

Flight Procedures Cover Page	Task Action: FLIGHT CHECK	Task Type: STAR	Estimated Chart Date: 02/25/2021	APWS Task ID: 0E8237951F6946C0AD72E250D9741D8B	APWS Request ID: 5F0004E890C34A2A9EE593D6421D0F5D
Procedure: MALNR FIVE ARRIVAL (RNAV)		Enroute: YES	Specialist: Martinelli, Tara		Agreement Number:
Airport ID: KRDU	Airport Name: RALEIGH-DURHAM INTL		Airport City: RALEIGH/DURHAM		State: NC
Facility ID:	Facility Type:	Flight Inspection Remark Type: New FC Slot			
<p><b>Procedure Comments:</b>  AMENDMENT: MALNR FIVE ARRIVAL (RNAV).</p> <p>APPROVAL REQUEST FOR DECENT GRADIENT 1 EA.</p> <p>APPROVAL REQUEST FOR LEG LENGTH FOR DECELERATION 3 EA.</p> <p>CONTACT: DON LANIER (405) 954-8242.</p> <p>THIS IS AN UPDATED COPY OF THE FORM DEVELOPED ON 01/03/2020</p> <p>1. ADDED NOTE: JET AIRCRAFT DESCEND VIA MACH NUMBER UNTIL 280K, MAINTAIN 280K UNTIL SLOWED BY THE STAR OR ATC, IF UNABLE, ADVISE ATC.</p>					



<b>FIPC DME/DME FORM</b>						
<b>PROCEDURE:</b> MALNR FIVE ARRIVAL (RNAV)			<b>AIRPORT NAME:</b> RALEIGH-DURHAM INTL		<b>AIRPORT ID:</b> KRDU	<b>SPECIAL CONTROL NO:</b> AG-02-045-20
<b>FAC ID:</b> MALNR5		<b>CITY:</b> RALEIGH/DURHAM			<b>ST:</b> NC	<b>ORIG CHART DATE:</b> 05/21/2020
<b>DFL TYPE:</b> PROC/D	<b>THIRD PARTY:</b> <input type="checkbox"/> YES	<b>EST. TIME ON SITE:</b> 1.0	<b>REIMB. NUMBER:</b> AC0683	<b>PTS TASK ID:</b>		
<b>PREFLIGHT NOTES</b>						
<b>REVIEWER:</b>					<b>DATE:</b>	
<b>COMMENTS:</b>					<b>CHECK ONE:</b> <input type="checkbox"/> FLT CK REQ <input type="checkbox"/> NFCR <input type="checkbox"/> REJECT <div style="display: flex; justify-content: flex-end; width: 100px;"> <div style="border: 1px solid black; padding: 2px 5px;">YES</div> <div style="border: 1px solid black; padding: 2px 5px;">NO</div> </div>	
					<b>CPV COMPLETE?</b> <div style="border: 1px solid black; padding: 2px 5px;">X</div>	
<b>PROCEDURE RESULTS</b>						
<b>INSPECTION DATE:</b> 03/02/2020	<b>CREW #:</b> VN376	<b>N #:</b> N88	<b>INSTRUMENT PROCEDURE STATUS:</b> <input checked="" type="checkbox"/> SAT <input type="checkbox"/> SAT W/CHANGES <input type="checkbox"/> UNSAT		<b>ARINC CODING:</b> <input type="checkbox"/> SAT <input checked="" type="checkbox"/> SAT/GOLD <input type="checkbox"/> UNSAT	
<b>FLIGHT INSPECTOR SIGNATURE:</b> thomas conklin @ 03/02/2020 16:48			<b>PRINTED NAME:</b> CONKLIN, THOMAS ROBERT			<b>NOTAM INITIATED?</b> <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
<b>FLIGHT INSPECTOR REMARKS:</b> Procedure Satisfactory for GNSS operations, DME/DME awaiting approval by the applicable AJV Operations Support Group						
<b>DME/DME STATUS:</b> <input checked="" type="checkbox"/> SAT <input type="checkbox"/> UNSAT	<b>SPECIALIST SIGNATURE:</b> mark ctr schoenhoff @ 03/20/2020 09:22			<b>PRINTED NAME:</b> MARK SCHOENHOFF		
<b>SPECIALIST REMARKS:</b> Post Flight DME/DME Analysis has been performed on the KRDU MALNR5 STAR with satisfactory results. All modeled DME's and ESV's were recorded by Flight Inspection and suitable for DME/DME/IRU operations.						
<b>IN-FLIGHT OBSTACLE REPORT</b>						
<b>OBSTRUCTION ID #:</b>	<b>COORDINATES OR LOCATION:</b>	<b>GNSS ALTITUDE (MSL):</b>	<b>BAROMETRIC ALTITUDE (MSL):</b>	<b>HEIGHT ABOVE GROUND LEVEL:</b>		

## FIPC DME/DME FORM

<b>PROCEDURE:</b> MALNR FIVE ARRIVAL (RNAV)		<b>AIRPORT NAME:</b> RALEIGH-DURHAM INTL		<b>AIRPORT ID:</b> KRDU	<b>SPECIAL CONTROL NO:</b> AG-02-045-20
<b>FAC ID:</b> MALNR5		<b>CITY:</b> RALEIGH/DURHAM		<b>ST:</b> NC	<b>ORIG CHART DATE:</b> 05/21/2020
<b>DFL TYPE:</b> PROC/D	<b>THIRD PARTY:</b> <input type="checkbox"/> YES	<b>EST. TIME ON SITE:</b> 1.0	<b>REIMB. NUMBER:</b> AC0683	<b>PTS TASK ID:</b>	

## PREFLIGHT NOTES

<b>REVIEWER:</b>	<b>DATE:</b>
<b>COMMENTS:</b>	<b>CHECK ONE:</b> <input type="checkbox"/> FLT CK REQ <input type="checkbox"/> NFCR <input type="checkbox"/> REJECT
	<b>YES</b> <b>NO</b>
	<b>CPV COMPLETE?</b> <b>X</b>

## PROCEDURE RESULTS

<b>INSPECTION DATE:</b> 03/02/2020	<b>CREW #:</b> VN376	<b>N #:</b> N88	<b>INSTRUMENT PROCEDURE STATUS:</b> <input checked="" type="checkbox"/> SAT <input type="checkbox"/> SAT W/CHANGES <input type="checkbox"/> UNSAT	<b>ARINC CODING:</b> <input type="checkbox"/> SAT <input checked="" type="checkbox"/> SAT/GOLD <input type="checkbox"/> UNSAT
<b>FLIGHT INSPECTOR SIGNATURE:</b> thomas conklin @ 03/02/2020 16:48		<b>PRINTED NAME:</b> CONKLIN, THOMAS ROBERT		<b>NOTAM INITIATED?</b> <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO

<b>FLIGHT INSPECTOR REMARKS:</b> Procedure Satisfactory for GNSS operations, DME/DME awaiting approval by the applicable AJV Operations Support Group		
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<b>DME/DME STATUS:</b> <input type="checkbox"/> SAT <input type="checkbox"/> UNSAT	<b>SPECIALIST SIGNATURE:</b>	<b>PRINTED NAME:</b>
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<b>SPECIALIST REMARKS:</b>
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## IN-FLIGHT OBSTACLE REPORT

<b>OBSTRUCTION ID #:</b>	<b>COORDINATES OR LOCATION:</b>	<b>GNSS ALTITUDE (MSL):</b>	<b>BAROMETRIC ALTITUDE (MSL):</b>	<b>HEIGHT ABOVE GROUND LEVEL:</b>
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<b>FIPC DME/DME FORM</b>						
<b>PROCEDURE:</b> MALNR FIVE ARRIVAL (RNAV)			<b>AIRPORT NAME:</b> RALEIGH-DURHAM INTL		<b>AIRPORT ID:</b> KRDU	<b>SPECIAL CONTROL NO:</b> AG-02-045-20
<b>FAC ID:</b> MALNR5		<b>CITY:</b> RALEIGH/DURHAM			<b>ST:</b> NC	<b>ORIG CHART DATE:</b> 05/21/2020
<b>DFL TYPE:</b> PROC/D	<b>THIRD PARTY:</b> <input type="checkbox"/> YES	<b>EST. TIME ON SITE:</b> 1.0	<b>REIMB. NUMBER:</b> AC0683	<b>PTS TASK ID:</b>		
<b>PREFLIGHT NOTES</b>						
<b>REVIEWER:</b>					<b>DATE:</b>	
<b>COMMENTS:</b>					<b>CHECK ONE:</b> <input type="checkbox"/> FLT CK REQ <input type="checkbox"/> NFCR <input type="checkbox"/> REJECT	
					<b>YES</b>	<b>NO</b>
					<b>CPV COMPLETE?</b> <input checked="" type="checkbox"/> X	
<b>PROCEDURE RESULTS</b>						
<b>INSPECTION DATE:</b> 03/02/2020	<b>CREW #:</b> VN376	<b>N #:</b> N88	<b>INSTRUMENT PROCEDURE STATUS:</b> <input checked="" type="checkbox"/> SAT <input type="checkbox"/> SAT W/CHANGES <input type="checkbox"/> UNSAT		<b>ARINC CODING:</b> <input type="checkbox"/> SAT <input checked="" type="checkbox"/> SAT/GOLD <input type="checkbox"/> UNSAT	
<b>FLIGHT INSPECTOR SIGNATURE:</b> thomas conklin @ 03/02/2020 16:48			<b>PRINTED NAME:</b> CONKLIN, THOMAS ROBERT			<b>NOTAM INITIATED?</b> <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
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<b>DME/DME STATUS:</b> <input checked="" type="checkbox"/> SAT <input type="checkbox"/> UNSAT	<b>SPECIALIST SIGNATURE:</b> mark ctr schoenhoff @ 03/20/2020 09:22			<b>PRINTED NAME:</b> MARK SCHOENHOFF		
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<b>OBSTRUCTION ID #:</b>	<b>COORDINATES OR LOCATION:</b>	<b>GNSS ALTITUDE (MSL):</b>	<b>BAROMETRIC ALTITUDE (MSL):</b>	<b>HEIGHT ABOVE GROUND LEVEL:</b>		

## PROCEDURE REVIEW BOARD (PRB) RESULTS

February 27, 2020 (rec 03/05/2020)

**\*\*\*PRB recommendations do not constitute approval\*\*\***

### 5. Approval: (RDU) RALEIGH-DURHAM INTL, RALEIGH/DURHAM, NC - MALNR FIVE (RNAV) STAR

<https://swims.faa.gov/PTR/Edit/7818>

Requested by: AIS

PRB Result: RECOMMEND DISAPPROVAL

a. The PRB identified an unmitigated/ineffective risk control. No operational restrictions prevent aircraft from being at the maximum altitude of the block 17000-11000 at MALNR. This could result in an excessive descent gradient to the maximum altitude specified in the block altitude 10000-9000 at NYGEL.

b. Additional information (non-substantive issues, correction optional):

1) Approval request (1 of 4) for MALNR-NYGEL descent gradient - The last sentence states, "... AFS memorandum cited above." There is no memorandum referenced elsewhere in the letter.

2) Approval request (4 of 4) for MALNR-NYGEL deceleration distance, page 1, last paragraph, the reference to 8260.46G should be 8260.3D.

3) Approval request (4 of 4), page 2, paragraph 2 - Sentence states, "Industry partners advise that aircraft FMSs would anticipate the 250 kt. restriction at EMRLL and begin reduction prior to MALNR if landing on runway 5L or 5R." Fix name EMRLL not used. Suspect it should be NYGEL instead.

All changes made and added statement pertaining to the addition of chart note ADDED CHART NOTE: "JET AIRCRAFT DESCEND VIA MACH NUMBER UNTIL 280K, MAINTAIN 280K UNTIL SLOWED BY THE STAR OR ATC, IF UNABLE, ADVISE ATC." per telcon with stakeholders, including AFS. Statement added to Approval Letter #4, 2nd page .

*Digitally signed by*  
**DONALD H LANIER**  
Mar 18, 2020

(MALNR.MALNR5) FIG

AL-516 (FAA)

# MALNR FIVE ARRIVAL (RNAV) Transition Routes

RALEIGH-DURHAM INTL (RDU)  
RALEIGH/DURHAM, NORTH CAROLINA

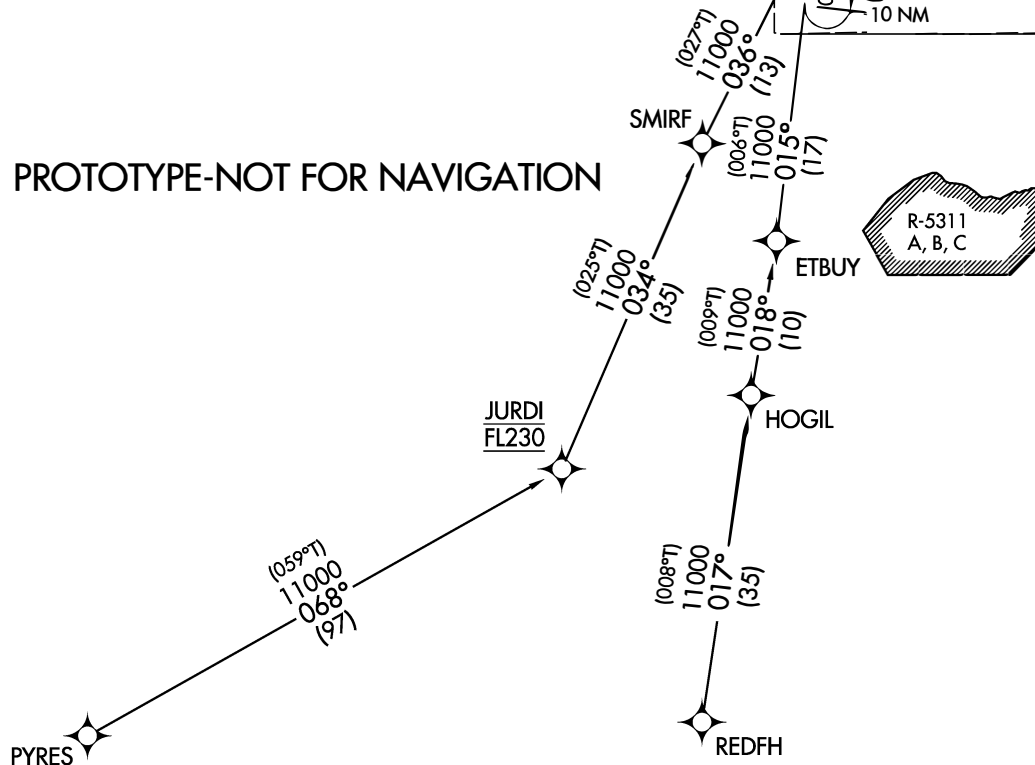
D-ATIS  
123.8  
RALEIGH APP CON  
128.3 307.9

MALNR  
17000  
11000

See following page  
for Arrival Routes

10 NM

PROTOTYPE-NOT FOR NAVIGATION



NOTE: RADAR required.

NOTE: RNAV 1.

NOTE: DME/DME/IRU or GPS required.

NOTE: Turbojet aircraft only.

NOTE: REDFH TRANSITION: Assigned by ATC only.

NOTE: Jet aircraft descend via mach number until 280K, maintain 280K until slowed by the STAR or ATC, if unable, advise ATC.

NOTE: LANDING NORTHEAST: Use Rwy 5L transition.

Expect runway assignment from TRACON prior to MALNR. NOTE: LANDING SOUTHWEST: Use Rwy 23R transition.

Expect runway assignment from TRACON prior to MALNR.

(CONTINUED ON FOLLOWING PAGE)  
(NARRATIVE ON FOLLOWING PAGE)

JURDI TRANSITION (JURDI.MALNR5)  
PYRES TRANSITION (PYRES.MALNR5)  
REDFH TRANSITION (REDFH.MALNR5)

NOTE: Chart not to scale.

AUTOMATED AL-516 MALNR ARRIVAL

SE-2

01/22/20

COMPILER: HD

REVIEWER:

DBL CHKR:

EFF DATE: FIG

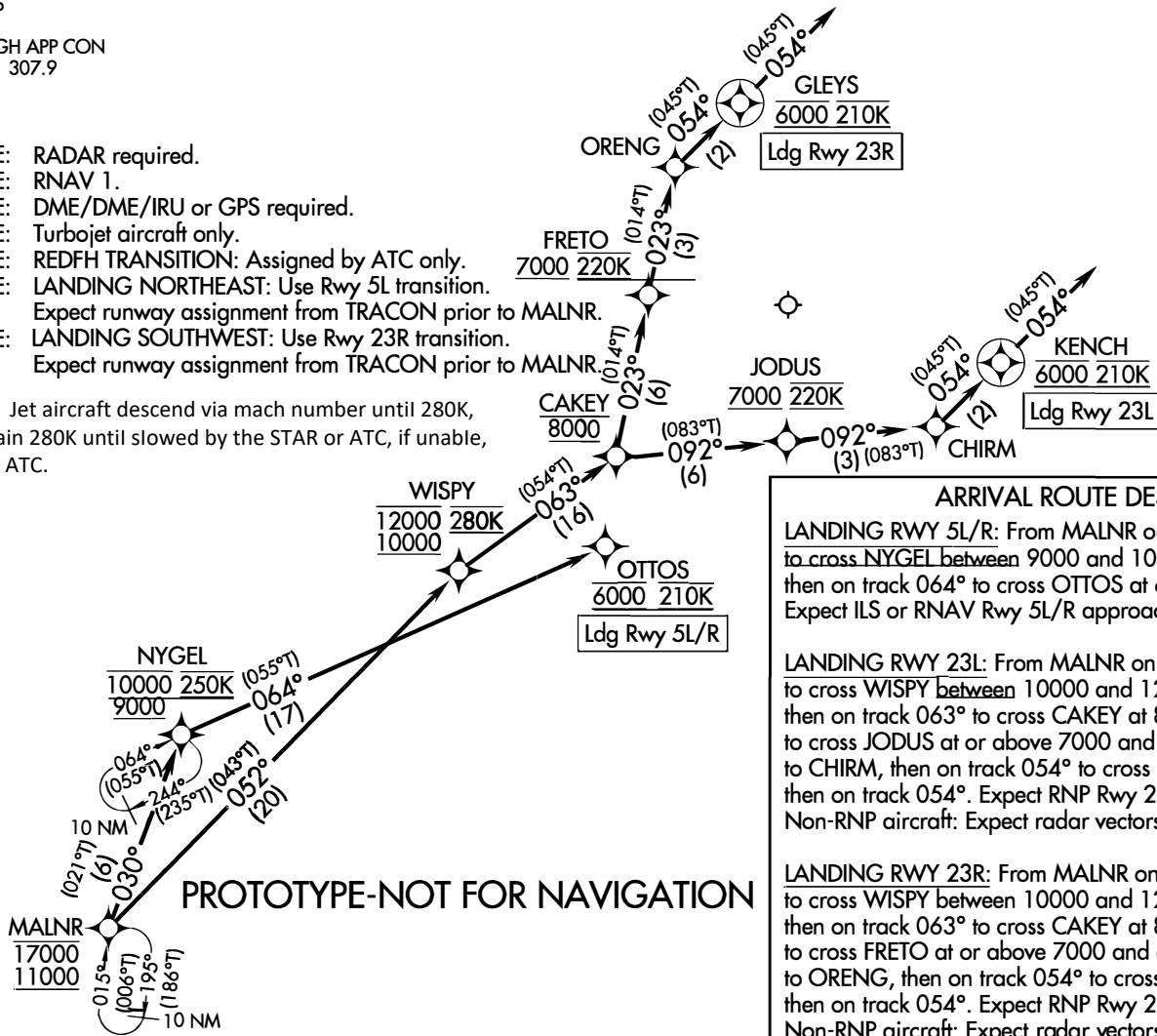
MALNR FIVE ARRIVAL (RNAV) Transition Routes  
(MALNR.MALNR5) FIG

RALEIGH/DURHAM, NORTH CAROLINA  
RALEIGH-DURHAM INTL (RDU)

D-ATIS  
 123.8  
 RALEIGH APP CON  
 128.3 307.9

- NOTE: RADAR required.  
 NOTE: RNAV 1.  
 NOTE: DME/DME/IRU or GPS required.  
 NOTE: Turbojet aircraft only.  
 NOTE: REDFH TRANSITION: Assigned by ATC only.  
 NOTE: LANDING NORTHEAST: Use Rwy 5L transition.  
 Expect runway assignment from TRACON prior to MALNR.  
 NOTE: LANDING SOUTHWEST: Use Rwy 23R transition.  
 Expect runway assignment from TRACON prior to MALNR.

NOTE: Jet aircraft descend via mach number until 280K, maintain 280K until slowed by the STAR or ATC, if unable, advise ATC.



NOTE: Chart not to scale.

#### ARRIVAL ROUTE DESCRIPTION

**LANDING RWY 5L/R:** From MALNR on track 030° to cross NYGEL between 9000 and 10000 and at 250K, then on track 064° to cross OTTOS at 6000 and at 210K. Expect ILS or RNAV Rwy 5L/R approach.

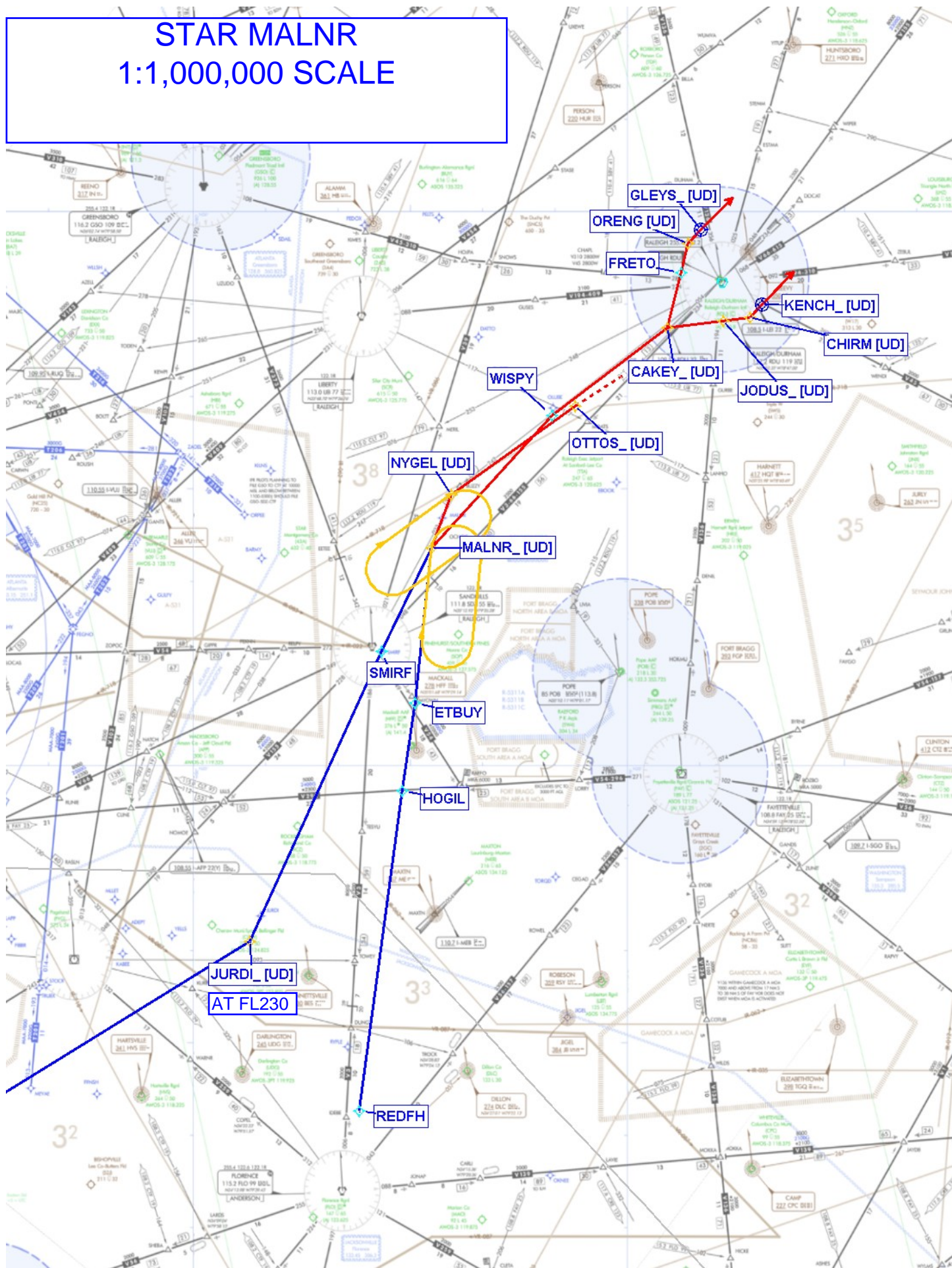
**LANDING RWY 23L:** From MALNR on track 052° to cross WISPY between 10000 and 12000 and at 280K, then on track 063° to cross CAKEY at 8000, then on track 092° to cross JODUS at or above 7000 and at 220K, then on track 092° to CHIRM, then on track 054° to cross KENCH at 6000 and at 210K, then on track 054°. Expect RNP Rwy 23L approach. Non-RNP aircraft: Expect radar vectors to final approach course.

**LANDING RWY 23R:** From MALNR on track 052° to cross WISPY between 10000 and 12000 and at 280K, then on track 063° to cross CAKEY at 8000, then on track 023° to cross FRETO at or above 7000 and at 220K, then on track 023° to ORENG, then on track 054° to cross GLEYS at 6000 and at 210K, then on track 054°. Expect RNP Rwy 23R approach. Non-RNP aircraft: Expect radar vectors to final approach course.

AUTOMATED AL-516 MALNR ARRIVAL (CONT)

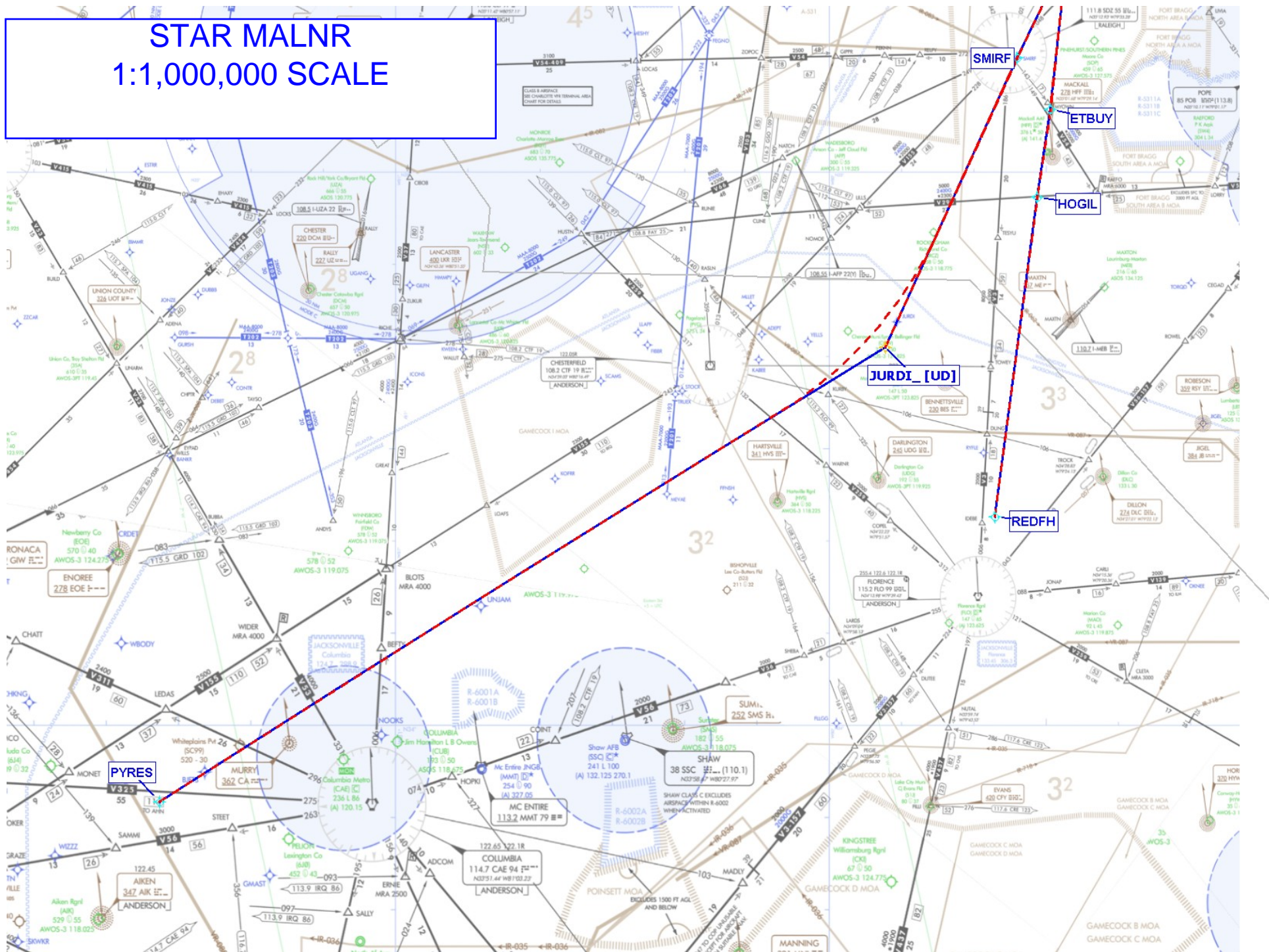
SE-2  
 01/22/20  
 COMPILER: HD  
 REVIEWER:  
 DBL CHKR:  
 EFF DATE: FIG

STAR MALNR  
1:1,000,000 SCALE

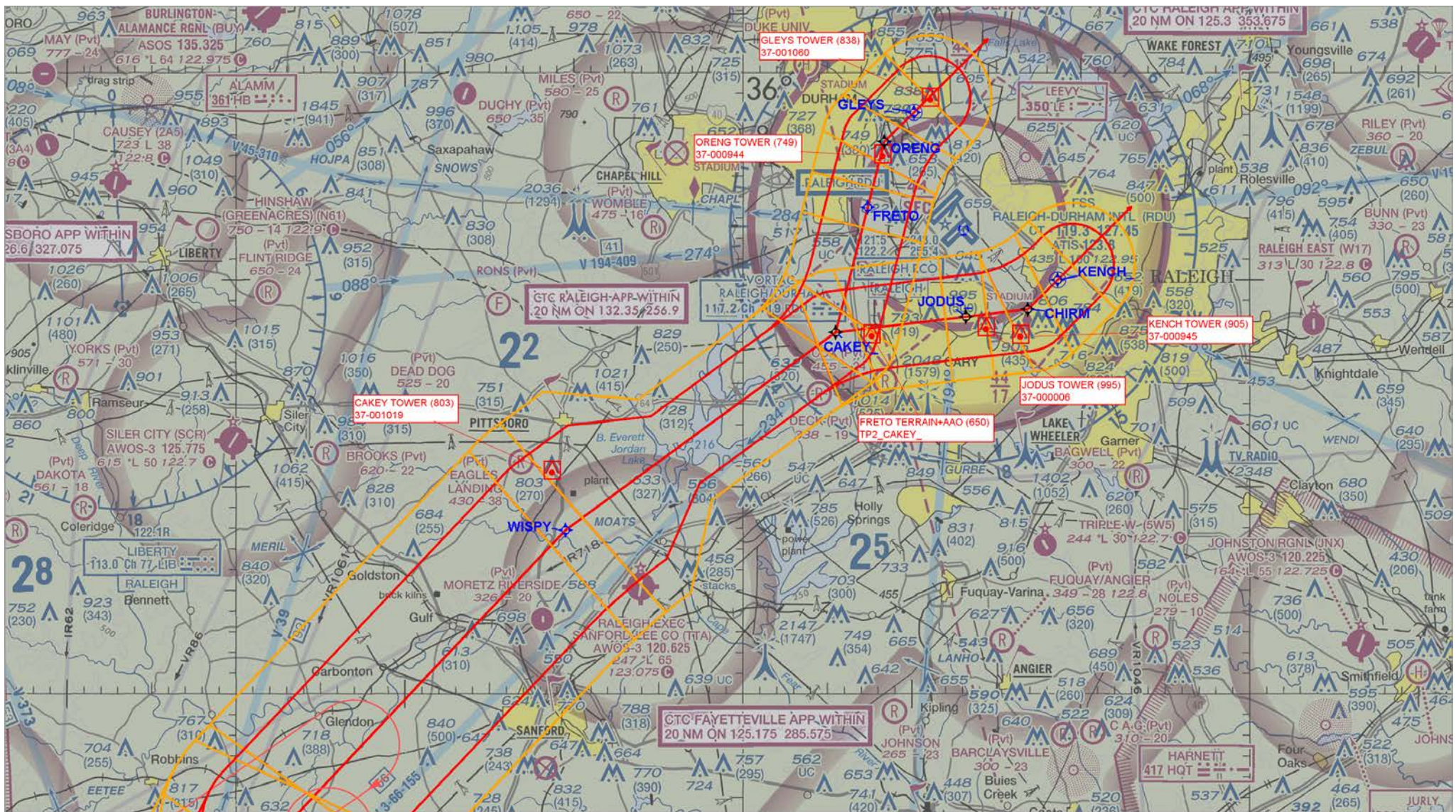




# STAR MALNR 1:1,000,000 SCALE

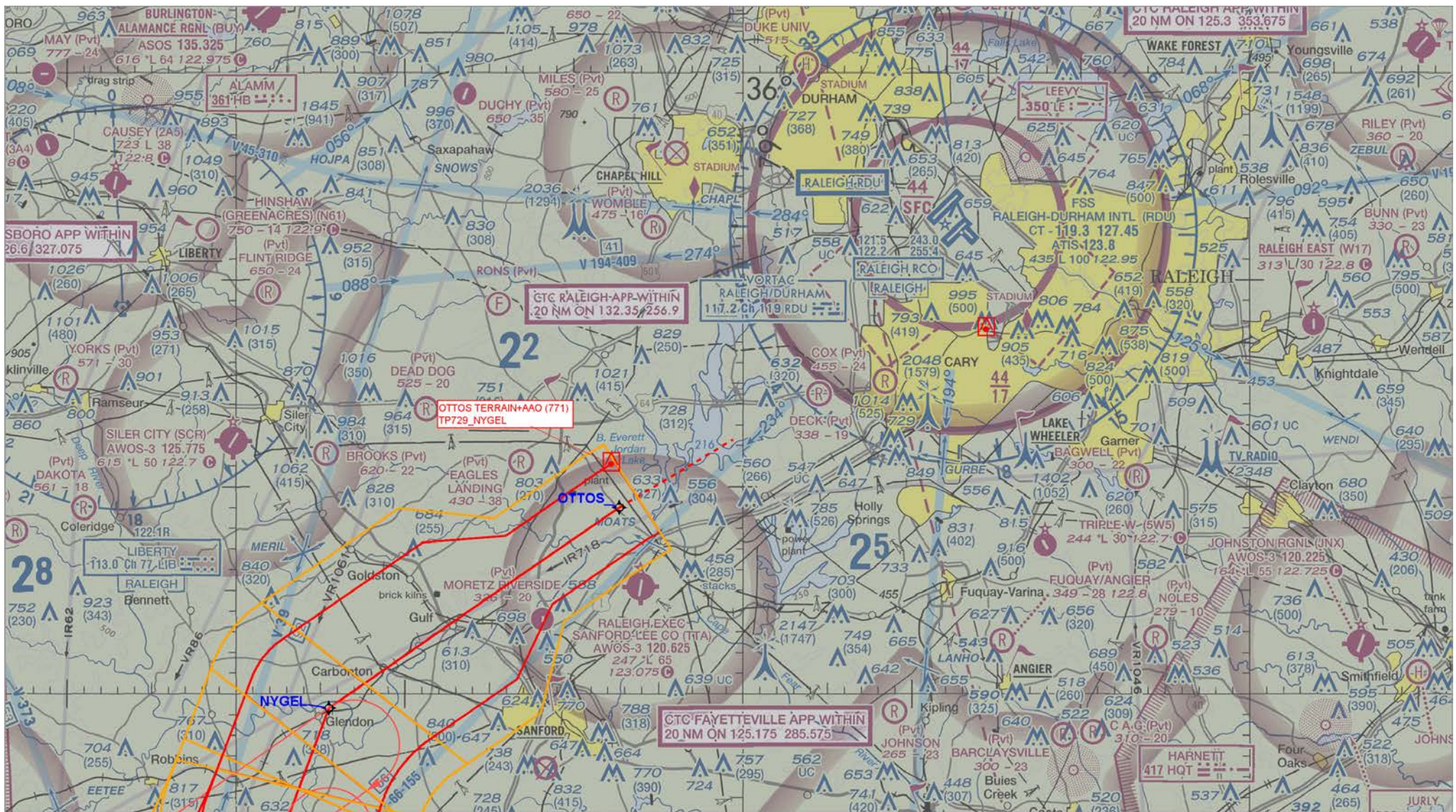






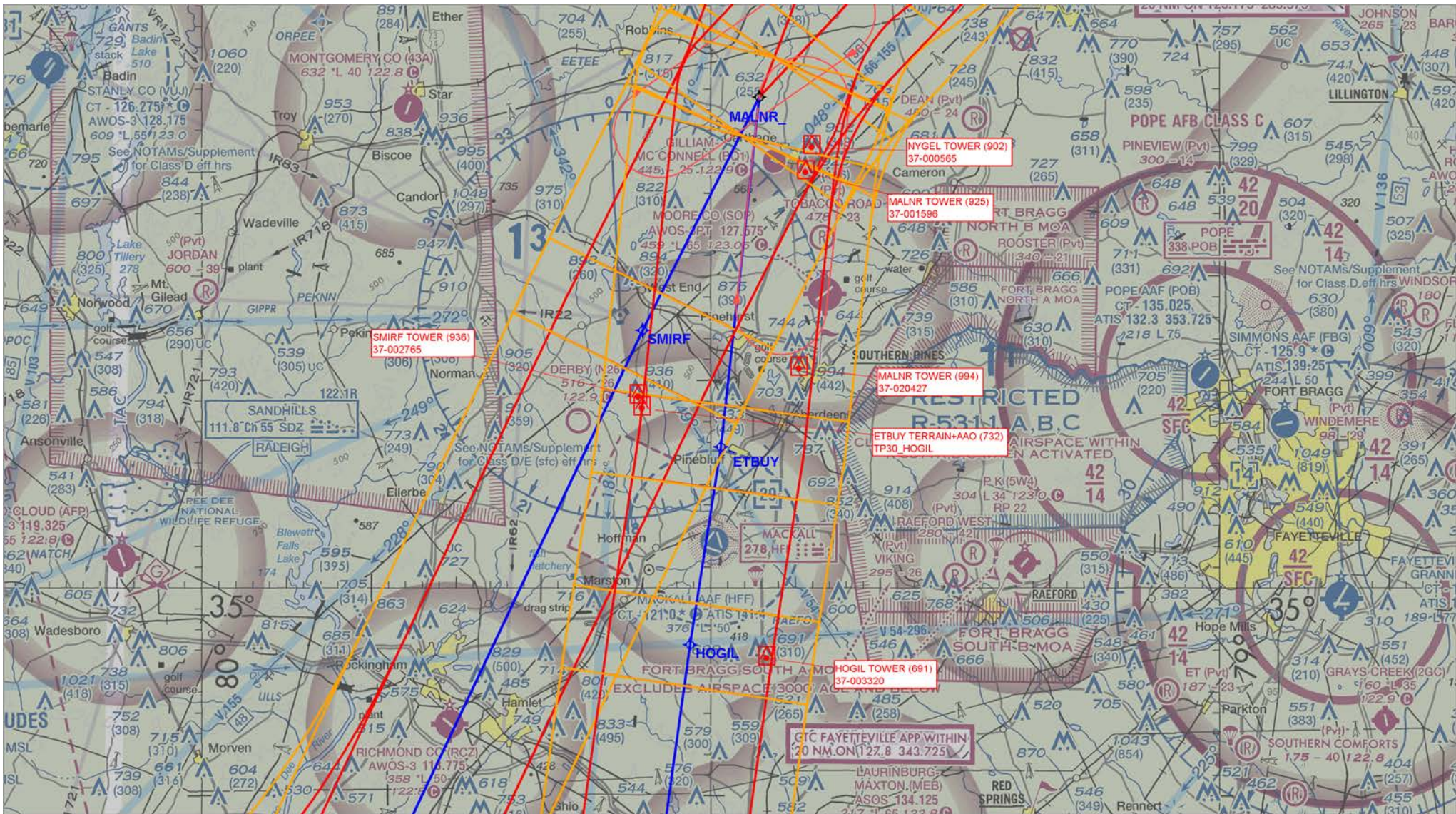
MALNR\_ (RNAV)





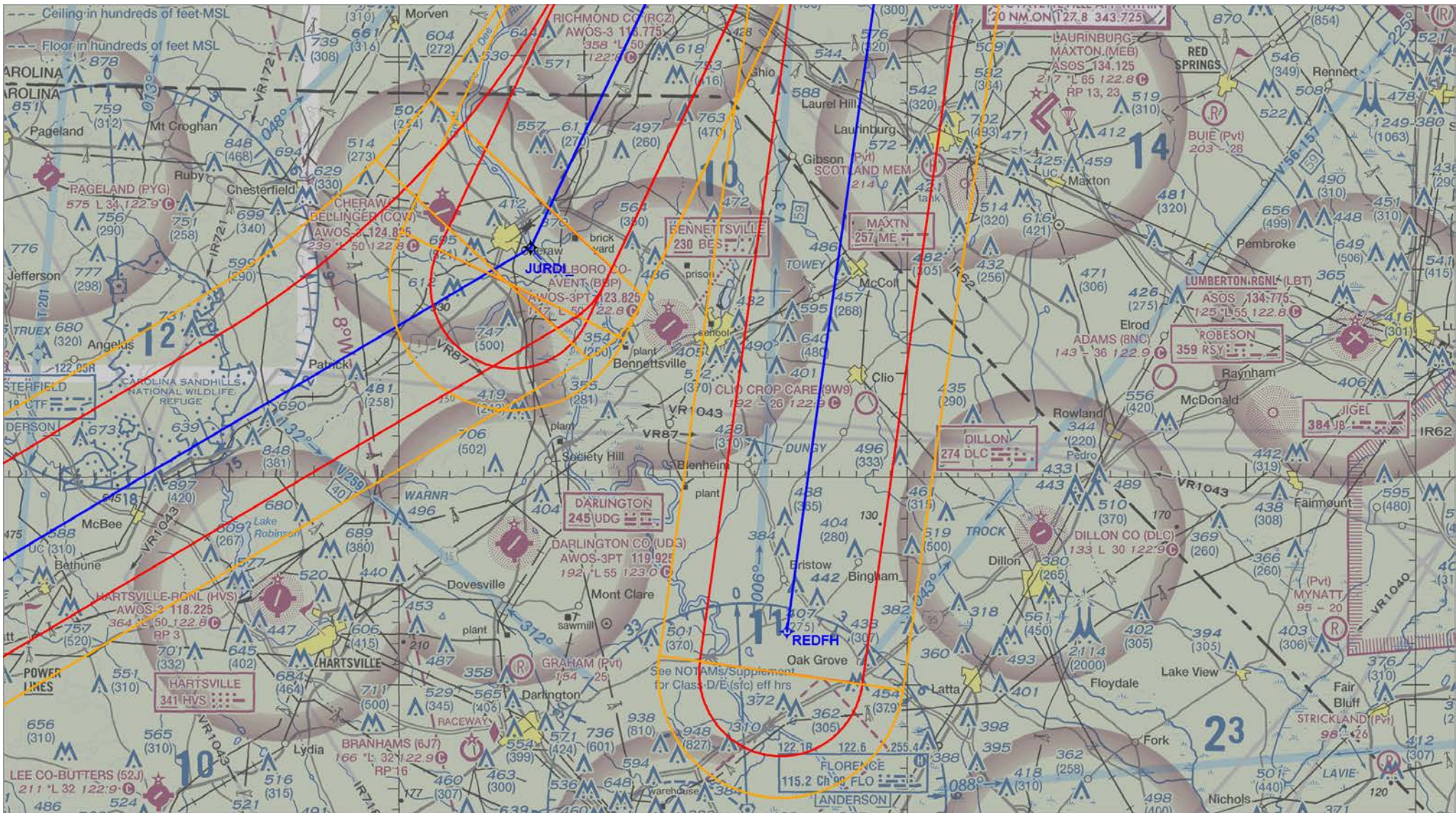
MALNR\_ (RNAV)





MALNR\_ (RNAV)



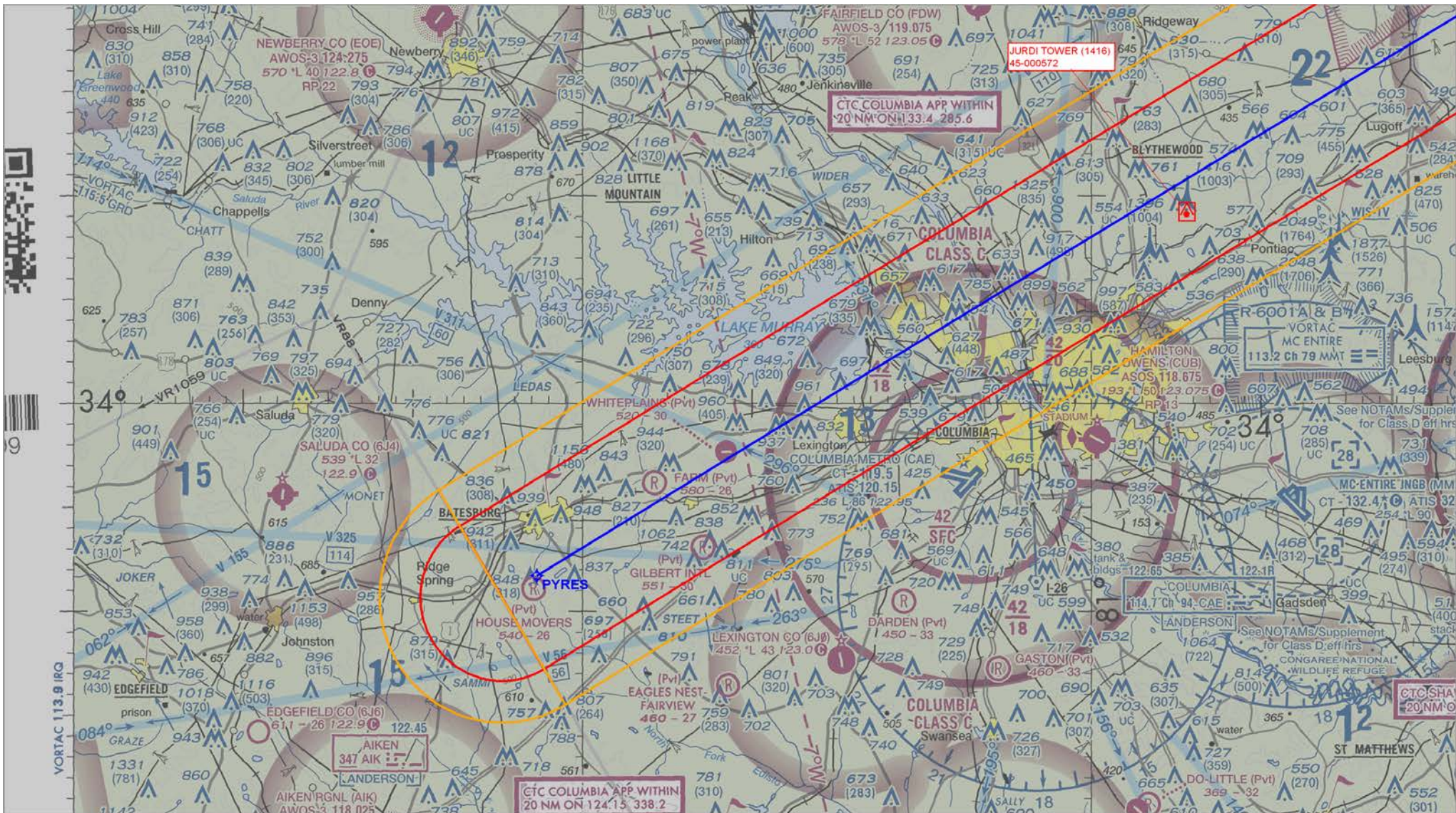


MALNR\_ (RNAV)









MALNR\_ (RNAV)





# Federal Aviation Administration

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## Memorandum

Date: January 27, 2020

To: Mark Steinbicker, Manager, AFS 400

Prepared by: Dennis W. Osterhage, Sr. ATC Specialist, NAVTAC contract support, 404-305-5657.

Subject: Descent Gradient Approval Request: Raleigh-Durham Intl, KRDU MALNR Arrival (RNAV) MALNR-NYGEL leg.

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The requirement stated in Order 8260.3D, paragraph 2-2-8.b.states:  
“When a gradient exceeds the maximum DG [descent gradient] allowed in paragraph 2-2-8.a, the STAR requires approval...”

According the TARGETS Reference Software (RS) the maximum allowable descent gradient for descent from 11000 to 9000 is 324 ft/NM. RS software is calculating the allowable DG by applying formula 2-2-1 given in 8260.3D paragraph 2-2-8.a.(3).

Calculating descent of 2000 ft. at a rate of 324 ft/NM results in a minimum required length of 6.17283951 NM. Rounding this result to the nearest one hundredth of a mile returns a result of 6.17 NM, which is the designed length of the MALNR-NYGEL leg. If an aircraft were to descend at exactly 324.0000000 ft/NM from 11000 to 9000, in 6.1700000 NM its altitude would be 9000.92. This difference from 9000 is essentially non-existent.

Formula 2-2-1 does not provide any requirements as to a required accuracy result when applying the formula, but the currently applied requirement for leg length distances for project development is to the nearest hundredth mile, and the publication of leg lengths reduces this accuracy even further to the nearest mile.

Aircraft flight profiles were analyzed using TARGETS Flight Evaluator scenario sets with 60 kt. tailwind, 60 kt. headwind and no wind conditions. Flight Evaluator projects these wind conditions onto the profile regardless of the aircraft track. All four types of turbojet aircraft in the Flight Evaluator profiles complied with all of the procedure design restraints except for the low performing large jet in the tailwind scenario (see attached).

Industry representatives at the design meeting stated that their simulations of the procedure using next generation aircraft simulators confirm that the restrictions on the procedure are within aircraft capabilities.



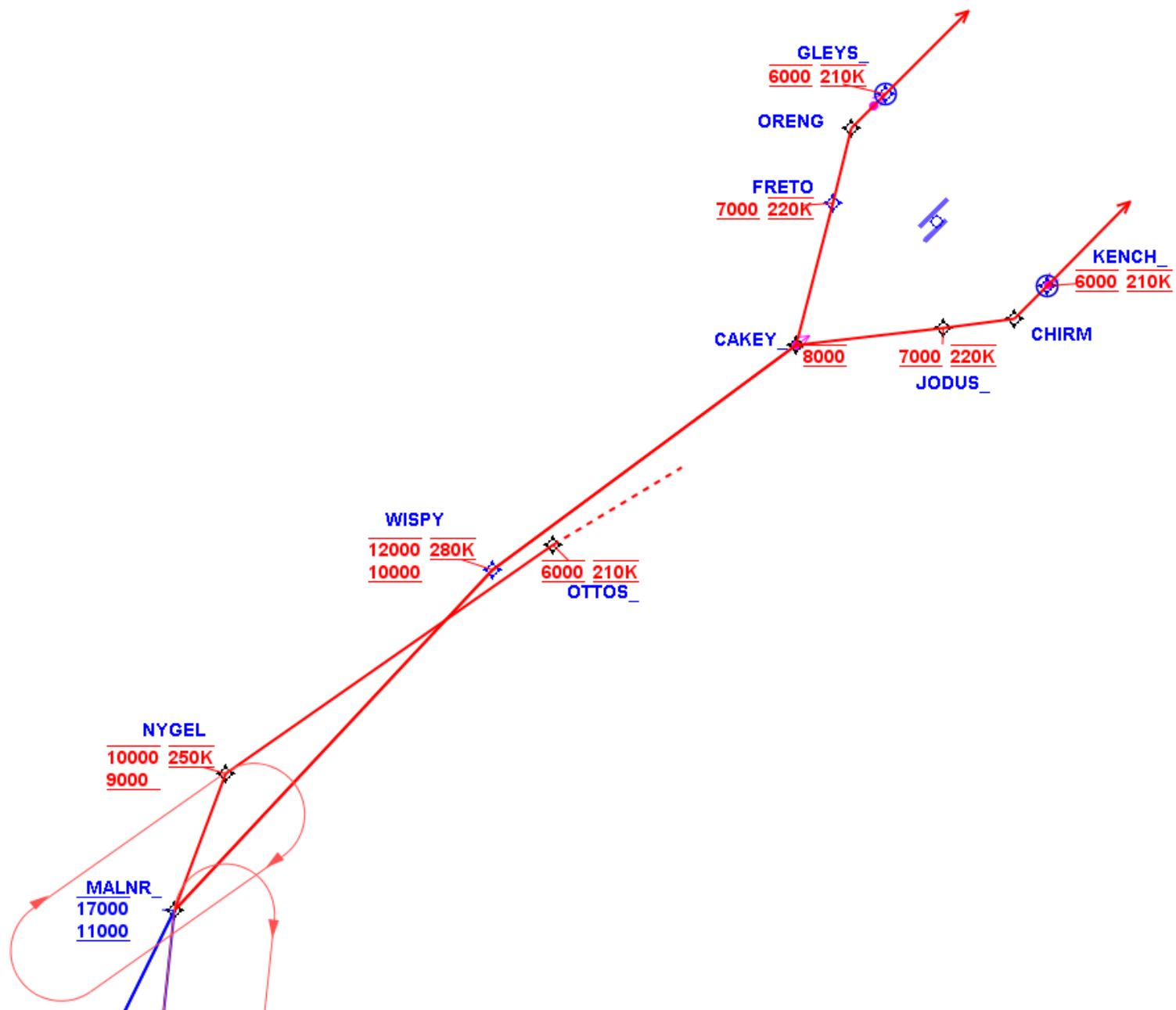
Request Flight Standards authorization to publish the KRDU MALNR Arrival (RNAV) with the location of MALNR and NYGEL points and their associated restrictions as designed per this memorandum.

A handwritten signature in black ink, appearing to read "Bryan Lehman". The signature is fluid and cursive, with the first name "Bryan" and last name "Lehman" clearly distinguishable.

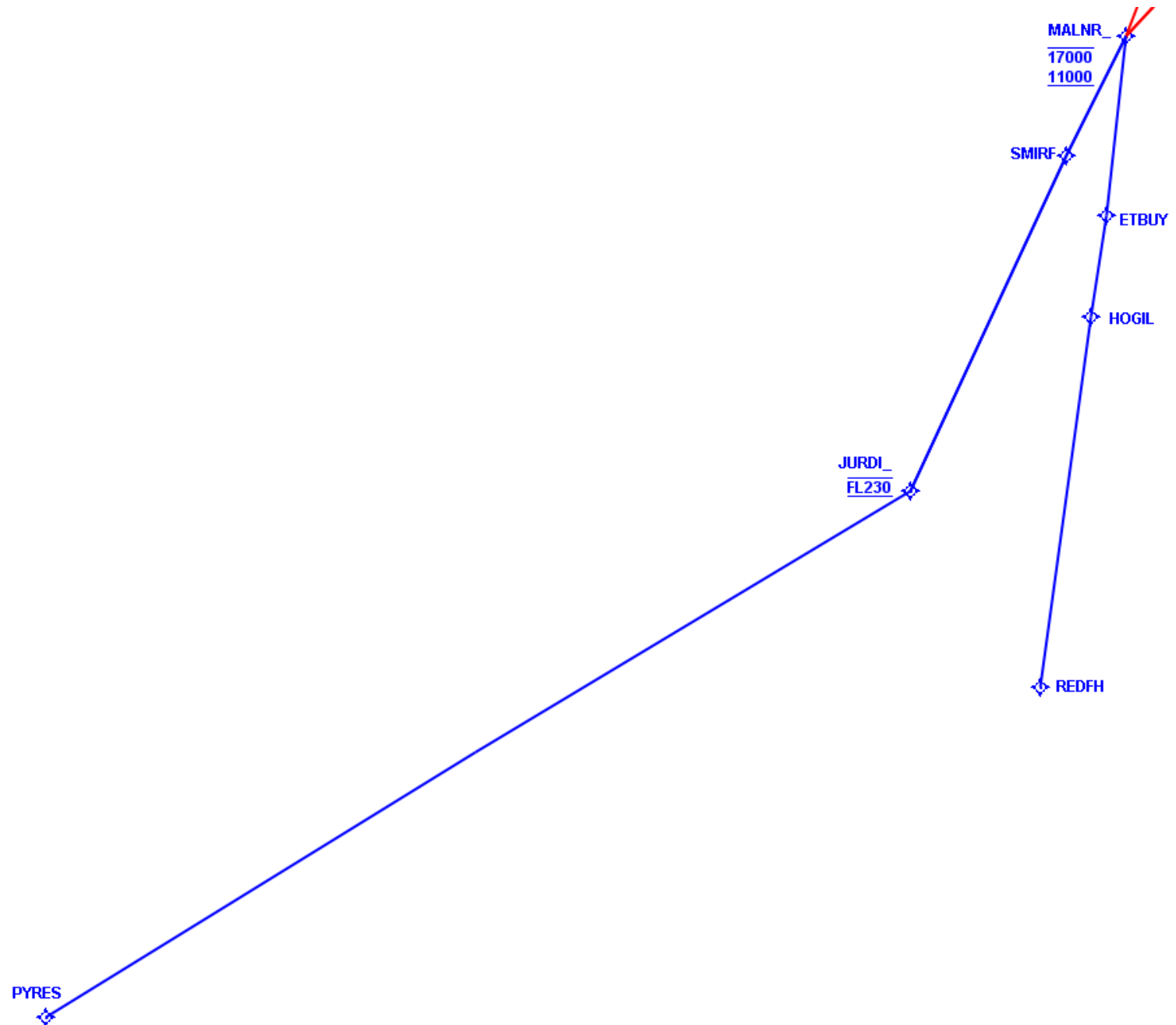
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Bryan Lehman  
Manager, Airspace and Procedures  
Washington District

# KRDU MALNR ARRIVAL (RNAV) RUNWAY TRANSITIONS



**KRDU MALNR ARRIVAL (RNAV)  
ENROUTE TRANSITIONS**



# FLIGHT EVALUATOR RESULTS

## 60 Kt. Headwind Scenario

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 s...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	6 min 17 sec	26.3 °	-15....	15,949	-7,041	203.0	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.57	2 min 32 sec	23.4 °	-2.9 °	12,088	-3,861	308.4	280
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.10	1 min 29 sec	39.6 °	16.1 °	10,038	-2,050	332.6	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.98	4 min 55 sec	55.6 °	16.0 °	5,986	-4,052	238.4	210

### LOW PERFORMING LARGE JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 s...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	6 min 17 sec	26.3 °	-15....	15,949	-7,041	203.0	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	2 min 32 sec	23.4 °	-2.9 °	11,962	-3,988	318.5	280
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.09	1 min 29 sec	39.6 °	16.2 °	10,030	-1,932	313.4	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.99	4 min 55 sec	55.6 °	16.0 °	5,996	-4,033	237.3	210

### LARGE JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	299
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 33 s...	41.4 °	-17....	23,024	-4,976	51.5	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.63	6 min 12 sec	26.3 °	-15....	15,941	-7,083	204.2	299
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.48	2 min 30 sec	23.4 °	-2.9 °	11,980	-3,961	316.4	277
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.12	1 min 30 sec	39.7 °	16.3 °	10,036	-1,944	315.4	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.98	4 min 55 sec	55.6 °	15.8 °	5,991	-4,045	237.9	210

### HEAVY JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	245
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.73	19 min 25 s...	41.2 °	-17....	23,003	-4,997	51.7	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.61	7 min 48 sec	26.4 °	-14....	15,934	-7,069	203.8	245
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.47	3 min 7 sec	23.4 °	-3.0 °	11,965	-3,969	317.0	245
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.13	1 min 35 sec	38.6 °	15.3 °	10,027	-1,938	314.4	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.97	4 min 52 sec	55.6 °	16.9 °	5,997	-4,030	237.0	210

### SMALL JET

# FLIGHT EVALUATOR RESULTS

## No Wind Scenario

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	26,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.71	13 min 47 s...	41.2 °	-17....	22,985	-3,015	31.2	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.50	5 min 24 sec	26.3 °	-14....	13,744	-9,241	266.5	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.52	2 min 10 sec	23.8 °	-2.5 °	11,027	-2,718	217.1	276
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.16	1 min 13 sec	39.1 °	15.3 °	10,017	-1,009	163.7	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.95	3 min 46 sec	55.6 °	16.5 °	6,003	-4,014	236.1	210

### LOW PERFORMING LARGE JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.66	13 min 34 s...	42.0 °	-17....	22,999	-5,001	51.7	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	5 min 19 sec	26.3 °	-15....	15,958	-7,041	203.0	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.55	2 min 7 sec	23.4 °	-2.9 °	11,985	-3,972	317.3	276
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.12	1 min 12 sec	40.0 °	16.5 °	10,046	-1,939	314.6	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.95	3 min 46 sec	55.6 °	15.6 °	5,998	-4,048	238.1	210

### LARGE JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	299
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.66	13 min 24 s...	41.4 °	-17....	22,993	-5,007	51.8	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.58	5 min 15 sec	26.3 °	-15....	15,950	-7,043	203.1	299
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.52	2 min 6 sec	23.4 °	-2.9 °	11,978	-3,972	317.3	275
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.11	1 min 12 sec	39.0 °	15.6 °	10,042	-1,936	314.1	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.95	3 min 46 sec	55.6 °	16.6 °	5,990	-4,051	238.3	210

### HEAVY JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	245
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.68	16 min 10 s...	41.3 °	-17....	22,991	-5,009	51.8	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.62	6 min 22 sec	26.4 °	-14....	15,946	-7,045	203.2	245
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.50	2 min 30 sec	23.4 °	-3.0 °	11,967	-3,979	317.8	245
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.16	1 min 16 sec	39.5 °	16.1 °	10,015	-1,952	316.6	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.91	3 min 44 sec	55.6 °	16.0 °	6,003	-4,012	236.0	210

### SMALL JET

# FLIGHT EVALUATOR RESULTS

## 60 Kt. Tailwind Scenario

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 s...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 38 sec	26.2 °	-15....	14,937	-8,059	232.4	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.50	1 min 49 sec	23.4 °	-2.8 °	12,192	-2,744	219.2	276
5	NYGEL	TF	X	✓	✓	9,000	10,000	250	6.17	6.08	59 sec	39.3 °	15.9 °	10,798	-1,394	226.2	251
6	OTTOS	TF	X	✓	✓	6,000	-	210	17.00	16.97	3 min 2 sec	55.6 °	16.3 °	6,712	-4,086	240.4	217

### LOW PERFORMING LARGE JET

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 s...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 36 sec	26.2 °	-15....	15,947	-7,048	203.2	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	1 min 49 sec	23.4 °	-2.8 °	12,073	-3,875	309.5	275
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.04	59 sec	39.4 °	16.0 °	10,224	-1,848	299.8	251
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.91	3 min 3 sec	55.6 °	16.2 °	6,026	-4,198	247.0	216

### LARGE JET

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	299
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.71	11 min 37 s...	41.5 °	-17....	23,011	-6,989	72.3	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 40 sec	26.3 °	-15....	12,256	-10,755	310.1	299
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.54	1 min 52 sec	23.3 °	-2.9 °	10,985	-1,271	101.5	275
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.09	1 min 0 sec	38.6 °	15.3 °	10,035	-950	154.1	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.99	3 min 4 sec	55.6 °	16.9 °	6,005	-4,030	237.1	216

### HEAVY JET

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	245
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.69	13 min 40 s...	41.4 °	-17....	22,993	-7,007	72.5	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.56	5 min 22 sec	26.0 °	-15....	15,953	-7,041	203.0	245
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.60	2 min 6 sec	23.4 °	-2.5 °	11,970	-3,982	318.1	245
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.06	1 min 2 sec	39.3 °	15.9 °	10,041	-1,929	312.9	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.96	3 min 3 sec	55.6 °	16.2 °	5,994	-4,047	238.1	218

### SMALL JET



# Federal Aviation Administration

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## Memorandum

Date: January 27, 2020

To: Mark Steinbicker, Manager, AFS 400

Prepared by: Dennis W. Osterhage, Sr. ATC Specialist, NAVTAC contract support, 404-305-5657.

Subject: Leg Length Approval Request: Raleigh-Durham Intl, KRDU MALNR Arrival (RNAV) CAKEY-FRETO leg.

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The requirement stated in Order 8260.3D, paragraph 2-2-10 states in part:

“Deceleration. Sufficient distance and a reduced descent gradient are required prior to any fix with a speed restriction...

...“b. When descent is permitted, the descent gradient leading to the fix with the speed restriction must be reduced. Apply formula 2-2-2 to determine the minimum deceleration distance (*DecelD*) required before the fix; the greater distance leads to a reduced descent gradient.”

Paragraph 1-4-2 states in part:

“**Nonstandard IFP.** ...obstacles, navigation information, or traffic congestion may require special consideration where justified by operational requirements. In such cases, nonstandard IFPs that deviate from these criteria may be approved, provided they are documented and an equivalent level of safety exists...”

8260.19H.paragraph 2-12-1 states: “**General.** ...Approval requests of these types [i.e. where a waiver is not required] must be made in plain text by memorandum and submitted to AFS-460 for approval.”

AFS Memorandum dated Sep. 24, 2018 states:

“This memorandum authorizes waivers to the FAA Order 8230.3D (sic)...paragraph 2-2-10 requirements for minimum deceleration distance/reduced descent gradient requirements prior to a fix with a speed restriction. STARs not meeting these requirements may be authorized with Flight Standards approval.”

The TARGETS Reference Software (RS) in version calculates the required leg length for the CAKEY-FRETO leg segment to be 7.0 NM based on crossing CAKEY at 8000 and 250 KIAS then descending to cross FRETO at 7000 and decelerating to 220 KIAS. However, the actual restriction at FRETO is at or above 7000 and at 220 KIAS, so it is permissible for an aircraft to pass FRETO at any altitude between 7000 and 8000 so long as it passes it at 220 KIAS. The location of the CAKEY and FRETO points were determined through the use of aviation partner

simulation that would allow the greatest feasible efficiency for arriving aircraft. The “at or above 7000” altitude restriction at FRETO is necessary to provide separation from departures that are assigned 6000 in their departure clearance. Making the restriction “at or above” provides for aircraft performance differences, yet still provides adequate distance to reach the “at 6000” terminal altitude.

Using TARGETS flight evaluator software, the flyability of the routes were evaluated using no wind, constant 60 knot tailwind, and constant 60 knot headwind scenarios. In each of these scenarios all four types of turbojet aircraft passed these points within the design parameters of the procedure. (See evaluator results in attachments.) Industry partner flight simulation of the procedure has confirmed these results.

Request Flight Standards authorization to publish the KRDU MALNR Arrival (RNAV) with the location of CAKEY and FRETO points and their associated restrictions as designed per the AFS memorandum cited above.

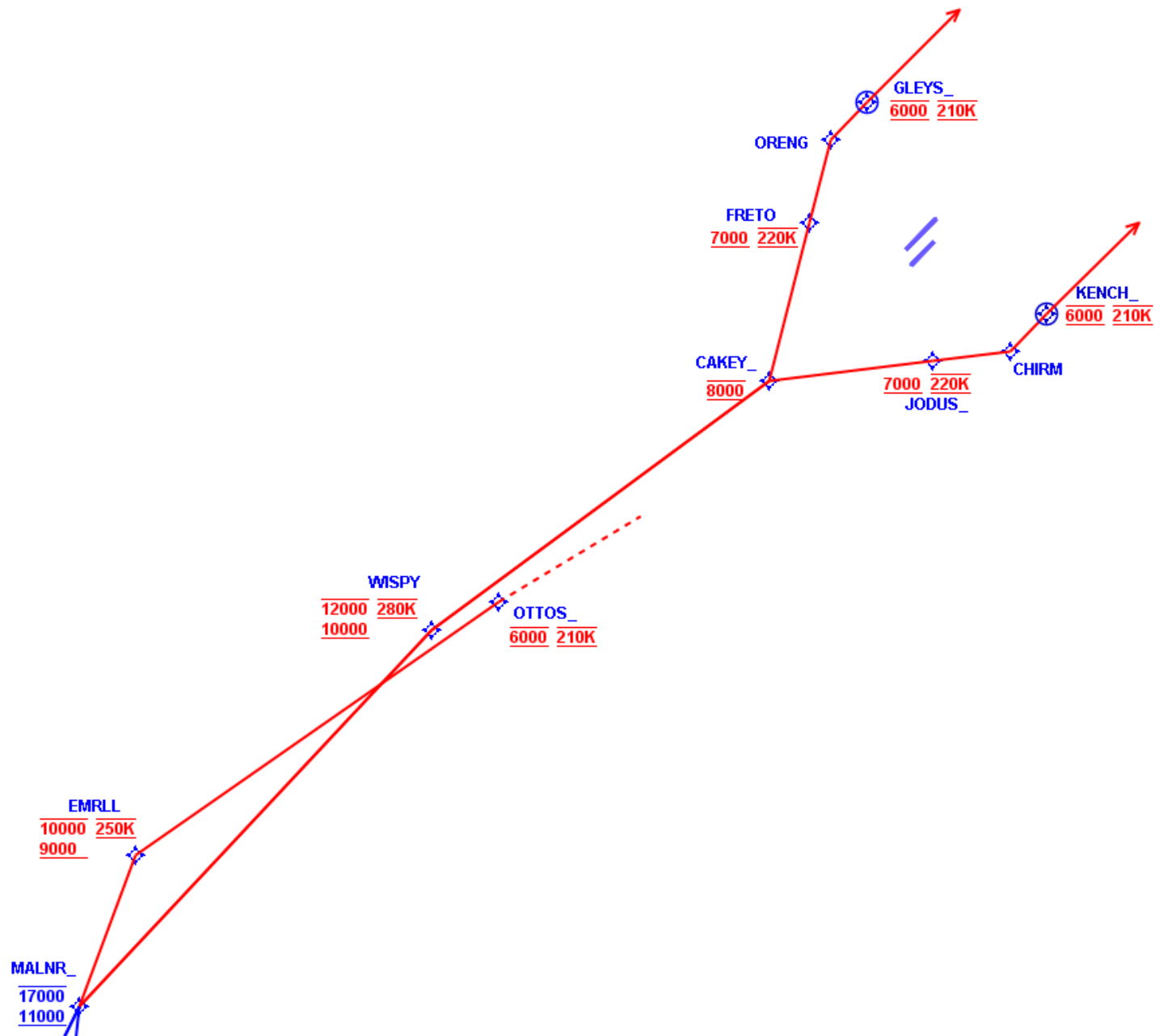


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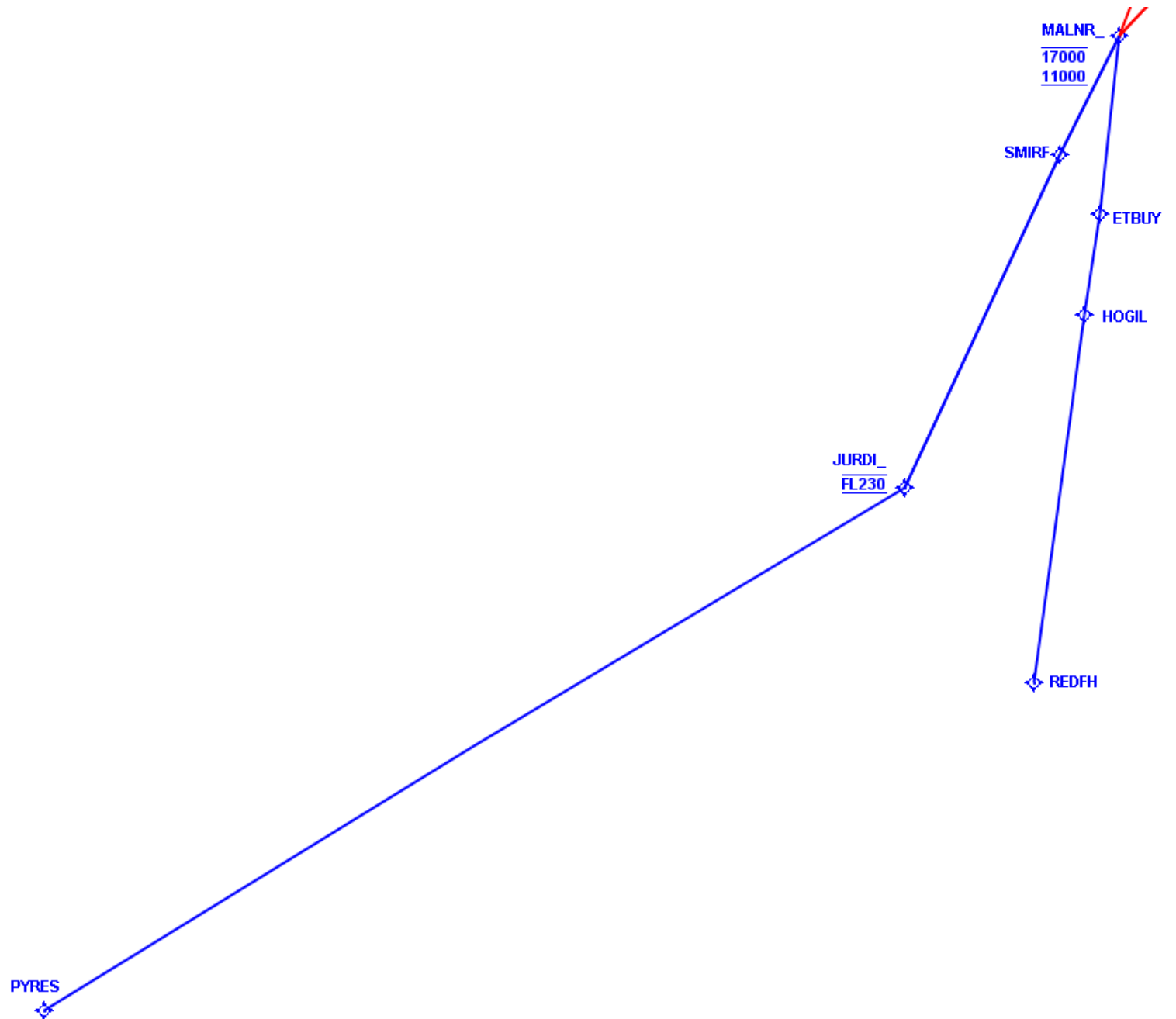
Bryan Lehman  
Manager, Airspace and Procedures  
Washington District



# KRDU MALNR ARRIVAL (RNAV) RUNWAY TRANSITIONS



**KRDU MALNR ARRIVAL (RNAV)  
ENROUTE TRANSITIONS**



## FLIGHT EVALUATOR RESULTS

### 60 Kt. Headwind Scenario

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 ...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.64	6 min 1 sec	26.2 °	-15....	20,979	-2,012	58.0	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.47	2 min 17 sec	35.6 °	9.4 °	17,053	-3,926	313.5	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.76	3 min 57 sec	49.4 °	13.8 °	12,021	-5,033	254.8	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.01	3 min 54 sec	31.8 °	-17....	8,011	-4,009	249.2	226
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.17	1 min 59 sec	14.4 °	-17....	7,669	-343	55.1	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.22	1 min 3 sec	30.8 °	16.5 °	6,652	-1,017	312.1	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.99	41 sec	45.4 °	14.5 °	6,004	-648	323.9	210

### Low Performing Large Jet

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 ...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.64	6 min 1 sec	26.2 °	-15....	20,979	-2,012	58.0	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.47	2 min 17 sec	35.6 °	9.4 °	17,015	-3,964	316.6	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.76	3 min 57 sec	48.9 °	13.3 °	12,005	-5,009	253.7	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.01	3 min 54 sec	33.0 °	-15....	8,020	-3,985	247.7	226
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.17	1 min 59 sec	14.3 °	-18....	7,673	-347	55.9	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.27	1 min 4 sec	32.0 °	17.7 °	6,638	-1,034	317.3	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.99	41 sec	45.1 °	13.1 °	5,996	-643	321.4	210

### Large Jet

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	299
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 33 ...	41.4 °	-17....	23,024	-4,976	51.5	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.58	5 min 55 sec	26.2 °	-15....	20,995	-2,029	58.5	299
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	2 min 16 sec	35.5 °	9.3 °	16,996	-3,999	319.4	299
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.73	3 min 54 sec	49.4 °	13.9 °	12,012	-4,984	252.4	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.01	3 min 54 sec	31.8 °	-17....	8,017	-3,995	248.3	226
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.17	1 min 59 sec	14.4 °	-17....	7,681	-336	54.1	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.22	1 min 3 sec	30.8 °	16.5 °	6,652	-1,029	315.7	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.99	41 sec	45.4 °	14.5 °	6,005	-647	323.3	210

### Heavy Jet

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	245
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.73	19 min 25 ...	41.2 °	-17....	23,003	-4,997	51.7	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	7 min 25 sec	26.4 °	-14....	20,979	-2,025	58.4	245
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.54	2 min 51 sec	35.4 °	9.1 °	17,013	-3,966	316.7	245
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.74	4 min 15 sec	48.9 °	13.5 °	12,026	-4,987	252.5	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.05	3 min 55 sec	31.7 °	-17....	8,016	-4,009	249.2	225
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.17	1 min 59 sec	14.4 °	-17....	7,678	-338	54.4	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.22	1 min 3 sec	30.8 °	16.5 °	6,661	-1,018	312.2	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.99	41 sec	45.4 °	14.6 °	6,000	-660	330.2	210

### Small Jet

## FLIGHT EVALUATOR RESULTS

### No Wind Scenario

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	33,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.68	13 min 4 ...	42.0 °	-16....	23,005	-9,995	103.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.62	5 min 9 sec	26.2 °	-15....	20,340	-2,665	76.8	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.43	1 min 56 ...	35.0 °	8.8 °	17,033	-3,307	264.1	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.83	3 min 18 ...	49.3 °	14.2 °	12,006	-5,027	254.6	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	15.95	3 min 5 sec	32.9 °	-16....	8,042	-3,964	246.3	239
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.15	1 min 28 ...	14.3 °	-18....	7,687	-355	57.1	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.25	48 sec	30.6 °	16.3 °	6,668	-1,018	312.4	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.97	30 sec	45.2 °	14.6 °	6,024	-645	322.4	210

### Low Performing Large Jet

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	39,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.72	12 min 29 ...	41.4 °	-17....	23,017	-15,983	165.3	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	5 min 7 sec	26.2 °	-15....	20,981	-2,035	58.7	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.49	1 min 56 sec	35.5 °	9.3 °	17,024	-3,957	316.1	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.73	3 min 17 sec	49.3 °	13.7 °	11,994	-5,031	254.7	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.03	3 min 6 sec	31.7 °	-17....	8,023	-3,971	246.8	238
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.14	1 min 28 sec	14.4 °	-17....	7,690	-333	53.5	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.25	48 sec	31.8 °	17.4 °	6,654	-1,036	317.8	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.96	30 sec	45.0 °	13.1 °	6,010	-644	322.1	210

### Large Jet

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	35,000	0	--	299
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.71	12 min 43 ...	41.5 °	-17....	23,005	-11,995	124.0	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.55	5 min 3 sec	26.2 °	-15....	20,975	-2,030	58.5	299
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.54	1 min 55 sec	35.4 °	9.2 °	17,012	-3,963	316.5	299
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.72	3 min 15 sec	49.3 °	13.8 °	12,005	-5,007	253.6	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.03	3 min 6 sec	31.7 °	-17....	8,011	-3,993	248.2	238
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.14	1 min 28 sec	14.3 °	-17....	7,686	-325	52.3	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.19	47 sec	30.6 °	16.3 °	6,668	-1,018	312.4	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	2.03	31 sec	45.1 °	14.5 °	6,004	-664	332.2	210

### Heavy Jet

Segment #	Termination Fix	Type	Alt	Speed	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	37,000	0	--	245
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	15 min 4 ...	41.4 °	-17....	23,003	-13,997	144.7	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.53	6 min 6 sec	26.0 °	-15....	21,003	-2,000	57.7	245
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.52	2 min 19 ...	35.4 °	9.4 °	17,016	-3,987	318.4	245
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.77	3 min 31 ...	48.9 °	13.5 °	12,002	-5,014	253.9	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.02	3 min 6 sec	32.9 °	-16....	8,018	-3,984	247.6	238
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.19	1 min 29 ...	14.3 °	-18....	7,660	-358	57.7	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.19	47 sec	30.6 °	16.3 °	6,668	-992	304.4	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.96	30 sec	45.1 °	14.5 °	6,036	-631	315.7	210

### Small Jet

# FLIGHT EVALUATOR RESULTS

## 60 Kt. Tailwind Scenario

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 ...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 38 sec	26.2 °	-15....	14,937	-8,059	232.4	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.53	1 min 48 sec	35.6 °	9.4 °	12,226	-2,710	216.5	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.66	2 min 54 sec	48.8 °	13.2 °	11,498	-729	36.9	281
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.07	2 min 37 sec	32.0 °	-16....	8,035	-3,463	215.2	241
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.08	1 min 10 sec	14.4 °	-17....	7,018	-1,016	163.6	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.27	39 sec	30.6 °	16.2 °	6,160	-859	263.5	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.97	24 sec	44.9 °	14.4 °	6,014	-146	72.8	211

## Low Performing Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 ...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.50	4 min 27 sec	26.2 °	-15....	20,973	-2,022	58.3	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	1 min 41 sec	35.5 °	9.3 °	17,012	-3,961	316.3	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.64	2 min 48 sec	48.7 °	13.2 °	12,011	-5,001	253.2	281
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.05	2 min 35 sec	32.5 °	-16....	8,046	-3,965	246.4	246
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.11	1 min 9 sec	14.3 °	-18....	7,670	-376	60.5	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.21	38 sec	30.4 °	16.1 °	6,782	-888	272.5	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.98	24 sec	44.6 °	14.2 °	6,206	-576	288.2	211

## Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	299
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.71	11 min 37 ...	41.5 °	-17....	23,011	-6,989	72.3	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.50	4 min 24 sec	26.2 °	-15....	20,980	-2,031	58.6	299
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.58	1 min 40 sec	35.4 °	9.2 °	17,018	-3,962	316.4	299
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.70	2 min 47 sec	49.2 °	13.8 °	12,023	-4,995	253.0	282
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	15.96	2 min 34 sec	32.6 °	-16....	8,048	-3,974	247.0	246
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.21	1 min 10 sec	14.4 °	-18....	7,662	-386	62.2	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.21	38 sec	31.6 °	17.2 °	6,759	-903	277.2	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.98	24 sec	44.5 °	12.9 °	6,199	-560	280.0	211

## Heavy Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	245
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.69	13 min 40 ...	41.4 °	-17....	22,993	-7,007	72.5	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.62	5 min 12 sec	26.3 °	-15....	20,976	-2,018	58.2	245
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.48	1 min 57 sec	35.3 °	9.0 °	17,022	-3,954	315.8	245
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.79	3 min 0 sec	49.3 °	14.0 °	11,989	-5,033	254.8	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	15.94	2 min 34 sec	32.5 °	-16....	8,030	-3,960	246.1	245
7	FRETO	TF	✓	✓	✓	+7,000	-	220	6.21	6.18	1 min 10 sec	14.4 °	-18....	7,666	-363	58.5	220
8	ORENG	TF	✓	✓	✓	-	-	-	3.26	3.21	38 sec	31.6 °	17.2 °	6,688	-979	300.2	220
9	GLEYS_	TF	✓	✓	✓	6,000	-	210	2.00	1.98	24 sec	44.4 °	12.8 °	6,067	-621	310.4	210
10		FM	✓	✓	✓	-	-	-	0.00	5.06	1 min 3 sec	45.3 °	0.9 °	6,000	-67	--	210

## Small Jet



# Federal Aviation Administration

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## Memorandum

Date: January 27, 2020

To: Mark Steinbicker, Manager, AFS 400

Prepared by: Dennis W. Osterhage, Sr. ATC Specialist, NAVTAC contract support, 404-305-5657.

Subject: Leg Length Approval Request: Raleigh-Durham Intl, KRDU MALNR Arrival (RNAV) CAKEY-JODUS leg.

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The requirement stated in Order 8260.3D, paragraph 2-2-10 states in part:

“Deceleration. Sufficient distance and a reduced descent gradient are required prior to any fix with a speed restriction...

...“b. When descent is permitted, the descent gradient leading to the fix with the speed restriction must be reduced. Apply formula 2-2-2 to determine the minimum deceleration distance (*DecelD*) required before the fix; the greater distance leads to a reduced descent gradient.”

Paragraph 1-4-2 states in part:

“**Nonstandard IFP.** ...obstacles, navigation information, or traffic congestion may require special consideration where justified by operational requirements. In such cases, nonstandard IFPs that deviate from these criteria may be approved, provided they are documented and an equivalent level of safety exists...”

8260.19H.paragraph 2-12-1 states: “**General.** ...Approval requests of these types [i.e. where a waiver is not required] must be made in plain text by memorandum and submitted to AFS-460 for approval.”

AFS Memorandum dated Sep. 24, 2018 states:

“This memorandum authorizes waivers to the FAA Order 8230.3D (sic)...paragraph 2-2-10 requirements for minimum deceleration distance/reduced descent gradient requirements prior to a fix with a speed restriction. STARs not meeting these requirements may be authorized with Flight Standards approval.”

The TARGETS Reference Software (RS) in version calculates the required leg length for the CAKEY- JODUS leg segment to be 7.0 NM based on crossing CAKEY at 8000 and 250 KIAS then descending to cross JODUS at 7000 and decelerating to 220 KIAS. However, the actual restriction at JODUS is at or above 7000 and at 220 KIAS, so it is permissible for an aircraft to pass JODUS at any altitude between 7000 and 8000 so long as it passes it at 220 KIAS. The location of the CAKEY and JODUS points were determined through the use of aviation partner

simulation that would allow the greatest feasible efficiency for arriving aircraft. The “at or above 7000” altitude restriction at JODUS is necessary to provide separation from departures that are assigned 6000 in their departure clearance. Making the restriction “at or above” provides for aircraft performance differences, yet still provides adequate distance to reach the “at 6000” terminal altitude.

Using TARGETS flight evaluator software, the flyability of the routes were evaluated using no wind, constant 60 knot tailwind, and constant 60 knot headwind scenarios. In each of these scenarios all four types of turbojet aircraft passed these points within the design parameters of the procedure. (See evaluator results in attachments.) Industry partner flight simulation of the procedure has confirmed these results.

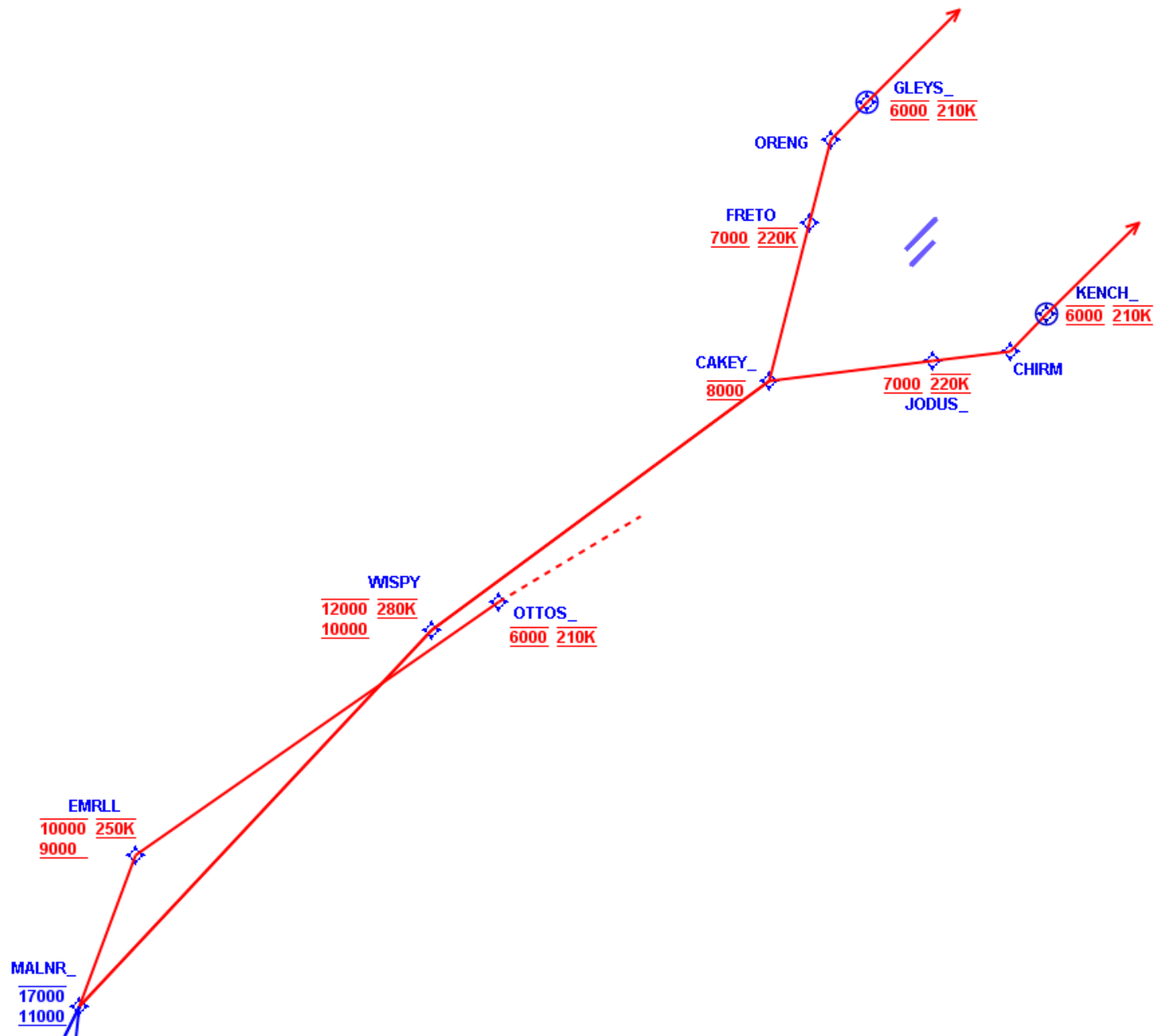
Request Flight Standards authorization to publish the KRDU MALNR Arrival (RNAV) with the location of CAKEY and JODUS points and their associated restrictions as designed per the AFS memorandum cited above.



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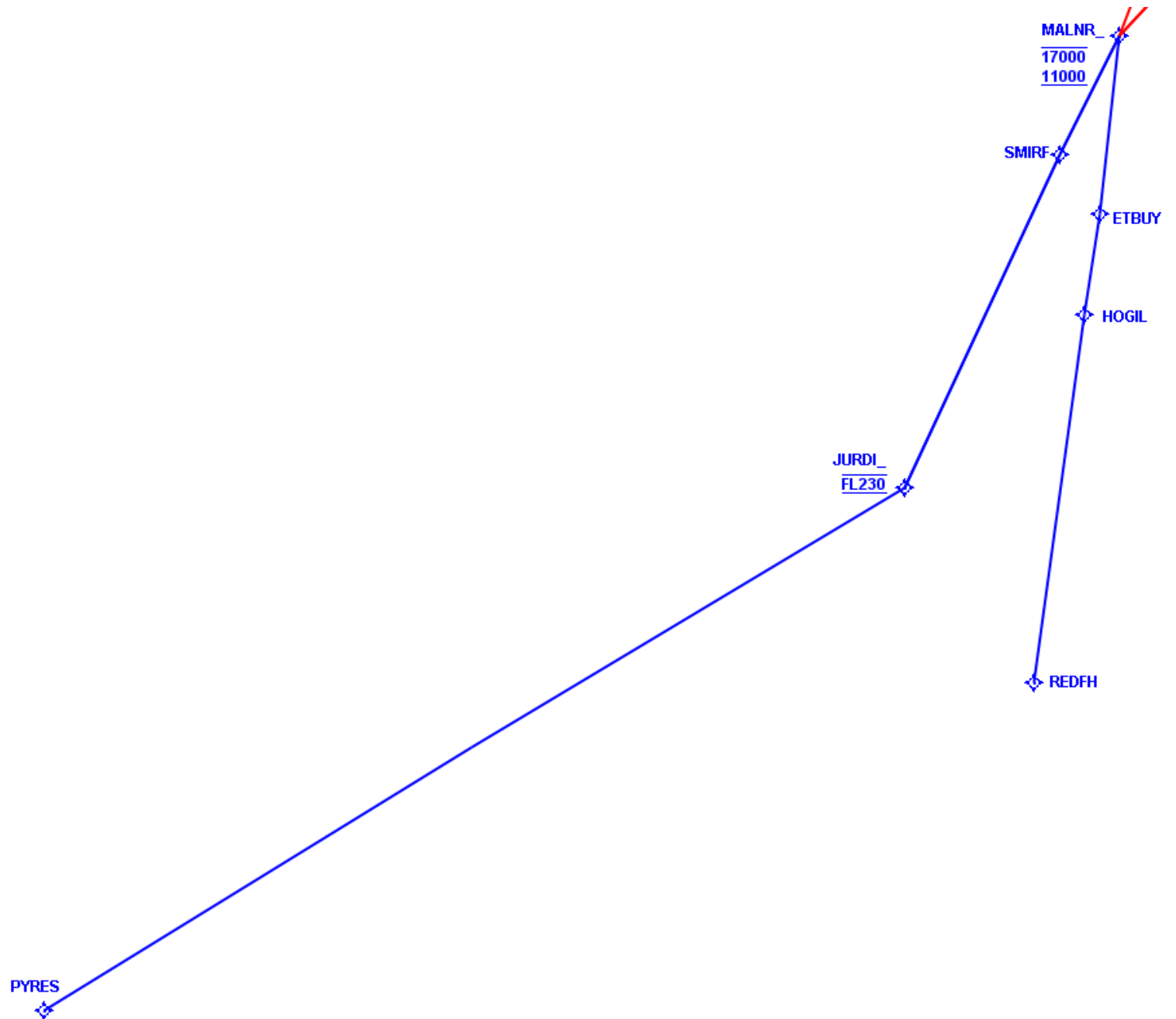
Bryan Lehman  
Manager, Airspace and Procedures  
Washington District

# KRDU MALNR ARRIVAL (RNAV) RUNWAY TRANSITIONS





**KRDU MALNR ARRIVAL (RNAV)  
ENROUTE TRANSITIONS**



# FLIGHT EVALUATOR RESULTS

## 60 Kt. Headwind Scenario

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 ...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.64	6 min 1 sec	26.2 °	-15....	20,979	-2,012	58.0	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.47	2 min 17 sec	35.6 °	9.4 °	17,053	-3,926	313.5	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.76	3 min 57 sec	49.4 °	13.8 °	12,021	-5,033	254.8	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.01	3 min 54 sec	69.4 °	20.0 °	8,016	-4,005	248.9	226
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.32	2 min 2 sec	83.2 °	13.8 °	7,578	-438	69.3	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.96	58 sec	61.9 °	-21....	6,659	-919	306.3	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.99	41 sec	45.2 °	-16....	6,006	-653	326.7	210

## Low Performing Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 ...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.64	6 min 1 sec	26.2 °	-15....	20,979	-2,012	58.0	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.47	2 min 17 sec	35.6 °	9.4 °	17,015	-3,964	316.6	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.76	3 min 57 sec	48.9 °	13.3 °	12,005	-5,009	253.7	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.06	3 min 55 sec	70.5 °	21.5 °	7,998	-4,007	249.0	226
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.27	2 min 1 sec	83.2 °	12.7 °	7,588	-411	65.0	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	3.01	59 sec	61.9 °	-21....	6,637	-951	316.9	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.94	40 sec	44.8 °	-17....	6,017	-619	309.8	210

## Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	299
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 33 ...	41.4 °	-17....	23,024	-4,976	51.5	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.58	5 min 55 sec	26.2 °	-15....	20,995	-2,029	58.5	299
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	2 min 16 sec	35.5 °	9.3 °	16,996	-3,999	319.4	299
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.73	3 min 54 sec	49.4 °	13.9 °	12,012	-4,984	252.4	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.01	3 min 54 sec	69.4 °	20.0 °	8,017	-3,995	248.3	226
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.32	2 min 2 sec	83.2 °	13.8 °	7,579	-438	69.2	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.96	58 sec	61.9 °	-21....	6,653	-926	308.7	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.99	41 sec	45.3 °	-16....	6,001	-652	325.9	210

## Heavy Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	245
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.73	19 min 25 ...	41.2 °	-17....	23,003	-4,997	51.7	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	7 min 25 sec	26.4 °	-14....	20,979	-2,025	58.4	245
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.54	2 min 51 sec	35.4 °	9.1 °	17,013	-3,966	316.7	245
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.74	4 min 15 sec	48.9 °	13.5 °	12,026	-4,987	252.5	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.05	3 min 55 sec	69.5 °	20.6 °	8,016	-4,009	249.2	225
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.32	2 min 2 sec	83.2 °	13.7 °	7,604	-413	65.3	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.96	58 sec	61.9 °	-21....	6,665	-939	312.9	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.99	41 sec	45.1 °	-16....	6,003	-662	331.1	210

## Small Jet

## FLIGHT EVALUATOR RESULTS

### No Wind Scenario

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	33,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.68	13 min 4 ...	42.0 °	-16....	23,005	-9,995	103.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.62	5 min 9 sec	26.2 °	-15....	20,340	-2,665	76.8	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.43	1 min 56 ...	35.0 °	8.8 °	17,033	-3,307	264.1	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.83	3 min 18 ...	49.3 °	14.2 °	12,006	-5,027	254.6	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.03	3 min 6 sec	69.6 °	20.3 °	8,023	-3,983	247.5	238
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.27	1 min 30 ...	83.3 °	13.7 °	7,596	-427	67.5	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.98	44 sec	62.2 °	-21....	6,666	-929	309.8	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.96	30 sec	45.3 °	-16....	6,010	-657	328.4	210

### Low Performing Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	39,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.72	12 min 29 ...	41.4 °	-17....	23,017	-15,983	165.3	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	5 min 7 sec	26.2 °	-15....	20,981	-2,035	58.7	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.49	1 min 56 sec	35.5 °	9.3 °	17,024	-3,957	316.1	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.73	3 min 17 sec	49.3 °	13.7 °	11,994	-5,031	254.7	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.03	3 min 6 sec	69.6 °	20.3 °	8,016	-3,978	247.2	238
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.34	1 min 31 sec	83.2 °	13.7 °	7,601	-415	65.6	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.91	43 sec	62.2 °	-21....	6,672	-928	309.4	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.97	30 sec	45.6 °	-16....	6,015	-657	328.5	210

### Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	35,000	0	--	299
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.71	12 min 43 ...	41.5 °	-17....	23,005	-11,995	124.0	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.55	5 min 3 sec	26.2 °	-15....	20,975	-2,030	58.5	299
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.54	1 min 55 sec	35.4 °	9.2 °	17,012	-3,963	316.5	299
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.72	3 min 15 sec	49.3 °	13.8 °	12,005	-5,007	253.6	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.03	3 min 6 sec	69.6 °	20.3 °	8,008	-3,996	248.4	238
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.27	1 min 30 sec	83.3 °	13.7 °	7,602	-406	64.3	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.98	44 sec	62.2 °	-21....	6,668	-934	311.4	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.96	30 sec	45.4 °	-16....	6,008	-659	329.6	210
10		FM	✓	✓	✓	-	-	-	0.00	5.02	1 min 20 sec	45.2 °	-0.2 °	4,293	-1,715	--	210

### Heavy Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	37,000	0	--	245
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	15 min 4 ...	41.4 °	-17....	23,003	-13,997	144.7	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.53	6 min 6 sec	26.0 °	-15....	21,003	-2,000	57.7	245
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.52	2 min 19 ...	35.4 °	9.4 °	17,016	-3,987	318.4	245
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.77	3 min 31 ...	48.9 °	13.5 °	12,002	-5,014	253.9	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.02	3 min 6 sec	69.6 °	20.7 °	8,015	-3,987	247.8	238
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.33	1 min 31 ...	83.2 °	13.6 °	7,610	-405	64.1	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.98	44 sec	62.2 °	-21....	6,650	-960	319.9	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.96	30 sec	45.2 °	-16....	6,016	-634	316.8	210

### Small Jet

# FLIGHT EVALUATOR RESULTS

## 60 Kt. Tailwind Scenario

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 ...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 38 sec	26.2 °	-15....	14,937	-8,059	232.4	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.53	1 min 48 sec	35.6 °	9.4 °	12,226	-2,710	216.5	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.66	2 min 54 sec	48.8 °	13.2 °	11,495	-732	37.1	281
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.07	2 min 37 sec	69.3 °	20.6 °	8,026	-3,469	215.6	241
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.34	1 min 13 sec	83.3 °	14.0 °	6,987	-1,039	164.3	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.94	35 sec	62.3 °	-21....	6,229	-758	252.6	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.97	24 sec	46.0 °	-16....	6,034	-196	97.8	211

## Low Performing Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 ...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.50	4 min 27 sec	26.2 °	-15....	20,973	-2,022	58.3	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	1 min 41 sec	35.5 °	9.3 °	17,012	-3,961	316.3	295
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.64	2 min 48 sec	48.7 °	13.2 °	12,011	-5,001	253.2	281
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.05	2 min 35 sec	69.0 °	20.3 °	8,039	-3,973	246.9	246
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.36	1 min 12 sec	83.3 °	14.3 °	7,573	-466	73.7	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.95	35 sec	62.4 °	-20....	6,736	-837	278.9	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.90	23 sec	45.7 °	-16....	6,185	-551	275.6	211

## Large Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	299
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.71	11 min 37 ...	41.5 °	-17....	23,011	-6,989	72.3	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.50	4 min 24 sec	26.2 °	-15....	20,980	-2,031	58.6	299
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.58	1 min 40 sec	35.4 °	9.2 °	17,018	-3,962	316.4	299
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.70	2 min 47 sec	49.2 °	13.8 °	12,023	-4,995	253.0	282
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.05	2 min 35 sec	69.9 °	20.8 °	8,023	-3,999	248.6	246
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.28	1 min 11 sec	83.3 °	13.3 °	7,598	-425	67.3	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.96	35 sec	62.4 °	-20....	6,767	-831	276.9	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.90	23 sec	45.9 °	-16....	6,230	-537	268.7	211

## Heavy Jet

Segment #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrS	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	245
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.69	13 min 40 ...	41.4 °	-17....	22,993	-7,007	72.5	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.62	5 min 12 sec	26.3 °	-15....	20,976	-2,018	58.2	245
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.48	1 min 57 sec	35.3 °	9.0 °	17,022	-3,954	315.8	245
5	WISPY	TF	✓	✓	✓	10,000	12,000	280	19.75	19.79	3 min 0 sec	49.3 °	14.0 °	11,989	-5,033	254.8	280
6	CAKEY_	TF	✓	✓	✓	8,000	-	-	16.09	16.03	2 min 35 sec	70.0 °	20.6 °	8,009	-3,980	247.4	245
7	JODUS_	TF	✓	✓	✓	+7,000	-	220	6.32	6.25	1 min 11 sec	83.3 °	13.3 °	7,579	-430	68.1	220
8	CHIRM	TF	✓	✓	✓	-	-	-	3.00	2.95	35 sec	62.4 °	-20....	6,680	-899	299.6	220
9	KENCH_	TF	✓	✓	✓	6,000	-	210	2.00	1.98	24 sec	46.0 °	-16....	6,059	-620	310.1	210

## Small Jet



# Federal Aviation Administration

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## Memorandum

Date: January 27, 2020

To: Mark Steinbicker, Manager, AFS 400

Prepared by: Dennis W. Osterhage, Sr. ATC Specialist, NAVTAC contract support, 404-305-5657.

Subject: Leg Length Approval Request: Raleigh-Durham Intl, KRDU MALNR Arrival (RNAV) MALNR-NYGEL leg.

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The requirement stated in Order 8260.3D, paragraph 2-2-10 states in part:

“Deceleration. Sufficient distance and a reduced descent gradient are required prior to any fix with a speed restriction.

“b. When descent is permitted, the descent gradient leading to the fix with the speed restriction must be reduced. Apply formula 2-2-2 to determine the minimum deceleration distance (*DecelD*) required before the fix; the greater distance leads to a reduced descent gradient.

Paragraph 1-4-2 states in part:

“**Nonstandard IFP.** ...obstacles, navigation information, or traffic congestion may require special consideration where justified by operational requirements. In such cases, nonstandard IFPs that deviate from these criteria may be approved, provided they are documented and an equivalent level of safety exists...”

8260.19H.paragraph 2-12-1 states: “**General.** ...Approval requests of these types [i.e. where a waiver is not required] must be made in plain text by memorandum and submitted to AFS-460 for approval.”

AFS Memorandum dated Sep. 24, 2018 states:

“This memorandum authorizes waivers to the FAA Order 8230.3D (sic)...paragraph 2-2-10 requirements for minimum deceleration distance/reduced descent gradient requirements prior to a fix with a speed restriction. STARs not meeting these requirements may be authorized with Flight Standards approval.”

The TARGETS Reference Software (RS) calculates the required leg length for the MALNR-NYGEL leg segment to be 12.06 NM vs the design length of 6.16 NM. This required length is derived from the RS calculating descent from crossing MALNR at 11000 and at 310 kts, then descending to cross NYGEL at 9000 and 250 kts. Using the formula given in 8260.3D, to descend

from 11000 to 9000 at 318 ft/NM requires approximately 6.29 NM. Additional required leg length is added to account for deceleration.

The actual restriction at NYGEL is “between 9000 and 10000 at 250 kts.” Industry partners advise that aircraft FMSs would anticipate the 250 kt. restriction at NYGEL and begin reduction prior to MALNR if landing on runway 5L or 5R. Consequently to descend from 11000 at MALNR to meet the altitude and speed constraints at NYGEL is within aircraft capability. The restrictions placed at MALNR and at NYGEL are based on consultation with industry and are designed to provide the greatest latitude to make the procedure as efficient as possible for both north and south operations at Raleigh-Durham Intl.

Aircraft flight profiles were analyzed using TARGETS Flight Evaluator scenario sets with 60 kt. tailwind, 60 kt. headwind and no wind conditions. Flight Evaluator projects these wind conditions onto the profile regardless of the aircraft track. All four types of turbojet aircraft in the Flight Evaluator profiles complied with all of the procedure design restraints except for the low performing large jet in the tailwind scenario (see attached). In the case of the low performing large jet’s failure with a tailwind, it crossed MALNR more than 1000 feet higher than the minimum altitude, and descended at a lower rate than the criteria standard of 330 ft. per mile. Had it crossed MALNR at 11000, it would have been within the design’s constraints.

Industry representatives at the design meeting stated that their simulations of the procedure using next generation aircraft simulators confirm that the restrictions on the procedure are within aircraft capabilities.

Additionally, the chart note: “Jet aircraft descend via Mach number until 280K, maintain 280K until slowed by the STAR or ATC, if unable, advise ATC.” will be added to the procedure to increase safety further.

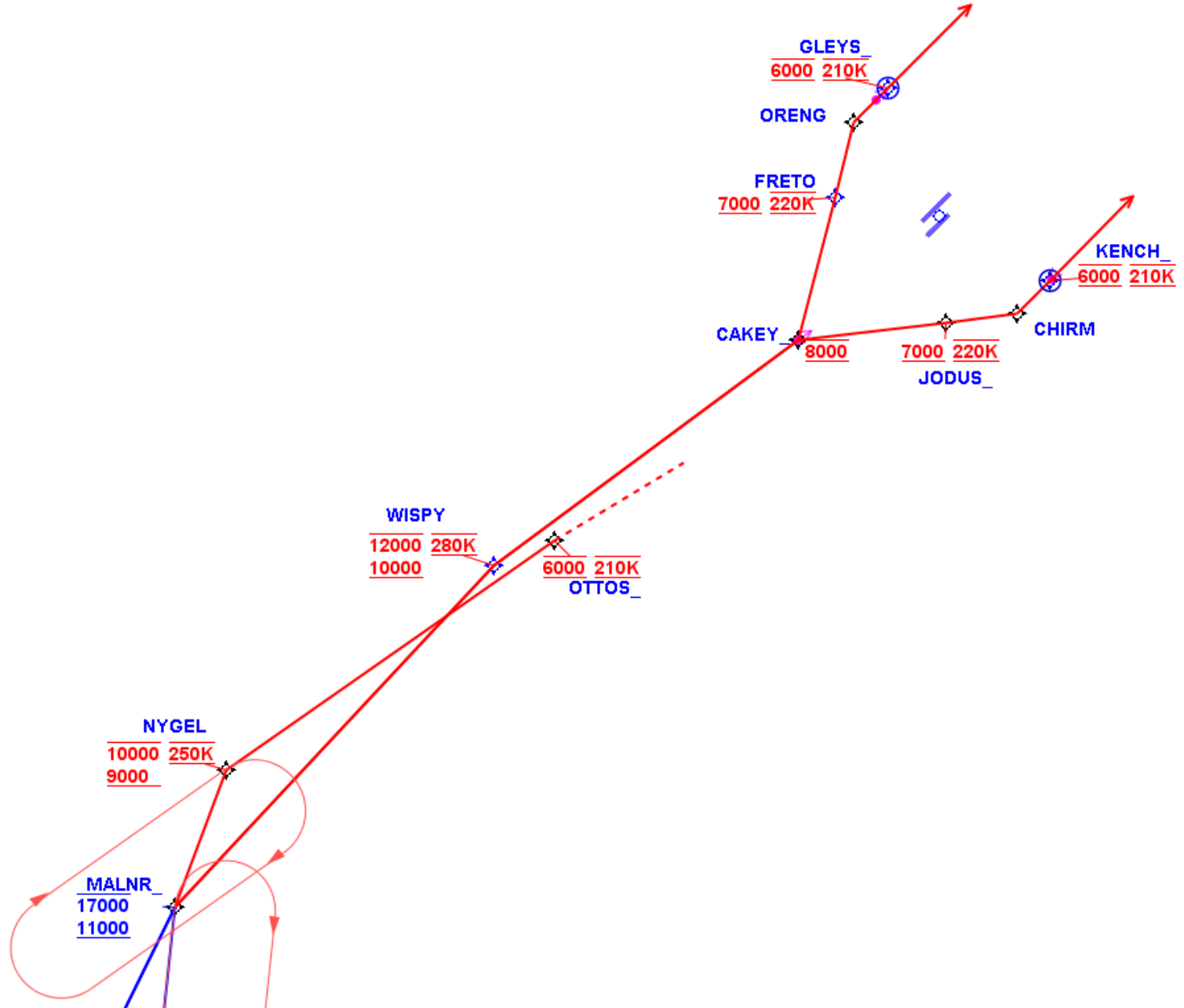
Request Flight Standards authorization to publish the KRDU MALNR Arrival (RNAV) with the location of MALNR and NYGEL points and their associated restrictions as designed per the AFS memorandum cited above.



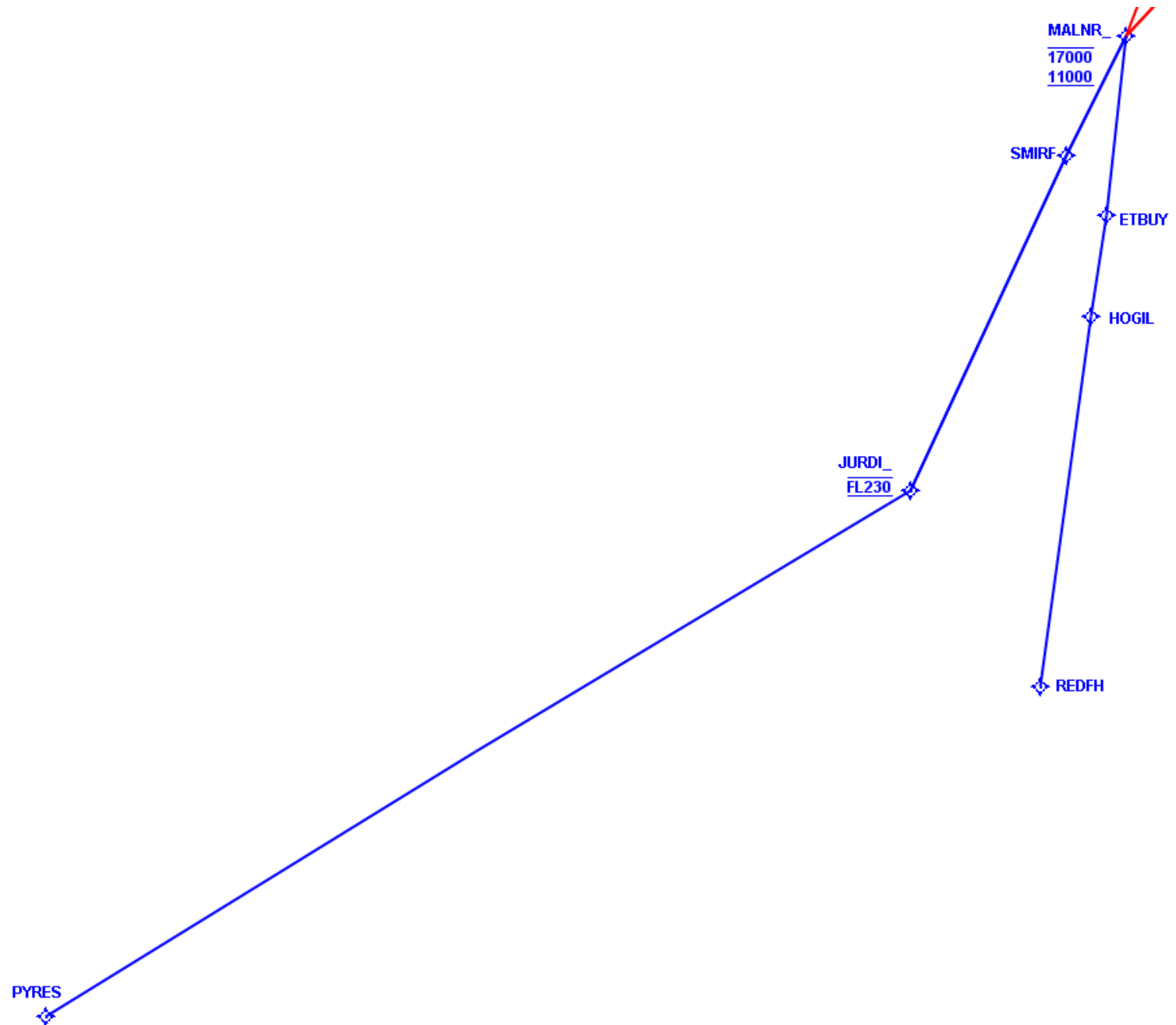
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Bryan Lehman  
Manager, Airspace and Procedures  
Washington District

# KRDU MALNR ARRIVAL (RNAV) RUNWAY TRANSITIONS



**KRDU MALNR ARRIVAL (RNAV)  
ENROUTE TRANSITIONS**





# FLIGHT EVALUATOR RESULTS

## 60 Kt. Headwind Scenario

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 s...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	6 min 17 sec	26.3 °	-15....	15,949	-7,041	203.0	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.57	2 min 32 sec	23.4 °	-2.9 °	12,088	-3,861	308.4	280
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.10	1 min 29 sec	39.6 °	16.1 °	10,038	-2,050	332.6	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.98	4 min 55 sec	55.6 °	16.0 °	5,986	-4,052	238.4	210

### LOW PERFORMING LARGE JET

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 47 s...	41.9 °	-17....	22,990	-5,010	51.8	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	6 min 17 sec	26.3 °	-15....	15,949	-7,041	203.0	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	2 min 32 sec	23.4 °	-2.9 °	11,962	-3,988	318.5	280
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.09	1 min 29 sec	39.6 °	16.2 °	10,030	-1,932	313.4	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.99	4 min 55 sec	55.6 °	16.0 °	5,996	-4,033	237.3	210

### LARGE JET

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	299
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.67	15 min 33 s...	41.4 °	-17....	23,024	-4,976	51.5	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.63	6 min 12 sec	26.3 °	-15....	15,941	-7,083	204.2	299
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.48	2 min 30 sec	23.4 °	-2.9 °	11,980	-3,961	316.4	277
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.12	1 min 30 sec	39.7 °	16.3 °	10,036	-1,944	315.4	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.98	4 min 55 sec	55.6 °	15.8 °	5,991	-4,045	237.9	210

### HEAVY JET

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	245
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.73	19 min 25 s...	41.2 °	-17....	23,003	-4,997	51.7	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.61	7 min 48 sec	26.4 °	-14....	15,934	-7,069	203.8	245
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.47	3 min 7 sec	23.4 °	-3.0 °	11,965	-3,969	317.0	245
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.13	1 min 35 sec	38.6 °	15.3 °	10,027	-1,938	314.4	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.97	4 min 52 sec	55.6 °	16.9 °	5,997	-4,030	237.0	210

### SMALL JET

# FLIGHT EVALUATOR RESULTS

## No Wind Scenario

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	26,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.71	13 min 47 s...	41.2 °	-17....	22,985	-3,015	31.2	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.50	5 min 24 sec	26.3 °	-14....	13,744	-9,241	266.5	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.52	2 min 10 sec	23.8 °	-2.5 °	11,027	-2,718	217.1	276
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.16	1 min 13 sec	39.1 °	15.3 °	10,017	-1,009	163.7	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.95	3 min 46 sec	55.6 °	16.5 °	6,003	-4,014	236.1	210

### LOW PERFORMING LARGE JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	295
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.66	13 min 34 s...	42.0 °	-17....	22,999	-5,001	51.7	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.57	5 min 19 sec	26.3 °	-15....	15,958	-7,041	203.0	295
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.55	2 min 7 sec	23.4 °	-2.9 °	11,985	-3,972	317.3	276
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.12	1 min 12 sec	40.0 °	16.5 °	10,046	-1,939	314.6	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.95	3 min 46 sec	55.6 °	15.6 °	5,998	-4,048	238.1	210

### LARGE JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	299
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.66	13 min 24 s...	41.4 °	-17....	22,993	-5,007	51.8	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.58	5 min 15 sec	26.3 °	-15....	15,950	-7,043	203.1	299
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.52	2 min 6 sec	23.4 °	-2.9 °	11,978	-3,972	317.3	275
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.11	1 min 12 sec	39.0 °	15.6 °	10,042	-1,936	314.1	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.95	3 min 46 sec	55.6 °	16.6 °	5,990	-4,051	238.3	210

### HEAVY JET

S e g #	Termination Fix	Type	A l t	S p d	T u r n	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	28,000	0	--	245
2	JURDI	TF	✓	✓	✓	23,000	-	-	96.71	96.68	16 min 10 s...	41.3 °	-17....	22,991	-5,009	51.8	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.62	6 min 22 sec	26.4 °	-14....	15,946	-7,045	203.2	245
4	MALNR	TF	✓	✓	✓	11,000	17,000	-	12.52	12.50	2 min 30 sec	23.4 °	-3.0 °	11,967	-3,979	317.8	245
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.16	1 min 16 sec	39.5 °	16.1 °	10,015	-1,952	316.6	250
6	OTTOS	TF	✓	✓	✓	6,000	-	210	17.00	16.91	3 min 44 sec	55.6 °	16.0 °	6,003	-4,012	236.0	210

### SMALL JET

# FLIGHT EVALUATOR RESULTS

## 60 Kt. Tailwind Scenario

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 s...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 38 sec	26.2 °	-15....	14,937	-8,059	232.4	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.50	1 min 49 sec	23.4 °	-2.8 °	12,192	-2,744	219.2	276
5	NYGEL	TF	X	✓	✓	9,000	10,000	250	6.17	6.08	59 sec	39.3 °	15.9 °	10,798	-1,394	226.2	251
6	OTTOS	TF	X	✓	✓	6,000	-	210	17.00	16.97	3 min 2 sec	55.6 °	16.3 °	6,712	-4,086	240.4	217

### LOW PERFORMING LARGE JET

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	295
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.74	11 min 45 s...	41.3 °	-17....	22,996	-7,004	72.4	295
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 36 sec	26.2 °	-15....	15,947	-7,048	203.2	295
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.56	1 min 49 sec	23.4 °	-2.8 °	12,073	-3,875	309.5	275
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.04	59 sec	39.4 °	16.0 °	10,224	-1,848	299.8	251
6	OTTOS_	TF	✓	✓	✓	6,000	-	210	17.00	16.91	3 min 3 sec	55.6 °	16.2 °	6,026	-4,198	247.0	216

### LARGE JET

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	299
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.71	11 min 37 s...	41.5 °	-17....	23,011	-6,989	72.3	299
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.51	4 min 40 sec	26.3 °	-15....	12,256	-10,755	310.1	299
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.54	1 min 52 sec	23.3 °	-2.9 °	10,985	-1,271	101.5	275
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.09	1 min 0 sec	38.6 °	15.3 °	10,035	-950	154.1	250
6	OTTOS_	TF	✓	✓	✓	6,000	-	210	17.00	16.99	3 min 4 sec	55.6 °	16.9 °	6,005	-4,030	237.1	216

### HEAVY JET

Seq #	Termination Fix	Type	Alt	Spd	Turn	Alt Restriction1 (ft MSL)	Alt Restriction2 (ft MSL)	Speed Restriction (KIAS)	Segment Length (nm)	Flight Path Length (nm)	Time to Fly	End Course	ΔCrs	End Alt (ft MSL)	ΔAlt (ft)	Descent Gradient (ft/nm)	End Speed (KIAS)
1	PYRES	IF	-	-	-	-	-	-	0.00	0.00	0 sec	58.9 °	0.0 °	30,000	0	--	245
2	JURDI_	TF	✓	✓	✓	23,000	-	-	96.71	96.69	13 min 40 s...	41.4 °	-17....	22,993	-7,007	72.5	245
3	SMIRF	TF	✓	✓	✓	-	-	-	34.68	34.56	5 min 22 sec	26.0 °	-15....	15,953	-7,041	203.0	245
4	MALNR_	TF	✓	✓	✓	11,000	17,000	-	12.52	12.60	2 min 6 sec	23.4 °	-2.5 °	11,970	-3,982	318.1	245
5	NYGEL	TF	✓	✓	✓	9,000	10,000	250	6.17	6.06	1 min 2 sec	39.3 °	15.9 °	10,041	-1,929	312.9	250
6	OTTOS_	TF	✓	✓	✓	6,000	-	210	17.00	16.96	3 min 3 sec	55.6 °	16.2 °	5,994	-4,047	238.1	218

### SMALL JET



# FAA

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## Memorandum

Date:

To: Gary Powell, Director, Aeronautical Information Services, AJV-5

From: Manager, Flight Technologies and Procedures Division, AFS-400

Prepared by: Flight Procedures & Airspace Group, AFS-420

Subject: Waiver to FAA Order 8260.3, U.S. Standard for Terminal Instrument

Procedures (TERPS) Standard Terminal Arrival Routes (STAR)

Danny E Hamilton  
Signed By: Danny E Hamilton Mon  
Sep 24 2018 16:07:46 GMT-  
05:00:00 (Central Standard Time)

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This memorandum authorizes waivers to the FAA Order 8230.3D, paragraph 2-2-7f(2) requirement to establish an altitude restriction at the STAR termination fix and the paragraph 2-2-10 requirements for minimum deceleration distance/reduced descent gradient requirements prior to a fix with a speed restriction. STARs not meeting these requirements may be authorized with Flight Standards approval.

This waiver remains in effect until rescinded or incorporated into the next Change to FAA Order 8260.3, whichever occurs first. No additional waiver request action is required; however, an approval request must be submitted and approved.

If you have any questions, please contact Mr. Thomas J. Nichols, Manager, Flight Procedure Standards Branch, AFS-420, at (405) 954-4164.