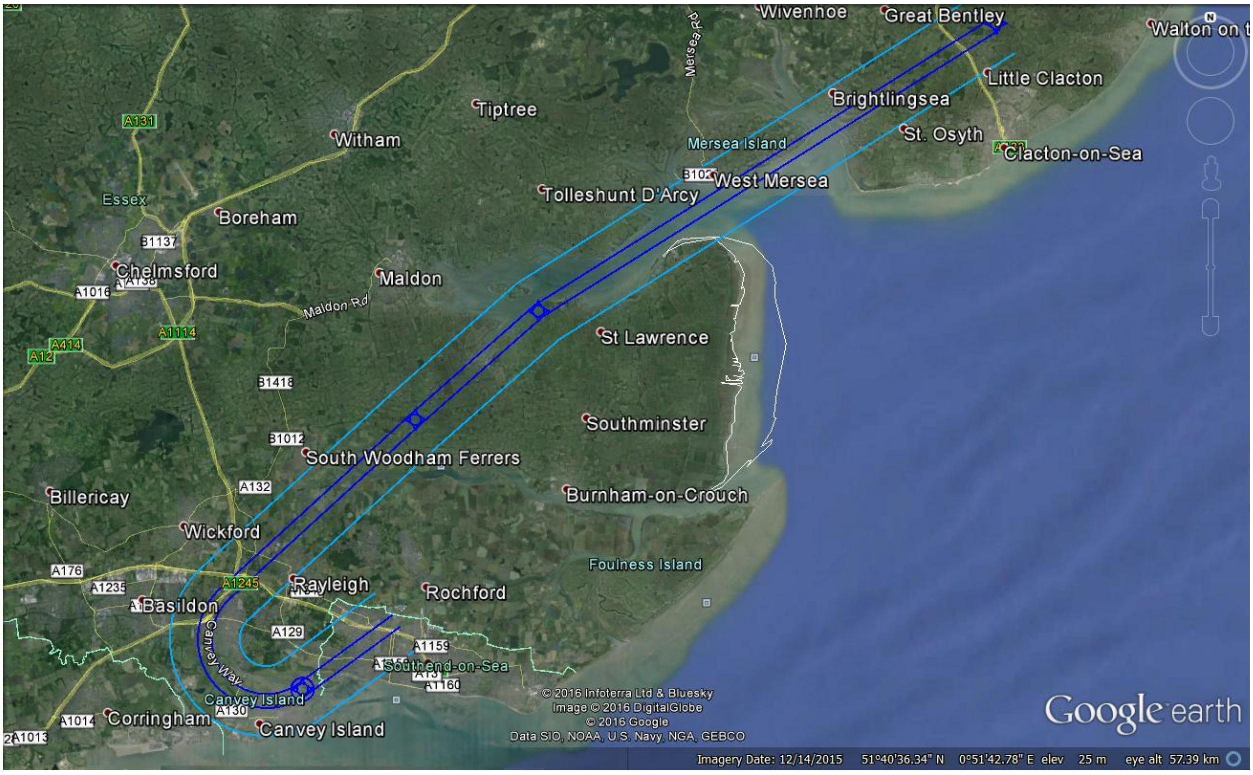
London Southend Airport
Airspace Change Proposal

Introduction of Standard Instrument Departure Procedures
to Routes in the London Terminal Control Area

Sponsor Consultation - 2016

Annex B to Part B
of the Consultation Document
Runway 23 Departures via CLN



Contents of Annex B to Part B

1. Runway 23: Departures to the east (CLN)

1.1. The procedure is known as the **CLN 1F** SID and reflects as closely as practicable the PDR from Runway 23[1].

1.2. CLN is the site (to the north of Clacton-on-Sea) of an historic ground-based navigation facility (Clacton VOR/DME) which defines Airways and eastbound routes from the London-area airports to the east towards the North Sea.

1.3. Current utilisation of this route (Summer 2015) is approximately 30 flights per week when runway 23 is in use. Forecast traffic growth is expected to lead to approximately 90 flights per week by 2021.

1.4. Figure B1 and B2 below show historic tracks of easyJet and Stobart Air aircraft departing from runway 23 via CLN over comparable 5-week periods in July/August 2014 and 2015 respectively[2].

1.5. Also, as detailed in Section 5 of **Part A** of the consultation document, once aircraft are beyond the end of the NAPs they may be tactically routed by LTC or LSA controllers for integration with other traffic flows. This is demonstrated by a number of plots routing to the north or south of the core plots as they are given a more direct routing to their destination once at higher levels in LTC airspace.

[1] As detailed in the main body of the Consultation Document, prior to November 2015 the runway designation at LSA was Runway 24. From November 2015 the designation is Runway 23 due to magnetic variation changes. For ease of reference, the runway is referenced as Runway 23 throughout this document, notwithstanding that for the presentation of historic data it was then designated Runway 24.

[2] It should be noted that the departures in 2014 took place before the introduction of controlled airspace around LSA and thus may include depiction of track deviations below 3500ft to avoid unknown aircraft in proximity to their intended route.

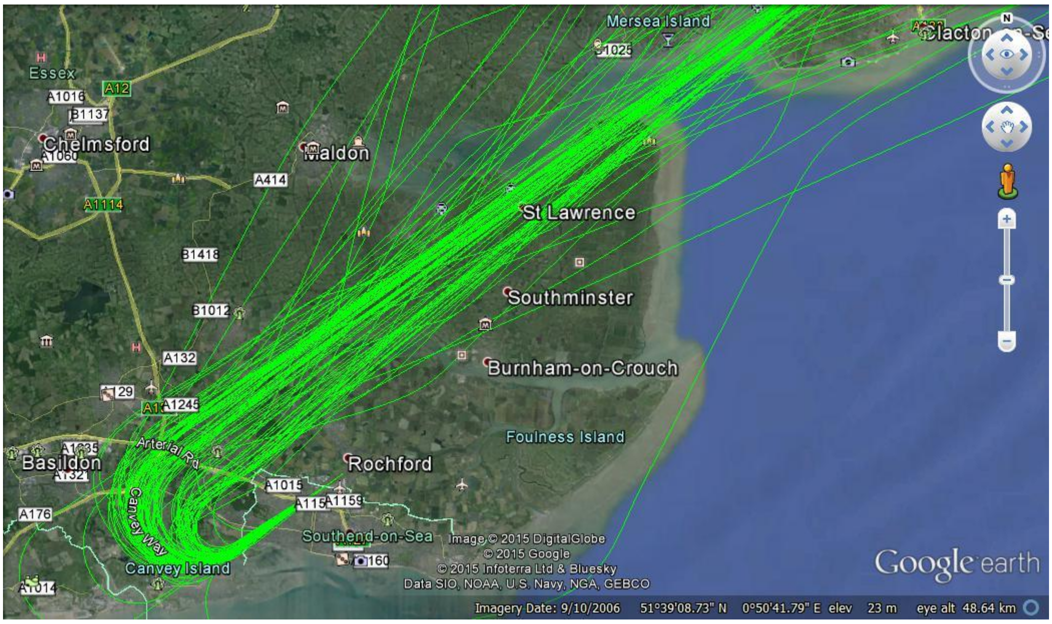


Figure B1: Runway 23. Historic departure tracks 5-week period Jly/Aug 2014 via CLN

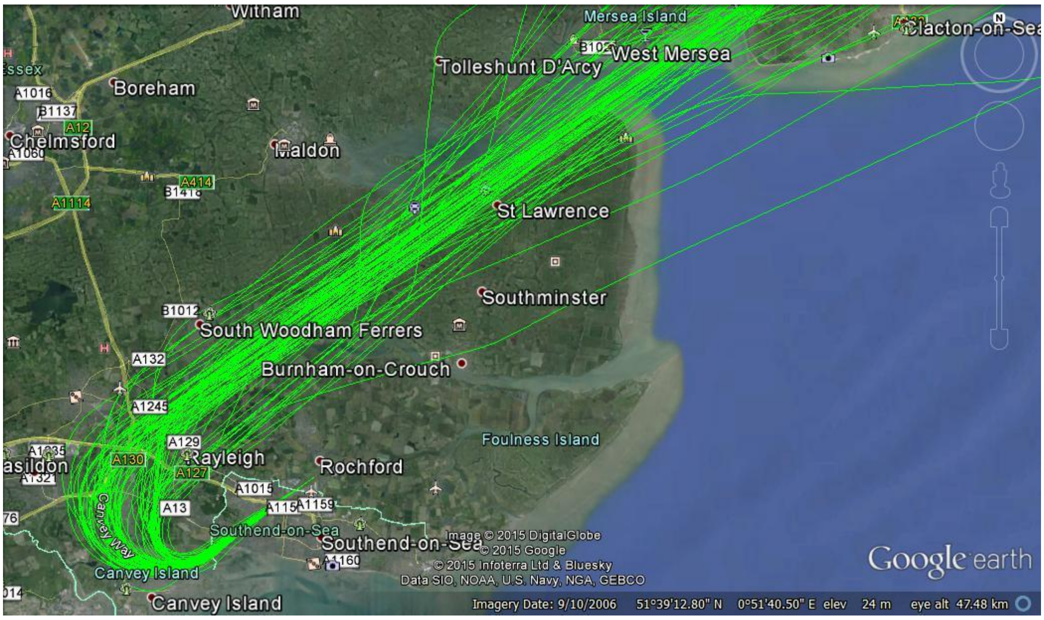


Figure B2: Runway 23. Historic departure tracks 5-week period Jly/Aug 2015 via CLN

2. The CLN 1F SID procedure

2.1. Climb on course 235°M to MCW03, to cross MCW03 not below 1500ft (CF leg). Turn right to MCN16 on course 048°M, then to MCN10 on course 050°M, then to CLN on course 059°M. Maximum speed 210kt IAS to MCN16, then maximum speed 250kt IAS to CLN. Cross MCN16 at 3000ft; MCN20 at 3000ft; CLN at 3000ft.

2.2. A schematic diagram of the SID is shown in Fig B3 below and a diagram of the SID overlaid on an Ordnance Survey map is shown at Appendix B1.

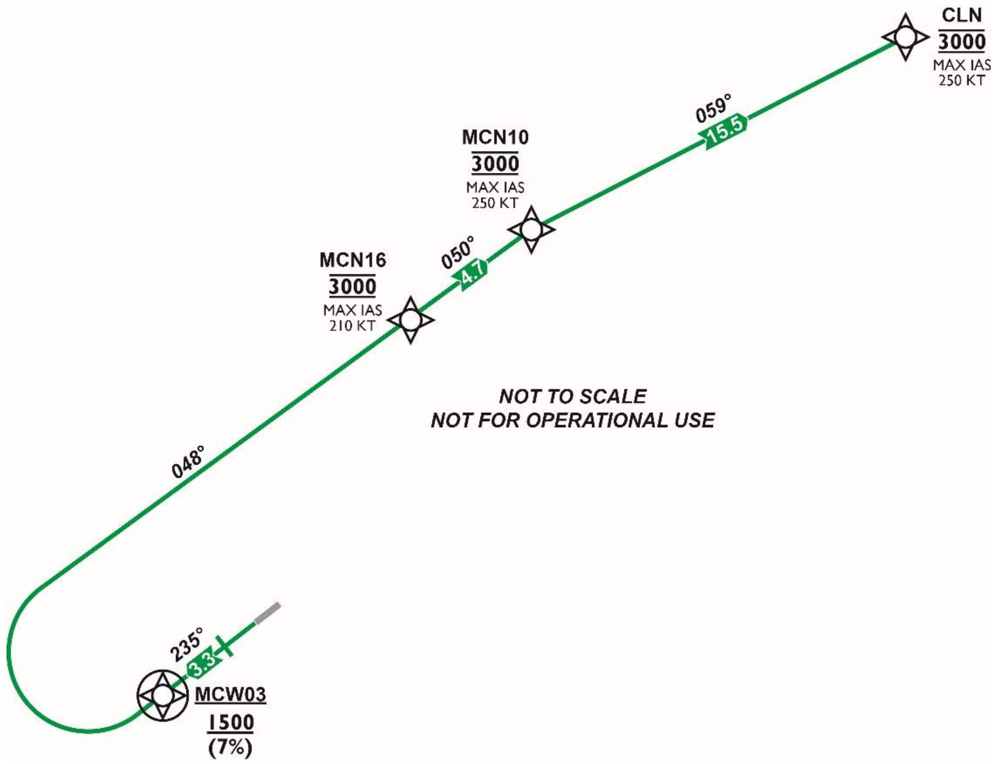


Figure B3: Schematic diagram of CLN 1F SID

2.3. Waypoint MCW03 is a flyover waypoint located 3.3NM from the end of the runway, which reflects both the earliest turn and minimum turning altitude of the NAPs as detailed in Section 14.2 of **Part B** of the consultation document. It is necessary to locate the waypoint at 3.3NM in order to take account of the fix tolerance of the RNAV waypoint to ensure that aircraft, under the worst navigational circumstances, do not start to turn before reaching 2.5NM from the end of the runway. Specification of not below 1500ft at the waypoint is based on a 7% (425ft/NM) procedure design climb gradient.

2.4. A speed limit of 210kt IAS has been applied to the initial portion of the SID to limit any westerly spread of faster departing aircraft around the turn and thereby reduce the number of households affected.

2.5. From the end of the NAP the procedure turns right onto a course of 048°M towards waypoints MCN16 located to the east of Stow Maries and MCN10 located to the south-east of Osea Island. The position of these waypoints has been determined so that the course reflects the historic core track of aircraft following the PDR whilst, at the same time, remaining south of South Woodham Ferrers and the subsequent course after MCN10 towards CLN lies, as far as practicable, over the Blackwater Estuary. In this way we have been able to reduce the random dispersion of tracks associated with the PDR on the north-easterly leg towards CLN and reduce overflight of built up areas as far as is practicable. The alignment of the SID route also ensures that adequate lateral separation will exist against the approach path to runway 23, thereby reducing the need for radar vectoring to ensure separation.

2.6. The intermediate waypoint MCN16 has been located at the closest allowable distance from MCW03 compatible with the PANS-OPS procedure design criteria for a track change angle of 173° at nominal 210kt in still air. Aircraft are required to have reached 3000ft by this point although invariably all will have reached 3000ft well before this waypoint and are likely, in the majority of cases, to have been given further climb clearance above 3000ft by ATC. The speed limit which constrains the first turn is also relaxed at this point, although, in practice it will normally be relaxed by ATC on completion of the turn. (The speed constraint cannot be removed earlier in the procedure design due to the minimum distance between waypoints constraint.)

2.7. Vertical constraints

2.7.1. An altitude limitation of 3000ft is necessary around the initial turn to MCN16 due to converging and crossing LCY SID procedures from the west. (See Figure B4 below.) There is insufficient airspace available for LSA departure procedures to "jump above" the LCY procedures before coming into conflict. Therefore it is necessary for LSA departures to be limited initially to 3000ft for safety management purposes, on the basis that the LTC Sector controllers will give climb clearance to LCY departures to ensure that they are at or above 4000ft before the conflict area.

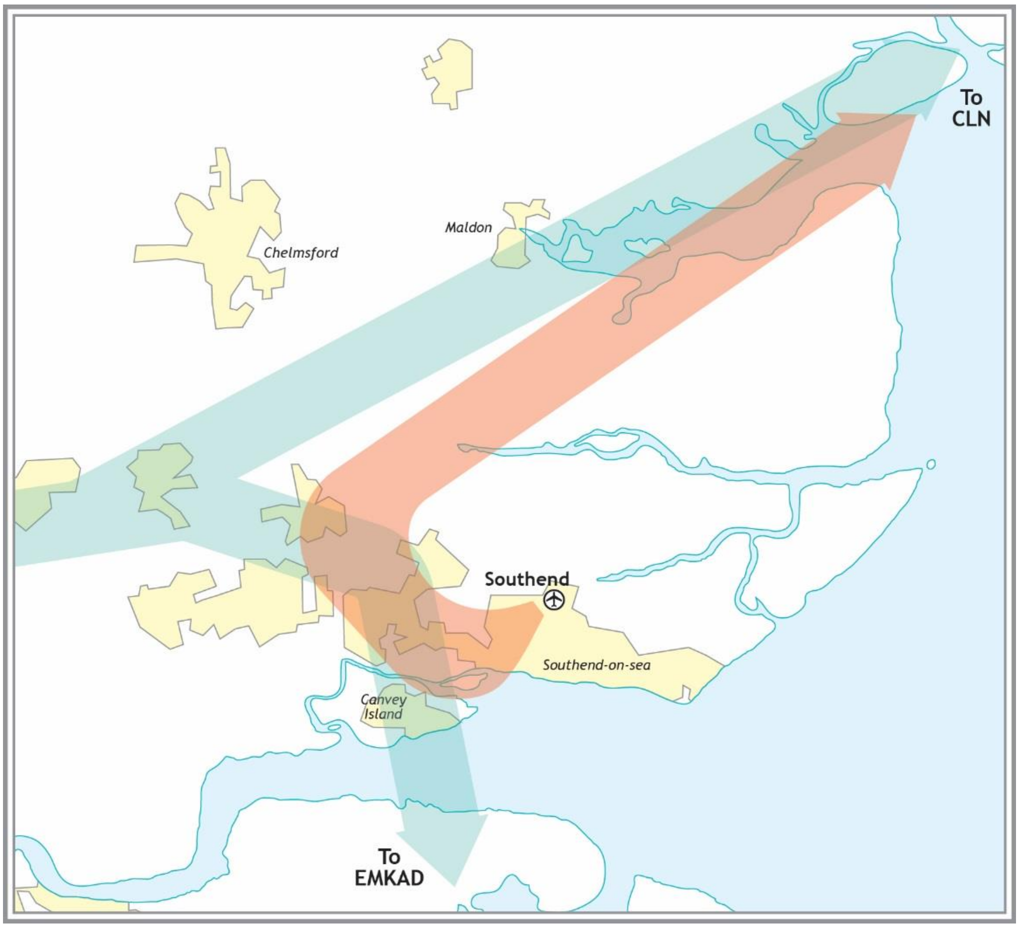


Figure B4: Schematic diagram of procedure conflicts. (LCY routes in blue, LSA routes in red.)

2.7.2. Once the procedure is inbound towards CLN and the interaction with LCY procedures above has reduced, it would normally be acceptable to apply procedurally safe "stepped climbs" above 3000ft to the procedure design. However, as explained in paragraph 14.3 of **Part B** of the consultation document, it is a procedural airspace design safety requirement for the published upper limit for the whole SID procedure to remain at 3000ft rather than allowing a "designed in" stepped climb to a higher level[3].

2.7.3. On a day-to-day basis, if there is not another aircraft in conflict, then aircraft departing from LSA would be given a direct climb clearance to a higher level either once in contact with the LTC radar controller or by the LSA radar controller in co-ordination with the LTC controllers. Standing Agreements will be in place between LSA ATC and LTC Sectors to ensure that climb clearance above the initial limit is given to the aircraft at the earliest opportunity.

[3] It should be noted that the basic procedures, as published, form a vital part of the Loss of Communication procedures and thus must be "procedurally" safe with respect to other procedures and flight paths in the airspace. In the "live" traffic situation, where air traffic controllers and pilots remain in communication with each other, the controllers are able to improve on both the vertical profile and the nominal routing of the SID procedure and thereby achieve the most effective use of the airspace and efficient flight profiles for all aircraft.

2.7.4. Empirical evidence indicates that aircraft departing from LSA would normally be expected to be well above 7000ft[4] before reaching the vicinity of CLN, notwithstanding that this cannot, for the safety management reasons outlined above, be specified within the procedure. Figure B5 below provides a colour-coded plot of the climb performance of departing aircraft via CLN over a 5-week period in Summer 2015.

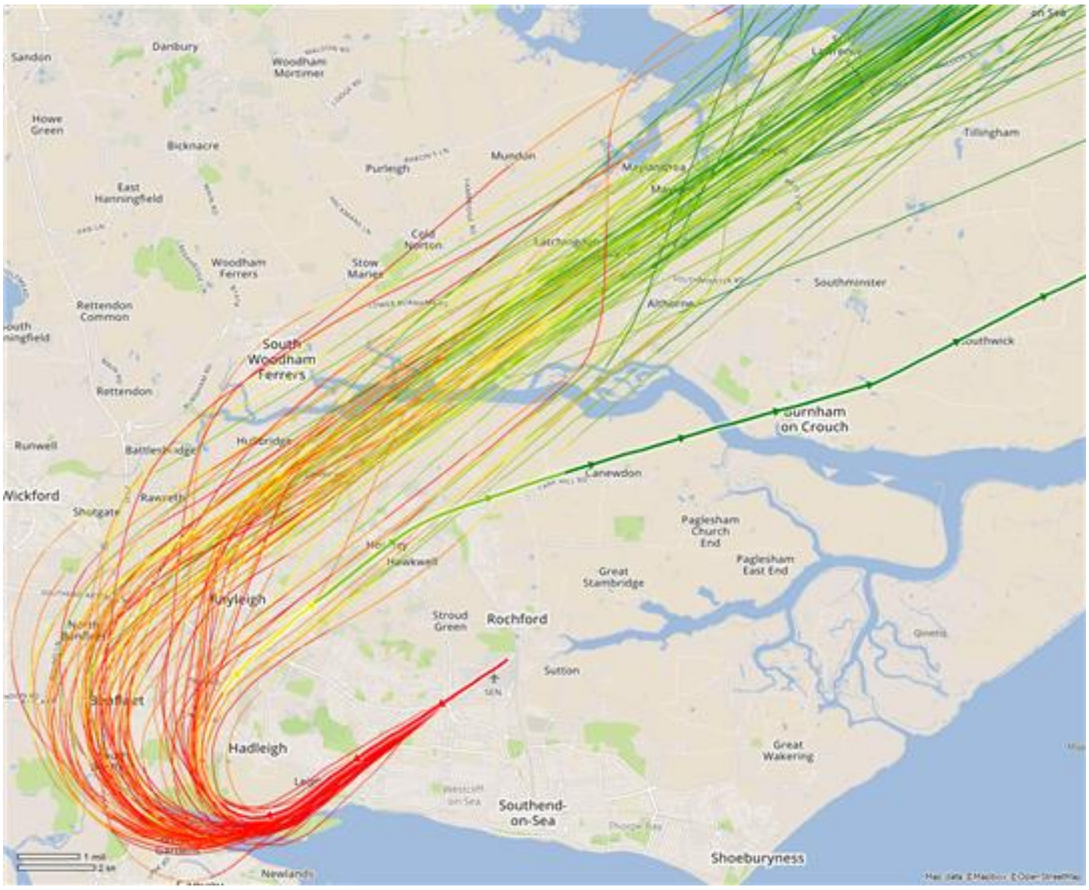


Figure B5: Colour coded climb profile of departing flights Summer 2015.
[Colour coding: Below 3000ft red; 3000 – 4000ft orange; 4000 – 5000ft yellow; 5000 – 7000ft light green; above 7000ft dark green.]

2.7.5. It can be seen from Figure B5 that a few departing aircraft have, in the past, been held down to 3000ft for quite some distance after departure. The main reason for this was that the timing of LSA departures on this route frequently conflicted with a heavy flow of arriving flights to LCY which used to converge overhead LSA and which were held by LTC sectors in a holding pattern which was located overhead LSA at 4000ft (known as the SPEAR hold). Thus aircraft departing from LSA could not be given climb clearance above 3000ft until clear to the east of the holding pattern. These LCY arriving flights also resulted in the issuance of delayed climb clearances for LCY departing aircraft; thereby delaying, in turn, climb clearance for LSA departures. Under the new LTMA arrangements introduced in February 2016

[4] An A319 given unrestricted climb clearance in typical weather conditions could be expected to be at approximately 10000ft by CLN.

aircraft inbound to LCY will no longer route over, nor are they held above, LSA. Therefore this constraint on the climb profile of departing aircraft from LSA has been removed and aircraft can be expected to be given climb clearance much earlier.

2.7.6. For those aircraft which have been given early climb clearance (in the absence of holding aircraft) it is seen in Figure B5 that most are in the level band 4000ft – 5000ft by the time they are passing abeam South Woodham Ferrers and a significant proportion are above 5000ft. We anticipate that under the revised LTMA arrangements this will become the "normal" climb profile for LSA departures towards CLN. This is an aspect that will be monitored closely by LSA, both with respect to the revised LTMA arrangements as a whole and with respect to the performance of aircraft departing on the CLN SID itself.

2.8. Radar Vectoring

2.8.1. As noted in Section 5 and paragraph 9.4 of **Part A** of the consultation document it is essential that controllers retain the operational flexibility to integrate aircraft flight paths with one another to achieve the most effective and efficient overall traffic flow and to get departing aircraft climbing to their cruising levels as quickly as possible.

2.8.2. Notwithstanding, recent operational experience has shown that the requirement for routine radar vectoring on this departure route is less frequent than hitherto as the recent revisions to the regional airspace arrangements (LAMP Phase 1a project) has resulted in improved interaction with routes to/from LCY and other airports.

2.8.3. It should be noted that the majority of the historic track dispersion of departing aircraft (as depicted in Figures B2, B3 and B5) is not a factor of radar vectoring but of the fact that no specified track towards CLN is included in the PDRs. The pilot of each aircraft has historically determined his/her own track towards CLN and the differing speeds and turning performance of individual aircraft has resulted in the spread of tracks.

2.8.4. Therefore, once the SIDs are introduced the lateral spread of tracks of departing aircraft will be substantially reduced and, although required on some occasions, the instances of ATC radar vectoring aircraft away from the SID route will also be reduced.

3. Differences between the CLN 1F SID and the PDR

3.1. A diagram showing the proposed CLN 1F SID overlaid on the actual tracks of aircraft operating on the CLN PDR is shown at **Appendix B2**. The widths of the swathes depicted in **Appendix B2** are ±1NM from the nominal route centre-line for the outer swathe, which represents the "worst case" flight safety navigational tolerance used for procedure design, and ±0.2NM for the inner swathe, which represents what we expect to be the day-to-day navigation accuracy expected on RNAV1 routes (based on experience of other ATM applications of RNAV1 operations elsewhere).

3.2. It should be noted that the PDRs were, historically, not designed to any formal procedure design criteria and the tracks to be flown were not specified with reference to the navigation infrastructure. It is therefore not possible to provide an exact comparison between the nominal tracks of the new SID procedure (designed to PANS-OPS criteria) and the old PDR. However, the SID route reflects, as closely as practicable, the main core of historic tracks of aircraft flying the CLN PDR.

3.3. Procedure design speed limits were not applied to the PDR, other than the standard international airspace speed limit of 250kt IAS outside controlled airspace. We have applied a speed limit of 210kt IAS for the SID procedure to limit the westerly extent of the initial turn by faster aircraft. In selecting an appropriate speed limit a fine balance is necessary between the preferred operating configurations and speeds of the variety of aircraft using the route and the ATM and environmental objectives. The application of the speed limit ensures that LSA departing aircraft do not fly further to the west than is necessary in the initial turn and assists in resolving the conflict between LSA departures and LCY departures as quickly as possible. The procedure initial speed limit is removed as soon as is practicable within the procedure design criteria.

3.4. It is seen from the diagram at **Appendix B2** that the route of the proposed SID procedure replicates very closely the core of the historically demonstrated routing of aircraft following the PDR.

3.5. With respect to the upper limit of the procedures, before the introduction of controlled airspace departing aircraft via CLN were permitted to climb initially to 3400ft. This was to ensure that the aircraft remained outside controlled airspace until given further climb clearance by LTC, the base level of controlled airspace being 3500ft. However, where both aircraft are inside controlled airspace the vertical separation to be applied by ATC is 1000ft. Thus, with the introduction of controlled airspace in April 2015 the upper limit of the PDRs has been changed to 3000ft. To ensure that standard separation is sustained with the introduction of SIDs, the initial level incorporated in the procedure design for LSA SID procedures must be 3000ft.

4. Other Options considered

4.1. **Use of flyby waypoints:** The use of flyby waypoints throughout the procedure design, which is the preferred methodology for aircraft navigation systems, was considered in the outline development of the procedure design. However, the positioning of the initial waypoint (defining the start of the first turn following noise abatement) to meet both the procedure design criteria and the definition of the noise abatement procedure meant that the track "rolling out" of the turn towards CLN would be noticeably different from the track achieved by the majority of aircraft following the PDR. Furthermore, the turn towards CLN would need to be designed as two consecutive turns of approximately 90° due to the PANS-OPS requirements for flyby waypoints. Conversely, using a flyover waypoint to define the start of the turn indicated that aircraft would more closely replicate the tracks flown on the PDRs with the resulting flight path affecting fewer people overall. LSA therefore has elected to utilise the flyover waypoint configuration rather than flyby configuration.

4.2. **An earlier right turn:** A right turn before 2.5NM from the end of the runway would offer distinct operational advantages to ATC as it would provide greater flexibility in reducing (but not eliminating) the conflict between aircraft departing from LCY and aircraft departing from LSA. However, it would result in overflight of a larger population as more people in Eastwood and Rayleigh would be more affected by departing aircraft. Moreover, an earlier right turn would require a change to the NAPs. LSA is not seeking to change the long-standing NAPs, which are the subject of a Section 106 Agreement. Therefore, this option is ruled out.

4.3. **A later right turn:** Extending the "straight ahead" element of the departure procedures to beyond the 2.5NM position would increase the interaction between departure procedures from LSA and those from LCY to the extent that lateral separation of aircraft could not be assured. Thus LSA departing traffic would be wholly dependent on "gaps" between successive LCY departures resulting in increased ATC co-ordination, departure delays and, potentially, runway congestion at LSA. Departing aircraft would be held down at lower altitudes for longer as the conflict with LCY traffic would take longer to resolve. Furthermore, any substantial westerly extension of the LSA departure track would place it in conflict with the approach path to runway 28 at LCY. Moreover, this option would probably require the provision of further, highly contentious, controlled airspace for the necessary containment of the SID IFPs. Consequently, this option is not considered feasible and has been ruled out.

4.4. **A more northerly track towards CLN:** Consideration was given in the procedure design to defining a more northerly route towards CLN. However, this would have resulted in greater overflight of Basildon, Wickford and South Woodham Ferrers and thus would have affected a greater population. The route would also be longer than the route proposed, resulting in a greater fuel-burn for no environmental gain. Furthermore, in airspace management terms, it would extend the period in which a "slower" CLN departure would affect (i.e. delay) a following "faster" LAM departure. It would also potentially impact on the ability for ATC to expeditiously resolve conflict between LSA departures and LCY departures in the airspace to the north of LSA. Thus, on balance, LSA prefers to retain the procedure which most closely reflects the long-standing PDR.

4.5. **Higher procedure altitudes:** Extensive and detailed studies were carried out co-operatively by LSA and the NATS LAMP Phase 1a development team to try and establish an upper limit above 3000ft for the initial leg of the LSA departure procedure towards CLN. However, as for the procedures towards LAM, procedural conflict with nearby LCY departure procedures crossing above and the predicted climb performance of LCY traffic precluded, for safety management purposes, the allocation of a higher altitude for LSA aircraft (see Figure B4 above). Furthermore, the safety management requirements with respect to "stepped climbs" in SID procedures and SSR Mode S depiction on LTC radar controllers data displays (as explained in paragraph 14.3 of **Part B** of the consultation document) has precluded the specification of higher levels in the published procedure, albeit that departing aircraft will routinely be given early clearance to climb above the specified levels on a tactical basis.

5. Environmental impact

5.1. It can be seen from the diagram at **Appendix B2** that the nominal route of the SID very closely reflects both the NAP and the main core of the historically achieved tracks of aircraft using the PDRs, within the constraints of the procedure design criteria.

5.2. It is noted that in the right turn after completing the NAP the turn radius and roll-out track towards CLN exhibited by non-jets is different to the wider turn exhibited by the faster jet aircraft. This is because there is no navigation track towards CLN specified in the PDR and the evident disparity in aircraft speeds.

5.3. The Airport Noise Contours are not affected by the change from PDR to SID as detailed in **Part A** Section 7. The increase in contour size from 2014 to 2021 would occur irrespective of whether the departure procedures remain as current or are changed to SIDs.

5.4. The introduction of a speed limit for the initial turn of the SID, together with specified tracks towards CLN, will reduce the spread of aircraft tracks around the turn and the initial routing towards the Blackwater Estuary, thereby reducing the number of people affected by departing aircraft on this route.

5.5. The SEL Chart at **Appendix B3** shows a slight change to the alignment of the "far out" extremity of the 80dB(A) SEL contour. This is due to the position of the first flyover waypoint which defines the NAP as a consequence of the PANS-OPS procedure design criteria.

5.6. **Table B1** below shows the area and population within the 80 and 90 dB(A) SEL footprints for departures by the Airbus A319 on the current route and the proposed SID procedure.

SEL Value	Runway	Route	Area (Km^2)		Population (thousands)	
			Current route	SID	Current route	SID
90 dB(A)	23	CLN	2.6	2.6	4.7	4.5
80 dB(A)			12.6	12.6	37.2	37.2

Table B1: SEL Footprints CLN PDR and CLN1F SID

5.7. The Chart at **Appendix A4** shows the departure swathes against which population counts have been made. The criteria against which the swathe widths and length have been determined are detailed in **Part A** paragraph 9.5 of the consultation document. Whilst the swathe widths reflect the general practice used at other UK airports it should be noted that we expect the day-to-day track-keeping performance for departing aircraft using the RNAV-1 SID procedures to be better than the 2km swathe width used for this analysis.

5.8. **Table B2** below provides a comparative count of the number of people within the respective swathes for the historic PDR and the proposed CLN 1F SID.

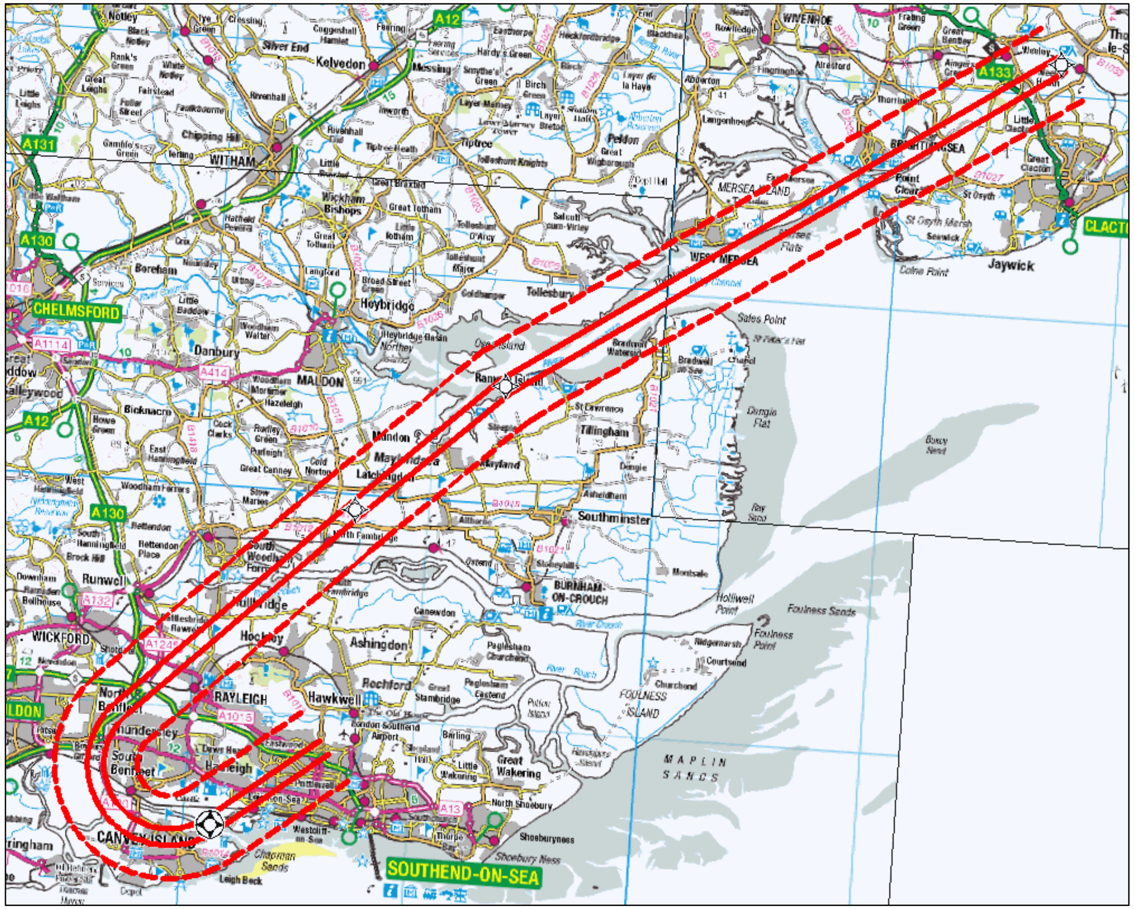
Runway	Route	Population (thousands)	
		Current Route (PDR) (nominal 3km width)	SID (nominal 2km width)
23	CLN	88.6 (jet) 91.0 (non-jet)	58.9

Table B2: Population Count for PDR and SID

5.9. The introduction of properly constructed RNAV SIDs with a navigation standard of RNAV-1 will result in improved repeatability of tracks in accordance with CAA policy and DfT guidance and this, in conjunction with the recently introduced controlled airspace around LSA and the improved airspace efficiency resulting from the recently introduced LAMP Phase 1a airspace arrangements, will enable earlier climb clearance to be given to departing aircraft above the 3000ft initial limitation of the SID procedure Furthermore, it is anticipated that the more efficient airspace arrangements will lead to a reduction in the need for ATC to radar vector aircraft away from the SID route at low altitudes in the early stages of departure.

5.10. Therefore, it is concluded that the impact of changing the PDR to a formal SID procedure brings an overall environmental benefit to communities on the ground as well as improved flight profiles and reduced fuel burn for aircraft operators.

Appendix B1 Diagram of CLN 1F SID overlaid on OS topographical map



CLN 1F SID: Diagram showing the anticipated maximum track dispersion (±0.2NM; solid red lines) and the maximum navigation tolerance (± 1.0NM; dashed red lines) overlaid on Ordnance Survey map.

Appendix B2 Diagrams of CLN 1F SID and historic tracks of aircraft flying on the CLN PDR.

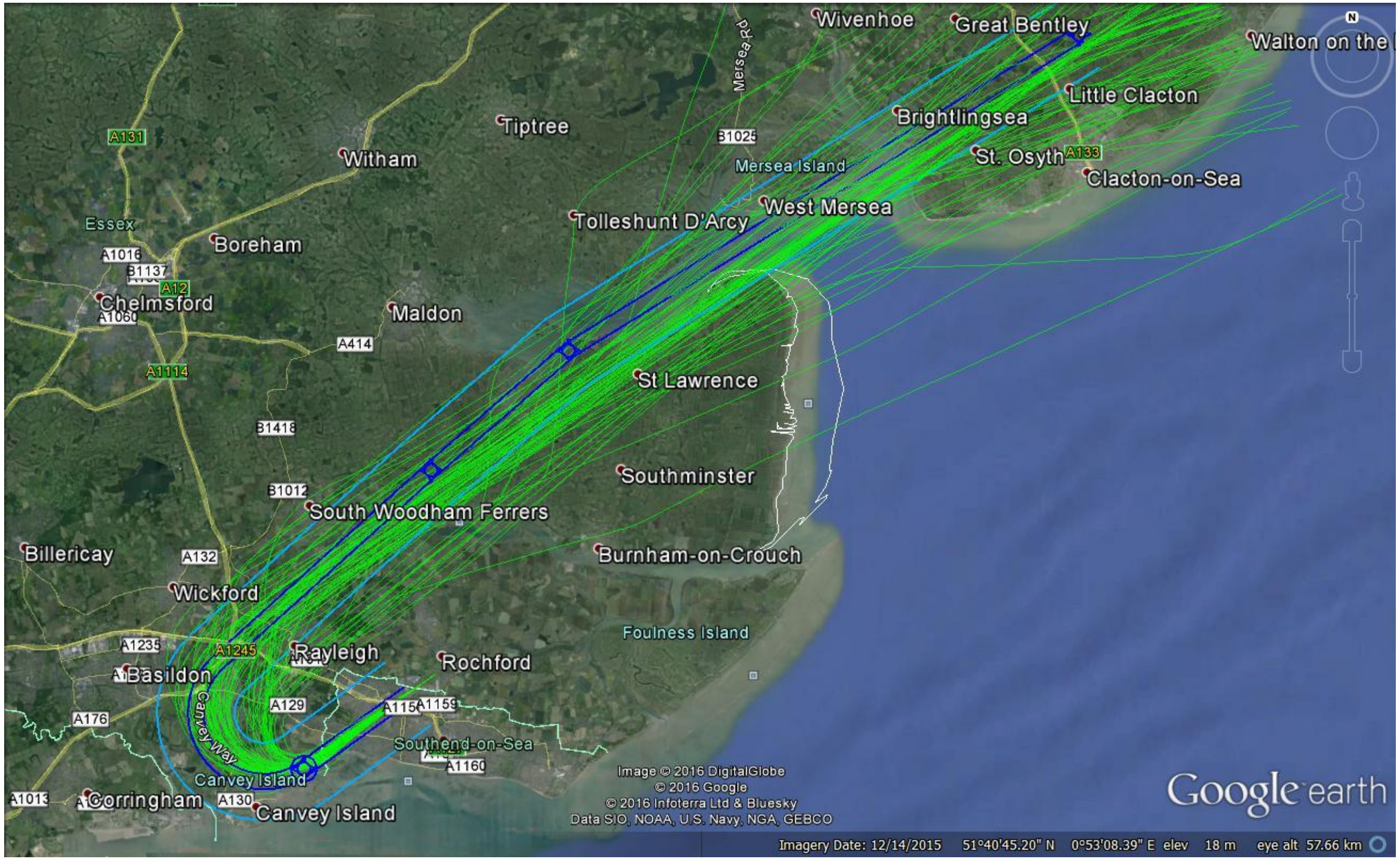
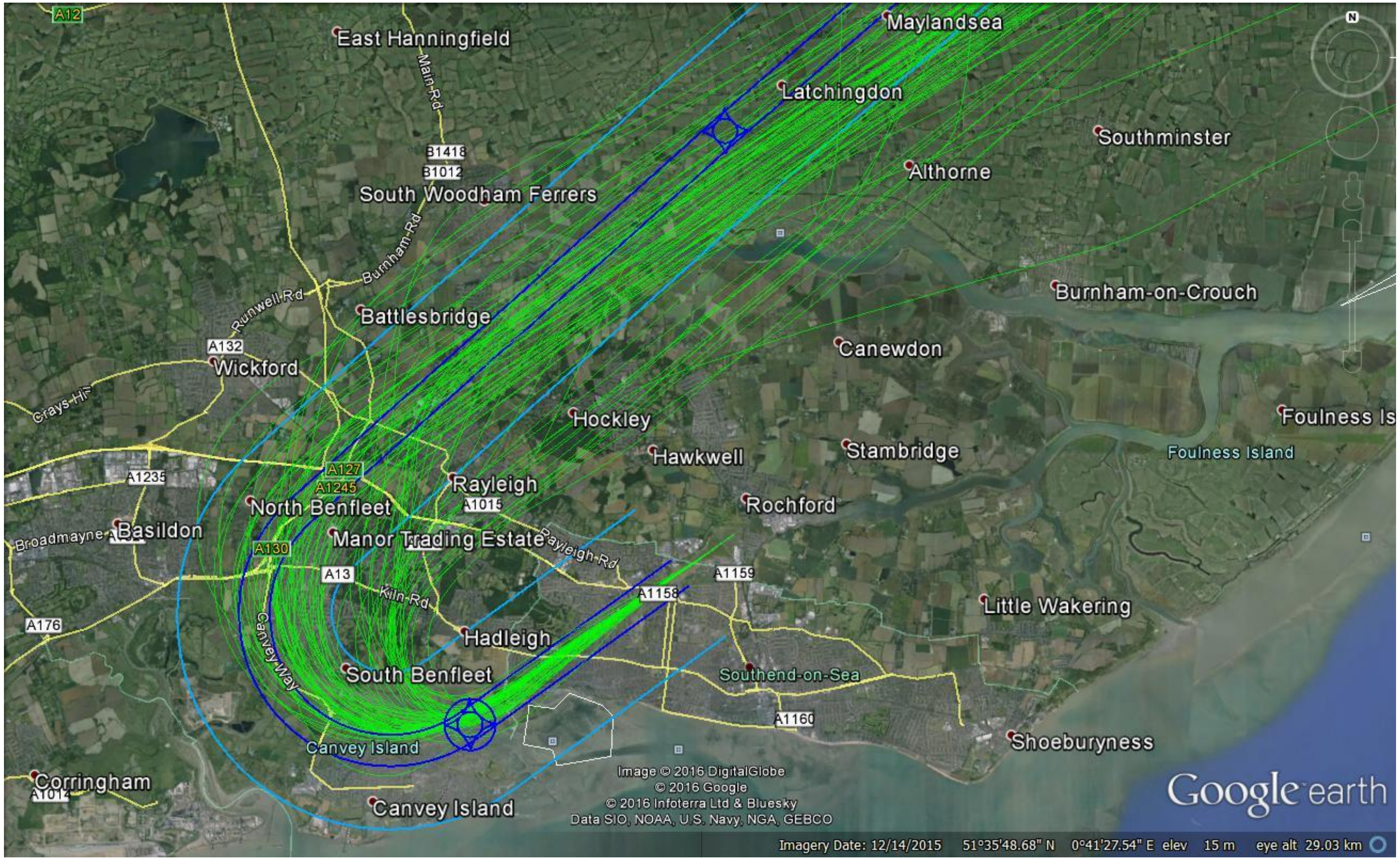


Diagram showing the anticipated maximum track dispersion (±0.2NM; dark blue) and the maximum navigation tolerance (± 1.0NM; light blue) for the CLN 1F SID against historic NTK tracks (green) for departing aircraft July/August 2015.



Enlarged segment of previous diagram

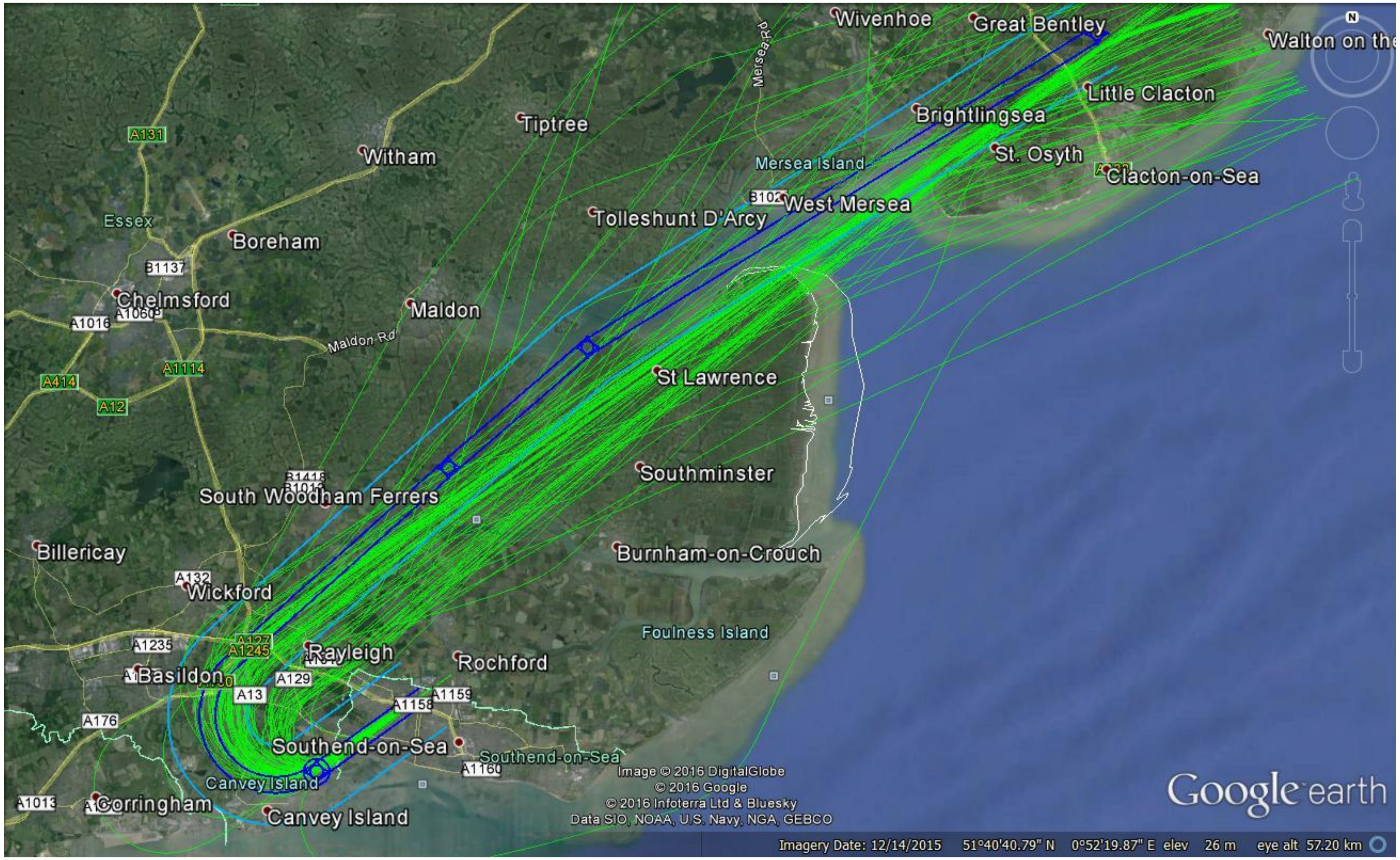
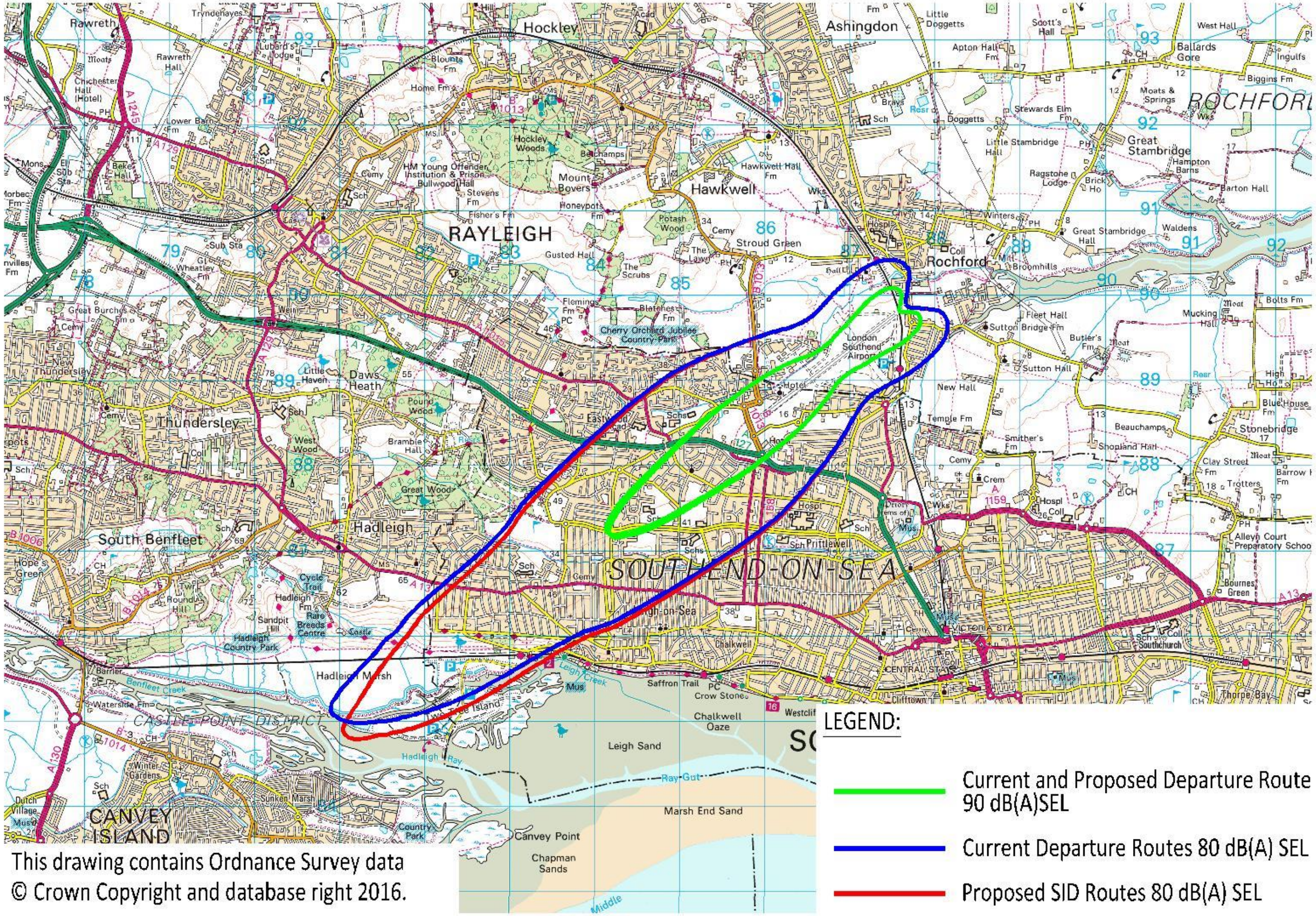
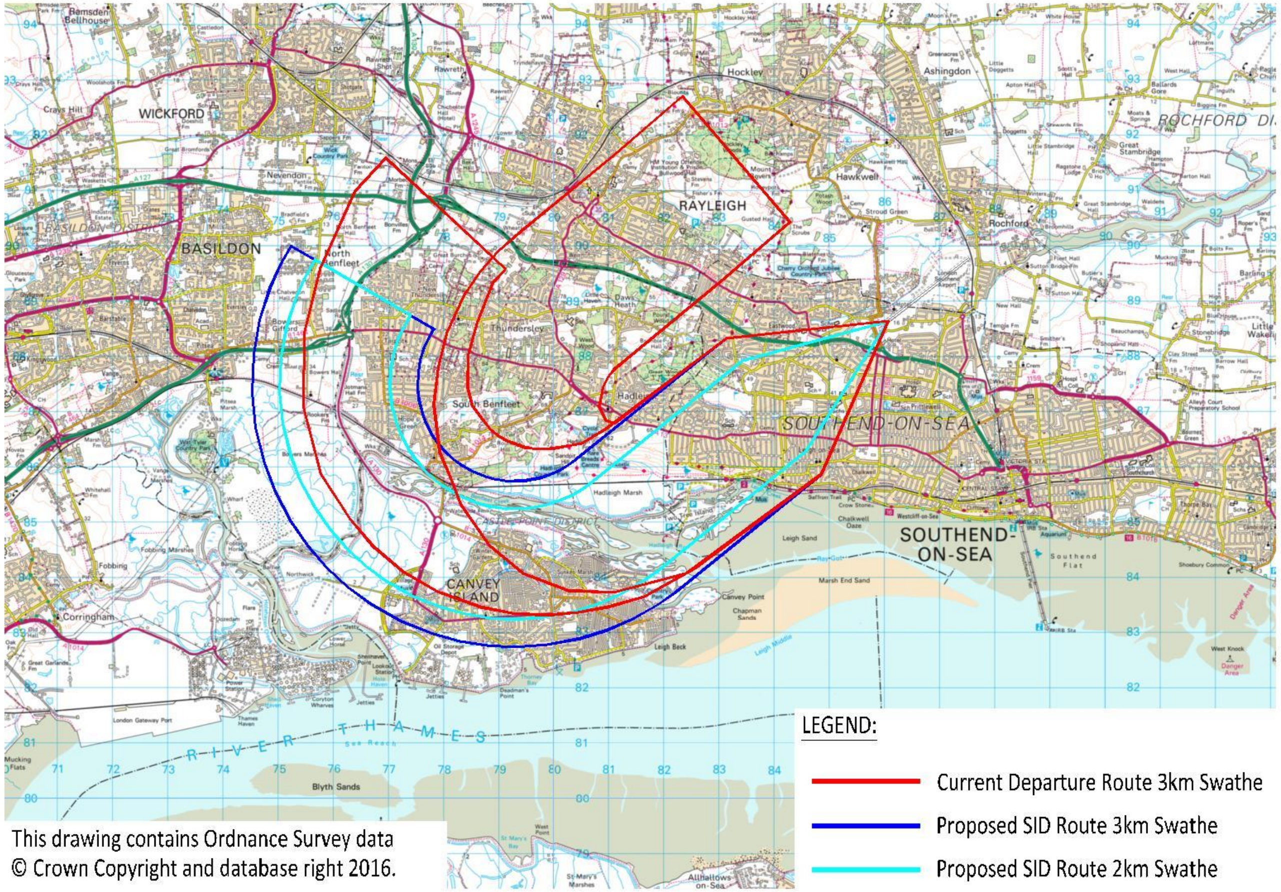


Diagram showing the anticipated maximum track dispersion (±0.2NM; dark blue) and the maximum navigation tolerance (± 1.0NM; light blue) for the CLN 1F SID against historic NTK tracks (green) for departing aircraft July/August 2014.

Appendix B3: SEL Chart for A319 aircraft



Appendix B4 Departure swathes for CLN PDR and CLN 1F SID



(See Part A paragraph 9.6 for explanation of swathe widths and length).

NB Swathes for current departure route (PDR) reflect different turning performance of jet and non-jet aircraft.