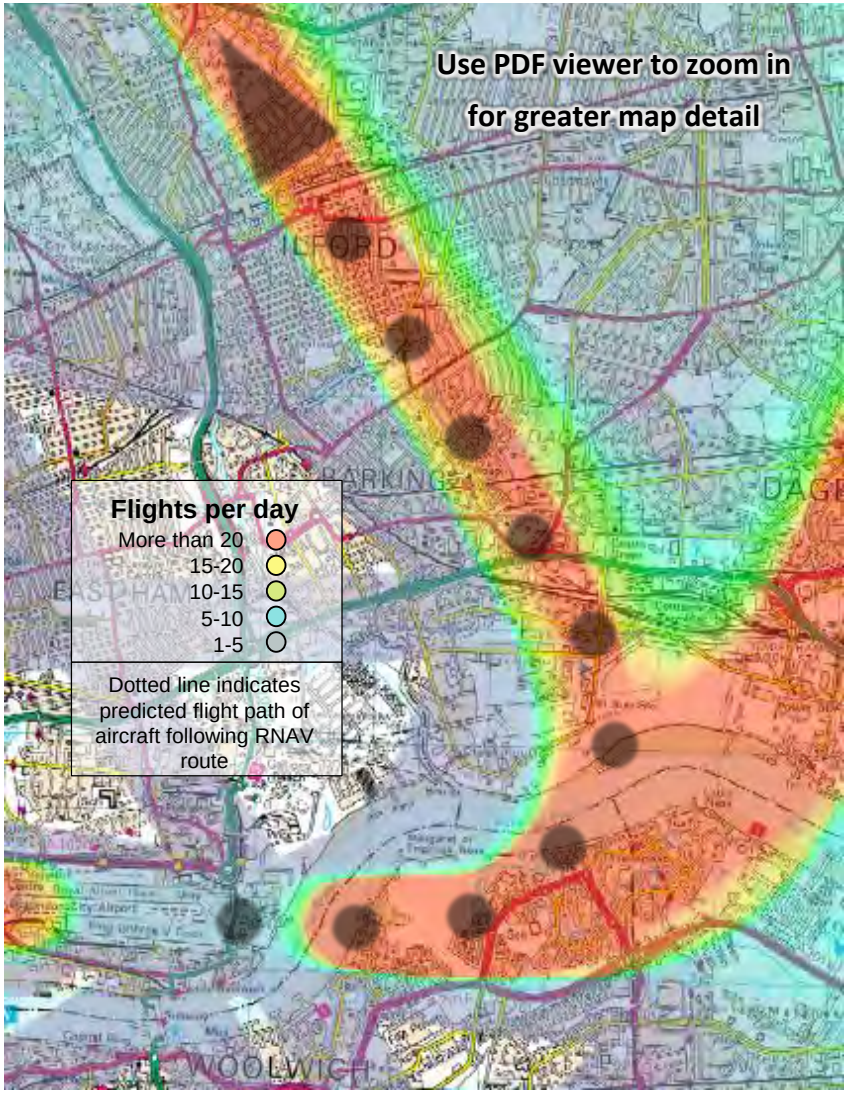


Figure 15: CLN7T RNAV simulator flight paths for the full route to Clacton. (zoomed out view – same route as Figures 12 & 13).

5.4.5 RWY09 Departure routes to the North: CPT 6U, BPK 5U (average 30-37 flights per day for 99 days per year)



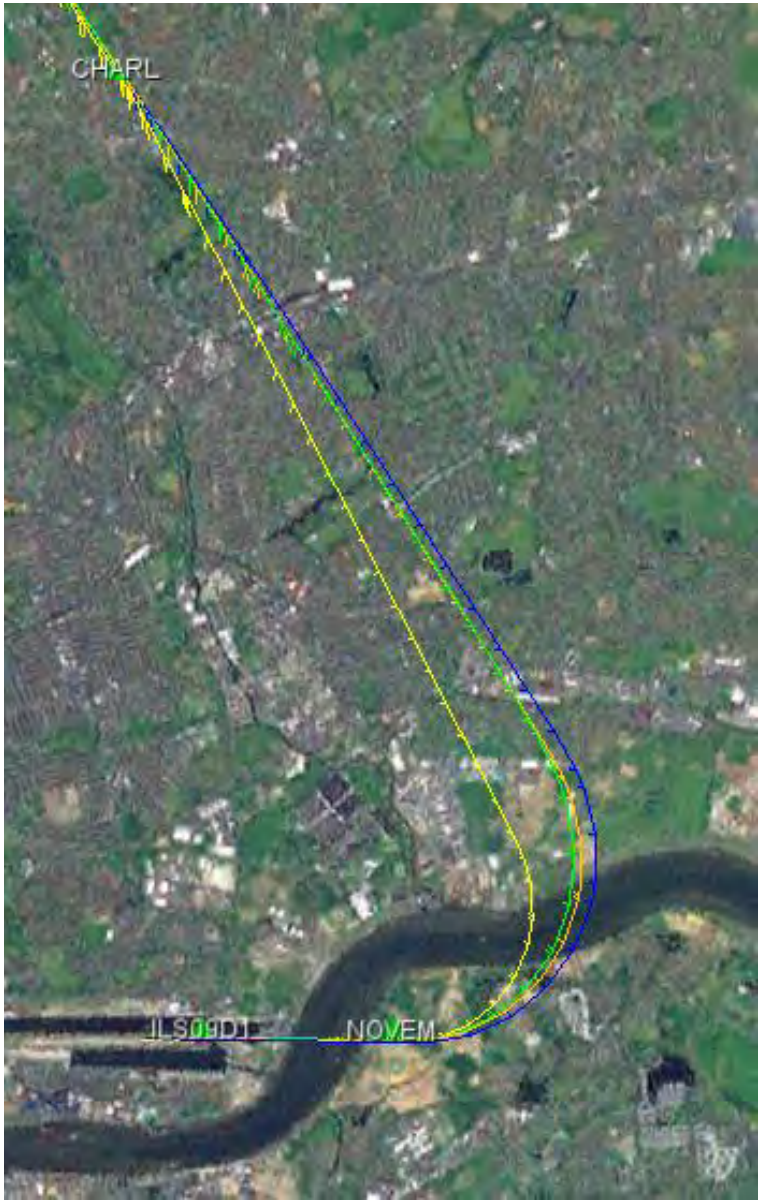


Figure 16: CPT 6U, BPK 5U Current day flight paths with indication of placement of RNAV route (Dotted line shows the area where most flights would be concentrated)
Figure 17: (Right) RNAV simulator flight paths

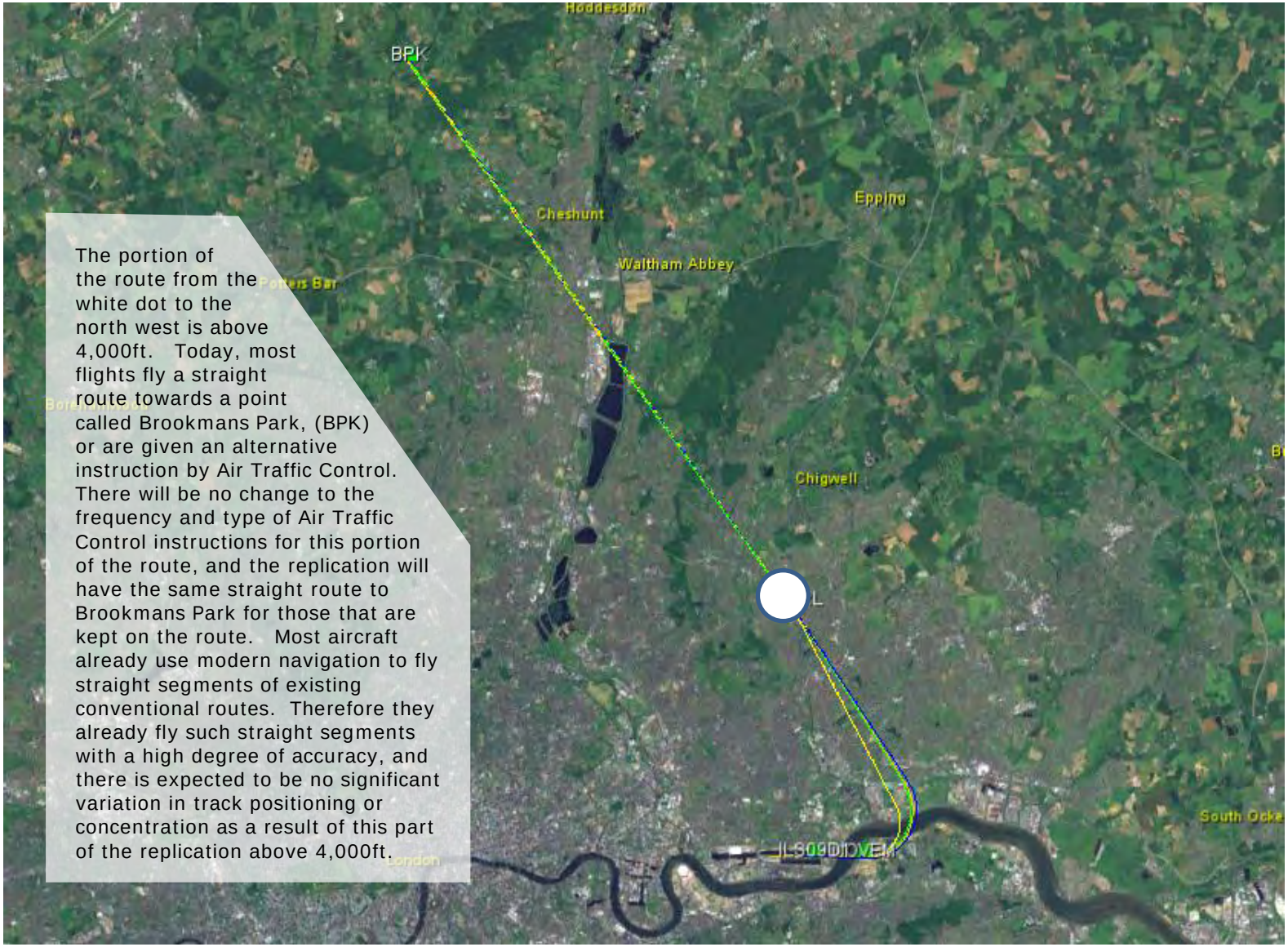


Figure 18: RNAV simulator flight paths for the full routes to Brookmans Park. (zoomed out view – same route as Figures 15 & 16)

5.4.6 RWY27 Departure routes to the North: CPT 6T, BPK 5T (average 30-37 flights per day for 266 days per year)

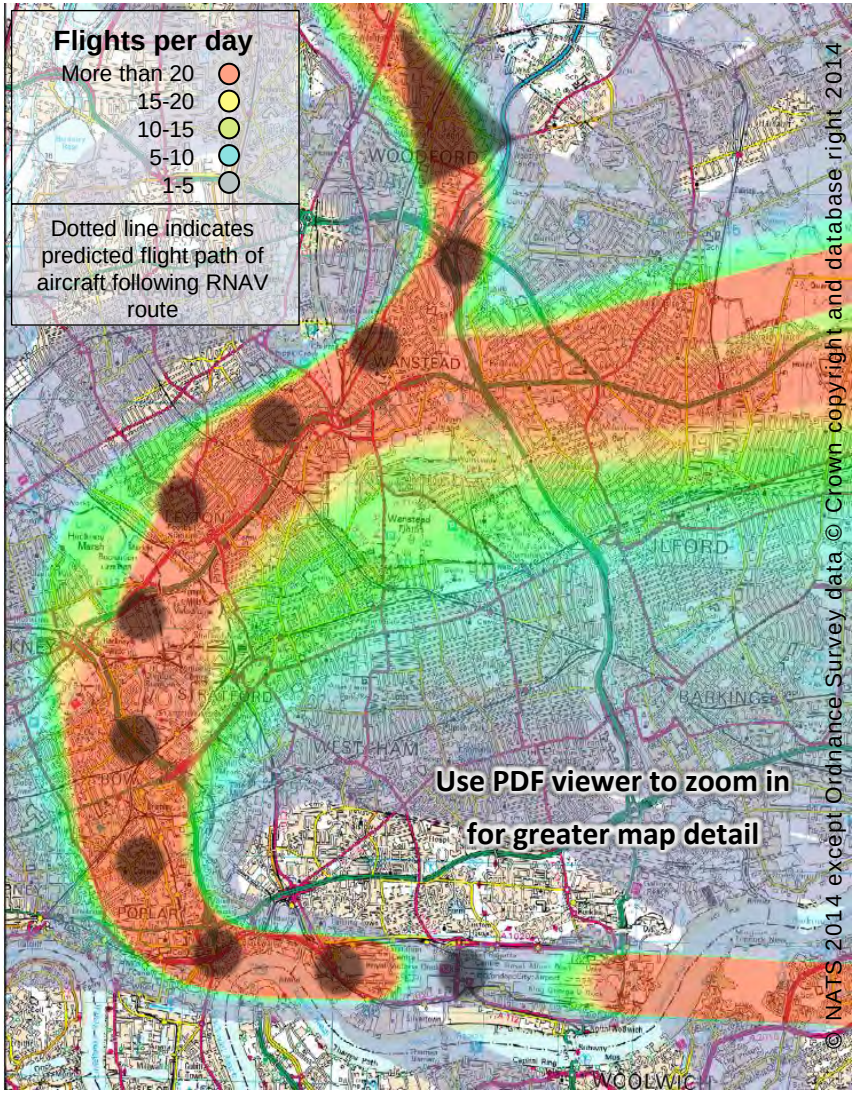


Figure 19: CPT 6T, BPK 5T Current day flight paths with indication of placement of RNAV route (Dotted line shows the area where most flights would be concentrated)

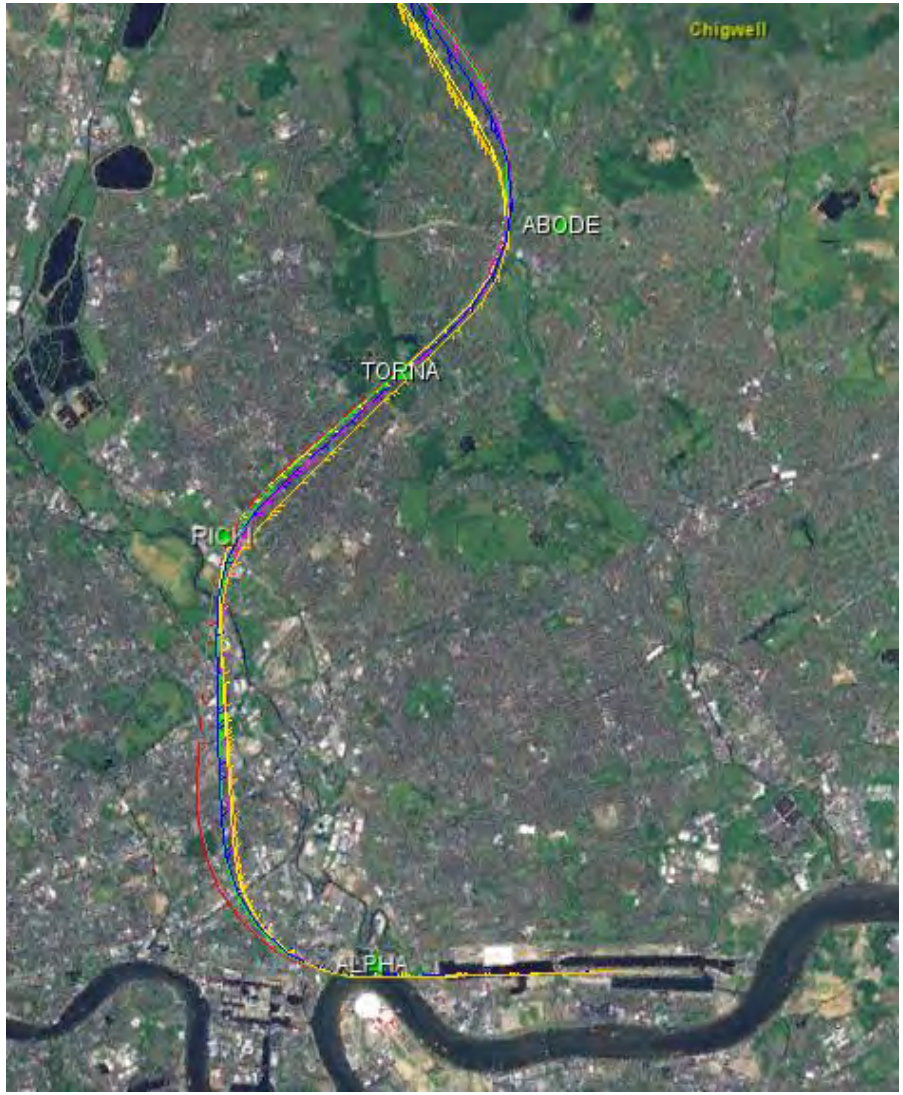


Figure 20: RNAV simulator flight paths

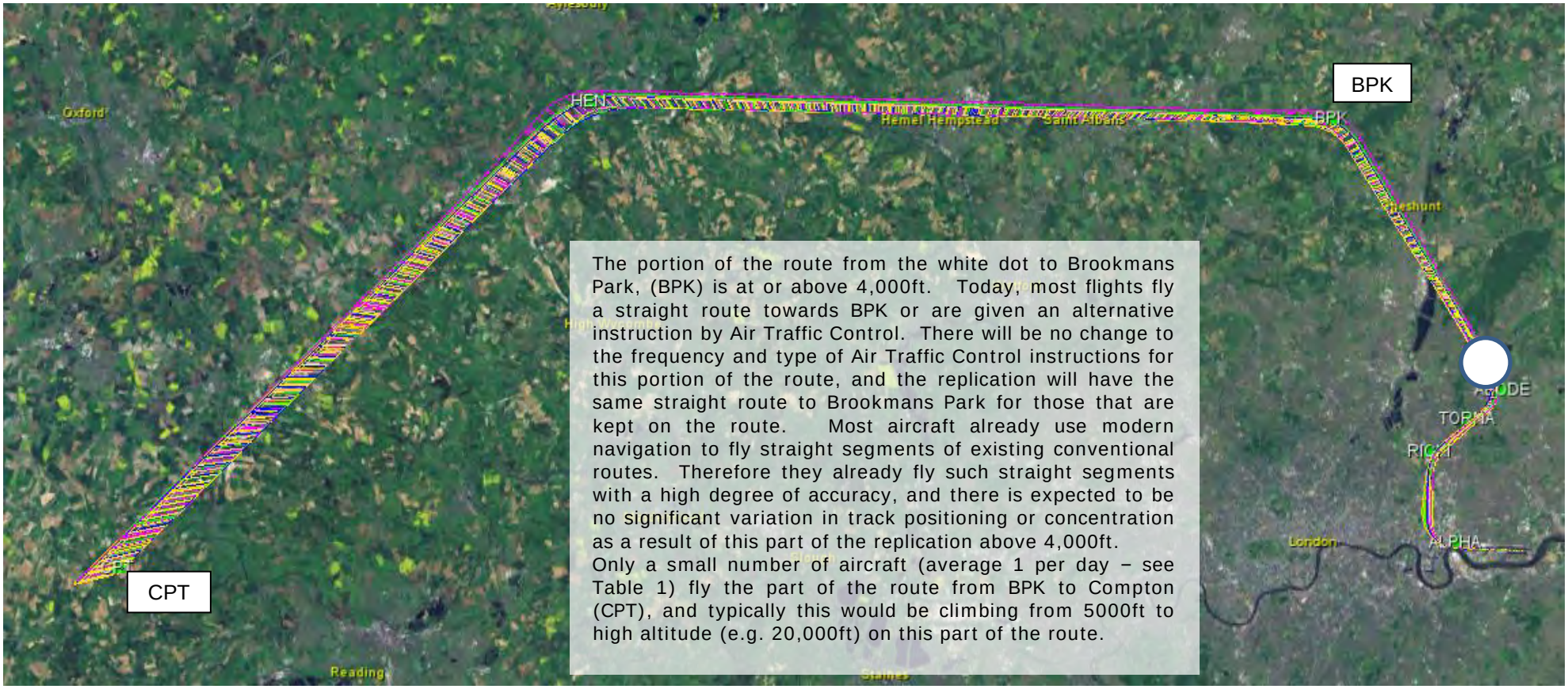


Figure 21: RNAV simulator flight paths for the full routes to Brookmans Park & Compton. (zoomed out view – same route as Figures 18 & 19)

Figure 22: RNAV simulator flight paths of all proposed RNAV SIDs

5.4.7 Runway 09 RNAV Arrivals (average 127-151 flights per day for 99 days per year)

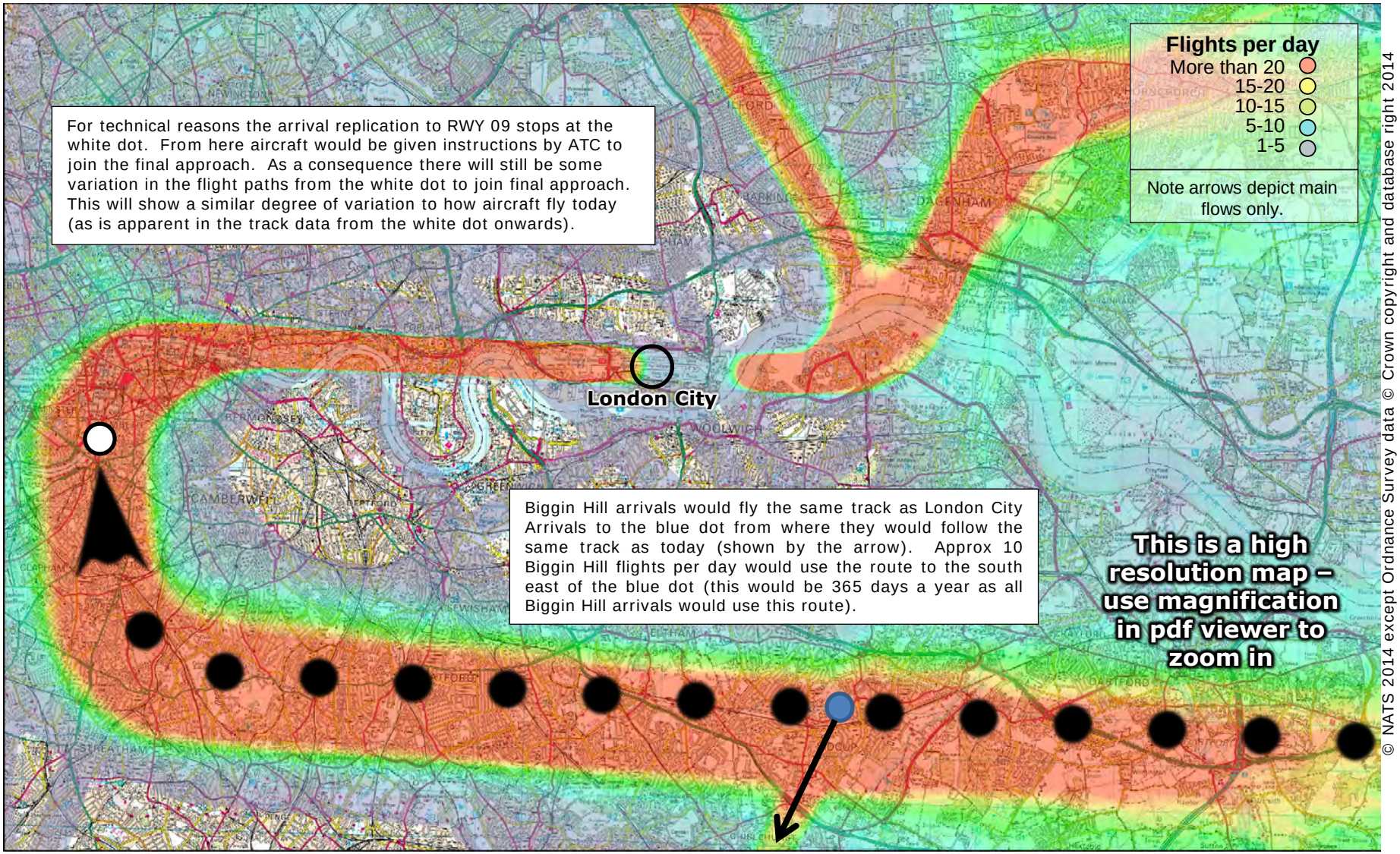


Figure 23: Arrivals to RWY09 (Dotted line shows the area where most flights would be concentrated)

Figure 24: RNAV simulator flight paths of proposed RNAV arrival route to runway 09

5.4.8 Runway 27 RNAV Arrival (average 127-151 flights per day for 266 days per year)

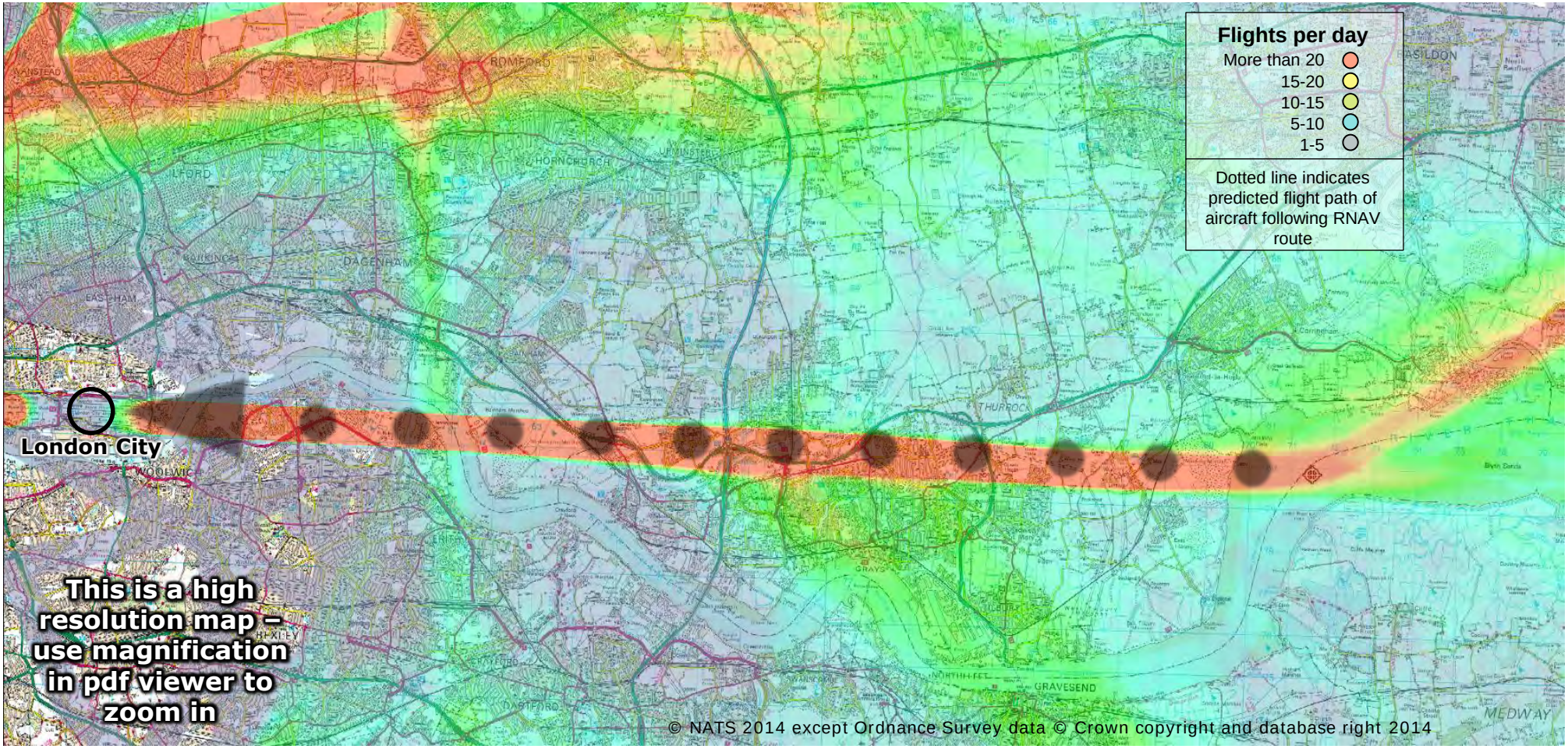


Figure 25: Arrivals to RWY27 (Dotted line shows the area where most flights would be concentrated)

Note: since the arrival route to RWY27 is simply a straight line, this has not been modelled in the computer simulation.

6 Environmental Considerations

This proposal is to replicate existing conventional routes with RNAV alternatives in line with upcoming European Legislative requirements. In accordance with the CAA policy for RNAV replication, London City Airport is not required to undertake assessment of local air quality, CO_2 or noise contours (Ref 7). This is because the effect associated with these potential impacts is expected to be small as a consequence of the objective to replicate rather than change the existing routes.

The previous sections provide pictorial comparisons of today's flight paths and the expected location of flight paths as a consequence of the replications.

Sections 2 and 3.1.1 describe how this proposal is an important enabler for wider changes to the route network over the whole of the south east which will deliver environmental and operational benefits.

6.1 Accurate Track Keeping

Aircraft using RNAV are often said to be on 'rails in the sky', i.e. they can follow a defined route accurately and repeatedly. This proposal is based upon the principal that the proposed RNAV routes will be designed to follow current aircraft tracks as closely as possible. This will avoid additional noise for areas not already subject to aircraft noise.

The use of RNAV technology enabling aircraft to fly routes more accurately does mean that over time as an increasing number of aircraft use the RNAV routes there will be an increased concentration of aircraft over certain core tracks, replacing the spread that is seen today.

The use of RNAV technology will allow an improvement of the positioning of aircraft to minimise track variation currently seen today. This increased track conformity, is in line with Department for Transport guidance on environmental objectives. (Aviation Policy Framework, Section 3.31 (Ref 5)) which embodies the Government guidance that it is desirable to concentrate aircraft along the fewest possible number of specified routes in the vicinity of airports. This will however represent a change in noise and visual intrusion impact. Typically locations either side of the routes will be overflown less and will be exposed to less aircraft noise, while locations close to the route centreline will be overflown more, and hence will be exposed to more aircraft noise.

6.2 Improved Descent Planning

When flying RNAV approaches, pilots have more certainty regarding the distance left to run before reaching key points in the approach. This enables them to plan their descent such that they are able to stay higher longer and to execute smooth continuous descents. This can save fuel, reduce CO_2 emissions, and reduce noise impact[11]. However these benefits are small and not easily quantified. The proposed change is not justified on the basis of these benefits and hence no analysis is required (see Ref. 7).

6.3 Noise

Due to the nature of replication there is no requirement to undertake noise modelling for this proposal. This is in line with the Future Airspace Strategy and CAA Policy requirements for replication (Refs. 6 & 7).

[11] Aircraft flying higher are quieter. Aircraft descending smoothly with reduced power settings are quieter than those having to descend then level off, which requires changes to the power settings which produce tonal changes in engine noise which are particularly noticeable to stakeholders on the ground. Smooth descents at reduced power settings requires less fuel/CO_2

7 How Do I Respond?

London City Airport requests that you consider this proposal and if necessary provide a written response. In accordance with the CAA airspace change process, a period of 12 weeks has been allowed for this stakeholder consultation. Where possible an early response would be appreciated so that any issues arising may be addressed as soon as possible.

The closing date for replies associated with consultation issues is **27th November 2014**.

You may wish to consider the following questions:

If you are an aircraft operator -

- Do you operate within the area in question?
- If yes, would the proposals benefit your operation now or in the future?
- Are there any unintended consequences of the proposed changes, of which you feel London City Airport should be made aware?

If you represent a local council or if you are a local resident –

- Are there any unintended consequences of the proposed changes, of which you feel London City Airport should be made aware?

This consultation will be primarily managed by email, however postal responses will be accorded identical status and processed in the same way.

7.1 Via Email

Please compose your response in the following format:

To: Lamp@londoncityairport.com

Subject: London City Airport RNAV Replications

First line of text:
"I am responding on behalf of [name of organisation/local council]"
or "I am responding as a member of the public"

Second line of text: [Agreement to pass on personal details to the CAA, for Data Protection Act compliance]:
"I/We agree/do not agree that personal details contained within this response may be sent to the CAA as part of the Airspace Change Proposal"

Third line of text: Your formal response, one of the following:
"I/We support the London City RNAV Replication proposal"
or "I/We object to the London City RNAV Replication proposal"
or "I/We have no objection to the London City Replication proposal"

Subsequent text:
Please state the reasons for your response, i.e. the reasons why you support or object to, the proposal.

7.2 Via Postal System

Please compose your response in the above format (Section 10.1), and send it to:

RNAV Replications Consultation Co-ordinator
London City Airport
City Aviation House,
Royal Docks,
London, E16 2PB

If you wish to submit a formal response to the consultation please use the contact information above marking clearly on your correspondence **'Response'** i.e. placing it in the subject line of the e- mail or letter reference and the name of any organisation or group you may be representing. Please include your contact details in case we need to contact you on any aspects of your response as appropriate.

The list of stakeholders in Appendix A is considered to be the most appropriate list of respondees but anyone can comment and feedback is requested from all.

7.3 If I have no comment to make on the proposal, do I need to do anything?

If you have no comment to make on the proposal, as a representative of an organisation **we would still like to know**. Please send your email with **'No Comment'** in the email subject line or letter reference, again stating your name and/or organisation you represent.

7.4 What happens to the responses to the consultation?

Responses to the Consultation are used to prepare a formal submission to the CAA SARG regarding proposed routes.

Responses to the consultation will be analysed to identify the key concerns of respondents and how these may be addressed. Where concerns can be addressed by making changes to the overall proposal, whilst still protecting the integrity, purpose and benefits of the proposal, these will be made and incorporated into the formal submission to the CAA SARG; any significant changes to the proposal may extend or restart the consultation process.

7.5 When does the CAA SARG decide on the outcome of the consultation?

Following consultation London City Airport will submit an Airspace Change Proposal (ACP) to the CAA. The CAA will make a decision within 16 weeks of the submission of the ACP. This is expected to be during the summer 2015.

7.6 Can I have copy of the consultation results?

A summary report including feedback of this consultation will be added to the website www.londoncityairport.com/londonairspacemanagement . This will be published shortly after the consultation closes.

7.7 What is the consultation not about?

The scope of this consultation is to gather the views of stakeholders and any interested parties regarding the implementation of precise navigation routes (RNAV) to replicate the existing aircraft tracks.

This consultation is not about: RNAV as a future tool; any other or future development; any aspect of Government airport or airspace policy; or the establishment of controlled airspace.

Comments in responses not directly related to the London City Airport RNAV replications proposal will be discounted from the analysis.

7.8 Who monitors the consultation and where can I go if I have concerns regarding how the consultation is being carried out?

This consultation is being conducted by London City Airport. The CAA SARG will oversee the consultation, to ensure that it adheres to the process laid down in CAP 725 (Ref 1) and government guidelines (Ref 3). If you have any complaints about how this consultation has been conducted, these should be referred to:

Airspace Business Coordinator
Airspace, ATM and Aerodromes
Safety & Airspace Regulation Group
CAA House
45-59 Kingsway
London
WC2B 6TE E-mail: airspace.policy@caa.co.uk

Please note that this address is for concerns and complaints regarding non-adherence to the defined consultation process. The SARG will not engage with consultees on details of this consultation. Response to the nature of this specific consultation should be addressed to London City Airport. The SARG will receive details of your response as part of the formal ACP submission for this proposal. (see 'Confidentially' below).

7.9 Will my query/response be treated as confidential?

The CAA requires all consultation material, which includes copies of responses from all key stakeholders, to be included in any formal submission. If you do not want your name and address details to be passed to the CAA, you may opt out using the appropriate text as per the template response given in section 7.1.

Apart from providing details to the CAA, London City Airport undertakes that personal details or content of responses and submissions will not be disclosed to any third parties without prior permission.

8 What happens next?

This consultation has been circulated to stakeholders who it is envisaged may have an interest in the proposed change. This includes aviation and non-aviation stakeholders which have been identified and agreed as appropriate with the CAA. The list of stakeholders can be found in Appendix A.

Following the consultation guidelines provided by the CAA, consultees will be provided with 12 weeks to consider and respond to the proposal.

Shortly after the consultation period closes, a feedback report will be published on the London City Airport website (www.londoncityairport.com/londonairspacemanagement). This will include summary details of the main issues that have been raised by stakeholders during the consultation period.

Once the consultation has been completed and any issues arising have been dealt with accordingly, London City Airport will submit a formal proposal for RNAV Replications to the CAA. It is a requirement of the consultation process that London City Airport provide the CAA with full details of the Consultation (including copies of responses and correspondence) together with all documentation necessary for the promulgation of the proposed route replications.

The CAA will then review the proposal (which can take up to 17 weeks) and reach a Regulatory Decision. If the proposal is approved, the implementation process could take a further twelve weeks. The target date for the RNAV routes to come into operation is 10th December 2015.