Annex C. London Luton Airport Runway 26 Brookmans Park RNAV-1 SID Track Analysis Review.

INTRODUCTION

1. Before reading this analysis of the data provided, it is recommended that readers first read the London Luton Airport Consultation document and the London Luton Airport Airspace Change Proposal (ACP).

2. To enable the CAA to conduct the PIR analysis, the change sponsor provided traffic pattern plots for a number of periods before and after implementation. The initial implementation was in 2015, however, due to flyability issues with some Boeing aircraft, the SID design had a minor modification which was then implemented in February 2017. Therefore, to enable the PIR analysis to consider the impacts of the modification the PIR data collection period was extended to September 2017.

3. The CAA's focus has been to analyse traffic patterns after February 2017 which were flown after the minor modification; however, the CAA has also analysed one set of traffic pattern data from the 2016 traffic samples so that interested parties can see the impacts that were evident with the initial implementation. The pre-implementation airspace designs are referred to as 'Conventional SID' and the post-implementation designs as 'RNAV-1 SID'.

4. The CAA believes that the sample of traffic patterns are consistent with the traffic patterns throughout the year, where seasonal variations with stronger winds and higher temperatures may result in some variations in certain phases of the departures procedure; for example, stronger winds from the north west may result in aircraft having a higher ground speed around the turn at Hemel Hempstead, and therefore turns could be wider; conversely, strong south westerly winds may result in aircraft flying the turn at Hemel Hempstead a lot tighter which could mean departures are slightly closer to Flamstead and Redbourn.

5. Whilst all data provided by London Luton Airport Operations Limited (LLAOL) for the PIR is available on the CAA Website , the following data samples have been used within this review:

   (1) Track dispersion plots July 2015 Conventional SID vs July 2016 RNAV-1 SID - track dispersion plots for departures in altitude bands in 1000ft intervals up to 7000ft.

   (2) Track dispersion plots August 2014 Conventional SID vs March 2017 and August 2017 RNAV-1 SID.

   (3) Track density plots August 2014 Conventional SID vs March 2017 and August 2017 RNAV-1 SID.

   (4) Track dispersion plots July 2015 Conventional SID vs August 2017 RNAV-1 SID - track dispersion plots for departures in altitude bands in 1000ft intervals up to 7000ft.

(5) Track Density diagrams for Runway 26 Conventional and RNAV-1 SIDs via Brookmans Park.

(6) Track dispersion plots for Runway 26 Conventional and RNAV-1 SIDs via Brookmans Park.

(7) Daily track plots during February, March and April 2017 only.

(8) Monthly track dispersion plots by aircraft type.

(9) Monthly track dispersion plots by airline.

It should be noted that for comparison purposes, we have combined relative traffic samples into single PDF documents and re-sequenced some slides to enable direct electronic comparison using the Adobe toolset for interested parties which have this capability.

ABBREVIATIONS/TERMINOLOGY

7. In this review, we refer to a number of technical aspects relating to the design of the arrival and departure procedures; to aid understanding, we have attempted to explain these terms in a non- technical manner and abbreviations:

amsl
Above mean sea level

AIP Chart
These AIP charts are the UK Aeronautical Information Publication SID procedures for the runway 26 SIDs via Brookmans Park.

DER
Departure End of Runway. For aeroplanes the SID begins at the DER, which is the end of the area declared suitable for take-off, in the case of Luton the Take-off Distance Available (TODA End) is a declared position off the end of the physical runway.

FMS
Flight Management System

IFPs
Instrument Flight Procedures

Navaid
Navigation aid

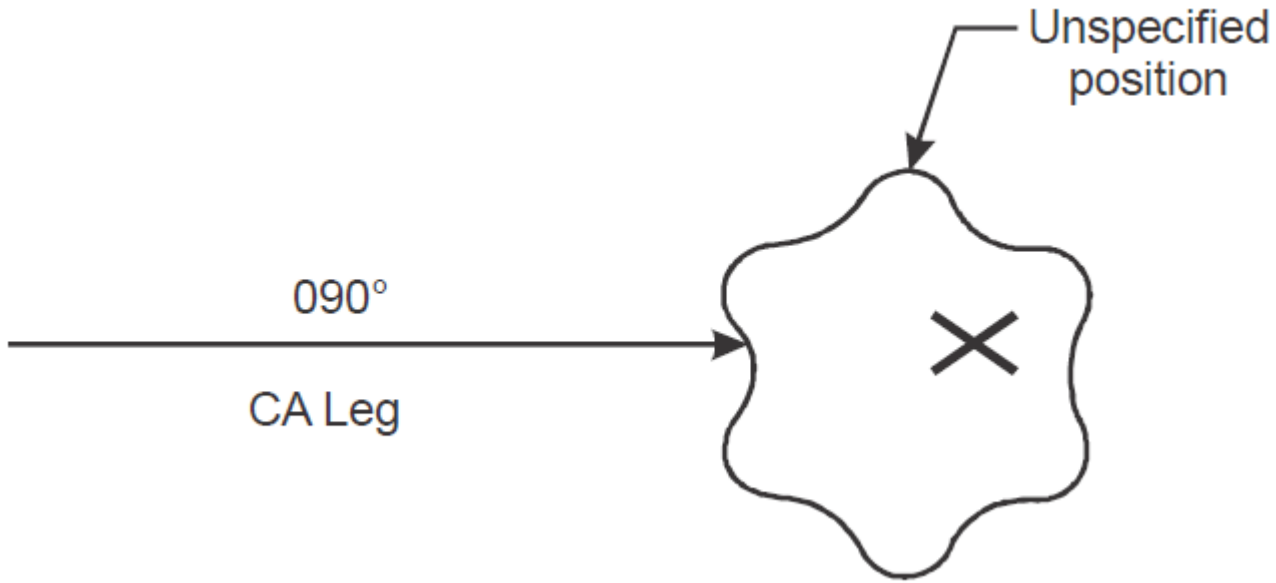
NM
Nautical mile. Equivalent to 1.852 km.

NPR
A Noise Preferential Route (NPR) is a path for aircraft to take until they reach a specific release altitude. Once an aircraft reaches the NPR release altitude, Air Traffic Control (ATC) can instruct the aircraft to turn onto a more direct heading to its destination, this is called vectoring, which, may take the aircraft outside the NPR corridor (normally defined as a swathe for track keeping monitoring purposes). There may be occasions where it is necessary for safety reasons (e.g. to avoid severe weather conditions) for ATC to vector aircraft off NPRs below the release altitude.

As part of this ACP and new narrower 2 km NPR was established around the RNAV-1 SID. For this NPR, the release altitude was increased from 3,000ft to 4,000ft and an ATC procedure was implemented that restricted vectoring until aircraft crossed the railway line between St Albans and Harpenden (unless deviation was required for safety reasons such as bad weather or to keep clear of other traffic).

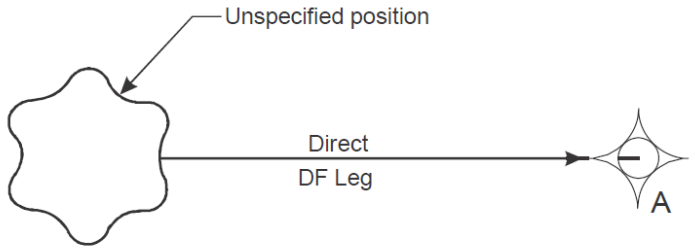
Path Terminator
A path terminator is a set of defined codes, each of which defines a specific type of flight path and a specific type of termination of that flight path. Examples of these in the Luton departure Instrument Flight Procedures (IFPs) are course to altitude (CA), direct to fix (DF) and track to fix (TF).

Course to Altitude (CA)
A CA is used to define the course of an outbound route segment that terminates at an altitude with an unspecified position.



Course to an altitude (CA) leg.

Direct to a Fix (DF)
A DF leg defines an unspecified track starting from an undefined position to a defined fix. It is used to define a route segment from an unspecified position on the aircraft's present track to a specified fix or waypoint. A DF path terminator does not provide a predictable, repeatable flight path, therefore, it is effective in dispersing the flight tracks over the widest area. When a DF is used it ensures that the shortest track distance is flown from the unspecified position to the fix or waypoint.



Direct to Fix (DF) Leg

Track to Fix (TF)
A TF leg is defined as a geodesic path between two fixes (waypoints). It is the preferred leg type in RNAV Terminal Procedures that are not using ground based navigational aid (navaid) references. The TF defines a great circle track over the ground between two known database fixes. The first fix is either the previous leg termination or an initial fix leg.

Track to Fix (TF) Leg

Area Navigation (RNAV)

Area navigation is a method of navigation which permits aircraft operation on a desired flight path without constraints of ground-based navigation aids. Area navigation is an enabler for Performance-based navigation (PBN), which is defined as a type of area navigation (RNAV) in which the navigation performance requirements are prescribed in navigation specifications.

RNAV-1
RNAV-1 is a navigation specification, which is defined as a set of aircraft and aircrew requirements needed to support PBN operations on the Luton SIDs. This navigation specification requires a minimum lateral track accuracy of +/- 1nm for 95% of the time.

Runway extended centreline
The runway extended centreline is an imaginary line that continues (extends) from the physical centreline of the runway

Standard Instrument Departure (SID)
A SID is as a designated instrument departure route linking an aerodrome, or a specified runway at an aerodrome, with a specified significant point, normally on a designated ATS route.

SID Nominal Track (NT)
The SID nominal track is the intended track to be flown when adhering to the speeds as shown on the procedure chart. The adherence to this published nominal track will vary in accordance with how the procedure has been designed to achieve either dispersion or concentration of flight tracks and external factors effecting aircraft ground speed e.g. wind conditions.

Track Concentration
Is where the tracks over the ground are concentrated on predictable flight tracks. Concentration of tracks can allow for noise sensitive areas to be avoided but it is not always possible to avoid all sensitive areas.

Track Dispersion
Is where the flight tracks over the ground of a procedure are varied due to the use of path terminator, differing aircraft types, standard operating procedures (SOPs) used by aircraft operators and wind conditions. Track dispersion typically spreads the noise over a wider area.

Vectoring
There may be occasions where it is necessary for ATC to vector aircraft off NPRs and onto a more direct heading. Typically, departures that are vectored by ATC tend to be dictated by the need to integrate Luton departures with other traffic.

WP Flyby (FB)
Waypoint flyby means that the aircraft will anticipate the turn before the waypoint to allow tangential interception of the next segment of the procedure. The faster the aircraft is travelling towards the FB WP, the further the aircraft will be from the FB WP before it commences the turn. Conversely, the slower the aircraft is travelling towards the FB WP, the closer the aircraft will be to the WP before it commences the turn.

WP Flyover (FO)
Waypoint flyover means that the aircraft will fly over the position of the waypoint before turning to intercept the next segment of the procedure.

GUIDE TO INTERPRETING TRACK DISPERSION AND DENSITY DIAGRAMS

8. Attached to this document (via Links) are the track dispersion and density plots which have been provided by LLAOL. These are similar to and include diagrams which are identical to those shown in the LLAOL consultation document except that the technical production methodology has been upgraded, so there may be different colour tints to the diagrams in PIR data. The before and after implementation track diagrams are in the same PDF documents to facilitate ease of comparison.

9. Where relevant, the track analysis review is described using references to locations shown on the diagrams.

Track Dispersion Diagrams

10. The track dispersion diagrams portray aircraft ground tracks on a map. Tracks are overlaid upon each other, such that if many tracks are overlaid on top of each other, individual tracks may no longer be visible. They are useful for illustrating the dispersion of the traffic pattern but are not useful for determining the density/concentration of tracks.

Track Density Diagrams

11. Track density diagrams portray the concentration of flight tracks using a colour code to indicate differing concentrations of flight tracks. They are sometimes referred to as “heat plot” diagrams. Whilst they can be used to illustrate traffic dispersion, they are most useful for illustrating if traffic is concentrated along a route. Depending on the key used for portraying track concentration, individual tracks towards the outer limits of the dispersion may not be visible on the diagram.

GUIDE TO READING THE CAA REVIEW OF TRACK ANALYSIS

SID TRACK PLOTS

12. Tables 1-4 show the CAA's Runway 26 Brookmans Park RNAV-1 SID Track Analysis Review. For analysis purposes, we have divided the track dispersion analysis into a number of segments; this is shown in Column 2. In Tables 1 and 4, where altitude bands are shown, we have used the altitude bands as segments for the purposes of showing comparisons of pre-implementation track plots and post - implementation track plots.

- **Column 1** shows the **CAA Web Link** to the relevant diagram, the document title and the name of the AIP chart departure procedure;
- **Column 2** describes the relevant segment of the SID design, with an approximate geographical description and/or location relative to the RNAV-1 waypoint;
- **Column 3** identifies the design path terminator used in the design, where relevant;
- **Column 4** describes the traffic pattern before the change (i.e. traffic pattern for Conventional SID) and in **blue** describes the expected traffic pattern (i.e. based on the observation from the 2014 RNAV-1 Trial);
- **Column 5** is a qualitative description of the new RNAV-1 SID traffic pattern and a comparison with the conventional SID before the change;
- **Column 6** is comparison of the new RNAV-1 SID vertical profile with the conventional SID vertical profile (Tables 1 and 4 only);
- **Column 7** indicates whether the expected track pattern has been achieved; and
- **Column 8** indicates whether the departure procedure is being flown correctly by operators as designed and whether the design is considered acceptable.

DEPARTURE PROCEDURES TRACK ANALYSIS

EXTRACTS FROM CONSULTATION DOCUMENT – DESCRIPTION OF TRAFFIC PATTERN BEFORE THE CHANGE AND EXPECTED TRAFFIC PATTERN BASED ON AN RNAV-1 TRIAL

SAMPLE FLIGHT TRACKS (SAMPLE 1) FOR CONVENTIONAL SID BEFORE THE AIRSPACE CHANGE – TRACK DISPERSION PLOT – APRIL 2014 STAKEHOLDER CONSULTATION DOCUMENT PAGE 7 FIG 2:

Departures climb straight ahead until passing 1030ft amsl (500ft above aerodrome elevation) then turn left towards the southwest. Departures form a concentrated traffic pattern along the runway extended centreline before the turn, and then a concentrated pattern centred along the NPR centreline to the M1 Junction 10 (J10).

After the M1 J10, aircraft continue along a south-westerly track on the NPR centreline and the majority fly in between Noise Monitoring Terminals NMT 02 and NMT 03.

After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans. Departures then fly a wide turn, which, takes them overhead the northern extremity of Hemel Hempstead and outside the conventional SID 3km wide NPR swathe.

After passing Hemel Hempstead, aircraft complete the turn onto an easterly track, and the majority of departures fly over the north of St Albans and Sandridge, where they then take a wide dispersed traffic pattern towards Hatfield and Welwyn Garden City.

SAMPLE FLIGHT TRACKS (SAMPLE 2) FOR CONVENTIONAL SID BEFORE THE AIRSPACE CHANGE – TRACK DENSITY PLOT - APRIL 2014 STAKEHOLDER CONSULTATION DOCUMENT PAGE 16 FIG 5:

Departures climb straight ahead until passing 1030ft amsl (500ft above aerodrome elevation) then turn left towards the southwest. Departures form a concentrated traffic pattern along the runway extended centreline before the turn, then the main core of departures form a concentrated pattern along the NPR centreline to the M1 Junction 10 (J10), but, there is also some dispersion either side of the main core of departures.

After the M1 J10, aircraft continue along a south-westerly track along the NPR centreline, forming a concentrated pattern along the NPR centreline with some dispersion either side of the main core, with the dispersed pattern extending over noise monitors NMT 02 and NMT 03.

After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a dispersed pattern over a widespread area from over the southern extremities of Redbourn in the north to over the northern extremities of Hemel Hempstead in the south (whilst the NPR swathe is not illustrated in this diagram, the turn is such that aircraft are flying outside the conventional SID 3km wide NPR swathe – illustrated by the fact departures overfly the populated areas of northern Hemel Hempstead which lies outside the NPR swathe).

After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a wide dispersed traffic pattern, although there is a more concentrated pattern (the orange tint) forming after passing the A5183 from St Albans to Redbourn, with the main concentrated pattern flying over Sandridge then routeing to Hatfield. Other tints of orange indicate strands of some concentration (difficult to determine) on the eastbound track as departures pass south of Redbourn. Either side of the main core of departures overhead Sandridge, there is a widespread pattern of departures, spread to the north of Sandridge and to the south of Sandridge (over north St Albans) which extends towards Hatfield and Welwyn Garden City.

SAMPLE FLIGHT TRACKS FROM THE RNAV-1 FLIGHT TRIAL AT 220KTS USED TO FORECAST THE IMPACT OF THE CHANGE – TRACK DENSITY PLOT - APRIL 2014 STAKEHOLDER CONSULTATION DOCUMENT PAGE 19 FIG 8:

Departures climb straight ahead until passing 1030ft amsl (500ft above aerodrome elevation) then turn left towards the southwest. Departures form a concentrated traffic pattern along the runway extended centreline before the turn, then the main core of departures form two patterns along the NPR centreline to the M1 Junction 10 (J10). The main core is concentred along the NPR centreline; a second less dense pattern is evident over Slip End with some departures flying slightly wider than the main core of departures.

After the M1 J10, the main core of departing aircraft continue along a concentrated south-westerly track centred along the NPR centreline, although there are some departures flying slightly to the west of noise monitor NMT 02.

After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a more concentrated traffic pattern around the turn flying between Redbourn in the north and Hemel Hempstead to the south, and thus the wide dispersion seen with the conventional SIDs is no longer apparent. Flights over Redbourn and Hemel Hempstead is less apparent in this density plot compared to the conventional traffic pattern in Fig 5.

After passing Hemel Hempstead and the M1, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge then routeing to Hatfield. Some departures are still flying over the northern parts of St Albans, and vectoring towards the northern part of Hatfield is evident after passing the A5183, which, extends towards Welwyn Garden City.

SAMPLE FLIGHT TRACKS FROM THE RNAV-1 FLIGHT TRIAL AT 220KTS USED TO FORECAST THE IMPACT OF THE CHANGE – TRACK DISPERSION PLOT - APRIL 2014 STAKEHOLDER CONSULTATION DOCUMENT PAGE 20 FIG 9:

Departures climb straight ahead until passing 1030ft amsl (500ft above aerodrome elevation) then turn left towards the southwest. Departures form a concentrated traffic pattern along the runway extended centreline before the turn, then the main core of departures form two patterns along the NPR centreline, one towards the M1 Junction 10 (J10) and a second smaller pattern flying slightly wider than the main core of departures and over Slip End.

After the M1 J10, most aircraft continue along the NPR centreline on a south-westerly track, and some departures fly slightly to the west of noise monitor NMT 02 and fly over the eastern extremity of Markyate.

After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a more concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead.

After passing Hemel Hempstead and the M1, aircraft complete the turn onto an easterly track in a more concentrated traffic pattern, which, continues towards Sandridge then routeing to Hatfield. Radar vectoring is apparent after passing the A5183 from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring towards the northern part of Hatfield remains evident and extends towards Welwyn Garden City.

Table 1 – CAA Track Analysis of the Track Dispersion Plots July 2015 Conventional SID Vs July 2016 RNAV-1 SID - Track Dispersion Plots for Departures in Altitude Bands in 1000ft Intervals Up To 7000ft

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
Conventional SID JULY 2015 (2482 departures) v RNAV-1 SID (+Conv SID) JULY 2016 (3020 departures) Notes: 1. The traffic samples only show departures routeing to Brookmans Park (which is the subject of this PIR) and do not show the Compton and Olney SIDs, which, also fly a similar route as far as the A5 between Markyate and Flamstead. 2. The July 2016 sample shows RNAV-1 departures and approximately 500 conventional departures.							
Annex H	**Up to 1000ft**	CA up to 1030ft	**Slide 3: July 2015** Departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline. **Forecast pattern**: Departures climb straight ahead and form a concentrated traffic pattern along the runway extended centreline before the turn.	**Slide 4: July 2016** The traffic pattern is similar to the 2015 pattern before the change. For the RNAV-1 SID, departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline.	**Slide 3 Vs Slide 4** Some departures are evident for a slightly longer distance in this altitude band.	Yes. The traffic pattern is generally as expected, except, some departures appear to fly a slightly longer distance in this band (i.e. climb less well).	Yes SID Design is Acceptable
Annex H	**1000ft to 2000ft**	CA up to 1030ft DF to GWS 01 TF to all following waypoints	**Slide 5: July 2015** Departures form a concentrated traffic pattern along the runway extended centreline and follow the NPR centreline during the turn towards the M1 Junction 10 (J10).	**Slide 6: July 2016** The traffic pattern is similar to the 2015 pattern before the change. Departures form a concentrated traffic	**Slide 5 Vs Slide 6** Some departures are evident for a slightly longer distance in this altitude band extending beyond the M1.	The traffic pattern is generally as expected, except, some departures appear to fly a slightly longer distance in this band (i.e. climb less well).	SID not flown by all aircraft types as designed. Therefore, SID design not acceptable. Boeing aircraft experienced some flyability issues with this

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			Forecast Pattern: Departures are dispersed across the NPR swathe, most departures fly towards the western side and several departures on the eastern side of the NPR centreline. The main core of departures forms two patterns, one centred along the NPR centreline to the M1 J10; and a second less dense pattern (with fewer aircraft) over Slip End, with some departures flying slightly wider than the main core of departures on the western extremity of the NPR swathe.	pattern along the runway extended centreline and during the southwest turn near the M1 J10, the main core of departures starts to form two patterns. Departures are dispersed across the NPR swathe, most tracks fly towards the western side and several departures on the east side of the NPR centreline.			segment of the SID. To address these, a minor modification (change GWS01 from a FO to FB WP) was made before being validated and then implemented in the AIP in February 2017.
Annex H	**2000ft to 3000ft**	DF to GWS 01 (FO WP) TF to all following waypoints	**Slide 7: July 2015** As before to the M1. After the M1 J10, the pattern reduces in width and as it passes the A5 between Markyate and Flamstead, the pattern starts to become concentrated along the NPR centreline.	**Slide 8: July 2016** Departing traffic is more dispersed compared with the conventional SID. As before to the M1. After the M1 J10, aircraft continue along a south-westerly track along the NPR centreline.	**Slide 7 Vs Slide 8** A similar profile is evident with the RNAV-1 SID.	No; some aircraft are wider during the initial turn to the southwest turn than was expected, and around NMT02, some departures fly slightly outside the NPR swathe. It should be noted that due to the 2016 sample containing samples of conventional SID	No Not acceptable As the resultant traffic pattern provided is more widespread to the west than was intended, this may be due to the GWS01 flyover waypoint. It is difficult to be certain of this at this point due to the 2016 sample

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			After passing the A5 between Markyate and Flamstead, departures continue straight ahead, for approximately 1km, following the NPR centreline before commencing the left turn towards St Albans and Sandridge. Some departures remain within this altitude band (i.e. below 3000ft) as they commence the left turn towards St Albans. **Forecast Pattern:** After the M1 J10, aircraft continue along the NPR centreline on a south-westerly track, although there are some departures flying slightly to the west of noise monitor NMT 02 and flying over the eastern extremity of Markyate. After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge; the traffic pattern is more concentrated around the inside (left hand side) of the NPR swathe.	The departures form a dispersed pattern across the NPR swathe, with some departures flying slightly to the west of noise monitor NMT 02 and flying over the eastern extremity of Markyate. After passing the A5 between Markyate and Flamstead, aircraft turn left towards Sandridge in a similar traffic pattern but just slightly further to the east on the inside of the NPR centreline.		departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved.	containing both conventional and RNAV SID departures. Boeing aircraft experienced some flyability issues with this segment of the SID. To address these, a minor modification (change GWS01 from a FO to FB WP) was made before being validated and then implemented in the AIP in February 2017.

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
Annex H	**3000ft to 4000ft**	DF to GWS 01 (FO WP) TF to all following waypoints	**Slide 9: July 2015** As before to the A5. After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn. The dispersion covers the southern extremities of Redbourn to the northern extremities of Hemel Hempstead. On the inside of the turn, some departures are flying over Flamstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track towards Sandridge and Hatfield. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic	**Slide 10: July 2016** As before to the A5. After passing the A5 between Markyate and Flamstead, aircraft fly a more concentrated traffic pattern during the left turn towards Sandridge. The main core of departures routes between Redbourn and Hemel Hempstead, with a few flights over Flamstead and Redbourn. Some departures also fly over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a more concentrated traffic pattern, which, continues towards Sandridge and Hatfield. In this sample, three departures leave the	**Slide 9 Vs Slide 10** A similar profile is evident with the RNAV-1 SID.	The traffic pattern is generally as expected, however some departures fly over the north of Hemel Hempstead which was not expected. It should be noted that due to the 2016 sample containing samples of conventional SID departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved.	No, as some aircraft fly over Hemel Hempstead. Not acceptable but see Column 7. Boeing aircraft experienced some flyability issues with this segment of the SID. This caused some of these aircraft to fly closer Hemel Hempstead than expected. To address these issues, a minor modification (change GWS01 from a FO to FB WP) was made before being validated and then implemented in the AIP in February 2017.

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.	NPR swathe early and fly over Harpenden.			

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
Annex H	**4000ft to 5000ft**	DF to GWS 01 (FO WP) TF to all following waypoints	**Slide 11: July 2015** As before to the A5. After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn. The dispersion covers the southern extremities of Redbourn to the northern extremities of Hemel Hempstead. On the inside of the turn, some departures fly over Flamstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track, in a wide dispersed traffic pattern, routeing towards St Albans and Sandridge then Hatfield and Welwyn Garden City. Widespread vectoring is apparent after passing Redbourn. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a	**Slide 12: July 2016** As before to the A5. After passing the A5 between Markyate and Flamstead, aircraft fly a dispersed left turn towards Sandridge. The main core of departures fly between Redbourn and Hemel Hempstead. In addition to the main core, several departures also fly over the southern part of Redbourn and the north of Hemel Hempstead. Some aircraft fly over Flamstead and a greater number of aircraft fly over Redbourn than in the lower altitude band up to 4000ft. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track and are dispersed across the NPR swathe. The dispersal is most likely due to radar vectoring by ATC.	**Slide 11 Vs Slide 12** A similar profile is evident with the RNAV-1 SID.	No, as after the left turn towards Sandridge, aircraft form a dispersed pattern. It should be noted that due to the 2016 sample containing samples of conventional SID departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved.	While less aircraft are seen over Redbourn as expected, the number of aircraft over Hemel Hempstead is more than expected. But it should be noted that due to the 2016 sample containing samples of conventional SID departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved. Therefore, SID design is not acceptable.

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.	Whilst some departures fly over south Harpenden and St Albans, less fly over Hemel Hempstead, Redbourn, and St Albans is apparent compared with the conventional SID. Towards Hatfield, the main core of departures remains along the SID nominal track and radar vectoring remains evident to the north of Hatfield and towards Welwyn Garden City.			

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
Annex H	**5000ft to 6000ft**	TF	**Slide 13: July 2015** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn. The dispersal extends from near the centre of Redbourn and southern areas of Harpenden and continues towards Welwyn Garden City to and over the north of St Albans and Hatfield. On the inside of the turn, several departures also fly over Flamstead and after passing Redbourn widespread vectoring is evident. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south.	**Slide 14: July 2016** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn. The main core of departures routes between Redbourn and Hemel Hempstead. However, several departures also fly over Redbourn, the north of Hemel Hempstead, the southern extremity of Harpenden, and the northern area of St Albans and some aircraft overfly Flamstead. There are less aircraft flying over Hemel Hempstead, Harpenden and St Albans compared with the conventional SID. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track remaining dispersed across the SID nominal route and widespread radar vectoring is apparent.	**Slide 13 Vs Slide 14** A similar profile is evident with the RNAV-1 SID.	No, as aircraft form a dispersed pattern around the turn. It should be noted that due to the 2016 sample containing samples of conventional SID departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved.	No, as the wider turns results in aircraft flying over Hemel Hempstead, which, was not expected in the numbers shown. But it should be noted that due to the 2016 sample containing samples of conventional SID departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved. Therefore, SID design is not acceptable.

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.	Aircraft continue to fly over Hatfield and Welwyn Garden City, in a similar pattern to the post implementation conventional SID. However, near Hatfield, several departures appear slightly further south than is evident for the conventional SID.			
Annex H	6000ft to 7000ft	TF	Slide 15: July 2015 After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a	Slide 16: July 2016 After the A5 between Markyate and Flamstead, the traffic pattern is less dispersed	Slide 15 Vs Slide 16 A similar profile is evident with the RNAV-1 SID.	No, as aircraft form a dispersed pattern around the turn. It should be noted that due to the 2016 sample containing samples of	No, as the wider turns results in aircraft flying over Hemel Hempstead, which, was not expected in the numbers shown.

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			wide dispersed turn. The dispersal extends from near the centre of Redbourn and southern areas of Harpenden and continues towards Welwyn Garden City to and over the north of St Albans and Hatfield. On the inside of the turn, several departures also fly over Flamstead and after passing Redbourn, widespread vectoring is evident. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent	in the turn towards St Albans and Sandridge. There are less flights over Hemel Hempstead, Redbourn, Harpenden and St Albans. The dispersed main core of departures is similar to the conventional SID pattern.		conventional SID departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved.	But it should be noted that due to the 2016 sample containing samples of conventional SID departures, it is difficult to form an accurate assessment of whether the desired outcome is achieved. Therefore, SID design is not acceptable.

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.				

Table 2 – Track Dispersion Plot Comparison - Conventional SID (August 2014) v RNAV-1 SID (March and August 2017)

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
Comparison of Conventional SID August 2014 (1968 departures) with RNAV-1 SID March 2017 (1912 departures) and August 2017 (2549 departures) Notes: 1. The traffic pattern figures only show departures routeing to Brookmans Park (which is the subject of this PIR) and do not show the Compton and Olney SIDs, which, also fly a similar route as far as the A5 between Markyate and Flamstead. 2. In these samples are several aircraft which are not flying the SID, these turn left towards Harpenden after the first turn. It is likely these are helicopters or light aircraft flying a non-standard departure. 3. It is not possible to compare the vertical profile for the samples provided due to the plots not showing altitude for the post implementation RNAV-1 SID							
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 1 DER to WP1 (Flyby) (Runway to GWS01) Take-off straight ahead to 1030ft, then a left turn to the M1 Junction 10. It should be noted that due to the design of the turn, aircraft cannot commence the turn until they reach 1030ft amsl.	Course to Altitude (CA) 1030ft. followed by Direct to Fix (DF) to GWS01 (FB WP)	**Slide 3: August 2014** Departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline. Aircraft commence the left turn around Junction 10A of the M1 and follow the NPR centreline in a dispersed pattern. Departures remain dispersed as they pass the M1 J10. As aircraft cross the M1, a few aircraft fly to the west and outside the NPR. in this sample some track plots departures fly straight ahead and turn	**Slide 4: March 2017** Departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline. Aircraft begin to turn around Junction J10A of the M1 and follow the NPR centreline in a dispersed pattern. Departures are spread across the NPR swathe to J10. As aircraft cross the M1, a few aircraft fly outside the NPR swathe. **Slide 5: August 2017** Very similar pattern to March 2017.		Yes; traffic pattern as expected. Luton has provided Monthly Track Dispersion Plots by Airline where it can be seen how each airline has flown the SID. Some of the airlines have flown more to the west of the NPR It would have been expected Luton engage with each of these airlines to ascertain why, but there is no evidence to suggest any engagement took place. In the Mar and Aug 2017 Monthly Track Dispersion Plots by Airline- March it	Yes Apart from the airlines mentioned in column 7 airlines are flying this segment of the SID as expected. Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			right. These could be due to aircraft flying a missed approach from Runway 26 and are being re-positioned for a further approach by ATC. But there is no evidence provided by Luton to conclusively confirm this. **Forecast Pattern:** Departures are concentrated along the runway centreline and then begin to disperse at the turn as expected.	Note: in this sample some departures fly straight ahead and turn right. These are most likely to be aircraft flying a missed approach from Runway 26 and are being re-positioned for a further approach by ATC.		can be seen Wizz Air, Easyjet and Blue Air are wide on the turn prior to and after GWS01. As all the other airlines are flying the SID as expected, each of these airlines should be contacted by Luton to explain why they are producing these tracks and to advise on how they will make improvements to the adherence to the lateral profile of the SID.	
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 2: WP1 to WP2 (GWS01 to GWS06) Flyby After J10 of the M1, continuation of the departure routeing between Markyate and Flamstead (approximately as far as the A5) before turning towards St Albans.	Track to Fix (TF)	**Slide 3 August 2014** After departures cross the M1 J10, the traffic pattern reduces in width, and becomes concentrated along the NPR centreline. Some departures start to commence the left turn towards St Albans/Sandridge before reaching Flamstead resulting in aircraft flying over Flamstead and Redbourn and Harpenden. This could be due to ATC vectoring. Forecast Pattern:	**Slide 4: March 2017** The traffic pattern is similar to the 2014 conventional sample. After departures cross the M1 J10, the main core is concentred along the NPR centreline. Some departures start to commence the left turn towards St Albans/Sandridge before reaching Flamstead resulting in aircraft flying over Flamstead and Redbourn. **Slide 5: August 2017**		Yes; we believe that the expected traffic pattern has been achieved and there has been an improvement following the Feb 2017 design modification implementation, which, changed the flyover waypoint at GWS01 to a flyby waypoint.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			The main core of departures forms two patterns, one centred along the NPR centreline from J10 to the A5 and a second less dense pattern (with fewer aircraft) over Slip End, with some departures flying slightly wider than the main core of departures on the western extremity of the NPR swathe.	Very similar pattern to March 2017. However, slightly more aircraft turn earlier towards Redbourn resulting in more flights over Flamstead and Redbourn.			
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 3: WP2 to WP3 (GWS06 to GWS12) From the turn commencement point, crossing the A5 towards St Albans as far as the railway line from St Albans to Harpenden.	Track to Fix (TF)	**Slide 3: August 2014** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn, covering an area from southern Redbourn in the north, to over the northern extremities of Hemel Hempstead in the south and resulting in some aircraft flying outside the NPR swathe. Some departures are flying over Flamstead and Redbourn on the inside of the turn. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a	**Slide 4: March 2017** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn over an area from the south-west of Redbourn to the north east of Hemel Hempstead. The expanse of the dispersion is much reduced around the turn, and significantly reduced after the turn (when aircraft establish on the easterly track passing south of Redbourn), compared with the pre-implementation Conventional SID.	**From the evidence presented by Luton aircraft are complying with the vertical profile of the SID.** **It needs to be understood the SID only requires aircraft to be at or above 3000' on reaching GWS12 (which is the end of the NPR) and not above 4000' on reaching GWE16. This will allow an aircraft with the available performance to be not above 4000' when passing GWS06 but an aircraft at 3000' on reaching GWS06 will still be in compliance with the**	Yes; however, the traffic pattern during the turn north of Hemel Hempstead is wider than expected from that shown in the Trial traffic sample in consultation, although it should be noted that the Trial sample had a significantly lower number of flights (it was not a monthly sample). Whilst the SID design was intended to restrict radar vectoring until departures had crossed the railway line, this initiative has not completely been achieved. Increased radar vectoring is evident and, likely due to the requirement to integrate	**Generally, the turn at GSW06 is being flown as expected but the monthly track dispersion plots by airline would suggest there are improvements each airline could make which would ensure less dispersal of tracks in the turn, both on the outside and inside of the turn. This would help to minimise impacts to the communities at Flamstead, Hemel Hempstead and Redbourn.** **Isolated track deviations could be attributed to ATC vectoring. But the**

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			wide dispersed traffic pattern, routeing towards Sandridge, and St Albans then Hatfield. After departures complete the turn, widespread radar vectoring is evident. On the south side of the traffic pattern, the northern half of St Albans is flown over. On the north side of the traffic pattern, the main core of traffic is to the south of Harpenden and Redbourn There are some isolated tracks over Harpenden and Redbourn but these are not part of the main core of departures. These tracks may be due to ATC radar vectoring. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying	There are less flights over Redbourn and Hemel Hempstead, similar flights over the southern area of Harpenden and less flights over St Albans up to the railway line (some of these flights may be attributed to radar vectoring by ATC and not because of the SID design). **Slide 5: August 2017** The traffic pattern is similar to that of March 2017 except that the flight tracks in the turn at GWS06 is more concentrated and mainly within the NPR swathe. The isolated flight tracks south of the NPR, some can be seen in the "170805 Monthly Track Dispersion Plots by Airline- Aug" where tracks attributed to Wizz Air (some tracks look like the a/c was being vectored), Thomson, Monarch (1 track over GWS06 and centre of Hemel Hempstead), El Al (1 track). The number of these tracks in this PP appear to be less than	**SID vertical requirements.**	Luton departures with other en-route network traffic patterns. In the Mar 2017 Track Dispersion plots (170305-Monthly Track Dispersion Plots by Airline- March) it can be seen airlines are producing a dispersal of tracks across the NPR swathe. This is expected with the design of the SID. But many of the airlines have deviated from the NPR both on the outside and inside of the turn at GWS06. In the Aug 2017 Monthly Track Dispersion Plots by Airline these deviations continue to occur. Therefore, each of the airlines should be contacted to explain why they are producing tracks as shown in the track plots and to advise on how they will make improvements to the adherence to the lateral profile of the SID.	**aerodrome need to work with the airlines to ensure better lateral adherence to the SID and with ATC to limit early vectoring.**

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			between Redbourn in the north and Hemel Hempstead to the south.	those shown in the Slide 5 of August 2017.			
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 4: WP3 to WP6 (GWS12 to BPK VOR) Both FB From crossing the railway line to Brookmans Park (near Brickendon Grange Golf Course).	Track to Fix (TF)	**Slide 3: August 2014** After passing the St Albans to Harpenden railway line, the traffic pattern is dispersed and likely due to radar vectoring by ATC. From this point the aircraft are no longer adhering to the lateral profile of the published SID due to the ATC vectoring. To the south of the nominal track, the northern half of St Albans and most of Hatfield is flown over. The traffic pattern (mainly centred over Sandridge), extends to the north with some departures flying over the southern area of Harpenden and the majority of Welwyn Garden City is flown over. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans	**Slide 4: August 2014** After passing the St Albans to Harpenden railway line, the traffic pattern is dispersed and likely due to radar vectoring by ATC. The northern half of St Albans continues to be flown over but not to the same extent as it was pre-implementation. Fly over of Hatfield is similar to the traffic pattern pre-implementation. Note: the flights over St Albans and parts of Hatfield which are located to the south of the nominal track of the SID design, are flown over as a result of radar vectoring and not as a direct result of the SID design. The traffic pattern (mainly centred over Sandridge), extends to the north with some departures flying over the		Yes; departures which fly the SID without any vectoring follow the SID design as expected. The intent to restrict radar vectoring until after passing the railway line has not been completely achieved. In the Aug 2017 (170803 Track Dispersion and Density Plots) slide 3 states “0.5% A/c flew outside of NPR below 4000’”. It should be noted; the SID does not require an aircraft to fly within the NPR at 4000’. The SID requires aircraft to be at or above 3000’ by GWS12, the end of the NPR and aircraft are achieving this requirement. The next SID requirement is aircraft will not be above 4000’ by GWE16. This can mean if an aircraft has the performance available, it can climb to 4000’ within the NPR, but it is not a SID requirement.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.	southern area of Harpenden. The majority of Welwyn Garden City continues to be flown over. Note: the flights over Harpenden and Welwyn Garden City, which, are located to the north of the nominal track of the SID design, are as a result of radar vectoring and not as a direct result of the SID design.			

Table 3 – Track Density Plot Comparison Conventional SID (August 2014) v RNAV-1 SID (March and August 2017)

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
Comparison of Conventional SID August 2014 (1968 departures) with RNAV-1 SID March 2017 (1912 departures) and August 2017 (2549 departures) Notes: 1. The traffic pattern figures only show departures routeing to Brookmans Park (which is the subject of this PIR) and do not show the Compton and Olney SIDs, which, also fly a similar route as far as the A5 between Markyate and Flamstead. 2. In these samples are several aircraft which are not flying the SID, these turn left towards Harpenden after the first turn. It is likely these are helicopters or light aircraft flying a non-standard departure. 3. It is not possible to compare the vertical profile for the samples provided due to the plots not showing altitude for the post implementation RNAV-1 SID							
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 1: DER to WP1 (Runway to GWS01) Take-off straight ahead to 1030ft, then a left turn to the M1 Junction 10	Course to Altitude (CA) 1030ft. followed by Direct to Fix (DF) to GWS01	**Slide 6: August 2014** Departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline. Aircraft begin to turn around Junction 10A of the M1 towards the M1 Junction 10. A concentrated pattern is evident, although, either side of the main departure pattern, there is some dispersion. A few aircraft fly further to the west as they cross the M1, and a number of departures turn early to	**Slide 7: March 2017** Departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline. Aircraft begin to turn around J10A of the M1 towards the M1 J10. A concentrated pattern remains evident, although there is some dispersion of aircraft either side of the main departure pattern. Some departures fly further to the west as they cross the M1.		Yes; traffic pattern as expected. While generally the traffic pattern is as expected, there are improvements that could be made by some airlines (see Table 2). Luton should work with airlines to see where some improvements could be made in achieving better compliance with the SID.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			fly over Harpenden and Redbourn Note: in this sample some departures fly straight ahead and turn right. These are most likely to be aircraft flying a missed approach from Runway 26 and are being re-positioned for a further approach by ATC. Other departures appear to turn left towards Harpenden after the first turn. It is not apparent what aircraft are flying this pattern – they could be helicopters or light aircraft flying a non-standard departure, but in any event, they are not flying the SID. **Forecast Pattern:** Departures are concentrated along the runway centreline and then being to disperse at the turn.	The traffic pattern is similar to that of the conventional SID, although the width of the pattern around the turn appears to be slightly less than the conventional SID. **Slide 8: August 2017** Very similar to the March 2017 traffic pattern. Note: in this sample some departures fly straight ahead and turn right. These are most likely to be aircraft flying a missed approach from Runway 26 and are being re-positioned for a further approach by ATC.			
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 2: WP1 to WP2 (GWS01 to GWS06) After J10 of the M1, as far	Track to Fix (TF)	**Slide 6: August 2014** Towards the A5 between Markyate and Flamstead, the traffic pattern is concentrated along the NPR centreline, with departures also flying	**Slide 7: March 2017** The traffic pattern is similar to the 2014 conventional SID sample.		Yes; traffic pattern as expected. The pattern is similar to the track plot shown for the Trial SID, resulting in aircraft flying between Markyate and Flamstead in a	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
	as approximately the A5, before turning towards St Albans.		both east and west of the main core of traffic. Some departures start to commence the left turn towards St Albans/Sandridge before reaching Flamstead, resulting in flights over Flamstead and Redbourn. **Forecast Pattern:** The main core of departures forms two patterns, one centred along the NPR centreline from J10 to the A5 and a second less dense pattern (with fewer aircraft) over Slip End, with some departures flying slightly wider than the main core of departures on the western extremity of the NPR swathe.	Towards the A5 between Markyate and Flamstead, the main core of departures is concentrated along the NPR centreline, with some departures also flying either side of the main core of traffic. Some departures start to commence the left turn towards St Albans/ Sandridge before reaching Flamstead resulting in flights over Flamstead and Redbourn. **Slide 8: August 2017** Very similar to March 2017, except that slightly more aircraft appear to be turning earlier towards Redbourn resulting in flights over Flamstead and Redbourn.		comparable manner to the conventional SID. However, we believe there has been a slight improvement in track keeping with the design modification changing the flyover waypoint at GWS01 to a flyby waypoint. The track adherence is generally acceptable, there are some airlines that Luton should work with to see where some improvements could be made in achieving better compliance with the SID.	
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 3: WP2 to WP3 (GWS06 to GWS12) From the turn commencement point, crossing the	Track to Fix (TF)	**Slide 6: August 2014** After passing the A5 between Markyate and Flamstead, the main core of departures turns left towards Sandridge and fly a wide turn, flying over the north-east of Hemel Hempstead (after the	**Slide 7: March 2017** After passing the A5 between Markyate and Flamstead, the main core of departures commences the left turn towards Sandridge earlier than they did flying the conventional		Yes; traffic pattern as expected. However, whilst the SID design was intended to restrict radar vectoring until departures had crossed the railway line, this initiative has not been completely	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
	A5 following the turn towards St Albans as far as the railway line from St Albans to Harpenden.		main core density changes from orange to yellow). Following the turn and by the time aircraft cross the St Albans to Harpenden railway line, aircraft establish on a direct track towards Brookmans Park. Departures are also widespread to the north and south of the main core in a less dense pattern (turquoise and purple patterns), flying over the northern area of Hemel Hempstead in the south and resulting in aircraft flying outside the NPR swathe. Departures on the north side of the main core (orange/yellow) fly over Flamstead and Redbourn on the inside of the turn; those aircraft being vectored by ATC fly over the southern area of Harpenden. After passing the M1 to the northeast of Hemel Hempstead, aircraft complete the turn onto an easterly track, with a denser core (yellow)	SID. They fly the turn passing north of Hemel Hempstead flying mid-way between Hemel Hempstead and Redbourn. The turn is completed by the M1 and compared with the conventional SID, the main core of departures is approximately 0.75NM (1400m) further north by the time it crosses the M1 eastbound than was the case, hence there is a distinct shift in the traffic pattern to the north towards Redbourn and away from Hemel Hempstead. After passing the M1, the main core of departures follows the SID eastbound nominal track to GWS12 (the railway line) where the next track change occurs. Departures outside the main core of the traffic pattern (shown by the turquoise and purple patterns), are less dispersed around the turn, resulting in less flights over Hemel		achieved, and likely due to the requirement to integrate Luton departures with other en-route network traffic patterns.	

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			evident by the time aircraft cross the railway line; the main core of departures continue to route towards Sandridge then Hatfield. During the wide turn north of Hemel Hempstead, by the time departures cross the M 1, widespread radar vectoring is evident when aircraft will be above 3000ft. On the south side of the traffic pattern, St Albans is flown over. On the north side of the traffic pattern, the main core is south of Redbourn and Harpenden, however, Redbourn and Harpenden are flown over by aircraft within the less dense traffic pattern (turquoise and purple). **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a	Hempstead, Redbourn, Harpenden and St Albans. **Slide 8: August 2017** The main core of departures is similar to that of March 2017, but with the increase in the August traffic sample, the main core is more noticeable with a denser pattern along the nominal track of the SID as the main core is now orange for the entire length of the traffic sample beyond Hatfield.			

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south.				
Annex J Rwy 26 MATCH 2Y AIP Chart AD 2 EGGW 6-2 & 6-10	Segment 4: WP3 to WP6 (GWS12 to BPK VOR) From crossing the railway line to Brookmans Park (near Brickendon Grange Golf Course).	Track to Fix (TF)	**Slide 6: August 2014** After passing the St Albans to Harpenden railway line, the main core of the departures follows the SID nominal track over Sandridge and continues towards Hatfield and then Brookmans Park. The main core of departures flies over Hatfield and all of Hatfield is flown over by aircraft within the less dense traffic pattern (turquoise and purple). To the south of the main core of departures, aircraft vectored by ATC are dispersed across all of St Albans and Hatfield. To the north of the main core of departures, aircraft are vectored over southern Harpenden,	**Slide 7: March 2017** After passing the St Albans to Harpenden railway line, the main core of departures follows the SID nominal track over Sandridge and continues towards Hatfield and then Brookmans Park. The main core of departures, flies over Hatfield and all of Hatfield is flown over by aircraft within the less dense traffic pattern (turquoise and purple). To the south of the main core of departures, aircraft vectored by ATC are dispersed across all of St Albans and Hatfield. Where the main core flies over Hatfield, there is an approximately 0.4 km southern shift in the track density pattern.		Yes; traffic pattern as expected. However, the intent to restrict radar vectoring until after passing the railway line has not been completely achieved, and likely due to the requirement to integrate Luton departures with other en-route network traffic patterns.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			Welwyn Garden City and the north of Hatfield. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern	To the north of the main core of departures, aircraft are vectored over southern of Harpenden, Welwyn Garden City and the north of Hatfield However, Harpenden is now less flown over, but, Hatfield and Welwyn Garden City continue to be flown over by the same extent as was evident before the change. Note: the flights over Harpenden and Welwyn Garden City, which, are located to the north of the nominal track of the SID design, are as a result of radar vectoring and not as a direct result of the SID design. **Slide 8: August 2017** The main core of departures is similar to that of March 2017, but the increase in the traffic sample is more noticeable with a denser (orange) pattern along the nominal track of the SID as the main core is now orange for the entire			

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.	length of the traffic sample beyond Hatfield.			

Table 4 – CAA Track Analysis of the Track Dispersion Plots July 2015 Conventional SID Vs August 2017 RNAV-1 SID - Track Dispersion Plots for Departures in Altitude Bands in 1000ft Intervals Up To 7000ft

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
TRACK DISPERSION PLOT ALTITUDE BAND COMPARISON UP TO 7000FT **Conventional SID JULY 2015 (2482 departures) v RNAV-1 SID August 2017 (2549 departures)** Notes: 1. The traffic pattern figures only show departures routeing to Brookmans Park (which is the subject of this PIR) and do not show the Compton and Olney SIDs, which, also fly a similar route as far as the A5 between Markyate and Flamstead.							
Annex K	**Up to 1000ft**		**Slide 3: July 2015** Departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline. **Forecast Pattern:** Departures climb straight ahead and form a concentrated traffic pattern along the runway extended centreline before the turn.	**Slide 4: August 2017** Departures climb straight ahead forming a concentrated traffic pattern along the runway extended centreline.	Some departures are evident for a slightly longer distance in this altitude band	Yes, traffic pattern as expected, however, departures appear to fly a slightly longer distance in this band.	Yes Acceptable
Annex K	**1000ft to 2000ft**		**Slide 5: July 2015** Departures form a concentrated traffic pattern along the runway extended centreline and follow the NPR centreline.	**Slide 6: August 2017** Departures form a concentrated traffic pattern along the runway extended centreline.	The traffic pattern is similar to the 2015 post-implementation Conventional SID.	Yes, expected traffic pattern achieved. The issue evident in the July 2016 traffic sample (i.e. initial implementation),	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			During the turn towards the M1 J10. **Forecast Pattern:** Departures are dispersed across the NPR swathe, most departures fly towards the western side and several departures on the eastern side of the NPR centreline. The main core of departures forms two patterns, one centred along the NPR centreline to the M1 J10; and a second less dense pattern (with fewer aircraft) over Slip End, with some departures flying slightly wider than the main core of departures on the western extremity of the NPR swathe.	During the turn, towards the M1 J10, there is dispersion across the NPR swathe, predominately on the western side.		with some departures flying a slightly longer distance in this altitude band is no longer evident in the 2017 sample. The CAA therefore believes the waypoint change from flyover to flyby has addressed this issue.	
Annex K	**2000ft to 3000ft**		**Slide 7: July 2015** As before to the M1. During the turn towards the M1 J10, departures are dispersed across the NPR swathe. As aircraft pass the A5 between Markyate and Flamstead, the traffic	**Slide 8: August 2017** As before to the M1. During the turn towards the M1 J10, departures are dispersed across the NPR swathe and predominately on the western side.	The traffic pattern is similar to the 2015 post-implementation Conventional SID. However, the 2017 RNAV SID traffic pattern is slightly more concentrated (because of the minor modification).	Yes, traffic pattern as expected.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			pattern reduces in width and becomes more concentrated along the NPR centreline. After passing the A5 between Markyate and Flamstead, departures continue straight ahead following the NPR centreline for at least 1000m before commencing a wide turn towards St Albans and Sandridge, which, take aircraft southeast of the NPR centreline. Some departures remain in this altitude band as they commence the left turn towards St Albans. **Forecast Pattern:** After the M1 J10, aircraft continue along the NPR centreline on a south-westerly track, although there are some departures flying slightly to the west of noise monitor NMT 02 and flying over the eastern extremity of Markyate. After passing the A5 between Markyate and Flamstead, aircraft turn	As aircraft pass the A5 between Markyate and Flamstead, the traffic pattern reduces in width and becomes more concentrated along the NPR centreline As departures cross the M1, the width of the traffic pattern has reduced by approximately 250m, and traffic is therefore less dispersed compared with the Conventional SID. After passing the A5 between Markyate and Flamstead, aircraft commence the left turn towards Sandridge, and as aircraft continue around the turn. The resultant traffic pattern is approximately 600m closer to Flamstead, compared with the pre-implementation conventional SID traffic pattern.	In addition, after passing the A5 between Markyate and Flamstead, aircraft commence the left turn earlier, which, results in aircraft flying closer to Flamstead.		

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			left towards St Albans and Sandridge; the traffic pattern is more concentrated around the inside (left hand side) of the NPR swathe.				
Annex K	3000ft to 4000ft		**Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing	**Slide 10: August 2017** As before to the A5. After passing the A5 between Markyate and Flamstead, aircraft are now displaced further to the east of the turn resulting to aircraft being closer to Flamstead. The main core of departures is between Redbourn and Hemel Hempstead, with a few flights over Flamstead, Redbourn and the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge then routeing to Hatfield. After departures cross the A5 southbound, there is a noticeable shift in the	A similar profile is evident with the RNAV-1 SID with a few aircraft remaining in this altitude band as far as Hatfield.	Yes, traffic pattern as expected.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.	traffic pattern. Measured from the roundabout at the northeast corner of the Hemel Ring Road (the A4147 Link Road/Cambrian Way roundabout), the main core has moved towards the northeast towards Redbourn by approximately 1.5km, and by the time it crosses the M1 eastbound. After passing the M1 eastbound towards Sandridge, the traffic pattern is more concentrated compared with the dispersion evident in the 2015 traffic sample.			
Annex K	**4000ft to 5000ft**		**Slide 11: July 2015** As before to the A5. After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn. The dispersion extends from the centre of Redbourn to northern Hemel Hempstead as far as the M1 J8. On the inside of	**Slide 12: August 2017** As before to the A5. After passing the A5 between Markyate and Flamstead, aircraft fly a widespread pattern around the left turn towards Sandridge. The main core of departures is between Redbourn and Hemel Hempstead, but several departures also fly over the south of	A similar profile is evident with the RNAV-1 SID. However, Redbourn is now flown over by only a few aircraft and, there are less flights over Hemel Hempstead, Redbourn, and St Albans.	Yes, traffic pattern as expected, although radar vectoring is evident before aircraft cross the railway line.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			the turn, some departures also fly over Flamstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a wide dispersed traffic pattern, routeing towards St Albans and Sandridge then Hatfield and Welwyn Garden City. Widespread vectoring is apparent after passing Redbourn. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent	Redbourn, the north of Hemel Hempstead and Flamstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track. Once south of Redbourn, radar vectoring becomes evident before aircraft cross the St Albans to Harpenden railway line. After passing the railway line, the traffic pattern becomes dispersed due to radar vectoring and not the SID design. The main core of departures remains centred along the SID nominal track towards Hatfield and GWS19.			

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.				
Annex K	**5000ft to 6000ft**		**Slide 13: July 2015** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn pattern; this extends from almost the centre of Redbourn, the southern area of Harpenden and Welwyn Garden City in	**Slide 14: August 2017** After passing the A5 between Markyate and Flamstead, aircraft fly a widespread pattern around the left turn towards Sandridge. The main core of departures is between Redbourn and Hemel Hempstead, but a small number of departures also fly over	A similar profile is evident with the RNAV-1 SID.	Yes, traffic pattern as expected. Note the SID final altitude is 5000. Any aircraft above 5000' has been re-cleared by ATC and in these cases the aircraft are no longer flying the SID vertical profile.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			the north, to over the northeast of Hemel Hempstead, the northern half of St Albans and Hatfield in the south. A few departures also fly over Flamstead on the inside of the turn. Widespread vectoring is apparent after passing Redbourn. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft	Redbourn, the north of Hemel Hempstead, the southern extremity of Harpenden, and the northern area of St Albans. A few aircraft fly over Flamstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track remaining in a more concentrated pattern until the St Albans to Harpenden railway line. After departures pass Harpenden, widespread radar vectoring by ATC is apparent. Redbourn, Hemel Hempstead and St Albans are now flown over less than before the change. Aircraft continue to fly over Hatfield and Welwyn Garden City in a similar pattern to that before the change, although whilst in the vicinity of Welwyn Garden City the pattern looks similar, in the			

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.	region of Hatfield, departures are not as far south.			
Annex K	6000ft to 7000ft		Slide 15: July 2015 After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge and fly a wide dispersed turn; this extends from almost the centre of Redbourn, the southern area of Harpenden and Welwyn Garden City in the north, to over the north east area of Hemel Hempstead, the northern half of St Albans and	Slide 16: August 2017 After passing the A5 between Markyate and Flamstead, aircraft fly a dispersed left turn towards Sandridge. The main core of departures is between Redbourn and Hemel Hempstead. A small number of departures fly over the north of Hemel Hempstead, the southern extremity of Harpenden, and the northern area of St Albans.	A similar profile is evident with the RNAV-1 SID.	Yes, traffic pattern as expected. Note the SID final altitude is 5000. Any aircraft above 5000' has been re-cleared by ATC and in these cases the aircraft are no longer flying the SID vertical profile.	Yes Acceptable

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			most of Hatfield in the south. Widespread vectoring is apparent after passing Redbourn. **Forecast Pattern:** After passing the A5 between Markyate and Flamstead, aircraft turn left towards St Albans and Sandridge. Departures fly a concentrated traffic pattern around the inside (left hand side) of the NPR swathe, flying between Redbourn in the north and Hemel Hempstead to the south. There are no flights directly over Flamstead and Redbourn, and in this sample, only a single departure is apparent over the north of Hemel Hempstead. After passing Hemel Hempstead, aircraft complete the turn onto an easterly track in a concentrated traffic pattern, which, continues towards Sandridge and Hatfield. After passing	After passing Hemel Hempstead, aircraft complete the turn onto an easterly track remaining in a more concentrated pattern until the St Albans to Harpenden railway line. Before departures pass Harpenden, widespread radar vectoring by ATC is apparent. Redbourn is no longer flown over by aircraft in this altitude band and there are less flights over Hemel Hempstead and St Albans compared with the conventional SID. Aircraft continue to fly over Hatfield and Welwyn Garden City in a similar pattern before the change, although whilst in the vicinity of Welwyn Garden City the pattern looks similar, in the region of Hatfield, departures are not as far.			

CAA Web Ref Procedure & AIP Chart Ref (Col 1)	Segment / Stage / Phase of SID & Waypoint (Col 2)	Path Terminator Employed (Col 3)	Pre-implementation Conventional SID Traffic pattern [in Blue is a description of the expected traffic pattern based on the 2014 Trial] (Col 4)	New RNAV-1 SID traffic pattern (Col 5)	Comparison of the new RNAV-1 SID vertical profile with the pre-implementation Conventional SID (Col 6)	Expected traffic pattern achieved? (Col 7)	SID Flown As designed (Yes/No)? SID Design Acceptable/Not-Acceptable? (Col 8)
			the A5183, radar vectoring becomes apparent from St Albans to Redbourn, and a widespread traffic pattern is evident. Some departures are still flying over the northern parts of St Albans, and vectoring remains evident towards the northern part of Hatfield, which, extends over Welwyn Garden City.				

CONCLUSIONS FROM CAA TRACK ANALYSIS

Table 5 – Track dispersion plots July 2015 Conventional SID v July 2016 RNAV-1 SID - Conclusions from CAA Track Analysis

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
Track dispersion plots July 2015 Conventional SID v July 2016 RNAV-1 SID. Notes: 1. SID design modified, with a revised design operated from Feb 17. Conclusions included for reference only.		
Up to 1000ft	Impacts as expected, except some departures slightly longer in this altitude band.	N/A as the SID was modified due to issues with some airlines.
1000ft to 2000ft	Impacts as expected, except some departures slightly longer in this altitude band extending beyond the M1.	N/A as the SID was modified due to issues with some airlines.
2000ft to 3000ft	Traffic more widely dispersed compared with conv SID.	N/A as the SID was modified due to issues with some airlines.
3000ft to 4000ft	In the main, impacts as expected, however, some departures flying over the north of Hemel Hempstead which was not intended as a result of the SID design.	N/A as the SID was modified due to issues with some airlines.
4000ft to 5000ft	The design resulted in a widespread turn with aircraft flying over Hemel Hempstead which was not intended.	N/A as the SID was modified due to issues with some airlines.
5000ft to 6000ft	The design resulted in a widespread turn with aircraft flying over Hemel Hempstead which was not intended. However, there are less flights over Hemel Hempstead, Harpenden, and St Albans. In the region of Hatfield, there is a slight displacement in the traffic pattern towards the south. Note: the SID vertical profile ends at 5000ft; above this altitude, the vertical profile is a result of tactical instructions issued by ATC.	N/A as the SID was modified due to issues with some airlines.
6000ft to 7000ft	The design resulted in a widespread turn with aircraft flying over Hemel Hempstead, which, was not intended. However, there are less aircraft flying over Hemel Hempstead, Redbourn, Harpenden and St Albans. Note: the SID vertical profile ends at 5000ft; above this altitude, the vertical profile is a result of tactical instructions issued by ATC.	N/A as the SID was modified due to issues with some airlines.

Table 6 – Track dispersion plots August 2014 Conventional SID v March 2017 and August 2017 RNAV-1 SID - Conclusions from CAA Track Analysis

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
Track dispersion plots August 2014 Conventional SID v March 2017 and August 2017 RNAV-1 SID.		
Segment 1 DER-GWS01	Impact as expected. Concentration along the runway centreline, then dispersion at the turn. Dispersion due to the turn at 1030ft being a variable. The SID design modification addressed some of the un-intended displacement to the west.	None.
Segment 2 GWS01-GWS06(GWS06 is the bisector of the turn, depending on the aircraft speed the turn will commence prior to GWS06) (to turn commencement)	Impact as expected. The traffic pattern is similar to the conventional SID. The August 17 sample showed more aircraft turning earlier resulting in flights over Flamstead and Redbourn.	Luton should engage with the airlines to see where the airlines can improve their track keeping in the turn, both on the outside and inside of the turn.
Segment 3 GWS06 (turn commencement-GWS12)	Impact as expected. The expanse of the dispersion north of Hemel Hempstead is much reduced around the turn, and significantly reduced after the turn (when aircraft establish on the easterly track passing south of Redbourn), compared with that evident from the traffic pattern before the airspace change. However, the traffic pattern is wider than portrayed in consultation, as departures pass Hemel Hempstead, possibly due to a larger traffic sample, nevertheless, Hemel Hempstead is flown over less. However, this wider pattern is still over an area previously overflown. There is less aircraft over Redbourn. There is considerably much less flight over Hemel Hempstead. There is a similar amount of overflight flights over of the southern area of Harpenden although this may be attributed to radar vectoring by ATC and not the SID design. There are less aircraft flying over St Albans up to the railway line, although some of these aircraft are likely due to radar vectoring by ATC and not as a result of the SID design.	Luton should engage with the airlines to see where the airlines can improve their track keeping in the turn, both on the outside and inside of the turn.

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
	Radar vectoring commences before the railway line, thus the intention to restrict this until the railway has not been completely achieved.	
Segment 4 GWS12-BPK VOR	Impact as expected. After passing the St Albans to Harpenden railway line, the traffic pattern is dispersed due to radar vectoring by ATC. The northern half of St Albans continues to be flown over, but, not to the same extent as it was prior to the RNAV-1 SIDs being implemented. The number of aircraft flying over Hatfield are similar to the traffic pattern before the change. Note: the flights over St Albans and parts of Hatfield which are located to the south of the nominal track of the SID design, are as a result of radar vectoring and not as a direct result of the SID design. The traffic pattern (mainly centred over Sandridge), extends to the north with some departures flying over the southern area of Harpenden. The majority of Welwyn Garden City continues to be flown over. Note: the aircraft flying over Harpenden and Welwyn Garden City, which, are located to the north of the nominal track of the SID design, are as a result of radar vectoring and not as a direct result of the SID design.	None.

Table 7 – Track density plots August 2014 Conventional SID v March 2017 and August 2017 RNAV-1 SID - Conclusions from CAA Track Analysis

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
Track density plots August 2014 Conventional SID v March 2017 and August 2017 RNAV-1 SID.		
Segment 1 DER-GWS01	Impact as expected. Concentration along the runway centreline, then dispersion at the turn either side of the main departure pattern Due to the turn at 1030ft being a variable. The main core density plot is unchanged from 2014.	None.

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
Segment 2 GWS01-GWS06 (to turn commencement)	Impact as expected. The main core density plot is unchanged from 2014. In the Aug 17 sample, some aircraft appear to be turning earlier towards Redbourn resulting in some aircraft flying over Flamstead and Redbourn. There has been an improvement in track keeping with the Feb 2017 design change.	None.
Segment 3 GWS06 (turn commencement-GWS12)	Impact as expected. After passing the A5 between Markyate and Flamstead, the main core of departures commences the left turn towards Sandridge earlier than they did flying the conventional SID. The turn is completed by the M1; the main eastbound core track is now approximately 0.75NM (1.4 km) further north by the time it crosses the M1 eastbound than was the case with the conventional SID, hence there is a distinct shift in the traffic pattern to the north towards Redbourn and away from Hemel Hempstead. After passing the MI, the main core of departures follows the SID eastbound nominal track to GWS12 (the railway line) where the next track change occurs. Departures outside the main core of the traffic pattern (shown by the turquoise and purple patterns), are less dispersed around the turn, resulting in less aircraft flying over Hemel Hempstead, and less aircraft over Redbourn, Harpenden and St Albans. Whilst there is less aircraft over St Albans up to the railway line, the aircraft that do fly over are due to radar vectoring by ATC and not as a result of the SID design. Note: Whilst the SID was intended to restrict radar vectoring until departures had crossed the railway line, this initiative has not been completely achieved, likely due to the requirement to integrate Luton departures with other en-route network traffic patterns.	None.
Segment 4 GWS12-BPK VOR	Impact as expected. After passing the St Albans to Harpenden railway line, the main core of the traffic pattern follows the SID nominal track over Sandridge towards Hatfield and then Brookmans Park. Harpenden and St Albans are flown over less. Hatfield and Welwyn Garden City flown over to a similar extent as the conventional SID traffic pattern.	None.

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
	Where the main core flies over Hatfield, there is a slight shift in the main core density pattern to the south by approximately 0.4 km. However, in the Aug 17 sample, the main core of the departure traffic pattern from Sandridge to Hatfield is also now in the same position as the 2014 traffic sample (before the change).	

Table 8 – Track dispersion plots July 2015 Conventional SID v August 2017 RNAV-1 SID - Conclusions from CAA Track Analysis.

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
Track dispersion plots July 2015 Conventional SID v August 2017 RNAV-1 SID.		
Up to 1000ft	Impacts as expected, except some departures slightly longer in this altitude band.	None.
1000ft to 2000ft	Impacts as expected. Traffic pattern similar to the 2015 pattern before the change.	None.
2000ft to 3000ft	Impact as expected. Widespread dispersion during the turn, then after the M1, the pattern becomes more concentrated and reduces in width by approximately 250m. After passing the A5 between Markyate and Flamstead, the traffic pattern becomes displaced to the east by approximately 600m, hence departures are closer to Flamstead.	None.
3000ft to 4000ft	Impacts as expected. Departures are closer to Flamstead. After passing the A5 southbound, the main core has moved to the northeast towards Redbourn by approximately 1.5km, and by the time it reaches the M1 eastbound, it has also shifted towards the north by approximately 1.5km. There is a more concentrated pattern as departures head towards Sandridge.	None.
4000ft to 5000ft	Impacts as expected.	None.

Segment / Stage / Phase of SID & Waypoint	Conclusion	Recommendations (if any)
	There are less aircraft flying over Hemel Hempstead, Redbourn and St Albans. Radar vectoring occurs before departures reach the railway line.	
5000ft to 6000ft	Impacts as expected. Redbourn is flown over less than it was before the change. There are less aircraft flying over Hemel Hempstead and St Albans. Note: the SID vertical profile ends at 5000ft; above this altitude, the vertical profile is a result of tactical instructions issued by ATC.	None.
6000 ft to 7000ft	Impacts as expected. Redbourn is not flown over. There are less aircraft flying over Hemel Hempstead and St Albans. Note: the SID vertical profile ends at 5000ft; above this altitude, the vertical profile is a result of tactical instructions issued by ATC.	None.