AERODROME CHART ICAO

N 53°18'10.77" W 006°27'19.46"

ELEV 319ft

TWR	123.500
GND	121.755
ATIS	122.805

CONSULT NOTAM FOR LATEST INFORMATION

BALDONNEL/CASEMENT

RWY	DIRECTION	THR	BEARING STRENGTH
04	044°	N 53°17'36.90" W 006°27'13.73"	PCN 46/F/D/W/T
10	105°	N 53°18'16.88" W 006°28'07.75"	PCN 52/F/D/W/T
22	224°	N 53°18'12.63" W 006°26'22.02"	PCN 46/F/D/W/T
28	285°	N 53°18'05.85" W 006°26'40.68"	PCN 52/F/D/W/T

BEARINGS ARE MAGNETIC.

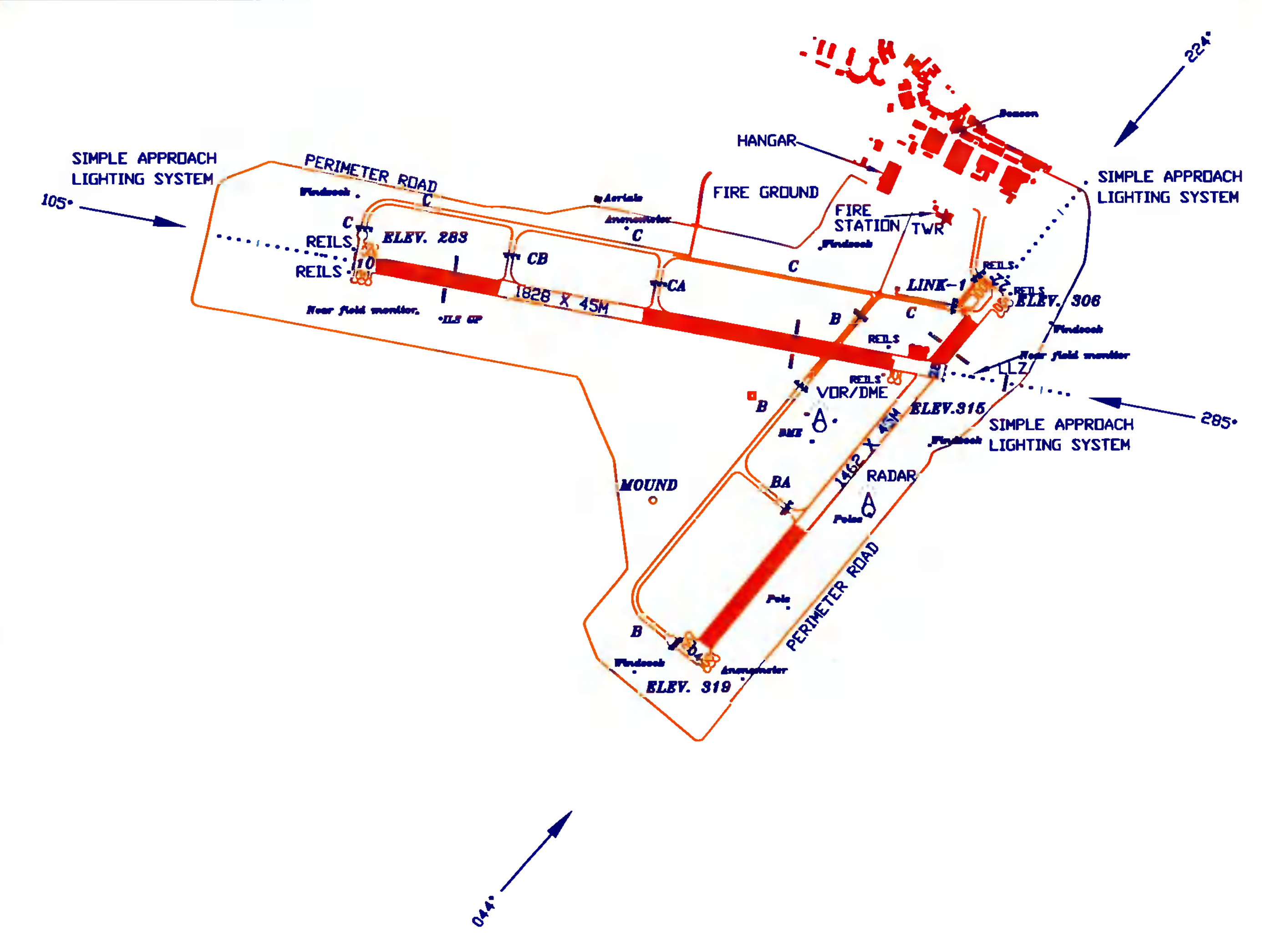
ELEVATIONS SHOWN IN FEET AMSL.

HEIGHTS IN FEET ABOVE AERODROME ELEVATION SHOWN IN BRACKETS.

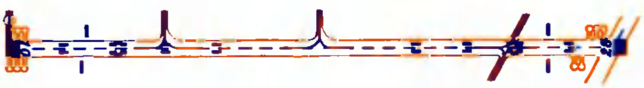
LINEAR DIMENSIONS IN METRES.

VAR 3° W 2019

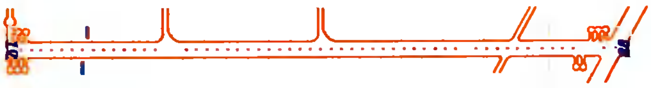
ANNUAL RATE OF CHANGE -11' W



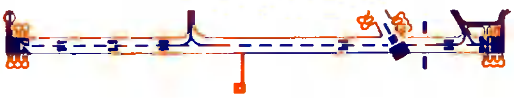
MARKING AIDS RWY 10/28



LIGHTING AIDS RWY 10/28



MARKING AIDS RWY 04/22



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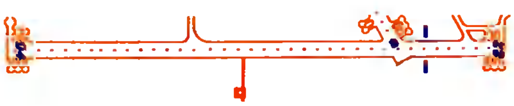


CHANGES : MAGNETIC VARIATION, BEARINGS, RUNWAY DESIGNATORS AND FREQUENCIES.

CGANGE: MAGVAR, TRACKS AND RADIALS, RUNWAY DESIGNATORS, PROCEDURE NAMES, ATIS FREQUENCY

INSTRUMENT DEPARTURE CHART - ICAO

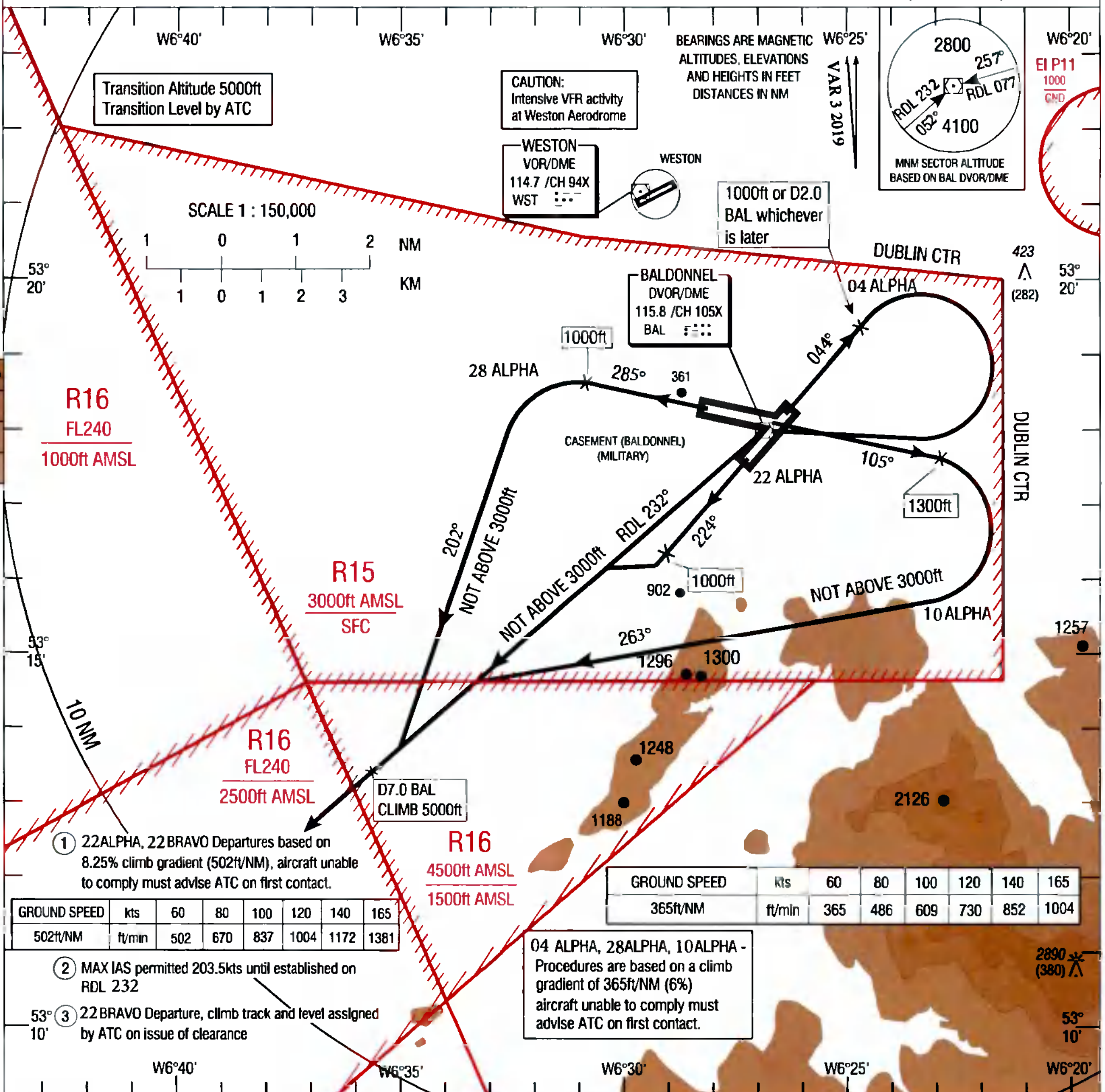
AERODROME ELEV 319 ft
HEIGHTS RELATED TO AERODROME ELEVATION

TWR BAL	123.500
RADAR	122.000
ATIS	122.805

CONSULT NOTAM FOR LATEST INFORMATION

BALDONNEL/CASEMENT (MIL) DEPARTURES

RWYs 28, 10, 22, 04 ① ② ③
(ACFT CAT A, B)



① 22ALPHA, 22BRAVO Departures based on 8.25% climb gradient (502ft/NM), aircraft unable to comply must advise ATC on first contact.

GROUND SPEED	kts	60	80	100	120	140	165
502ft/NM	ft/min	502	670	837	1004	1172	1381

② MAX IAS permitted 203.5kts until established on RDL 232

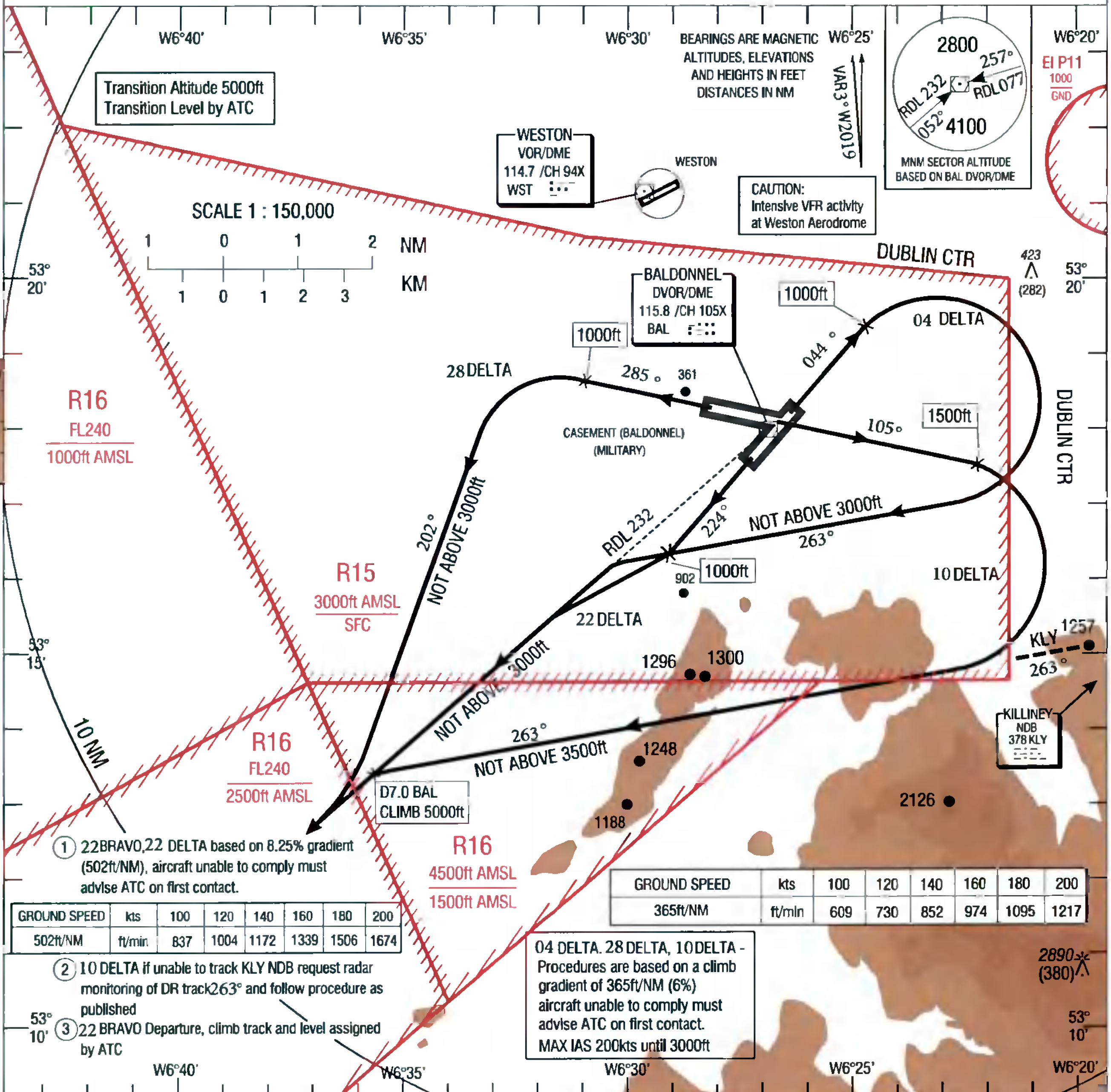
③ 22BRAVO Departure, climb track and level assigned by ATC on issue of clearance

GROUND SPEED	kts	60	80	100	120	140	165
365ft/NM	ft/min	365	486	609	730	852	1004

04 ALPHA, 28ALPHA, 10ALPHA - Procedures are based on a climb gradient of 365ft/NM (6%) aircraft unable to comply must advise ATC on first contact.

Departure	Routeing	Climb Instruction
04 ALPHA	Climb on runway track, at 1000ft or D2.0 BAL DME, whichever is later, turn right inbound to BAL VOR, from BAL track RDL 232	Climb 3000ft Passing D7.0 BAL outbound on RDL 232 continue climb to 5000ft Maintain 6% climb gradient until 2800ft
28 ALPHA	Climb on runway track, at 1000ft turn left to track 202°, to intercept RDL 232 BAL outbound	Climb 3000ft Passing D7.0 BAL outbound on RDL 232continue climb to 5000ft Maintain 6% climb gradient until 2800ft
10 ALPHA	Climb on runway track, at 1300ft turn right to track 263°, to intercept RDL 233 BAL outbound	Climb 3000ft Passing D7.0 BAL outbound on RDL 232continue climb to 5000ft Maintain 6% climb gradient until 2800ft.
22 ALPHA	Climb on runway track, at 1000ft turn right to intercept RDL 232 BAL outbound	Climb 3000ft Passing D7.0 BAL outbound on RDL 232 continue climb to 5000ft Maintain 8.25% climb gradient until 2800ft
22 BRAVO	Climb on track 239°, at 1000ft turn right to track assigned by ATC	Climb to assigned level Maintain 8.25% climb gradient until initial assigned level

INSTRUMENT DEPARTURE CHART - ICAO	AERODROME ELEV 319 ft HEIGHTS RELATED TO AERODROME ELEVATION	TWR 123.500 BAL RADAR 122.000 ATIS 122.805	CONSULT NOTAM FOR LATEST INFORMATION	BALDONNEL/CASEMENT (MIL) DEPARTURES RWYs 28, 10, 22, 04 (1)(2)(3) (ACFT CAT C, D)



(1) 22BRAVO,22 DELTA based on 8.25% gradient (502ft/NM), aircraft unable to comply must advise ATC on first contact.

GROUND SPEED	kts	100	120	140	160	180	200
502ft/NM	ft/min	837	1004	1172	1339	1506	1674

(2) 10 DELTA if unable to track KLY NDB request radar monitoring of DR track263° and follow procedure as published

(3) 22 BRAVO Departure, climb track and level assigned by ATC

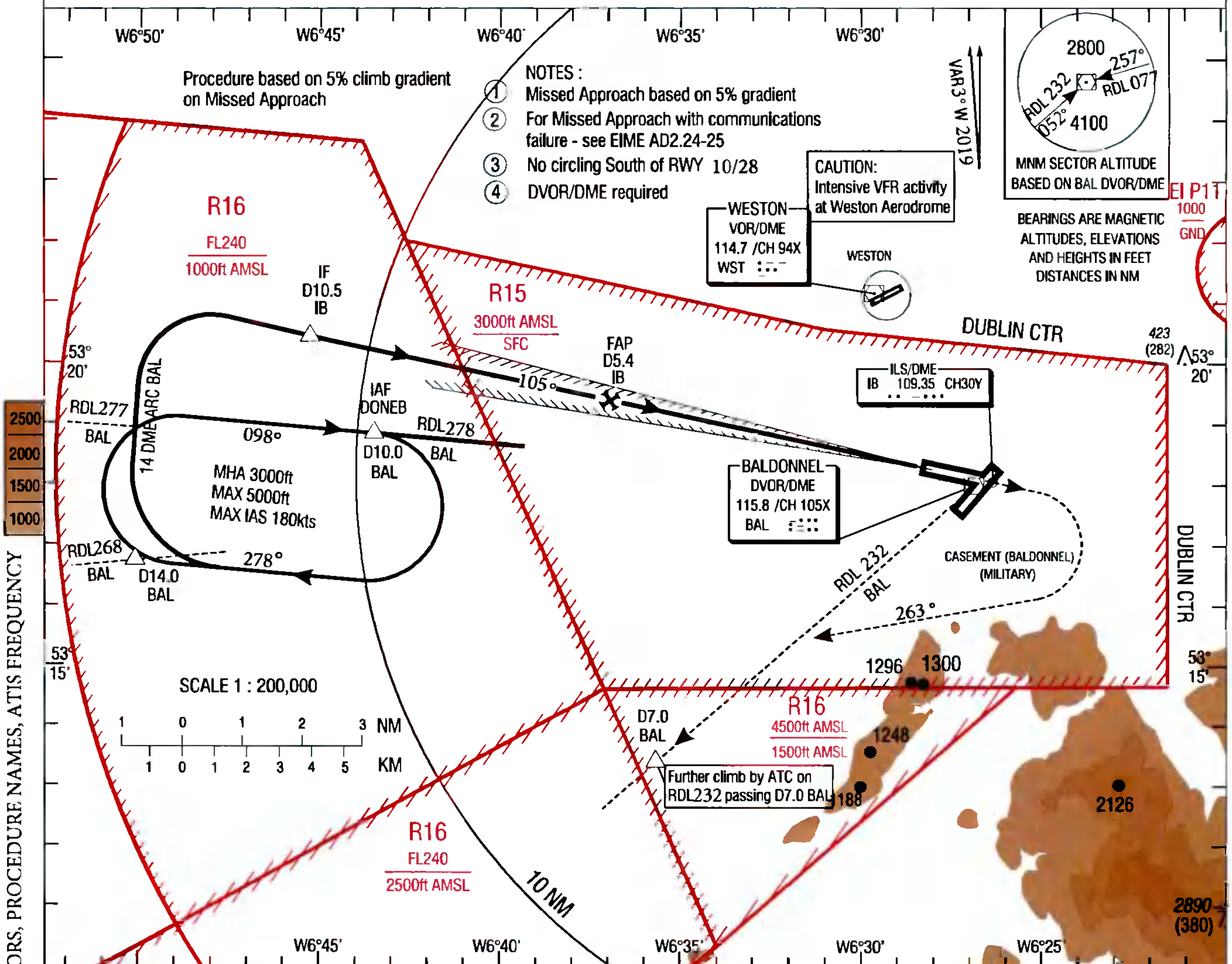
GROUND SPEED	kts	100	120	140	160	180	200
365ft/NM	ft/min	609	730	852	974	1095	1217

04 DELTA. 28 DELTA, 10DELTA - Procedures are based on a climb gradient of 365ft/NM (6%) aircraft unable to comply must advise ATC on first contact.
MAX IAS 200kts until 3000ft

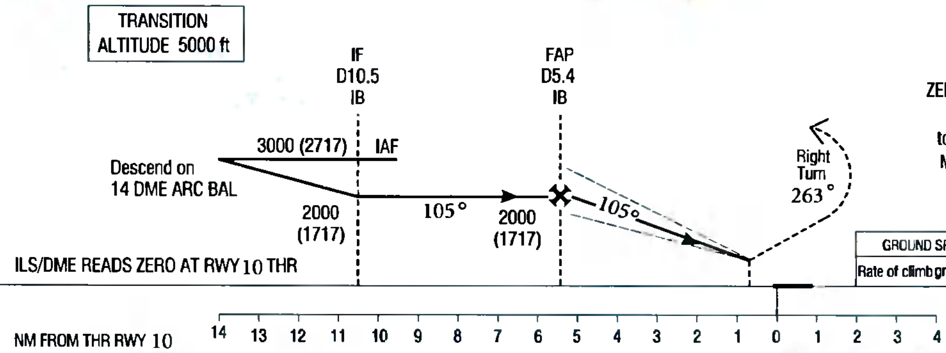
Departure	Routeing	Climb Instruction
04 DELTA	Climb on runway track, at 1000ft turn right TO TRACK 263° to intercept RDL 232 BAL outbound	Climb 3000ft Passing D7.0 BAL outbound on RDL232 continue climb to 5000ft Maintain 6% climb gradient until 2800ft
28DELTA	Climb on runway track, at 1000ft turn left to track 202°, to intercept RDL 232 BAL outbound	Climb 3000ft Passing D7.0 BAL outbound on RDL 232 continue climb to 5000ft Maintain 6% climb gradient until 2800ft
10 DELTA (2)	Climb on runway track, at 1500ft turn right to intercept bearing263° from KLY to intercept RDL 232 BAL outbound	Climb 3500ft Passing D7.0 BAL outbound on RDL 232continue climb to 5000ft Maintain 6% climb gradient until 3100ft.
22 DELTA	Climb on runway track, at 1000ft turn right to intercept RDL 232BAL outbound	Climb 3000ft Passing D7.0 BAL outbound on RDL 232continue climb to 5000ft Maintain 8.25% climb gradient until 2800ft
22 BRAVO (3)	Climb on track239°, at 1000ft turn right onto track assigned by ATC	Climb to assigned level Maintain 8.25% gradient until initial assigned level

CHANGE: MAGVAR, TRACKS AND RADIALS, RUNWAY DESIGNATORS, PROCEDURE NAMES, ATIS FREQUENCY

INSTRUMENT APPROACH CHART - ICAO	AERODROME ELEV 319 ft HEIGHTS RELATED TO THR RWY 10 - ELEV 283 ft	TWR 123.500 BAL RADAR 122.000 ATIS 122.805	CONSULT NOTAM FOR LATEST INFORMATION	BALDONNEL/CASEMENT (MIL) ILS z RWY 10 ①②③④ (ACFT CAT A, B)



TRANSITION ALTITUDE 5000 ft



MISSED APPROACH:
Initial climb 3000ft
Climb on track105°, at 1300ft, ZERO DME IB whichever is later, climbing to 3000ft turn right onto track263° to intercept BAL RDL232. Contact ATC. Maintain 5% climb gradient until 2800ft.

ELEV 283ft (THR RWY10)

GROUND SPEED	kts	60	80	100	120	140	150
Rate of climb gradient 5%	ft/min	304	405	506	608	709	760

STRAIGHT IN LANDING RWY 10				
	OCA(H)	CEILING	RVR/VIS	ALS OUT
A	438 (155)	200	800m	1200m
B	446 (163)	200	800m	1200m
OCAs based on 2.5% Missed Approach climb gradient				
A	870 (587)	600	1000m	1400m
B	960 (677)	700	1000m	1400m

CIRCLE TO LAND (heights AAL)			
	OCA (H)	CEILING	VIS
A	720 (401)	500	2000m
B	820 (501)	600	2000m

LIGHTING	IDEAL ALTITUDE (HEIGHT) ON FINAL APPROACH						
PAPI 3° REILS RWY LTs SALS	NM	5.3	5.0	4.0	3.0	2.0	1.0
	ALT (HT)	2000 (1717)	1880 (1597)	1560 (1277)	1240 (957)	920 (637)	600 (307)

GROUND SPEED	kts	60	80	100	120	140	150
Rate of descent gradient 3°	ft/min	318	424	530	636	743	796

Rate of climb missed approach 2.5%							
GROUND SPEED	kts	60	80	100	120	140	150
Rate of climb gradient 2.5%	ft/min	152	203	254	304	355	380

CHANGE: MAGVAR, TRACKS AND RADIALS, RUNWAY DESIGNATORS, PROCEDURE NAMES, ATIS FREQUENCY

INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 319 ft
HEIGHTS RELATED TO
THR RWY 10 - ELEV 283 ft

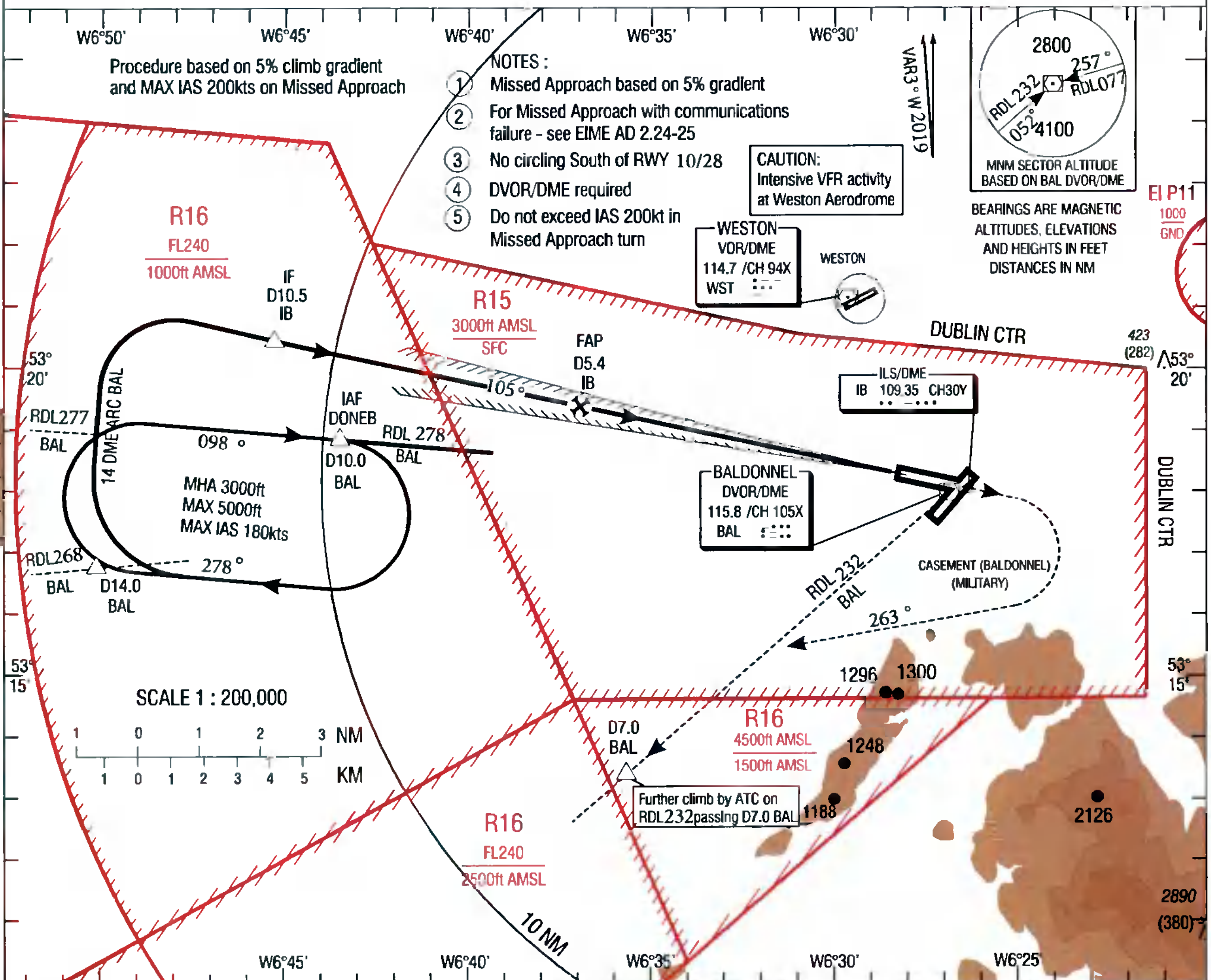
TWR	123.500
BAL RADAR	122.000
ATIS	122.805

CONSULT NOTAM FOR LATEST INFORMATION

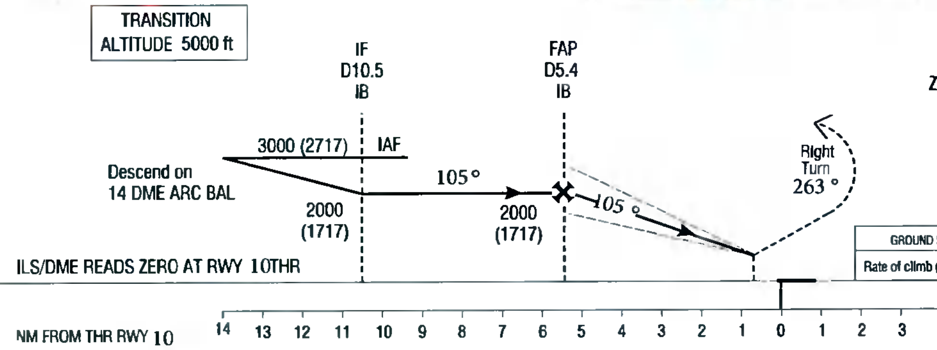
BALDONNEL/CASEMENT (MIL)

ILS y RWY 10 ① ② ③ ④ ⑤

(ACFT CAT C, D)



TRANSITION ALTITUDE 5000 ft



MISSED APPROACH:
Initial climb 3500ft
Climb on track 105°, at 2000ft,
ZERO DME IB whichever is later, climbing
to 3500ft turn right onto track 263°
to intercept BAL RDL232 . Contact ATC.
Maintain 5% climb gradient until 2800ft.
Do not exceed IAS 200kt in turn.
ELEV 283ft (THR RWY10)

GROUND SPEED	kts	100	120	140	160	180	200
Rate of climb gradient 5%	ft/min	506	608	709	811	912	1013

STRAIGHT IN LANDING RWY 10				
	OCA(H)	CEILING	RVR/VIS	ALS OUT
C	456 (173)	200	800m	1200m
D	467 (184)	200	800m	1200m
OCAs based on 2.5% Missed Approach climb gradient				
C	1030 (747)	800	4000m	4200m
D	1030 (747)	800	4400m	4600m

CIRCLE TO LAND (heights AAL)			
	OCA (H)	CEILING	VIS
C	910 (591)	600	2400m
D	1010 (691)	700	2800m

LIGHTING	IDEAL ALTITUDE (HEIGHT) ON FINAL APPROACH						
PAPI 3° REILS RWY LTs SALS	NM	5.3	5.0	4.0	3.0	2.0	1.0
	ALT (HT)	2000 (1717)	1880 (1597)	1560 (1277)	1240 (957)	920 (637)	600 (307)

GROUND SPEED	kts	100	120	140	160	180
Rate of descent gradient 3°	ft/min	530	636	743	849	955

Rate of climb missed approach 2.5%

GROUND SPEED	kts	100	120	140	160	180	200
Rate of climb gradient 2.5%	ft/min	254	304	355	406	456	507

Approved by GOC Air Corps

31 DEC 2020

CHANGE: MAGVAR, TRACKS AND RADIALS, RUNWAY DESIGNATORS, PROCEDURE NAMES, ATIS FREQUENCY

INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 319 ft
HEIGHTS RELATED TO
THR RWY 10 - ELEV 283ft

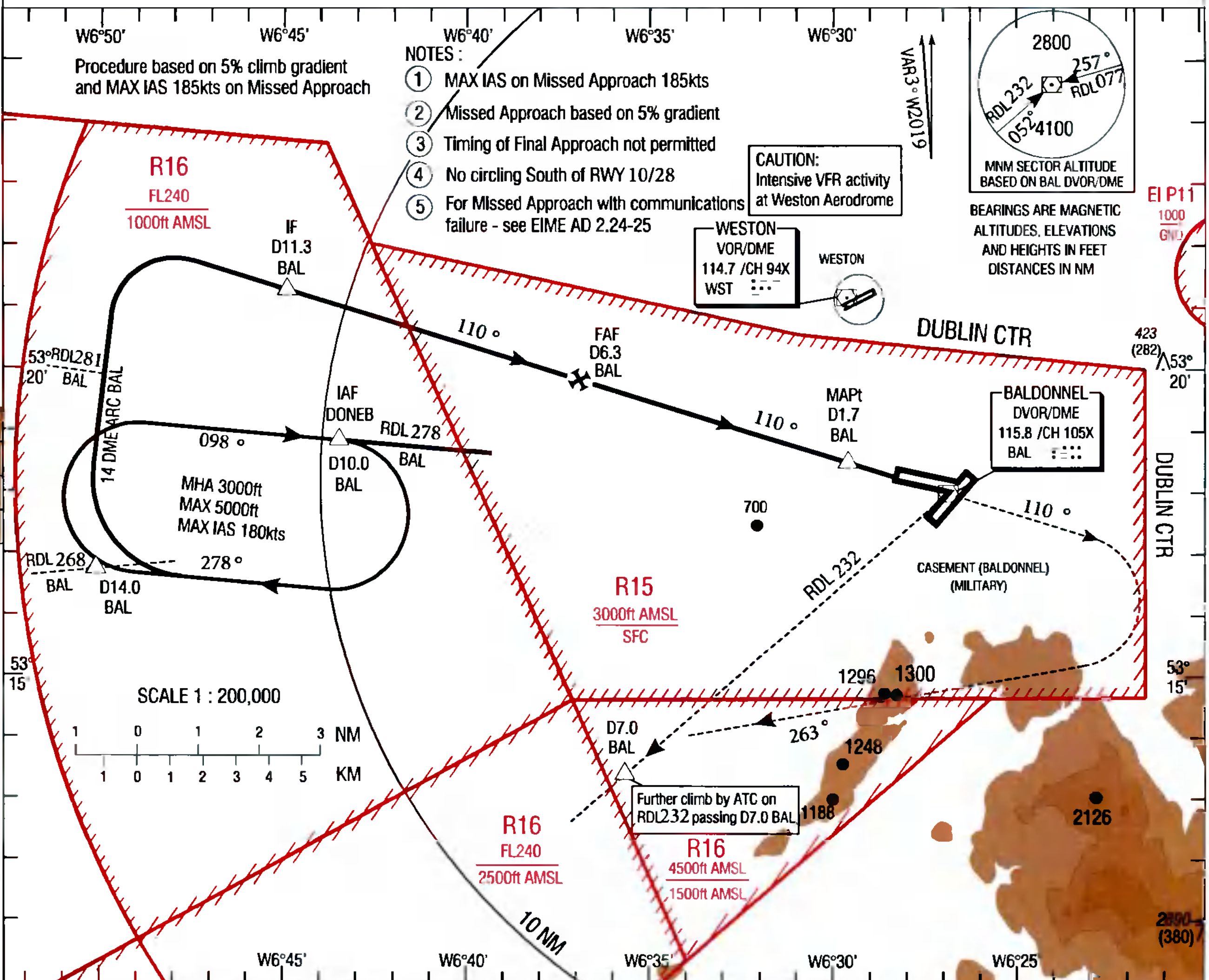
TWR	123.500
BAL RADAR	122.000
ATIS	122.805

CONSULT NOTAM FOR LATEST INFORMATION

BALDONNEL/CASEMENT (MIL)

VOR/DME RWY 10 ① ② ③ ④ ⑤

(ACFT CAT A, B, C, D)



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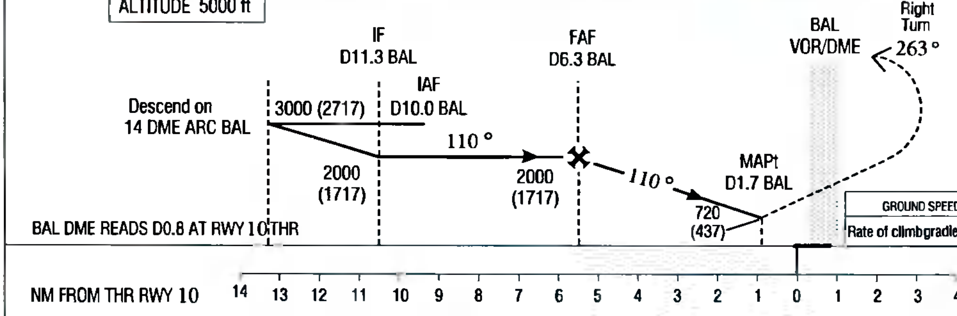
CHANGE: MAGVAR, TRACKS AND RADIALS, RUNWAY DESIGNATORS, PROCEDURE NAME, ATIS FREQUENCY

TRANSITION ALTITUDE 5000 ft



MISSED APPROACH:
Initial climb 3000ft
At D1.7 climb on track 110°,
at 1500ft climbing to 3000ft, turn right
onto track 263° to intercept
BAL RDL 232 Contact ATC.
Maintain 5% climb gradient until 2800ft.
Do not exceed IAS 185kts in turn.
ELEV 283ft (THR RWY10)

GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of climb gradient 5%	ft/min	304	405	506	608	709	810	911

	CAT	A	B	C	D
STRAIGHT IN LANDING RWY 10 OCA (H) 720 (437)	CEILING	500	500	500	500
	VIS	2000	2000	2400	2800
	ALS OUT	2400	2400	2800	3200
CIRCLE TO LAND (Heights AAL)	OCA (H)	720 (401)	820 (501)	910 (591)	1010 (691)
	CEILING	500	600	600	700
	VIS	2000	2000	2800	3600

OCAs based on 2.5% Missed Approach climb gradient

CAT	A	B	C	D
OCA	1000	1230	1400	1420

LIGHTING

PAPI 3°
REILS
RWY LTs
SALS

IDEAL ALTITUDE (HEIGHT) ON FINAL APPROACH

DME (BAL)	6.0	5.0	4.0	3.0	2.0
ALT (HT)	1910 (1627)	1610 (1327)	1300 (1017)	1000 (717)	700 (417)

GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of descent gradient 5%	ft/min	304	405	506	608	709	810	911

GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of climb gradient 2.5%	ft/min	152	203	254	304	355	406	456

INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 319 ft
HEIGHTS RELATED TO AERODROME ELEVATION

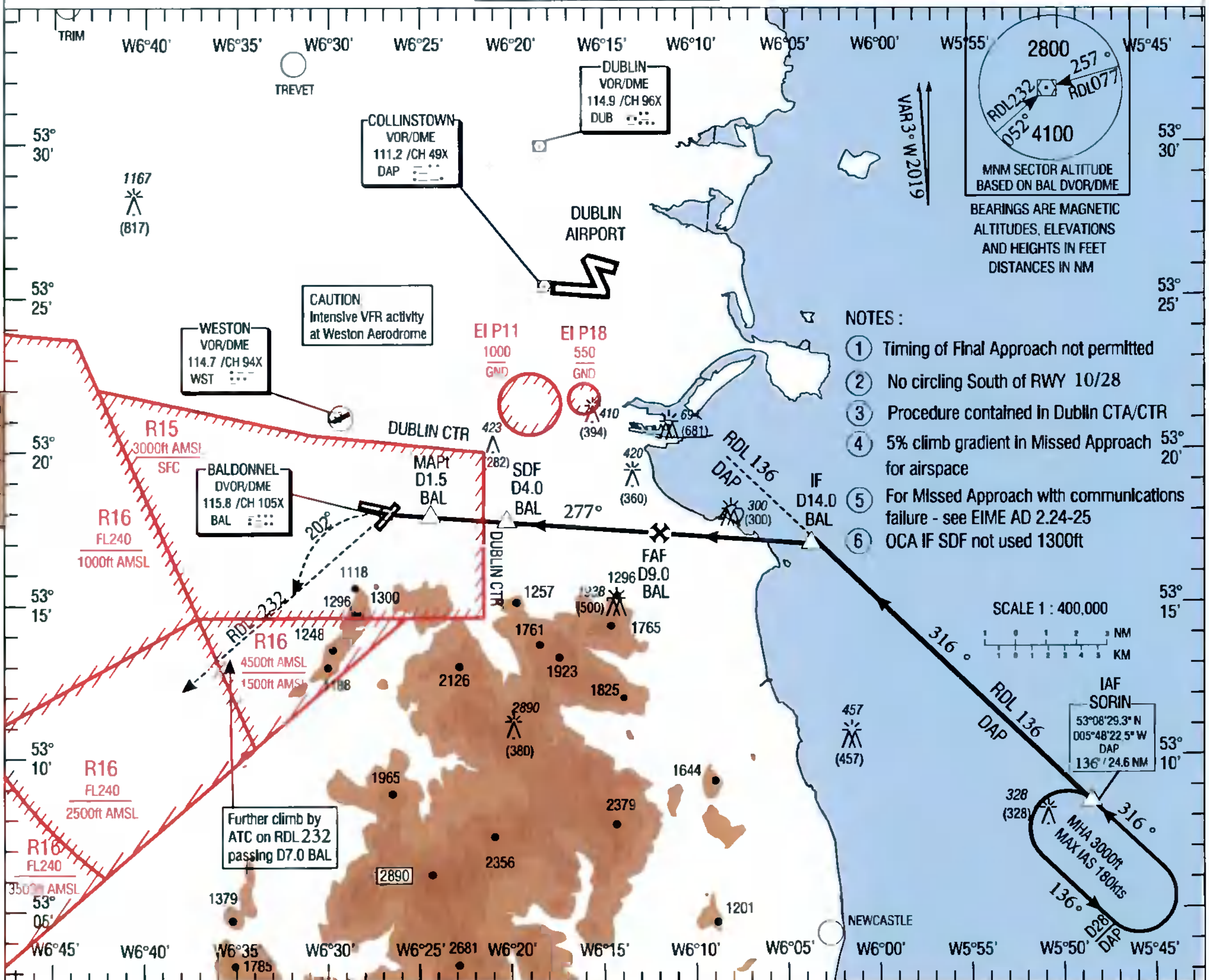
TWR	123.500
BAL RADAR	122.000
ATIS	122.805
DUBLIN LOWER SOUTH	120.755
DUBLIN LOWER NORTH	132.580

CONSULT NOTAM FOR LATEST INFORMATION

BALDONNEL/CASEMENT (MIL)

VOR/DME RWY 28 (1) (2) (3) (4) (5) (6)

(ACFT CAT A, B, C, D)



VAR, TRACKS, RADIALS, FREQUENCIES, RWY DESIGNATORS

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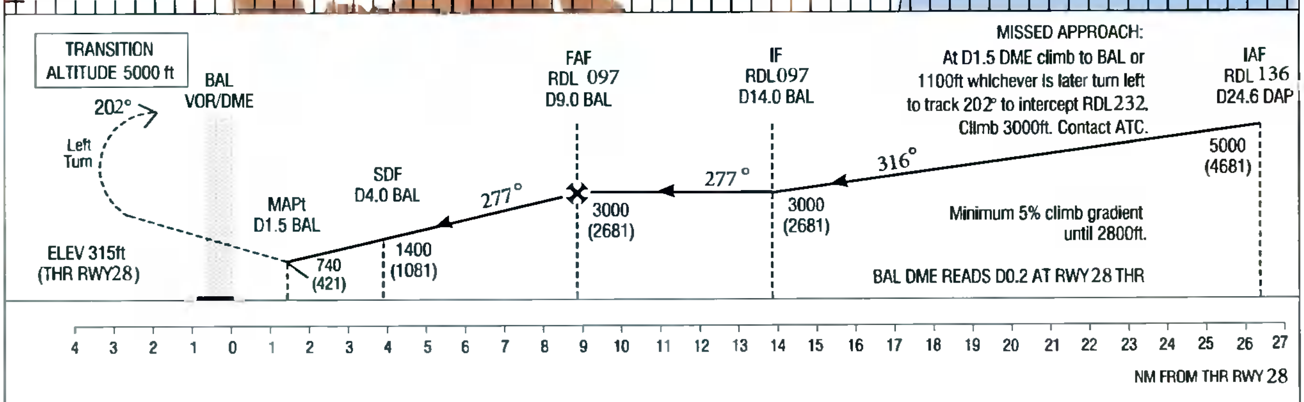


STRAIGHT IN LANDING RWY28 OCA (H) 740 (421)	CAT	A	B	C	D
	CEILING	500	500	500	500
	VIS	2000	2000	2400	2800
	ALS OUT	2400	2400	2800	3200
CIRCLE TO LAND (Heights AAL)	OCA (H)	740 (421)	820 (501)	910 (591)	1010 (691)
	CEILING	500	600	600	700
	VIS	2000	2000	2800	3600

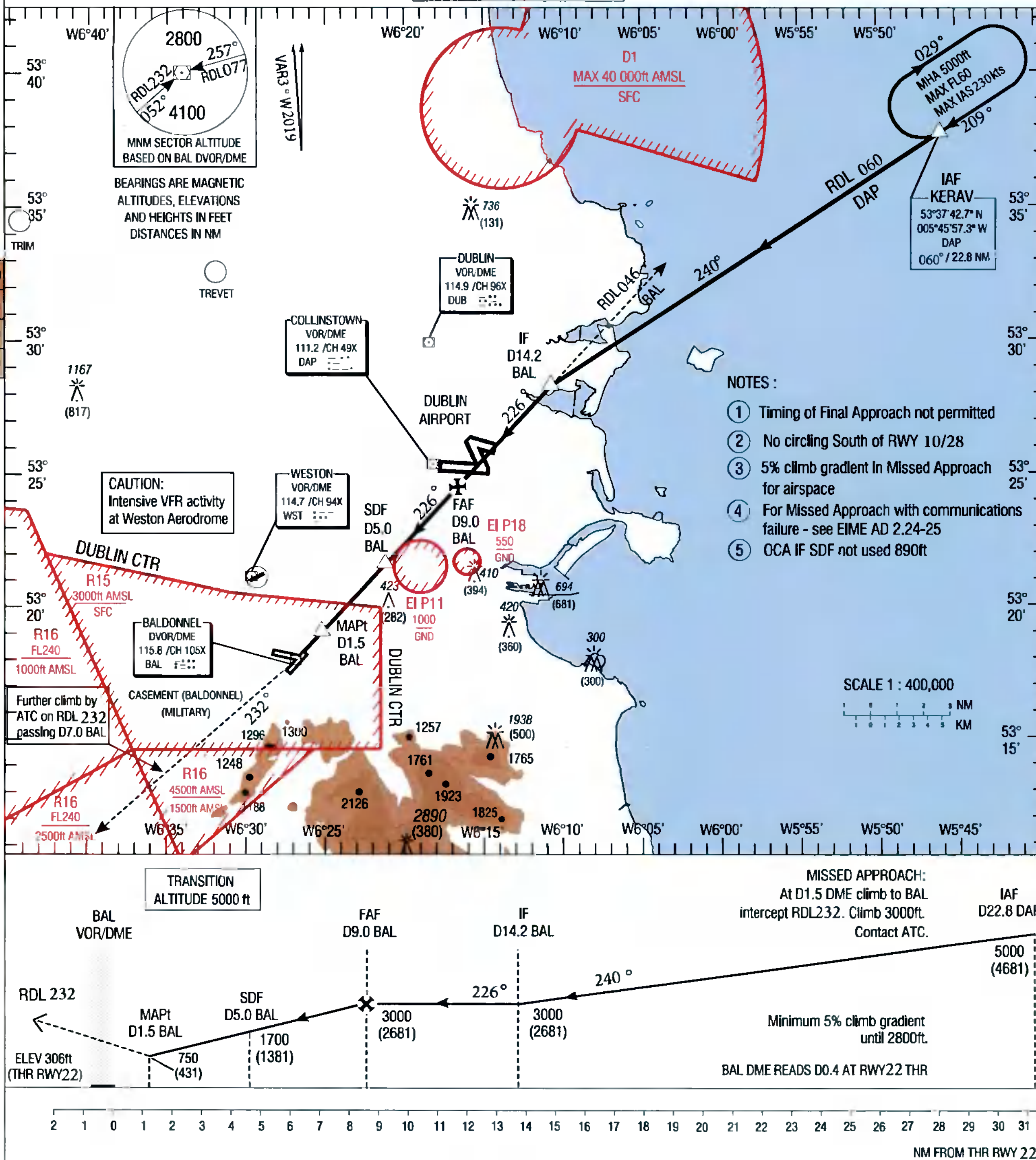
IDEAL ALTITUDE (HEIGHT) ON FINAL APPROACH

DME (BAL)	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0
ALT (HT)	3000 (2681)	2710 (2391)	2410 (2091)	2120 (1801)	1820 (1501)	1530 (1211)	1230 (911)	930 (611)

GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of descent gradient 4.88%	ft/min	297	395	494	593	692	791	890

LIGHTING
PAPI 3°
REIL
RWY LTs
SALS

INSTRUMENT APPROACH CHART - ICAO	AERODROME ELEV 319 ft HEIGHTS RELATED TO AERODROME ELEVATION	TWR 123.500 BAL RADAR 122.000 ATIS 122.805 DUBLIN LOWER SOUTH 120.755 DUBLIN LOWER NORTH 132.580	CONSULT NOTAM FOR LATEST INFORMATION	BALDONNEL/CASEMENT (MIL) VOR/DME RWY 22 ① ② ③ ④ ⑤ (ACFT CAT A, B, C, D)



	CAT	A	B	C	D
STRAIGHT IN LANDING RWY 22	CEILING	500	500	500	500
OCA (H) 750 (431)	VIS	2000	2000	2400	2800
	ALS OUT	2400	2400	2800	3200
CIRCLE TO LAND (Heights AAL)	OCA (H)	750 (431)	820 (501)	910 (591)	1010 (691)
	CEILING	500	600	600	700
	VIS	2000	2000	2800	3600

IDEAL ALTITUDE (HEIGHT) ON FINAL APPROACH

DME (BAL)	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0
ALT (HT)	3000 (2681)	2690 (2371)	2390 (2071)	2090 (1771)	1780 (1461)	1480 (1161)	1180 (861)	870 (551)

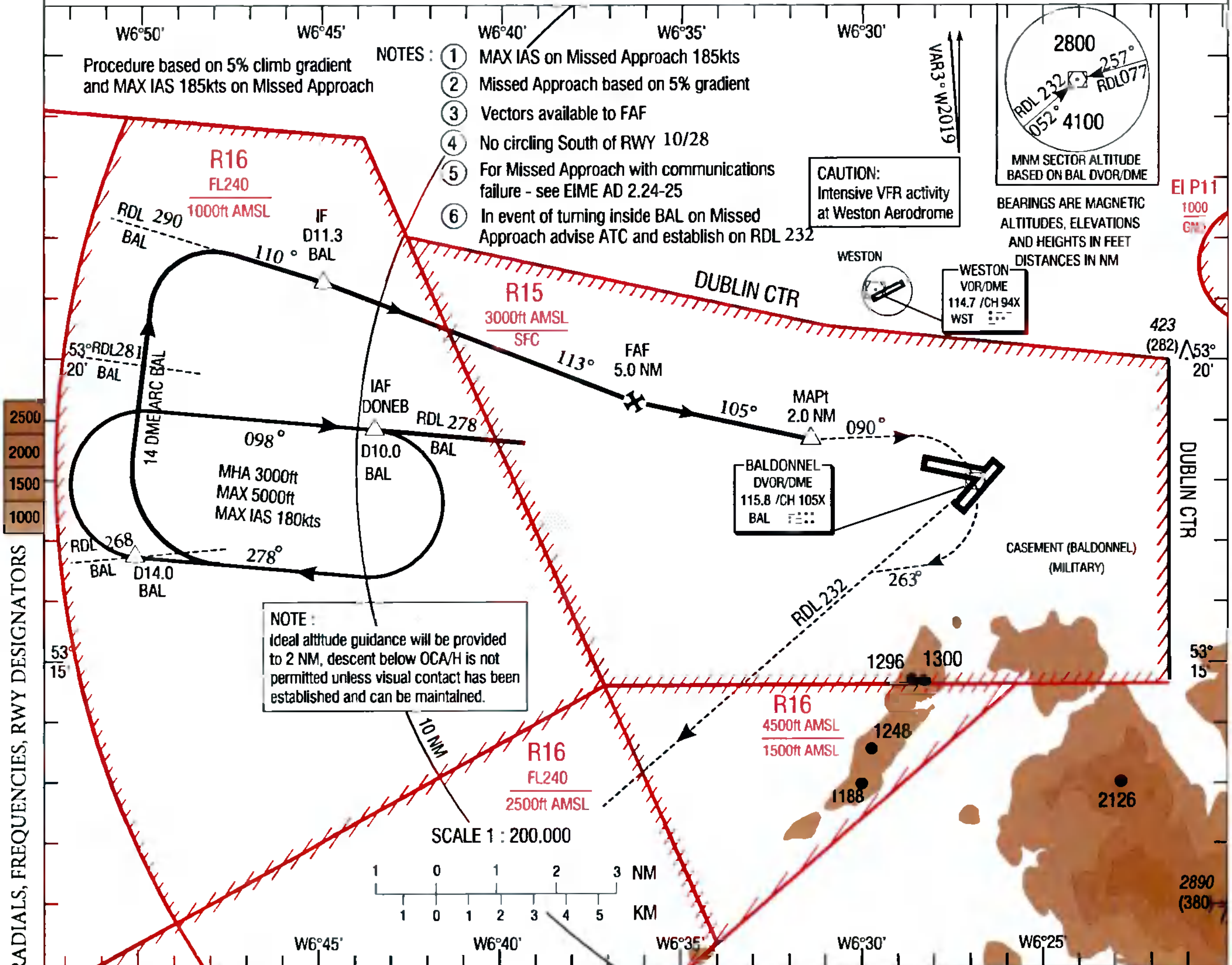
GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of descent gradient 5%	ft/min	304	405	506	608	709	810	911

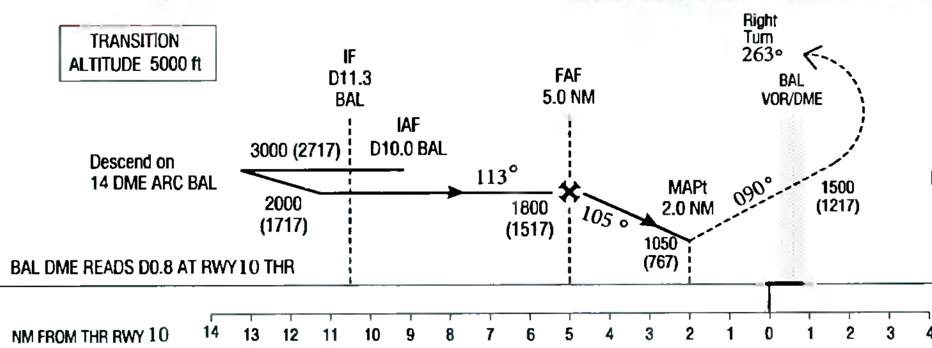
LIGHTING

PAPI 3°
REIL
RWY LTs
SALS

CHANGES: VAR, TRACKS, RADIALS, FREQUENCIES, RWY DESIGNATORS

INSTRUMENT APPROACH CHART - ICAO	AERODROME ELEV 319 ft HEIGHTS RELATED TO THR RWY 10 - ELEV 283ft	TWR BAL 123.500 RADAR 122.000 ATIS 122.805	CONSULT NOTAM FOR LATEST INFORMATION	BALDONNEL/CASEMENT (MIL) SRA RWY 10 ① ② ③ ④ ⑤ ⑥ (ACFT CAT A, B, C)





MISSED APPROACH:
At 2.0 NM turn left onto track090° climb 3000ft, at 1500ft turn right onto track263° to intercept RDL 232 from BAL. Contact ATC.
Do not exceed IAS 185kts 3000ft
Maintain 5% climb gradient until 2800ft.

ELEV 283ft (THR RWY 10)

	CAT	A	B	C
STRAIGHT IN LANDING RWY 10 OCA (H) 1050 (767)	CEILING	800	800	800
	VIS	2000	2000	3600
	ALS OUT	2400	2400	4000
CIRCLE TO LAND (Heights AAL)	OCA (H)	1050 (731)	1050 (731)	1050 (731)
	CEILING	800	800	800
	VIS	2000	2000	3600
	OCAs based on 2.5% Missed Approach climb gradient			
	CAT	A	B	C
	OCA	1130	1280	1460

LIGHTING

PAPI 3°
REIL
RWY LTs
SALS

IDEAL ALTITUDE (HEIGHT) ON FINAL APPROACH				
Distance (NM)	5.0	4.0	3.0	2.0
ALT (HT)	1800 (1517)	1500 (1217)	1200 (917)	900 (617)

GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of descent gradient 5%	ft/min	304	405	506	608	709	810	911

GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of climb gradient 2.5%	ft/min	152	203	254	304	355	406	456

CHANGES: VAR, TRACKS, RADIALS, FREQUENCIES, RWY DESIGNATORS

INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 319 ft
HEIGHTS RELATED TO AERODROME ELEVATION

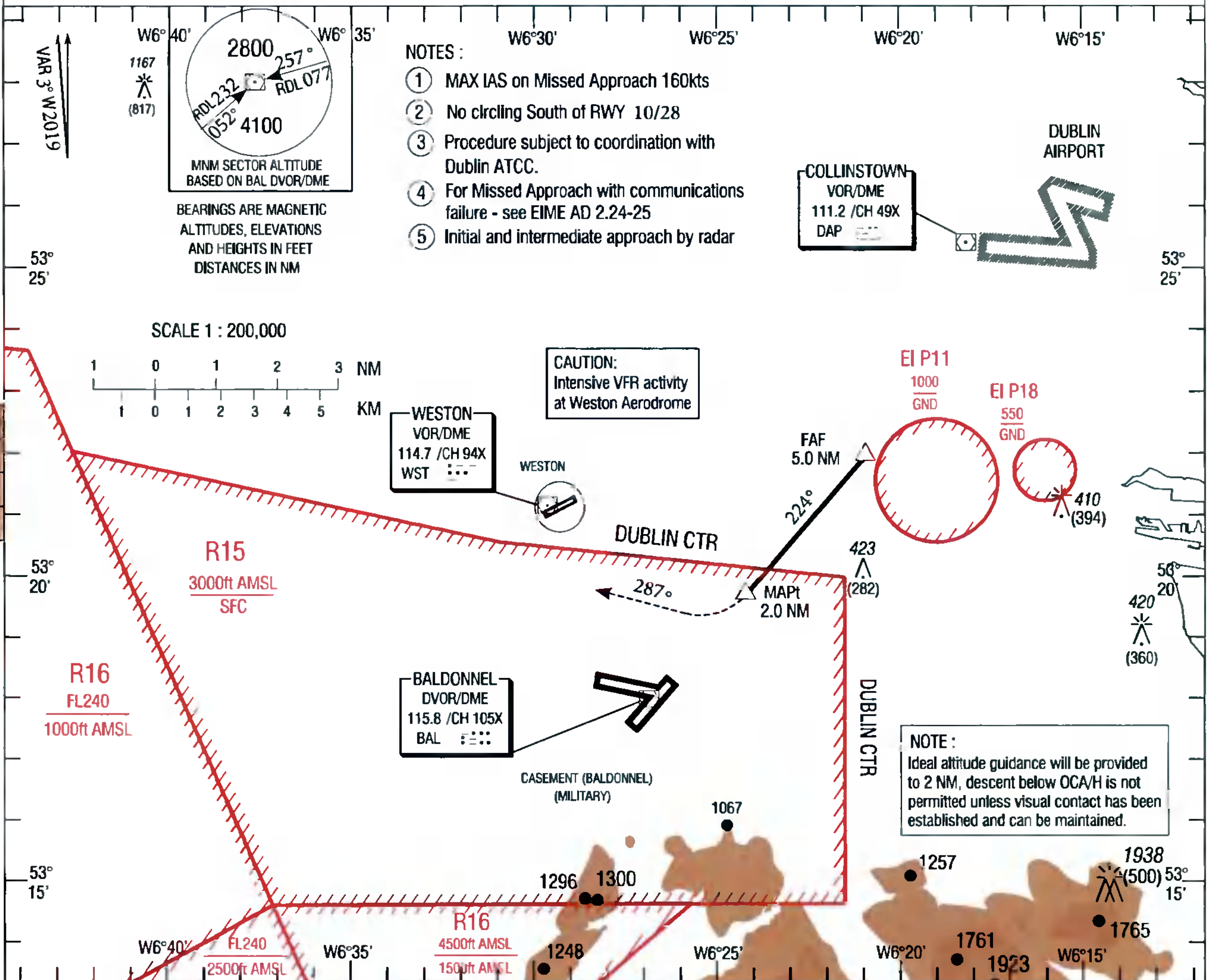
TWR BAL	123.500
RADAR	122.000
ATIS	122.805

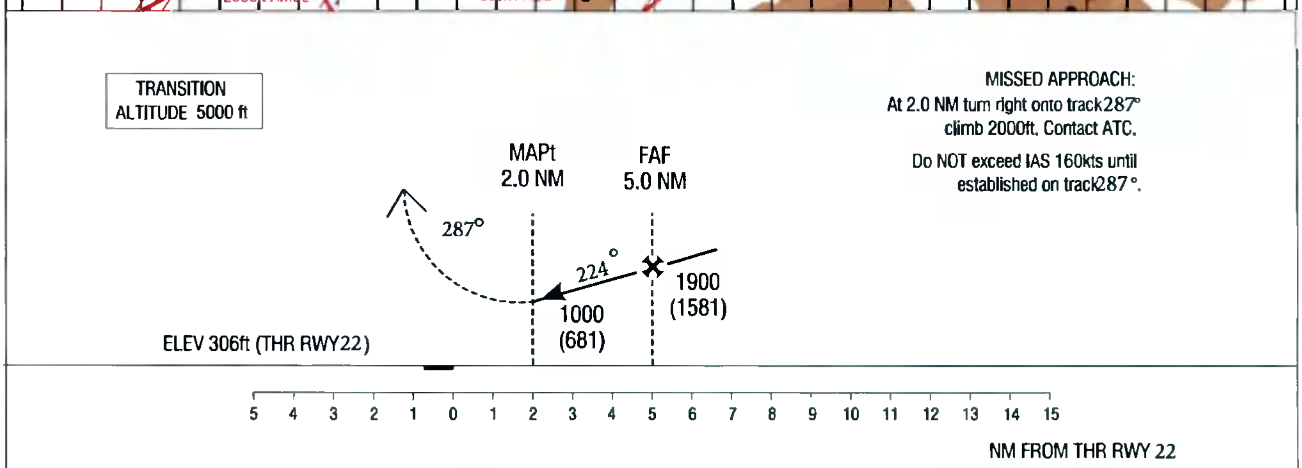
CONSULT NOTAM FOR LATEST INFORMATION

BALDONNEL/CASEMENT (MIL)

SRA RWY22 ① ② ③ ④ ⑤

(ACFT CAT A, B, C)





	CAT	A	B	C
STRAIGHT IN LANDING RWY22 OCA (H) 1000 (681)	CEILING	700	700	700
	VIS	2000	2000	3600
	ALS OUT	2400	2400	4000
CIRCLE TO LAND (Heights AAL)	OCA (H)	1000 (681)	1000 (681)	1000 (681)
	CEILING	700	700	700
	VIS	2000	2000	3600

LIGHTING

PAPI 3°
REIL
RWY LTs
SALS

IDEAL ALTITUDE (HEIGHT) ON FINAL APPROACH								
Distance (NM)		5.0		4.0		3.0		2.0
ALT (HT)		1900 (1581)		1590 (1271)		1280 (961)		970 (651)
GROUND SPEED	kts	60	80	100	120	140	160	180
Rate of descent gradient 5%	ft/min	304	405	506	608	709	810	911

CHANGE: VAR, TRACKS, RWY DESIGNATOR

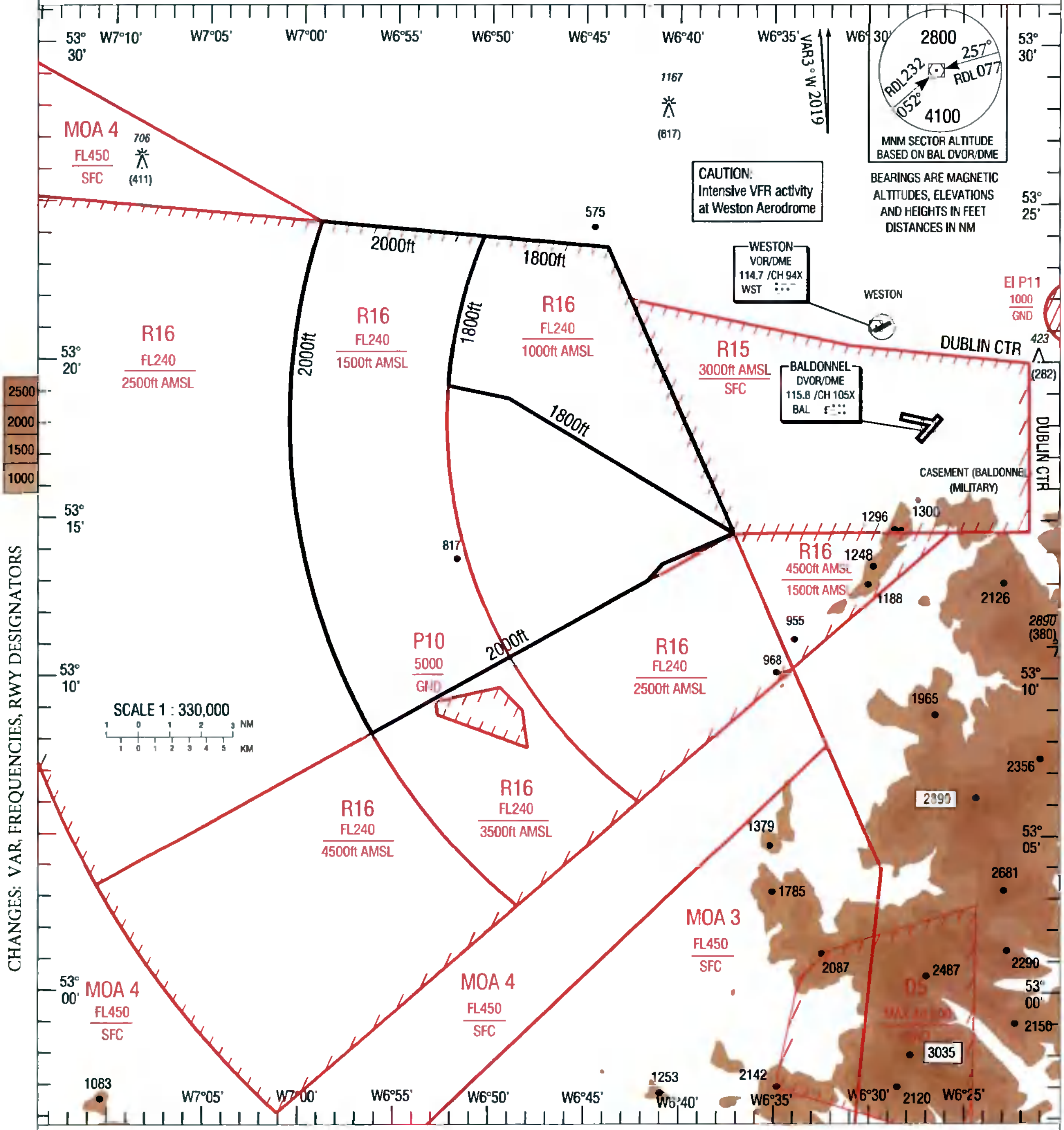
INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 319 ft
HEIGHTS RELATED TO AERODROME ELEVATION

TWR	123.500
BAL RADAR	122.000
ATIS	122.805

CONSULT NOTAM FOR LATEST INFORMATION

BALDONNEL/CASEMENT (MIL)
RADAR VECTORING
(ACFT CAT A, B, C, D)



CHANGES: VAR, FREQUENCIES, RWY DESIGNATORS

NOTES :

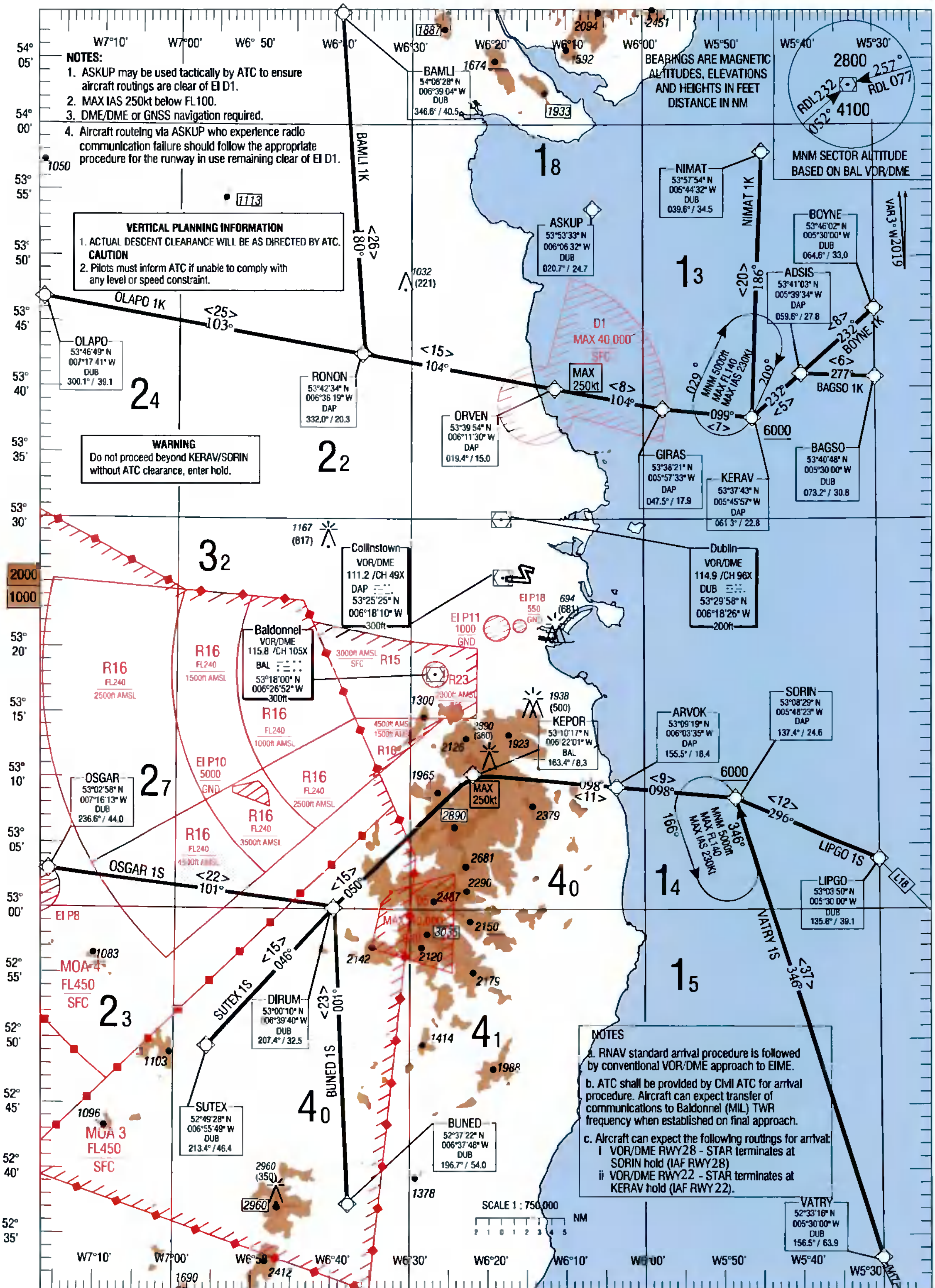
1. RADAR service normally available MON to FRI 0900 - 1630 (1)
2. Vectors available to establish on Final Approach for all instrument procedures
3. SRAs to RWY 10 and RWY 22 on request

RNAV STANDARD ARRIVAL CHART
INSTRUMENT (STAR) - ICAO

TRANS ALT 5000ft
TRANS LEVEL by ATC

TWR	123.500
BAL RADAR	122.000
ATIS	122.805
DUBLIN LOWER SOUTH	120.755
DUBLIN LOWER NORTH	132.580

BALDONNEL/CASEMENT (MIL)
RWY 22/28
NIMAT 1K, BOYNE 1K, BAGSO 1K, LIPGO 1S, VATRY 1S, BUNED 1S, SUTEX 1S, OSGAR 1S, OLAPO 1K, BAMLI 1K

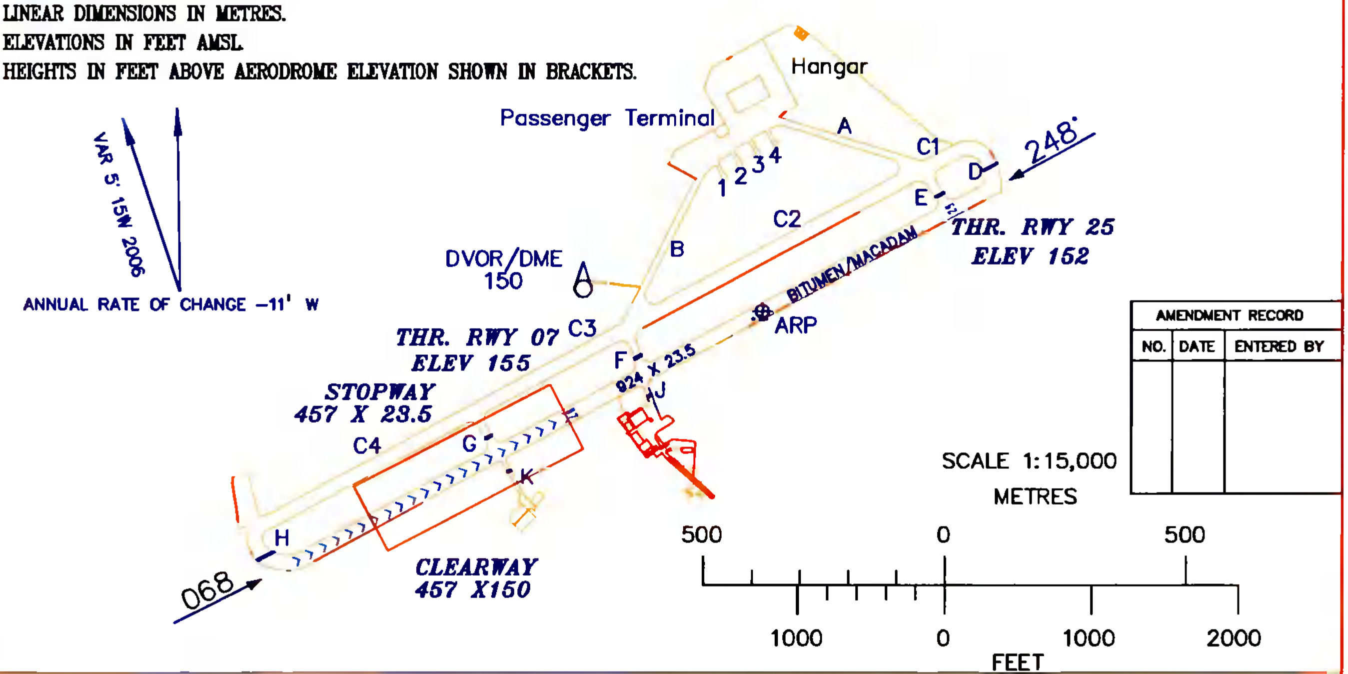


AERODROME CHART – ICAO	53 21 08.25 N 006 29 17.92 W	ELEV 155FT	TWR 122.4 GND 119.425 ATIS 118.875	CONSULT NOTAM FOR LATEST INFORMATION	WESTON AIRPORT/ DUBLIN

RWY	DIRECTION	THR		BEARING STRENGTH
07	068°	53 21 01.48 N	006 29 40.17 W	PCN 45/F/A/W/T
25	248°	53 21 15.03 N	006 28 55.66 W	

LEGEND	
HELICOPTER STANDS	1
RUNWAY HOLDING POSITION MARKING	═ ═ ═ ═

BEARINGS ARE MAGNETIC.
LINEAR DIMENSIONS IN METRES.
ELEVATIONS IN FEET AMSL.
HEIGHTS IN FEET ABOVE AERODROME ELEVATION SHOWN IN BRACKETS.



MARKING AIDS RUNWAY 07/25

NIL

LIGHTING AIDS RUNWAY 07/25

Helicopter Stand	Latitude	Longitude	Max Wingspan	Max Length	Conditions
01	53 21 17.18 N	006 29 22.05 W			
02	53 21 17.96 N	006 29 20.18 W			
03	53 21 18.67 N	006 29 18.25 W			
04	53 21 19.31 N	006 29 16.26 W			

NOTE 1: TAXIWAY AND APRON : PCN 45/F/A/W/T.
NOTE 2: TAXIWAY C1, C2, C3 AND C4: 30M WIDE.
NOTE 3: TAXIWAY A, B, D, E, F, G, H AND J: 16M WIDE.
NOTE 4: TAXIWAY K: 7M WIDE.

CHANGES: NEW ARP COORDINATES; NEW THRESHOLD COORDINATES FOR RUNWAY 25 AND 07; NEW THRESHOLD ELEVATION RUNWAY 07

APPENDIX 2
AVIATION WILDLIFE IMPACT ASSESSMENT REPORT

Intended for
Vantage Data Centers DUB11 Limited

Date
December 2021

Project Number
1620012232

VANTAGE DATA CENTER
AVIATION WILDLIFE IMPACT ASSESSMENT

RAMBOLL Bright ideas. Sustainable change.

VANTAGE DATA CENTER
AVIATION WILDLIFE IMPACT ASSESSMENT

Project no.	**1620012232**
Version	**F2**
Date	**15/12/2021**
Prepared by	**Danny Oliver**
Checked by	**Michael Beagan**
Approved by	**Cathal McKenna**

Ramboll
240 Blackfriars Road
London
SE1 8NW
United Kingdom

T +44 20 7631 5291
https://uk.ramboll.com

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Ramboll UK Limited
Registered in England & Wales
Company No: 03659970
Registered office:
240 Blackfriars Road
London
SE1 8NW

CONTENTS

1. BACKGROUND

1.1 Site Location

1.1.1 The site is located at Irish grid reference O 03687 30780, within Profile Park, as presented in Figure 1.1

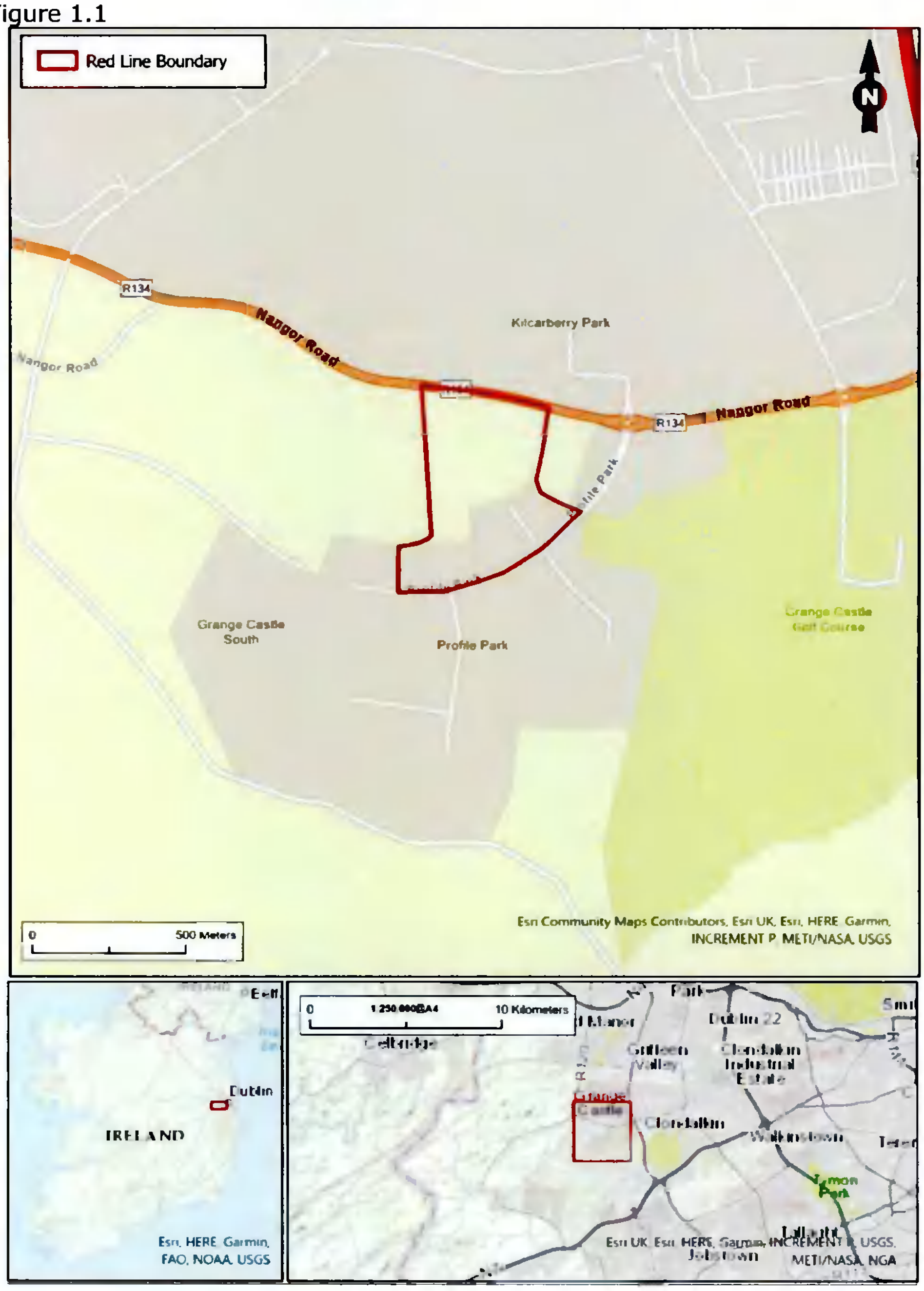

Figure 1.1: Site Location Plan

1.2 Site Description

1.2.1 The site boundaries are defined by:

- New Nangor Road (R134) to the north, beyond is an industrial park;
- Agricultural fields to the east, beyond which is Profile Park Road and Grange Castle Golf Club;
- Profile Park Road and roundabout to the south; and
- A data center development on agricultural fields and Bolands Car Garage to the west.

1.2.2 The site covers an area of approximately 8.7 hectares (ha).

1.2.3 The site is currently predominantly vacant. The site comprises a single storey residential dwelling and agricultural fields. The Baldonnel stream runs through the site in a south-east to north-west direction, flowing towards the north-west.

1.2.4 Representative photographs of the site are shown in Figure 1.2.

Figure 1.2: Site Photographs (left upper image looking north at residential dwelling onsite, left lower image looking north along Baldonnel Stream, centre looking south and right looking southeast at site boundaries)

1.2.5 This proposed development is located approximately 1.6km to the north of Runway 29 at Baldonnel (Casement) Aerodrome.

1.3 Legislation

1.3.1 Airports are bound by the United Nations International Convention on Civil Aviation standards and recommended practices enacted under the International Civil Aviation Organisation (ICAO), Annex 14. Chapter 9.5.4 requires airports to protect flights from the risks posed by wildlife hazards with guidance provided to enable these actions under national law.

1.3.2 The requirements provide for any development within the vicinity of an airport (guided as a 13km radius from an aerodrome reference point), that has the potential to attract hazardous birds (birds that have the possibility of causing damage to aircraft) to be reviewed and the risks eliminated or reduced to as low as reasonably practicable.

1.4 General risks to Aircraft

1.4.1 As bird strikes are not an uncommon occurrence, most aircraft have design parameters that include airframe and engine testing in relation to different size individual and flocks of birds.

1.4.2 As a military aerodrome that supports private aviation, Baldonnel aerodrome is used by aircraft that are generally more susceptible to damage from birds and other wildlife than civil airliners.

1.4.3 Developments that attract birds that have the potential to cause damage require consideration in relation to any increase in risk that may occur.

1.5 Development Risk

1.5.1 The wetland ponds, building roof and planting palette all present potential attractants to hazardous wildlife. There are similar sized ponds with islands that exist at similar distances to the airfield at present. These include waterbodies within the City West Hotel Golf club and Grange Castle Golf Club as well as at Kilmatead and on the south side of Greenogue Business Park. A small burn also runs around the west side of the airfield (the Griffeen River) and is identified on flood drawings as part of the development plans.

1.5.2 The proposals for the Data Center include landscaping for tree/shrub habitat has the potential to attract species of birds that will be hazardous to aviation. The habitat must be reviewed within the context of the existing background populations of hazardous birds and habitats within the area in order to determine any changes to risk.

1.5.3 The roof of the development may offer opportunities for nesting birds (e.g. Herring (Larus argentatus) or Lesser Black-backed (Larus fuscus) gulls) that could pose a threat to air safety. Other species that may potentially be attracted and are considered a hazard to aviation include arboreal birds such as Crows and other corvids (Corvidae) and Wood Pigeons (Columba palumbus) that may be attracted to the planting regime along with common waterbirds such as Mallard (Anas platyrhncos), feral geese (Branta/Anser spp), Mute Swan and potentially fish eating birds such as Grey Heron (Ardea cineria) to the waterbodies. The probability of these residing at levels different to the existing background populations, however, will vary. There are densities of existing trees both currently at the development site and within the surrounding area that indicate that the proposed planting scheme will not affect background levels and will not, therefore constitute an increase in risk.

1.5.4 The planting regime does not require modification as it matches existing background habitats. At this distance from the airport, however, the species planted, should aim to have no more than 15% berry or fruit bearing trees or bushes as these may attract larger numbers of arboreal species.

1.5.5 The rooftop is proposed within an area with several industrial estates present and is thus unlikely to add significantly to any attractant that already exists. It remains be prudent to have a bird hazard management plan attached to the building that prevents roof nesting gulls from establishing. This would require access to the roof to enable checks and / or dispersal / nest removal to be undertaken under licence. If annual checks in April occur and do not identify nesting gull presence, no further action would be required. As gulls have been known to cause roof damage it would be practical to have such a condition in place anyway in order to prevent any potential for roof damage that could result in water ingress to such a building. A simple annual check and subsequent licensed removal or prevention to stop nesting would be all that would be required.

1.5.6 The water retention ponds (designed to provide soakaway and reduce flooding but not to hold permanent water), are likely to result in less overall open water and for shorter periods of time than water corridors that already exist and local natural flooding areas would produce. As such, water retention ponds are unlikely to result in any increase in hazardous waterbird presence and do not require design modifications.

1.5.7 The proposed permanent waterbodies are not large enough to provide a site for a nocturnal gull roost, and, with overhead trees and planting is unlikely to be an attractant to gulls for bathing or resting during the day. Given that the site is designed for nature conservation and does not feature feeding opportunities, there will be little additional attraction to gulls or other scavenging birds that may be of concern to the airport. Some attraction may occur to species such as Grey Heron that may visit the site to hunt fish or amphibians that may be introduced or would naturally colonise the water. It is unlikely, however, that the site would increase the numbers of Grey Herons in the area as any birds that may visit such a site would be most likely to be related to birds that already occur in the area and utilise existing water corridors and ponds. Reducing the ability of such birds to use the waterbody would be beneficial.

1.5.8 The proposed ponds do not have islands. This significantly reduces the potential for nesting opportunities for larger hazardous waterfowl including Mallard, feral geese or Mute Swans. The presence of such birds can result in a significant issue for flight safety.

1.6 Management options

1.6.1 In order to minimise the risk of large hazardous waterfowl, all large islands shall be removed entirely. Doing so removes the security provided by being surrounded by water and discourages the use of the site by such species. e.g. feral geese and mute swan.

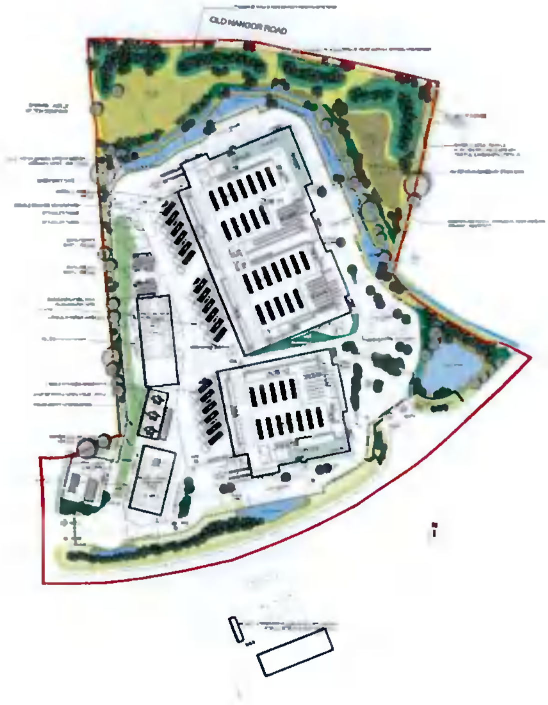

Figure 1.3: Site Layout Plan

1.6.2 Further reductions in the risk from other hazardous birds that may be attracted would include steepening the sides of the embankments and reducing any short vegetation adjoining the margins. Planting a barrier along the shoreline with, for example, shrubs and brambles will enhance the biodiversity of the site for non-hazardous species whilst reducing the presence of hazardous birds on a pond this small.

1.6.3 Similarly, the planting of a wide barrier of tall marginal vegetation such as Reedmace (Typha latifolia) will reduce the surface area of the water that acts as an attractant, prevent any potential 'feeding of the ducks', and again provide an enhanced habitat for small birds whilst reducing the ability of more hazardous birds to enter or exit the water.

1.7 Construction Phase

1.7.1 Any development that involves disruption of the ground has the potential to attract scavenging species particularly small gulls (e.g. Chroicocephalus ridibundus) and corvids (e.g. Corvus frugilegus). Any significant presence of these birds over and above that which would otherwise be present may present a significant flight safety risks should birds transit over or through the critical airspace. A construction phase bird hazard management plan (BHMP) would be put in place to ensure that, when the development is being constructed, no significant numbers of hazardous birds are allowed to forage on the site.

1.7.2 The contractor would ensure that enabling works occur in sections (cut/fill), reducing the area of land exposed (which may attract flocks of foraging birds) at any given time. The presence of humans and loud machinery on site is also likely to deter large flocks. The creation of any habitat likely to attract foraging birds will be small in area and temporary.

1.7.3 Whilst this is unlikely to require any action, a BHMP that requires the developer to disperse any increased presence of scavenging birds should be initiated. As such a site at this distance from the airport a suggested dispersal actions, for example, would occur whenever more than 20 gulls, corvids or Starlings attempted to use areas where ground works or other activities on site resulted in their presence. The objective should be to ensure that all such birds are dispersed off-site within 30 minutes of their detection. If necessary, the developer should equip and train staff in the use of a small starter pistol and instruct staff to record a log of any actions taken. A range of techniques may be used, including but not limited to, human presence, arm waving, flags, or acoustic noises.

1.8 Summary

1.8.1 The development plans predominantly match the existing environment and do not present a significant probability of increasing hazardous bird presence and thus increasing risk to aircraft operating out of Baldonnel Aerodrome.

1.8.2 Never the less, it is recommended that a bird hazard management plan is provided to reduce the presence of any hazardous birds that arrive during the construction phase of the development. Similarly, the planting palette used for landscaping shall not exceed 15% berry bearing bushes and the permanent wetland should be modified to remove the islands and to enhance biodiversity whilst reducing hazardous bird access to the site.

1.8.3 Where this cannot be delivered, a longer term BHMP that aims to disturb and prevent hazardous waterfowl nesting at the site may be beneficial. This may also include a plan to prevent gulls from nesting on the rooftop of the site should it be suitable for such species to breed.

APPENDIX 3
PV GLINT AND GLARE ASSESSMENT REPORT

Glint and Glare Assessment

Profile Park Data Centre Solar Array

21/02/2022

Disclaimer

Neo Environmental Limited shall have no liability for any loss, damage, injury, claim, expense, cost or other consequence arising as a result of use or reliance upon any information contained in or omitted from this document.

Neo Environmental Ltd

Head Office - Glasgow:
Wright Business Centre,
1 Lonmay Road,
Glasgow.
G33 4EL
T 0141 773 6262
E: info@neo-environmental.co.uk

Warrington Office:	**Rugby Office:**
Cinnamon House, Crab Lane, Warrington, WA2 0XP. T: 01925 661 716 E: info@neo-environmental.co.uk	Valiant Suites, Lumonics House, Valley Drive, Swift Valley, Rugby, Warwickshire, CV21 1TQ. T: 01788 297012 E: info@neo-environmental.co.uk
Ireland Office:	**Northern Ireland Office:**
Johnstown Business Centre, Johnstown House, Naas, Co. Kildare. T: 00 353 (0)45 844250 E: info@neo-environmental.ie	83-85 Bridge Street Ballymena, Co. Antrim BT43 5EN T: 0282 565 04 13 E: info@neo-environmental.co.uk

neo ENVIRONMENTAL

Prepared For:

Ramboll

Prepared By:

Tom Saddington BEng, MSc.

Michael McGhee TechIOA BSc

David Thomson BSc (Hons), MSc

	Name	Date
Edited By:	Tom Saddington	21/02/2022
Checked By:	Nicole Beckett	21/02/2022
	Name	**Signature**
Approved By	Paul Neary	

Contents

1. EXECUTIVE SUMMARY

1.1. There is no guidance or policy available across Ireland in relation to the assessment of glint and glare from a Proposed Development. However, as identified by UK policy, it is recognised as a potential impact which needs to be considered for a proposed solar development.

1.2. This assessment considers the potential impacts on ground-based receptors such as roads and residential dwellings as well as aviation assets. A 500m survey area around the Application Site is considered adequate for the assessment of ground-based receptors, whilst a 30km study area is chosen for aviation receptors. Within 500m of the Application Site, there is one residential receptor and five road receptors which were considered. As per the methodology section, where there are a number of residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for the glint and glare analysis as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been included in the glint and glare analysis with some context to all receptors given in the visual analysis. Three road-based receptors were dismissed as they are located within the no reflection zones and therefore, will not be impacted upon because of the Proposed Development. Five aerodromes are located within 30 km of the Proposed Development: Casement Aerodrome, Weston Airport, Dublin Airport, Gowran Grange Airfield and Ballyboughal Airfield. Three Aerodromes, Casement Aerodrome, Weston Airport and Dublin Airport, require a detailed assessment due to their size and orientation in relation to the Proposed Development.

1.3. The solar panels will face in a southwards direction, 157.7 degrees on the roof of DUB11.1 and DUB11.2 and 168.6 degrees on the roof of DUB12, will be inclined at an angle of 10 degrees and at a height of 14.12m above ground level (AGL). As the panels will be fixed in this position, points at the tops of the panels have been used to determine the worst-case impacts on receptors.

1.4. Geometric analysis was conducted for one individual residential receptor and two road receptors.

1.5. The assessment concludes that:

- Solar reflections are possible at none of the one residential receptor assessed within the 500m study area. Initial impacts were **None** at the receptor.
- Solar reflections are possible at one of the two road receptors assessed within the 500m study area. Initial impacts were **Low** at one and **None** at one receptor. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** at all receptor points.
- **No impact** on train drivers or railway infrastructure is predicted.

- Green glare impacts are predicted on aviation receptors for Runways 10 and 22 at Casement Aerodrome. Green glare is an **acceptable** impact on aviation receptors for runways. Therefore, impacts on the Casement Aerodrome Runways 10 and 22 aviation receptors are **Not Significant**.

1.6. **No mitigation is required**, as the impacts are **None** and **Not Significant**.

1.7. The effects of glint and glare and their impact on local receptors has been analysed in detail and is predicted to be **None** impacts at all ground-based receptors, and **None** or **Not Significant** at all aviation receptors, and therefore **acceptable impacts**.

2. INTRODUCTION

BACKGROUND

2.1. Neo Environmental Ltd has been appointed by Ramboll (the "Applicant") to undertake environmental assessments and associated planning for a proposed solar array development (the "Proposed Development") at the Profile Park Data Centre, Dublin (the "Application Site").

2.2. For the purposes of this report, the site is one distinct area. This can be viewed in **Appendix B and C.**

Development Description

2.3. The Proposed Development will consist of the construction of PV panels mounted on the roofs of two proposed structures, DUB11.1 and DUB11.2, and DUB12.

2.4. Please see **Figure 3, 4 and 5 of Appendix A** for the overall layout of the Proposed Development.

Site Description

2.5. The Application Site is located in the city of Dublin, at the site of the proposed Profile Park Data Centre at approximate Irish Grid Reference (IGR) N230714 E303734, the Application Site covers a total area of c. 9.8 hectares. The Application Site consists of one distinct area of land.

2.6. The Application Site comprises a single site and the Proposed Development will be accessed via existing roads from Falcon Avenue. The solar panels will be confined entirely to the roofs of the proposed structure at a height of approximately 14.12m.

2.7. The Application Site is generally well enclosed and consists of grasslands. The site is surrounded by vegetation and commercial/industrial buildings. The solar panels and main infrastructure will occupy the roofs in the Application Site. Please See **Figure 3** for the overall layout.

SCOPE OF REPORT

2.8. Although there may be small amounts of glint and glare from the metal structures associated with the solar farm, the main source of glint and glare will be from the panels themselves and this will be the focus of this assessment.

2.9. For the purpose of this report, the roofs will be treated as smooth glass with no anti-reflection coating to conform with a worst-case scenario assessment. Furthermore, the legislation and guidance that would be used for a similar size photovoltaic ("PV") solar farm will be used when assessing this development.

2.10. Glare is significantly less intense in comparison to glint and can be described as a continuous source of bright light, relative to diffused lighting. This is not a direct reflection of the sun, but a reflection of the sky around the sun.

2.11. This report will concentrate on the effects of glint and glare and its impact on local receptors and will be supported with the following Figures and Appendices.

- Appendix A: Figures
  - Figure 1: Residential Receptors
  - Figure 2: Road Based Receptors
  - Figure 3: Site Layout
  - Figure 4: DUB11 Roof Plan
  - Figure 5: DUB12 Roof Plan
  - Figure 6: Casement Aerodrome Chart
  - Figure 7: Weston Airport Aerodrome Chart
  - Figure 8: Dublin Airport Aerodrome Chart
- Appendix B: Residential Receptor Glare Results
- Appendix C: Road Receptor Glare Results
- Appendix D: Aviation Receptor Glare Results
- Appendix E: Visibility Assessment Evidence
- Appendix F: Solar Module Glare and Reflectance Technical Memo[1]

Statement of Authority

2.12. This Glint and Glare Assessment has been produced by Tom Saddington, Michael McGhee and David Thomson of Neo Environmental. Having completed a civil engineering degree in 2012, Michael has produced Glint and Glare assessments for over 1GW of solar farm developments across the UK and Ireland.

---

[1] Sunpower Corporation (September 2009), T09014 Solar Module Glare and Reflectance Technical Memo

2.13. Tom has an undergraduate degree in Bioengineering and graduated with an MSc in Environmental and Energy Engineering in January 2020. He has been working on various technical assessments including glint and glare reports for numerous solar farms in Ireland and the UK.

2.14. David has an undergraduate degree in physics, as well as a MSc in sensor design and a MSc in nanoscience. He is an Environmental Engineer currently being trained in Glint and Glare assessments.

Definitions

2.15. This study examined the potential hazard and nuisance effects of glint and glare in relation to ground-based receptors, this includes the occupants of surrounding dwellings as well as road users. The Federal Aviation Guidance (FAA) in their "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[2] have defined the terms 'Glint' and 'Glare' as meaning;

- Glint – *"A momentary flash of bright light"*
- Glare – *"A continuous source of bright light"*

2.16. Glint and glare are essentially the unwanted reflection of sunlight from reflective surfaces. This study used a multi-step process of elimination to determine which receptors have the potential to experience the effects of glint and glare. It then examined, using a computer-generated geometric model, the times of the year and the times of the day such effects could occur. This is based on the relative angles between the sun, the panels and the receptor throughout the year.

General Nature of Reflectance from Photovoltaic Panels

2.17. In terms of reflectance, photovoltaic solar panels are not highly reflective surfaces. They are designed to absorb sunlight and not to reflect it. Nonetheless, photovoltaic panels have a flat polished surface, which omits 'specular' reflectance rather than a 'diffuse' reflectance, which would occur from a rough surface. Several studies have shown that photovoltaic panels (as opposed to Concentrated Solar Power) have similar reflectance characteristics to water, which is much lower than glass, steel, snow and white concrete by comparison (see **Appendix F** for details). Similar levels of reflectance can be found in rural environments from shed roofs and the lines of plastic mulch used in cropping. In terms of the potential for reflectance from photovoltaic panels to cause hazard and/ or nuisance effects, there have been several studies undertaken in respect of schemes in close proximity to airports. The most recent of these was compiled by the Solar Trade Association (STA) in April 2016 which used a number of case

[2] Harris, Miller, Miller & Hanson Inc. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at:

https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf studies and expert opinions, including from Neo Environmental. The summary of this report states that *"the STA does not believe that there is cause for concern in relation to the impact of glint and glare from solar PV on aviation and airports..."*[3].

Time Zones / Datum's

2.18. Locations in this report were given in Eastings and Northings using the 'OSNI 1952 Irish National Grid' grid reference system unless otherwise stated. Ireland uses Irish Standard Time (IST, UTC+01:00) in the summer months and Greenwich Mean Time (UTC+0) in the winter period. For the purposes of this report all time references were in GMT, however if reference was made to a time which falls within the IST then this was outlined in the report.

Consultation

2.19. This Glint and Glare Assessment has been produced in anticipation of South Dublin City Council requesting further information.

[3] Solar Trade Association. (April 2016). *Summary of evidence compiled by the Solar Trade Association to help inform the debate around permitted development for non - domestic solar PV in Scotland. Impact of solar PV on aviation and airports.* Available at: http://www.solar-trade.org.uk/wp-content/uploads/2016/04/STA-glint-and-glare-briefing-April-2016-v3 pdf

3. LEGISLATION AND GUIDANCE

PLANNING POLICY

3.1. The National Planning Framework (NPF) was adopted by the Irish Government on the 29th of May 2018. However, this policy document provides no current provision within the Irish Planning System for the requirement of Glint and Glare Assessments to support applications for the installation of ground mounted solar PV systems. It is therefore considered appropriate to defer to extant policy guidance within the UK planning system; the National Planning Policy Guidance (NPPG) on Renewable and Low Carbon Energy[4].

3.2. Paragraph 013 sets out planning considerations that relate to large scale ground-mounted solar PV farms. This determines that the deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively. Considerations to be taken into account by local planning authorities are;

- *"the proposal's visual impact, the effect on landscape of glint and glare and on neighbouring uses and aircraft safety;*
- *the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun."*

INTERIM CAA GUIDANCE – SOLAR PHOTOVOLTAIC SYSTEMS (2010)

3.3. There is little guidance on the assessment of glint and glare from solar farms with regards to aviation safety. The Civil Aviation Authority (CAA) has published interim guidance on 'Solar Photovoltaic Systems[5]', they also intend to undertake a review of the potential impacts of solar PV developments upon aviation, however this is yet to be published.

3.4. The interim guidance identifies the key safety issues with regards to aviation, including *"glare, dazzling pilots leading them to confuse reflections with aeronautical lights."* It is outlined that solar farm developers should be aware of the requirements to comply with the Air Navigation

[4] NPPG Renewable and Low Carbon Energy. Available at: http://planningguidance.communities.gov.uk/blog/guidance/renewable-and-low-carbon-energy/particular-planning-considerations-for-hydropower-active-solar-technology-solar-farms-and-wind-turbines/#paragraph_012

[5] CAA (2010) Interim CAA Guidance – Solar Photovoltaic Systems. Available at: http://www.enstoneflyingclub.co.uk/files/caa_view_on_solar_panel_instalations.pdf?PHPSESSID=8900a41db8a205da84fca7bbc14eae69

Order (ANO), published in 2009. In particular, developers should take cognisant of the following articles of the ANO[6], including:

- *"Article 137 – Endangering safety of an aircraft – A person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person in an aircraft."*
- *Article 221 - Lights liable to endanger – "A person must not exhibit in the United Kingdom any light which:*
  - *a) by reason of its glare is liable to endanger aircraft taking off or from landing at an aerodrome; or*
  - *b) by reason of its liability to be mistaken for an aeronautical ground light liable to endanger aircraft"*
- *Article 222 – Lights which dazzle or distract – "A person must not in the United Kingdom direct or shine any light at any aircraft in flight so as to dazzle or distract the pilot of the aircraft."*

3.5. Relevant studies generally agree that there is potential for glint and glare from photovoltaic panels to cause a hazard or nuisance for surrounding receptors, but that the intensity of such reflections is similar to that emanating from still water. This is considerably lower than for other manmade materials such as glass, steel or white concrete (SunPower – 2009).

3.6. These Articles are considered within the assessment of glint and glare of the Proposed Development.

US Federal Aviation Administration Policy

3.7. The US Federal Aviation Administration (FAA) in their Solar Guide (Federal Aviation Authority, 2010)[7] incorporates a chapter on the impact and assessment of glint from solar panels. It concludes that (although subject to revision):

> *"...evidence suggests that either significant glare is not occurring during times of operation or if glare is occurring, it is not a negative effect and is a minor part of the landscape to which pilots and tower personnel are exposed."*

[6] CAA (2015) Air Navigation: The Order and Regulations. Available at: http://publicapps.caa.co.uk/docs/33/CAP%20393%20Fourth%20edition%20Amendment%201%20April%202015.pdf

[7] FAA (2010), Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide-print.pdf

3.8. The current policy (Federal Register, 2013)[8] demands that an ocular impact assessment must be assessed at 1-minute intervals from when the sun rises above the horizon until the sun sets below the horizon. Specifically, the developer must use the 'Solar Glare Hazard Analysis Tool' (SGHAT) tool specifically and reference its results as this was developed by the FAA and Sandia National Laboratories as a standard and approved methodology for assessing potential impacts on aviation interests, although it notes other assessment methods may be considered. The SGHAT tool has since been licensed to a private organisation who were also involved in its development and it is the software model used in this assessment.

3.9. Crucially, the policy provides a quantitative threshold which is lacking in the Irish guidance. This outlines that a solar development will not automatically receive an objection on glint grounds if low intensity glint is visible to pilots on final approach. In other words, low intensity glint with a low potential to form a temporary after-image would be considered acceptable under US guidance. Due to the lack of legislation and guidance within Ireland, this US document has been utilised as guidance for this report.

3.10. The FAA guidance states that for a solar PV development to obtain FAA approval or to receive no objection, the following two criteria must be met:

- No potential for glint or glare in the existing or planned Air Traffic Control Tower (ATCT)
- No potential for glare (glint) or "low potential for after-image" along the final approach path for any existing or future runway landing thresholds (including planned or interim phases), as shown by the approved layout plan (ALP). The final approach path is defined as 2 miles from 50 feet above the landing threshold using a standard 3-degree glide path.

3.11. The geometric analysis included later in this report, which defines the extent and time at which glint may occur, is required by the FAA as the methodology to be used when assessing glint and glare impacts on aviation receptors. This report will follow the methodology required by the FAA as it offers the most robust assessment method currently available.

DUBLIN CITY DEVELOPMENT PLAN 2016 - 2022

3.12. The Dublin City Development Plan 2016 – 2022[9] was adopted by Dublin City Council at a Special Council Meeting on 23rd September 2016. The plan came into effect on 21st October 2016.

3.13. The plan states the following in **Policy CC3**:

[8] FAA (2013), Interim Policy, *FAA Review of Solar Energy System Projects on Federally Obligated Airports*. Available at https://www.federalregister.gov/documents/2013/10/23/2013-24729/interim-policy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

[9] Dublin City Development Plan 2016 – 2022. Available at: https://www.dublincity.ie/dublin-city-development-plan-2016-2022

'It is the Policy of Dublin City Council:

To promote energy efficiency, energy conservation, and the increased use of renewable energy in existing and new developments.'

3.14. There are no policies contained within the CDP which are of relevance to this Glint and Glare Assessment.

3.15. Dublin City Council is reviewing the current Dublin City Development Plan 2016 – 2022 and preparing a new City Development Plan (the Plan) up to 2028. The pre-draft consultation ended on 22bd February 2021. The Chief Executives response to the issues raised in the submissions has been prepared and his report has been submitted to the City Council for the Elected Members consideration.

3.16. After this stage, the draft development plan will be prepared and submitted to the members for their consideration in late November 2021.

4. METHODOLOGY

4.1. A desk-based assessment was undertaken to identify when and where glint and glare may be visible at receptors within the vicinity of the Proposed Development, throughout the day and the year.

SUN POSITION AND REFLECTION MODEL

Sun Data Model

4.2. The calculations in the solar position calculator are based on equations from Astronomical Algorithms[10]. The sunrise and sunset results are theoretically accurate to within a minute for locations between +/- 72° latitude, and within 10 minutes outside of those latitudes. However, due to variations in atmospheric composition, temperature, pressure and conditions, observed values may vary from calculations.

Solar Reflection Model

4.3. The position of the sun is calculated at one-minute intervals of a typical year, in this instance the year assessed is 2022.

4.4. In order to determine if a solar reflection will reach a receptor, the following variables are required:

- Sun position;
- Observer location; and
- Tilt, orientation, and extent of the modules in the solar array.

4.5. The model assumes that the azimuth and horizontal angle of the sun is the same across the whole solar farm. This is considered acceptable due to the distance of the sun from the Proposed Development and the miniscule differences in location of the sun over the Proposed Development.

4.6. Once the position of the sun is known for each time interval, a vector reflection equation determines the reflected sun vector, based on the normal vector of the solar array panels. This assumes that the angle of reflection is equal to the angle of incidence reflected across a normal plane. In this instance the plane being the vector which the solar panels are facing.

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[10] Jean Meeus, *Astronomical Algorithms* (Second Edition), 1999

4.7. On knowing the vector of the solar reflection, the azimuth is calculated and the horizontal reflection from multiple points within the solar farm. These are then compared with the azimuth and horizontal angle of the receptor from the solar farm to determine if it is within range to receive solar reflections.

4.8. The solar reflection in the model is considered to be specular as a worst-case scenario. In practice the light from the sun will not be fully reflected as solar panels are designed to absorb light rather than reflect it. The previous text and **Appendix F** outline the reflective properties of solar glass and compares it to other reflective surfaces. Although the exact figures in this report could be argued, it is included as a visual guide and it agrees with most other reports, in that solar glass has less reflective properties than other types of glass, bodies of water and snow, and that the amount of reflective energy drops as the angle of incidence decreases.

4.9. Most modern panels have a slight surface texture which should have a small effect on diffusing the solar radiation further; although, this has not been modelled to conform with the worst-case scenario assessment.

4.10. The panel reflectivity has been modelled to assume an anti-reflective coating (ARC) which is the industry standard for photo-voltaic panels and further reduces the reflective properties of the PV panels.

Determination of Ocular Impact

4.11. The software used for this assessment is based on the Sandia Laboratories Solar Glare Hazard Analysis Tool (SGHAT). This tool is specifically mentioned in the FAA guidance as the software which should be used in this type of assessment.

4.12. Determination of the ocular impact requires knowledge of the direct normal irradiance, PV module reflectance, size and orientation of the array, optical properties of the PV module, and ocular parameters. These values are used to determine the retinal irradiance and subtended source angle used in the ocular hazard plot.

4.13. The ocular impact[11] of viewed glare can be classified into three levels based on the retinal irradiance and subtended source angle: low potential for after-image (green), potential for after-image (yellow), and potential for permanent eye damage (red).

4.14. Green glare can be ignored when looking at ground based and some aviation receptors. Green glare does not cause temporary flash blindness and happens at an instant with very slight disturbance. As per FAA guidelines mitigation is only required for green glare when affecting an Air Traffic Control Tower, but not for when affecting pilots. Therefore, it can be assumed that green glare is acceptable for ground-based receptors.

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[11] Ho, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation, Journal of Solar Energy Engineering-Transactions of the Asme, 133(3).

4.15. The subtended source angle represents the size of the glare viewed by an observer, while the retinal irradiance determines the amount of energy impacting the retina of the observer. Larger source angles can result in glare of high intensity, even if the retinal irradiance is low.

Relevant Parameters of the Proposed Development

4.16. The panels will be mounted on metal frames on the roofs of two proposed buildings.

4.17. The maximum above ground level height of the panels is 14.12m and points at the top of the panels are used to determine the potential for glint and glare generation.

IDENTIFICATION OF RECEPTORS

Ground Based Receptors

4.18. Glint is most likely to impact upon a ground-based receptor close to dusk and dawn, when the sun is at its lowest in the sky. Therefore, any effect would likely occur early in the day or late in the day, reflected to the west at dawn and east at dusk.

4.19. A 500m study area from the panels was deemed appropriate for the assessment of ground-based receptors as this seemed to contain a good spread of residential and road receptors in most directions from the Proposed Development. The further distance a receptor is from a solar farm, the less chance it has of being affected by glint and glare due to scattering of the reflected beam and atmospheric attenuation, in addition to obstructions from ground sources, such as any intervening vegetation or buildings.

4.20. An observer height of 2m was utilised for residential receptors, as this is a typical height for a ground-floor window. Upper floor windows are not analysed geometrically; however, are considered as part of the visual analysis. With regards to road users, a receptor height of 1.5m was employed as this is typical of eye level. Rail driver's eye level was assumed to be 2.75m above the rail for signal signing purposes and therefore this is the height used for assessment purposes.

4.21. Where there are a number of residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for full assessment as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group has been analysed in detail with the worst-case impacts attributed to that receptor.

Aviation

4.22. Glint is only considered to be an issue with regards to aviation safety when the solar farm lies within proximity to a runway, particularly when the aircraft is descending to land. En-route activities are not considered an issue as the flight will most likely be at a higher altitude than the solar reflection.

4.23. Should a solar farm be proposed within the safeguarded zone of an aerodrome, a full geometric study may be required (depending on the orientation from the Proposed Development) which would determine if there is potential for glint and glare at key locations, most likely on the descent to land.

4.24. Buffer zones to identify aviation assets vary depending on the safeguarding criteria of that asset. All aerodromes within 30km will be identified, however generally the detailed assessments are only required within 20km for large international aerodromes, 10km for military aerodromes and 5km for small aerodromes.

Magnitude of Impact

Static Receptors

4.25. Although there is no specific guidance set out to identify the magnitude of impact from solar reflections, the following criteria has been set out for the purposes of this report:

- **High** - Solar reflections impacts of over 30 hours per year or over 30 minutes per day
- **Medium** - Solar reflections impacts between 20 and 30 hours per year or between 20 minutes and 30 minutes per day
- **Low** - Solar reflections impacts between 0 and 20 hours per year or between 0 minutes and 20 minutes per day
- **None** - Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

Moving Receptors (Road and Rail)

4.26. Again, no specific guidance is available to identify the magnitude of impact from solar reflections on moving receptors except in aviation, however it is thought that a similar approach should be applied to moving receptors as aviation, based on the ocular impact and the potential for after-image.

4.27. The FAA guidance states that for a solar PV development to obtain FAA approval or to receive no objection the following criteria must be met:

- No potential for glare (glint) or "low potential for after-image" along the final approach path for any existing or future runway landing thresholds (including planned or interim phases), as shown by the approved layout plan (ALP).

Moving Receptors (Aviation)

Approach Paths

4.28. Each final approach path which has the potential to receive glint is assessed using the Solar Glare Hazard Analysis Tool (SGHAT) model. The model assumes an approach bearing on the runway centreline, a 3-degree glide path with the origin 50ft (15.24m) above the runway threshold.

4.29. The computer model considers the pilots field of view. The azimuthal field of view (AFOV) or horizontal field of view (HFOV) as it is sometimes referred, refers to the extents of the pilot's horizontal field of view measured in degrees left and right from directly in front of the cockpit. The vertical field of view (VFOV) refers to the extents of the pilot's vertical field of view measured in degrees from directly in front of the cockpit. The HFOV is modelled at 90 degrees left and right from the front of the cockpit whilst the VFOV is modelled at 30 degrees.

4.30. The FAA guidance states that there should be no potential for glare or 'low potential for after-image' at any existing or future planned runway landing thresholds in order for the proposed Development to be acceptable.

Air Traffic Control Tower (ATCT)

4.31. An air traffic controller uses the visual control room to monitor and direct aircraft on the ground, approaching and departing the aerodrome. It is essential that air traffic controllers have a clear unobstructed view of aviation activity. The key areas on an aerodrome are the views towards the runway thresholds, taxiways and aircraft bays.

4.32. The FAA guidance states that no solar reflection towards the ATCT should be produced by a proposed solar development, however this should be assessed on a site by site basis and will depend on the operations at a particular aerodrome.

4.33. In order to determine the impact on the ATCT, the location and height of the tower will need to be fed into the SGHAT model and where there is a potential for 'low potential for After-Image' or more, then mitigation measures will be required.

Assessment Limitations

4.34. Below is a list of assumptions and limitations of the model and methods used within this report:

- The model does not consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
- The model does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results.
- Due to variations in atmospheric composition, temperature, pressure and conditions, observed values may vary slightly from calculated positions.
- The model does not account for the effects of diffraction; however, buffers are applied as a factor of safety.
- The model assumes clear skies at all times and does not account for meteorological effects such as cloud cover, fog, or any other weather event which may screen the sun.

4.35. Due to these assumptions and limitations the model overestimates the number of minutes of glint and glare which are possible at each receptor and presents the worst-case scenario. Where glint and glare are predicted a visibility assessment is carried out to determine a more accurate, real-world prediction of the impacts.

5. BASELINE CONDITIONS

5.1. In the northern hemisphere, there will never be solar reflections due south of a solar PV development as the position of the sun is always south. Furthermore, due to the slant of a solar panel (where the sun is due south, with an azimuth angle of 180 degrees), reflections will be directed skyward and not impact on ground-based receptors.

5.2. Based on the relatively flat topography in the area, solar reflections between five degrees below the horizontal plane to five degrees above it are described as near horizontal. Reflections from the Proposed Development within this arc have the potential to be seen by receptors at or near ground level.

5.3. Further analysis showed that this will only occur between the azimuth of 241.92 degrees and 291.18 degrees in the western direction (late day reflections) and 71.36 degrees and 121.27 degrees in the eastern direction (morning reflections) and therefore any ground-based receptor outside these arcs will not have any impact from solar reflections.

5.4. **Figure 1, 2 and 3 of Appendix A** show the respective study areas whilst also subtracting from this the areas where solar reflections will not impact on ground-based receptors due to the reasons set out in **paragraphs 5.1 to 5.3.**

RESIDENTIAL RECEPTORS

5.5. Residential receptors located within 500m of the Application Site have been identified (**Table 5 - 1**). Glint was assumed to be possible if the receptor is located within the ground-based receptor zones outlined previously.

5.6. There are no residential receptors which are within the no-reflection zones and are clearly identifiable in **Figure 1: Appendix A**. The process of how these are calculated is explained in **paragraphs 5.1 to 5.3** of this report.

5.7. As per the methodology section, where there are a number of residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for detailed analysis as the impacts will not vary to any significant degree. Where small groups of receptors are evident, the receptors on either end of the group have been assessed in detail.

Table 5 - 1: Residential Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	304134	230909	Yes

Road / Rail Receptors

5.8. There is one road within the 500m study area that requires detailed glint and glare analysis, which is New Nangor Road (R134).

5.9. The ground receptor no-reflection zones are clearly identifiable on **Figure 2: Appendix A** and the process of how these are calculated is explained in **paragraphs 5.1 to 5.3** of this report.

5.10. **Table 5 - 2** shows a list of receptors points within the study area which are 200m apart.

Table 5 - 2: Road Based Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	304151	230863	Yes
2	303952	230859	Yes
3	303756	230900	No
4	303557	230916	No
5	303374	230991	No

5.11. There are no railway lines within the 500m study area.

Aviation Receptors

5.12. Aerodromes within 30km of the proposed solar development can be found in **Table 5 - 3**.

Table 5 - 3: Airfields within close proximity

Airfield	Distance	Use
Casement Aerodrome	1.48km	Military
Weston Airport	4.85km	Licensed Aerodrome
Dublin Airport	15.54km	Licensed Aerodrome
Gowran Grange	19.89km	Small grass strip
Ballyboughal Airfield	26.38km	Small grass strip

5.13. There are three aerodromes, Casement Aerodrome, Weston Airport and Dublin Airport, within 30km of the Proposed Development which have been deemed large enough or close enough (for their size) to warrant a detailed assessment. This is in accordance with the safeguarding buffer zones outlined in **paragraph 4.24**.

Casement Aerodrome

5.1. Casement Aerodrome (ICAO code EIME) is designated as a IFR/VFR Military Aerodrome. It is located approximately 6.5NM (12km) west of Dublin.

5.2. The elevation of the aerodrome at the Aerodrome Reference Point (ARP) is 319ft (97.2m). It has two asphalt strip runways, details of which are given in **Table 5 - 4.**

Table 5 - 4: Runways at Casement Aerodrome

Runway Designation	True Bearing (°)	Length (m)	Width (m)
04	044	1463	45
22	224	1463	45
10	105	1829	45
28	285	1829	45

5.3. The threshold location and height of the runway at Casement Aerodrome are given in **Table 5 - 5**.

Table 5 - 5: Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
04	53° 17′ 62″ N	006° 27′ 25″ W	97.2
22	53° 18′ 20″ N	006° 26′ 37″ W	92.9
10	53° 18′ 27″ N	006° 28′ 13″ W	86.5
28	53° 18′ 05″ N	006° 26′ 53″ W	95.7

5.4. The ARP is located north of the midpoint of Runway 10/28. The actual location of the ARP and the ATCT is given in **Table 5 - 6** overleaf. The height of the ATCT is estimated to be 10m.

Table 5 - 6: Casement Aerodrome Reference Point

	Latitude	Longitude	Eastings	Northings
ARP	53° 17' 59.56" N	006° 26' 52.14" W	303526	228829
ATCT	53° 18' 19.78" N	006° 26' 30.43" W	303915	229460

Weston Airport

5.5. Weston Airport (ICAO code EIWT) is designated as a VFR only Aerodrome. It is located approximately 8NM (11.11 km) west of Dublin.

5.6. The elevation of the aerodrome at the Aerodrome Reference Point (ARP) is 155ft (47.24m). It has one bitumen/macadam strip runway, details of which are given in **Table 5 - 7**.

Table 5 - 7: Runways at Weston Airport

Runway Designation	True Bearing (°)	Length (m)	Width (m)
07	068	924	23
25	248	924	23

5.7. The threshold location and height of the runway at Weston Airport are given in **Table 5 - 8**.

Table 5 - 8: Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
07	53° 21' 01.48" N	006° 29' 40.17" W	47.24
25	53° 21' 15.03" N	006° 28' 55.66" W	46.33

5.8. The ARP is located 501m from the Runway 25 threshold. The actual location of the ARP and the ATCT is given in **Table 5 - 9**. The height of the ATCT is estimated to be 15m.

Table 5 - 9: Weston Airport Reference Point

	Latitude	Longitude	Eastings	Northings
ARP	53° 21' 08.25" N	006° 29' 17.92" W	300710	234595
ATCT	53° 35' 55.98" N	006° 48' 94.50" W	300615	234971

Dublin Airport

5.9. Dublin Airport (ICAO code EIDW) is designated as an International Civil Aerodrome. It is located approximately 5.3NM (10km) north of the city of Dublin.

5.10. The elevation of the aerodrome at the Aerodrome Reference Point (ARP) is 242ft (73.8m). It has two asphalt strip runways, details of which are given in **Table 5 - 10** overleaf.

Table 5 - 10: Runways at Dublin Airport

Runway Designation	True Bearing (°)	Length (m)	Width (m)
10R	095.24	2,637	45
28L	275.27	2,637	45
16	156.58	2,072	61
34	336.59	2,072	61

5.11. The threshold location and height of the runway at Dublin Airport are given in **Table 5 - 11**.

Table 5 - 11: Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
10R	53° 25′ 20.75″ N	006° 17′ 24.27″ W	73.76
28L	53° 25′ 12.94″ N	006° 15′ 02.08″ W	61.57
16	53° 26′ 13.16″ N	006° 15′ 43.12″ W	66.14
34	53° 25′ 11.66″ N	006° 14′ 58.54″ W	61.57

5.12. The ARP is located at the midpoint of the main runway. The actual location of the ARP and the ATCT is given in **Table 5 - 12**. The height of the old ATCT is 22m and the height of the new ATCT is 86.9m.

Table 5 - 12: Dublin Airport Reference Point

	Latitude	Longitude	Eastings	Northings
ATCT (New)	53° 25′ 44″ N	006° 15′ 52″ W	116820	400930
ATCT	53° 25′ 42″ N	006° 15′ 43″ W	116983	400858
ARP	53° 25′ 17″ N	006° 16′ 12″ W	116402	400118

6. IMPACT ASSESSMENT

6.1. Following the methodology outlined earlier in this report, geometrical analysis comparing the azimuth and horizontal angle of the receptors from the Proposed Development and the solar reflection was conducted. Although this assessment did not consider obstructions such as vegetation and buildings, discussion on the potentially impacted receptors is provided where necessary.

GROUND BASED RECEPTORS

Residential Receptors

6.2. **Table 6 – 1** identifies the receptors that will experience solar reflections based on solar reflection modelling and whether the reflections will be experienced in the morning (AM), evening (PM), or both.

6.3. There were no receptors which were within the no-reflection zones outlined previously.

6.4. **Appendix B** contains the detailed analysis of the glint and glare impacts. **Table 6 - 1** shows the worst-case impact at each receptor (bald earth scenario – not including actual visibility or actual visibility with mitigation) and outlines at which orientation this will likely occur.

Table 6 - 1: Potential for Glint and Glare impact on Residential Receptors

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
1	No	No	0	0	None

6.5. As detailed in **Table 6 - 1**, under the 'bald earth scenario', there is a **None** impact at the receptor. **Appendix B** shows detailed analysis of when the glare impacts are possible, whilst also showing which parts of the solar farm glint is reflected from.

6.6. **Appendix E** shows Google Earth images that give an insight into how each receptor will be impacted by the glint and glare from the Proposed Development. There is a mixture of images used, which include aerial, ground level and street level. The aerial images show the location of the receptor with the solar farm drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible. The area of the solar farm from where reflections may be possible has been drawn as a yellow polygon. The ground level terrain is based on the height data of the surrounding land showing no intervening vegetation or buildings. The white and yellow polygons can be seen in this view also. The street view gives a good indication as to whether the area of the solar farm where reflections are theoretically possible will be visible from the receptor point. Also, where appropriate images that have been taken from within the Application Site have been used to show up to date imagery.

Road Receptors

6.7. Table 6 - 2 shows a summary of the modelling results for each of the Road Receptor Points, whilst the detailed results and ocular impact charts can be viewed in Appendix C.

6.8. The three receptors within the no-reflection zones outlined previously have been excluded from the detailed modelling as they will never receive glint and glare impacts from the Proposed Development.

Table 6 - 2: Potential for Glint and Glare impact on Road Based Receptors

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
1	30	0	0	Low
2	0	0	0	None

6.9. As can be seen in Table 6 - 2, one out of the two receptor points have potential glare impacts consisting of "low potential for after-image" (green glare) which is a Low impact. Appendix C shows detailed analysis of when the glint and glare impacts are possible, whilst also showing from which parts of the solar farm the solar glint is reflected from.

6.10. Appendix E shows Google Earth images that give an insight into how each receptor will be impacted by glint and glare from the Proposed Development. There is a mixture of images used, which include aerial, ground level and street level. The aerial images show the location of the receptor with the solar farm drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible. The area of the solar farm from where reflections may be possible has been drawn as a yellow polygon. The ground level terrain is based on the height data of the surrounding land showing no intervening vegetation or buildings. The white and yellow polygons can be seen in this view also. The street view gives a good indication as to whether the area of the solar farm where reflections are theoretically possible will be visible from the receptor point. Also, where appropriate images that have been taken from within the Application Site have been used to show up to date imaging.

6.11. As can be seen in Appendix E, all receptors will have views of the Proposed Development blocked by intervening buildings and therefore their impact can be reduced to None.

AVIATION RECEPTORS

6.12. **Table 6 - 3** overleaf shows a summary of the modelling results for the runway approach paths as well as the ATCTs whilst the detailed results and ocular impact charts can be viewed in Appendix D.

Table 6 - 3: Summary of Glare Results

Component	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)
Casement Aerodrome			
Runway 04	0	0	0
Runway 22	11708	0	0
Runway 10	10105	0	0
Runway 28	0	0	0
ATCT	0	0	0
Weston Airport			
Runway 07	0	0	0
Runway 25	0	0	0
ATCT	0	0	0
Dublin Airport			
Runway 10R	0	0	0
Runway 28L	0	0	0
Runway 16	0	0	0
Runway 34	0	0	0
ATCT (new)	0	0	0
ATCT (old)	0	0	0

6.13. As can be seen in **Table 6 - 3**, only green glare is expected to impact on Runways 10 and 22 at Casement Aerodrome. Green glare is described as 'Low Potential for After Image' which is an **acceptable** impact when pilots are approaching runways/helipads, according to FAA guidance as outlined in **paragraph 4.30**.The impact on aviation receptors is therefore **Not Significant**.

7. GROUND BASED RECEPTOR MITIGATION

7.1. Mitigation is not required due to all impacts being **None**.

7.2. **Table 7 - 1** and **Table 7 - 2** show the impacts at each stage of the glint and glare analysis, with the final residual impacts considered once the mitigation, if any, is in place.

Table 7 - 1: Potential Residual Glint and Glare Impacts on Residential Receptors

	Magnitude of Impact		
Receptor	Theoretical Visibility	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
1	None	None	**None**

Table 7 - 2: Potential Residual Glint and Glare Impacts on Road Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
1	Low	None	**None**
2	None	None	**None**

7.3. **Table 7 -** and **Table 7 - 4** show the overall impacts for all residential, road and rail receptors.

Table 7 - 3: Solar Reflections: Residential Receptors

Magnitude	Theoretical Visibility	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	0	0	0
Medium	0	0	0
Low	0	0	0
None	1	1	1

- **High** – Solar reflections impacts of over 30 hours per year or over 30 minutes per day
- **Medium** - Solar reflections impacts between 20 and 30 hours per year or between 20 minutes and 30 minutes per day
- **Low** - Solar reflections impacts between 0 and 20 hours per year or between 0 minutes and 20 minutes per day

- **None** - Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

Table 7 - 4: Solar Reflections: Road Receptors

Magnitude	Theoretical Visibility	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	0	0	0
Medium	0	0	0
Low	1	0	0
None	1	2	2

- **High** - Solar reflections impacts of over 30 hours per year or over 30 minutes per day
- **Medium** - Solar reflections impacts between 20 and 30 hours per year or between 20 minutes and 30 minutes per day
- **Low** - Solar reflections impacts between 0 and 20 hours per year or between 0 minutes and 20 minutes per day
- **None** - Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

8. SUMMARY

8.1. There is no guidance or policy available across Ireland in relation to the assessment of glint and glare from a Proposed Development. However, as identified by UK policy, it is recognised as a potential impact which needs to be considered for a proposed solar development.

8.2. This assessment considers the potential impacts on ground-based receptors such as roads and residential dwellings as well as aviation assets. A 500m survey area around the Application Site is considered adequate for the assessment of ground-based receptors, whilst a 30km study area is chosen for aviation receptors. Within 500m of the Application Site, there is one residential receptor and five road receptors which were considered. As per the methodology section, where there are a number of residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for the glint and glare analysis as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been included in the glint and glare analysis with some context to all receptors given in the visual analysis. Three road-based receptors were dismissed as they are located within the no reflection zones and therefore, will not be impacted upon because of the Proposed Development. Five aerodromes are located within 30 km of the Proposed Development: Casement Aerodrome, Weston Airport, Dublin Airport, Gowran Grange Airfield and Ballyboughal Airfield. Three Aerodromes, Casement Aerodrome, Weston Airport and Dublin Airport, require a detailed assessment due to their size and orientation in relation to the Proposed Development.

8.3. The solar panels will face in a southwards direction, 157.7 degrees on the roof of DUB11.1 and DUB11.2 and 168.6 degrees on the roof of DUB12, will be inclined at an angle of 10 degrees and at a height of 14.12m above ground level (AGL). As the panels will be fixed in this position, points at the tops of the panels have been used to determine the worst-case impacts on receptors.

8.4. Geometric analysis was conducted for one individual residential receptor and two road receptors.

8.5. The assessment concludes that:

- Solar reflections are possible at none of the one residential receptor assessed within the 500m study area. Initial impacts were **None** at the receptor.
- Solar reflections are possible at one of the two road receptors assessed within the 500m study area. Initial impacts were **Low** at one and **None** at one. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** at all receptor points.
- **No impact** on train drivers or railway infrastructure is predicted.

- Green glare impacts are predicted on aviation receptors for Runways 10 and 22 at Casement Aerodrome. Green glare is an **acceptable** impact on aviation receptors for runways. Therefore, impacts on the Casement Aerodrome Runways 10 and 22 aviation receptors are **Not Significant**.

8.6. **No mitigation is required**, as the impacts are **None** and **Not Significant**.

8.7. The effects of glint and glare and their impact on local receptors has been analysed in detail and is predicted to be **None** impacts at all ground-based receptors, and **None** or **Not Significant** at all aviation receptors, and therefore **acceptable impacts**.

9. APPENDICES

Appendix A: Figures

- Figure 1: Residential Receptors
- Figure 2: Road Based Receptors
- Figure 3: Site Layout
- Figure 4: DUB11 Roof Plan
- Figure 5: DUB12 Roof Plan
- Figure 6: Casement Aerodrome Chart
- Figure 7: Weston Airport Aerodrome Chart
- Figure 8: Dublin Airport Aerodrome Chart

Appendix B: Residential Receptor Results

Appendix C: Road Receptor Results

Appendix D: Aviation Receptor Results

Appendix E: Visibility Assessment Evidence

Appendix F: Solar Module Glare and Reflectance Technical Memo

neo ENVIRONMENTAL

GLASGOW - HEAD OFFICE

Wright Business Centre, 1 Lonmay Road, Glasgow G33 4EL
T: 0141 773 6262
www.neo-environmental.co.uk

N. IRELAND OFFICE

83-85 Bridge Street
Ballymena, Co. Antrim
Northern Ireland
BT43 5EN
T: 0282 565 04 13

IRELAND OFFICE

Johnstown Business Centre
Johnstown House, Naas
Co. Kildare
T: 00 353 (0)45 844250
E: info@neo-environmental.ie

RUGBY OFFICE

Valiant Office Suites
Lumonics House, Valley Drive,
Swift Valley, Rugby,
Warwickshire, CV21 1TQ
T: 01788 297012

WARRINGTON OFFICE

Cinnamon House, Cinnamon Park
Crab Lane, Fearnhead
Warrington
Cheshire
T: 01925 661 716