



INTERNATIONAL CIVIL AVIATION ORGANIZATION

A United Nations Specialized Agency

PBN Airspace Design Workshop

CASE STUDY 02 – UJUNG PANDANG

**Asia and Pacific Regional Sub-Office
Beijing, China**

Introduction

- ❖ This module provides basic information on the Ujung Pandang TMA.
- ❖ This overview, which will provide a basis for understanding the present TMA operations
 - will be the starting point for an air space design conceptualisation,
 - followed by designing appropriate PBN SIDs and STARs for one or both runway ends.



PBN Implementation Process

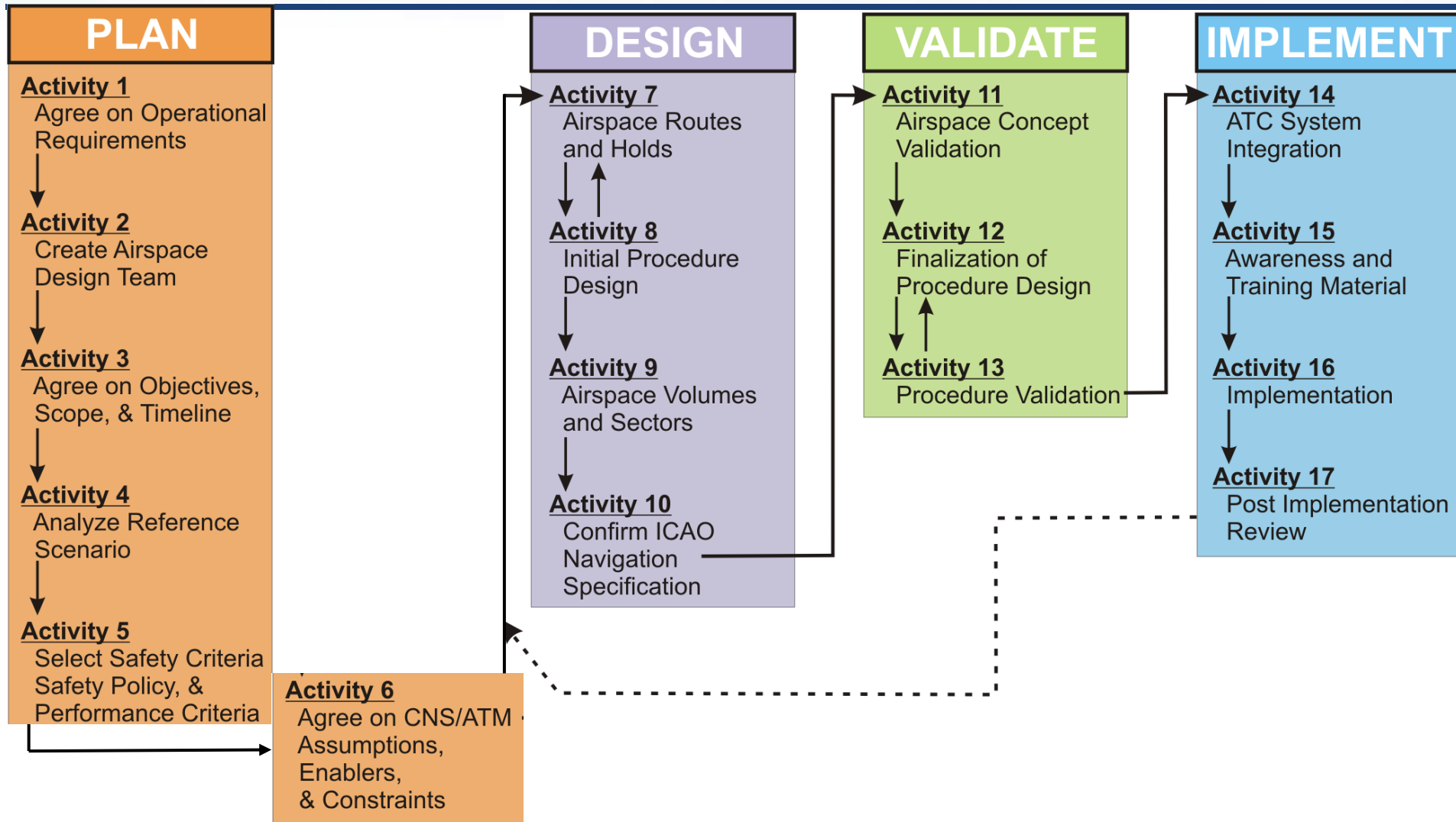
PLAN

DESIGN

VALIDATE

IMPLEMENT

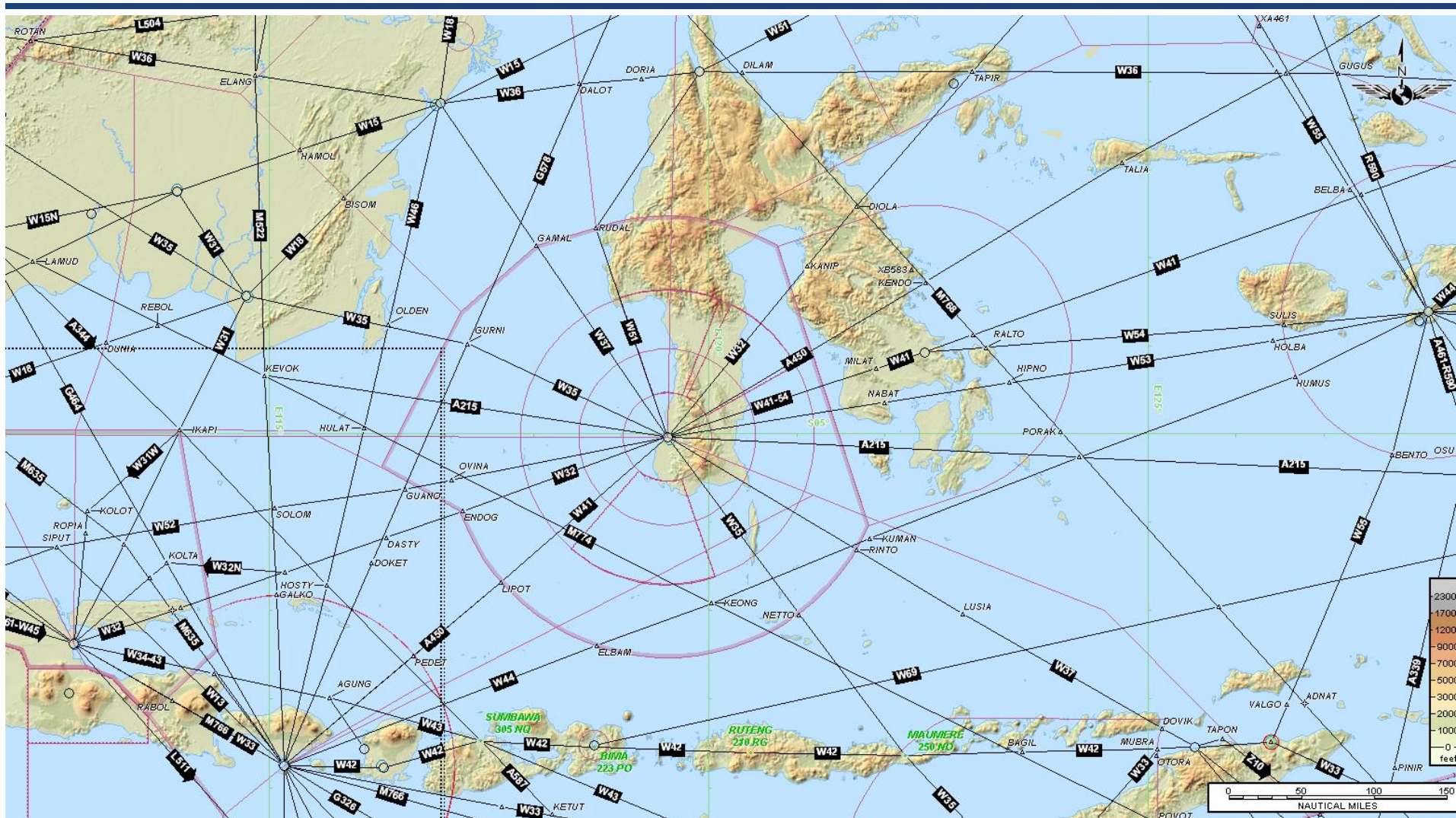
Implementation Activity Overview



Ujung Pandang FIR (WAAF)



Ujung Pandang FIR (WAAF)



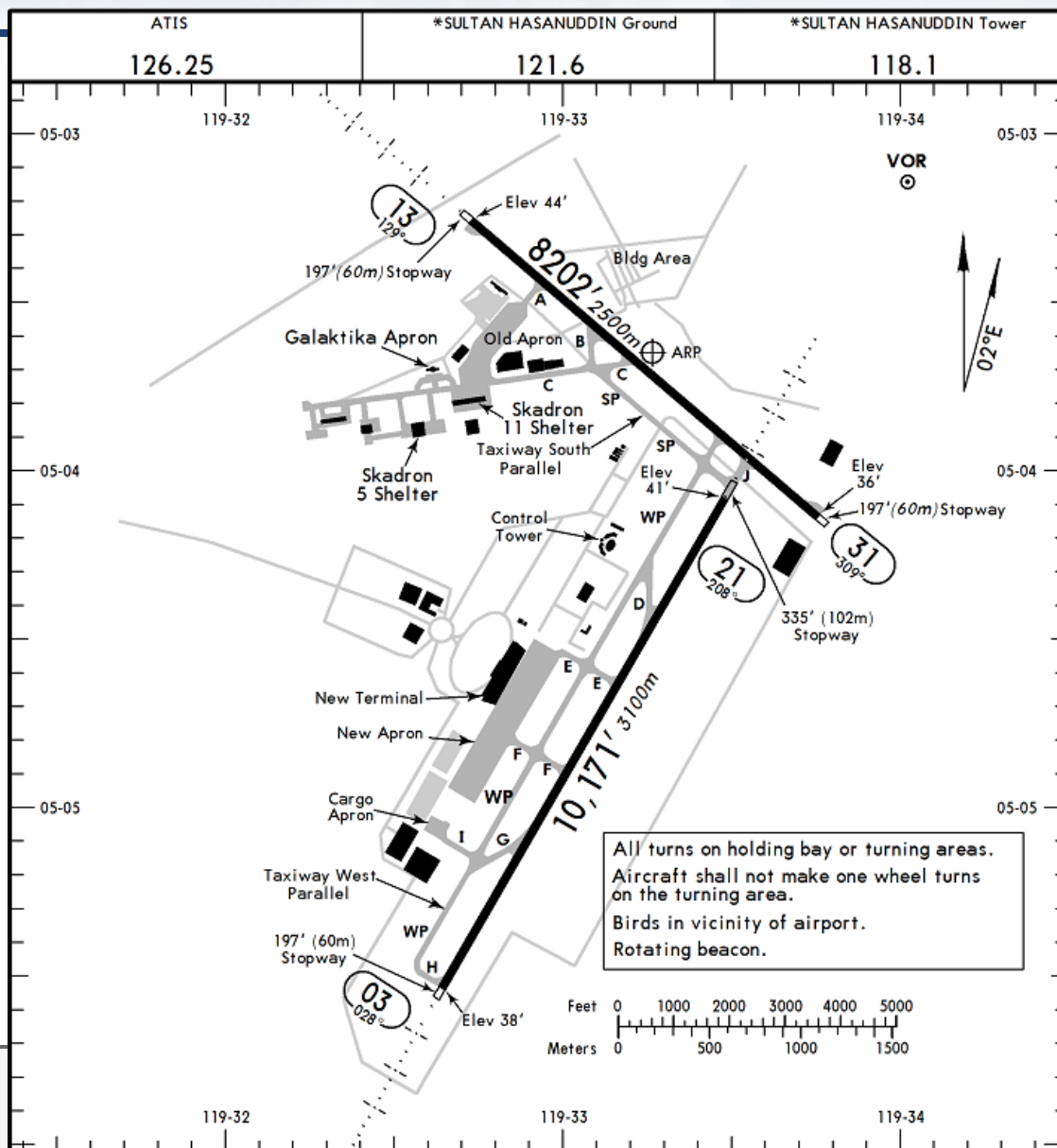




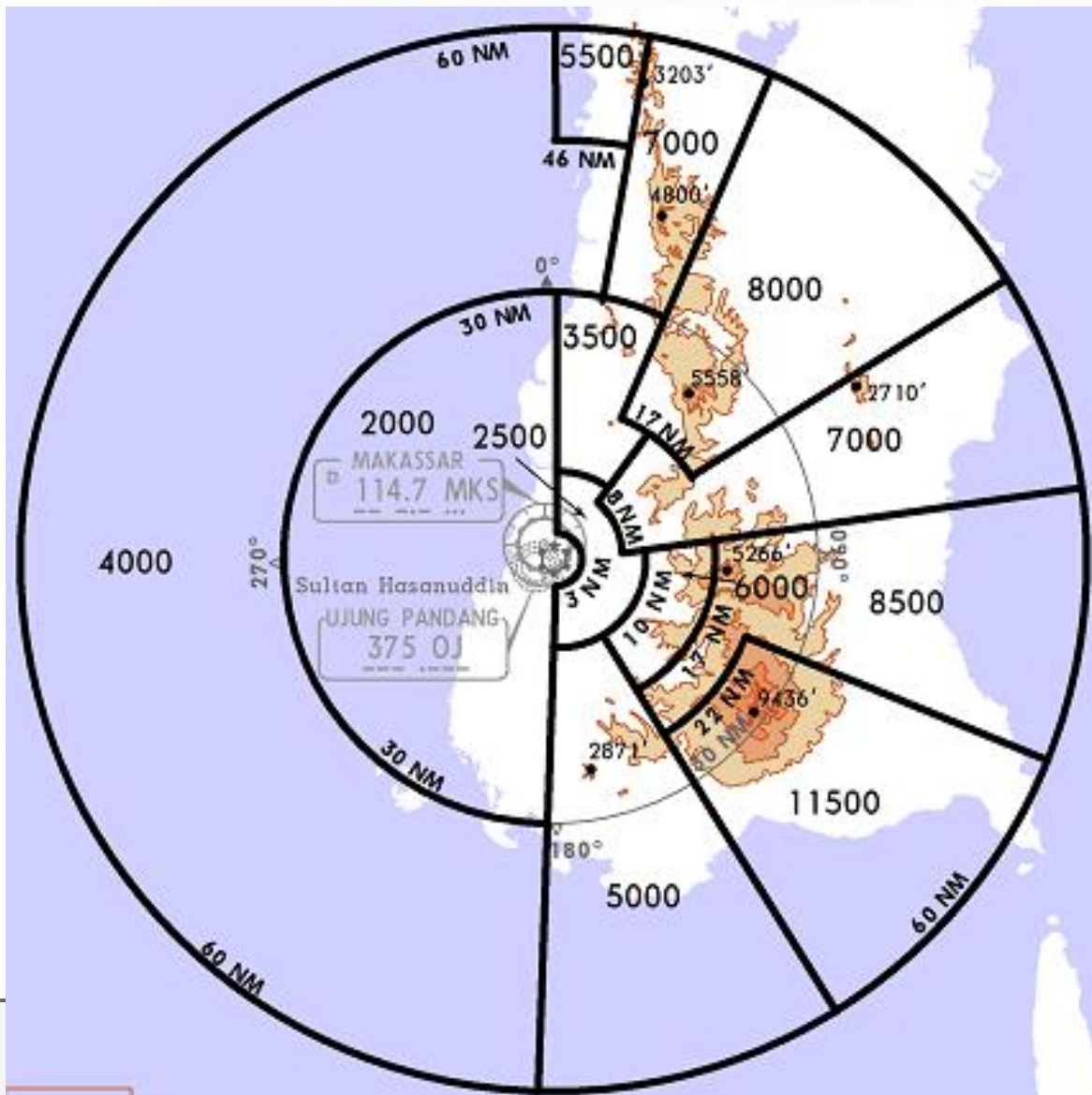
WAAA Aerodrome Information

**MAKASSAR, INDONESIA
SULTAN HASANUDDIN
WAAA/UPG**

Airport Elevation 47 ft

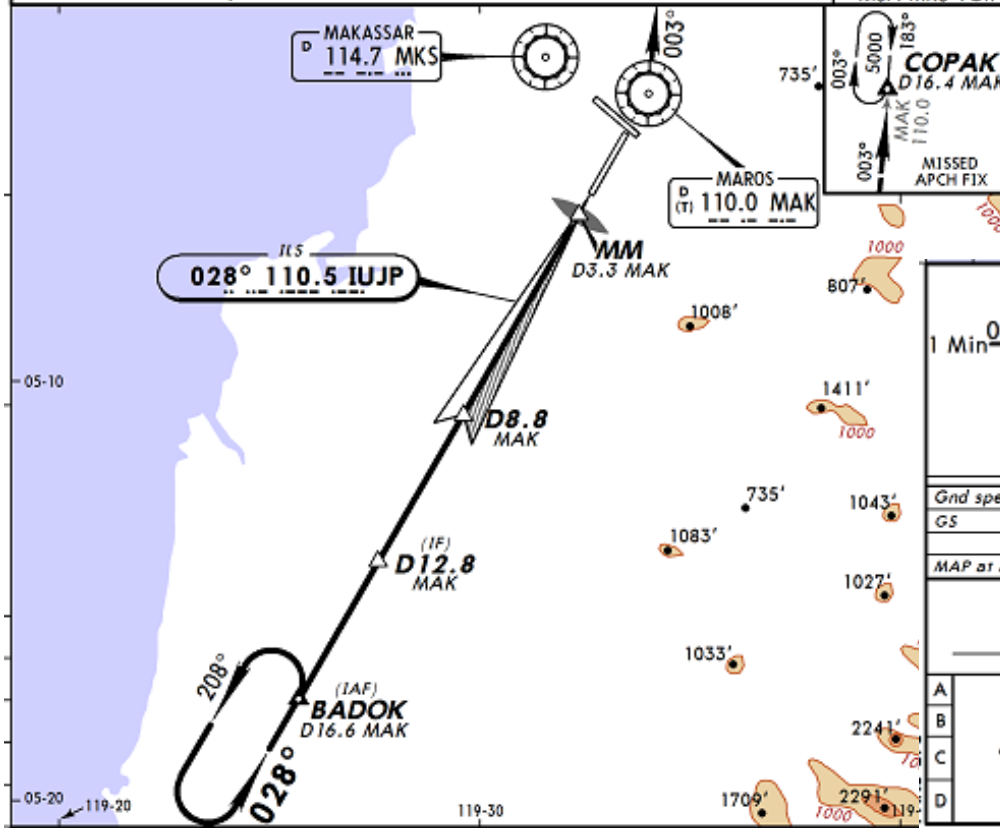


WAAA MVA Chart



WAAA IFP - ILS RWY 03

ATIS 126.25		*MAKASSAR Director (R) 120.6 119.4		*SULTAN HASANUDDIN Tower 118.1	*Ground 121.6
LOC IUJP 110.5	Final Apch Crs 028°	GS D8.8 MAK 2000' (1962')	ILS DA(H) 270' (232')	Apt Elev 47' Rwy 03 38'	
MISSED APCH: Climb STRAIGHT AHEAD to 5000', after MAK VOR join R-003 outbound to COPAK, or as instructed by ATC.					
Alt Set: hPa	Rwy Elev: 1 hPa	Trans level: FL 130	Trans alt: 11000'		

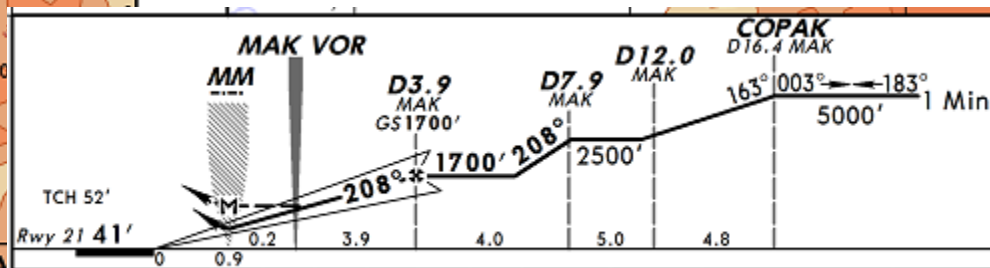
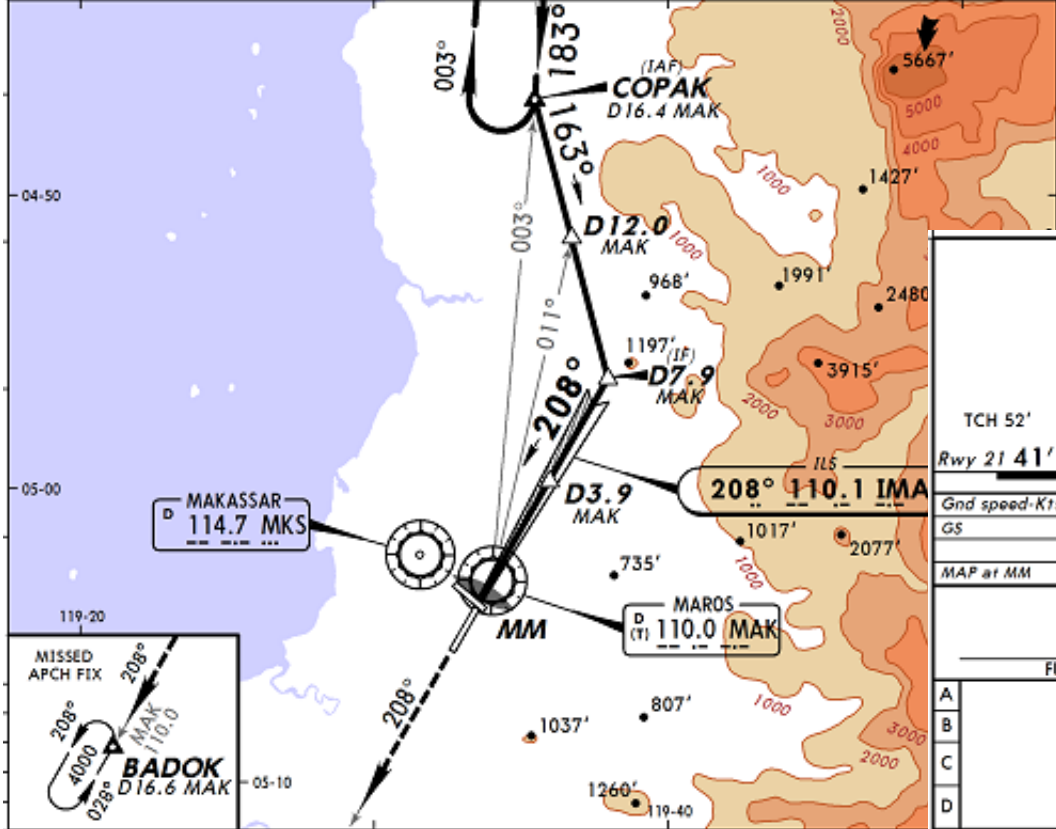


BADOK D16.6 MAK D12.8 MAK D8.8 MAK GS 2000'		MM D3.3 MAK		TCH 52'						
1 Min	4000'	2800'	2000'	0.6 Rwy 03 38'						
Gnd speed-Kts		70	90	100	120	140	160	PAPI HIALS 5000'	MAK 110.0	MAK 110.0 R-003
GS		3.00°	372	478	531	637	743			
MAP at MM		STRAIGHT-IN LANDING RWY 03		CIRCLE-TO-LAND						
ILS DA(H) 270' (232')		LOC (GS out) MDA(H) 500' (462')								
FULL		HIALS out		HIALS out		Max Kts		MDA(H)		
A						100		1300' (1253') - 1600m		
B				1600m		135		1450' (1403') - 2400m		
C		800m		1200m		180		1450' (1403') - 3800m		
D				2800m		205				



WAAA IFP - ILS RWY 21

ATIS 126.25		*MAKASSAR Director (R) 120.6 119.4		*SULTAN HASANUDDIN Tower 118.1	*Ground 121.6
LOC IMAK 110.1	Final Apch Crs 208°	GS D3.9 MAK 1700' (1659')	ILS DA(H) 380' (339')	Apt Elev 47' Rwy 21 41'	
<p>MISSED APCH: Climb to 5000' outbound on R-208 MAK VOR, proceed to BADOK or as instructed by ATC.</p> <p>Alt Set: hPa Rwy Elev: 2 hPa Trans level: FL 130 Trans alt: 11000'</p> <p>1. ILS Rwy 21 identification "IMAK" on frequency 110.1 classification restricted due to terrain (hill) at final approach.</p>					



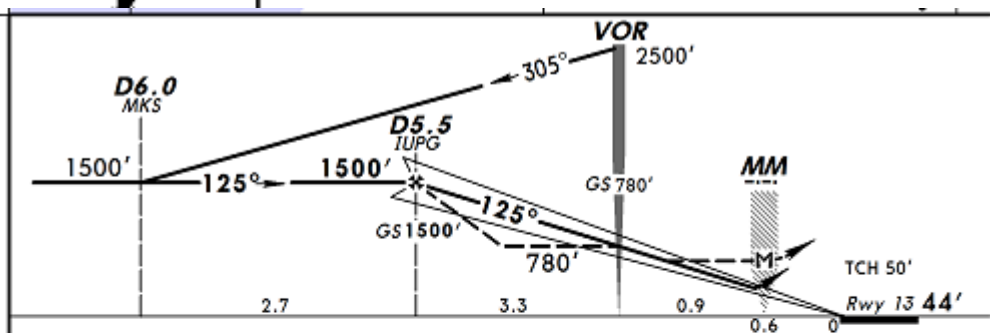
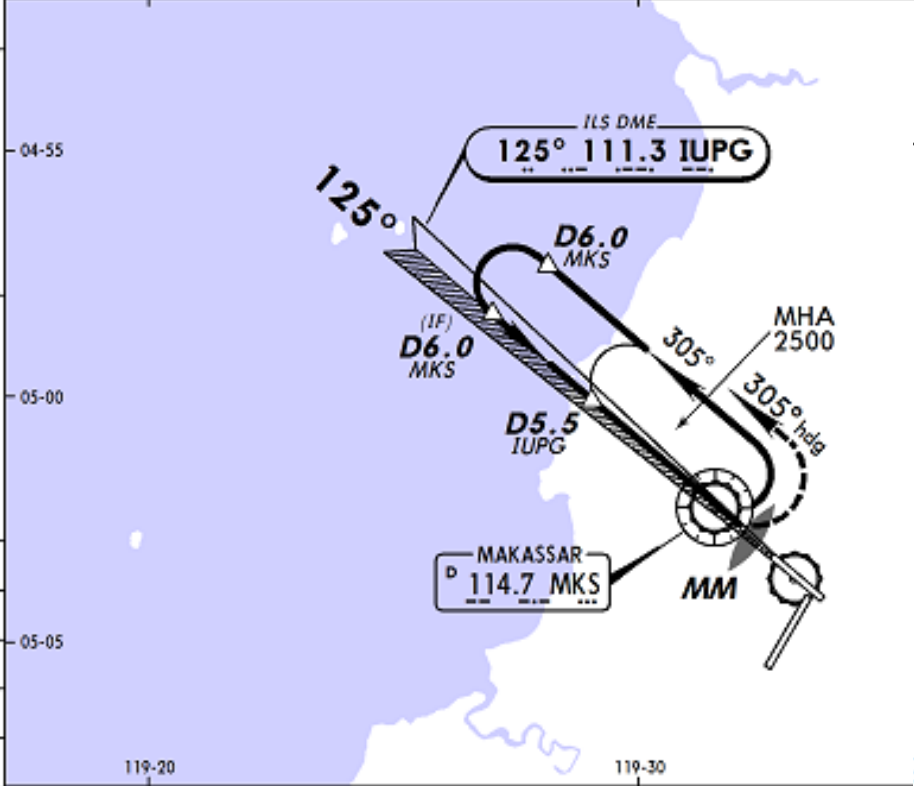
Gnd speed-Kts	70	90	100	120	140	160	PAPI HIALS	5000' MAK on 110.0 R-208	BADOK
GS	3.00°	372	478	531	637	743			
MAP at MM									

STRAIGHT-IN LANDING RWY 21				CIRCLE-TO-LAND	
A	FULL	HIALS out	LOC (GS out)		Max Kts
			DA(H) 380' (339')	MDA(H) 500' (459')	
B				1600m	130' (1253')-1600m
C		1200m		2000m	145' (1403')-2400m
D				2800m	145' (1403')-3800m



WAAA IFP - ILS RWY 13

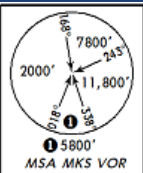
ATIS 126.25		*MAKASSAR Director (R) 120.6 119.4		*SULTAN HASANUDDIN Tower 118.1	*Ground 121.6
LOC IUPG 111.3	Final Apch Crs 125°	GS D5.5 IUPG 1500' (1456')	ILS DA(H) 344' (300')	Apt Elev 47' Rwy 13 44'	
MISSED APCH: Immediate LEFT climbing turn to 2500' on 305° heading and contact ATC .					
Alt Set: hPa	Rwy Elev: 2 hPa	Trans level: FL 130	Trans alt: 11000'		



Gnd speed-Kts	70	90	100	120	140	160	PAPI HEALS REIL	2500' 305° LT on hdg
GS	2.90°	3.59	4.62	5.13	6.16	8.21		
MAP at MM or D5.5 IUPG to MAP	4.2	3:36	2:48	2:31	2:06	1:48		

STRAIGHT-IN LANDING RWY 13				CIRCLE-TO-LAND	
ILS DA(H) 344' (300')		LOC (GS out) MDA(H) 645' (601')		Max Kts	MDA(H)
FULL	HTALS out	HTALS out	HTALS out		
A			800m	1600m	100 1250' (1203')-2000m
B					135 1250' (1203')-2400m
C	900m	1500m	2000m	2800m	180 1250' (1203')-4800m
D			2400m	3200m	205 1450' (1403')-4800m

WAAA IFP - STAR RWY 21



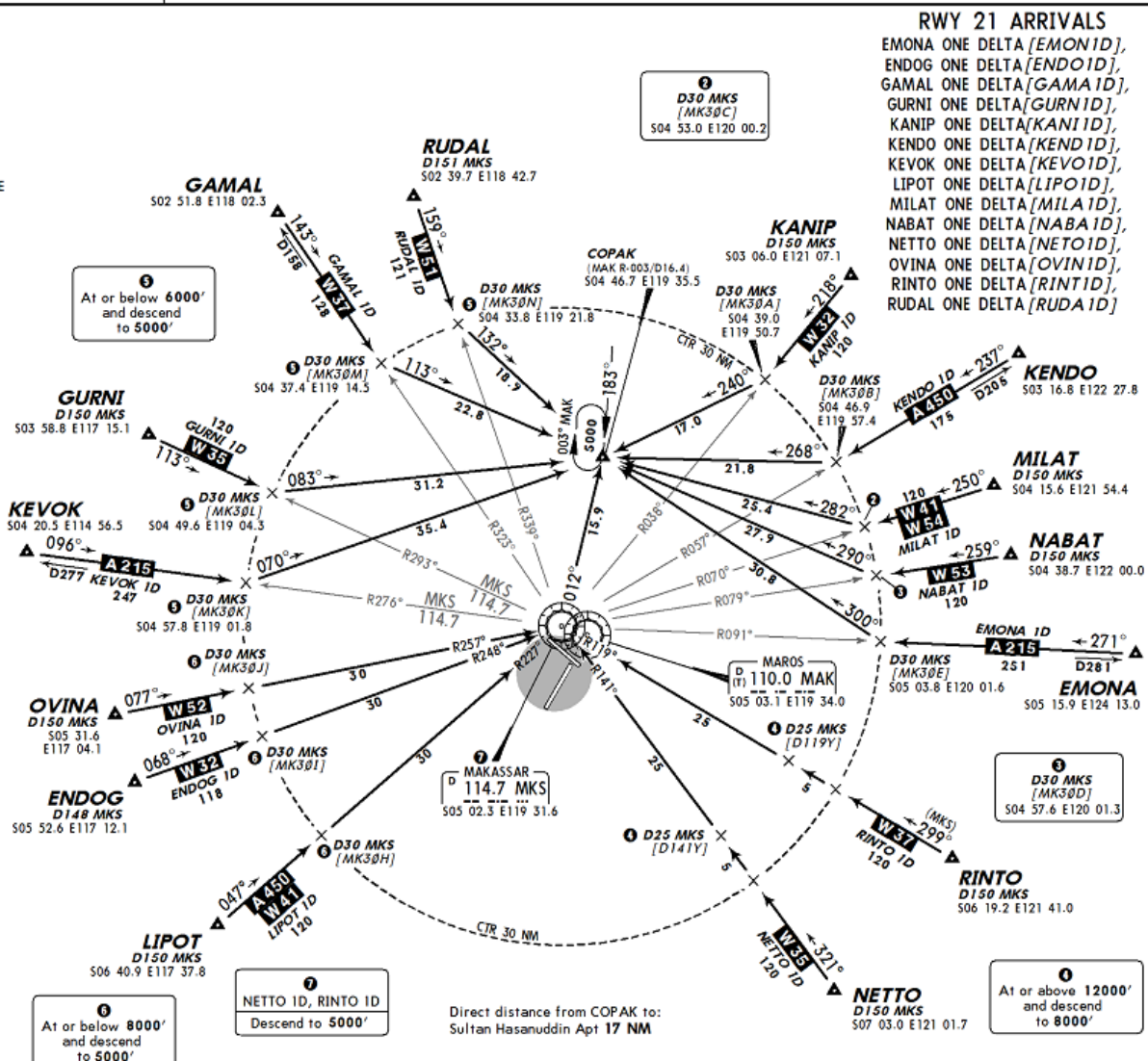
ATIS
126.25

Apt Elev
47'

Alt Set: hPa Trans level: FL 130 Trans alt: 11000'



STAR	ROUTING
EMONA ONE DELTA	From EMONA to MKS, at D30 MKS turn RIGHT track 300°, MAINTAIN 8000' to COPAK.
ENDOG ONE DELTA	From ENDOG to MKS, at D30 MKS descend to 5000' to overhead MKS, join MKS R-012 to COPAK.
GAMAL ONE DELTA	From GAMAL to MKS, at D30 MKS turn LEFT track 113°, descend to 5000' to COPAK.
GURNI ONE DELTA	From GURNI to MKS, at D30 MKS turn LEFT track 083°, descend to 5000' to COPAK.
KANIP ONE DELTA	From KANIP to MKS, at D30 MKS turn RIGHT track 240°, MAINTAIN 8000' to COPAK.
KENDO ONE DELTA	From KENDO to MKS, at D30 MKS turn RIGHT track 268°, MAINTAIN 8000' to COPAK.
KEVOK ONE DELTA	From KEVOK to MKS, at D30 MKS turn LEFT track 070°, descend to 5000' to COPAK.
LIPOT ONE DELTA	From LIPOT to MKS, at D30 MKS descend to 5000' to overhead MKS, join MKS R-012 to COPAK.
MILAT ONE DELTA	From MILAT to MKS, at D30 MKS turn RIGHT track 282°, MAINTAIN 8000' to COPAK.
NABAT ONE DELTA	From NABAT to MKS, at D30 MKS turn RIGHT track 290°, MAINTAIN 8000' to COPAK.
NETTO ONE DELTA	From NETTO to MKS MAINTAIN 12000' or above until D25 MKS. Then descend to 8000' to overhead MKS, join MKS R-012, descend to 5000' to COPAK.
OVINA ONE DELTA	From OVINA to MKS, at D30 MKS descend to 5000' to overhead MKS, join MKS R-012 to COPAK.
RINTO ONE DELTA	From RINTO to MKS MAINTAIN 12000' or above until D25 MKS. Then descend to 8000' to overhead MKS, join MKS R-012, descend to 5000' to COPAK.
RUDAL ONE DELTA	From RUDAL to MKS, at D30 MKS turn LEFT track 132°, descend to 5000' to COPAK.

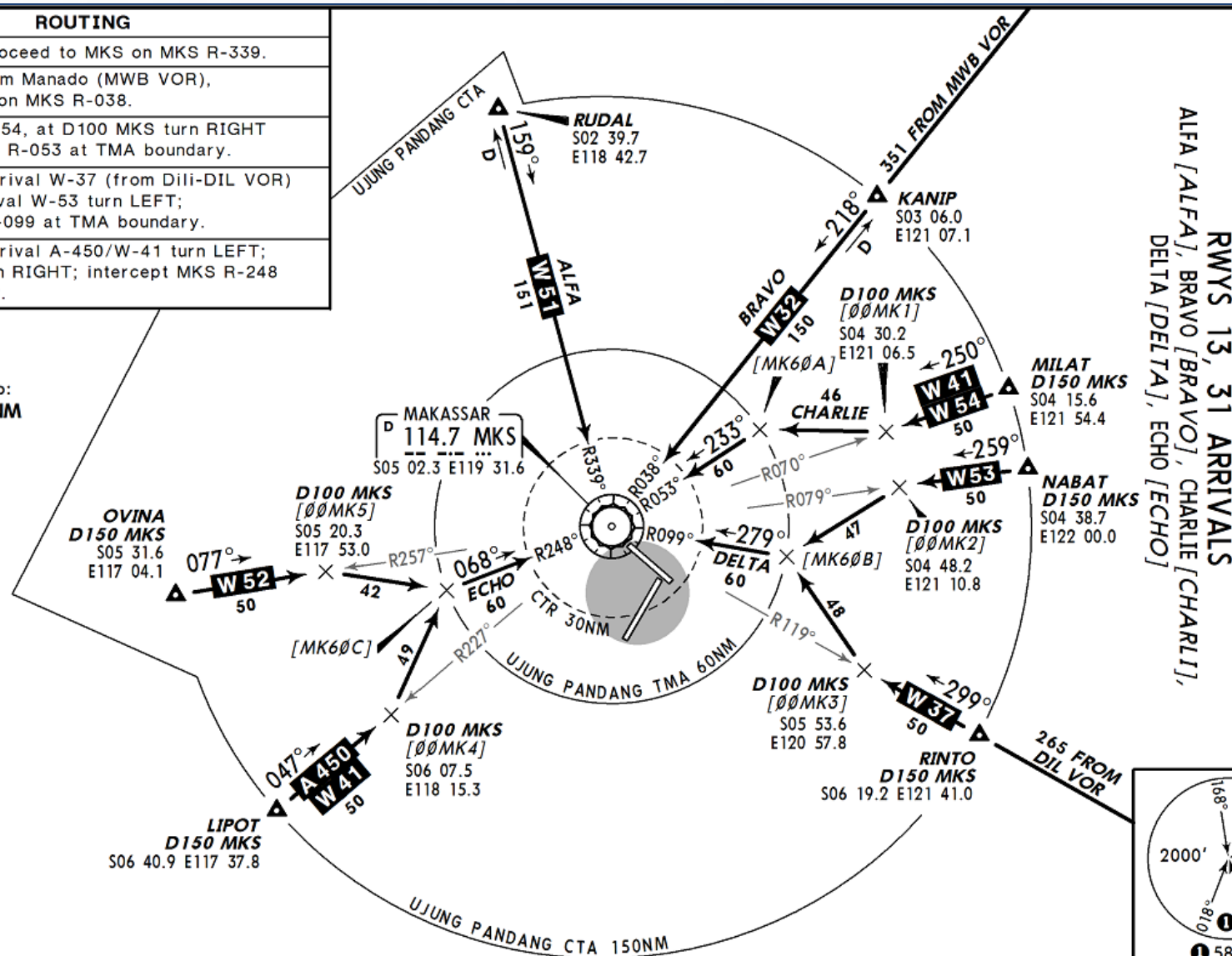


RWY 21 ARRIVALS
 EMONA ONE DELTA [EMONID],
 ENDOG ONE DELTA [ENDOID],
 GAMAL ONE DELTA [GAMALID],
 GURNI ONE DELTA [GURNID],
 KANIP ONE DELTA [KANIPID],
 KENDO ONE DELTA [KENDID],
 KEVOK ONE DELTA [KEVOID],
 LIPOT ONE DELTA [LIPOID],
 MILAT ONE DELTA [MILALID],
 NABAT ONE DELTA [NABALID],
 NETTO ONE DELTA [NETOID],
 OVINA ONE DELTA [OVINID],
 RINTO ONE DELTA [RINTID],
 RUDAL ONE DELTA [RUDALID]

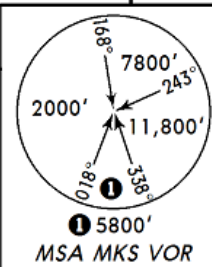
WAAA IFP - STAR RWY 13/31

STAR	ROUTING
ALFA	Arrival W-51, proceed to MKS on MKS R-339.
BRAVO	Arrival W-32 from Manado (MWB VOR), proceed to MKS on MKS R-038.
CHARLIE	Arrival W-41/W-54, at D100 MKS turn RIGHT to intercept MKS R-053 at TMA boundary.
DELTA	At D100 MKS, arrival W-37 (from Dili-DIL VOR) turn RIGHT; arrival W-53 turn LEFT; intercept MKS R-099 at TMA boundary.
ECHO	At D100 MKS, arrival A-450/W-41 turn LEFT; arrival W-52 turn RIGHT; intercept MKS R-248 at TMA boundary.

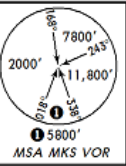
Direct distance from MKS to:
Sultan Hasanuddin Apt 2 NM



ATIS	126.25
Apt Elev	47'
Alt Set: hpa	
Trans level: FL 130	
Trans alt: 11000'	

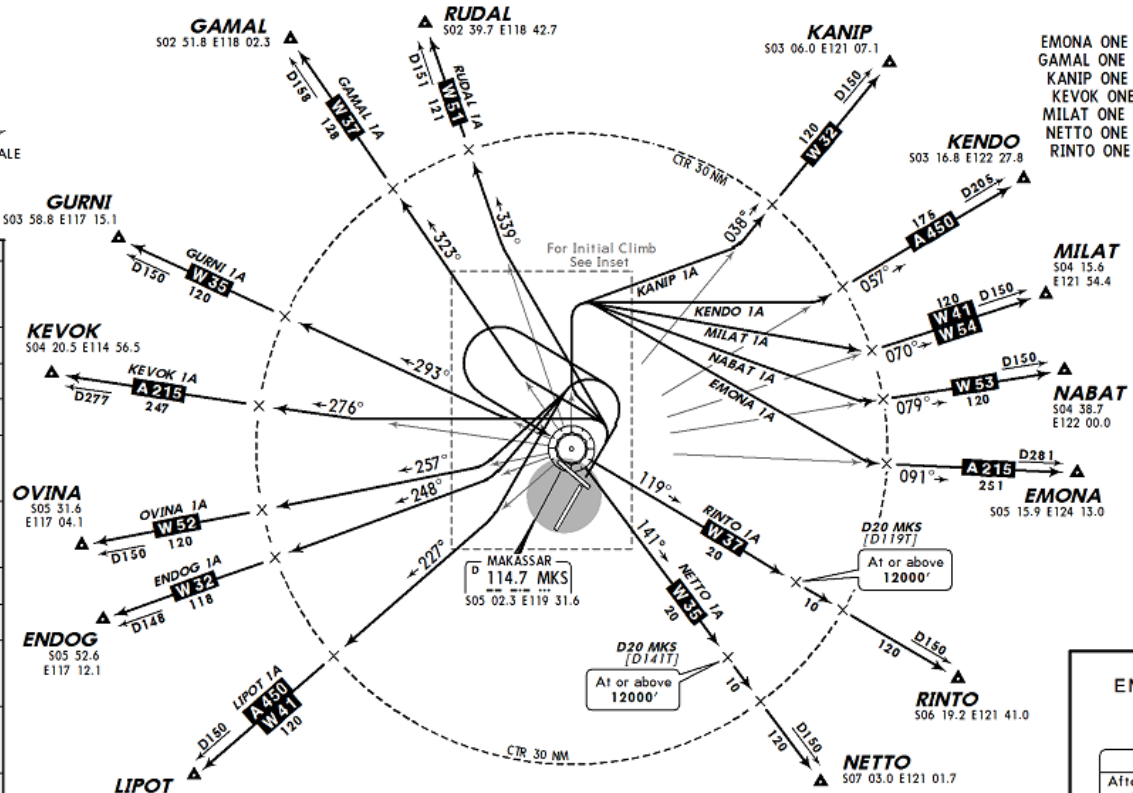


WAAA IFP - SID RWY 03



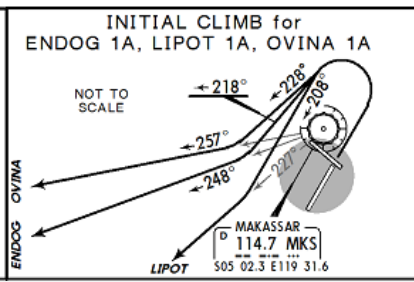
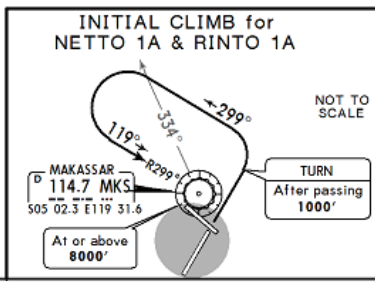
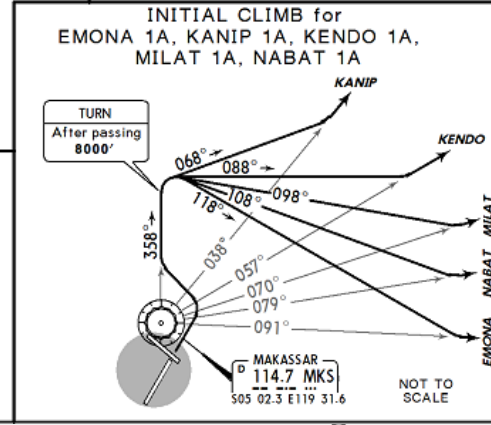
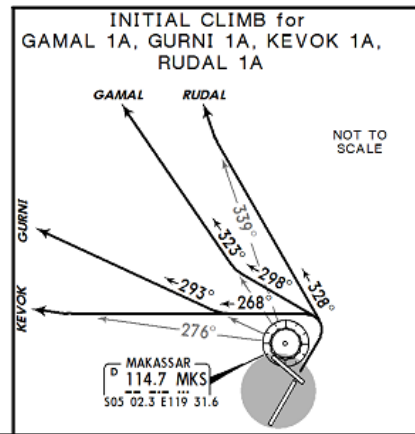
Apt Elev
47'

Trans level: FL 130 Trans alt: 11000'



RWY 03 DEPARTURES
 EMONA ONE ALPHA [EMONIA], ENDOG ONE ALPHA [ENDO1A], GAMAL ONE ALPHA [GAMA1A], GURNI ONE ALPHA [GURNIA], KANIP ONE ALPHA [KAN1IA], KENDO ONE ALPHA [KEND1A], KEVOK ONE ALPHA [KEVO1A], LIPOT ONE ALPHA [LIPO1A], MILAT ONE ALPHA [MILA1A], NABAT ONE ALPHA [NABA1A], NETTO ONE ALPHA [NETO1A], OVINA ONE ALPHA [OVIN1A], RINTO ONE ALPHA [RINT1A], RUDAL ONE ALPHA [RUDA1A]

SID	INITIAL CLIMB
EMONA ONE ALPHA	Immediately turn LEFT, intercept MKS R-358. After passing 8000' turn RIGHT to proceed on track 118° and join A-215.
ENDOG ONE ALPHA	Immediately turn LEFT, track 218° and join W-32.
GAMAL ONE ALPHA	Immediately turn LEFT, track 298° and join W-37.
GURNI ONE ALPHA	Immediately turn LEFT, track 268° and join W-35.
KANIP ONE ALPHA	Immediately turn LEFT, intercept MKS R-358. After passing 8000' turn RIGHT, track 068° and join W-32.
KENDO ONE ALPHA	Immediately turn LEFT, intercept MKS R-358. After passing 8000' turn RIGHT, track 088° and join A-450.
KEVOK ONE ALPHA	Immediately turn LEFT, track 268° and join A-215.
LIPOT ONE ALPHA	Immediately turn LEFT, track 208° and join W-41/A-450.
MILAT ONE ALPHA	Immediately turn LEFT, intercept MKS R-358. After passing 8000' turn RIGHT, track 098° and join W-41/W-54.
NABAT ONE ALPHA	Immediately turn LEFT, intercept MKS R-358. After passing 8000' turn RIGHT, track 108° and join W-53.
NETTO ONE ALPHA	After passing 1000' turn LEFT, track 299° until passing MKS R-334, then turn LEFT and join MKS R-299 inbound to cross MKS at or above 8000' to join W-35 and cross 12000' or above at or before D20 MKS.
OVINA ONE ALPHA	Immediately turn LEFT, track 228° and join W-52.
RINTO ONE ALPHA	After passing 1000' turn LEFT, track 299° until passing MKS R-334, then turn LEFT and join MKS R-299 inbound to cross MKS at or above 8000' to join W-37 and cross 12000' or above at or before D20 MKS.
RUDAL ONE ALPHA	Immediately turn LEFT, track 328° and join W-51.



Direct distance from Sultan Hasanuddin Apt to: MKS 2 NM

NOT TO SCALE

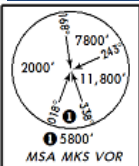
At or above 12000'

At or above 8000'

NOT TO SCALE



WAAA IFP - SID RWY 21



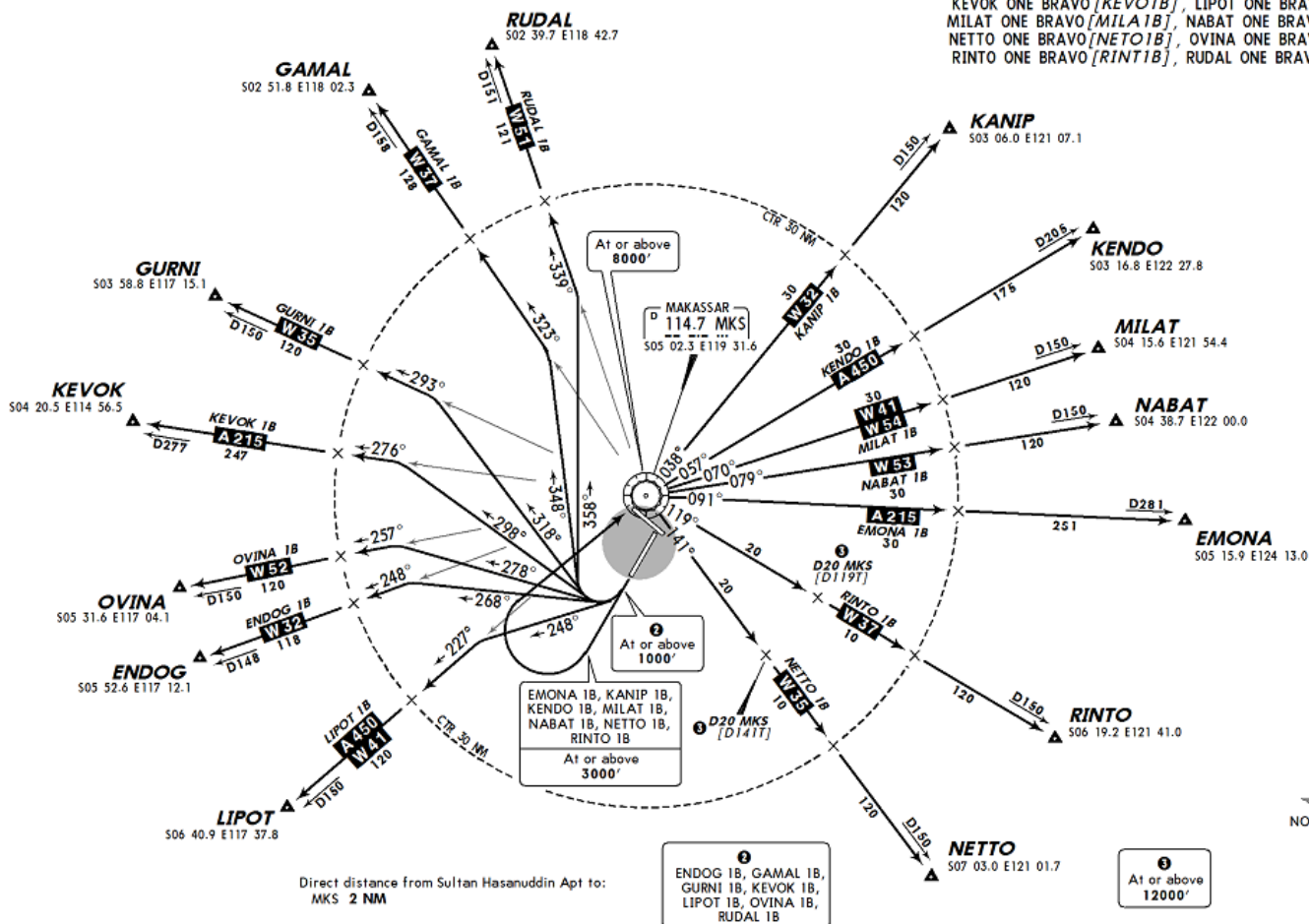
Apt Elev
47'

Trans level: FL 130 Trans alt: 11000'

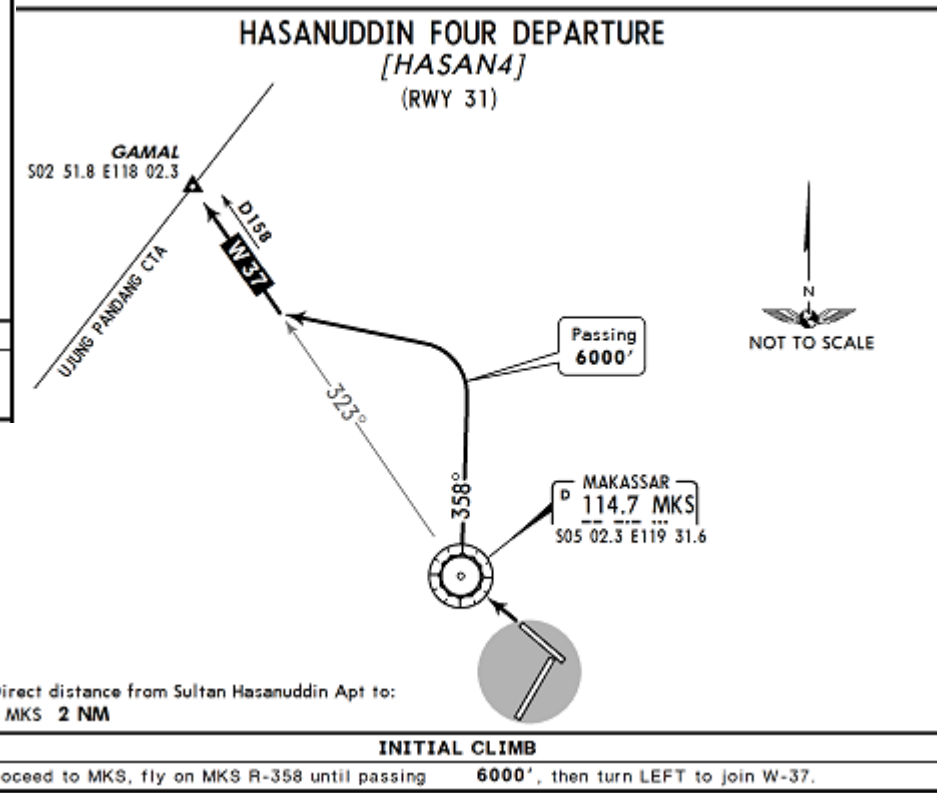
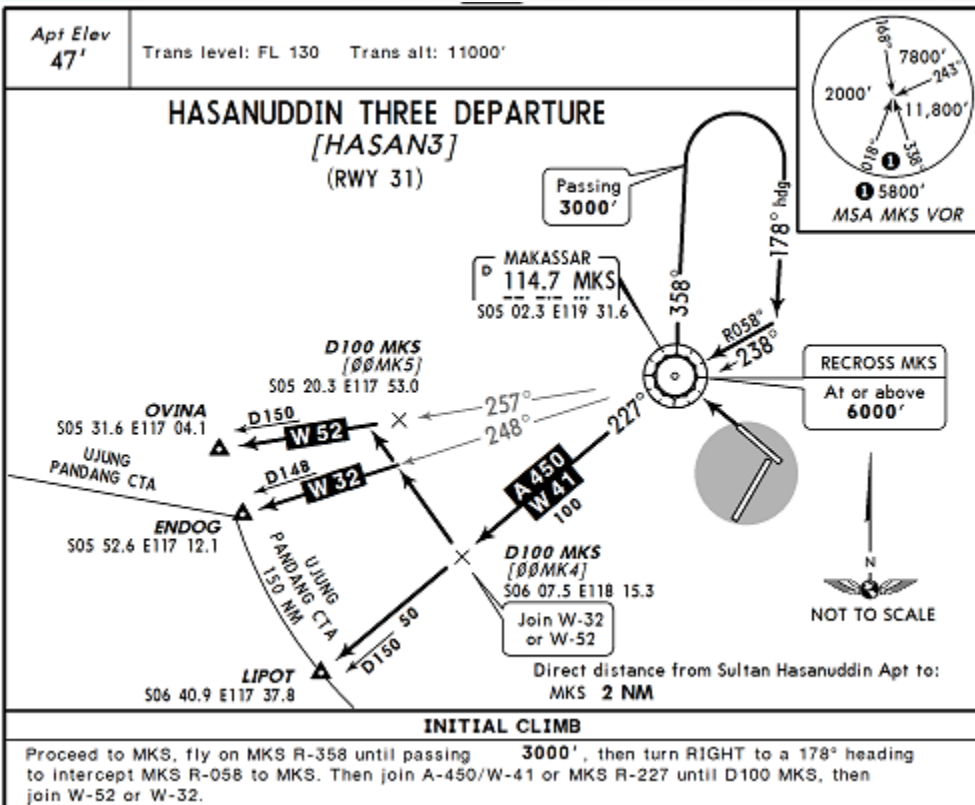
RWY 21 DEPARTURES

EMONA ONE BRAVO [EMON1B], ENDOG ONE BRAVO [ENDO1B],
GAMAL ONE BRAVO [GAMA1B], GURNI ONE BRAVO [GURN1B],
KANIP ONE BRAVO [KANI1B], KENDO ONE BRAVO [KEND1B],
KEVOK ONE BRAVO [KEVO1B], LIPOT ONE BRAVO [LIPO1B],
MILAT ONE BRAVO [MILA1B], NABAT ONE BRAVO [NABA1B],
NETTO ONE BRAVO [NETO1B], OVINA ONE BRAVO [OVIN1B],
RINTO ONE BRAVO [RINT1B], RUDAL ONE BRAVO [RUDA1B]

SID	INITIAL CLIMB
EMONA ONE BRAVO	Climb runway heading. After passing 3000' turn RIGHT, proceed to overhead MKS at or above 8000' and join A-215.
ENDOG ONE BRAVO	Climb runway heading. After passing 1000' turn RIGHT, track 268° and join W-32.
GAMAL ONE BRAVO	Climb runway heading. After passing 1000' turn RIGHT, track 348° and join W-37.
GURNI ONE BRAVO	Climb runway heading. After passing 1000' turn RIGHT, track 318° and join W-35.
KANIP ONE BRAVO	Climb runway heading. After passing 3000' turn RIGHT, proceed to overhead MKS at or above 8000' and join W-32.
KENDO ONE BRAVO	Climb runway heading. After passing 3000' turn RIGHT, proceed to overhead MKS at or above 8000'. Join MKS R-057 and proceed to KENDO.
KEVOK ONE BRAVO	Climb runway heading. After passing 1000' turn RIGHT, track 298° and join A-215.
LIPOT ONE BRAVO	Climb runway heading. After passing 1000' turn RIGHT, track 248° and join W-41/A-450.
MILAT ONE BRAVO	Climb runway heading. After passing 3000' turn RIGHT, proceed to overhead MKS at or above 8000' and join W-41/W-54.
NABAT ONE BRAVO	Climb runway heading. After passing 3000' turn RIGHT, proceed to overhead MKS at or above 8000' and join W-53.
NETTO ONE BRAVO	Climb runway heading. After passing 3000' turn RIGHT, proceed to overhead MKS at or above 8000'. Join W-35 and cross 12000' or above at or before D20 MKS.
OVINA ONE BRAVO	Climb runway heading. After passing 1000' turn RIGHT, track 278° and join W-52.
RINTO ONE BRAVO	Climb runway heading. After passing 3000' turn RIGHT, proceed to overhead MKS at or above 8000'. Join W-37 and cross 12000' or above at or before D20 MKS.
RUDAL ONE BRAVO	Climb runway heading. After passing 1000' turn RIGHT, track 358° and join W-51.



WAAA IFP - SID RWY 31 3&4





WAAA General Information

- ❖ Area Control Service: **24/7**
- ❖ Terminal Approach Service : **24/7**
- ❖ Radar Service : **24/7**
- ❖ WAAA : RWY 03/21, RWY 13/31 (Crossing Runway)
- ❖ IAPs : ILS (CAT I) and VOR for RWY 03, 21 & 13, NDB for RWY 13
- ❖ STAR for all runway ends
- ❖ SID for RWY 03, 21 & 13
- ❖ Approximately **225** movements per day
- ❖ Aircraft Mix : Jets + Turbo Prop
- ❖ Transition Altitude: 11000ft, Transition Level: FL130
- ❖ Radar APP Service



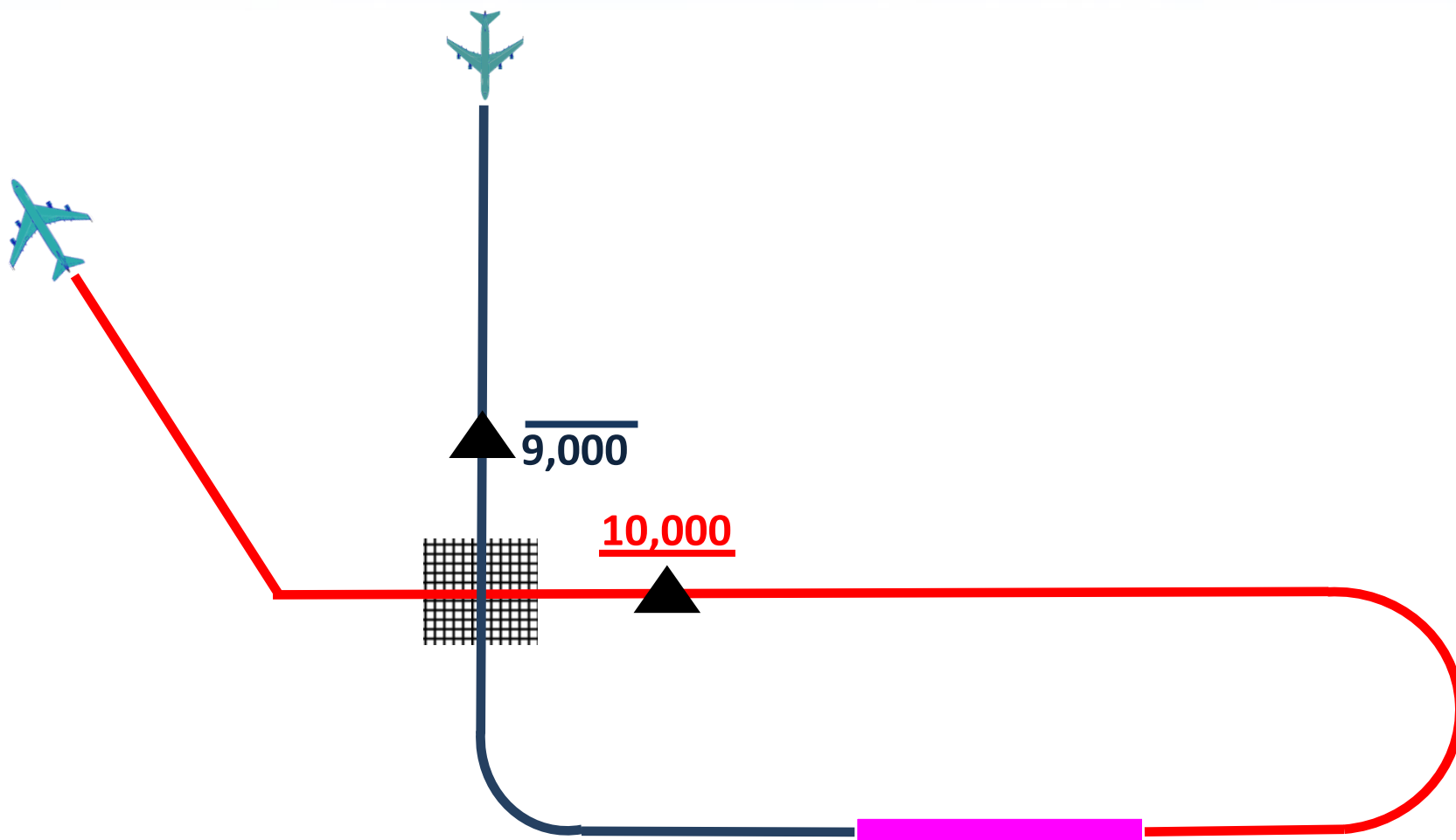
WAAA General Information

NAVSPEC	COMPLIANCE LEVEL
RNAV 10 (RNP 10)	88.6% (8752)
RNAV 5 all sensors	24.3% (2396)
RNAV 5 GNSS	0.5% (52)
RNAV 5 DME/DME	0.02% (2)
RNAV 5 VOR/DME	0.03% (3)
RNAV 2 all sensors	23.3% (2300)
RNAV 2 GNSS	0.5% (49)
RNAV 1 all sensors	86.3% (8521)

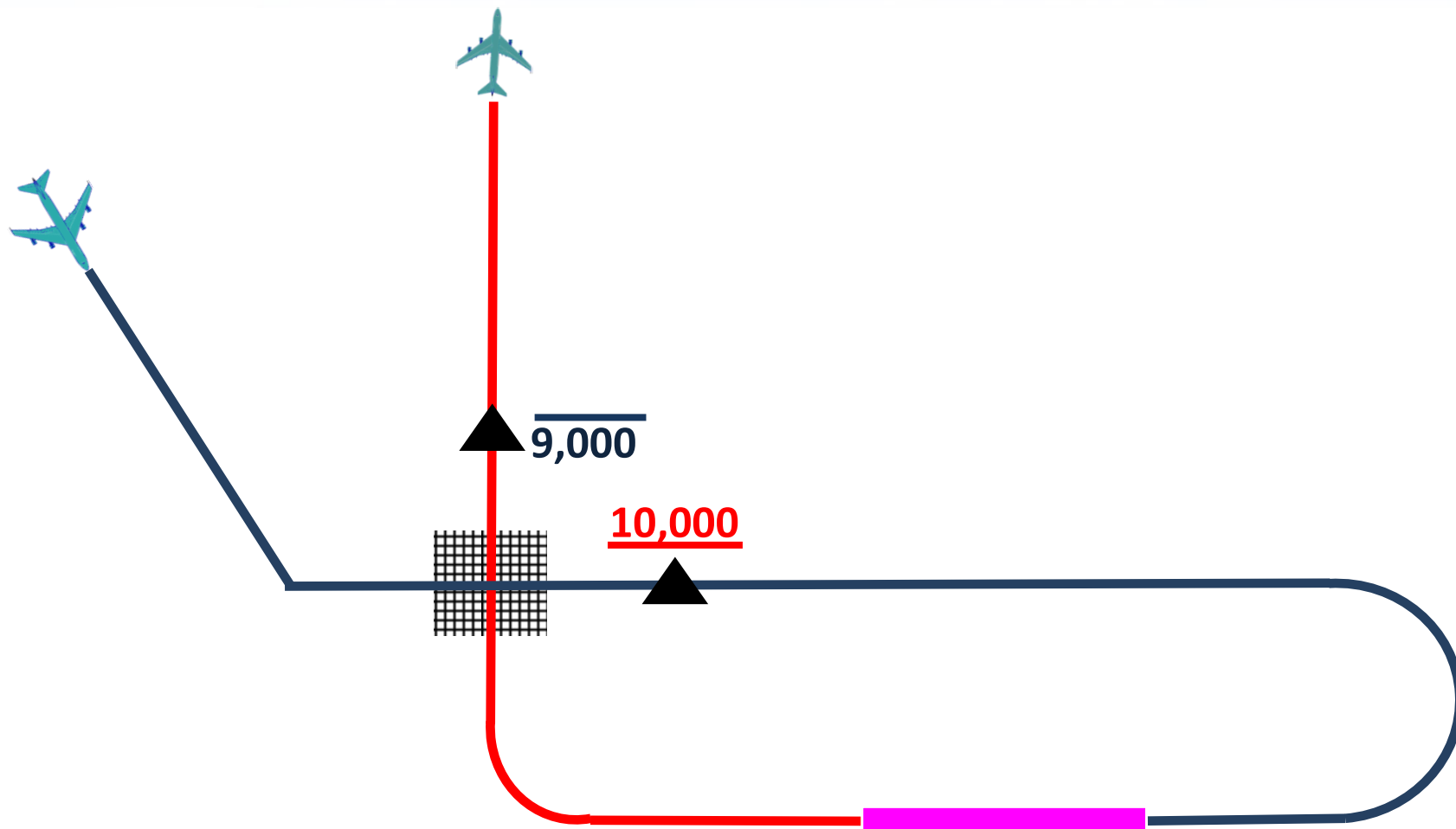
NAVSPEC	COMPLIANCE LEVEL
RNAV 1 GNSS	0.5% (49)
Basic RNP 1 all sensors	57.6% (5689)
Basic RNP 1 GNSS	0.7% (74)
RNP APCH	11.5% (1139)
RNP BARO-VNAV	14.5% (1434)
RNP AR (No RF)	7.2% (712)
RNP 4	37.4% (3693)
(Blanks)	11.4% (1122)

- **51 flights deliberately inserted an 'S' letter after 'S1' and can be assumed it should have been 'S2'. Adding 51 flights compliant with RNP BARO-VNAV**
- **249 flights with 'T' letter on the flight plan, adding up to RNP AR capable traffic but the RF capability is not known**
- **8570 (86.8%) RNAV 1 GNSS capable traffic and 5763 (58.35%) RNP 1 GNSS capable**

Rules of Thumb



Rules of Thumb



Rule of Thumb

CCO and CDO are operating techniques.

CDO descent rough starting points:

- **3 miles per thousand feet plus 1 mile per 10knots**
or
- **4 miles per thousand feet**

CCO climb rough starting points:

- **Very Slow climber - 5 miles per thousand feet**
- **Medium climber – 3 to 4 miles per thousand feet**
- **Faster climber – 2 miles per thousand feet**
- **Rocket ship - 1 mile per thousand feet**

- **RNAV Final between 4-5 nm**

Case Study 2

❖ Task 1

- Select Team Leader
- Select Team Name
- Select Recorder
- Decide Objectives – **WHY?**
 - *Safety, Capacity, Access, Efficiency, Environment*
- Decide Scope – **WHAT**
- Decide Timeline – **WHEN**

❖ Task 2

- Design SIDs – RWY 03, 21, or 13
- Design STARs – RWY 03, 21, or 13

Case Study 2

❖ Task 3

- Design Holds
- Redesign WAAA TMA if required
- Sectorize WAAA TMA if required

❖ Task 4

- Presentation of Case Study 2
 - Team Dynamics
 - Assumptions
 - Navigation Specifications
 - Objectives
 - Goals
 - Timelines (Hypothetical)
 - Presentation of Airspace Design (Including ITERATIONS if applicable)

Case Study 2

❖ Task 4

➤ Presentation of Case Study 2

- Team Dynamics
- Assumptions
- Navigation Specifications
- Objectives
- Goals
- Timelines (Hypothetical)
- Presentation of Airspace Design (Including ITERATIONS if applicable)



North American
Central American
and Caribbean
(NACC) Office
Mexico City

South American
(SAM) Office
Lima

ICAO
Headquarters
Montreal

Western and
Central African
(WACAF) Office
Dakar

European and
North Atlantic
(EUR/NAT) Office
Paris

Middle East
(MID) Office
Cairo

Eastern and
Southern African
(ESAF) Office
Nairobi

Asia and Pacific
(APAC) Office
Bangkok

Asia and Pacific
Regional Sub-Office
Beijing (APAC RSO)

Questions?



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Central American
and Caribbean
(NACC) Office
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(SAM) Office
Lima

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Montreal

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Central African
(WACAF) Office
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Thank You