London Southend Airport Flight Path Consultation

Consultation Concerning the Introduction of New Approach Procedures

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Executive Summary

This consultation is about the introduction of new approach procedures at London Southend Airport (LSA), and the impact they may have.

The procedures that we are seeking to implement do not replace any existing procedures, instead they offer an alternative type of route onto final approach for aircraft operating into LSA. The final approaches themselves would not change – this consultation is about a new way for aircraft to join the final approaches.

LSA is following the CAA's process CAP725 'CAA Guidance on the Application of the Airspace Change Process' to introduce these procedures. This consultation is part of that process.

The procedures that are being proposed are known as Performance Based Navigation (PBN) and rely on newer technology which allows aircraft to reliably follow air routes with a greater level of accuracy than they do today.

The implementation of PBN at LSA is consistent with the Government's objectives to improve the efficiency of the UK airspace network and to mitigate the environmental impact of aviation as part of the Future Airspace Strategy.

It is expected that there will be a gradual migration towards the use of these procedures but it is difficult to provide any firm/ accurate timescales for this. However, there would be no change to the final approaches themselves, within about 7 nautical miles[1] from the runways.

The procedures have been designed to reflect as closely as possible existing routings flown by aircraft on approach to LSA. Where this hasn't been possible, environmental, operational and procedure design criteria have been taken into account throughout the design process.

The consultation begins at 16:00 on Tuesday 6th June 2017 and ends at 23:59 on Wednesday 13th September 2017 a period of 14 weeks.

Details on how to participate in the consultation are provided in Section 2 & 7.

This document describes LSA's proposal to replicate, implement and (as technology dictates) migrate over time the current routes to join final approach with more accurately defined flight paths utilising the improved capabilities of modern aircraft. These new capabilities are known as 'Performance-Based Navigation', or PBN. A more detailed overview of PBN is available at Appendix A: Technical Details.

[1] A nautical mile is the standard unit of measurement for aircraft. It is 1,852 metres, slightly longer than a statute 'road' mile of 1,609 metres.

We are seeking your views on our preferred options for these flight paths which aim to replicate as closely possible the routes flown by aircraft today. Where that is not possible, we have looked to minimise noise impacts and/or the numbers of people overflown.

This document has been designed to provide information you may need to understand the consultation, to gain an insight into how and why the routes have been designed the way they have and the process involved in giving us your views. We have included information for each of the preferred arrival flight path options, as well as details on those options which were considered but then deemed inappropriate or less suitable.

Some of the details may be considered technical in nature but a plain English explanation is always given as we feel that it is important that all of the information is available in one document, to those who may require it.

Section 1 briefly introduces PBN technology how it will be used, and its potential benefits.

Section 2 explains why this consultation is required, covers what the consultation is and is not about and details the stakeholders with whom LSA is consulting and explains how they can get involved in the process.

Section 3 provides an overview of current operations at LSA, including diagrams illustrating current tracks over the ground by aircraft approaching LSA with indicative height information to provide a complete picture for today.

Section 4 sets out the proposed PBN routes, which are designed to either replicate the current tracks or minimise noise exposure where LSA has deviated from them.

Section 5 sets out environmental considerations.

Section 6 considers design and routing options and their evolution, explaining why certain options were discarded in the process.

Section 7 sets out how stakeholders should respond to the consultation and explains what will happen next.

1 Justification for PBN Routes

The airspace route network in the UK is predominantly based on 'conventional navigation' whereby required routes are aligned to ground based navigation aids. However, without standardisation of how aircraft interpret the conventional route structure, the tracks currently flown by different aircraft and operators on the same route can vary. Route variation also occurs where air traffic controllers manually direct aircraft (known as tactical vectoring, giving the pilot a heading and altitude to fly) in order to safely and efficiently move them through the airspace.

With modern technology, most commercial aircraft flying in the UK have the potential to use what is termed Performance Based Navigation (PBN). This technology gives aircraft the ability to follow a route with an even greater level of accuracy than they do today.

LSA has identified an opportunity to introduce PBN for the routes aircraft use to join final approaches, using European funding as part of a push by the EU to modernise the air route system. This is part of a phased implementation of PBN into UK and European airspace as a whole and is consistent with the Government's objectives to improve the efficiency in the UK airspace network and to mitigate the environmental impact of aviation.

This proposal will introduce advanced PBN arrival procedures to complement the current arrival flight paths at LSA, replicating where possible these existing route alignments. However some of the technical design criteria mean that, in some places, LSA cannot precisely follow the current flight paths. Where this is the case we have used the greater navigational accuracy of PBN to try to reduce the number of people overflown. In essence we have maintained current flight paths where possible and minimised the number of new people impacted.

In some instances an obvious improvement to aircraft flight paths has been possible; enabled by the improved track keeping of aircraft using PBN procedures. Where we have taken these opportunities, some deviation from current flight paths has occurred even where it would have been possible to replicate the existing tracks.

1.1 What will PBN Routes Achieve?

The use of PBN will enhance navigational accuracy and introduce a number of key benefits. These include: a safer and more efficient Air Traffic Control (ATC) system requiring less controller intervention; more efficient operations leading to reduced cost, flying time and greenhouse gas emissions; and the ability to allow more predictable patterns of over flight as well as stabilised arrivals and approaches which should generate less noise.

By giving pilots a defined flight path from beginning to end they can plan a descent which avoids level segments, optimises power settings and speed in the descent, configures the aircraft for minimum noise, reduces fuel burn and keeps the aircraft higher over the ground for longer.

The benefits of PBN technology are well documented by the CAA[2].

An aircraft must be certificated as having the appropriate navigation systems and flight crew procedures before it can fly PBN routes. The operation of the Air Traffic Management system beyond LSA will also affect the likely take-up of PBN procedures in the immediate future. It is the case therefore that ATC at LSA will still interact with arriving aircraft on a flight by flight, tactical basis, creating a spread of aircraft tracks, similar to that experienced now.

This is not predicted to change significantly in the short term, until new arrival management tools are implemented on a pan-European basis. However, over time, as technology across the UK and Europe shifts towards PBN, the new routes will become the primary inbound paths flown by the majority of aircraft arriving at all major UK airports; which includes LSA.

The implementation of PBN at LSA is consistent with the Government's objectives to improve the efficiency of the UK airspace network and to mitigate the environmental impact of aviation.

1.1.1 Our Aims for Modernising the Airspace

We seek to complement our current arrival routes, taking advantage of the improved navigational capabilities of PBN to introduce additional route options which, where possible, minimise the impact to people on the ground. This is especially true in any area where we need to deviate from today's aircraft tracks. The benefits of PBN and the UK's future direction regarding air travel navigation are explained in the UK Civil Aviation Authorities Future Airspace Strategy document[3].

Although for the most part we are placing the new tracks along the same routes as the current aircraft tracks, there are small areas of difference, and it is with these divergences that we have paid particular attention in trying to minimise the numbers of people overflown, especially those below 4,000ft. Where we must change a flight path, we seek to minimise the population impacted under the route.

Aircraft will follow PBN routes more consistently than the arrival routes they fly today. This is due to the improved track-keeping ability of PBN. Improved track keeping means that there will be less dispersion of aircraft either side of the route; this would mean a reduction in the overall area regularly overflown, but an increase in the concentration of over-flights in some areas.

[2] https://www.caa.co.uk/WorkArea/DownloadAsset.aspx?id=4294976459
[3] https://www.caa.co.uk/fas/

While PBN routes are flown more accurately they also open up the possibility of designing route configurations to specifically address local environmental issues, such as placing the flight path to avoid heavily populated areas. This consultation shows all of the route options that have been considered, and explains how the preferred route position has been selected.

The new PBN routes would, in some instances, represent a change to the current published routes. For this reason LSA has a duty, as prescribed by the Civil Aviation Authority, Safety and Airspace Regulation Group[4] (CAA, SARG), to consult on any proposals for new routes.

The airspace change process as prescribed by the CAA and as followed by LSA is covered in CAA Publication CAP724(5) & CAP725(6).

[4] The CAA is the UK's independent airspace regulator.
[5] http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=366
[6] http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=395

2 Consultation

2.1 What is this Consultation about?

This consultation only concerns aircraft arriving at LSA. It does not concern departures.

This change would introduce additional arrival routes to complement those already in operation and these additional routes are designed to replicate where possible the flight paths being flown today.

These additional routes would bring aircraft to the final 'straight in' approach for both runways (approximately the last 7nm). After aircraft are aligned with the runway they would follow the same final approach path as today.

The final 'straight in' portion of the approach is not the subject of this consultation. See Section 2.2 below.

2.2 What is this Consultation **not** about?

This consultation is not related to air traffic growth or the airport's growth in general.

This is a consultation in line with Government and CAA guidance. We value all feedback, however this consultation is not a referendum and as such this consultation is not looking to establish the most popular routes.

Instead it presents routes which have been carefully designed to balance the twin values of minimising new noise disturbance to people currently not affected with a reduction, where possible, of the noise experienced by those currently affected. The proposed routes also balance optimised route lengths and descent profiles whilst providing improved predictability for aircraft operators.

Your responses should highlight key issues within the route designs presented which you feel could have a fundamental impact on the proposals.

Government policy regarding the change to Performance Based Navigation (PBN) is outside the scope of this consultation. This consultation is not about PBN as a future tool, any other or future development, any aspect of government or airspace policy, or the establishment of controlled airspace.

We regret that comments and responses not directly related to this consultation will be classed as 'out of scope' of the consultation and will not be considered for the purposes of this change.

2.3 Who is being consulted?

LSA is consulting with many national and local bodies as well as local councils, residents' representative groups and MPs.

These can be broadly grouped into:

- NATMAC – National ATM Management Advisory Committee
- National/Local Bodies/Groups/Organisations
- Airlines/Airfields/Flying Clubs/Private Jets/All Airspace Users
- Kent Councils
- Essex Councils
- MPs

A full list of stakeholders is available at Appendix B: List of Stakeholders

2.4 Why should you participate?

LSA believes that the routes presented here offer the best compromise between efficiency and environmental impact. However we would like you to take the time to read this document, to examine the proposed routes and to consider these routes in the context of where aircraft currently fly.

We would like to hear from if you have an opinion on this change. We especially want to hear from people and organisations who feel they will be affected by the change, either negatively or positively and we want to hear from you even if you do not believe you will be affected (or do not have a strong opinion on the change). To know that we have reached our neighbours and stakeholders and informed you of our plans is very important to LSA.

Section 7, How do you participate? gives full details on how to submit your comments to this consultation.

Diagrams of the current aircraft tracks and the proposed routes are contained within the document (see Sections 3 & 4) to enable you to make the most informed decision possible and to respond accordingly. It is entirely likely that many aircraft will continue to use the existing routes alongside the new routes as the UK airways system and the aircraft operators adopt and adapt to the new technology. All such circumstances are explained within this document.

LSA has followed government guidance to minimise new noise exposure to new people and where possible has taken existing routes away from heavily populated areas. However there are technical constraints which limit how the routes can be designed. Again, these are explained within this document.

3 Current Aircraft Operations at London Southend Airport

3.1 London Southend Airport Airspace

London Southend Airport (LSA) is situated to the east of, and is overflown by, some of the busiest and most complex airspace in the world. It is affected by flights to and from the major airports of Stansted, Luton, London City, Gatwick and Heathrow (see Figure 1).

The consequence of LSA being positioned in such close proximity to these other London airports is that it sits underneath their traffic flows. Figure 2 shows the departure and arrival traffic from London City and Stansted (the airports which affect LSA to the greatest extent). When the traffic flows for the other airports are added (not illustrated) the picture becomes extremely busy.

LSA sits underneath the London Terminal Manoeuvring Area (LTMA) airspace. The LTMA comprises layers of 'controlled'[7] airspace used by air traffic controllers to manage the flights of LSA and other airports. These layers of LTMA airspace dictate the vertical and horizontal extent of LSA's own airspace, as can be seen in Figure 3. The area in which LSA is situated sees the LTMA rising from 3,500 feet to over 20,000 feet with LSA's airspace stepping up underneath this. See Figure 4 for an image detailing the lateral and vertical extent of LSA airspace.

Military danger areas abut that of LSA, further restricting our airspace, as well as densely populated areas and the Kent Downs Area of Outstanding Natural Beauty (AONB) to the South (see Figure 3).

[7] 'Controlled' airspace is airspace where every pilot must obey commands issued by air traffic controllers. In 'uncontrolled' airspace, pilots may fly where they like, subject to very basic air rules.

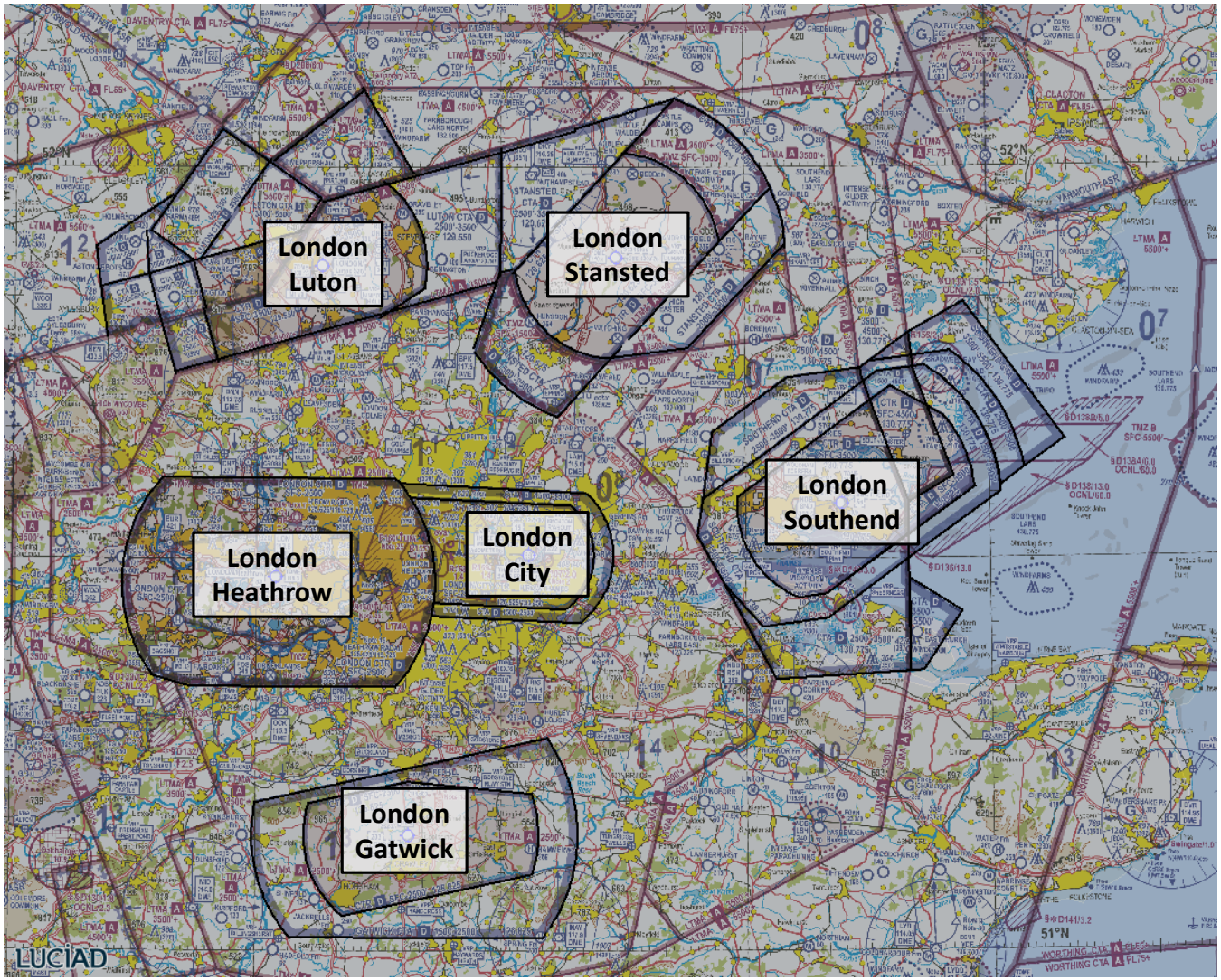

Figure 1: London's major airports and their associated Controlled Airspace

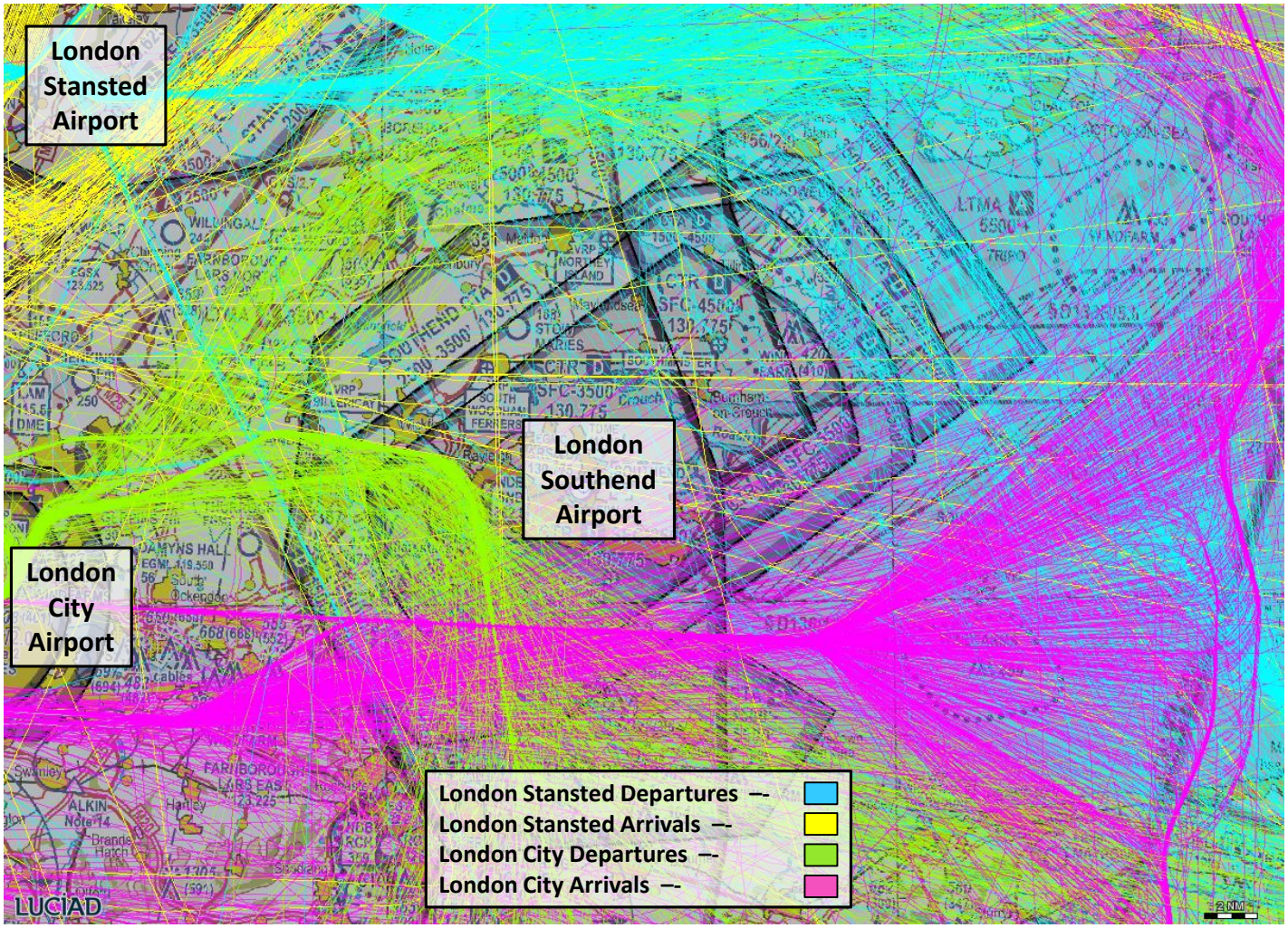

Figure 2: London Stansted & London City arrivals and departures over LSA and surrounding area (one week, August 2016)

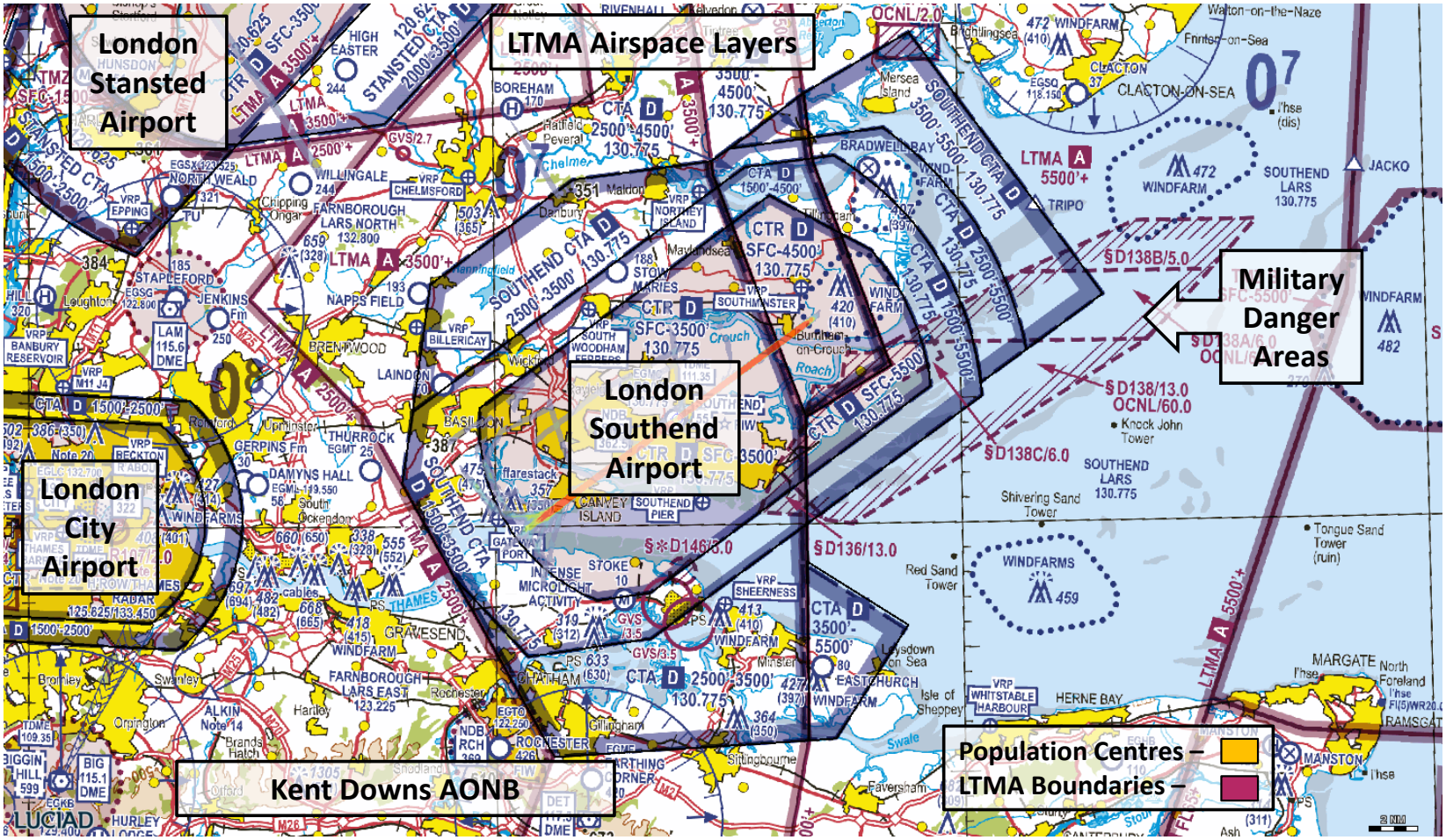

Figure 3: LSA Controlled Airspace with Military Danger Areas, restricted airspace, population centres & AONBs

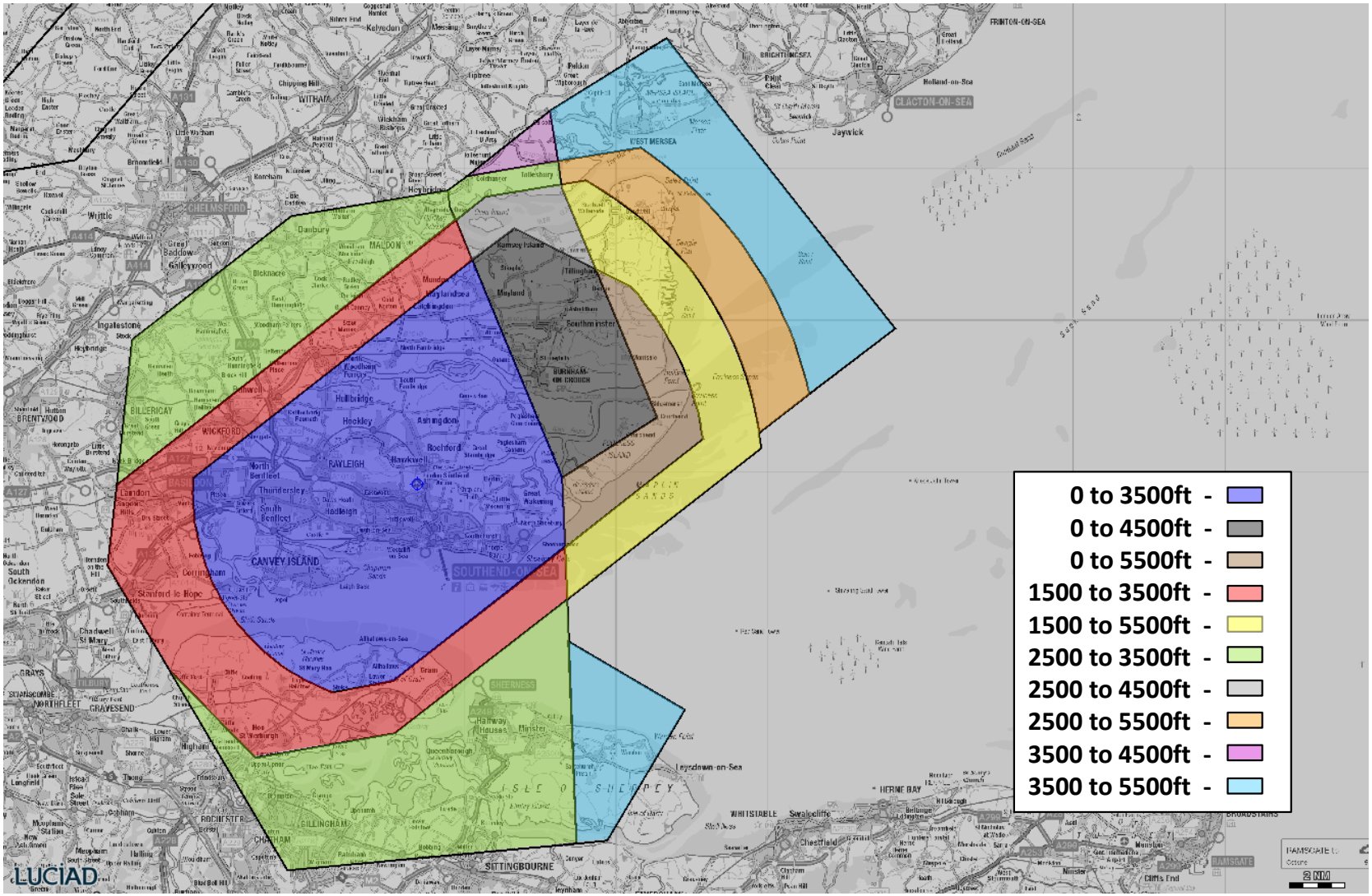

Figure 4: Key to LSA Airspace, heights above sea level

3.2 Runways & Current Procedures

3.2.1 Runways

The runways at LSA are aligned northeast and southwest. The southwesterly facing runway is designated as Runway 23 whilst the northeasterly facing runway is designated Runway 05. The designation refers to the runway heading in degrees of the compass. See Figure 5.

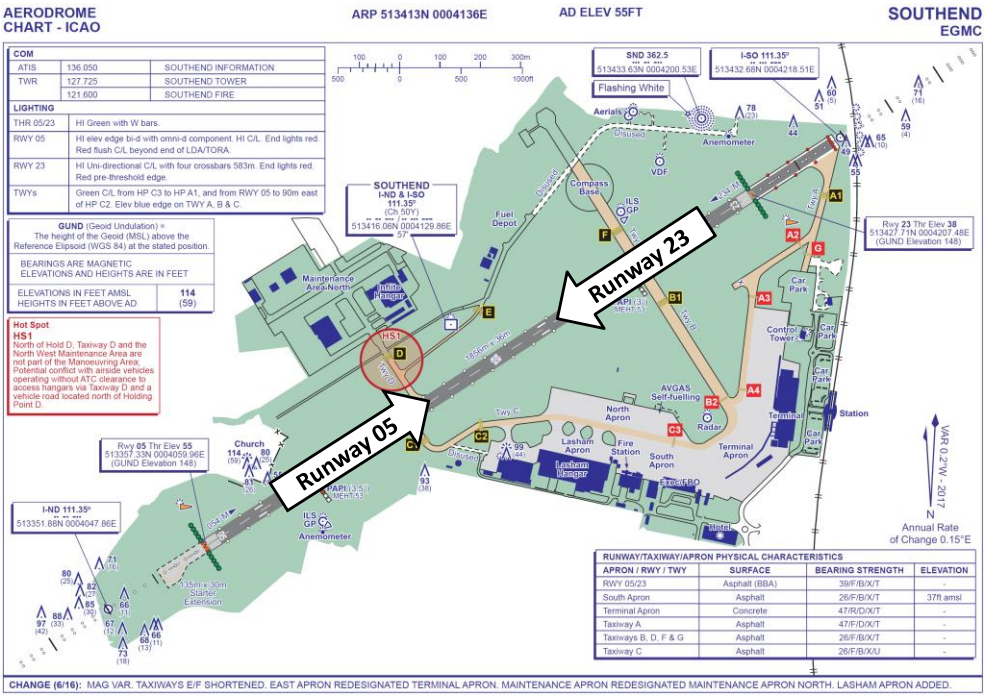

Figure 5: Runway Orientation for LSA. UK AIP

Aircraft generally take off and land into the wind. Due to the prevailing wind conditions in the UK this means that runway 23 (heading roughly 230°) at LSA is utilised approximately 70% of the time, with runway 05 (heading roughly 050°) the remaining 30%.

3.2.2 Current Procedures

Aircraft inbound to LSA use Standard Arrival Routes (STARs). Due to the complexity of the airspace around Southend and the proximity to London and other major airports, these STARs route aircraft around this airspace and deliver them to appropriate points from which they can be directed by LSA ATC to the runway. These arrival routes are illustrated in Figure 6 to Figure 9.

Figure 8 and Figure 9 show the route from the north, depositing aircraft overhead LSA. It is very rare that aircraft get that far and generally they are directed to the runway well before then (see Figure 10 and Figure 11 for aircraft tracks from the north).

Figure 6 shows the route from the south whilst Figure 7 shows the route from the east. These aircraft are routed to a holding waypoint known as GEGMU. However in the majority of cases they are acquired by ATC well before entering the holding pattern, and are directed to the runway in use.

Air traffic arriving from GEGMU is proposed to formally route to the final approach. For runway 23 the track routes to the runway from GEGMU whilst for runway 05 a 'transition' route is proposed to take aircraft to the start of the procedure for that runway (see section 4).

Traffic from the north will, as today be tactically vectored to the start of a PBN route for each runway.

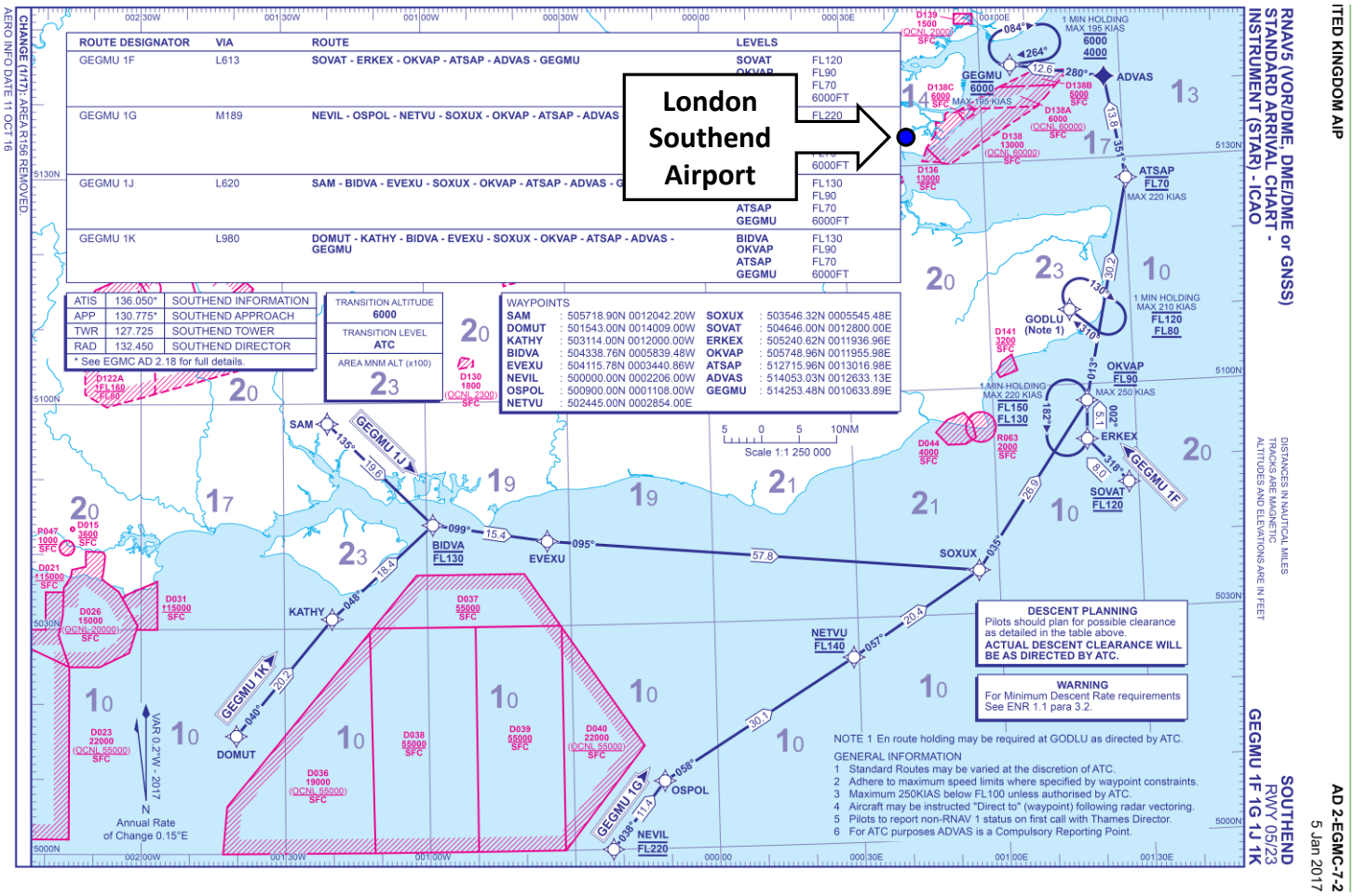

Figure 6: GEGMU STAR from the south

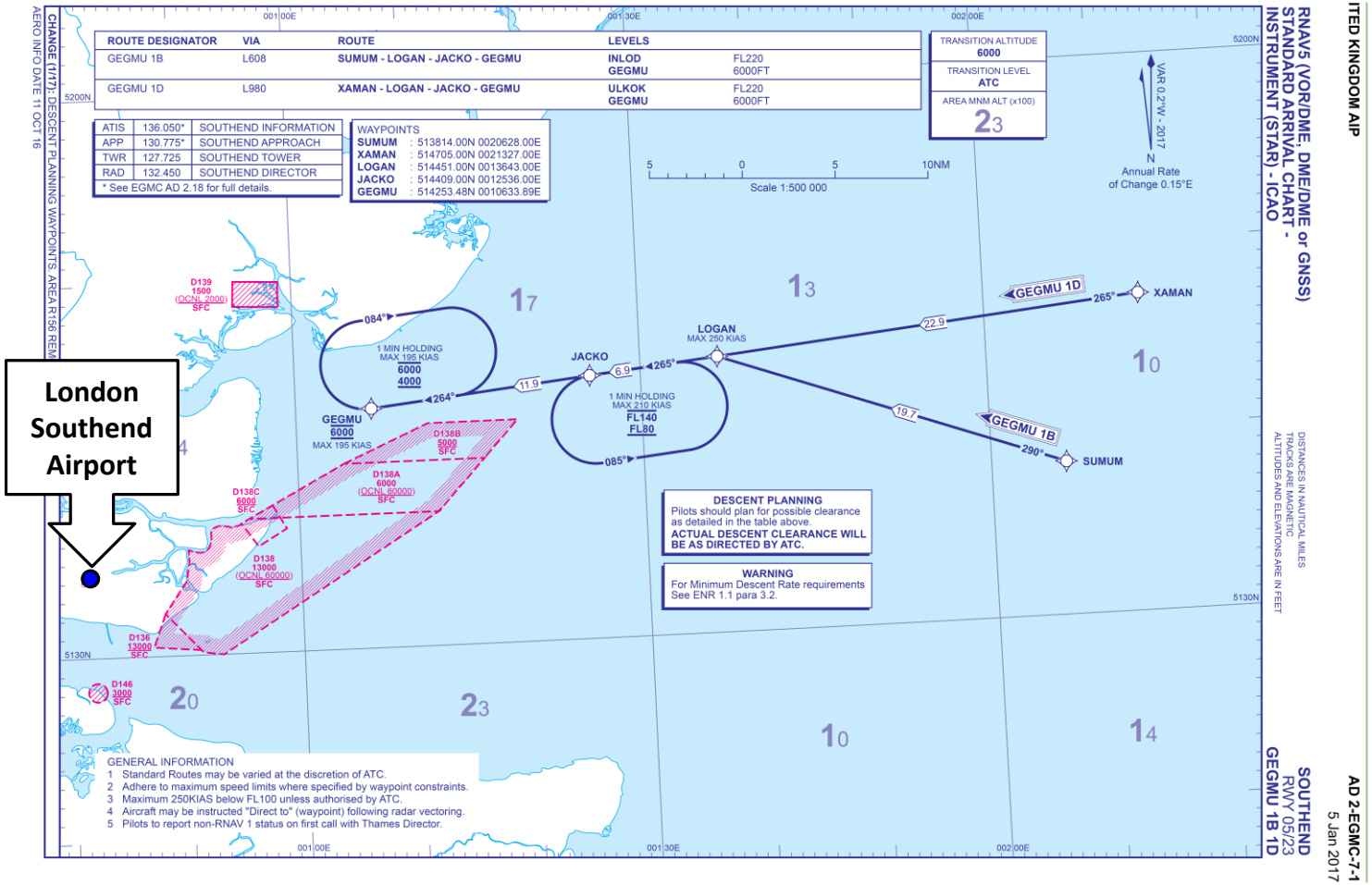

Figure 7: GEGMU STAR from the east

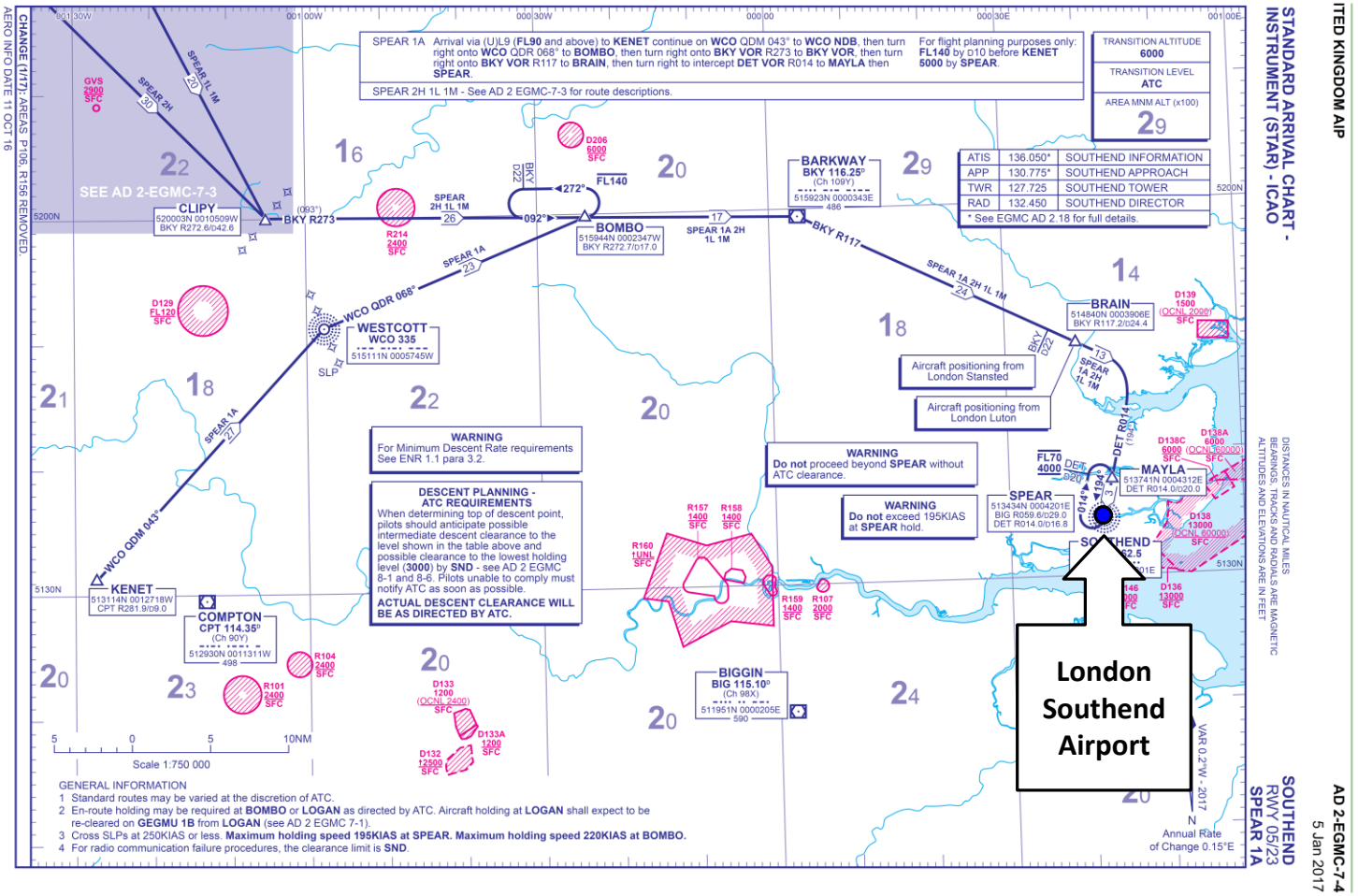

Figure 8: STAR from the north and west

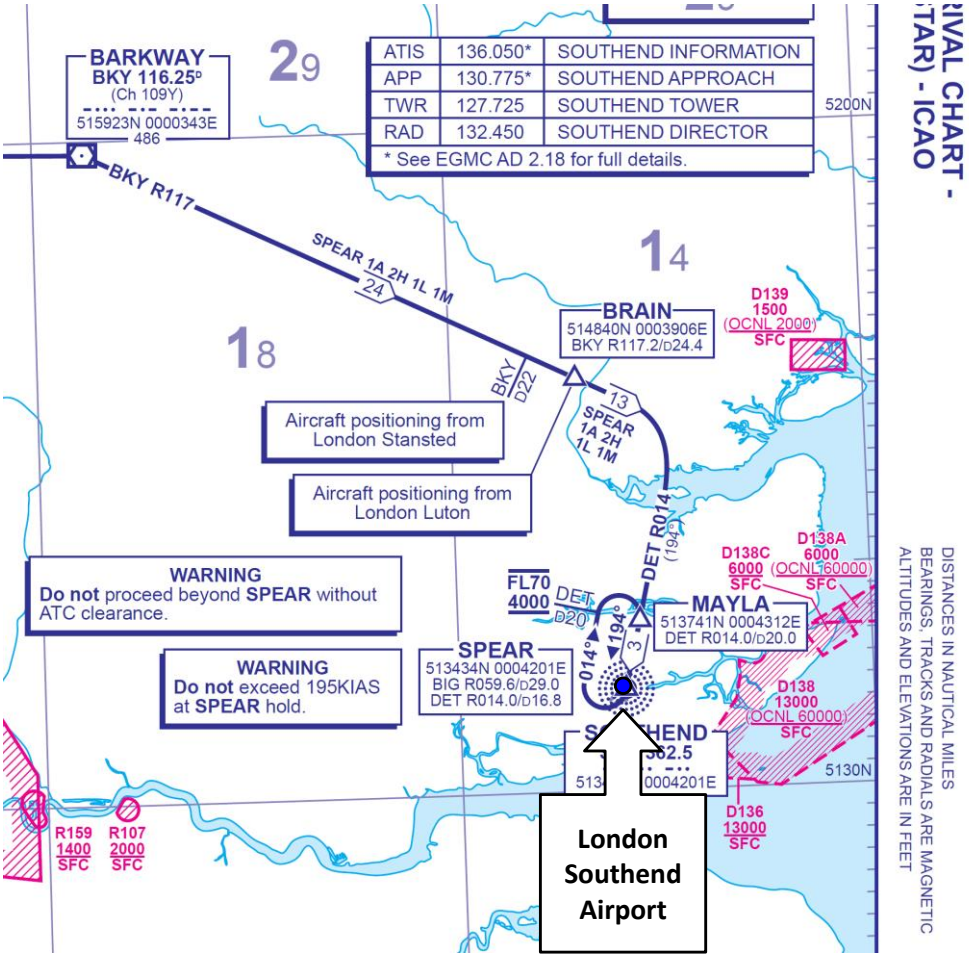

Figure 9: Detail of STAR from the north

3.3 Arrival Tracks

Aircraft arriving at LSA predominantly fly tracks from the east and south with a very few, non-scheduled flights arriving from the north. Figure 10 and Figure 11 illustrate the arrival tracks actually flown by aircraft to the airport for the month of August 2016. The location of the arrival tracks is dictated by the airspace routes leading to LSA and these are part of the wider UK airspace network.

LSA's proximity to other London airports restricts the movement and subsequent flight paths of many of the flights. These wider network issues are beyond the control of LSA and fall outside of the scope of this consultation.

The proposed tracks for arrivals at LSA have been designed with these existing route constraints in mind. The main directions illustrated in Figure 10 and Figure 11 will remain broadly the same but small alterations are proposed.

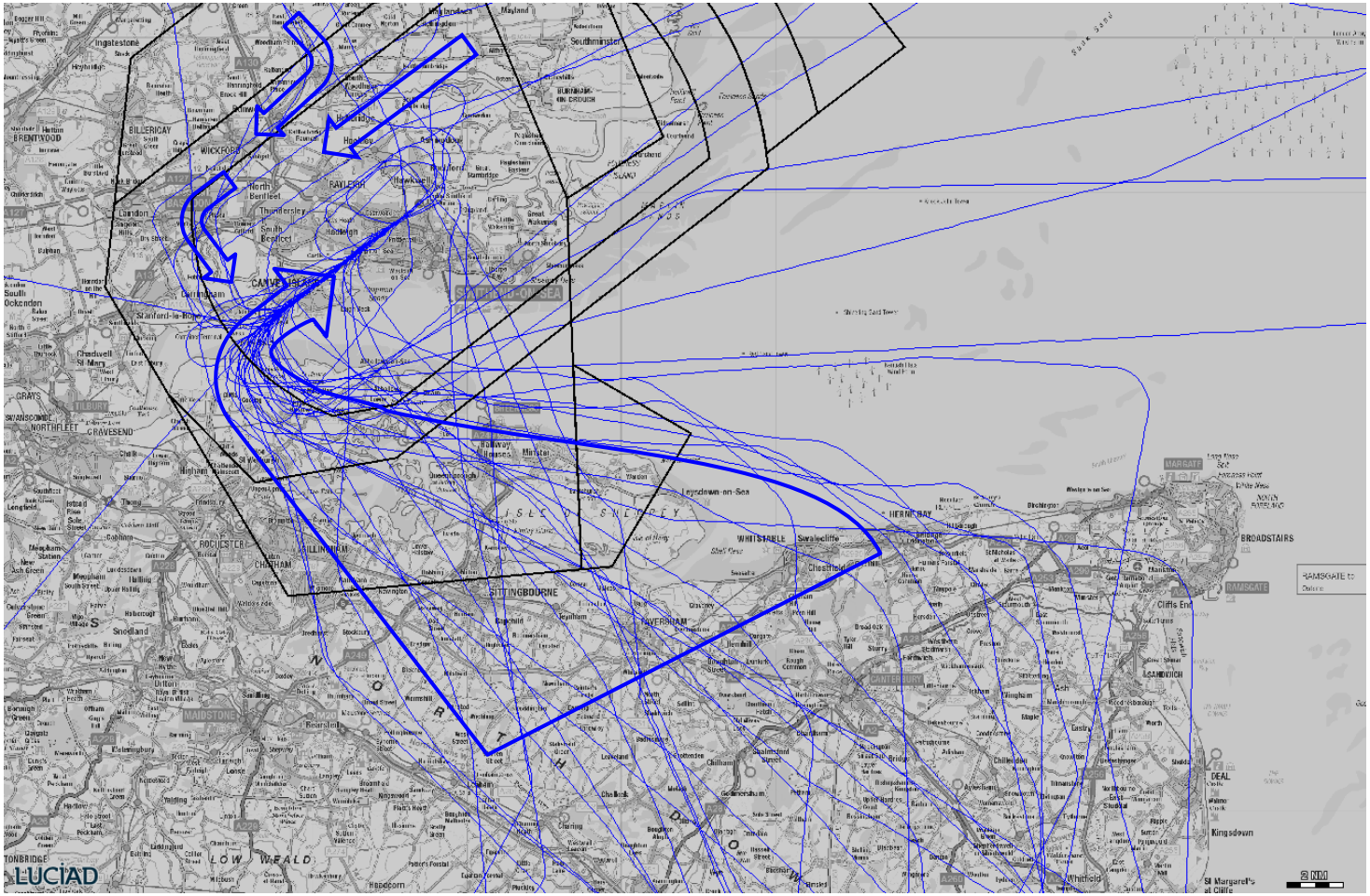

Figure 10: Today's arrival tracks (predominantly commercial traffic) for runway 05, indicated by direction of arrows

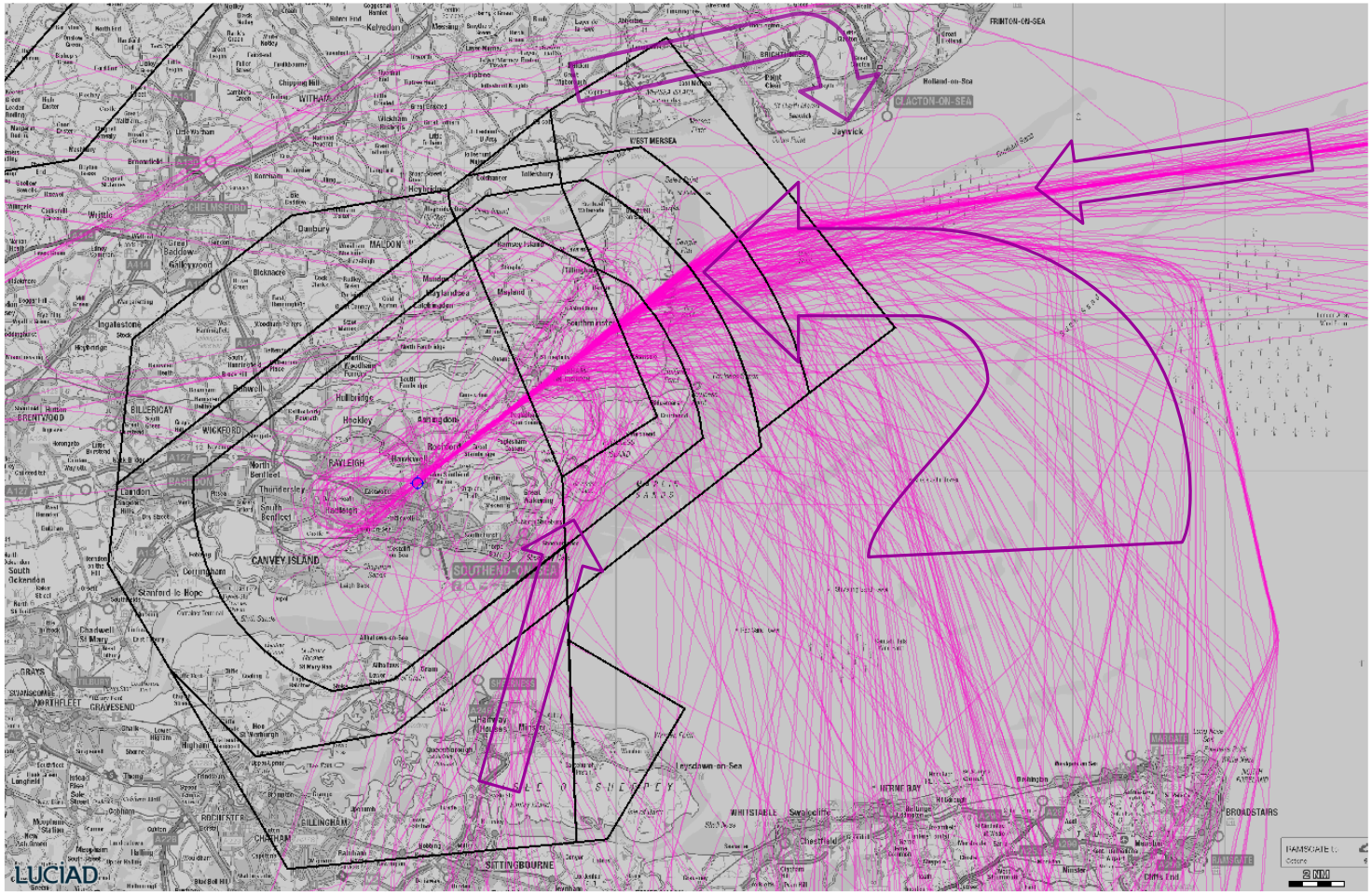

Figure 11: Today's arrival tracks (predominantly commercial traffic) for runway 05, indicated by direction of arrows

3.3.1 Aircraft Types & Numbers

LSA attracts a wide range of aircraft from surrounding areas as well as having a number of based commercial aircraft. The based aircraft are predominantly medium sized twin engine jets (Airbus 319 and320/E195/BAE146) and twin propeller aircraft (AT72). LSA also caters for small business jets and single and twin engine propeller aircraft for training and private (General Aviation) use.

Table 1a illustrates the utilisation of LSA by aircraft movement type as categorised by the CAA, for 2016. It gives a total number of movements figure of 23,449, which if split by runway usage (as described in section 3.2.1) indicates roughly 7,034 movements operated to/from runway 05 in 2016 whilst 16,415 utilised runway 23.

Table 1b illustrates volumes of arriving aircraft to Southend by month of the year.

This proposal is not predicted to change the aircraft types using the airport, nor the relative proportions of those types.

Note that one movement is an arrival *or* a departure. An aircraft landing, turning around and taking off counts as two airport movements.

Type of movement	Number of movements
Air Transport (inc Air Taxi)	9,201
Positioning	949
General Aviation	12,119
Official	10
Military	106
Business Aviation	993
Other	71

Month - 2016	Number of movements
January	1,453
February	1,415
March	1,634
April	1,899
May	2,123
June	2,215
July	2,443
August	2,322
September	2,380
October	2,399
November	1,691
December	1,475

Total movements 23,449

Table 1a & 1b: Aircraft movements by type and month, LSA 2016

Aircraft type	Number of movements	Proportion of movements
A320 family	5,773	24.6%
ATR family	2,291	9.8%
Business Aviation	703	3.0%
Bae146 family	431	1.8%
Embraer family	164	0.7%
B737 family	20	0.1%
Other IFR	1,948	8.3%
Other VFR GA-types	12,119	51.7%
Total movements 23,449		

Table 2 Movements by aircraft type and proportion, for 2016

It is expected that over the next 5 years the total number of aircraft movements per annum at LSA will grow to 53,500. The total number of aircraft movements is subject to a cap, which is part of a Section 106 planning agreement.

3.4 Runway 05

3.4.1 Arrivals

Aircraft arriving for runway 05 (roughly 30% of all movements) predominantly do so from the south with very few currently arriving from the north, although this could change if LSA airline customer demand required it (but not as a result of this proposal). Figure 12 illustrates individual arrival tracks over the ground for August 2016 whilst Figure 13 shows the same track data presented as a density plot and giving detail closer to the runway. The density plot identifies the centre track across the ground flown by the majority of aircraft, enabling the design of routes which follow the tracks of the majority of today's traffic and potentially reduce exposure of new residents to aircraft noise.

Indicative heights over the ground for today's traffic (Figure 12) has been overlaid with height information. It can be seen that flights from the south fly a swathe of tracks to the east of Rochester to the coast. Roughly 6nm north of Rochester they come together to turn north overhead Blyth Sands at approximately 2,500ft (over the water).

They continue to turn onto a heading of 050° in line with the runway and cross the north shore to the south east of Canvey Island at 1,800ft. From here they track directly to the airport passing overhead Canvey Island at 1,600ft and descending to 800ft overhead Leigh-on-Sea, en route to the runway. Figure 13 shows the detail of the final approach path for runway 05.

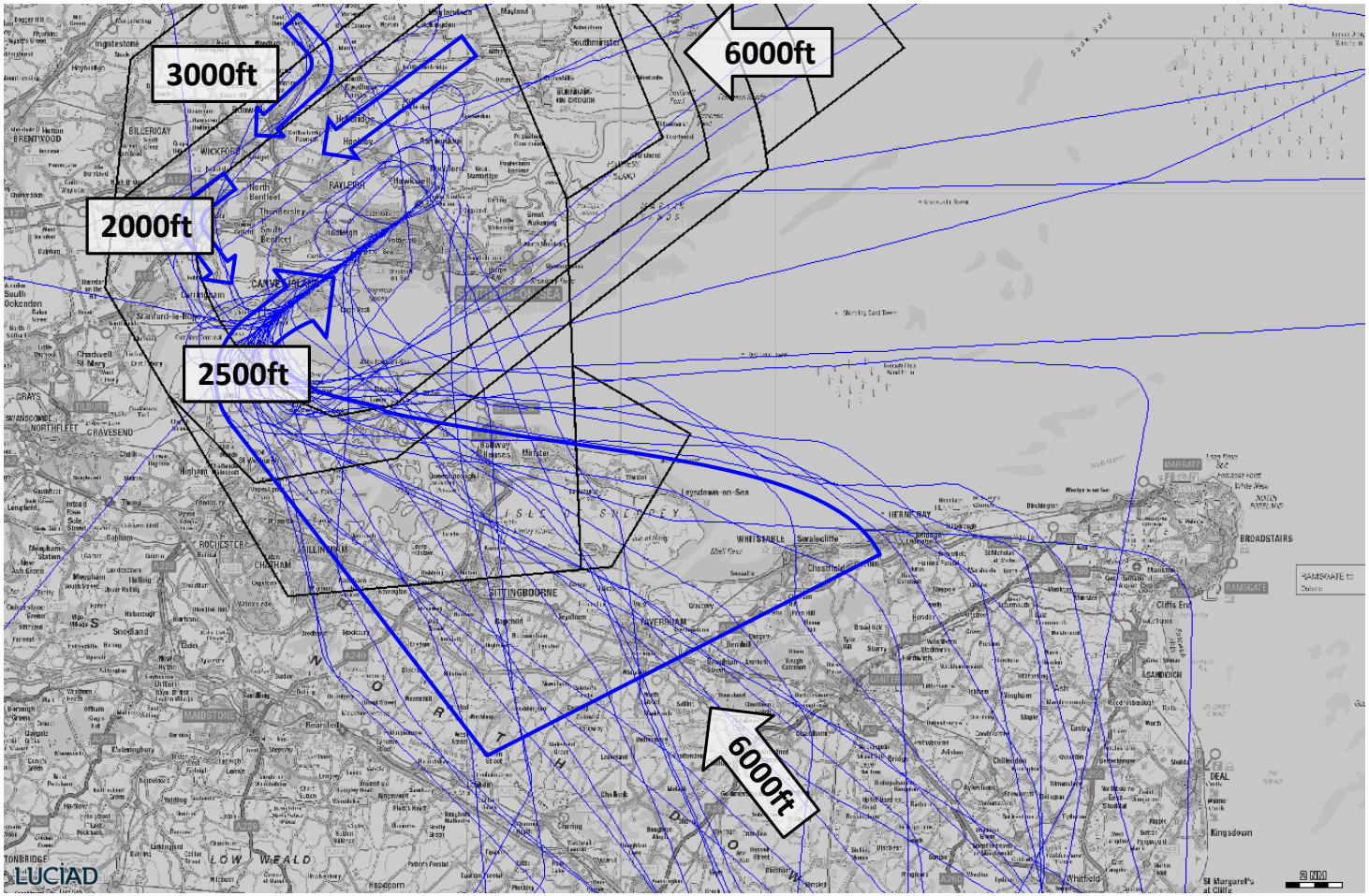

Figure 12: Arriving aircraft tracks, runway 05 with indicative heights, August 2016

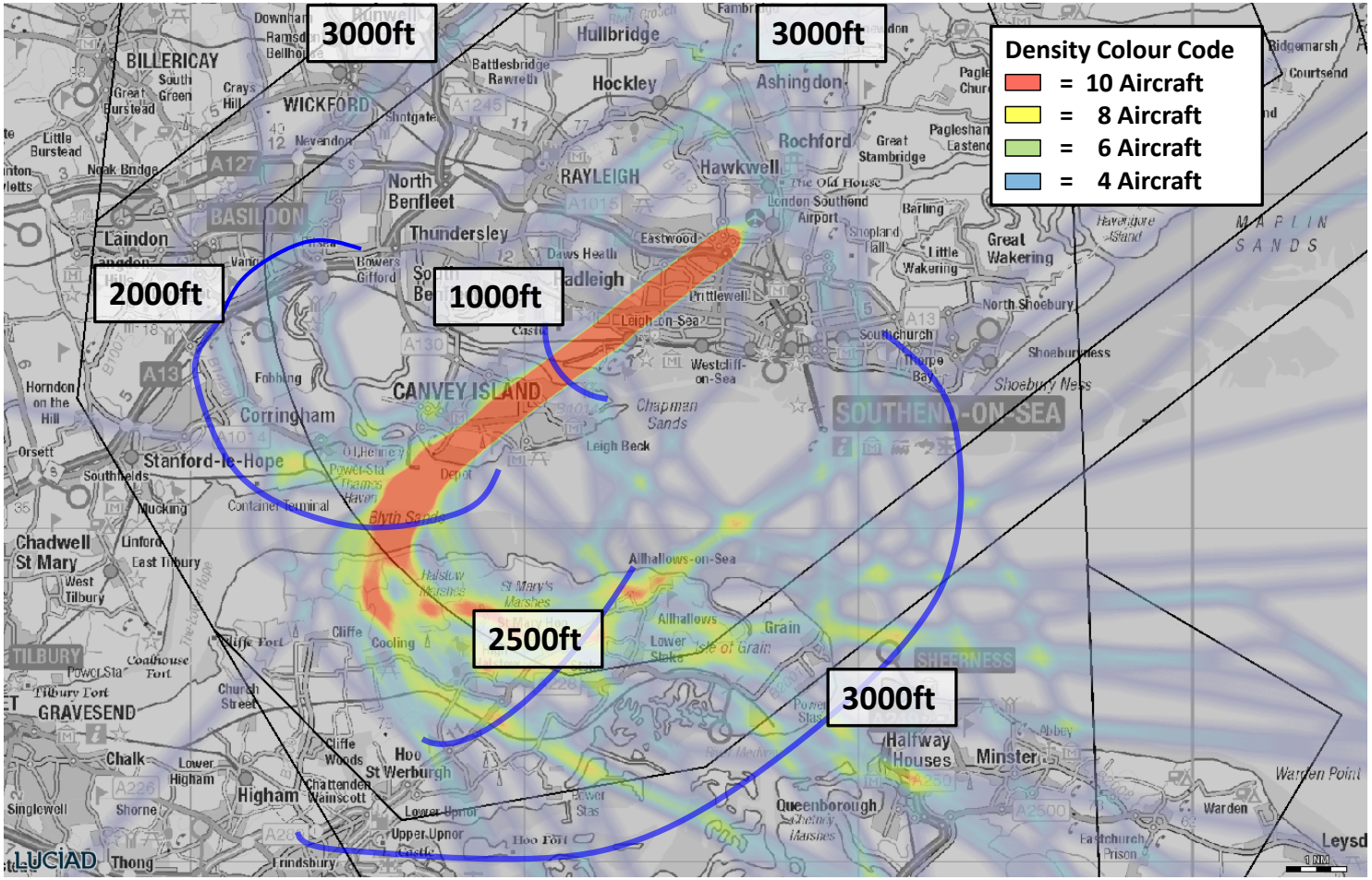

Figure 13: Close-in detail, arriving aircraft density plot, Runway 05, indicative heights, 1 month August 2016

3.4.2 Runway 05 Missed Approach

Aircraft approaching the runway to land but which ultimately do not are said to have executed an unplanned 'missed approach' or aborted that landing attempt. This is a perfectly routine, but rare, occurrence with approximately two movements (a quarter of one per cent) doing this per month, throughout 2016. Pilots always study the standard missed approach procedure as part of their landing preparation.

The current missed approach procedure for runway 23 is detailed in Figure 14. This illustrates the Instrument Landing System (ILS)[8] approach with aircraft arriving from the northeast, with the missed approach shown as a dotted line to the southwest. This dotted line leaves the airport on a direct track away from the runway and then turns back toward the airport, aiming to be overhead the airport from where ATC would direct the aircraft back to the ILS again.

A dialogue box on the approach chart in Figure 14 gives further instructions and asks pilots to fly straight ahead to 2,000 feet before commencing a turn back to the airport.

In reality ATC will give instructions to the aircraft some time before they commence the turn back to the airport. Depending on the reason for the missed approach, the instructions from ATC may either be to line the aircraft up for another approach to land or to give the aircraft directions appropriate to the circumstances.

The result is that very few missed approaches are executed in the same way and in the same position in the sky or take the same route over the ground. Factors such as how early or late in the approach the aircraft executes a missed approach and the volume of traffic in the pattern for LSA all affect the routing instructions given to the aircraft.

[8] An ILS approach is typical for most large airports. Antennae are aligned with each runway, sending out accurate radio beams (horizontally and vertically) that guide the aircraft to touchdown, even in bad weather and poor visibility.

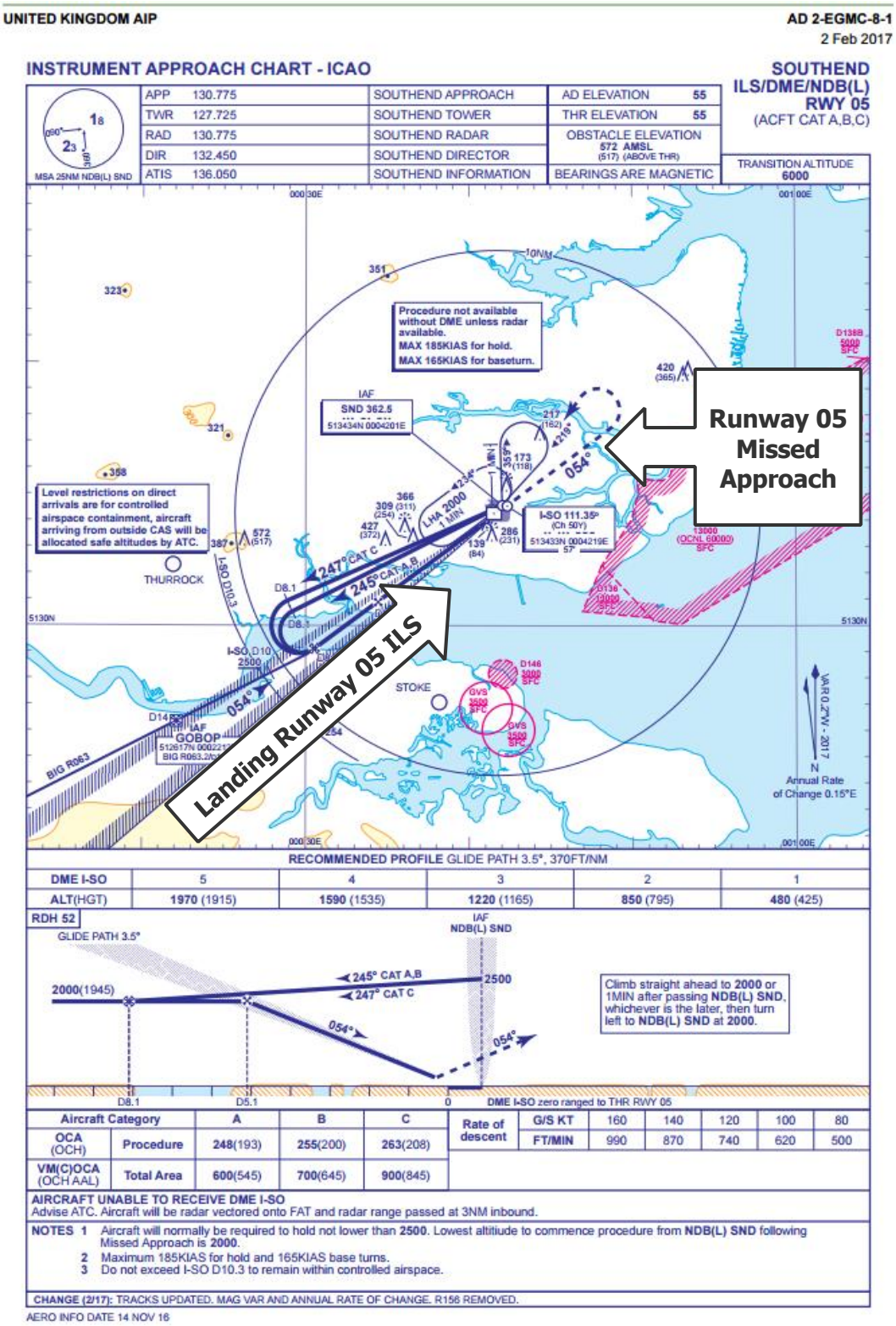

Figure 14: Runway 05 ILS procedure with missed approach

3.5 Runway 23

3.5.1 Arrivals

Aircraft arriving for runway 23 (roughly 70% of all movements at LSA) predominantly do so from the east and south with a very few currently arriving from the north (this could change in future if demand from LSA airline customers required it, but not as a result of this proposal). Figure 10 illustrates individual arrival tracks over the ground for August 2016. In order to determine the central track(s) across the ground of these arrival flights we can generate a density plot image, see Figure 15. This enables the design of routes which follow the tracks of the majority of aircraft today and potentially reduce exposure of new residents to aircraft noise.

To give an indication of current heights over the ground Figure 15 has been overlaid with indicative height information. It can be seen that flights from the east turn on to the runway heading of 230° roughly 5nm off the coast to the south east of Clacton-on-Sea (over the water). At this point they are at approximately 5,000ft when they track towards the runway arriving over the coast roughly 5nm to the north east of Burnham-on-Crouch having descended to approximately 3,000ft.

Figure 16 shows the detail of the final approach path for runway 23. From the coast aircraft descend on a direct track towards the runway. As they fly overhead Burnham-on-Crouch they are approximately 1,500ft above sea level, descending further to arrive at LSA.

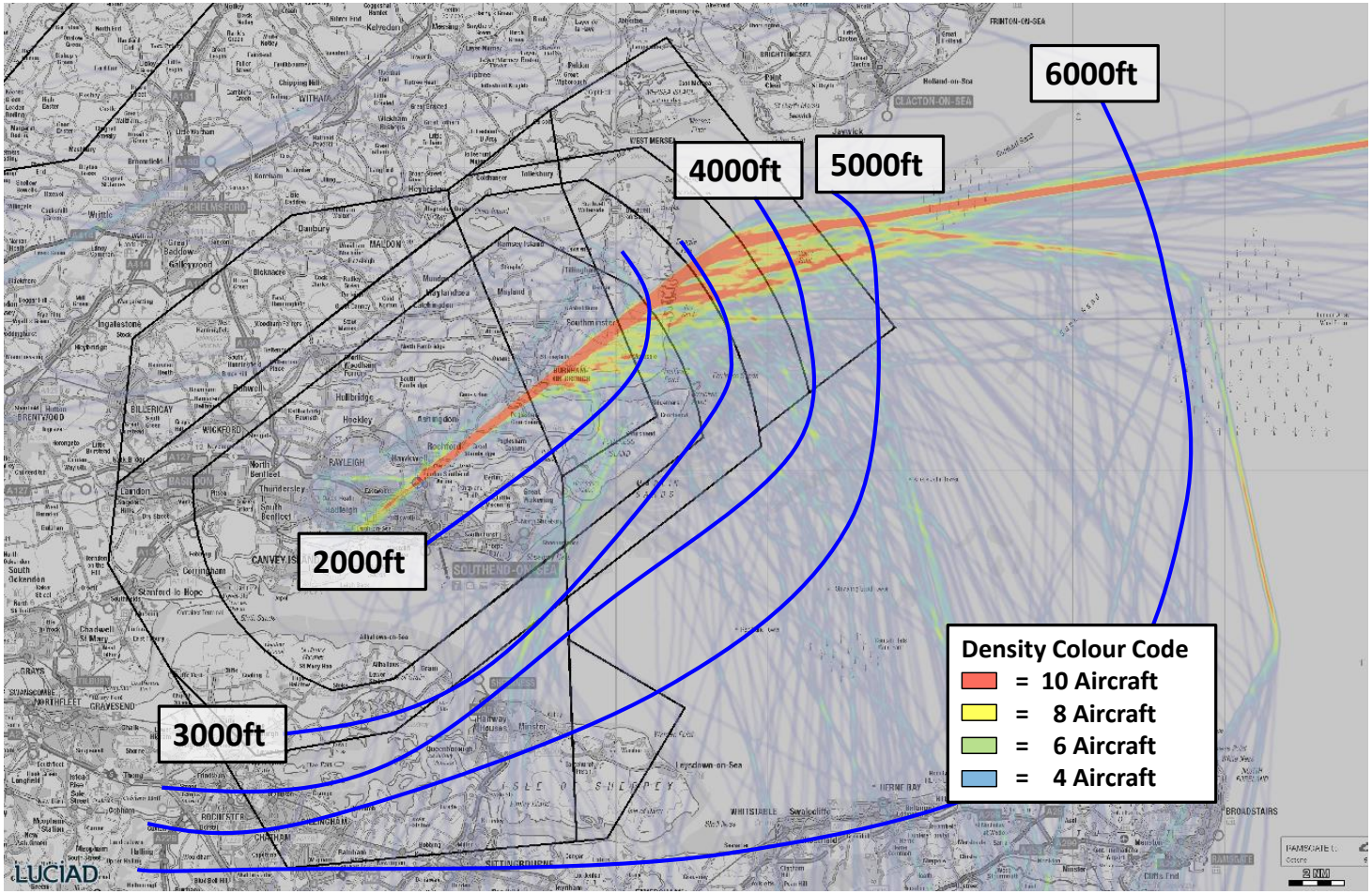

Figure 15: Runway 23 arriving aircraft density plot, 1 month August 2016

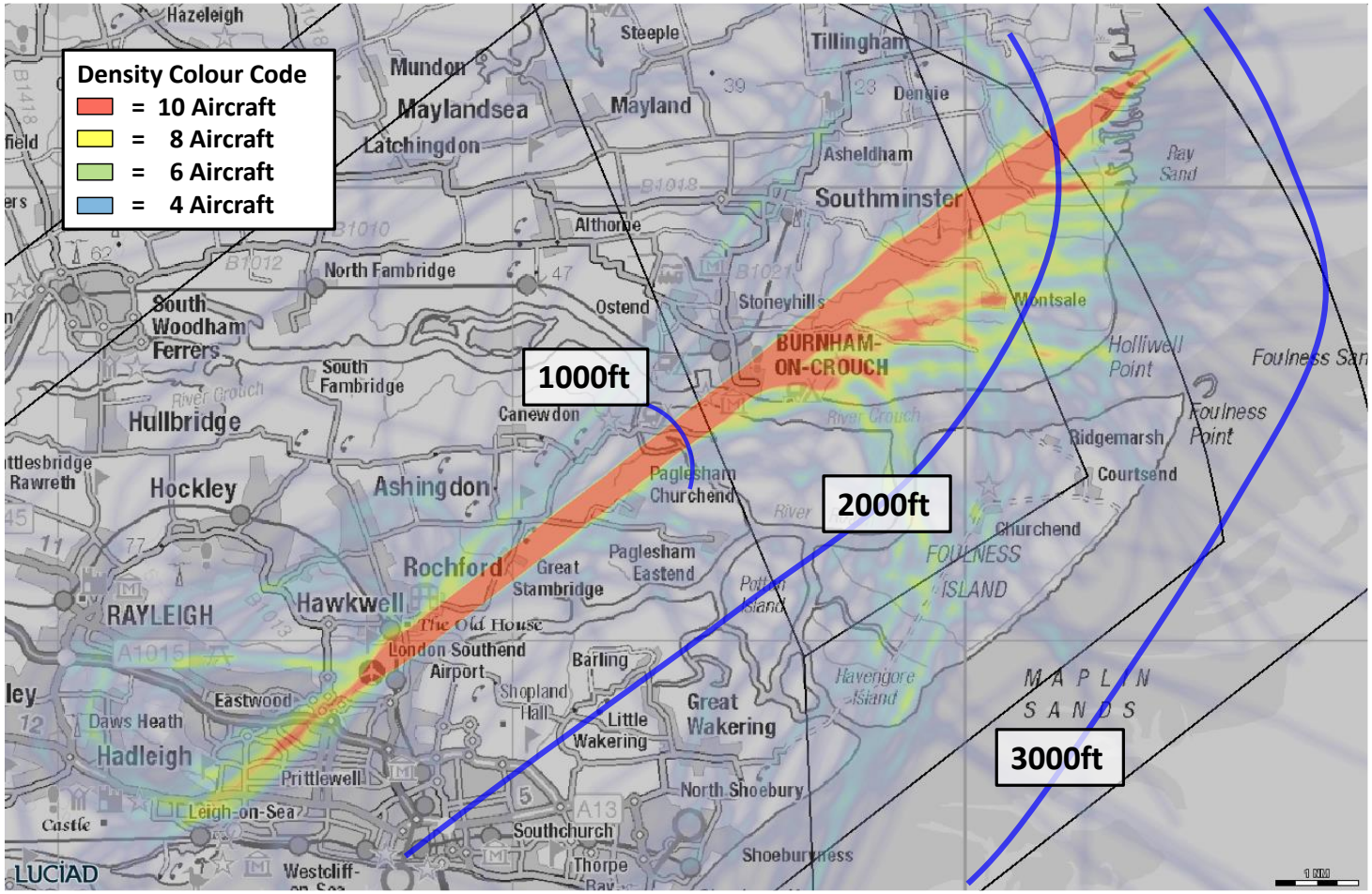

Figure 16 (Detail): Runway 23, aircraft approach, 1 month August 2016

3.5.2 Runway 23 Missed Approach

The details for aircraft executing a missed approach and the reasons why the tracks over the ground are rarely the same is explained in Section 3.4.2 for runway 05.

Figure 17 illustrates the ILS approach for runway 23 and gives the missed approach procedure. Routing directly away from the runway (dotted line in the image), climbing to 2,000 feet and turning right back to the airport overhead. In the same manner as runway 05, in the majority of cases ATC will issue instructions to redirect the aircraft before they reach the airport overhead.

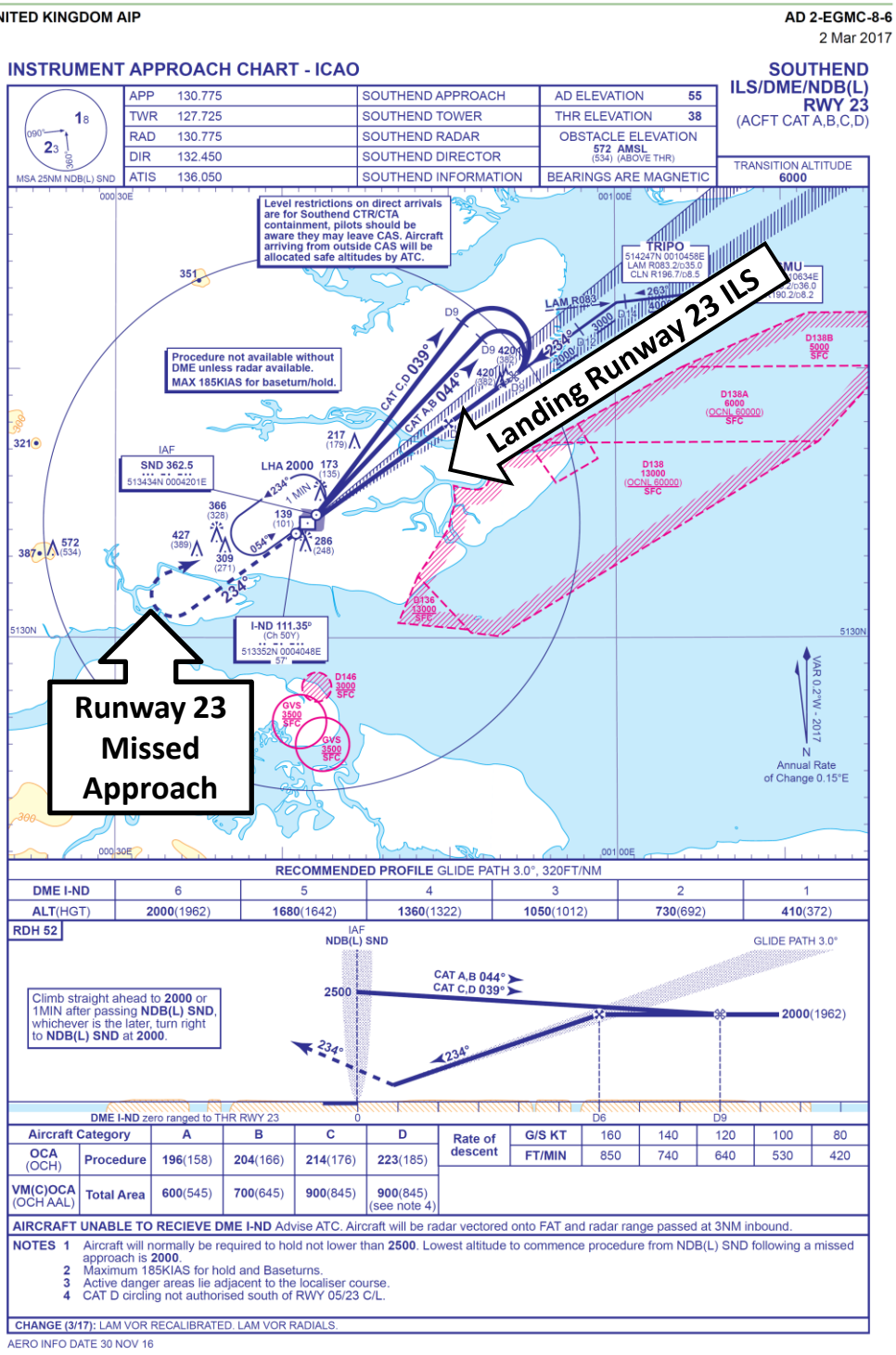

Figure 17: Runway 23 ILS procedure with missed approach

4 Proposed Additions/ Operations

The proposal will see current routes and air traffic control procedures complemented with additional route options rather than replacing them.

The proposed PBN approach routes have been designed to replicate current aircraft tracks wherever possible, to minimise the numbers of additional residents affected by aircraft noise as a consequence of these changes. Notwithstanding the previous statement - where an opportunity to move a track away from populated areas has presented itself, this opportunity has been taken.

In the short to medium term it is likely that there will be no noticeable difference to current aircraft tracks and behaviours. These changes are a method of 'future proofing' LSA in light of European wide developments in air traffic management and providing a measure of redundancy in the event of failure of the ground based Instrument Landing System. Over time more and more aircraft will carry the required equipment to be able to follow the newly prescribed paths with an extremely high level of accuracy but it will take some time for the transition by aircraft, operators and crew to occur.

The proposed routes and the local Controlled Airspace (CAS) within which they have been designed are illustrated in Figure 18 and Figure 19. Figure 18 illustrates the straight-in sections of the approach (Yellow) which are a direct replication of what happens today and are currently being assessed by the CAA for introduction in advance of the wider PBN procedures (the design of which is the subject of this consultation). The image also shows the proposed PBN routes to runways 05 and 23, from the north (in Red), from the south (in Green) and straight in from the east (in Purple).

Figure 19 illustrates the remaining aspects of the change. The missed approach procedures for each runway are represented in pale Blue and are used either on the rare occasion aircraft fail to successfully complete an approach, or by pilots training for such an event. A transition route is also illustrated (Red) for aircraft inbound from the east for runway 05 and ensures that aircraft remain within LSA CAS.

The PBN routes have been designed using a series of 'fixes' (coordinates defined for that purpose) which aircraft would use to make their turns and to stay on track. These fixes are detailed on the diagrams below, labelled either with a name and/or the function of the fix i.e. IAF, IF etc (terminology explained below). The following sections of the document will describe each of these routes and terms in more detail.

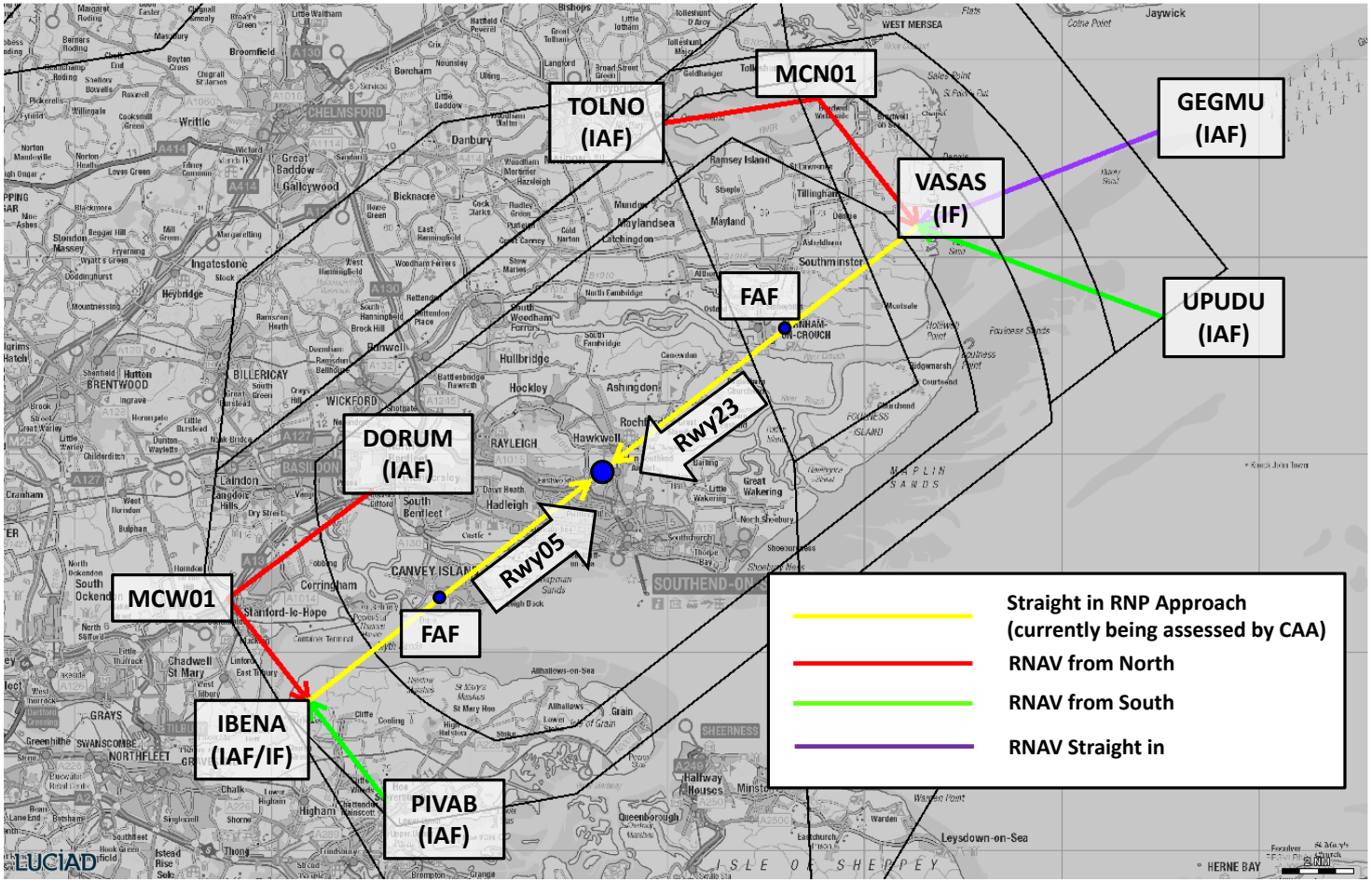

Figure 18: LSA Controlled Airspace & proposed additional routes

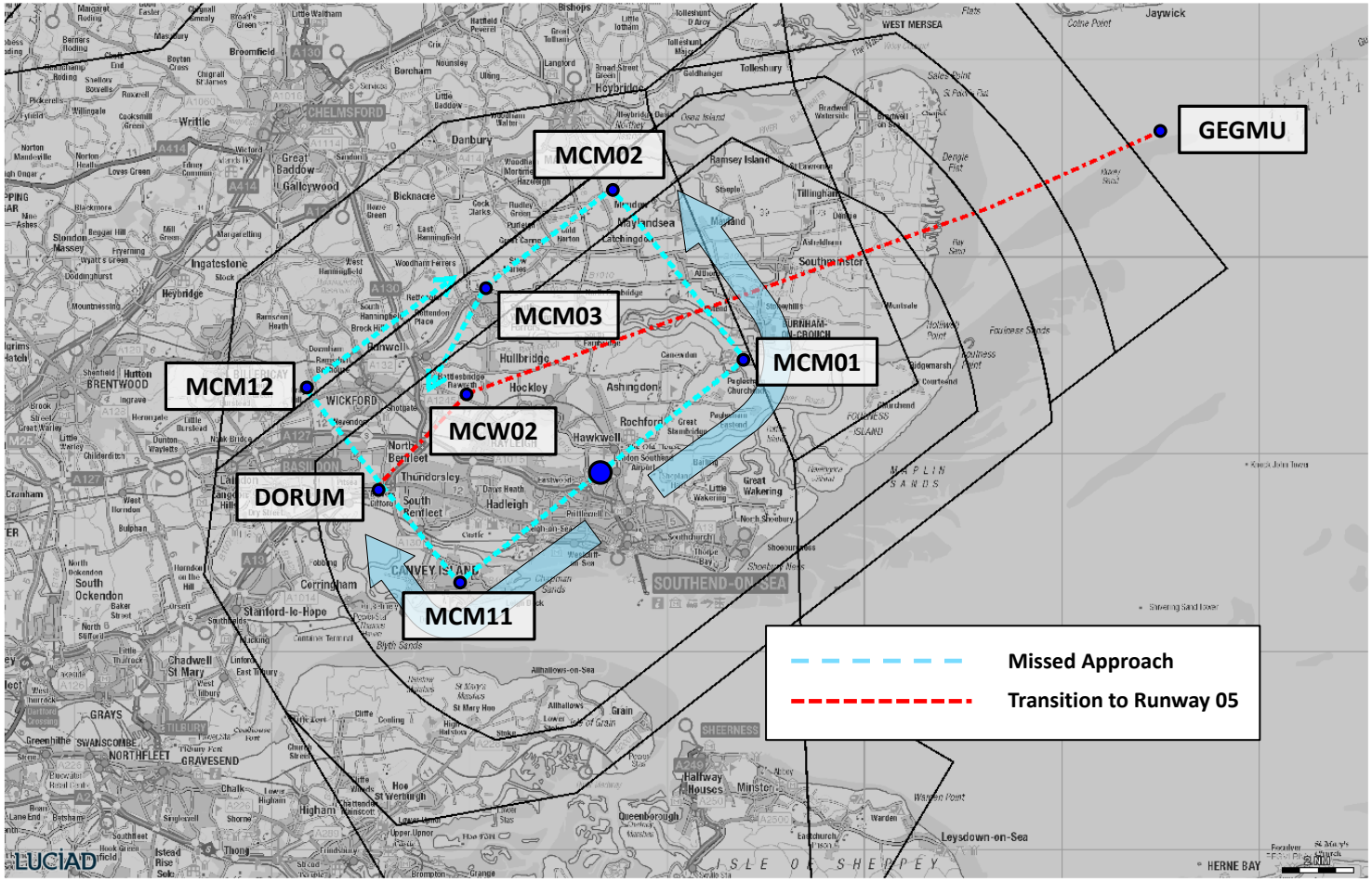

Figure 19: LSA Controlled Airspace & proposed missed approaches and transition to runway 05

The IAF (Intermediate Approach Fix) represents the start point for each track; there being one at the start of each of the Red, Green and the Purple route as well as the Yellow route for runway 05. Aircraft will pass over these to start along the routes inbound to the runway.

For the Red tracks from the north the next fix on the route is at the 'elbow' (labelled MCN01 and MCW01 in Figure 18) and is classed as a 'fly-by' waypoint. This means that aircraft will fly towards these points but make a turn inside of them rather than flying over them.

The Red, Green and Purple routes then 'fly' to the Intermediate Fix (IF) which again is a fly-by point. Aircraft on the Red and Green tracks will turn inside of the IF whilst those on the Purple track are likely to fly over it as they have a shallow turn to make on to the Yellow portion of their track. Aircraft can be routed directly to the IF by ATC for tactical reasons, shortcutting the aircrafts' route. This means that there will be random tracks in the vicinity of the IF in the same manner as today.

The yellow tracks represent the straight in portion of the approach along an extended centreline from the runway, from the IAF/IF through the Final Approach Fix (FAF) which aircraft will fly over, descending to the runway.

These yellow portions represent a 'replication' of the current track (in the vertical and horizontal plane) which aircraft follow today when they approach each runway utilising the currently available Instrument Landing System (ILS). The ILS radiates out from the runway along an extended centreline of each (to about 15 nautical miles from the airport) and allows aircraft to approach to land in all weather conditions including poor visibility.

The ILS is the current state of the art landing system but requires ground based infrastructure. The PBN version represented above (Yellow tracks in Figure 18) utilises space based satellites and equipment on board the aircraft. This provides LSA with a level of redundancy in case of ILS failure or removal from service for maintenance.

As the PBN option is almost identical to the current ILS with no noticeable difference in aircraft performance or behaviour, the CAA in conjunction with LSA has determined that this final section of the approach does not require consultation in order to provide an alternative guidance mechanism and is mentioned here only for completeness of information.

4.1 Runway 05

4.1.1 Runway 05 Approach in Detail

Figure 20 shows the new PBN procedures in close detail, overlaid with a density plot of current traffic patterns from August 2016. It illustrates that the Yellow track (a replication of the current landing system) matches the centre of the current aircraft tracks. It is designed to deliver aircraft to the runway in a manner which is very similar to today in both the horizontal and vertical planes. An observer on the ground would be unlikely to differentiate between aircraft following the PBN route and aircraft following the 'conventional' (today's) route.

The straight edged red and green tracks in Figure 20, between the labelled points, represent the initial segments of the new PBN approaches before turning onto the final (Yellow track) approach. The current typical turn-point onto final approach is at about 7nm (Blyth Sands from the south and the oil refinery from the north). However the design criteria within which LSA has had to construct the PBN routes (as prescribed by the International Civil Aviation Organisation (ICAO)) has led to the Yellow track being 9.7nm from the runway, terminating at point IBENA.

The blue dotted lines illustrate the likely path which could be flown by arriving aircraft. This path turns inside of IBENA but is still further to the west than the current turn-in point.

It is assumed therefore that any aircraft which follows the PBN path as designed would route further to the west than today, and would cover increased track mileage to the runway. However there are several factors which reduce the impact of this potential increase in track mileage.

The biggest of these mitigating factors is the prevailing wind – runway 05 is used by roughly 30% of flights. This means that the majority (70% of flights) use runway 23, which has PBN designs more closely replicating today's traffic patterns. It is also likely that ATC will intercede and shorten the route of many aircraft, directing them to similar points at which they turn today to intercept the ILS at a point roughly 2nm prior to the FAF on the final approach (see Figure 20). ATC tactical shortcuts would reduce track mileage, free up the approach path for the next flight and/or de-conflict flights from other approaching aircraft.

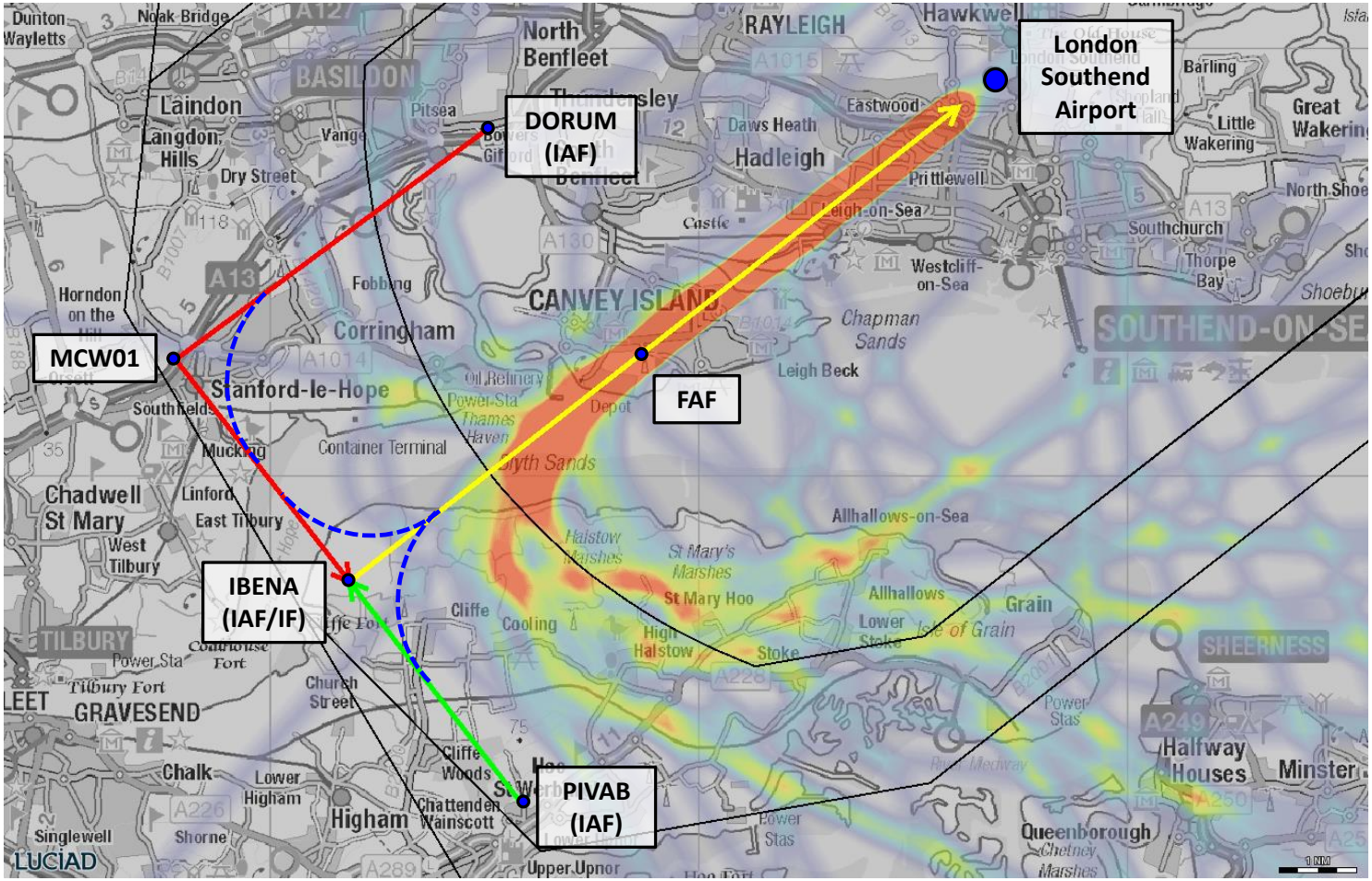

Figure 20: Proposed procedures to join final approach, runway 05 in detail (same density key as before)

For those aircraft which follow the full length of the route, the predictability of the prescribed path should allow them to better plan their descent and power settings to optimise their fuel use and maximise the benefits gained from flying a pre-determined path; this is one of the most significant benefits identified by the aviation industry with PBN designed routes.

Finally, the numbers of aircraft which will fly the full PBN route is initially expected to be low. This is due to the time it will take for carriers to convert their aircraft and crew to this new method of navigation for the final stages of flight. Additionally the traffic complexity at LSA with very light aircraft mixed with medium sized commercial jets may mean that the opportunity for ATC to leave commercial aircraft on the entire route is limited to certain time periods.

The aspiration for the UK and Europe is that eventually every scheduled aircraft in the region will fly on predefined PBN routes, optimising fuel, delay and complexity but this is some time away.

4.1.2 Missed Approach

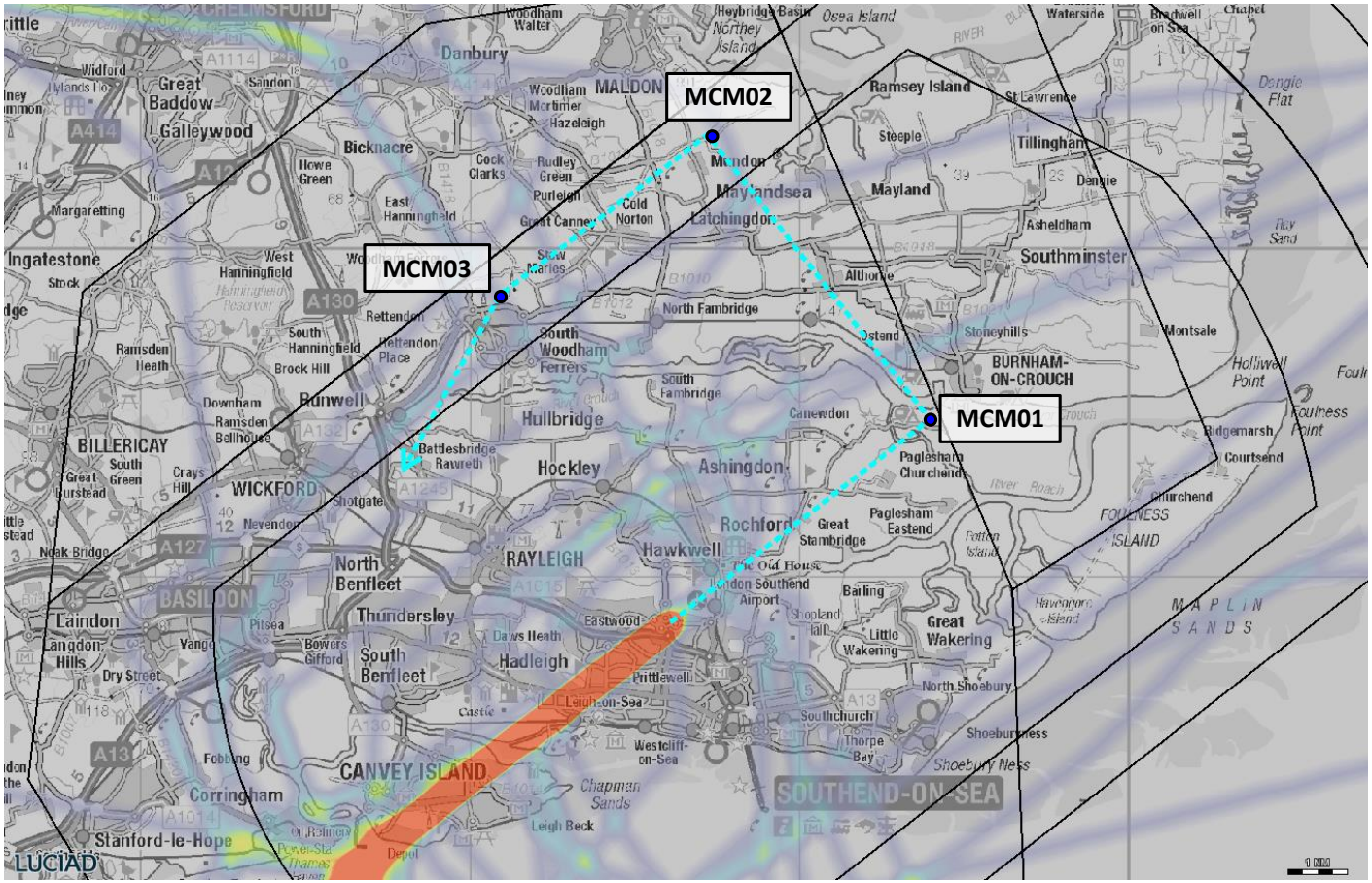

Figure 21: Runway 05 missed approach path (same density key as before)

The current missed approach procedure (as explained in Section 3.4.2) sees the aircraft tracking away from the runway to turn left back towards the airport overhead.

The PBN procedure as illustrated in Figure 21 will direct the aircraft to climb straight ahead to 2,000 feet as in the current procedure, then execute a left turn at point MCM01 to fly a straight path to MCM02 and then another left turn to MCM03. Finally the aircraft would make a left turn heading towards the IAF for runway 05 in order to start another approach.

There is a high possibility that ATC will interrupt this procedure to manually direct aircraft back to the start of the approach either for expediency or to allow for other traffic approaching the runway. This is what happens to every missed approach today. However, in the event that LSA does not have a radar capability, or if specifically requested by the pilot, they may fly the entire route.

4.1.3 Runway 05 Arrival Transition

Runway 05 is proposed to have a PBN Arrival Transition (Figure 22). This is a route which takes aircraft from the end of the current STARs at GEGMU to the start of the approach procedure (the IAF) at DORUM. The transition ensures that aircraft remain within the LSA controlled airspace.

The volume of aircraft utilising the full PBN transition route is likely to be low as explained previously. As aircraft and crew equipage increases the uptake is likely to increase over time. It is envisaged that initially it will be used when LSA is without its radar (either due to radar failure or routine maintenance) or when radar is not manned.

As LSA receives a backup radar feed from London Stansted Airport the times when radar is totally unavailable are negligible, with a failure rate in 2016 of approximately 0.01% of the time. This leaves the periods when radar is not manned as the most likely for the procedures to be used and this is 0130-0630 local time.

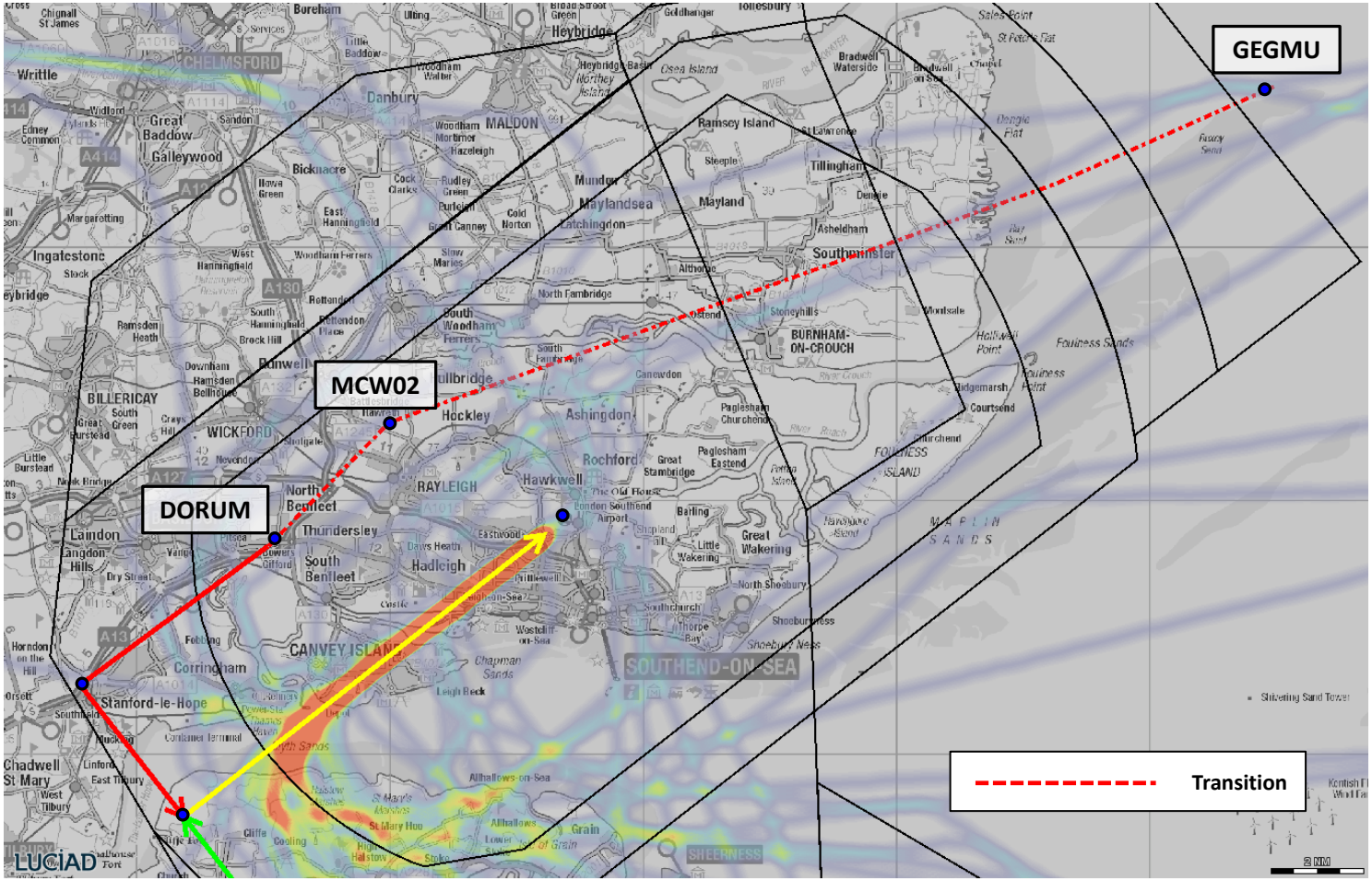

Figure 22: Transition from GEGMU for Runway 05 (same density key as before)

4.2 Runway 23

4.2.1 Runway 23 Approach in Detail

Figure 23 shows the new PBN procedures in close detail, overlaid with a density plot of current traffic patterns from August 2016. It illustrates that the Yellow track (a replication of the current landing system) matches the centre of the current aircraft tracks. It is designed to deliver aircraft to the runway in a manner which is very similar to today in both the lateral and vertical planes. An observer on the ground would be unlikely to differentiate between aircraft following the PBN route and aircraft following the 'conventional' (today's) route.

The red, purple and green tracks in Figure 23, between the labelled points, represent the initial segments of the new PBN approaches before turning onto the final (Yellow track) approach. The current typical turn-area onto final approach stretches from west of Burnham-on-Crouch (at about 5.5nm) to the coast at Ray Sand (10nm). The design criteria within which LSA has constructed the PBN routes (as described earlier in Section 4.1.1) has allowed them to be placed at the extreme end of the current turn-point range (10.5nm) at point VASAS, the IAF/IF.

The blue dotted lines illustrate the likely path which could be flown by arriving aircraft. This path turns inside of VASAS and takes the routes to the far end of the range at which controllers currently turn aircraft on to the final approach. From here the aircraft would track the yellow line through the centre concentration of the current final approach track.

The IAFs have been designed to capture aircraft coming from the three major directions for runway 23. It is however likely that ATC will continue operating as it does today and tactically vectoring aircraft early towards the runway from TOLNO and UPUDU. Those from the south west being particular candidates for an early left turn.

Those from GEGMU may be given a more direct route to the FAF (part way down the Yellow final approach path) but GEGMU traffic is more likely to remain on the PBN path. Whether aircraft remain on the proposed new routes or are turned early for the runway, their tracks would remain within today's swathes. There should therefore be no noticeable change to residents in the vicinity of the current tracks and the proposed routes.

For those aircraft which follow the full length of the route the predictability of the prescribed path should allow them to better plan their descent and power settings to optimise their fuel use and maximise the benefits gained from flying a pre-determined path; this is one of the most significant benefits identified by the aviation industry with PBN designed routes.

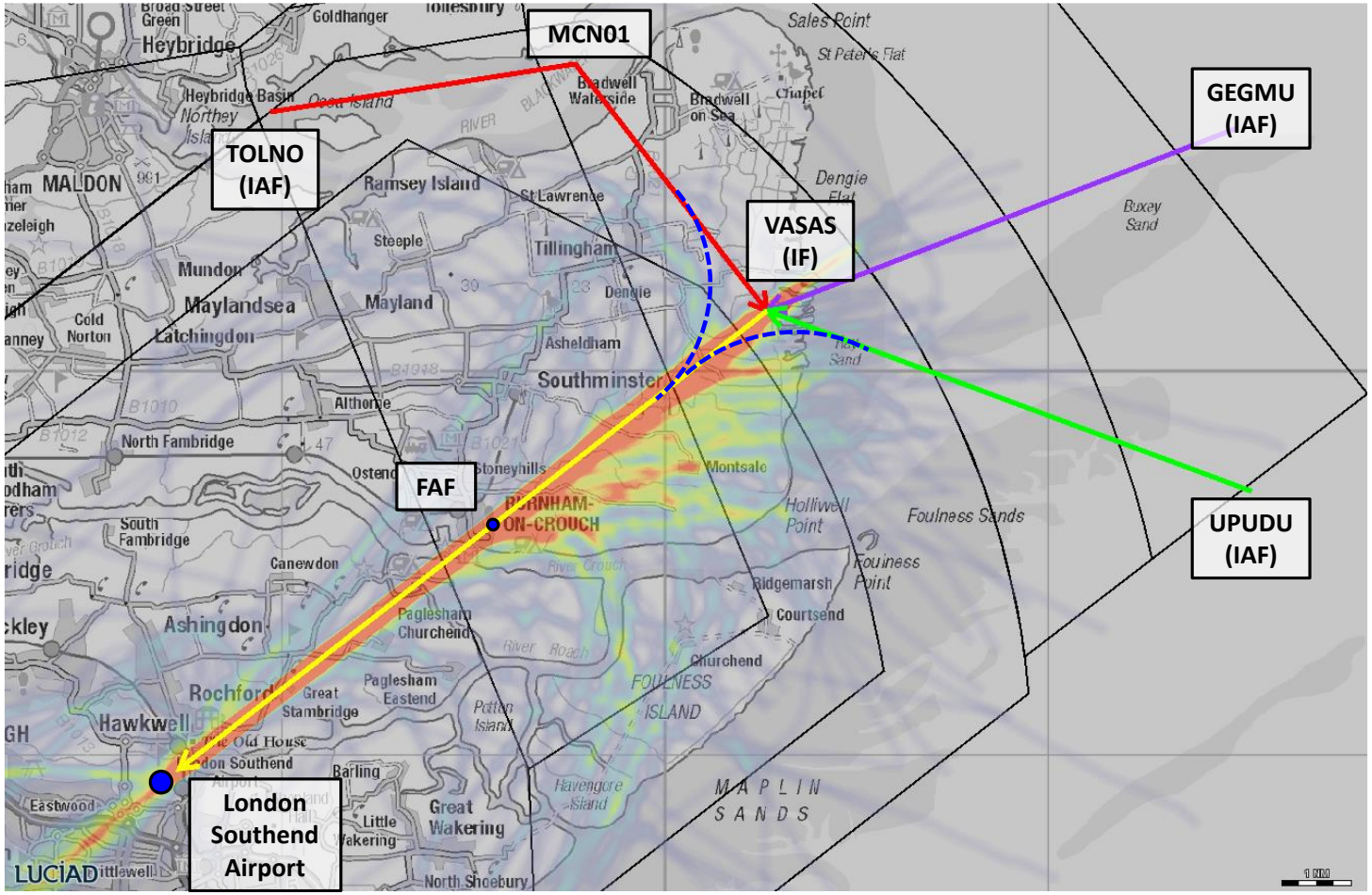

Figure 23: Proposed PBN routes to join final approach, runway 23 in detail (same density key as before)

Finally, the numbers of aircraft which will fly the full PBN route is initially expected to be low. This is due to the time it will take for carriers to convert their aircraft and crew to this new method of navigation for the final stages of flight. Additionally the traffic complexity at LSA with very light aircraft mixed with medium sized commercial jets may mean that the opportunity for ATC to leave commercial aircraft on the entire route is limited to certain time periods.

The aspiration for the UK and Europe is that eventually every scheduled aircraft in the region will fly on predefined PBN routes, optimising fuel, delay and complexity but this is some time away.

4.2.2 Missed Approach

The current missed approach procedure (as explained in Section 3.4.2) sees the aircraft tracking away from the runway to turn left back towards the airport overhead.

The proposed PBN missed approach procedure as illustrated in Figure 24 directs the aircraft to climb straight ahead to 3000 feet and execute a right turn at point BEARD MCM11 to fly a straight path to MCM12 and then a further right turn to MCM03 to remain on a heading to point at the IAF TOLNO for runway 23 in order to start another approach.

There is a high possibility that ATC will interrupt this procedure to manually direct aircraft back to the start of the approach either for expediency or to allow for other traffic approaching the runway (in much the same way as they do today). However, in the event that LSA does not have a radar capability, or if specifically requested by the pilot, they may fly the entire route.

Figure 24 reveals a small turning track departing from Runway 23 and making a right hand turn back the airport overhead Hadleigh and then Rayleigh. This is made up of smaller, propeller driven training aircraft and not larger commercial jet aircraft. If this proposal is approved this track and the types of aircraft making it is not expected to change. There may however be an increase in training traffic utilising the PBN procedures which could see a subsequent rise in the number of aircraft making this turn back to the airport overhead.

The size and type of the aircraft is likely to remain the same and any increase in volume is unpredictable.

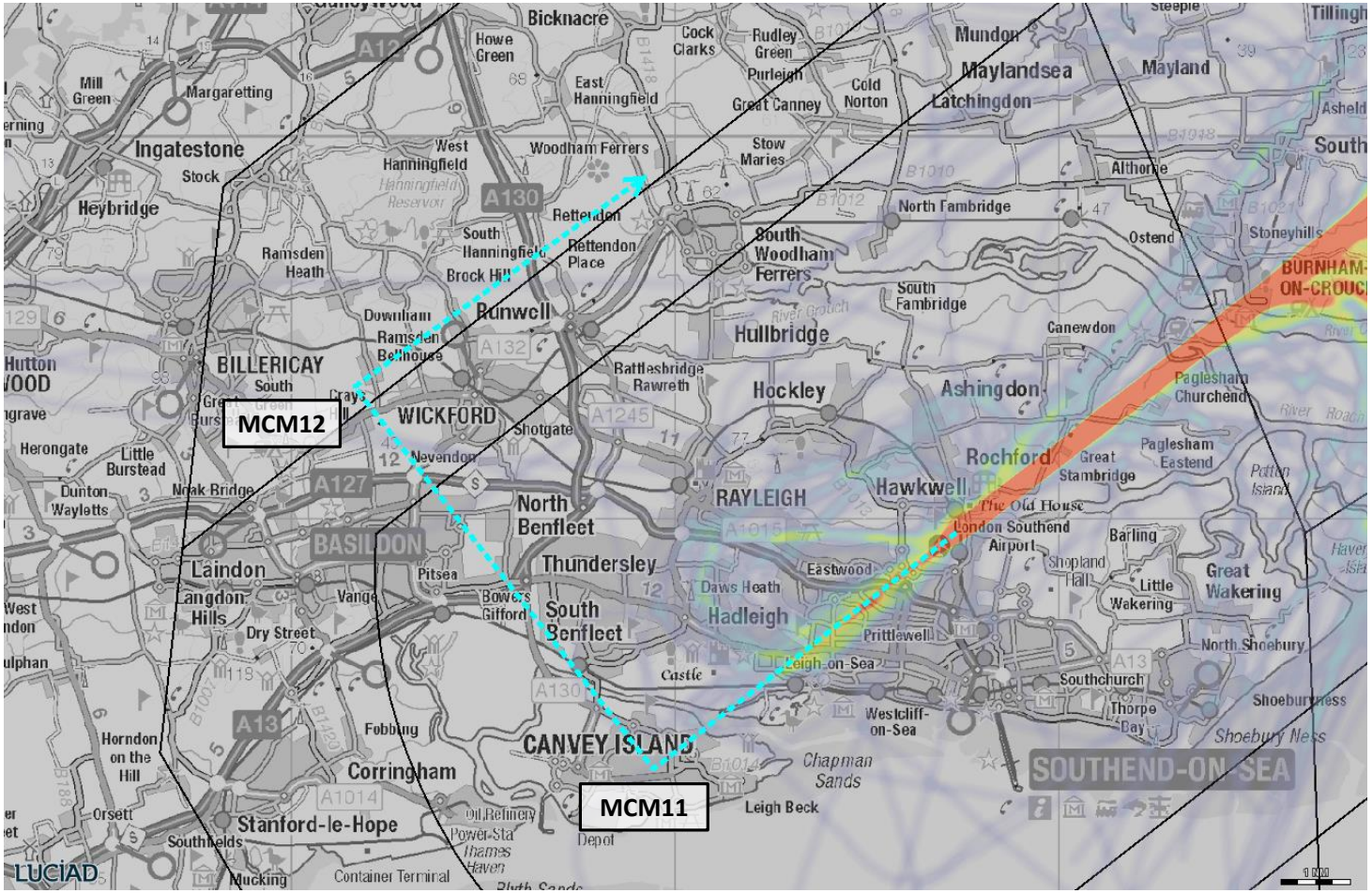

Figure 24: Proposed Runway 23 PBN Missed Approach

5 Environmental Considerations

5.1 Noise

The Government's overall policy on aviation noise, as established in the Aviation Policy Framework, March 2013[9], is *'to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise'*. Consistent with this policy, the Government believes that, in most circumstances, it is desirable to concentrate aircraft along the fewest possible number of specified routes in the vicinity of airports and that these routes should avoid densely populated areas as far as possible.

Further to this, in intermediate airspace (4,000ft to 7,000ft above ground level) the focus should be on minimising the impact of aviation noise, balanced with the need for an efficient flow of traffic that minimises emissions. In low altitude airspace (below 4,000ft agl) the priority is wholly on minimising aviation noise impact and the number of people affected by it.

LSA has taken an approach to 'replicate' the current aircraft tracks as much as possible, to reduce the numbers of new people exposed to noise. Where in a few instances LSA has had to move away from existing aircraft tracks, the government criteria have been borne in mind and LSA has tried to minimise the noise impact to new people being overflown.

5.1.1 What is aircraft noise?

Noise is defined as unwanted sound that may result in disturbance and annoyance. Aircraft noise is caused by airflow around the aircraft fuselage and wings as well as noise from the engines, with different aircraft producing different noise levels and different noise frequencies and tones. Aircraft are individually less noisy than in previous generations with a reduction of noise by more than 90% since jet aircraft entered service in the 1960s.

The way that people experience noise from all types of sources can significantly differ. But noise is not always just about decibels; the pitch, vibration, variation in intensity and the length of exposure time can have impacts too. The level of annoyance also varies according to factors such as the length of time a person lives in an area affected by aircraft noise, personal sensitivity, the impact of outside influences and the activity the individual is engaged in at the time e.g. sleeping, working, watching TV.

The noise level of aircraft can vary immensely depending on a number of factors;

- How high aircraft are above the ground.

[9] https://www.gov.uk/government/publications/aviation-policy-framework

- Position with respect to the route centreline - whether aircraft are directly overhead or how far they are laterally displaced from the observer (in any direction).
- Phase of flight – whether aircraft are arriving or departing which can affect the amount of engine thrust they are using (and therefore the noise level) and the amount of aerodynamic noise due to the fuselage, wings and undercarriage.
- The weather which can increase or decrease the experience of noise depending on conditions. Weather can also affect where aircraft are in the sky since aircraft take-off and land into the wind, affecting which runway is used.

5.1.2 How is noise measured?

The human ear can handle an enormous range of sound levels. To measure this, the decibel scale (dB) is used, which encapsulates the energy of sound with reference to the threshold of hearing using a logarithmic scale. This relates sound intensity to the smallest audible sound of 0dB, so a sound 10 times more powerful is 10dB, whilst a sound 100 times more powerful than the threshold of hearing is 20dB.

Noise measurement also needs to take account of the varying response of the human ear to different frequencies of sound with most sensitivity occurring at the 2-4 kHz range. Therefore the decibel unit used to express human response to loudness or annoyance includes a weighting that varies with both intensity and frequency. The most common measure of this is the A-weighted sound level known as dBA.

Knowing the scale of noise is only one element of capturing its impact, it is also important to consider how we measure the impact of an individual event. There are a number of decibel metrics by which aircraft noise is often described. The one we are interested in for the purposes of this document is:

- L_{max}, this is a measure of the loudest part of a flight i.e. the peak noise experienced during one overflight event.

5.1.2.1 Calculation Process

Data is derived from the UK civil Aircraft Noise Contour model, 'ANCON' version 2. This has been used since 1995 to calculate noise contours at the designated London airports. Every summer the ANCON model is validated with hundreds of thousands of measurements obtained from around Heathrow, Gatwick and Stansted airports.

The process measures noise levels that are generated for locations at specific altitudes beneath an aircraft flight track.

5.1.3 Aircraft Height & Noise

The CAA Environmental Research & Consultancy Department (ERCD), using their noise modelling system known as 'ANCON', has provided data on aircraft types and how much noise they make. ANCON is the CAA's standard way of describing and analysing aircraft noise information.

Table 3 groups types of aircraft together which produce a similar noise. The two most relevant aircraft type-groups using LSA are.

Aircraft Type Examples	Aircraft Type-Groups as per ANCON	Proportion of commercial flights at LSA
ATR-72 or similar types using LSA	50-70 seat turboprop	9.8%
Airbus, Boeing or similar types using LSA	125-180 seat single-aisle 2-eng jet	25.4%

Table 3: LSA Aircraft types and how they are grouped for ANCON noise information

Compare the aircraft grouping and height information in the next table with height information taken from the images in the remainder of this section, to help you gauge the likely noise levels in your area of interest.

Table 4 predicts the typical noise levels produced by each group of types, in their arrival configuration, for direct overflight at specific heights:

Height (ft)	Turbo-prop (L_{max}dBA)	50 seat regional jet (L_{max}dBA)	70-90 seat regional jet (L_{max}dBA)	125-180 seat single-aisle 2-eng jet (L_{max}dBA)
1,000-2,000	79-70	73-63	77-67	77-69
2,000-3,000	70-66	63-56	67-61	69-64
3,000-4,000	66-64	56-55	61-57	64-61
4,000-5,000	64-62		57-56	61-59
5,000-6,000	62-61		56-55	59-57
6,000-7,000	61-59			57-56

Table 4: Arriving aircraft noise levels, by LSA aircraft type groups and heights

Note: L_{max} noise levels of less than 55dBA are considered non-intrusive by the CAA and are not quantified since they are generally less than ambient background noise.

The height data given in Figure 25 through to Figure 29 are the theoretical minimum and maximum at which the aircraft should be operating. The only exceptions are the FAF altitude of 2,000ft – all aircraft should be at (or close to) this altitude here.

Compare the heights in your area of interest with Table 5 which gives equivalent sounds, allowing you to more easily interpret the potential noise impact.

Example Sound	**Noise level (L_{max}dBA)**
Kerbside of busy road, 5m away	80
Vacuum cleaner, 1m distance	70
Conversational speech, 1m away	60
Quiet office	50
Room in quiet suburban area	40

Table 5 Table of noise levels for equivalent sounds

It is expected that the majority of commercial aircraft operating on the procedures will remain broadly in line with the heights at which they operate today as LSA has tried where possible to maintain the same routes, turning points and level restrictions as today. For today's operating heights for Runway 23 see Figure 15 & Figure 16 and for Runway 05 see Figure 12 & Figure 13.

5.1.4 Runway 05 and DORUM Transition

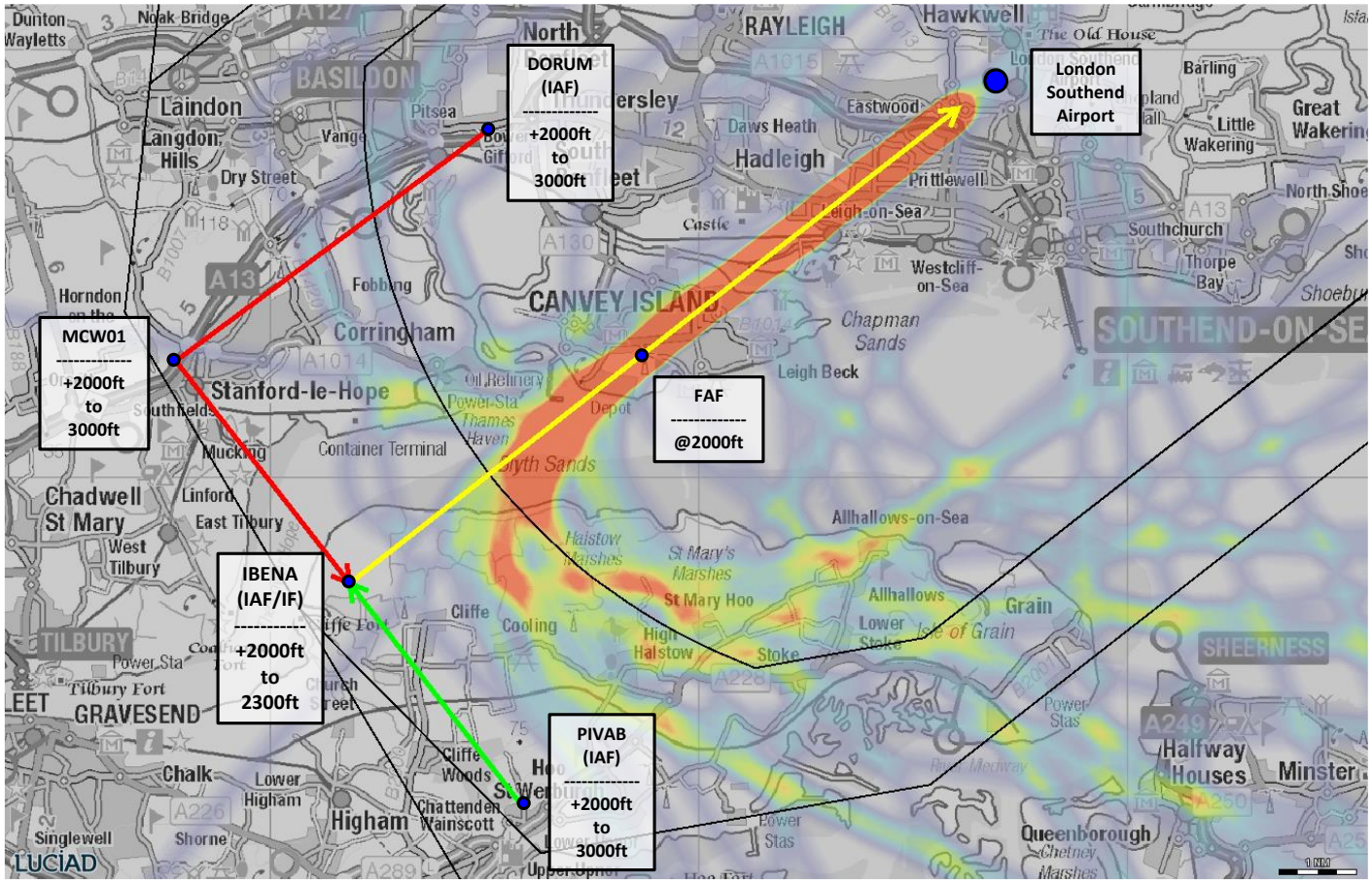

Figure 25: Proposed PBN route to join Runway 05 approach, with height details

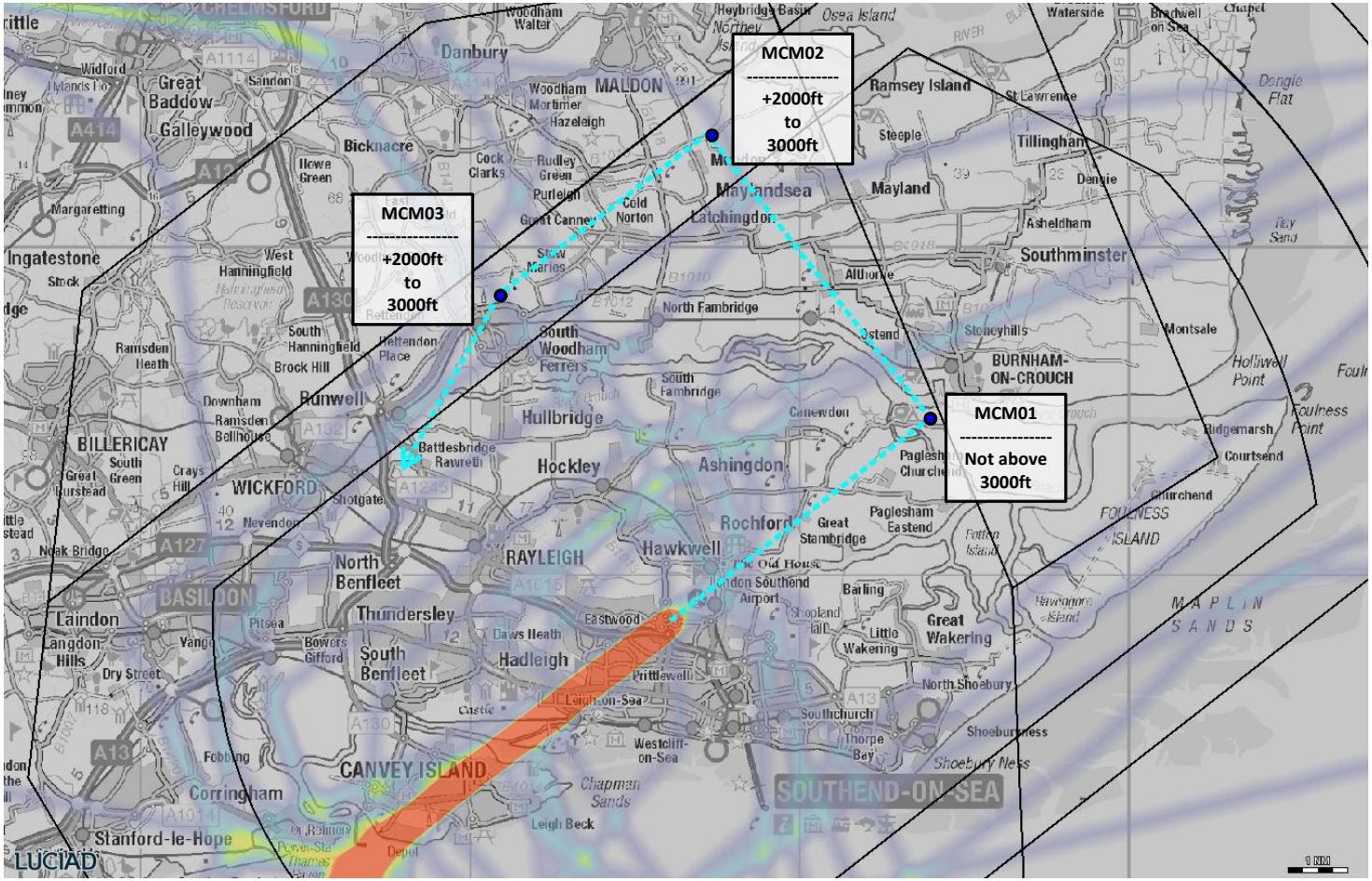

Figure 26: Proposed Runway 05 PBN missed approach, with height details

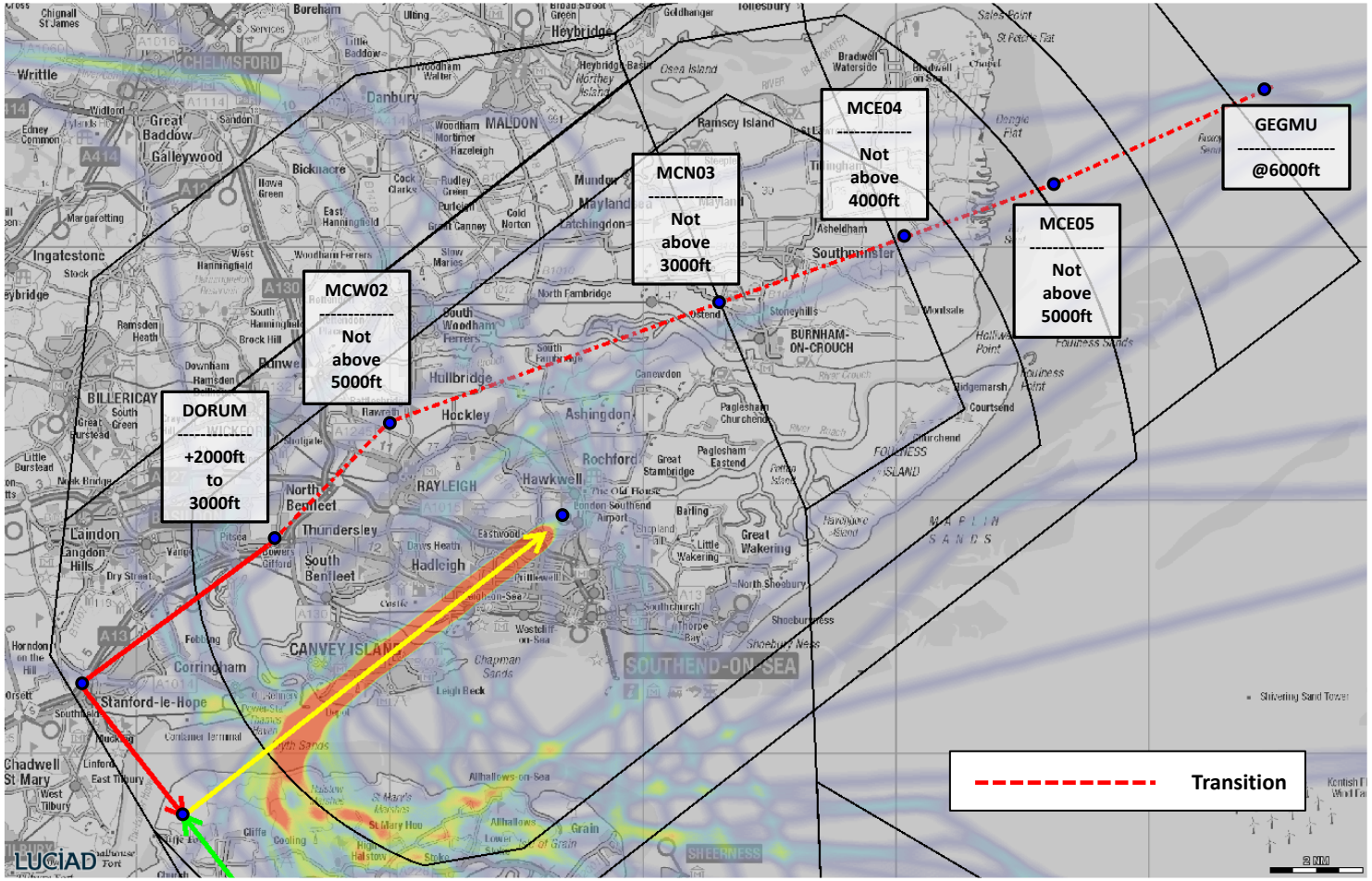

Figure 27: Proposed Runway 05 GEGMU PBN transition, with height details

5.1.5 Runway 23

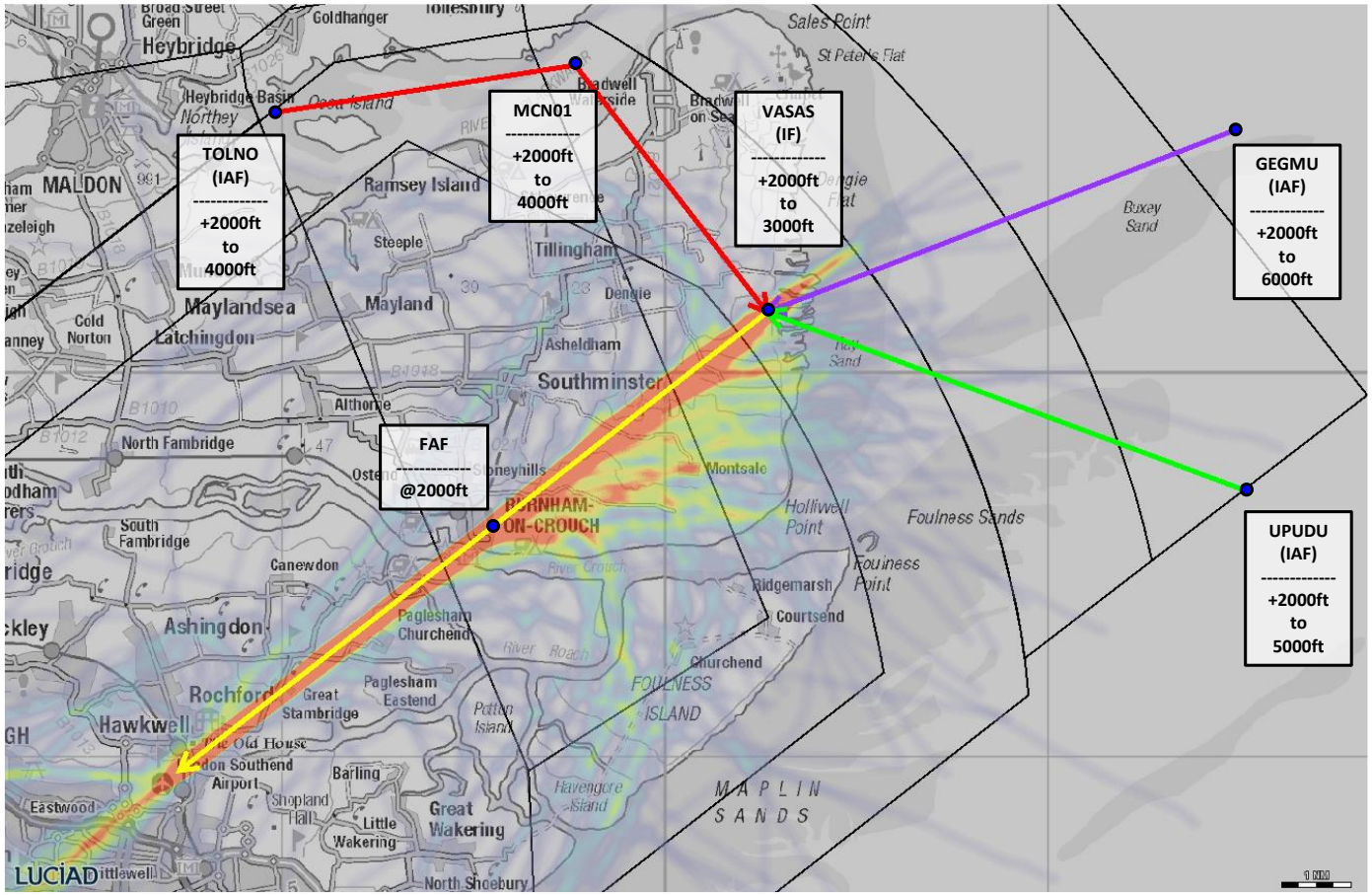

Figure 28: Proposed PBN route to join Runway 23 approach, with height details

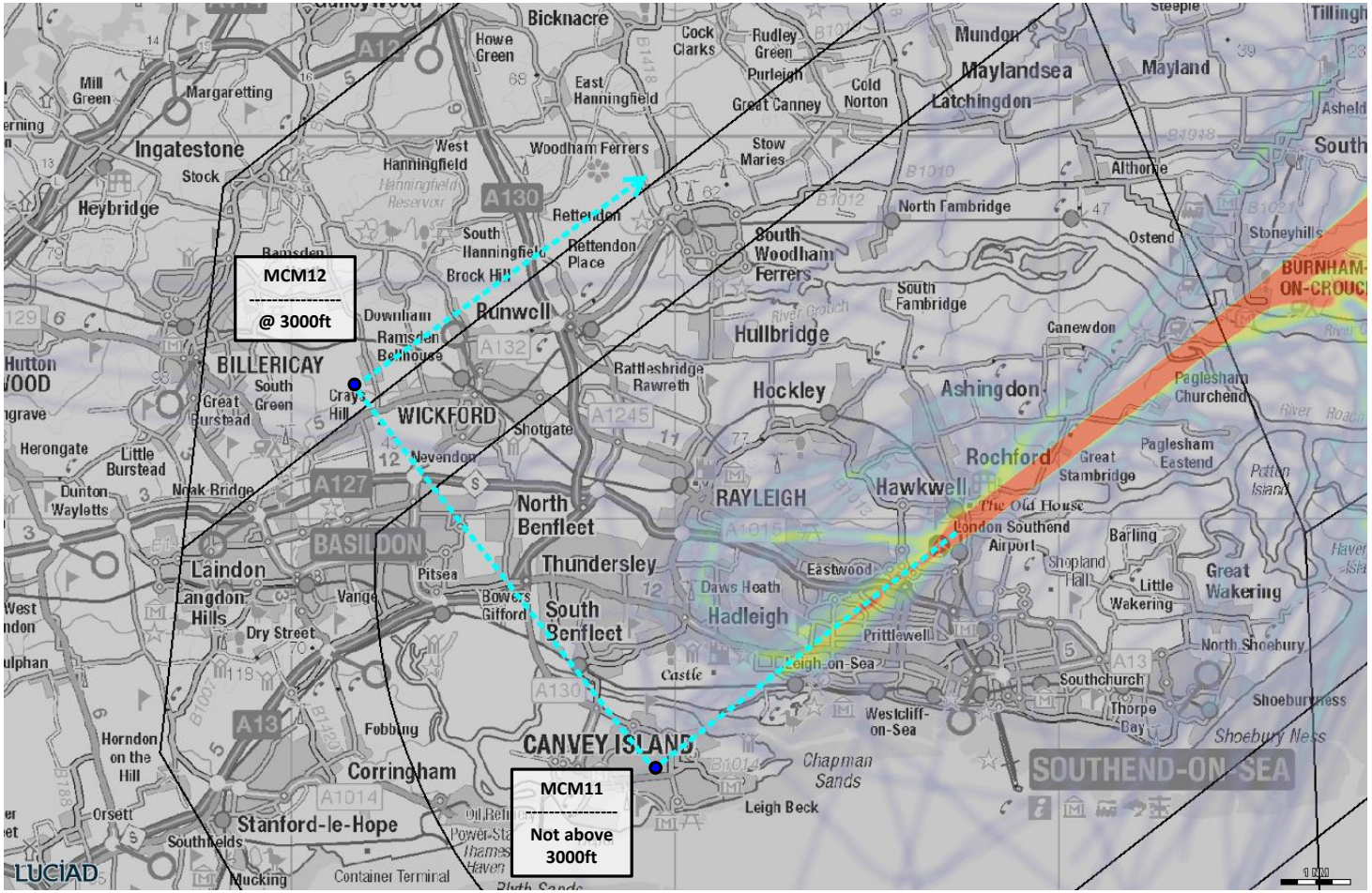

Figure 29: Proposed Runway 23 PBN missed approach, with height details

5.2 Uptake of PBN and Consequent Track Concentration

We expect the majority of LSA based commercial aircraft to be capable of flying the PBN routes. However not every flight may wish to fly PBN routes on every arrival and for tactical reasons ATC may wish to manage flights with vectors (or headings to fly). Also the proportion of aircraft equipped to fly PBN routes will increase over time. Thus it is anticipated that there will be a gradual progression to the use of the PBN routes. At the outset there should be no detriment compared with the current operation. Aircraft will fly similar flight paths, no lower than today, and at broadly the same speeds.

The numbers of aircraft utilising the PBN routes is similarly difficult to predict. In the short to medium term we expect that there will be little discernible difference to the tracks over the ground. Those aircraft which can use the new procedures will be tactically directed by air traffic control to take tactical shortcuts to the runway as they do today, to minimise track mileage where possible and to de-conflict from one another.

Over time it is expected that an increased number of aircraft will use the PBN routes without ATC intervention, resulting in increased traffic concentration along the new designed routes. However the rate at which this may occur is not something LSA can quantify.

Initially LSA is most likely to use the PBN routes as an alternative approach method when either radar or the ILS is unavailable. As previously discussed in Section 4.1.3 radar is most commonly unavailable -0130-0630 as it is not manned during these times whilst the ILS failure rate in 2016 was less than 0.4%. Therefore initial use of the procedures is likely to be low.

5.3 Routing

The proposed PBN routes have been designed to follow current aircraft track concentrations as closely as possible. This should reduce additional noise for people not already subject to it. However, in some instances the route has been positioned in order to avoid over-flight of populated areas. These deviations are considered in section 6.

5.3.1 Runway 23 Arrival Transition-PBN Approach

The arrival transitions for runway 23 start over the sea at GEGMU and UPUDU and make landfall over the coast in a sparsely populated area near Ray Sand. This is the same area in which aircraft currently turn for the runway and make their approach. Hence this represents a close replication of the current-day flight paths.

The route from TOLNO starts south of Heybridge and was carefully designed to track along the Blackwater estuary north of Osea Island. It makes a right turn to MCN01 at the point which threads through the villages in the area, to the southwest of Bradwell on Sea and to the northeast of Tillingham, ending at VASAS where it joins the yellow final approach path.

The final approach path replicates almost exactly the path flown by aircraft today both vertically and horizontally. See Figure 23.

5.3.2 Runway 05 Arrival Transition-PBN Approach

From the north at point DORUM a slight right kink was developed to take the track close to the A13 road as far north of Corringham as possible before turning left at MCW01 for point IBENA. It may be that in the instances where aircraft follow the entire procedure without intervention from ATC, Stanford-le-Hope will receive more aircraft overflying it than today. ICAO design criteria prevent the design from matching the current tracks for the last turn on to final approach. However in many instances ATC will intervene to turn aircraft onto final approach in the same areas as today.

The new procedures turn onto the final approach over a sparsely populated area. The final approach then almost exactly matches the vertical and lateral profile of today's flights.

From the south the route starts north of Rochester at PIVAB, then to IBENA before making the right turn on to final approach in the sparsely populated area north east of Cliffe Fort.

See Figure 20.

5.3.2.1 Runway 05 Arrival Transition

The PBN transition from GEGMU for runway 05 has been designed to avoid populated areas where possible. Current tracks are not well defined due to the large variation in tactical vectoring by ATC and they are mixed with tracks from aircraft routing from the north. See Figure 8 and Figure 9.

The transition starts at GEGMU, over the water and crosses the coast where aircraft turn for final approach to runway 23 today. It tracks to the south of Southminster and north of Burnham-on-Crouch and to the south of Hullbridge. It turns south to the north of Rayleigh and tracks over the A13/A130 motorway intersection to the north of Thundersley and South Benfleet to join the PBN approach procedure at point DORUM.

See Figure 22.

5.4 Visual Impact and Tranquillity

Visual impact and tranquillity are usually considered with respect to designated areas such as National Parks and Areas of Outstanding Natural Beauty (AONBs). The size and types of aircraft and the levels at which they operate are not expected to change as a consequence of this proposal.

As can be seen in Figure 2 the area around LSA is overflown by many more commercial aircraft than operate at LSA alone. The southeast of England is also popular with general aviation (GA) flyers that fly smaller aircraft, lower, and crisscross the entire area, especially on good weather days. It is possible that the introduction of PBN routes draws a number of smaller aircraft to LSA to operate and practice on, but it is unlikely that the introduction of these proposals would cause a noticeable change to visual intrusion in the area surrounding LSA.

5.4.1 National Parks, AONBs or Sensitive Areas

No AONBs or National Parks are directly overflown by the proposed routes although aircraft on the routes are likely to be visible from the AONBs and National Parks as they are today. Where possible consideration has been given to design the routes away from populated areas and over the water whilst also trying to minimise impact on wildlife reserves such as Osea Island and Blackwater Estuary.

5.5 CO_2 Emissions & Local Air Quality

5.5.1 CO_2 Emissions

Reducing fuel burn, and the consequent CO_2 emissions, is prioritised where aircraft operate above 7,000ft agl. The changes within this proposal are predominantly below 7,000ft therefore LSA has balanced emissions priorities against those of noise for portions of the change from 7,000ft to 4,000ft, in line with government guidance.

Sections 5.1 Noise and Section 6 Design Evolution & Considered Options demonstrate how LSA has balanced these competing priorities of reducing aircraft track miles in order to reduce emissions whilst trying to avoid overflying the most populated areas and achieving this within the restrictions imposed by the local airspace environment.

These proposals are not expected to affect the numbers of commercial aircraft operating at LSA but they could enable a more efficient operation of these aircraft by enabling better route and descent planning. Due to the uncertainty it is difficult to predict the change of CO_2 emissions. Hence LSA make no claims for CO_2 emissions benefit, however there should be no detriment/increase in CO_2 emissions per flight as a consequence of these proposals.

5.5.2 Local air quality

With respect to airspace change, government guidance only takes account of local air quality where changes are made to flight paths below 1,000ft AGL. None of the proposals include changes below 1,000ft.

6 Design Evolution & Considered Options

LSA set out to design the best routes possible within the restrictions imposed by the surrounding airspace and the PBN design guidance. The aim has been to implement routes for airline customers which optimise fuel burn/CO_2 emissions, while improving efficiency through predictability of flight paths, and taking account of the current government guidance to try to minimise new noise exposure to populated areas that are currently rarely exposed. At the same time LSA has looked for opportunities to reduce noise exposure to those currently affected by it.

With this aim the designs went through several iterations to arrive at the proposals presented in this consultation document.

This section of the document captures the design decisions and explains why certain routes were chosen over others.

6.1 Runway 23

6.1.1 Initial Approach Design

The first concept laid down for each approach is what is called the 'Y-bar' and the 'T-bar' due to the shape they create in plan view. See Figure 30.

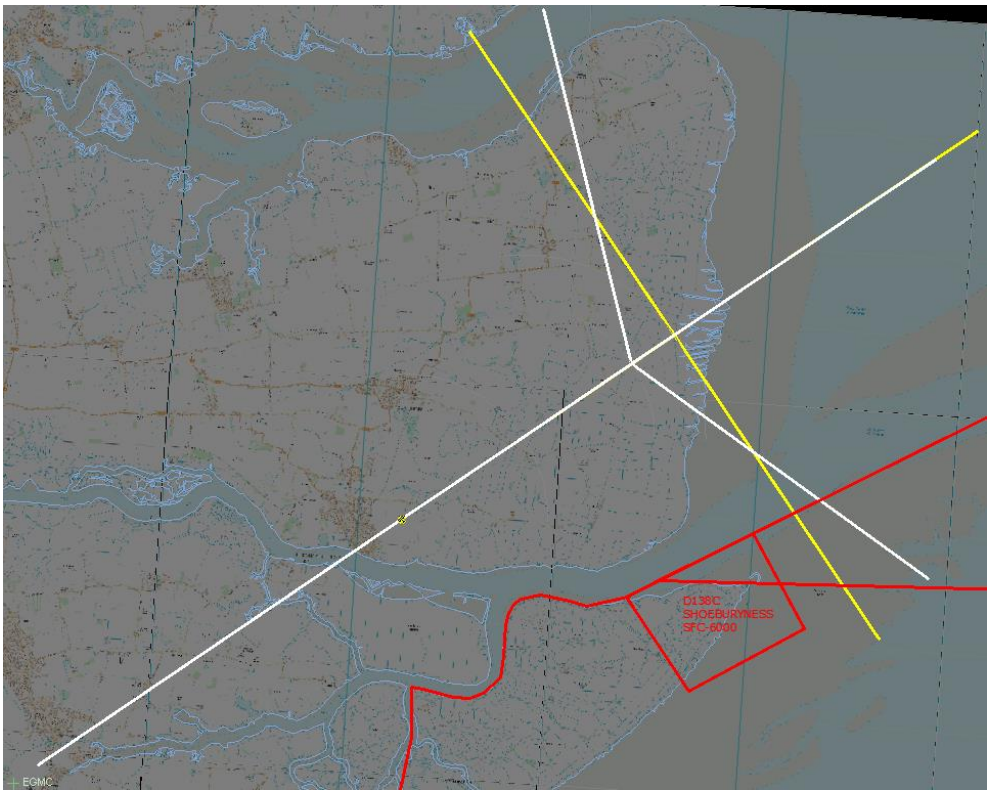

Figure 30: Runway 23, Y-bar & T-bar

During the initial design workshop the T-bar (in Yellow) was chosen over the Y-bar (White) as offering the most appropriate fit for LSA airspace. Aircraft would approach from each of the three ends of the Yellow cross and track towards the intersection. Prior to reaching the intersection from the cross sections they would turn inside of it and track along the White line towards the runway in the bottom left corner of the image.

If they approached from the northeasternmost point they would continue straight in along the Yellow and then the White line path.

6.1.2 Approach Iterations

After consideration the T-bar design was altered.

The straight-in initial approach segment in the top right corner was linked to point GEGMU (a pre-existing point at which the STARs from the east and south currently terminate). In addition the southern initial segment was shifted away from the Danger area D138C. As a result, this initial segment would now follow the Y-bar structure. See the Blue additions in Figure 31.

To the north there was concern that aircraft tracking towards that initial fix from the north west would fly over Osea Island. To remedy this, a 'wing bar' was added to the northern segment to route traffic south of the island.

Figure 31 illustrates the original T-bar design in Yellow against the revised designs in Blue. The half circle dotted areas illustrate the capture angle for the end points or IAFs. An aircraft can approach from an angle which is within that semi-circle and track along the path.

Further discussion revolved around the wing bar of the Initial Approach Fix (IAF). This was shifted to place the track and especially the 'elbow' over the water whilst still avoiding Osea Island. Two options for the revised wing bar were considered and are presented in Figure 32 below as magenta lines (one solid, one dashed). Of these two the dashed line was adopted to the final concept.

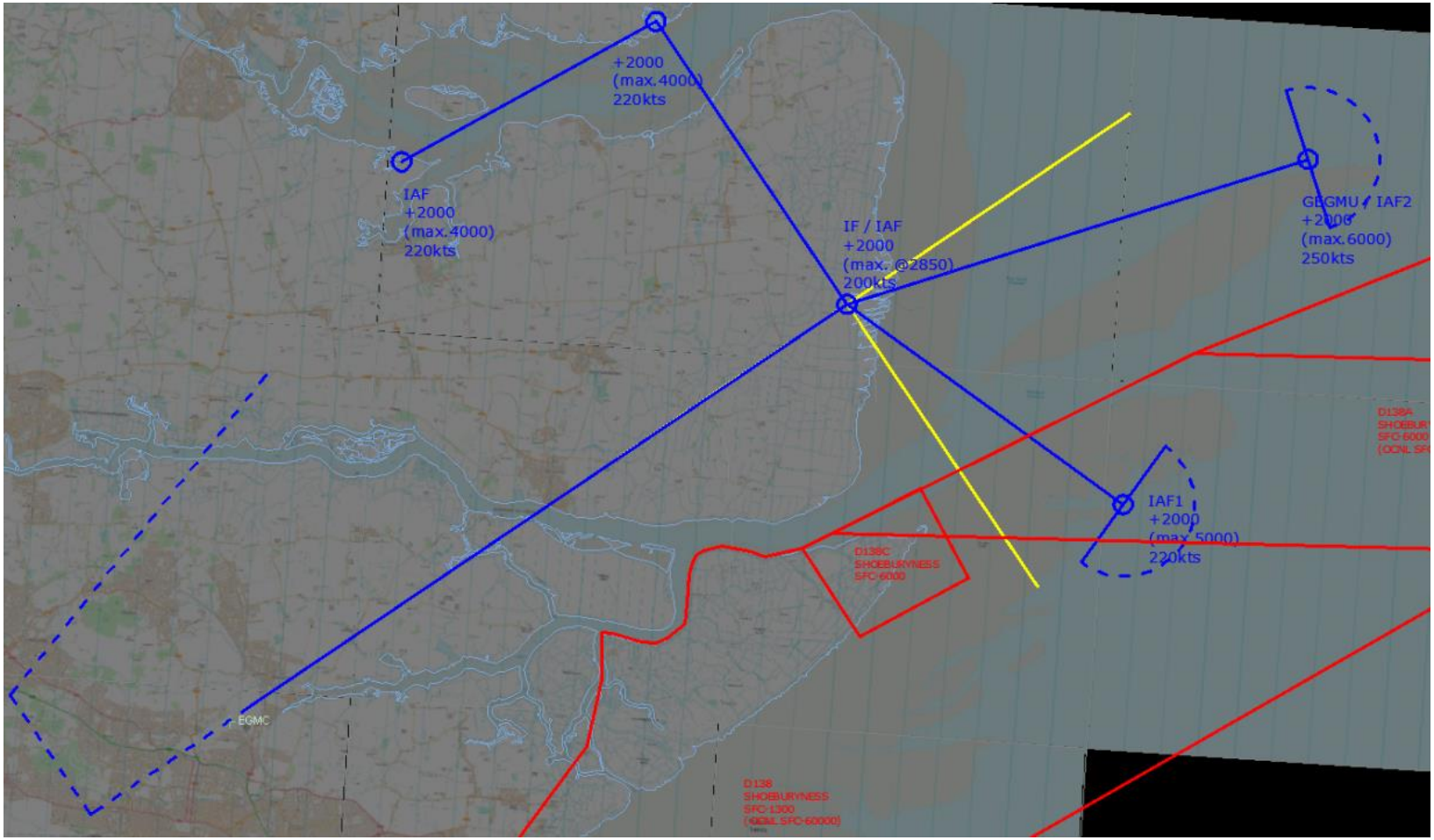

Figure 31: Runway 23, Initial Alterations

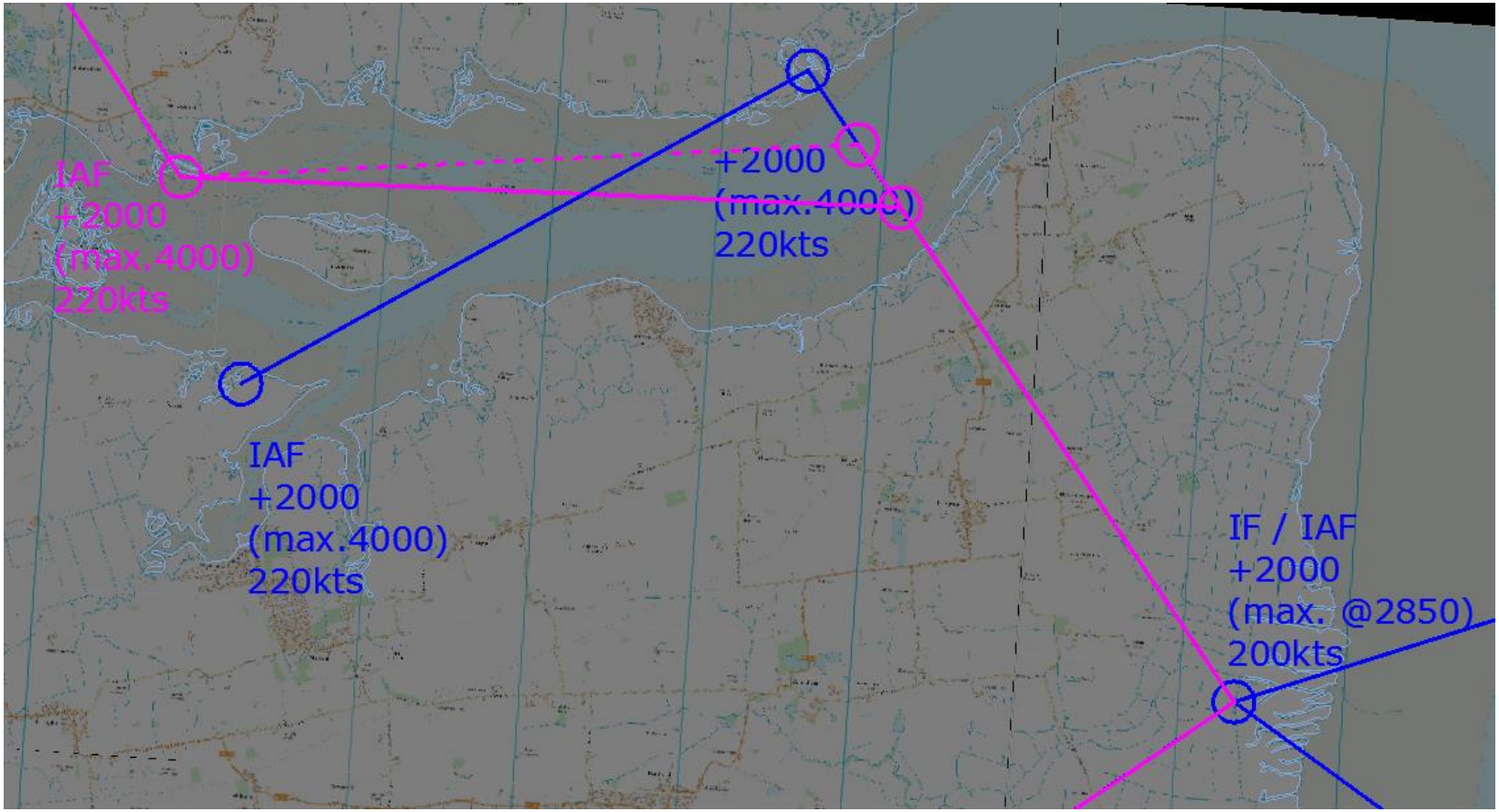

Figure 32: Runway 23 northern wing bar design options

6.1.3 Initial Missed Approach Design

The initial missed approach path was designed subject to the technical limitations imposed by the design authorities, however the general concepts of turn direction and the turn location were applied to try to deliver the optimal route to reduce noise for residents and improve predictability and flight profiles for aircraft operators as far as possible.

The designs would be subject to scrutiny and subsequent change as part of the iterative design process in the same manner as the arrival paths as previously described. The initial missed approach design, climbing straight ahead and then turning right 90° and then right again 75° can be seen in Figure 33, dotted line to the south west of the image. This design directs the aircraft towards the IAF to re-join the approach procedure, rather than returning the aircraft to overhead the airport as is the case with a standard conventional procedure.

6.1.4 Missed Approach Iteration

After some consideration and examination of the design criteria the missed approach design was changed to that illustrated in Figure 29 with two 90° turns to the right thus keeping the procedure as close to the airport as possible whilst still allowing the aircraft to return to the IAF or to be directed tactically by ATC.

Figure 33: Runway 23 initial missed approach design

6.1.5 Final Concepts

The final design for runway 23 including the missed approach procedure, closely followed the final iteration as described in Section 6.1 above and can be seen fully described Section 4.2.

6.2 Runway 05

6.2.1 Initial Approach Design

The first concept laid down for the approach is the 'Y-bar' and the 'T-bar' so named due to the shape they create in plan view. See Figure 34 for runway 05.

Figure 34: Runway 05, Y-bar & T-bar

During the initial design workshop the T-bar (in Yellow) was chosen over the Y-bar (White) as offering the most appropriate fit for LSA airspace. However due to restrictions with LSA airspace boundaries the straight-in segment which lies furthest to the west was removed leaving only the northern and the southern legs.

Aircraft would approach from each of the northern and southern ends of the Yellow cross and track towards the intersection. Prior to reaching the intersection from the cross sections they would turn inside of it and track along the White line towards the runway in the top right of the image.

In a further move the length of the straight-in section was shortened to draw the procedure further from the west and the edge of the airspace boundary.

6.2.2 Approach Iterations

After consideration the T-bar design was altered with the addition of another leg or 'wing bar' for each. Figure 35 illustrates these additional legs as well as the new position of the T-bar with wings (Purple) further to the east compared to the original T-bar (Yellow). ICAO design restrictions prevent the T-bar from being any closer to the runway. This means that the new routes are not an exact replication of the existing tracks and that the new tracks may present an increased number of over-flights overhead Stanfod-le-Hope.

It is however expected that this will be minimal for reasons covered in the main body of this consultation document.

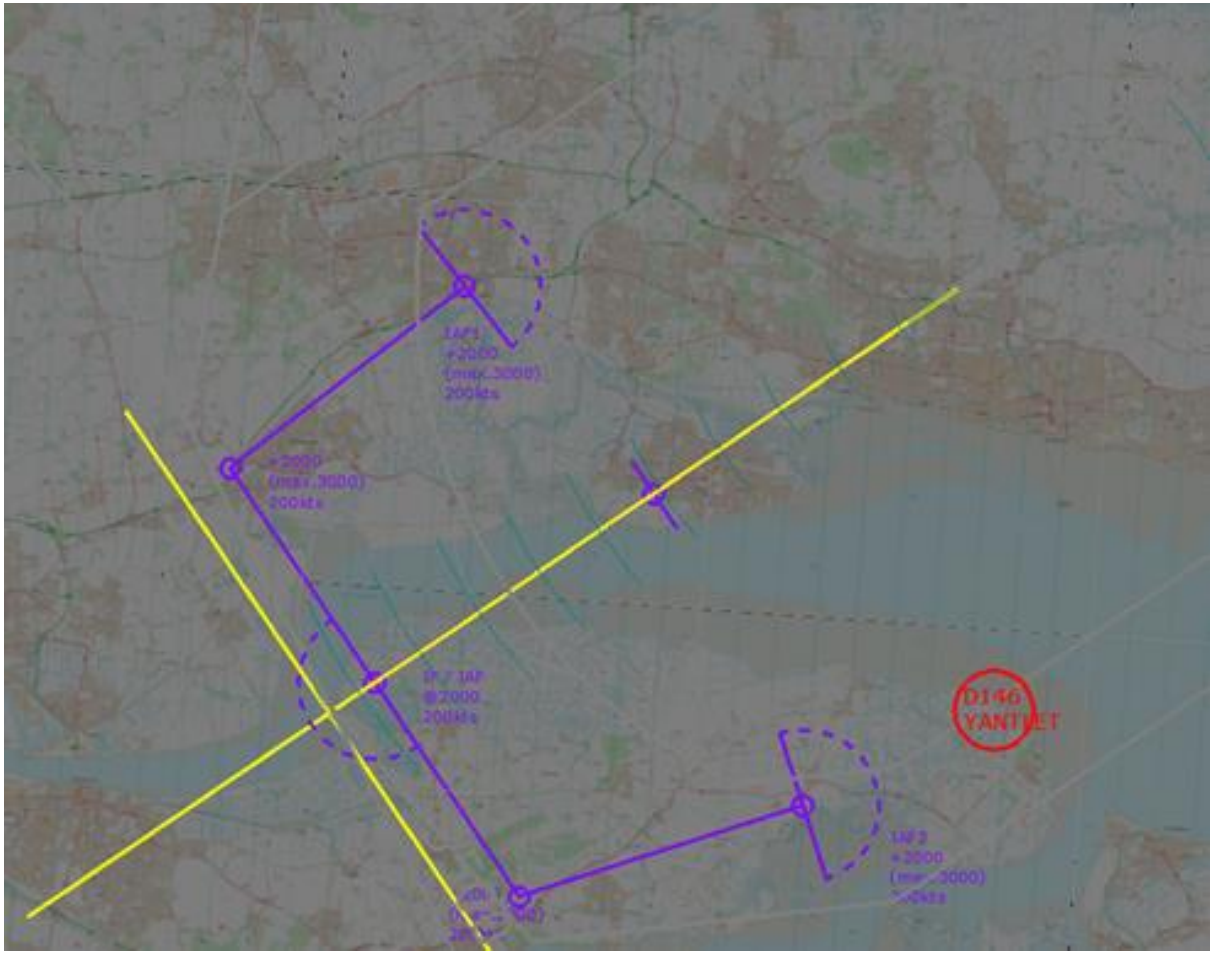

Figure 35: Runway 05 T-bar with additional 'wing bars'

During further design talks the northern wing bar was shifted to the north in order to move it away from Corringham/Stanford-le-Hope areas and the IAF (northern most point to the west) which was located over Basildon was moved away from the populated area, to a location approximately between Basildon and Benfleet (see Yellow tracks in Figure 36). Ultimately however design considerations and airspace restrictions mean that the final design resembles the purple tracks.

At the same time, the southern wing bar was moved further south to allow flying over the water rather than land and the track moved away from the three Stoke villages.

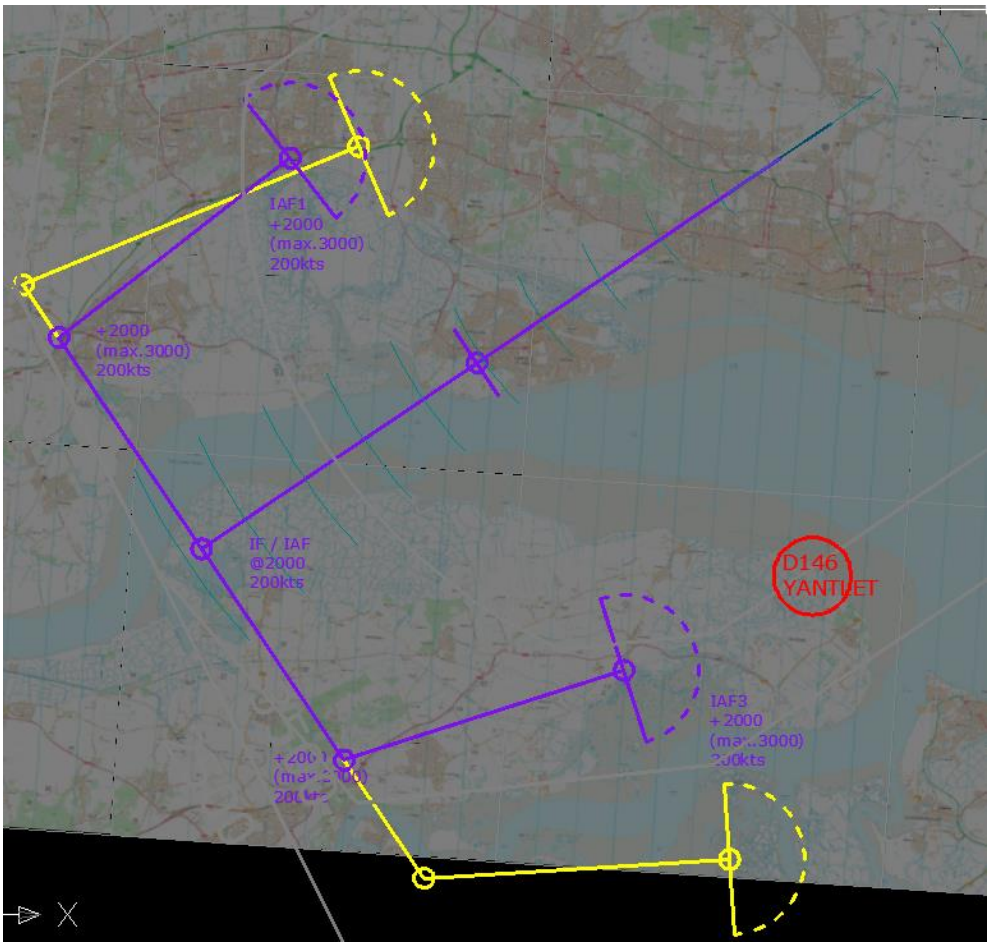

Figure 36: Runway 05, further design iterations of 'wing bars'

6.2.3 Initial Missed Approach Design

The initial missed approach path was designed subject to the technical limitations imposed by the design authorities however the general concepts of turn direction and the turn location were applied to try to deliver the optimal route to reduce noise for residents and improve predictability and flight profiles for aircraft operators as far as possible.

The designs would be subject to scrutiny and subsequent change as part of the iterative design process in the same manner as the arrival paths previously described. The initial missed approach design, climbing straight ahead and then turning right and/or left 90° (with the final turn direction to be decided in a later iteration) and then right and left again 85°, can be seen as blue dotted lines in Figure 37.

This design directs the aircraft towards the IAF to re-join the approach procedure, with tactical intervention from ATC, rather than returning the aircraft to overhead the airport as is the case with a standard conventional procedure.

Figure 37: Runway 05, missed approach initial design

6.2.4 Missed Approach Iteration

After some consideration and examination of the design criteria the initial missed approach design was changed to that illustrated in with a 90° left turn only and a further 90° turn after that, thus keeping the procedure as close to the airport as possible whilst allowing the aircraft to return to the IAF or to be directed tactically by ATC.

6.2.5 Final Concepts

The final design for runway 23 including the missed approach procedure is fully described in Section 4.2.

The runway 05 approach was altered further with the northern 'wing bar' having to be brought back to the south due to the limits of LSA airspace and how close this design would have placed that point to London airspace (see Figure 1 for London airspace chart) however the IAF remained between the populated areas of Basildon and Benfleet rather than over them.

The southern 'wing bar' proved to be impractical over the water and rather than place the track over the land the bar was removed completely. Figure 38 illustrates these changes with Purple showing the initial designs and Red the final design iteration.

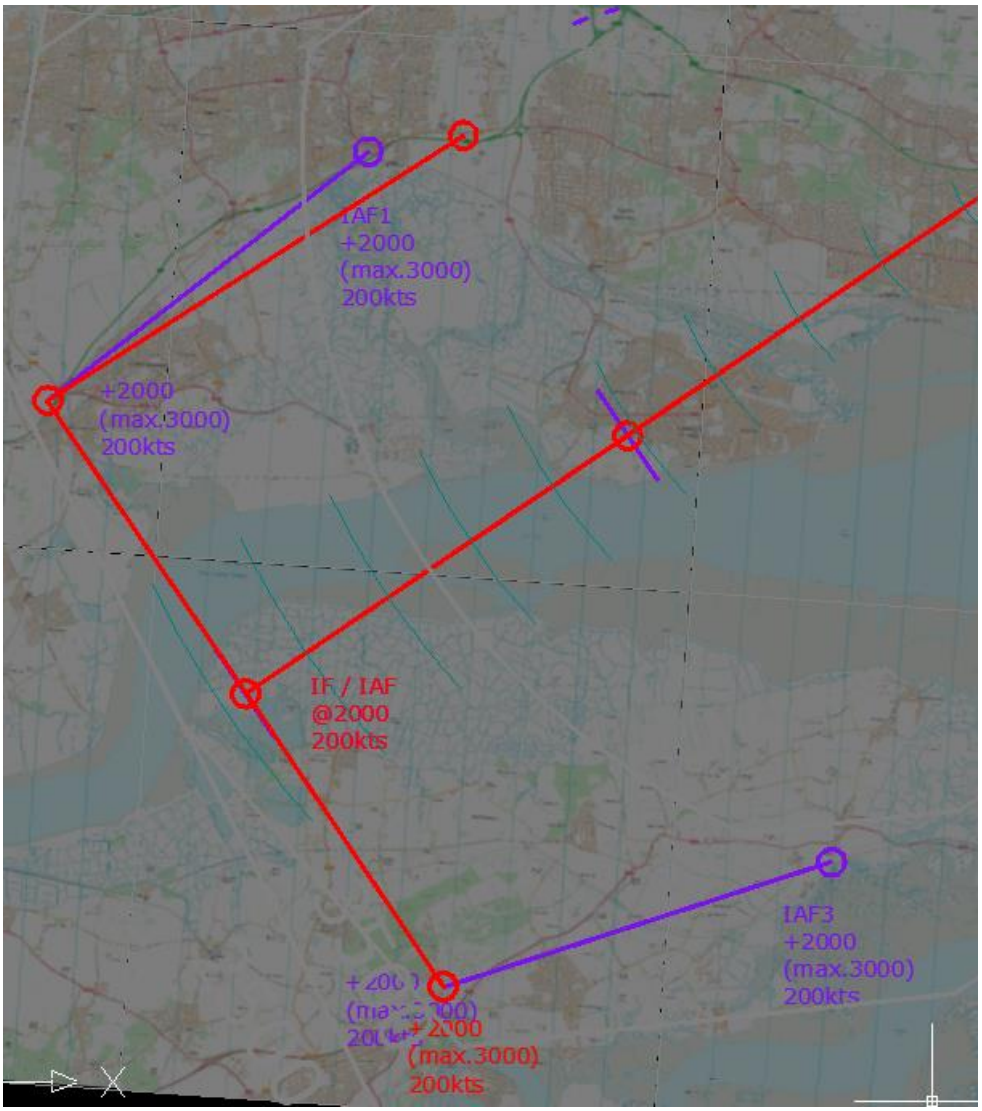

Figure 38: Runway 05, final design iteration

6.3 GEGMU Transition

The transition was required to link the end of the STAR at point GEGMU to final approach for runway 05 in a way which would keep traffic inside LSA controlled airspace. The new designs already allowed aircraft to proceed to runway 23 from GEGMU.

The first proposal drafted in the design workshops was a direct route from GEGMU to the northern IAF for runway 05. The end point (northern IAF) can be seen in Figure 38 (Red line, northwesternmost point), whilst the initial GEGMU proposals can be seen in Figure 39. This straight line design was the simplest and most direct solution. However, as the route crossed over the top of populated areas it was decided to add a turning point to the north of Rayleigh, to route aircraft to the north of that town and additionally away from Burnham-on-Crouch.

Following further discussion the final design has incorporated another turn to route traffic to the south of Southminster. Figure 39 illustrates the original direct line design (Purple), the first iteration (Yellow) and the final design (Black), with appropriate turning points.

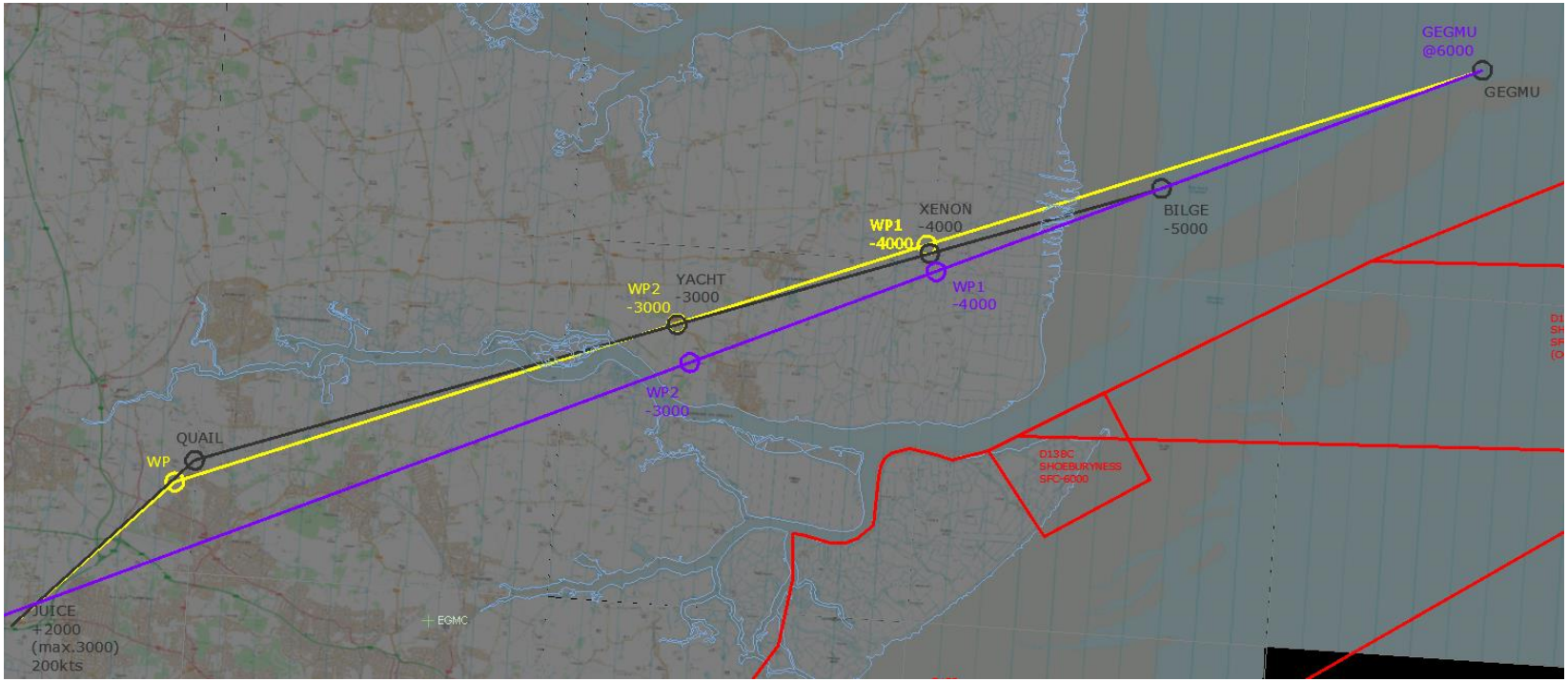

Figure 39: GEGMU Transition, to runway 05 IAF, illustrating design iterations

7 How do you participate?

The consultation will run for a period of 14 weeks and will close on Wednesday 13th September 2017 at 23:59.

The consultation document is available for download from our website

http://southendairport.com/corporate-and-community/proposed-arrival-routes

along with information about how to respond to the consultation.

7.1 How to respond

There are two ways to respond – by email, and by post.

Please use this email address to respond to the consultation: LSA.approaches@southendairport.com

Details of this email address and how to respond can also be found on the following page on our website

http://southendairport.com/corporate-and-community/proposed-arrival-routes

Please:

- Indicate clearly that this is your response to the consultation
- State clearly whether you support, object, or have no objection to the proposal.
- If you are responding on behalf of an organisation, ensure you make this clear.

E-mail responses will be automatically acknowledged.

If you are unable to submit your response by email you may do so in writing to the following address:

PBN Approaches Consultation
Project Manager
London Southend Airport
Southend-on-Sea
Essex
SS2 6YF

Responses sent by post will not be acknowledged. We recommend using a recorded delivery service.

All responses will be passed to the CAA. If you do not want your name and address to go to the CAA please make that clear in your response (see paragraph 7.7 below).

Responses received after the closing date of the consultation will be recorded and stored but will not form part of the analysis.

We cannot guarantee that a response submitted by any other means, than those above, will be accounted for in the consultation.

Whilst we will not enter in to correspondence with individuals, if you have any queries about our proposals then please contact us by email or in writing as detailed above, indicating clearly that it is a query. We will endeavour to reply as soon as is practicable. We ask that any queries are sent early on in the consultation process to ensure there is time for us to provide the required information and there is still time for a response to be submitted.

7.2 Who are we consulting?

LSA has developed a comprehensive list of stakeholders who may be affected either positively or negatively by the proposals, including local and national bodies, Airspace Users, MPs and both Local and Parish councils. LSA will email these consultees directly, whist local media publications will be used to invite people to respond via our dedicated web page.

The UK is currently in a period of Purdah due to the dissolution of Parliament on 3 May 2017. This means that every MP's House of Commons seat is vacant until after the general election on 8 June 2017. LSA has identified a number of constituencies which may have an interest in the proposals and plans to contact the MPs for those constituencies following the election on the 8th June.

A full list of stakeholders can be found at Appendix B: List of Stakeholders.

The consultation is also open to any interested parties / individuals who wish to provide feedback on the proposals.

7.3 What if you have no comment to make on the proposals?

We would still like to hear from you even if you have no comment to make on these proposals.

It is useful information for us to know that you considered the information we have provided. We ask you to respond as per the guidance given in this section.

7.4 What happens with the responses?

Following the consultation, LSA will analyse all responses to determine if any local information and feedback affecting the preferred options presented in the consultation document has not previously been considered. Responses to the consultation will be analysed to identify the concerns and comments of respondents.

The final designs will look to address comments and concerns raised during the consultation where possible, and our final route options will be submitted to the CAA as our Airspace Change Proposal.

7.5 Can I have a copy of the consultation responses?

A Feedback Report will be published following the consultation which will summarise the key issues raised. This report will be made available through our website for download. No personal details of respondents will be included in the Report.

7.6 Who monitors the consultation and who can I contact if I have concerns?

The consultation is being conducted by London Southend Airport (LSA). The Civil Aviation Authority's Safety And Airspace Regulation Group (SARG) will oversee the consultation and ensure that it adheres to the process laid down in CAP725 and government guidelines.

If you have any complaints about how this consultation has been conducted, these should be referred to:

Airspace regulator (Coordination)
Airspace, ATM & Aerodromes
Safety & Airspace Regulation Group
CAA House
45-49 Kingsway
London WC2B 6TE

Please note that this address is for concerns and complaints regarding the non-adherence to the defined consultation process and SARG will not engage in communication regarding the proposed changes.

Comments regarding the airspace change proposal should be addressed following the guidance in Section 7.1 How to respond.

7.7 Will my query/response be treated as confidential?

The CAA requires all consultation material, which includes copies of responses, to be included in any formal submission.

LSA undertakes that personal details or content of responses or submissions will be treated in line with our privacy policy.

Please advise us in your response if you do not wish for your personal details to be forwarded to the CAA as part of the formal response submission. The data that we pass to the CAA is bound by the Data Protection Act.

7.8 Analysis of the consultation feedback

On completion of the consultation we will analyse all responses and compile a Feedback Report of the consultation. We will identify any major themes that emerge from the consultation and make a response to them in the Report. The Report will be posted on the LSA website and will form part of the formal ACP. We consider all relevant feedback received from consultees or the general public, taking into account the guidance from government and the CAA and the various CAA policy requirements.

Where it is identified that a change to the proposed procedure designs may be of overall benefit, taking due regard of the safety, procedure design criteria and airspace management constraints, we will consider implementing changes. However, as stated previously, some changes may be individually desirable from a community point of view, but may not be feasible for procedure design or operational reasons or may be outweighed by dis-benefits to other communities.

The feedback from the consultation will be made available to the CAA as part of the airspace change proposal. This will allow them to ensure that LSA has drawn the appropriate consultations from the feedback received whilst, at the same time, complying with the procedure design and consultation process.

It should be noted, that although some changes may be individually desirable from a community point of view, they may not be possible for procedure design or operational reasons and may even be outweighed by dis-benefits to other communities.

It will be the CAA's decision whether or not be approve the procedures that we submit following this consultation.

The CAA's decision will be published on their website.

7.9 What happens next?

After the publication of the Consultation Feedback Report, LSA will compile a formal Airspace Change Proposal (ACP) for submission to the CAA, together with the proposed procedure designs. We expect to make this submission in Winter 2017. An ACP is a package of documents, data and evidence that the CAA uses to determine if a proposed airspace change has merit.

The CAA will assess the ACP in accordance with CAP725 and will assess the procedure designs in accordance CAP778 and CAP785.We expect a regulatory decision from the CAA in Spring 2018.

If the CAA were to approve the ACP and procedure designs, LSA would expect the approaches to be promulgated in the UK AIP by Summer 2018.

If approved, the CAA will conduct a Post Implementation Review (PIR) a year after the procedures have been in operation to ensure that the objectives of the change are being met. The review will be published on the CAA website.

Appendices

Appendix A: Technical Details

Variations of PBN and the difference between RNAV and RNP

There are several variations of PBN; LSA is interested in two of these.

- RNAV (Area Navigation) - precise navigation but without the aircraft having an on-board conformance monitoring capability. This means that whilst the aircraft navigates to a high level of accuracy using satellite and ground based references, it will not monitor its own performance against the track over the ground which it is keeping. Air Traffic Control (ATC) monitor flights (as is routine) to ensure accuracy of track keeping. There are 3 different levels of accuracy RNAV10/RNAV5/RNAV1 the figure refers to the navigational accuracy: i.e. RNAV1 - the aircraft will be within 1nm of the centre-line of the prescribed track for more than 95% of the time. In reality this is a minimum performance and the majority of the time the aircrafts' track keeping accuracy will be much higher than this. Typically, along straight segments, aircraft following an RNAV1 route will be within 0.2nm of the route centreline.
- RNP (Required Navigation Performance) – precise navigation with the additional capability that the aircraft is able to monitor its own track keeping performance. The levels of navigational accuracy possible are RNP4/RNP2/RNP1/RNP0.3/RNP APCH AR (accuracy +/- 0.1nm). RNP gives the potential for extremely accurate track keeping with the lowest level of RNP navigational accuracy (RNP Approach, Approval Required) having accuracy of +/- 0.1nm i.e. 95% of the time the aircraft will be within 0.1nm of the centre line of the prescribed track. All RNP equipped aircraft can operate in an RNAV environment whilst RNAV only aircraft cannot operate in an RNP mode.

Figure 40 details the variations of PBN and highlights the variations to be deployed at LSA.

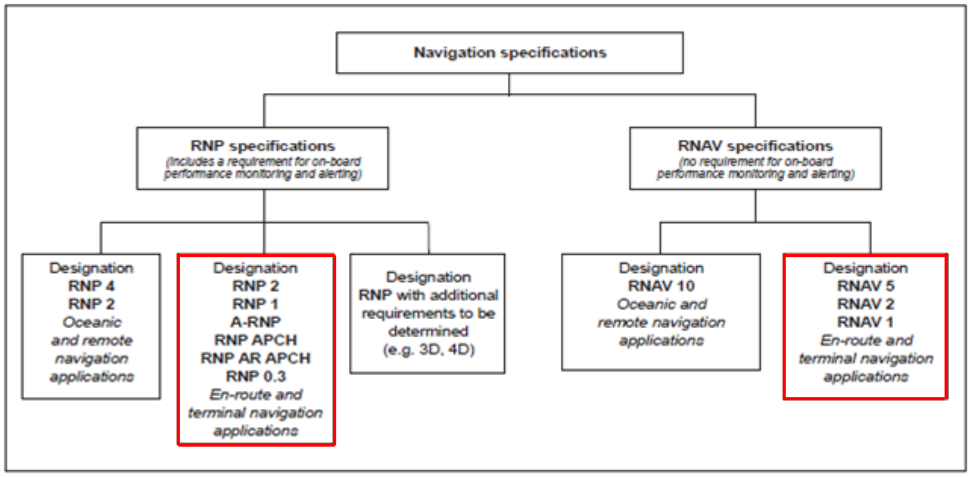

Figure 40: PBN Specification, Versions of RNAV & RNP to be used by LSA outlined in red

Why PBN and why now?

The CAA, with support from the Department for Transport, the Ministry of Defence, NATS and the Irish Aviation Authority, has been leading work to develop the Future Airspace Strategy (FAS) for the period to 2030. The CAA's primary objective is to develop a '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'.

This national strategy is aligned with the UK's commitments under the Single European Sky (SES) legislation, including implementation of the Single European Sky Air Traffic Management Research (SESAR) programme. The aim of this proposal is to build on these UK and European initiatives, utilising the latest navigation technology to enable the previously described benefits of noise and emissions.

This will entail the redesign of the UK's airspace to facilitate the use of new procedures such as PBN and better queue management techniques.

Which of the new routes at LSA will be RNAV and which will be RNP?

Figure 41 below details the tracks to be deployed with this proposal. The colour code illustrates that the Red, Green, Purple dashed and Red dashed lines are RNAV routes, whilst the Yellow lines are RNP. The Yellow paths are not part of this proposal but do make up a part of the new routes. They are already under consideration by the CAA as part of a separate proposal and will represent virtually no change from today final approach path.

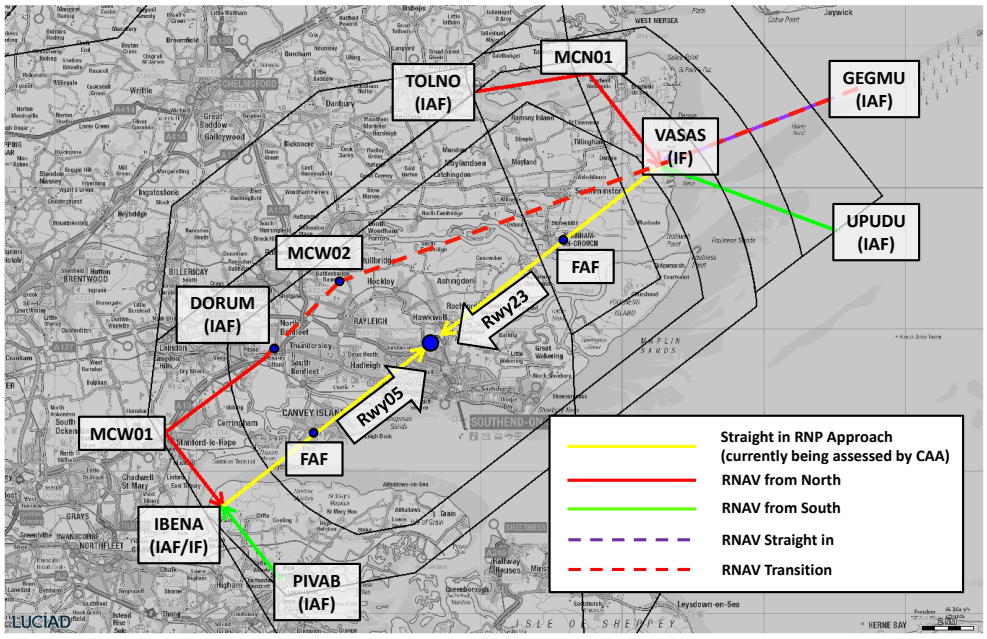

Figure 41: RNAV and RNP routes at LSA

Appendix B: List of Stakeholders

This list identifies those stakeholders known to have an interest in this proposal. It is not exhaustive and any individual or organisation may respond to this consultation.

1. NATMAC
2. NATIONAL / LOCAL Bodies / Groups
3. Airlines / Airfields / Flying Clubs / Private Jets
4. Kent Councils
5. Essex Councils
6. MPs

1. NATMAC

Airport Operators Association	Aircraft Owners and Pilots Association UK	Aircraft Owners & pilots Association
Airlines	Aviation Environment Federation	British Airways
BAE Systems	BALPA	British Balloon and Airship Club
British Business and General Aviation Association	Gliding Association	Hang Gliding and Paragliding Association
British Microlight Aircraft Association & The General Aviation Safety Council	British Model Flying Association	British Parachute Association
British Helicopter Association	Honourable Company Air Pilots	Light Aircraft Association
Guild of Air Traffic Control Officers	Helicopter Club of Great Britain	Heavy Airlines
The Future Airspace Strategy VFR Implementation Group	General Aviation Alliance	Light Airlines
Low fares Airlines	NATS	PPL/IR Europe
Unmanned Aerial Vehicles Society	UK Airprox Board	UK Flight Safety Committee
3 AF-UK/A3	Aviation Division Naval Command HQ	Naval Command HQ
Airfield Operators Group	Defence Airspace & Air Traffic Management	Isle of Man

2. NATIONAL / LOCAL Bodies / Groups

Natural England	CPRE - Essex	CPRE - Kent
English Heritage	Environment Agency	Friends of the Earth
National Trust	SAEN	Airport Consultative Committee
RSPB	Friends of North Kent Marshes	QinetiQ

3. Airlines / Airfields / Flying Clubs / Private Jets

easyJet	ESSEX PASU	Barling
Stobart Air	BA CityFlyer	Biggin Hill Airport
Flybe	Volotea	Laindon (Bensons Farm)
Essex Air Ambulance	CityJet	London City Airport
London Stansted Airport	Stow Maries Airfield	Seawing Flying Club
Rochester Airport	Thurrock Airfield	Southend Flying Club
St Lawrence Airfield	Tillingham Strip	Avionicare
Stapleford Aerodrome	London Luton Airport	Select Plant
Stoke Microlight	London Heathrow Airport	London Executive Aviation / Execujet
Kings Aviation	Terry Holding	Woodgate
Net Jets	Air Hamburg	Capital Air Ambulance
JOTA	Excel Charter	Apollo Air Services
Flightworx		

4. Kent Councils

Kent County Council	Higham Parish Council	Frindsbury Extra Parish Council
Gravesham Borough Council	Cliffe and Cliffe Woods Parish Council	High Halstow Parish Council
Medway Council	Cooling Parish Council	Hoo St Werburgh Parish Council

5. Essex Councils

Essex County Council	Ashingdon Parish Council	Rayleigh Town Council
Southend Borough Council	Barling Magna Parish Council	Rochford Parish Council
Rochford District Council	Canewdon Parish Council	Stambridge Parish Council
Castlepoint Borough Council	Foulness Parish Council	Sutton Parish Council
Basildon District Council	Great Wakering Parish Council	Billericay Town Council
Chelmsford City Council	Hawkwell Parish Council	Bowers Gifford and

		North Benfleet Parish Council
Maldon District Council	Hockley Parish Council	Great Burstead and South Green Village Council
Thurrock Council	Hullbridge Parish Council	Noak Bridge Parish Council
Leigh Town Council	Paglesham Parish Council	Ramsden Bellhouse Parish Council
Canvey Island Town Council	Rawreth Parish Council	Ramsden Crays Parish Council
Shotgate Parish Council	Bradwell on sea Parish Council	Goldhanger Parish Council
Althorne Parish Council	Burnham on Crouch Town Council	Hazeleigh & Woodham Mortimer Parish Council
Asheldham Dengie Parish Council	Cold Norton Parish Council	Heybridge Parish Council
Latchingdon Parish Council	St Lawrence Parish Council	East Hanningfield Parish Council
Little Totham Parish Council	Steeple Parish Council	Rettendon Parish Council
Maldon Town Council	Stow Maries Parish Council	Runwell Parish Council
Mayland Parish Council	Tillingham Parish Council	South Hanningfield Parish Council
Mundon Parish Council	Tollesbury Parish Council	South Woodham Ferrers Town Council
North Fambridge Parish Council	Tolleshunt D'Arcy Parish Council	Woodham Ferrrers and Bicknacre Parish Council
Purleigh Parish Council	Tolleshunt Major Parish Council	Southminster Parish Council
Danbury Parish Council		

6. MPs

MP for Southend East	MP for Maldon	MP for Chelmsford
MP for Rayleigh	MP for South Basildon & East Thurrock	MP for Thurrock
MP for Southend West	MP for Basildon and Billericay	MP for Rochester and Strood
MP for Castle Point	MP for Gravesham	MP for Witham

Appendix C: Acronym List

Acronym	**Full Term**
ACC	Airport Consultative Committee
ACP	Airspace Change Proposal
agl	Above Ground Level
ANCON	Aircraft Noise Contour Model
AONB	Area of Outstanding Natural Beauty
ATC	Air Traffic Control
ATM	Air Traffic Management
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAS	Controlled Airspace
CDA	Continuous Descent Approach
CO2	Carbon Dioxide
dB	Decibel (measure of sound level)
dBA	Decibel A Weighted
DAP	Director of Airspace Policy
ERCD	Environmental Research & Consultancy Department (CAA)
EU	European Union
FAS	Future Airspace Strategy
FAF	Final Approach Fix
ft	Feet (unit of measurement)
GA	General Aviation
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation
IF	Intermediate Fix
ILS	Instrument Landing System
LSA	London Southend Airport
LTMA	London Terminal Manoeuvring Area
MP	Member of Parliament
NATMAC	National Air Traffic Management Committee
nm	Nautical Mile
PBN	Performance-Based Navigation
PIR	Post Implementation Review
RNAV	aRea NAVigation
RNP	Required Navigation Performance
SARG	Safety & Airspace Regulation Group
SES	Single European Sky
SESAR	Single European Sky ATM Research
STAR	Standard Terminal Arrival Route
UK	United Kingdom
WP	Waypoint

End of consultation document