ABCx2 Component 2 Report
(Volume 2)

TECHNICAL REPORT
PHASE I: ARRIVAL PROCEDURE DESIGN
FOR NOISE MITIGATION NORTH OF
RONALD REAGAN WASHINGTON NATIONAL AIRPORT (KDCA)

Prepared by Vianair Inc. & ABCx2, LLC.

Executive Summary

This report summarizes the Phase I procedure design alternatives for arrival and approach procedures serving Ronald Reagan Washington National Airport (DCA). These procedures were designed to reduce noise impacts in communities including Arlington County, Montgomery County, Fairfax County and Washington, D.C. Procedural changes include Redesigned procedures include the RNAV (RNP) RWY 19 Standard Instrument Approach Procedure (SIAP) and proposals for the development of a RNAV (GPS) RWY 19 SIAP.

In addition to evaluating the notional procedures based on FAA criteria and aircraft performance, the procedures were also analysed based on noise exposure to the neighboring communities. Noise metrics included LAmax and DNL. Noise exposure based on land-uses (noise-sensitive versus non-noise-sensitive) and population densities were also evaluated. Noise exposure associated with the notional procedures and procedure modifications were compared to existing conditions.

The notional procedures and procedure modifications were evaluated to ensure compliance with both Standard for Terminal Instrument Procedures (TERPS) and Performance-Based Navigation (PBN) design criteria. Cases of non-compliance are described in this report.

A discussion of the overall process and recommendations for other changes that will need to be made to accommodate implementation of the notional procedures presented for consideration herein, can be found in Section 5 of this report.

Table of Contents

1. Problem Description

The purpose of this task (Phase I – Arrivals and Approaches) was to reduce community noise impacts from DCA arrivals as identified by the North of Airport Committee (NOA) of the Community Working Group (CWG) in areas north of the airport including Arlington County, Montgomery County, Fairfax County and Washington, D.C. These communities are impacted by noise associated with aircraft arrivals during south flow operations to Runway 19. Noise impacts associated with the following instrument approach procedures were of particular concern to the community:

- RNAV (RNP) RWY 19
- LDA Z RWY 19

Figure 1 summarizes the currently utilized procedures that are addressed by this report.

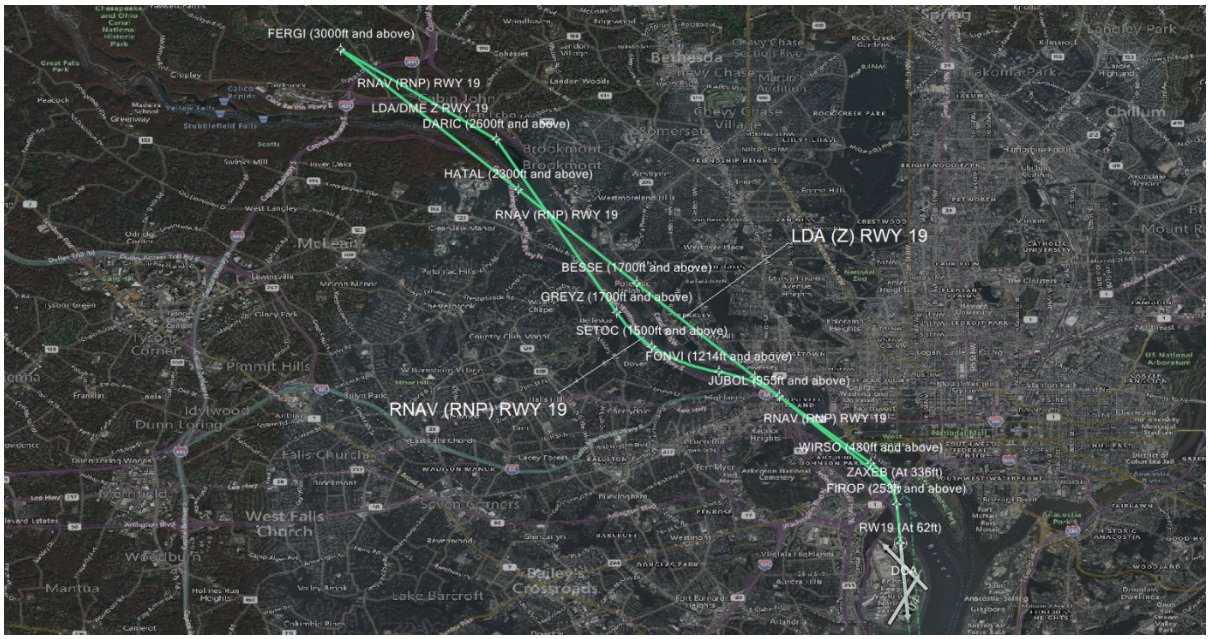

Figure 1 Currently utilized LDA Z RWY 19 Approach and RNAV (RNP) RWY 10 Approach procedures

To reduce community noise impacts associated with the RNAV (RNP) RWY 19, notional revisions to the existing RNAV (RNP) RWY 19 SIAP were developed. In addition, to mitigate noise impacts associated with the LDA Z RWY 19 approach, two notional RNAV (GPS) RWY 19 Standard Instrument Approach Procedure (SIAP) alternatives were evaluated. One notional procedure was developed by the FAA and one was developed by ABCx2. Existing versus notional procedures are presented in Table 1. Existing procedures will be referred to as "baseline" for the remainder of this report.

BASELINE APPROACH PROCEDURES	NOTIONAL / REVISED PROCEDURES
LDA Z RWY 19-EXIST RNAV (GPS) RWY 19-FAA*	RNAV (GPS) RWY 19-ABCX2
RNAV (RNP) RWY 19-EXIST	RNAV (RNP) RWY 19-ABCX2

Table 1 Existing (baseline) vs. new (notional) procedures

**Note- Even though the notional RNAV (GPS) RWY 19 Approach developed by the FAA was never implemented, for the purposes of this study, it was treated as a baseline approach for evaluation against the notional RNAV (GPS) RWY 19 Approach developed by ABCx2.*

Waypoint	Description		Procedure	Description
TIMMY	Currently published WP		DPART1-EXIST/ ILS RWY 26-EXIST	Currently published procedure
TIMMY-NEW	New WP not previously published, common to all proposals		DPART1-NEW/ ILS RWY 26-NEW	New procedure not previously published.
TIMMY-FAA	New or revised WP proposed by FAA		DPART1-FAA/ ILS RWY 26-FAA	New or revised procedure proposed by FAA
TIMMY-ABCX2	New or revised WP proposed by ABCx2		DPART-ABCX2/ ILS RWY 26-ABCX2	New or revised procedure proposed by ABCx2

Table 2 Waypoint (WP) & Procedure Nomenclature

The report is structured as follows:

- Section 2 includes an analysis of the baseline procedures in terms of their design and community noise impacts.
- Section 3 includes the design rationale of the notional procedures and an analysis of the Terminal Procedures (TERPS) / Performance Based Navigation (PBN) criteria and noise impacts.
- Section 4 includes a comparison of select waypoints and noise sensitive areas identified by the client. A noise exposure comparison was conducted based on the baseline and notional procedures.
- Section 5 provides a summary of ABCx2's recommended notional procedures and other flight procedures that must be taken into consideration by the FAA to facilitate implementation of the notional procedures.
- Appendix 1 presents the noise exposure calculation methodology referencing Eurocontrol's Document 29 methodology which is also used by FAA's Aviation Environmental Design Tool (AEDT) software.
- Appendix 2 includes all TERPS / PBN criteria calculation results.

2. Baseline Procedures Analysis

Figure 2, Figure 3, Figure 4, Figure 5 and Figure 6 illustrate the calculation of the LAmax noise contours for the LDA Z RWY 19-EXIST, RNAV (GPS) RWY 19-FAA, and RNAV (RNP) RWY 19-EXIST, respectively.

Note- LAmax and other noise calculations are discussed in Appendix 1

In Figure 2 below, the noise contour is illustrated for the existing (baseline) LDA-Z approach. Noise contours range from a low of 50dB to a high of 90dB. Note that the 70dB contour encompasses communities north and east of the Georgetown Reservoir.

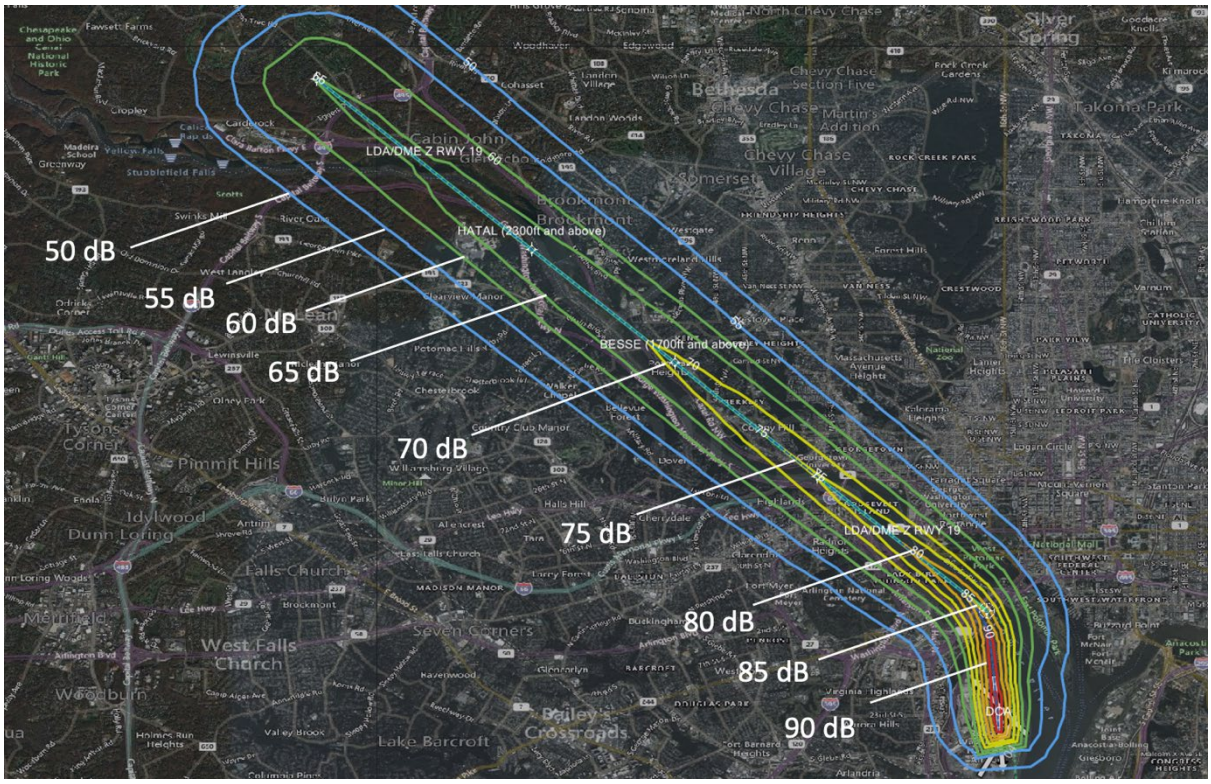

Figure 2 LDA Z RWY 19-EXIST - LAmax Noise Contours (B737-700, 129200.00 lbs landing weight)

In Figures 3 and 4 below, the noise contours of the baseline RNAV (GPS) RWY 19 - FAA Approach and the RNAV (RNP) RWY 19 – EXIST approach, show a more equitable distribution of noise between communities on either side of the river. One of the stated goals of the DCA Design Group was to achieve a more equitable distribution of noise so that no one community had to bear the brunt of the aviation noise. The ABCx2 designs improved on these metrics as will be illustrated throughout the document.

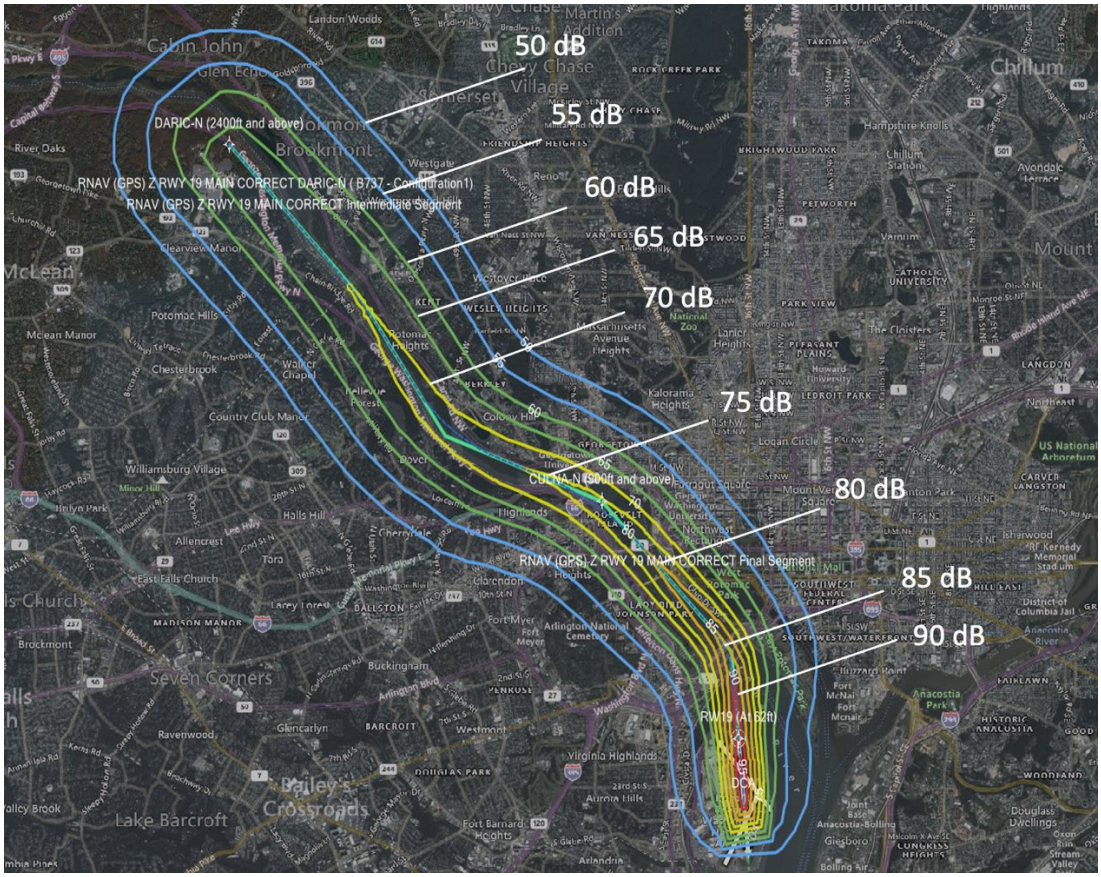

Figure 3 Notional RNAV (GPS) RWY 19-FAA - LAmax Noise Contours (129200.00 lbs landing weight)

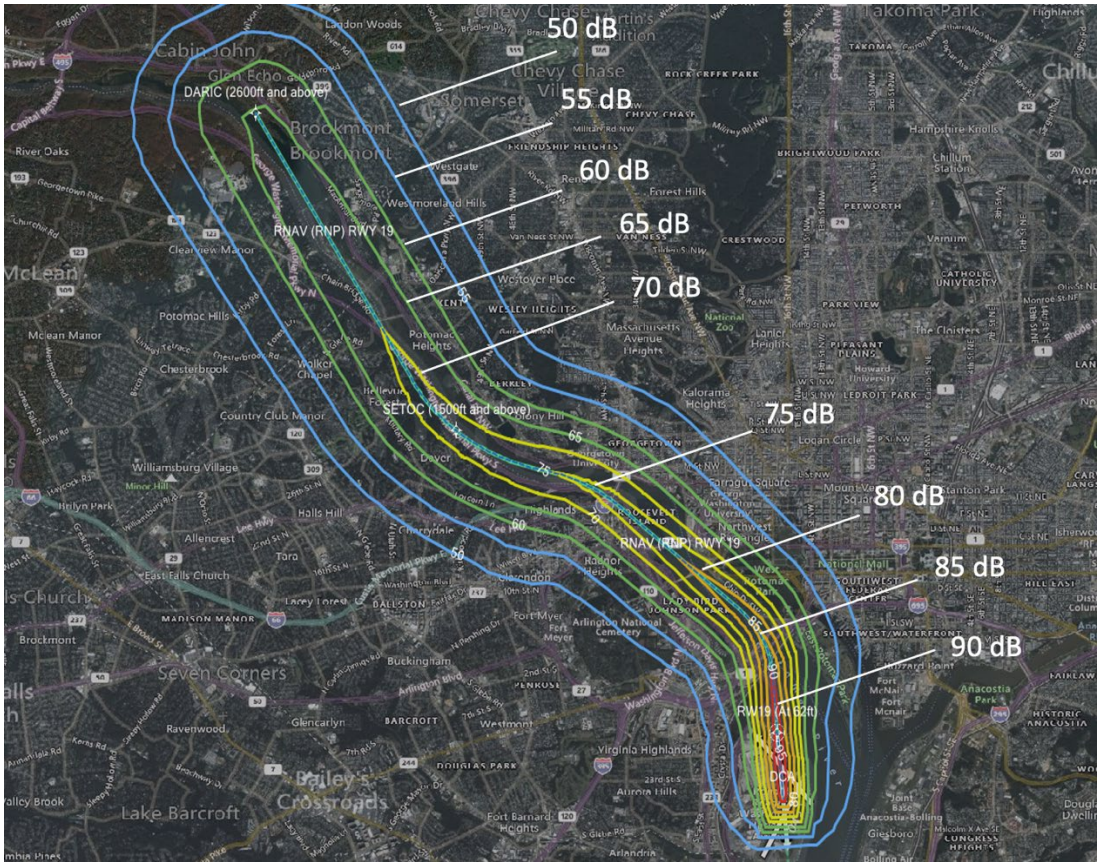

Figure 4 RNAV (RNP) RWY 19 -EXIST (post 12/31/2020) - LAmax Noise Contours (129200.00 lbs landing weight)

3. Notional Alternatives for South Flow Approaches to Runway 19

3.1 Background

Runway 01/19 is the longest runway at DCA, at 7169' it is approximately 2000' longer than Runways 4/22 and 15/33, making it the preferred runway for air carrier jet operations. Access to DCA Runway 19 during Instrument Meteorological Conditions (IMC) is challenging, due in large part to the location of Prohibited Airspace P-56A (Depicted in Figure 13) overlying the Washington D.C./National Mall area. Additionally, noise friendly access is limited during IMC due to aircraft and crew requiring RNP certification to fly the most noise friendly route, the RNAV (RNP) RWY 19. The alternative route imposes substantial noise impacts on the D.C. area communities with aircraft conducting the LDA-Z RWY19. The following section provides an analysis of notional procedure revisions, and new notional procedures, intended to maximize access to the runway while reducing community noise impacts.

3.2 Notional RNAV (GPS) RWY 19-ABCX2

This section presents the notional development of an RNAV (GPS) RWY 19 approach. As previously mentioned, two proposals were considered and evaluated, one by the FAA, hereinafter referred to as "RNAV (GPS) RWY 19-FAA", and one by ABCx2, hereinafter referred to as "RNAV (GPS) RWY 19-ABCX2". The purpose of these designs is to provide reduced noise impact to affected communities, provide IFR minimums equal to or lower than the existing LDA-Z RWY 19 minimums, increase safety by providing vertical guidance, and provide access to a higher percentage of the fleet servicing DCA than the baseline RNAV RNP procedure. It is anticipated this procedure would become the preferred approach for Runway 19 arrivals, providing substantial relief to the affected D.C. communities. Figure 7, Figure 8 and Figure 9 illustrate the notional procedure route geometry, satellite map overlay and vertical profile, respectively.

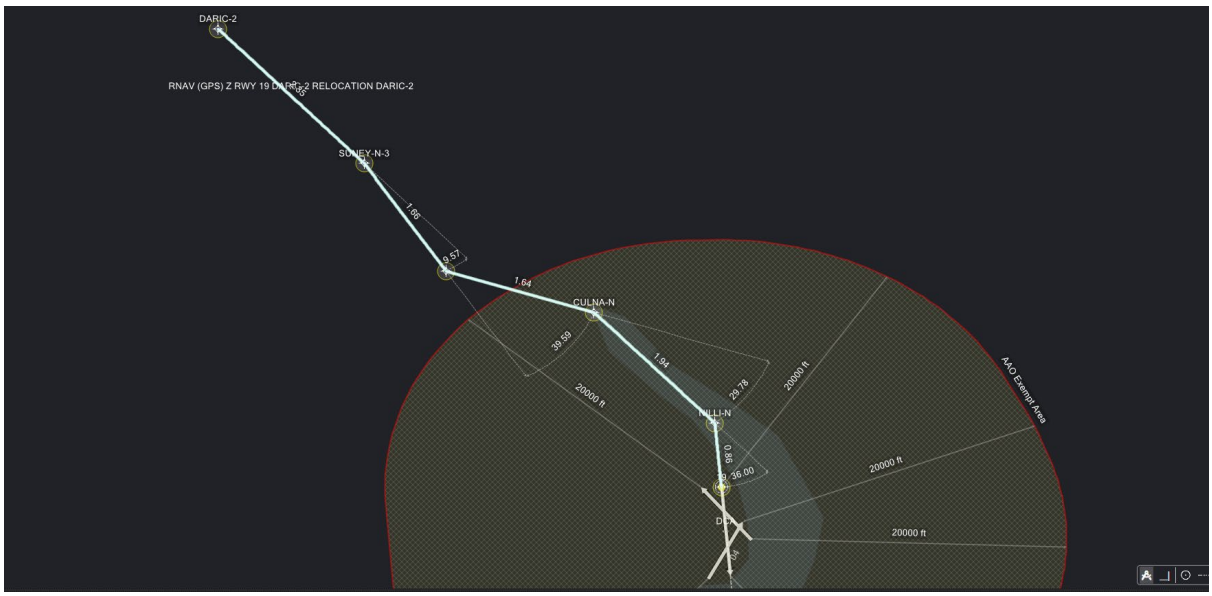

Figure 5 RNAV (GPS) RWY 19-ABCX2 - Route Geometry

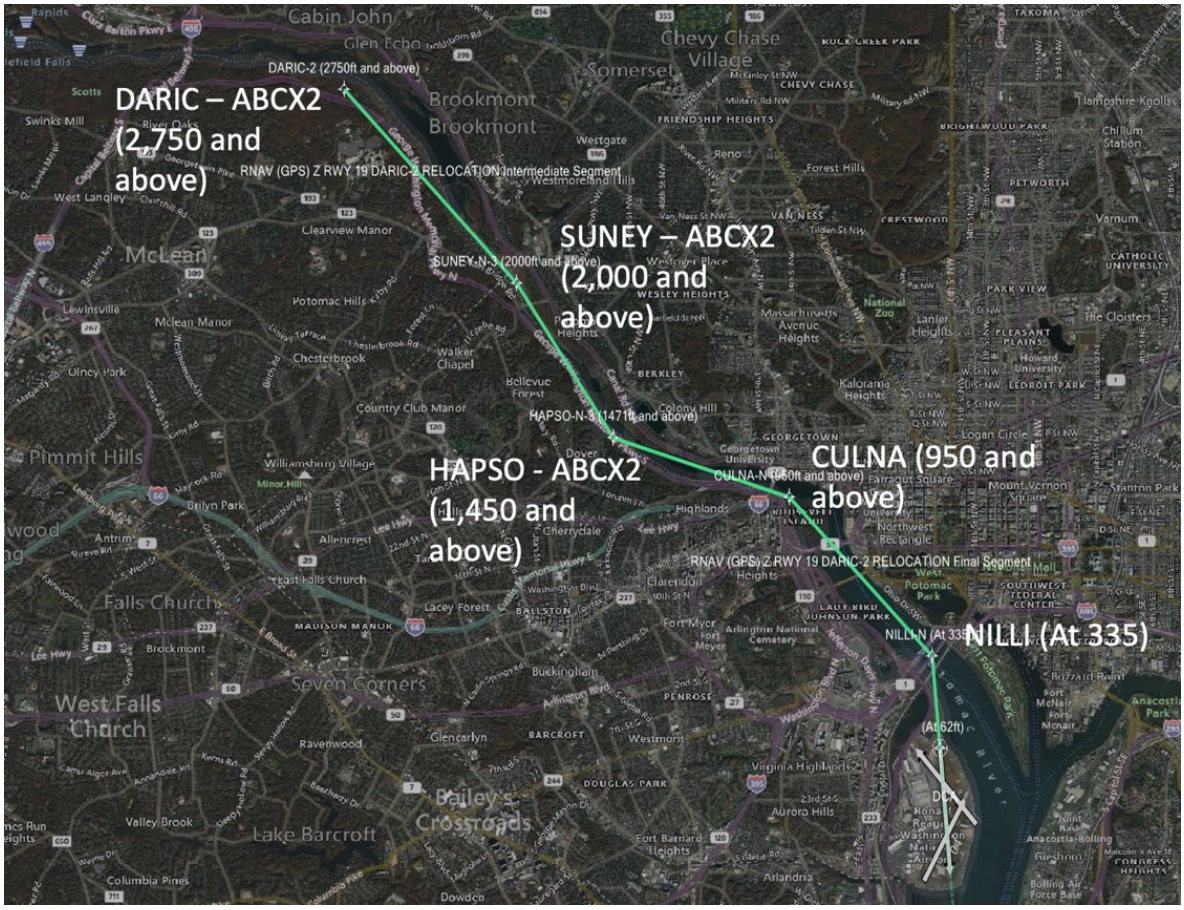

Figure 6 RNAV (GPS) RWY 19-ABCX2 - Satellite map overlay

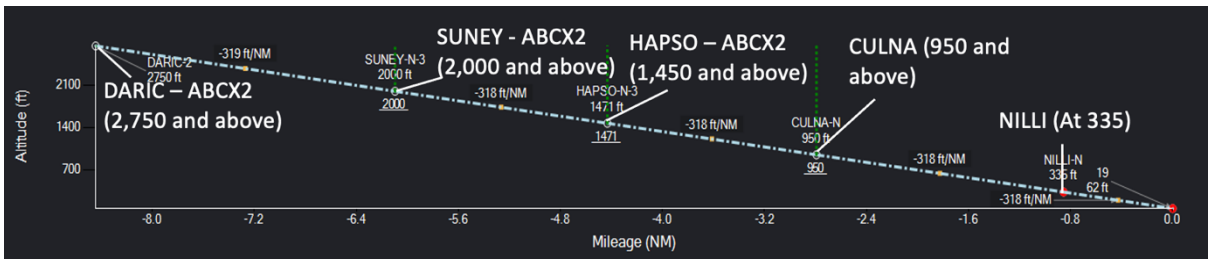

Figure 7 RNAV (GPS) RWY 19– ABCX2 - Vertical Profile

The notional RNAV (GPS) RWY 19-ABCX2 redesign coordinates and characteristics are presented in Table 2:

Table 2 RNAV (GPS) RWY 19-ABCX2 coordinates

Waypoint Name*	Waypoint Type	MSL Altitude	Crossing Speed	Latitude	Longitude	Leg Type	Flight Phase	RNP Value	Leg Length
DARIC-ABCX2	FlyBy	2750+	200-	38.96294	-77.15058	TF	Intermediate	1.00	2.34
SUNEY-ABCX2	FlyBy	2000+	200-	38.93308	-77.11813	TF	Intermediate	1.00	1.66
HAPSO-ABCX2	FlyBy	1471+	165-	38.90921	-77.09996	TF	Intermediate	1.00	1.63
CULNA	FlyBy	950+	165-	38.89999	-77.06701	TF	Final	0.30	1.93
NILLI**	FlyBy	335	165-	38.87542	-77.04016	TF	Final	0.30	0.85
RWY 19	-	62		38.86119	-77.03872				

**Per FAA Order JO 7400.2 the names of relocated waypoints are subject to change*
***Altitude at NILLI is for glidepath calculation only. Approach minimums may be determined to be substantially higher by the FAA.*

The key objectives of the design were i) reducing community noise exposure and ii) equitable noise exposure distribution (to the extent possible) between communities on the two sides of the river in accordance with the "*NOA Guiding Principles for Equitable Flight Procedure Design"* document developed and agreed to by the NOA on October 15, 2020 and approved by the CWG on 10/22/2020. These were achieved by:

- Optimizing the approach descent gradient (i.e., raising the altitude at the initial approach fix), enabling aircraft to remain higher, longer along the approach path, reducing the noise impact.

- Modifying the route in a way that produces a flight path (using the simulated track as a proxy) that flies as close as possible to the river centerline (greater gains realized over **HAPSO-ABCX2**).

- Track relocation for the parts of the river to the north and west (over **SUNEY-ABCX2**) aimed to relocate the route slightly to the south, thus shifting noise towards the CIA headquarters (Langley) over non-residential areas, thereby reducing noise in noise-sensitive residential communities in Montgomery County.

3.2.1. Noise Analysis and Comparison to Baseline

The LAmax metric was used to estimate noise exposure from the operation of a B737-700 (129,200 lbs / 1,500 – 2,000 NM trip)*. Figure 10 illustrates noise exposure in contours. The 40 and 45 dBA contours are illustrated in purple, 50 and 55 dBA contours in blue, 60 and 65 dBA contours in green, 70 and 75 dBA contours in yellow, 80 and 85 dBA contours in orange.

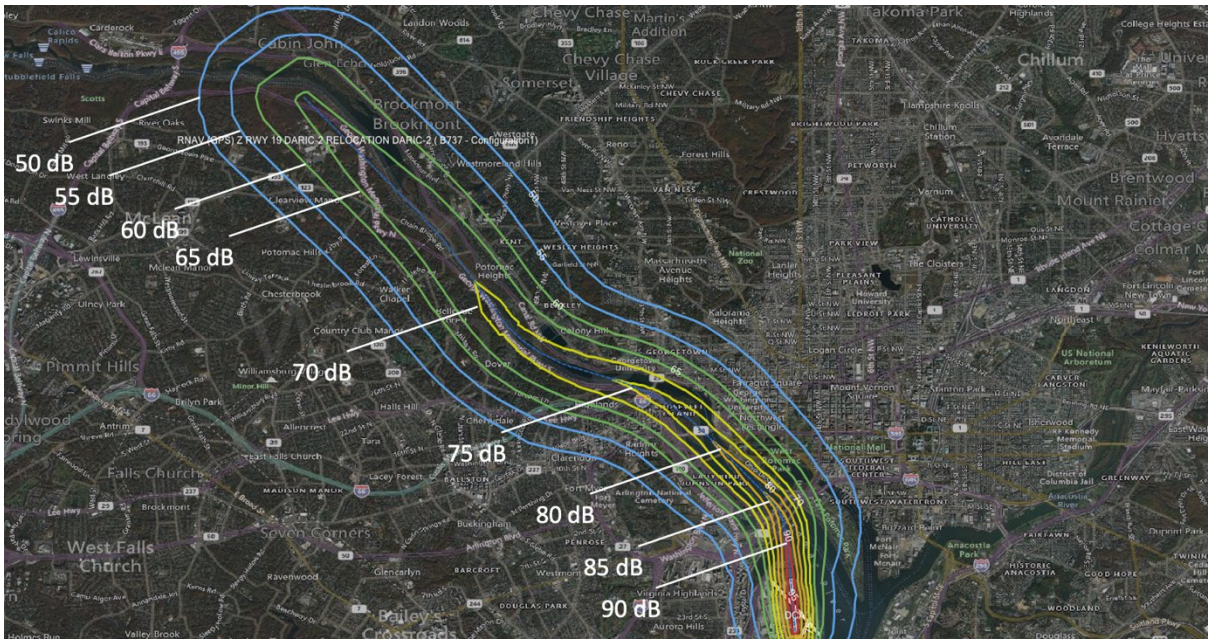

Figure 8 RNAV (GPS) RWY 19-ABCX2 - LAmax noise contours for operation of a B737-700

* Additional assumptions for the LAmax calculation include an 8-knot headwind, temperature of 15°C, a 70% relative humidity and a 1 bar atmospheric pressure.

Figure 11 illustrates the effect of the notional procedure over population zones, with the darker colors corresponding to higher population density as opposed to lower population density represented by lighter blue / grey color. It is evident that the notional procedure reduces exposure to high density population areas both in D.C. and Arlington County, as its centerline is overflying the Potomac river.

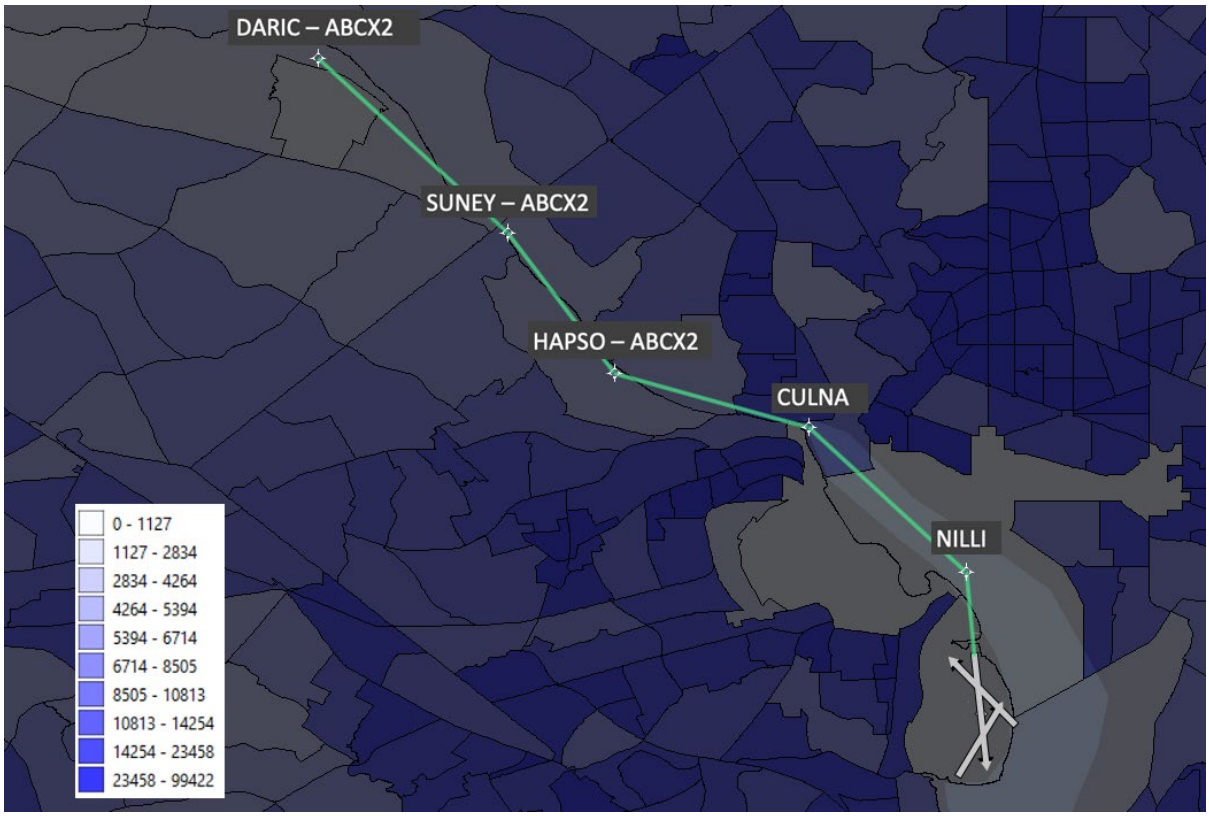

Figure 9 RNAV (GPS) RWY 19-ABCX2 over population zones (Census data) - darker blue color corresponds to areas of high population density; lighter blue / grey colors correspond to low population density

Figure 12 illustrates the noise exposure resulting from the procedure over population zones along the flight track from a vertical perspective. Green shaded areas represent parts of the procedure with minimal impact to the residents, while red shades indicate parts of the procedure that overfly, or fly close to, high density population areas.

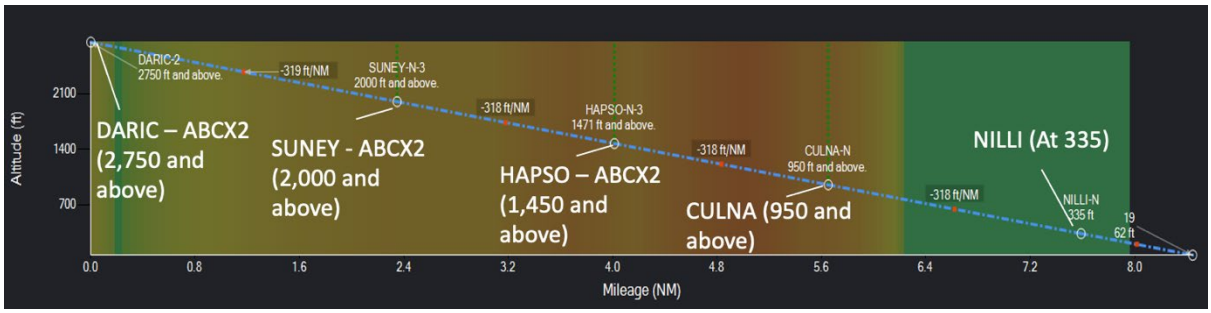

Figure 10 Vertical analysis of noise exposure to population density along the flight track - red color corresponds to high population exposure; green corresponds to low population exposure

3.2.2. Comparison of Notional Design to Baseline

Figure 13 illustrates the differences in the vertical profile of the ABCx2 notional design vs. the FAA notional design. ABCx2 was able to gain a slight improvement of the vertical profile over the flight track resulting in raising the altitude at almost all of the waypoints.

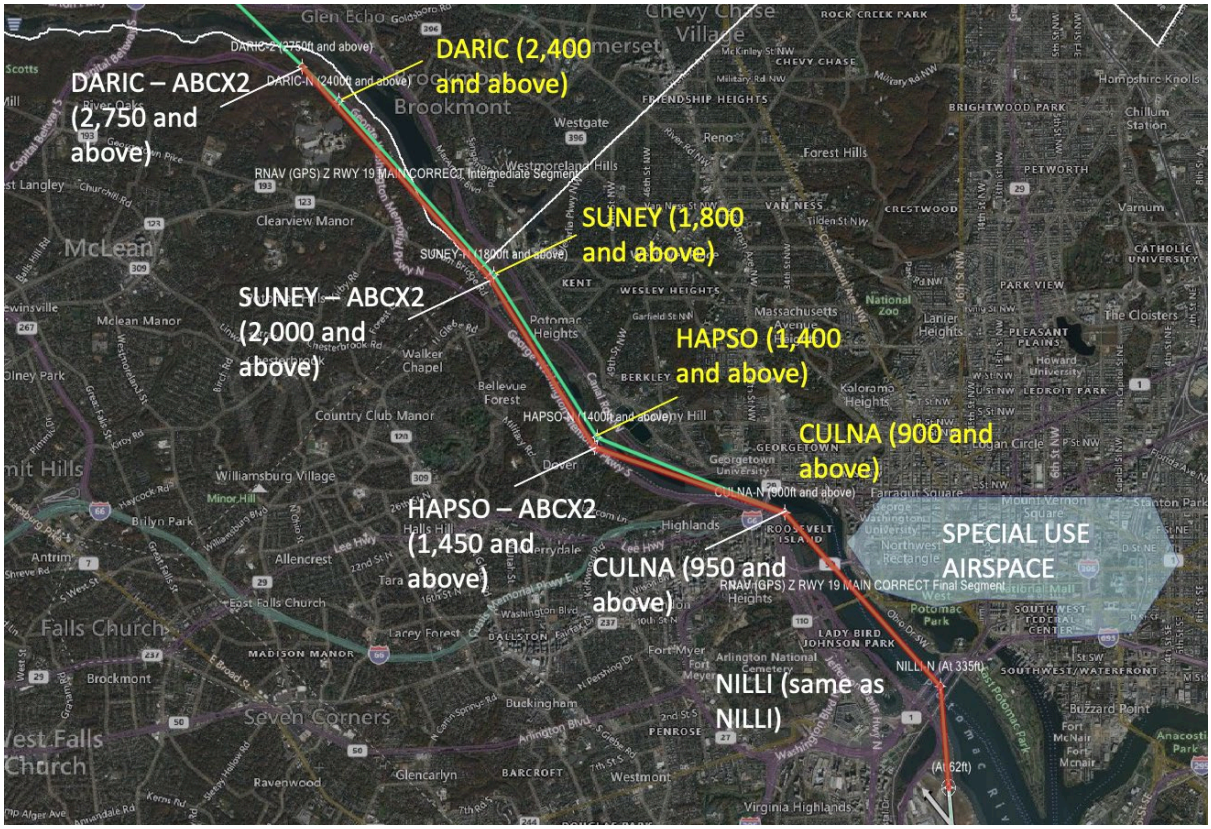

Figure 11 Notional RNAV (GPS) RWY 19-ABCX2 (red) vs. Notional RNAV (GPS) RWY 19 – FAA (green)

Figure 14 illustrates a comparison between the simulated paths for i) the notional design and ii) the baseline. It is evident that the ABCx2 notional design over the HAPSO waypoint (depicted by the red line) remains over the river reducing overflight of residential portions of Arlington County, while remaining south of the reservoir, thus avoids over flying D.C. Communities.

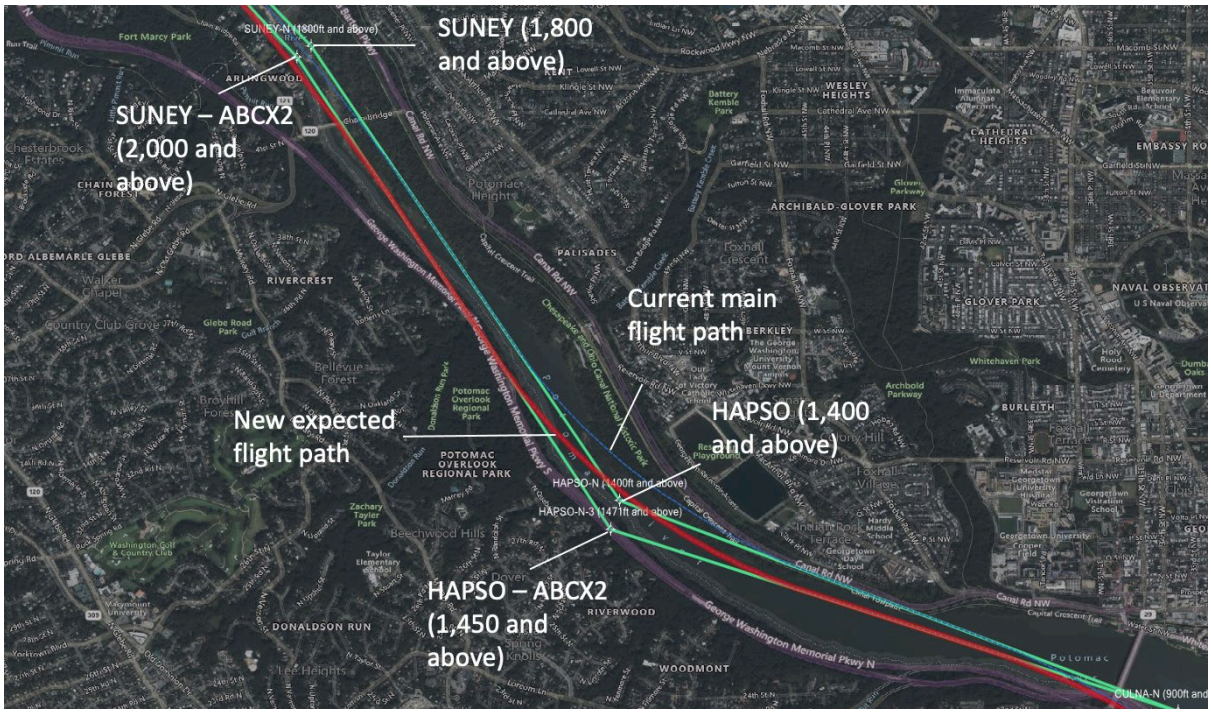

Figure 12 Expected aircraft flight paths; Notional RNAV (GPS) RWY 19-ABCX2 over HAPSO NEW (Red Line) versus RNAV (GPS) RWY 19 – FAA over HAPSO (Light Dashed Blue Line)

Figure 15 illustrates a comparison between the simulated paths for i) the ABCx2 notional design and ii) the FAA baseline over the SUNEY-ABCX2 waypoint. The ABCx2 notional design was shifted slightly southwest, further away from Sibley Memorial Hospital and away from higher density populations. The resultant path follows more closely the south bank of the river. As a result, flights are expected to avoid overflying densely populated noise sensitive areas of D.C. and Montgomery County, located on the north side of the river. The DARIC waypoint has also been relocated to DARIC-ABCX2, as shown in Figure 15. This change moves flight tracks over a more compatible land use, the CIA Headquarters, and way from densely populated noise sensitive areas of Montgomery County.

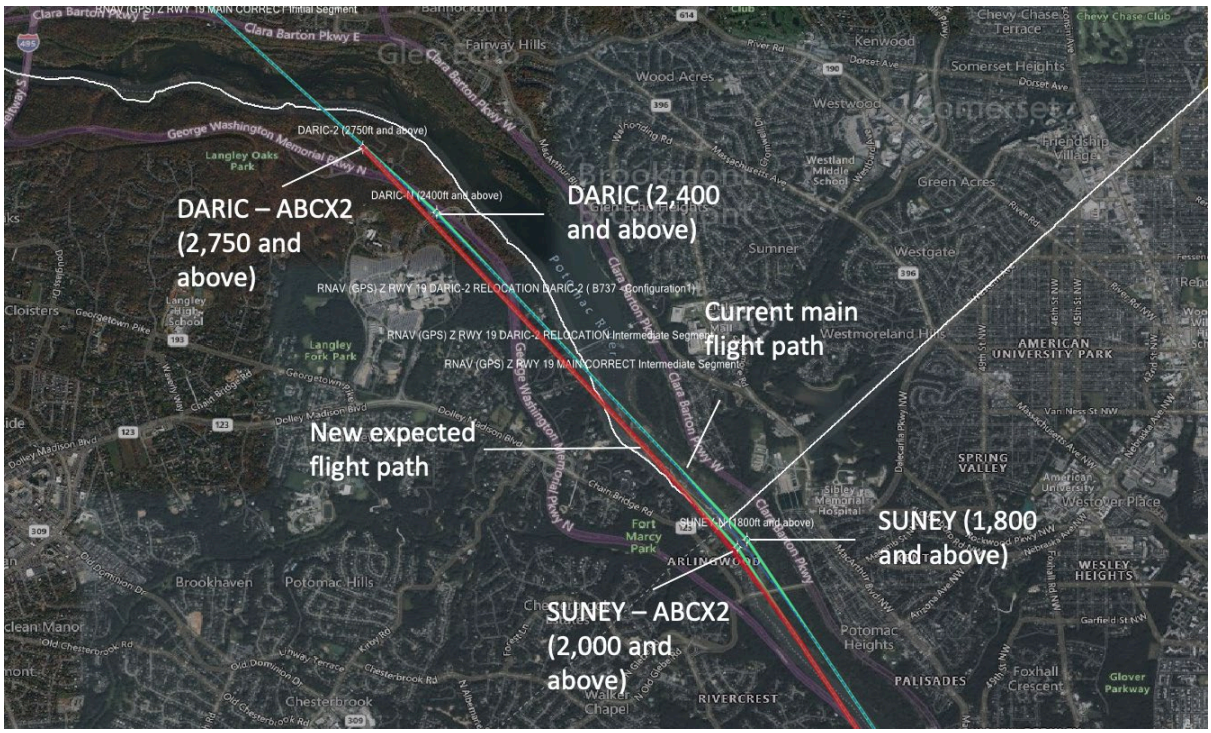

Figure 13 Expected aircraft flight paths; Notional RNAV (GPS) RWY 19-ABCX2 over SUNEY NEW (Red) versus RNAV (GPS) RWY 19 – FAA over SUNEY (Green with Thin Blue Dashed Line)

3.2.3. TERPS / PBN Considerations

The final segment of the ABCx2 notional approach procedure, from **CULNA** to the runway, (See Figure 16 below) has remained unchanged, matching the RNAV (GPS) RWY 19 – FAA. This design is outside criteria and will require waivers by the FAA. The relevant waivers involve use of a simulated runway, extending straight ahead of **NILLI**, such that the **NILLI** waypoint is the (imaginary) threshold and the **CULNA → NILLI** leg is a simulated straight-in landing. The total turn angle at **CULNA** is 29.78°. Because **CULNA** is the Final Approach Fix (FAF), the only Landing Systems that allow this angle are **LNAV** (*without vertical guidance*) and **LP** (*without vertical guidance*), for which the maximum allowed Fly-By turn at the FAF is 30°.

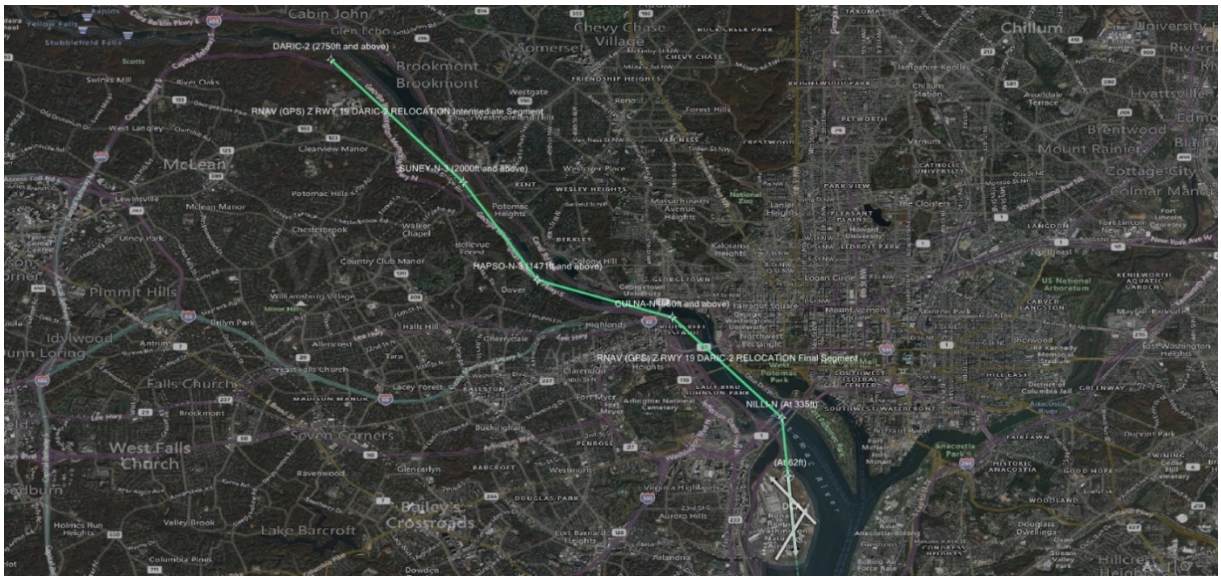

Figure 14 RNAV (GPS) RWY 19-ABCX2 - Satellite map overlay

The *minimum required length of the last two legs* is substantially higher than those of the previous ones, because the altitude of **NILLI** is < *500 ft above airport elevation*. Because of this, the maximum design bank angle allowed (for altitudes < 500 ft above-ground) is 3° and this, in turn, allows only very shallow turns, thus requiring substantially more length available to fit those turns. This affects both legs (the inbound and the outbound with respect to **NILLI**). Normally, final segments do not have Fly-By turns in them. *The simulated aligned runway on **NILLI** eliminates the turn at that point, thereby resolving this problem.*

In summary, the waivered criteria with regards to minimum leg lengths are presented below (note, both legs are also included in FAA's notional design):

- CULNA -> NILLI Leg Length (NM): 1.94 >= 4.21 (outside criteria)
- NILLI -> RWY 19 Leg Length (NM): 0.86 >= 3.62 (outside criteria)

Based upon discussions with the FAA, it is assumed that this procedure will first be implemented as a Special Flight Procedure that will allow for the necessary waivers for implementation. The procedure will initially only be available to a few operators and aircraft types for testing and data gathering. Once the initial flight trials have been completed, it is expected that the vast majority of operators will begin utilizing this approach as the preferred approach to the KDCA airport. This process could take several years to complete.

3.3 Notional RNAV (RNP) RWY 19-ABCX2

This section presents a notional redesign of the existing RNAV (RNP) RWY 19. The notional revisions seek to reduce the noise exposure to local communities compared to the baseline. Although the existing procedure provides some relief to D.C. communities over the LDA-Z approach, it's use is limited to a small percentage of the aircraft fleet serving DCA. The notional revision, RNAV (RNP) RWY 19-ABCX2, retains the noise reduction benefits for D.C. communities, and reduces noise impacts for Montgomery County, MD. This proposal also benefits ATC that has voiced the desire to move all approaches over a common waypoint (DARIC-ABCx2) and "decouple" the approach from the STARs thereby bringing the STARs back into conformance with FAA design criteria.

Figure 17, Figure 18 and Figure 19 illustrate the notional procedure route geometry, satellite map overlay and vertical profile, respectively.

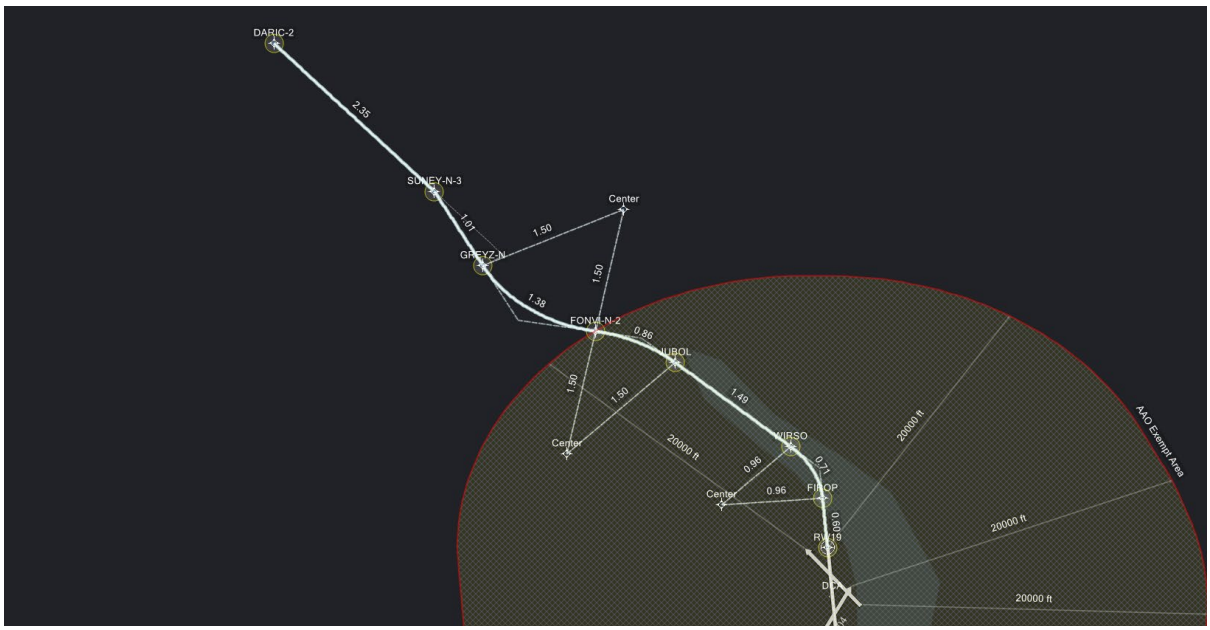

Figure 15 Notional RNAV (RNP) RWY 19-ABCX2 - Route Geometry – Note-Waypoint names do not follow the naming convention in this illustration.

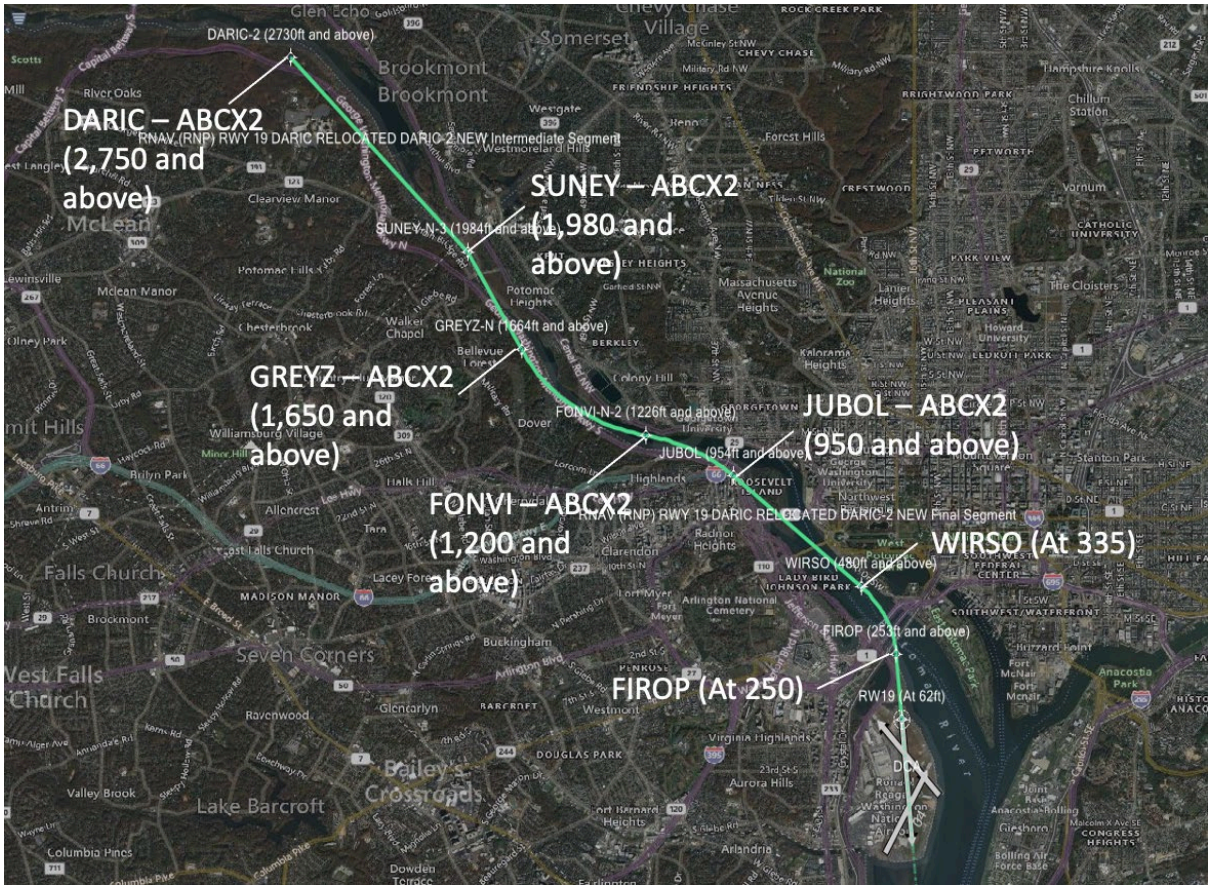

Figure 16 RNAV (RNP) RWY 19-ABCX2 - Satellite map overlay

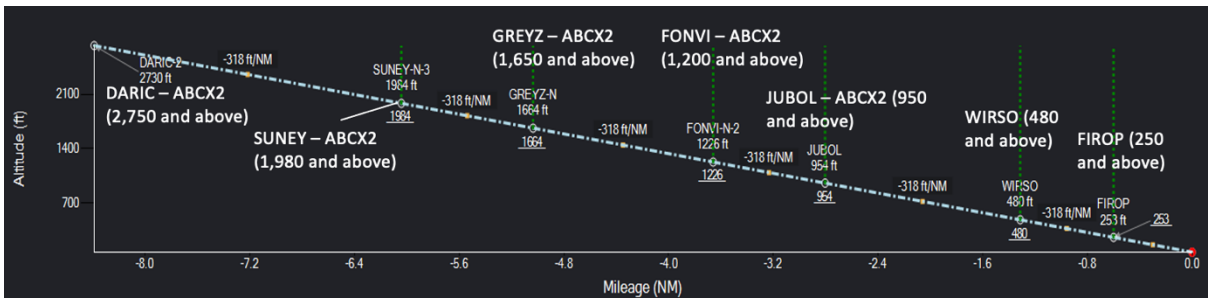

Figure 17 RNAV (RNP) RWY 19-ABCX2 - Vertical Profile

The notional RNAV (RNP) RWY 19-ABCX2 redesign coordinates and characteristics are presented in Table 3:

Table 3 RNAV (RNP) RWY 19-ABCX2 coordinates

Waypoint Name*	Waypoint Type	MSL Altitude	Crossing Speed	Latitude	Longitude	Leg Type	Flight Phase	RNP Value	Leg Length	RF Radius
DARIC-ABCX2	FlyBy	2730+	200-	38.9629	-77.1506	TF	Intermediate	1.00	2.34	
SUNEY-ABCX2	FlyBy	1984+	180-	38.9331	-77.1181	TF	Intermediate	0.89	1	
GREYZ-ABCX2	FlyBy	1664+	165-	38.9181	-77.1084	RF	Final	0.30	1.29	1.43
FONVI-ABCX2	FlyBy	1250+	165-	38.9055	-77.0869	RF	Final	0.30	0.92	1.66
JUBOL	FlyBy	955+	165-	38.8986	-77.0695	TF	Final	0.30	1.49	
WIRSO	FlyBy	480+	140-	38.8816	-77.0462	RF	Final	0.30	0.71	0.95
FIROP	FlyBy	253+	140-	38.8712	-77.0397	TF	Final	0.30	0.59	
RW19	FlyOver	62	140-	38.8612	-77.0387					

**Per FAA Order JO 7400.2 the names of relocated waypoints are subject to change*

Both the notional and the existing RNP approaches require RNP certification for the aircraft and crew per FAA Advisory Circular 90-101A. Although this may initially result in limited utilization of the procedure due to fleet and flight crew certification requirements, given the expectation of lower IFR minimums, providing better, safer access to the airport in IMC, and as older airframes are updated or replaced with newer aircraft, use of this procedure is expected to increase and render the existing LDA procedures obsolete. It is anticipated that there are noise related benefits to be gained, even from limited use of this procedure and substantial benefits will be realized as its use increases.

To realize these benefits, the main aim of this design is to keep the route as close to the river as possible. For this, the following design considerations were taken into account:

The RNAV (RNP)-EXIST route tracks almost exclusively to the South-West of the river centerline prior to **SETOC**. To balance this issue, the notional RNAV (RNP)-ABCX2 route has two crossover points. The first crossover point is located just prior to **SUNEY-ABCX2** and helps redistribute noise towards the South-West of the river prior to **SUNEY-ABCX2** and then towards to the North-East in the vicinity of **SUNEY-ABCX2**. The second crossover is close to **SETOC** and this helps "shift" the track close to the baseline track, while maintaining a slight southward relocation after **SETOC**. This achieves both a minor noise mitigation close to the reservoir in the vicinity of **FONVI-ABCX2**, while also enabling the perfect "merge" with the existing track at **JUBOL**. Because of the low altitudes involved, noise mitigation through track-displacement is a viable option that is expected to provide some improvements.

3.3.1. Noise Analysis and Comparison to Baseline

The LAmax metric was used to estimate noise exposure from the operation of a B737-700 (129,200 lbs / 1,500 – 2,000 NM trip)[†]. Figure 20 illustrates noise exposure in contours. The 40 and 45 dBA contours are illustrated in purple, 50 and 55 dBA contours in blue, 60 and 65 dBA contours in green, 70 and 75 dBA contours in yellow, 80 and 85 dBA contours in orange.

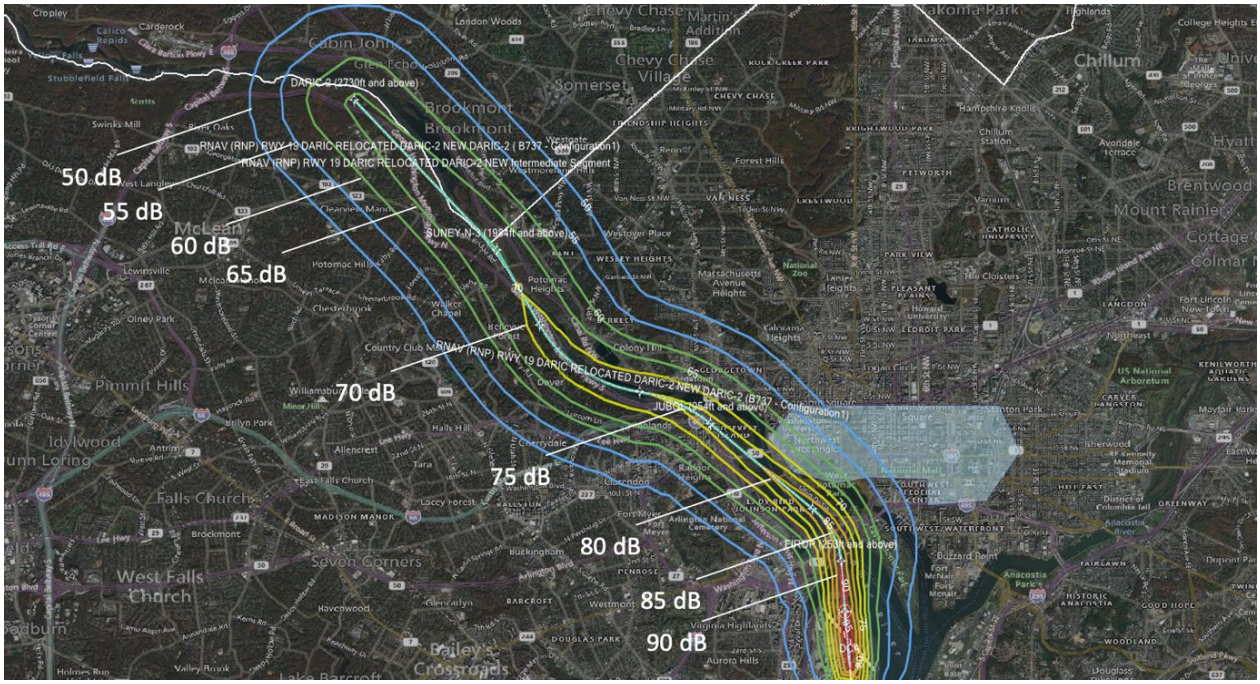

Figure 18 RNAV (GPS) RWY 19-ABCX2 - LAmax noise contours for operation of a B737-700

Figure 21 illustrates the effect of the notional procedure over population zones, with the darker colors corresponding to higher population density as opposed to lower population density represented by lighter blue / grey color. It is evident that the notional procedure avoids high density population areas both in D.C. and Arlington County, as its centerline is overflying the Potomac river.

[†] Additional assumptions for the LAmax calculation include an 8-knot headwind, temperature of 15°C, a 70% relative humidity and a 1 bar atmospheric pressure.

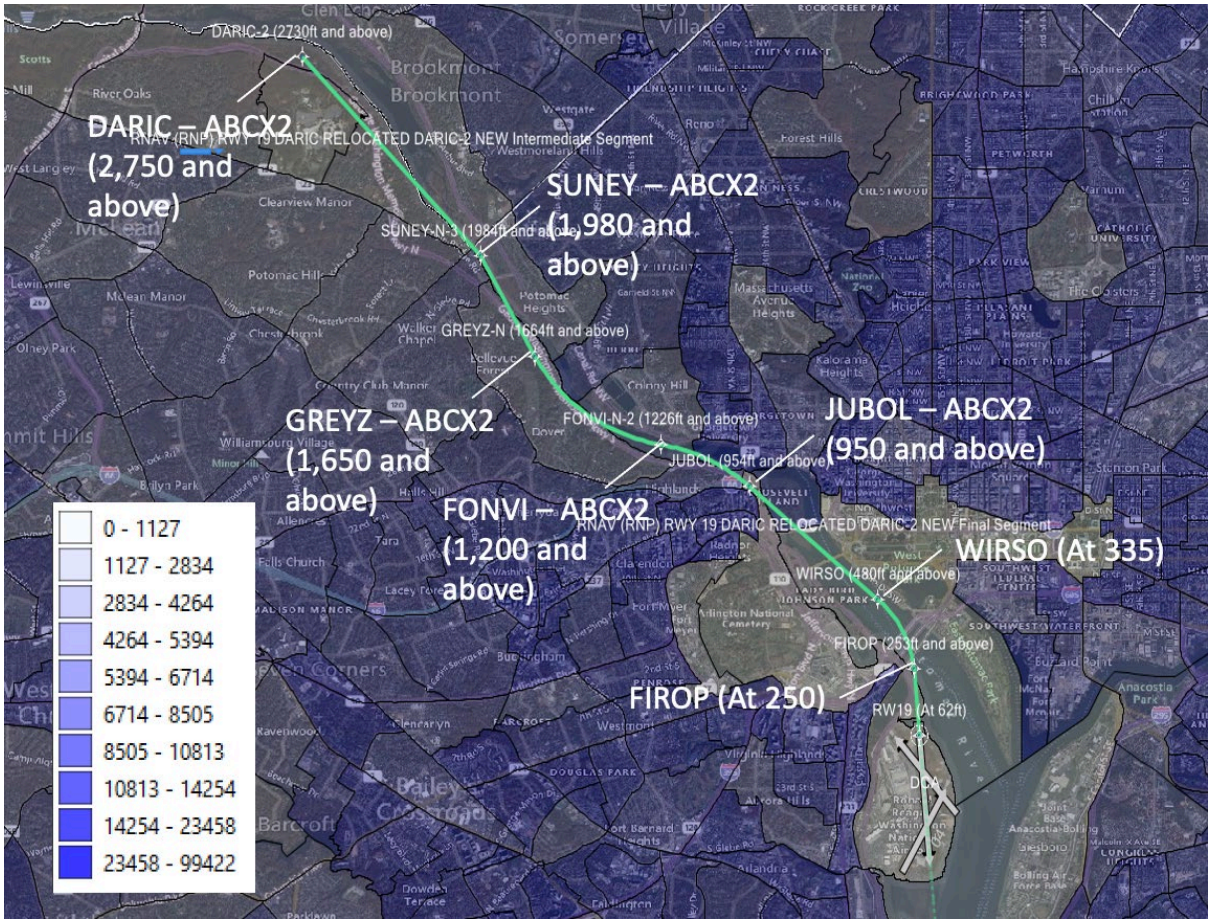

Figure 19 RNAV (RNP) RWY 19-ABCX2 over population zones (Census data) - darker blue color corresponds to areas of high population density; lighter blue / grey colors correspond to low population density

Figure 22 illustrates the effect of the procedure over populated zones across the route mileage from a vertical perspective. Green shaded areas represent parts of the procedure with minimal impact to the residents, while red shades indicate parts of the procedure that overfly high density population areas.

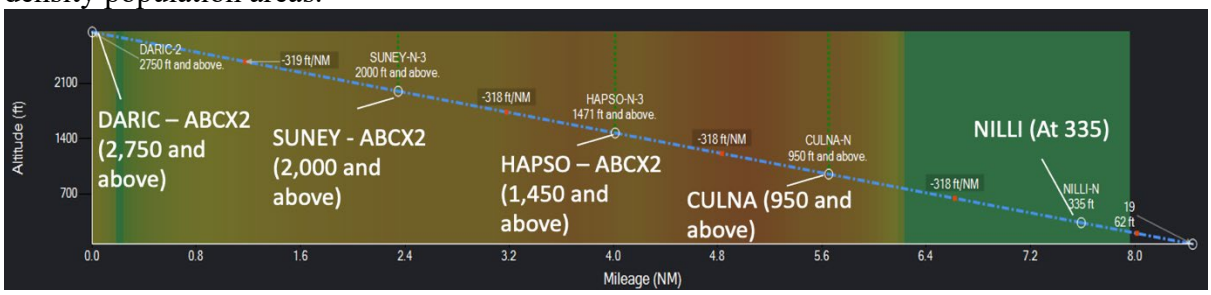

Figure 20 RNAV (RNP) RWY 19-ABCX2 - Vertical analysis of noise exposure to population density across the route mileage - red color corresponds to high population exposure; green corresponds to low population exposure

3.3.2. Comparison of Notional Design to Baseline

Figure 23 illustrates the differences between the RNAV (RNP) RWY 19-ABCX2 and the baseline. The red line indicates the path of the ABCx2 notional RNP procedure and the green line indicates the existing, or baseline, RNP currently published. This Figure also illustrates the altitude differences at the respective waypoints. Additionally, DARIC waypoint has been relocated to DARIC-ABCX2 as shown in Figure 23. This change moves flight tracks over the CIA Headquarters, which is a less noise sensitive area compared to the neighboring D.C. and Montgomery County areas on the other side of the river.

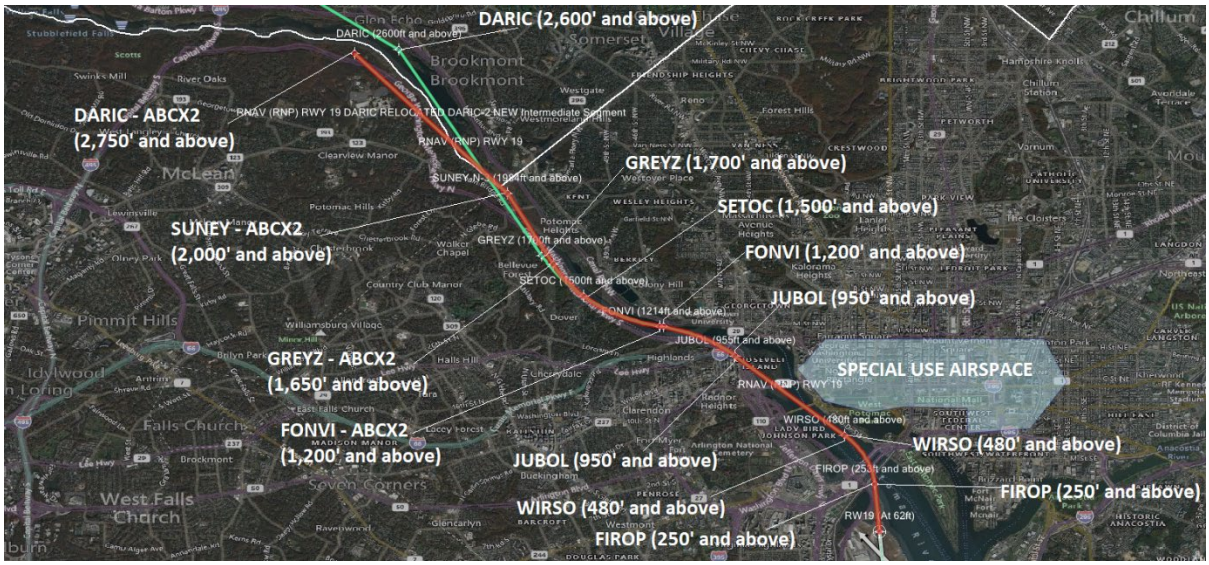

Figure 21 RNAV (RNP) RWY 19-ABCX2 (red) vs. Baseline (green)

Figure 24 below illustrates where the notional design path crosses over the baseline path. This is due to the relocation of the DARIC waypoint and the resultant flight path geometry to ensure the initial segment of the approach matches the notional RNAV (GPS) RWY 19 flight path, and to ensure FAA criteria is met. It is evident that the notional design moves slightly east, closer to the south bank of the river, avoiding directly overflying non-compatible land to the extent possible in Arlington County. The notional RNP approach also remains south of the reservoir, thus avoids over flying D.C. Communities. (See Figures 24 and 25)

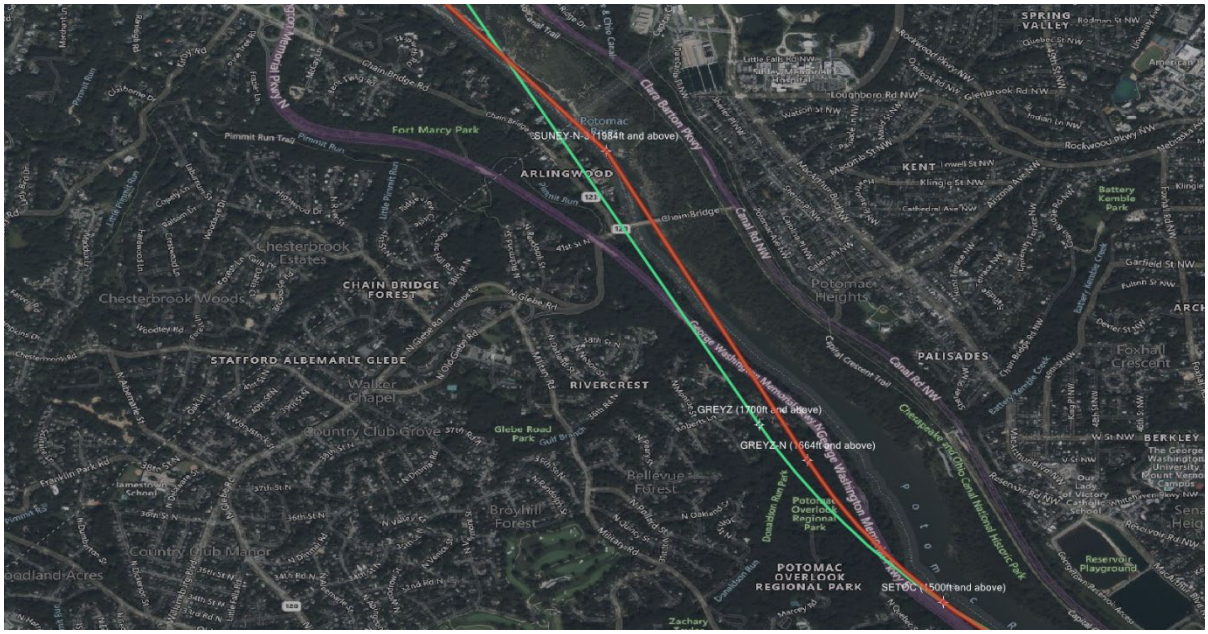

Figure 22 Notional RNAV (RNP) RWY 19-ABCX2 crossovers versus RNAV (RNP) RWY 19 – EXIST.

Figure 25 illustrates another crossover point between the two flight paths. This results in the notional RNP path moving slightly further away (0.01NM) from the Georgetown Reservoir. As a result, flights are expected to remain over water and avoid overflying noise sensitive areas in D.C. located on the north side of the river.

Figure 235 Expected aircraft flight paths; Notional RNAV (GPS) RWY 19-ABCX2 over SUNEY-ABCX2 versus RNAV (GPS) RWY 19 – EXIST over SUNEY

3.3.3. TERPS / PBN Considerations

The final part of the design – from the Final Roll-Out Point (FIROP WP) to the runway – exactly matches the existing design. According to TERPS / PBN criteria, the required distance between the last RF leg endpoint and the runway corresponds to the FROP (Final Roll-Out Point) distance. This is equal to the length required to reach the threshold point (50 ft above ground for this runway) from 500 ft above airport. Using a 3° constant descent gradient from 500 ft AGL (Above Ground Level) to 50 ft AGL results in 1.41 NM of length.

This segment of the notional procedure is 0.60 NM, matching the segment length of the existing approach, which was waivered by the FAA, allowing for implementation. It is anticipated that the same criteria will be waived for the notional procedure as well.

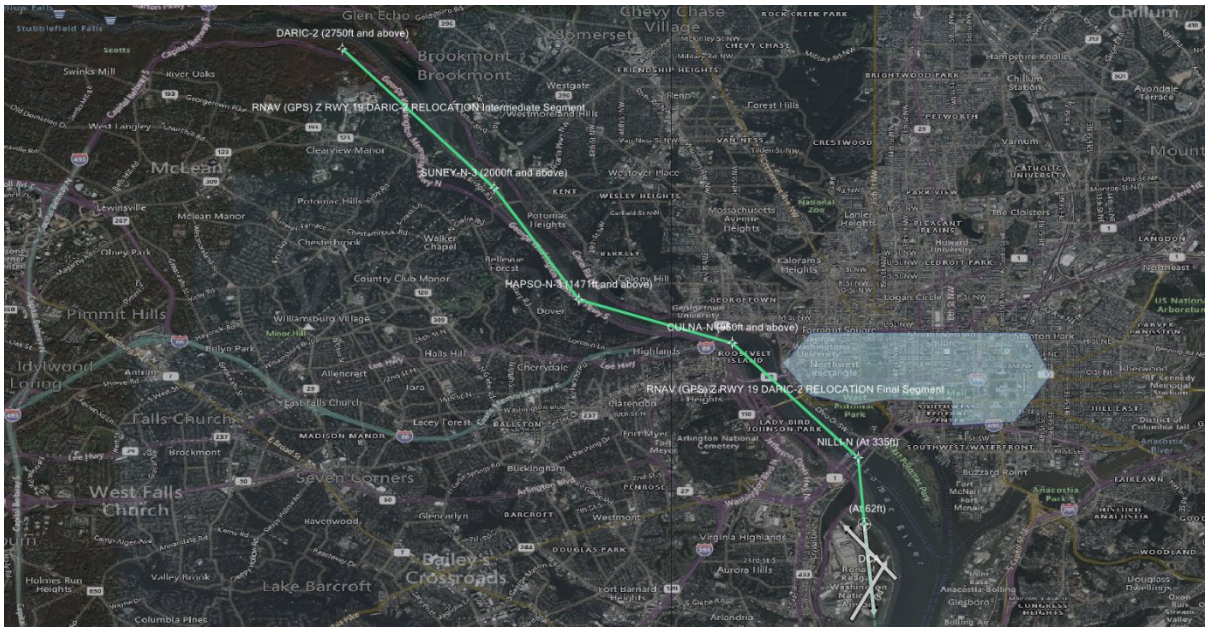

Figure 24 RNAV (GPS) RWY 19-ABCX2 - Satellite map overlay

In summary, the waivered criteria with regards to minimum leg lengths are presented below:

- WIRSO -> FIROP (RF) Distance of the RF Leg end point from runway (NM): 0.60 >= 1.41 (outside criteria).

The detailed criteria evaluation for the total route is provided in Appendix 2.

4. Baseline Versus New Procedure Noise Comparison

Section 2 and Section 3 provided an analysis on the existing and notional SIAPs serving DCA RWY 19. This section provides a comparison of the notional versus existing procedures, in order to estimate the noise benefits of the recommended designs.

There were two major areas of concern identified by the DCA Design Group. One area is where the LDA-Z approach overflies residential areas north and east of the Georgetown Reservoir, and the other is where the existing approaches overfly residential areas between the FERGI and DARIC waypoints.

As will be illustrated in this section, there is benefit derived at some point for all communities along the river depending on which procedures are being compared. In the final configuration, there will still be four (4) different approaches that may be used from time to time. The result is that whenever a particular approach is flown, a particular set of communities benefit. This is also in keeping with the Design Philosophy which states that no one community should bear all the noise burden all the time.

4.1 LDA Z RWY 19-EXIST vs. Notional RNAV (RNP) RWY 19-ABCX2

In the first example, the LDA Z RWY 19-EXIST is compared to the notional RNAV (RNP) RWY 19-ABCX2. In Figure 27 below, there is a substantial improvement for the residential areas north and east of the Georgetown Reservoir. However, there is a disbenefit for residents west of the Georgetown Reservoir. The result, however, is that noise is shared more equitably between communities on either side of the river in accordance with the Design Philosophy.

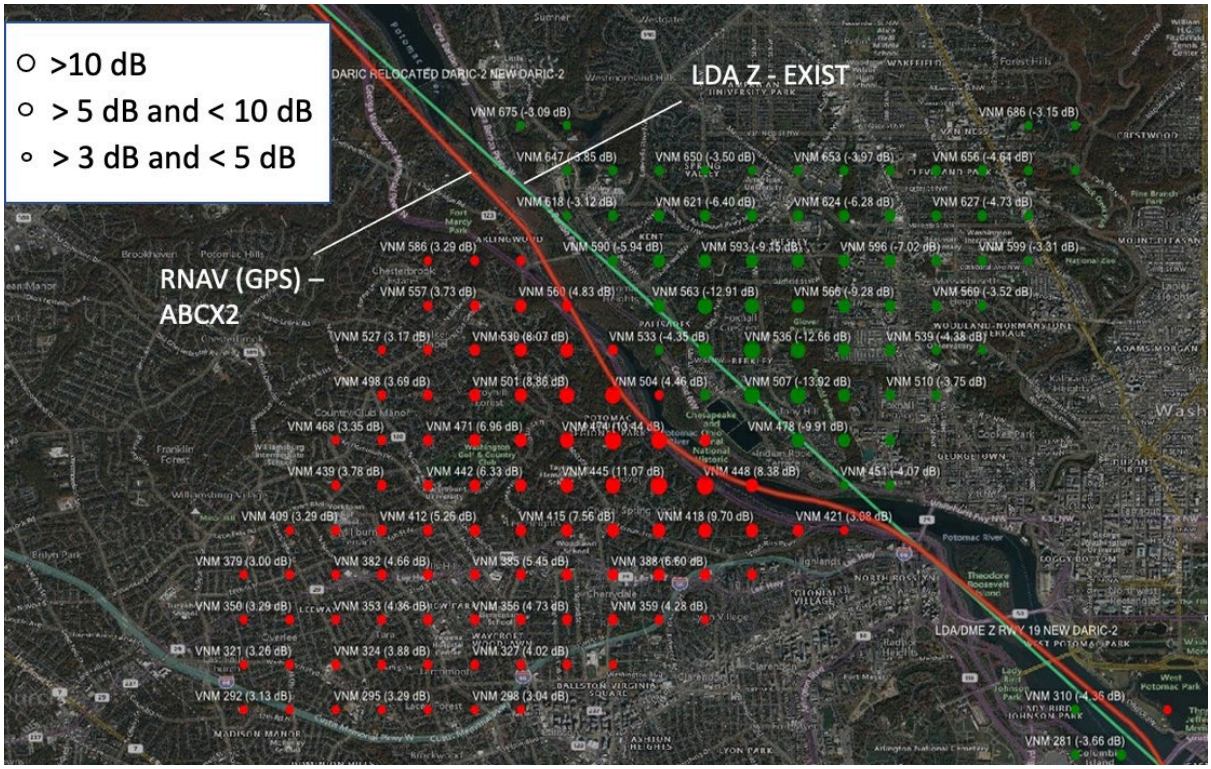

Figure 257 LDA Z RWY19-EXIST (baseline - green line) vs. RNAV (RNP) RWY 19-ABCX2 (red line)

4.2 RNAV (GPS) RWY 19-FAA vs. Notional RNAV (GPS) RWY 19-ABCX2

In Figure 28 below, the major modification from the baseline was the elimination of the transition from FARGI waypoint to DARIC waypoint and the movement of DARIC to the new DARIC-ABCx2 location. Other slight modifications were made to the flight path in the vicinity of the reservoir but do not substantially change the noise footprint.

Figure 28 RNAV (GPS) RWY 19 - FAA (baseline) vs. RNAV (GPS) RWY 19-ABCX2

4.3 RNAV (RNP) RWY 19-EXIST vs. Notional RNAV (RNP) RWY 19-ABCX2

The major change in the RNAV (RNP) RWY 19-ABCx2 approach vs the RNAV (RNP) RWY 19-EXIST approach is also in the elimination of the FERGI-DARIC segment. As seen below in Figure 29, substantial improvement is achieved for Montgomery County residents while the vast majority of the noise that is shifted to the south side of the river is placed over compatible land, namely government owned land at Langley. Other flight path improvements are recommended down river but none of them produce a substantial improvement in noise impact.

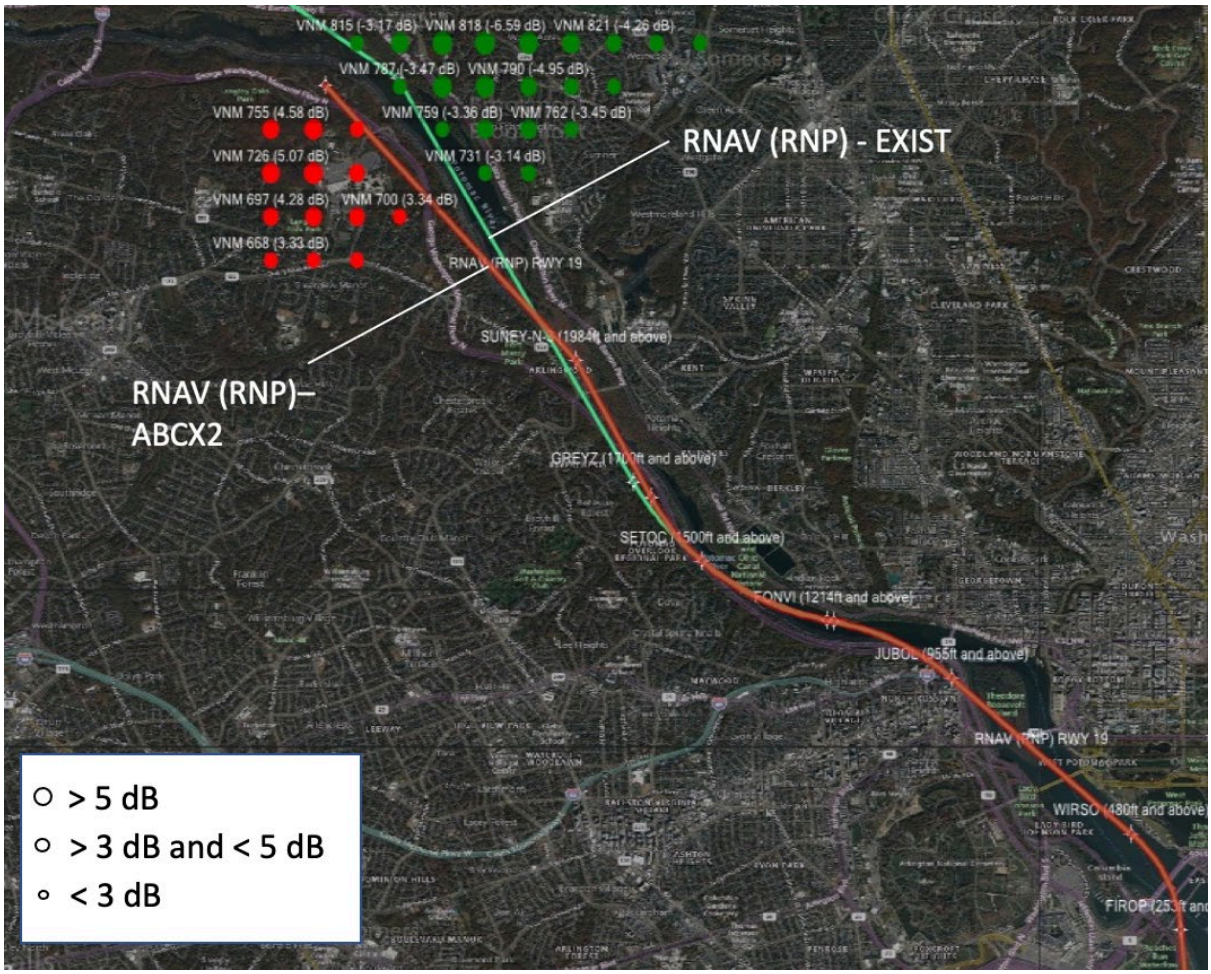

Figure 29 RNAV (RNP)-EXIST (baseline - green line) vs. Revised RNAV (RNP)-ABCX2 (red line)

4.4 RNAV (RNP) RWY 19-EXIST vs. Notional RNAV (GPS) RWY 19-ABCX2

One of the major goals of this project was to produce a procedure that the vast majority if aircraft could fly but that would be as close to the existing RNAV (RNP) RWY 19-EXIST Approach as possible. The general consensus being that the path that the current RNP approach takes is generally acceptable to all of the communities along the river.

The Notional RNAV (GPS) RWY 19-ABCx2 Approach is designed as close to the RNAV (RNP) RWY 19-EXIST flight path as possible taking into consideration FAA design criteria. As in the comparison in Figure 29 above, the most substantial noise benefit is derived at the beginning of the approach where the segment from FERGI-DARIC is removed and DARIC is repositioned to DARIC-ABCx2 located over compatible government land.

Additional benefit is seen in Rosslyn where the GPS approach is unable to make the turn along the river as tightly as the RNP approach. This results in some noise benefit for Rosslyn and some disbenefit for Georgetown as illustrated in Figure 30 below.

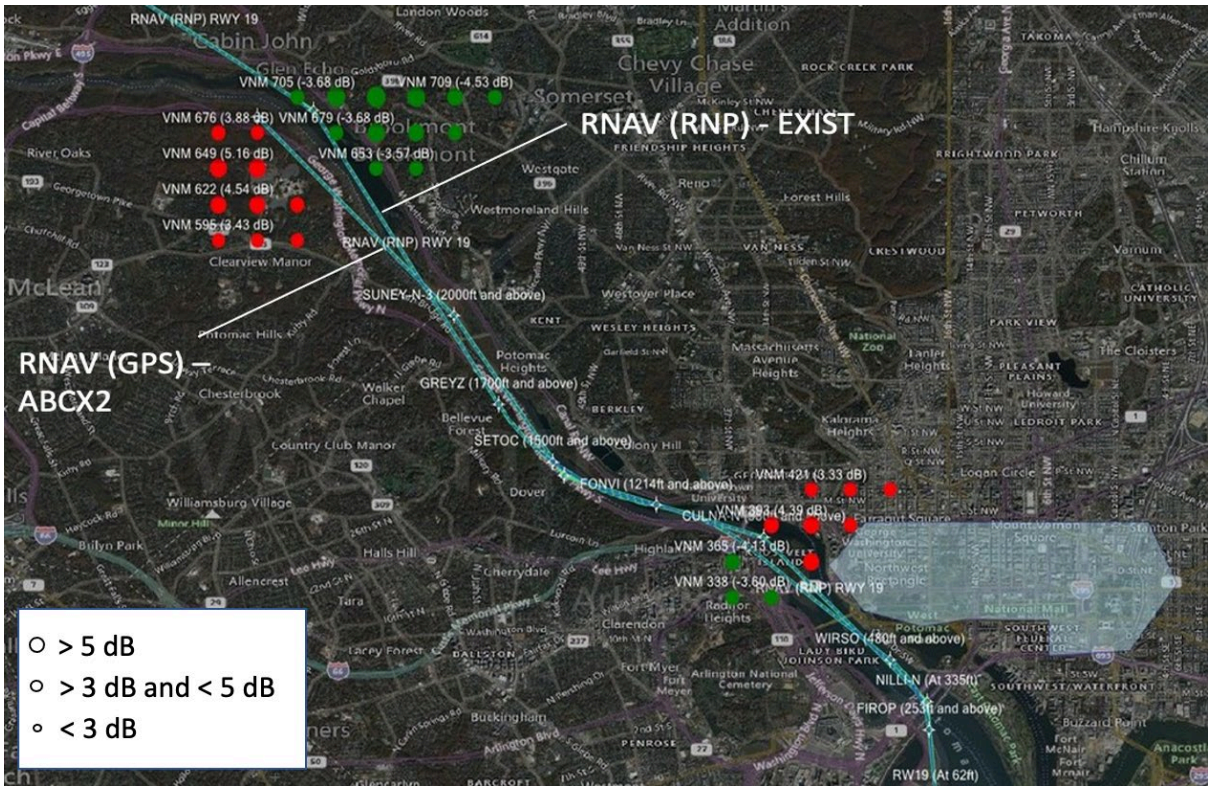

Figure 30 RNAV (RNP) RWY 19-EXIST (baseline) vs. RNAV (GPS) RWY 19-ABCX2

4.5 River Visual RWY 19 Approach (Baseline) vs. Notional RNAV (GPS) RWY 19 – ABCx2

The River Visual RWY 19 Approach (Baseline) is flown more than any other single approach into Runway 19 at KDCA. Aircraft are instructed to "follow the river" on this approach, which allows pilots to fly the airplane manually and to visually navigate along the river. In theory, this would allow pilots to remain over the centerline of the river in visual flight conditions using manual control that cannot be achieved by published flight procedures due to leg length requirements and other criteria.

In the case illustrated in Figure 31 below, the centerline of the river is closer to Georgetown than the expected path that aircraft will fly on the Notional RNAV (GPS) RWY 19-ABCx2 Approach, resulting in a slight benefit to Georgetown over the River Visual RWY 19 Approach.

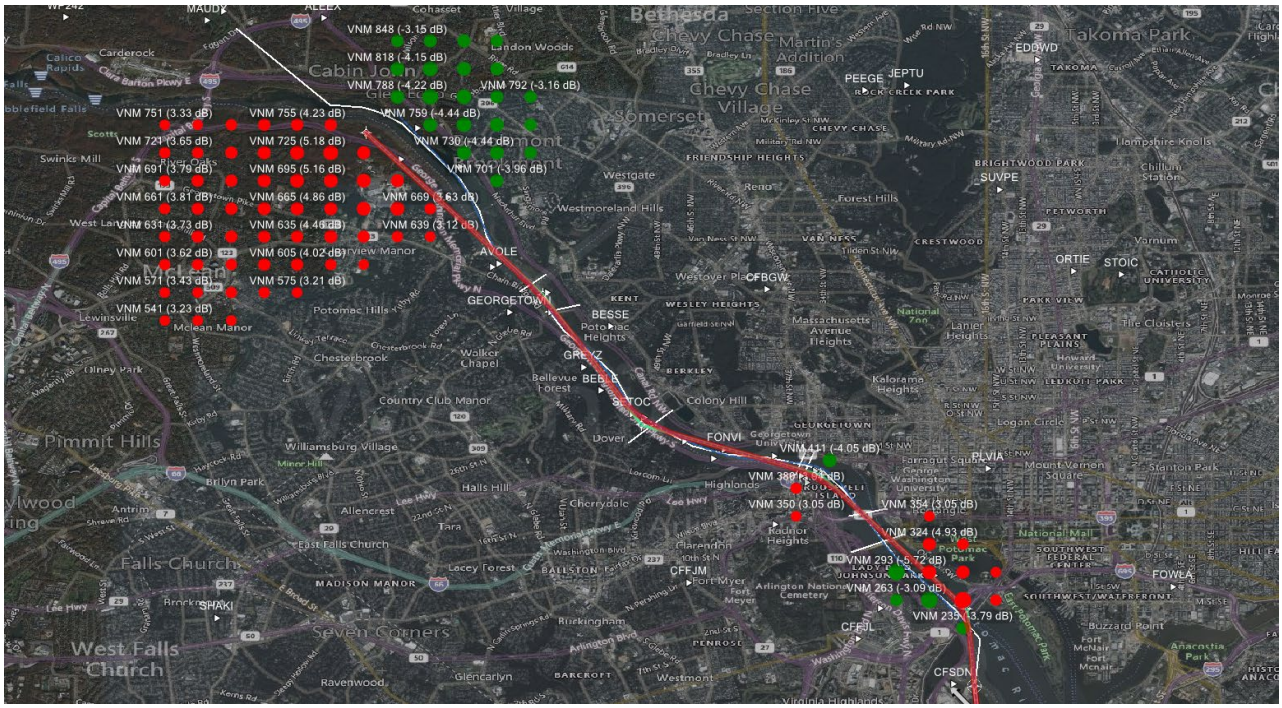

***Figure 31 Baseline**: River Visual RWY 19 overlay (dashed blue line – original overlay in white) vs. **Compared**: Notional RNAV (**GPS**) RWY 19 – ABCx2 (highlighted in red)*

4.6 River Visual RWY 19 Approach (Baseline) vs. Notional RNAV (GPS) RWY 19 – ABCx2

Figure 32 below depicts a closer view of the benefit to Georgetown when using the RNAV (GPS) RWY 19-ABCx2 Approach vs. the River Visual RWY 19 Approach (Baseline).

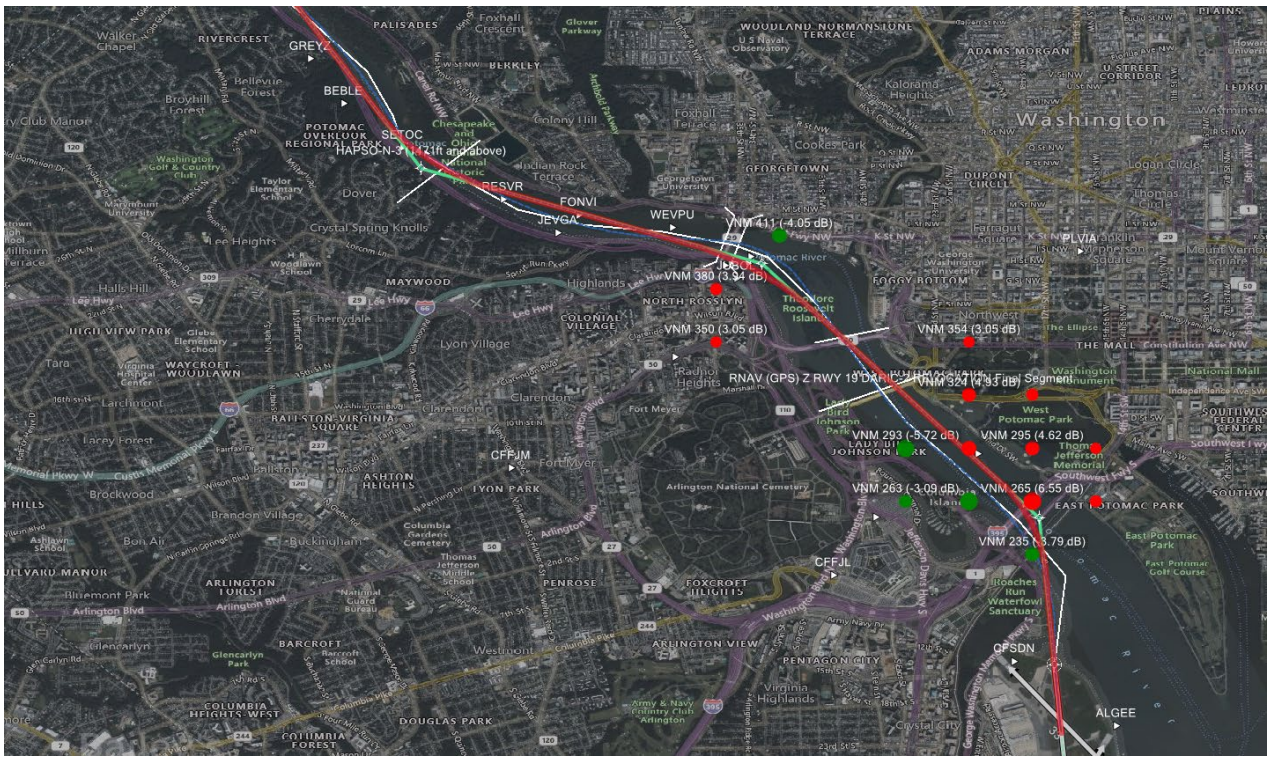

Figure 32 Baseline: River Visual RWY 19 overlay (dashed blue line – original overlay in white) vs. Notional RNAV (GPS) RWY 19 – ABCx2 (highlighted in red) – Close up to Georgetown

5. Summary of Recommendations

5.1 History of Noise Shifts

Pre-Metroplex, the original RNAV (RNP) RWY 19 Approach was implemented on a path that took aircraft west of the CIA Headquarters at Langley. This resulted in aircraft overflying noise-sensitive residential areas in Fairfax and Arlington Counties before joining the river for the final segments of the approach. The next procedure to be implemented was the existing RNAV (RNP) RWY 19 Approach, which shifted the flight path substantially to the east. This resulted in the initial segment of the approach overflying noise sensitive, densely populated residential areas in Montgomery County before joining the river. The easterly shift of the flight path benefited Fairfax and Arlington Counties while increasing noise impacts for residents of Montgomery County.

The ABCx2 notional designs of the two recommended approaches seek to create a balance between the residential areas of the counties on either side of the river by utilizing compatible land whenever possible and sharing the noise equitably between the communities along the river in accordance with the Design Philosophy developed by the North of Airport Committee (NOA) and approved by the Community Working Group (CWG).

5.2 Design Philosophy

The Design Philosophy was a set of priorities developed by the NOA consisting of representatives from Arlington, Fairfax, and Montgomery Counties, and the District of Columbia.

The NOA and the DCA Design Group unanimously concurred on the Design Philosophy to establish expectations and metrics for success. In this manner, the Design Group was able to refer to the Design Philosophy throughout the design process to ensure that the stated goals were being met and that the final designs would be in accordance with the established Design Philosophy.

There were five (5) design sessions. In each session and at the end of Session 5, consensus checks were conducted to determine if everyone was satisfied with the designs and in concurrence that the recommended notional designs were following the Design Philosophy. At the end of Session 5, the DCA Design Group came to consensus on the notional designs for the RNAV (GPS) RWY 19 Approach and the RNAV (RNP) RWY 19 Approach. These two notional procedures will be recommended to the North of Airport (NOA) Committee and ultimately to the Community Working Group (CWG) for consideration. If both the NOA and CWG concur with the notional procedure designs, they will be submitted to the FAA for evaluation and implementation.

The complete Design Philosophy can be found in the main body (Volume 1) of this report.

5.3 RNAV (GPS) RWY 19 Approach

The notional RNAV (GPS) RWY 19 Approach was developed by the DCA Design Group with Subject Matter Experts from ABCx2 and Vianair. The starting point was a notional procedure previously developed by the FAA.

The goal of the RNAV (GPS) RWY 19 Approach was to provide an approach that virtually all aircraft that utilize the DCA Airport can fly. This will enable aircraft to fly a stabilized approach that provides both vertical and lateral guidance to the runway while providing a flight path that is as close as criteria will allow to the RNAV (RNP) RWY 19 Approach and/or the River Visual RWY 19 Approach. The result will be an approach that increases safety of flight while at the same time reduces noise impact to communities currently being overflown by the LDA-Z RWY 19 Approach.

The new notional approach will accomplish the above stated goals and address the concerns of residents currently under the flight path from the FERGI waypoint to the DARIC waypoint. This is because the DARIC waypoint would be moved to the northwest over compatible land (CIA Langley) resulting in a flight path to the river that places aircraft over mostly non-residential areas until joining the river.

There were also several improvements along the river where the flight path was designed to provide a track that was more evenly located between population areas. While these enhancements are not expected to substantially reduce the noise impact to residents that live near the river, they are intended to share the noise exposure more equitably between communities, consistent with the agreed to Design Philosophy.

Additionally, through collaboration with the FAA Potomac TRACON (PCT) the new location of DARIC-ABCx2 will also benefit air traffic controllers by providing a better visual reference for turning aircraft on to the final approach course during inclement weather. The new location for DARIC-ABCx2 will also provide a common Initial Approach Fix (IAF) for all runway 19 approaches. Both enhancements will improve safety and efficiency in PCT airspace.

5.4 RNAV (RNP) RWY 19 Approach

The primary objective of the notional redesign of the RNAV (RNP) RWY 19 Approach was to move the initial segment from over non-compatible (residential) land use, to over compatible (government) land and to make the initial segment of the approach coincidental with the notional RNAV (GPS) RWY 19 Approach described above. The redesigned notional approach will also start at DARIC-ABCx2 waypoint thereby providing a common IAF for all approaches.

Some additional enhancements were made downriver. While these enhancements are not expected to substantially reduce the noise impact to residents that live near the river, they are intended to share the noise more equitably between communities as required by the Design Philosophy.

5.5 LDA-Z RWY 19 Approach

ABCx2 is recommending the FAA add DARIC-ABCx2 to the LDA-Z RWY 19 Approach as the IAF for the approach. As a result of the collaboration with the FAA Potomac TRACON (PCT) the new location of DARIC-ABCx2 will also be benefit air traffic control by providing a better visual reference for turning aircraft on to the final approach course during inclement weather. The new location for DARIC-ABCx2 will also provide a common Initial Approach Fix (IAF) for all runway 19 approaches. Both enhancements will improve safety and efficiency in PCT airspace.

5.6 River Visual Runway 19 Approach

ABCx2 is recommending the FAA make DARIC-ABCx2 the IAF for the River Visual Runway 19 Approach. The approach should also be modified to follow the initial segment of the new notional RNAV (GPS) RWY 19 Approach and the new notional RNAV (RNP) RWY 19 Approach until joining the river. As a result of the collaboration with the FAA Potomac TRACON (PCT) the new location of DARIC-ABCx2 will also benefit air traffic control by providing a common Initial Approach Fix (IAF) for all runway 19 approaches. This will improve safety and efficiency in PCT airspace.

5.7 Standard Terminal Arrival Routes (STARs)

ABCx2 is recommending that the STARs be disconnected from the approaches. In other words, remove the portion of the approach between the FERGI and DARIC waypoint that connects the approach to the FRDMM and TRUPS STARs. This will allow the STARs to be brought into compliance with current FAA criteria as well as provide the opportunity for controllers to assign more randomized direct routing to the new DARIC-ABCx2 waypoint thereby providing track variability and reducing the concentration of aircraft overflying residential areas.

It is further recommended that the FRDMM and TRUPS STARs terminate at the STAND waypoint at an appropriate altitude and on an appropriate heading. We believe that this configuration will provide controllers an abundance of sequencing options while at the same time promoting more track variability.

This recommendation enhances the safety and efficiency of the PCT airspace by standardizing approach clearances and providing air traffic controllers more sequencing options to provide track variability for aircraft commencing approach over the DARIC-ABCx2 waypoint.

Appendix 1 – Noise Calculations

Noise calculations are based on exposure-based noise level metrics. For this, a grid of noise receptor locations is created along the path of the flight path to be evaluated for noise first. For each flight path, exposure-based noise level metrics due to fixed-wing aircraft and helicopter operations from each flight path segment are computed. The total noise exposure is then calculated at each receptor location by combining all the individual flight path segment noise contributions at that location.

For the calculation of the exposure-based noise level metrics for each flight, the following methodology is applied.

Each flight has an associated number of operations for day, evening and night-time periods. Furthermore, depending on each metric, each time period may have a weighting factor, i.e. a noise penalty.

To compute the weighted sound exposure ration $E_{wt,seg}$, the number of operations associated with each time period and for given weighting factors is calculated using the following equation:

$$E_{wt,seg} = \left[W_{day} \cdot N_{day} + W_{eve} \cdot N_{eve} + W_{ngt} \cdot N_{ngt}\right] \cdot E_{seg}$$

where

N_{day} Number of user-specified operations between 07:00 and 19:00 hours local time;
N_{eve} Number of user-specified operations between 19:00 and 22:00 hours local time;
N_{ngt} Number of user-specified operations between 22:00 and 07:00 hours local time;
W_{day} Day-time weighting factor, either standard or user-defined;
W_{eve} Evening weighting factor, either standard or defined;
E_{ngt} Night-time weighting factor, either standard or user-defined;
E_{seg} Sound exposure ratio at a receptor location due to a single flight path segment of a flight operation.

The weighted sound exposure ratio is computed iteratively for each segment $E_{wt,seg(i)}$ and the sum of all segments of the flight path result in the weighted sound exposure ratio for an entire flight operation, using the following equation:

$$E_{wt,flt} = \sum_{i=1}^{n_{seg}} E_{wt,seg(i)}$$

where

n_{seg} Number of segments in the three-dimensional flight path;
$E_{wt,seg(i)}$ Weighted sound exposure ratio for the operation on the i_{th} segment of a flight path.

Once the maximum noise level for each flight path segment is calculated, the maximum noise level at a receptor location can be computed by pair-wise comparing all flight-segments at each receptor location and preserving the largest value.

$$L_{Smx,flt} = Max_{i=1}^{n_{seg}}\left[L_{Smx,seg(i)}\right]$$

where

n_{seg} Number of segments in the three-dimensional flight path.

<u>A note on noise scales and levels, metrics and indices</u>

Two particular scales are important for aircraft noise: the A-weighted sound level and the Tone-corrected perceived noise level.

The A-weighting is a simple filter applied to sound measurements, which applies more or less emphasis to different frequencies to mirror the frequency sensitivity of the human ear at moderate sound energy levels. The A-weighted sound level is an almost universally used scale of environmental noise levels and is used for most aircraft monitoring applications, typically denoted as L_A.

The noise impact assessments needed to generate noise exposure contours generally rely in A-weighted metrics.

There are two main types of noise metrics: Single Noise Event Metrics and total noise experienced over longer time periods (Cumulative Noise Metrics). Noise levels (specific dB values) are usually defined at fixed observer locations or mapped as contours (isolines) depicting the area where the specified levels are exceeded.

Single event noise metrics are used to describe the acoustic event caused by a single aircraft movement. Two types are typically used: 1) The LA_{max} based on the maximum sound intensity during the event and LE, based on the total sound energy in the event. The total sound energy can be expressed as the product of the maximum sound intensity and an affective duration of the event.

Three corresponding single event metrics of particular importance in aircraft noise are:

1. Maximum A-weighted Sound level (LA_{max})
2. Sound Exposure Level (SEL or L_{AE})
3. Effective Perceived Noise Level (LEPN)

Two of these, L_{AE} and LA_{max} can be measured directly with a standard precision sound level meter. Theoretically, L_{AE}, is generally preferred, as it accounts for the duration of the event as well as its intensity. However, for aircraft noise, L_{AE} measurements are more susceptible to interference from background noise and many non-specialists find the L_{AE} concept difficult to grasp, because for the same event, L_{AE} typically exceeds LA_{max} by approximately 10dB. Thus, LA_{max} is the favored metric for day-to-day noise monitoring at airports.

Lastly, cumulative noise metrics, such as the Day Night Level (DNL) which is weighted to account for annoyance during specific periods of day (typically day, evening and night) are also biased by assumptions about aircraft traffic mix, frequency and distribution during its period. When comparing route alternatives, it is preferred to use the LAmax metric as it allows for a direct and unbiased comparison between route design alternatives.

For the above reasons the LA_{max} metric was selected for this study.

The weight factors for different types are given in the following table. It is noted that in this case the A-weighted LA_{max} metric was used. The weighting factors for the A-weighted LA_{max} are equal to 1 for each period.

Table 4 Weighting factors for Document 29 Noise Metrics

Noise Family	Metric Type	Noise Metric	Weighting Factors			Averaging Time (hr)	Time-Averaging Constant (N_T)
			Day (W_{day})	Evening (W_{eve})	Night (W_{ngt})		
A-Weighted	Exposure Based	SEL	1	1	1	-	1
		DNL	1	1	10	24	86,400
		CNEL	1	3[xxi]	10	24	86,400
		LAEQ	1	1	1	24	86,400
		LAEQD	1	1	0	15	54,000
		LAEQN	0	0	1	9	32,400
		User-defined	A	B	C	T	T*3,600

		NANL	1	1	1	-	1
	Maximum Level	LAMAX	1	1	1	-	-
		User-defined	A	B	C	-	-
		NANL	1	1	1	-	-
	Time-Based	TALA	1	1	1	-	-
		TAUD	1	1	1	-	-
		TAUDSC	1	1	1	-	-
		TAUDP	1	1	1	-	-
		TAUDPSC	1	1	1	-	-
		User-defined	A	B	C	-	-
C-Weighted	Exposure Based	CDNL	1	1	1	24	8,6400
		CEXP	1	1	1	-	-
		User-defined	A	B	C	T	T*3,600
		NANL	1	1	1	-	-
	Maximum Level	LCMAX	1	1	1	-	-
		User-defined	A	B	C	-	-
		NANL	1	1	1	-	-
	Time-Based	TALC	1	1	1	-	-
		User-defined	A	B	C	-	-
Tone-Corrected Perceived	Exposure Based	EPNL	1	1	1	-	1
		NEF	1	1	16.7	24	630,957,345[xxii]
		WECPNL	1	3[xxiii]	10	24	8,640[xxiv]
		User-defined	A	B	C	T	T*3,600
		PNLTM	1	1	1	-	-

Appendix 2 – Calculation Tables

Table 5 RNAV (GPS) RWY 19-ABCX2 (LNAV – No Vertical Guidance) TERPS / PBN design criteria evaluation

A/A	INFORMATION / ELEMENTS	STATUS	RESULT ANALYSIS	ENFORCEMENT	SOURCE	SOURCE TEXT
1	Leg Transition (from Final to Final) : CULNA ---> NILLI ---> 19.	Invalid	No turns are permitted during the final segment in a RNAV(GPS) procedure	Mandatory	FAA PBN - 8260.58A: Chapters 3,4	On RNAV(GPS) approaches, align the intermediate course within 30 degrees of a LNAV or LP final approach course and within 15 degrees of a LNAV/VNAV and LPV/GLS final approach course. On RNAV(RNP) approaches, FB turns at the PFAF are limited to a maximum of 15 degrees on RNAV(RNP).
2	Leg (Intermediate) : DARIC-ABCX2 --> SUNEY-ABCX2.	Invalid	The current gradient of -319 ft/NM is steeper than the maximum permitted gradient of -318 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
3		Invalid	Minimum leg length requirement not met for Leg CULNA --> NILLI (Min: 4.03 NM, current: 1.94 NM. Increase the leg length or decrease the turn magnitude. Minimum leg length requirement not met for Leg NILLI --> 19 (Min: 3.47 NM, current: 0.86 NM. Increase the leg length or decrease the turn magnitude.	Mandatory	FAA PBN - 8260.58A: 1-2-5,b,1	Minimum length (fix-to-fix). Generally, minimum leg length is the lesser of 2 — XTT or 1 NM, but where applicable may also be no less than the sum of Distance-to-Turn anticipation (for fly-by transitions) or the distance for return to course centerline (for fly-over turns).
4	Leg (Missed approach) : RW19 --> BADDN.	Invalid	Current gradient of 490 ft/NM is greater than the maximum permitted gradient of 425 ft/NM.	Mandatory	FAA PBN - 8260.58A: 1-3-1,g,(2)	A climb gradient greater than 425 ft/NM is not authorized for missed approach.
5	Leg (Intermediate) : DARIC-ABCX2 --> SUNEY-ABCX2.	Invalid	Current gradient is: -319 ft/NM. The optimum gradient is between 0 ft/NM and -150 ft/NM.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
6	Leg (Intermediate) : SUNEY-ABCX2 --> HAPSO-ABCX2.	Invalid	Current gradient is: -318 ft/NM. The optimum gradient is between 0 ft/NM and -150 ft/NM.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
7	Leg (Intermediate) : HAPSO-ABCX2 --> CULNA.	Invalid	Current gradient is: -318 ft/NM. The optimum gradient is between 0 ft/NM and -150 ft/NM.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
8		Valid	All legs on the same phase have the same navigation specification.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	All legs on the same phase should have the same navigation specification.
9	Leg (Final) : CULNA --> NILLI.	Valid	The current gradient of -318 ft/NM is at least as steep as the minimum gradient of -318 ft/NM	Requires Approval	FAA TERPS - 8260.3D: 2-6-3	Other cases or GPAs less than 3.00 degrees require approval

10	Leg (Final) : NILLI --> 19.	Valid	The current gradient of -318 ft/NM is at least as steep as the minimum gradient of -318 ft/NM	Requires Approval	FAA TERPS - 8260.3D: 2-6-3	Other cases or GPAs less than 3.00 degrees require approval
11	Leg Transition (from Intermediate to Final) : HAPSO-ABCX2 ---> CULNA ---> NILLI.	Valid	The alignment angle of 29.78 degrees between the two legs does not exceed the maximum alignment angle of 30.00 degrees with FB turn at the PFAF.	Mandatory	FAA PBN - 8260.58A: Chapters 3,4	On RNAV(GPS) approaches, align the intermediate course within 30 degrees of a LNAV or LP final approach course and within 15 degrees of a LNAV/VNAV and LPV/GLS final approach course.On RNAV(RNP) approaches, FB turns at the PFAF are limited to a maximum of 15 degrees on RNAV(RNP).
12	Leg (Intermediate) : SUNEY-ABCX2 --> HAPSO-ABCX2.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -318 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
13	Leg (Intermediate) : HAPSO-ABCX2 --> CULNA.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -318 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
14	Leg (Final) : CULNA --> NILLI.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -372 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
15	Leg (Final) : NILLI --> 19.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -372 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
16	Leg (Final) : NILLI --> 19.	Valid	The current gradient of -318 ft/NM is the optimum suggested gradient.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
17		Valid	All leg types used in the route are permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Permitted leg types for feeder, initial, intermediate and final approach segments.
18	Leg (Intermediate) : DARIC-ABCX2 --> SUNEY-ABCX2.	Valid	The navigation specification is : RNP APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
19	Leg (Intermediate) : SUNEY-ABCX2 --> HAPSO-ABCX2.	Valid	The navigation specification is : RNP APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
20	Leg (Intermediate) : HAPSO-ABCX2 --> CULNA.	Valid	The navigation specification is : RNP APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
21	Leg (Final) : CULNA --> NILLI.	Valid	The navigation specification is : RNP APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
22	Leg (Final) : NILLI --> 19.	Valid	The navigation specification is : RNP APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
23	Leg (Intermediate) : DARIC-ABCX2 --> SUNEY-ABCX2.	Valid	The current leg is not an RF leg.	Requires Approval	FAA PBN - 8260.58A: 3-1-1	An RNAV(GPS) approach that requires use of an RF leg in the missed approach, intermediate, or in all initials requires Flight Standards approval.

24	Leg (Intermediate) : SUNEY-ABCX2 --> HAPSO-ABCX2.	Valid	The current leg is not an RF leg.	Requires Approval	FAA PBN - 8260.58A: 3-1-1	An RNAV(GPS) approach that requires use of an RF leg in the missed approach, intermediate, or in all initials requires Flight Standards approval.
25	Leg (Intermediate) : HAPSO-ABCX2 --> CULNA.	Valid	The current leg is not an RF leg.	Requires Approval	FAA PBN - 8260.58A: 3-1-1	An RNAV(GPS) approach that requires use of an RF leg in the missed approach, intermediate, or in all initials requires Flight Standards approval.
26	Final Segment of RNAV (GPS) RWY 19-ABCX2 DARIC-ABCX2 RELOCATION DARIC-ABCX2.	Valid	Consistent Final Segment. The descent gradient of: -318 ft/NM is the same for every leg in the Final Segment.	Mandatory	FAA PBN - 8260.58A: PBN manual	In the Final Segment the Descent Gradient must be the same for every leg.
27	Final Segment of RNAV (GPS) RWY 19-ABCX2 DARIC-ABCX2 RELOCATION DARIC-ABCX2.	Valid	The last leg of the Final Segment is perfectly aligned with the runway.	Mandatory	FAA PBN - 8260.58A: Chapter 3 and 4-2-2 a	Permitted alignment between final segment and runway
28	Final Segment of RNAV (GPS) RWY 19-ABCX2 DARIC-ABCX2 RELOCATION DARIC-ABCX2.	Valid	The Final segment length is: 2.79 NM which is less than the maximum permitted length of 10.00 NM.	Mandatory	FAA PBN - 8260.58A: 3-2-3,a,(1) & 3-2-3,b,(1) & 3-3-3	Segment length is the distance from the PFAF location to the LTP/FTP. In LNAV, LP, LNAV-VNAV guided approach procedures, the maximum length is 10 NM.
29	Leg Transition (from Intermediate to Intermediate) : DARIC-ABCX2 ---> SUNEY-ABCX2 ---> HAPSO-ABCX2.	Valid	The alignment angle between the two tracks, which is equal to 9.57° , is less than the maximum permitted alignment angle of 90.00° below FL195.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
30	Leg Transition (from Intermediate to Intermediate) : SUNEY-ABCX2 ---> HAPSO-ABCX2 ---> CULNA.	Valid	The alignment angle between the two tracks, which is equal to 39.59° , is less than the maximum permitted alignment angle of 90.00° below FL195.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
31	Leg Transition (from Intermediate to Final) : HAPSO-ABCX2 ---> CULNA ---> NILLI.	Valid	The alignment angle between the two tracks, which is equal to 29.78° , is less than the maximum permitted alignment angle of 90.00° below FL195.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees

32	Leg Transition (from Final to Final) : CULNA ---> NILLI ---> 19.	Valid	The alignment angle between the two tracks, which is equal to 36.00° , is less than the maximum permitted alignment angle of 90.00° below FL195.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
33		Valid	There is no Crossing speed decrement (based on previous crossing speed restrictions, if any) during the Missed Approach procedure.	Recommended	FAA PBN - 8260.58A: PBN manual	Crossing Speed can only be increased (if necessary) during a Missed Approach Procedure.
34	Final Segment of RNAV (GPS) RWY 19-ABCX2 DARIC-ABCX2 RELOCATION DARIC-ABCX2. Missed Approach of RNAV (GPS) RWY 19-ABCX2 DARIC-ABCX2 RELOCATION DARIC-ABCX2.	Valid	Change of direction for every leg and the final segment does not exceed the maximum change direction of 15.00° in a straight missed approach.	Mandatory	FAA TERPS - 8260.3D: 2-8-4	When the missed approach course is within 15 degrees of the final approach course, it is considered a straight missed approach.
35	Leg (Missed approach) : RW19 --> BADDN.	Valid	Valid - Current gradient of 490 ft/NM is greater than the minimum required gradient of 200 ft/NM.	Mandatory	FAA PBN - 8260.58A: 1-3-1,g,(2)	The minimum climb gradient for missed approach is 200 ft/NM.
36		Valid	Minimum leg length requirement met for all route legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,b,1	Minimum length (fix-to-fix). Generally, minimum leg length is the lesser of 2 — XTT or 1 NM, but where applicable may also be no less than the sum of Distance-to-Turn anticipation (for fly-by transitions) or the distance for return to course centerline (for fly-over turns).

Table 6 Revised RNAV (RNP) RWY 19 (VNAV Guidance) TERPS / PBN Criteria Evaluation

A/A	INFORMATION / ELEMENTS	STATUS	RESULT ANALYSIS	ENFORCEMENT	SOURCE	SOURCE TEXT
1	Final Segment of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Invalid	An RF leg in the final segment must end at or prior to the minimum FROP distance of 1.41 NM. Current leg (WIRSO --> FIROP) end point, along track distance from the end of the route: 0.60 NM. Increase the distance of the RF leg end point from the runway or use an TF leg instead of the RF.	Mandatory	FAA PBN - 8260.58A: 4-2-2 b	For an RNAV(RNP) Approach, the RF leg must terminate and be followed by a TF leg, meeting FAS alignment, at or prior to reaching the minimum FROP distance.
2	Final Segment of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2. Missed Approach of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Invalid	Missed Approach initial point distance from FAF of 5.04 NM cannot be greater than Critical point (derived from IAP Obstacle Evaluation) distance from FAF of 4.07 NM.	Mandatory	FAA PBN - 8260.58A: PBN manual	Missed Approach initial point must be located on Final Approach course and its altitude must be inside permitted range.

3	Missed Approach of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Invalid	At mileage 0.19 NM Route Altitude of 155 ft is less than the required Termination Altitude of 697 ft. Raise climb gradient or try to avoid the obstacle.	Mandatory	FAA PBN - 8260.58A: Chapters 3-4	Obstacle clearance surface (OCS): Where a higher than standard CG is required, apply the associated OCS from the SOC to the CG termination altitude, then revert to the default OCS.
4	Missed Approach of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2. Final Segment of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Invalid	Type: DF of Leg 1 (RW19 --> BADDN) of the missed approach is not permitted. Permitted leg types are: TF, RF	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Missed Approach segment permitted leg types.
5	Leg (Missed approach) RW19 --> BADDN.	Invalid	Current gradient of 490 ft/NM is greater than the maximum permitted gradient of 425 ft/NM.	Mandatory	FAA PBN - 8260.58A: 1-3-1,g,(2)	A climb gradient greater than 425 ft/NM is not authorized for missed approach.
6	Leg (Intermediate) DARIC-ABCX2 --> SUNEY-ABCX2.	Invalid	Current gradient is: -318 ft/NM. The optimum gradient is between 0 ft/NM and -150 ft/NM.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
7	Leg (Intermediate) SUNEY-ABCX2 --> GREYZ-ABCX2.	Invalid	Current gradient is: -318 ft/NM. The optimum gradient is between 0 ft/NM and -150 ft/NM.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
8	Leg (Final) : JUBOL --> WIRSO.	Invalid	Current gradient is: -318 ft/NM. The optimum gradient is: -318 ft/NM.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
9		Valid	Legs that required level OCS (Feeder, Initial and Intermediate flight phase), respective altitudes are above the minimums permitted. DA/MDA altitude of 371 ft is less than FAF altitude of 1664 ft.	Mandatory	FAA PBN - 8260.58A: PBN manual: Chapters 3-4 and TERPS manual : 2-1-3	Obstacle clearance result for feeder, initial, intermediate, final segments and missed approach section 1.
10		Valid	All legs on the same phase have the same navigation specification.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	All legs on the same phase should have the same navigation specification.
11	Leg (Final) : GREYZ-ABCX2 --> FONVI-ABCX2.	Valid	The current gradient of -318 ft/NM is at least as steep as the minimum gradient of -318 ft/NM	Requires Approval	FAA TERPS - 8260.3D: 2-6-3	Other cases or GPAs less than 3.00 degrees require approval
12	Leg (Final) : FONVI-ABCX2 --> JUBOL.	Valid	The current gradient of -318 ft/NM is at least as steep as the minimum gradient of -318 ft/NM	Requires Approval	FAA TERPS - 8260.3D: 2-6-3	Other cases or GPAs less than 3.00 degrees require approval
13						
14	Leg (Final) : JUBOL --> WIRSO.	Valid	The current gradient of -318 ft/NM is at least as steep as the minimum gradient of -318 ft/NM	Requires Approval	FAA TERPS - 8260.3D: 2-6-3	Other cases or GPAs less than 3.00 degrees require approval
15	Leg (Final) : WIRSO --> FIROP.	Valid	The current gradient of -318 ft/NM is at least as steep as the minimum gradient of -318 ft/NM	Requires Approval	FAA TERPS - 8260.3D: 2-6-3	Other cases or GPAs less than 3.00 degrees require approval
16	Leg (Final) : FIROP --> RW19.	Valid	The current gradient of -319 ft/NM is at least as steep as the minimum gradient of -318 ft/NM	Requires Approval	FAA TERPS - 8260.3D: 2-6-3	Other cases or GPAs less than 3.00 degrees require approval
17	Leg Transition (from Intermediate to Final) : SUNEY-ABCX2 ---> GREYZ-ABCX2 ---> FONVI-ABCX2.	Valid	The alignment angle of 0.00 degrees between the two legs does not exceed the maximum alignment angle of 15.00 degrees with FB turn at the PFAF.	Mandatory	FAA PBN - 8260.58A: Chapters 3,4	On RNAV(GPS) approaches, align the intermediate course within 30 degrees of a LNAV or LP final approach course and within 15 degrees of a LNAV/VNAV and LPV/GLS final approach course.On RNAV(RNP) approaches, FB turns at the PFAF are limited to a maximum of 15 degrees on RNAV(RNP).

18	Leg (Intermediate) : DARIC-ABCX2 --> SUNEY-ABCX2.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -318 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
19	Leg (Intermediate) : SUNEY-ABCX2 --> GREYZ-ABCX2.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -318 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
20	Leg (Final) : GREYZ-ABCX2 --> FONVI-ABCX2.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -372 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
21	Leg (Final) : FONVI-ABCX2 --> JUBOL.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -372 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
22	Leg (Final) : JUBOL --> WIRSO.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -372 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
23	Leg (Final) : WIRSO --> FIROP.	Valid	The current gradient of -318 ft/NM is less steep than the maximum permitted gradient of -372 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
24	Leg (Final) : FIROP --> RW19.	Valid	The current gradient of -319 ft/NM is less steep than the maximum permitted gradient of -372 ft/NM	Mandatory	FAA TERPS - 8260.3D: Chapter 2	The maximum descent gradient for each leg.
25	Leg (Final) : GREYZ-ABCX2 --> FONVI-ABCX2.	Valid	The current gradient of -318 ft/NM is the optimum suggested gradient.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
26	Leg (Final) : FONVI-ABCX2 --> JUBOL.	Valid	The current gradient of -318 ft/NM is the optimum suggested gradient.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
27	Leg (Final) : WIRSO --> FIROP.	Valid	The current gradient of -318 ft/NM is the optimum suggested gradient.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
28	Leg (Final) : FIROP --> RW19.	Valid	The current gradient of -319 ft/NM is the optimum suggested gradient.	Recommended	FAA TERPS - 8260.3D: Chapter 2	The optimum descent gradient for each leg type.
29		Valid	All leg types used in the route are permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Permitted leg types for feeder, initial, intermediate and final approach segments.
30	Leg (Intermediate) : DARIC-ABCX2 --> SUNEY-ABCX2.	Valid	The navigation specification is : RNP AR APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
31	Leg (Intermediate) : SUNEY-ABCX2 --> GREYZ-ABCX2.	Valid	The navigation specification is : RNP AR APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
32	Leg (Final) : GREYZ-ABCX2 --> FONVI-ABCX2.	Valid	The navigation specification is : RNP AR APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
33	Leg (Final) : FONVI-ABCX2 --> JUBOL.	Valid	The navigation specification is : RNP AR APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.

34	Leg (Final) : JUBOL --> WIRSO.	Valid	The navigation specification is : RNP AR APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
35	Leg (Final) : WIRSO --> FIROP.	Valid	The navigation specification is : RNP AR APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
36	Leg (Final) : FIROP --> RW19.	Valid	The navigation specification is : RNP AR APCH which is permitted.	Mandatory	FAA PBN - 8260.58A: Chapter 2-3	Approach segment permitted Navigation Specification.
37		Valid	Minimum leg length requirement met for all route legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,b,1	Minimum length (fix-to-fix). Generally, minimum leg length is the lesser of 2 — XTT or 1 NM, but where applicable may also be no less than the sum of Distance-to-Turn anticipation (for fly-by transitions) or the distance for return to course centerline (for fly-over turns).
38	Final Segment of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Valid	Consistent Final Segment. The descent gradient of: -319 ft/NM is the same for every leg in the Final Segment.	Mandatory	FAA PBN - 8260.58A: PBN manual	In the Final Segment the Descent Gradient must be the same for every leg.
39	Final Segment of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Valid	The last leg of the Final Segment is perfectly aligned with the runway.	Mandatory	FAA PBN - 8260.58A: Chapter 3 and 4-2-2 a	Permitted alignment between final segment and runway
40	Leg Transition (from Intermediate to Intermediate) : DARIC-ABCX2 ---> SUNEY-ABCX2 ---> GREYZ-ABCX2.	Valid	The alignment angle between the two tracks, which is equal to 13.28° , is less than the maximum permitted alignment angle of 90.00° below FL195.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
41	Leg Transition (from Intermediate to Final) : SUNEY-ABCX2 ---> GREYZ-ABCX2 ---> FONVI-ABCX2.	Valid	The alignment angle between the two tracks does not exceed the maximum permitted alignment angle of 0.00° between TF and RF legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
42	Leg Transition (from Final to Final) : GREYZ-ABCX2 ---> FONVI-ABCX2 ---> JUBOL.	Valid	The alignment angle between the two tracks does not exceed the maximum permitted alignment angle of 0.00° between TF and RF legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees

43	Leg Transition (from Final to Final) : FONVI-ABCX2 ---> JUBOL ---> WIRSO.	Valid	The alignment angle between the two tracks does not exceed the maximum permitted alignment angle of 0.00° between TF and RF legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
44	Leg Transition (from Final to Final) : JUBOL ---> WIRSO ---> FIROP.	Valid	The alignment angle between the two tracks does not exceed the maximum permitted alignment angle of 0.00° between TF and RF legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
45	Leg Transition (from Final to Final) : WIRSO ---> FIROP ---> RW19.	Valid	The alignment angle between the two tracks does not exceed the maximum permitted alignment angle of 0.00° between TF and RF legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,a,(3)	The alignment tolerance is ± 0.03 degrees of all course differentials. The alignment restriction between TF and RF legs is no course change exceeding tolerance. Otherwise, the general alignment restriction at or above FL 195 is limited to maximum course change of 70 degrees, while below FL 195 is 90 degrees
46	Leg (Final) : GREYZ-ABCX2 --> FONVI-ABCX2.	Valid	The RF leg turn radius is: 1.50 NM which is greater than or equal to the minimum allowed turn radius of 0.60 NM. The bank angle is: 21.10° which is less than or equal to the maximum allowed bank angle of 25.00°.	Mandatory	FAA PBN - 8260.58A: 1-2-5,d,(3)	RF OEA construction limits turn radius to a minimum value equal to or greater than the OEA (primary and secondary if applicable) half - width. The bank angle should be less than or equal to 25 degrees.
47	Leg (Final) : FONVI-ABCX2 --> JUBOL.	Valid	The RF leg turn radius is: 1.50 NM which is greater than or equal to the minimum allowed turn radius of 0.60 NM. The bank angle is: 20.80° which is less than or equal to the maximum allowed bank angle of 25.00°.	Mandatory	FAA PBN - 8260.58A: 1-2-5,d,(3)	RF OEA construction limits turn radius to a minimum value equal to or greater than the OEA (primary and secondary if applicable) half - width. The bank angle should be less than or equal to 25 degrees.
48	Leg (Final) : WIRSO --> FIROP.	Valid	The RF leg turn radius is: 0.96 NM which is greater than or equal to the minimum allowed turn radius of 0.60 NM. The bank angle is: 23.94° which is less than or equal to the maximum allowed bank angle of 25.00°.	Mandatory	FAA PBN - 8260.58A: 1-2-5,d,(3)	RF OEA construction limits turn radius to a minimum value equal to or greater than the OEA (primary and secondary if applicable) half - width. The bank angle should be less than or equal to 25 degrees.
49		Valid	There is no Crossing speed decrement (based on previous crossing speed restrictions, if any) during the Missed Approach procedure.	Recommended	FAA PBN - 8260.58A: PBN manual	Crossing Speed can only be increased (if necessary) during a Missed Approach Procedure.
50	Missed Approach of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Valid	Valid - The Navigation Specification for all legs in the Missed Approach Segment is the recommended RNP AR APCH.	Recommended	FAA PBN - 8260.58A: 4-3-1,a	In order to serve the largest number of users, specify a default (Navigation Specification: RNP AR APCH) or RNAV (Navigation Specification: RNAV 1) Missed Approach Segment where possible.
51	Missed Approach of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Valid	The accuracy value for all legs in Missed Approach Segment is the recommended (1.0 NM).	Recommended	FAA PBN - 8260.58A: 4-3-1,a,(1)	Default Missed Approach Segment accuracy value is 1.0 NM.

52	Final Segment of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2. Missed Approach of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Valid	The first leg of the Missed Approach Segment is aligned with the Final Approach Course.	Mandatory	FAA PBN - 8260.58A: 4-3-1,a,(1)	RNP Missed Approach Segment : The construction is a continuation of the Final Approach Course.
53	Final Segment of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2. Missed Approach of RNAV (RNP) RWY 19 DARIC RELOCATED DARIC-ABCX2 NEW DARIC-ABCX2.	Valid	Change of direction for every leg and the final segment does not exceed the maximum change direction of 15.00° in a straight missed approach.	Mandatory	FAA TERPS - 8260.3D: 2-8-4	When the missed approach course is within 15 degrees of the final approach course, it is considered a straight missed approach.
54	Leg (Missed approach) : RW19 --> BADDN.	Valid	Valid - Current gradient of 490 ft/NM is greater than the minimum required gradient of 200 ft/NM.	Mandatory	FAA PBN - 8260.58A: 1-3-1,g,(2)	The minimum climb gradient for missed approach is 200 ft/NM.
55		Valid	Minimum leg length requirement met for all route legs.	Mandatory	FAA PBN - 8260.58A: 1-2-5,b,1	Minimum length (fix-to-fix). Generally, minimum leg length is the lesser of 2 — XTT or 1 NM, but where applicable may also be no less than the sum of Distance-to-Turn anticipation (for fly-by transitions) or the distance for return to course centerline (for fly-over turns).