MANSTON AIRPORT
NIGHT NOISE CONTOURS
INM ASSUMPTIONS

Report to

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1.0 INTRODUCTION

Bickerdike Allen Partners (BAP) have been retained by Manston Airport to determine airborne aircraft noise contours.

Noise contours are predicted based on actual and predicted aircraft movements using the Federal Aviation Administration (FAA) Integrated Noise Model (INM) Version 7.0b aircraft noise prediction software. This contour methodology is recognised worldwide and is in accordance with the methodology used for strategic noise mapping under the Environmental Noise (England) Regulations 2006.

This document sets out the assumptions used in the computation of the night-time airborne aircraft noise contours.

2.0 THE AIRPORT

The runway, bearing 10/28, has a (True) bearing of 101.24°, is 2752 m long and 61 m wide. There are no displaced runway approach thresholds.

3.0 AIRCRAFT OPERATIONS

3.1 General

Aircraft movement data, supplied by the Airport, has been processed in relation to aircraft type, departure and arrival route, stage length and runway usage to enable input into the noise computation program, the Integrated Noise Model (INM). This section of the report describes how this information has been compiled in a form suitable for analysis purposes and considers the following:

- Traffic distribution by aircraft type;
- Flight tracks;
- Dispersion;
- Flight profiles;
- Traffic distribution by route.

This data has been processed into a form suitable for use with the INM model after clarifications from the airport and assumptions made by BAP based on previous experience.

3.2 Traffic distribution by aircraft type

Details of the aircraft type and predicted annual movements in 2018 as supplied by the Airport are given in Table 1.

Type	Aircraft	Period			
		0700-2300	2300-2330	2330-0600	0600-0700
Passenger	A320	610	305	183	122
	A340	101	51	30	20
	B737-800	610	305	183	122
	B757	204	102	61	41
	DH8-Q400	304	152	91	61
	E195	204	102	61	41
Freight	A300	40	8	24	8
	A310	40	8	24	8
	A330	40	8	24	8
	B747-400	235	47	141	47
	B747-800	79	16	47	16
	DC10	119	24	71	24
	DC8	79	16	47	16
	MD11	156	31	94	31

Table 1 – Annual aircraft movements by aircraft type 2018

The 8 hour night-time period is between 2300 and 0700 hours.

3.3 Flight Tracks

Flight tracks similar to a SID or a STAR are not available for the Airport. Flight tracks required for INM noise contour generation have been developed based on information provided by the Airport and are based on the Airport's Noise Abatement Procedures..

Aircraft departing the Runway 10 climb straight ahead until passing 4 DME where they are directed by ATC. Aircraft departing the Runway 28 climb straight ahead to 1.5 DME where they then turn right onto a bearing of 310º (Magnetic) until they pass 5 DME where they are then directed by ATC.

Preliminary analysis showed that the SEL contours under consideration in this study do not extend as far as 4 DME and 5 DME for runways 10 and 28 respectively and therefore separate tracks have not been developed beyond these locations.

Circuits are not applicable to aircraft operating at night.

Arriving aircraft are assumed to follow the extended centre line of the runways, compatible with the use of the Instrument Landing System (ILS).

The arrival, departure and circuit tracks have been arrived at through consultation with the Airport and Air Traffic Control.

Arrival and departure routes are shown in Figure 1.

3.4 Dispersion

Aircraft on departure are allocated a departure route to follow. In practice, this route is not followed precisely by all aircraft allocated to this route. The actual pattern of departing aircraft is dispersed about the route’s main track. The degree of dispersion is normally a function of the distance travelled by an aircraft along the route after take-off and also on the form of route.

When considering many departures, it is commonly found that the spread of aircraft approximates to a "normal distribution" pattern, the shape or spread of which will vary with distance along the route. A simplified mathematical model can be adopted to represent a normal distribution of events, based on standard deviations. Airport noise modelling commonly assumes that there are five "dispersed" tracks associated with each departure route; these comprise the Main Track of each route and the two Sub Tracks either side.

The allocation of movements adopted in this case to each track is as follows:

- 53.3% departures along the Main Track;
- 22.2% departures along each of the two inner Sub Tracks either side of the Main Track and offset by a distance of 1.355 standard deviations;
- 1.15% departures along each of the two outer Sub Tracks either side of the Main Track and offset by a distance of 2.71 standard deviations.

This dispersion model has been applied to a typical departure offset profile determined from data collected at other similar airports.

The resultant dispersion scenario for all routes is shown in Table 2.

Distance from SOR, km	Outer Track Displacement[1], m
End of Runway	0
3.5	105
4.0	211
4.5	323
5.0	434
5.5	556
6.0	678
6.5	792
7.0	905
7.5	1007
8.0	1109
8.5	1184
9.0	1260
9.5	1324
10.0	1387
10.5	1444
11.0 and above	1500

Table 2 – Assumed route dispersion

Note 1: 2.71 x Standard Deviation.

3.5 Flight profiles

For the departure movements the INM model offers a number of standard flight profiles for most aircraft types, and in particular for the larger aircraft types. These relate to different departure weights which are greatly affected by the length of the flight, and consequently the fuel load. In the INM model this is referred to as the stage length and is in increments of 500 and then 1000 nm. The INM model assumes all aircraft take off with a full passenger load irrespective of stage length. As the stage length increases the aircraft has to depart with greater fuel and so its flight profile is slightly lower than when a shorter stage length is flown.

Stage lengths for the passenger aircraft types are given in Table 3. These are based on destinations.

Aircraft	Destination	Stage length
A320	S. Spain	2
A340	US, Florida	6
B737-800	Mallorca	2
B757	US, E. coast	5
DH8-Q400	Domestic/Near Europe	1
E195	Rome/Warsaw	2

Table 3 – Passenger aircraft stage lengths

As the freight aircraft types are generally flying out empty or to destinations within 500 nm, the stage length for all these aircraft types is 1.

3.6 Traffic distribution by route

The assumed runway utilisation for the aircraft is 33% easterly (Runway 10) and 67% westerly (Runway 28) for both arrivals and departures for 2018. This is consistent with the runway utilisation observed for 2009.

Aircraft movements are equally split between arrivals and departures.

4.0 INM MODEL

4.1 General

All contours and areas are determined using the Integrated Noise Model (INM) version 7.0b software.

The Integrated Noise Model (INM) software evaluates aircraft noise in the vicinity of airports using flight track information, aircraft fleet mix, standard defined aircraft profiles, user-defined aircraft profiles and terrain where information is available. INM is used to produce noise exposure contours as well as predict noise levels at specific user-defined sites.

4.2 Assumptions

Manston Airport data relevant to the INM study is taken from the latest edition of the UK Aeronautical Information Package.

A 3.0° approach angle is used for all aircraft and the ground topography is assumed to be flat. The INM default headwind of 14.8 km/hr and all-soft ground lateral attenuation is assumed.

Following a number of validation studies at other airports by BAP, it has been found necessary to modify the input assumptions to better reflect actual operations and resulting noise levels for a number of aircraft types. These are the Bombardier Dash 8 Series 400 aircraft (designated

DHC8-400), and the Embraer E195 (designated E195). Also, as the Boeing 747-800 aircraft (designated B748) is not currently in operation and is not an available INM type, a substitution is required for this aircraft with an assumption made of the aircraft's likely noise characteristics.

The noise characteristics of these aircraft have been adjusted by both modifying the actual movement numbers and aircraft type. These modifications are detailed in Table 4.

Aircraft	**INM Type Substitution**	**Modification to Movement Numbers**	
		Departures	**Arrivals**
DHC8-400	DHC6/SD330	1.0 x DHC6	1.3 x SD330
E195	A319-131	2.0 x A319-131	2.0 x A319-131
B748	747400	0.5 x 747400	0.5 x 747400

Table 4 – Modifications to INM assumptions

A summary of the aircraft types and movements numbers used in the for generation of the night-time $L_{Aeq,8h}$ contours are given in Table 5. These tables summarise the resulting movements by INM aircraft type and take into consideration those aircraft for which a substitution or modification to the initial INM assumptions has been made and the associated INM aircraft type is given. Details of the procedural profiles associated with each aircraft type and INM stage length can be found in the INM 7.0b documentation.

Aircraft Description	INM Aircraft Type	Runway 10		Runway 28	
		Arrivals	Departures	Arrivals	Departures
Airbus A300B4-200/CF6-50C2	A300B4-203	6	6	13	13
Airbus A310-304/CF6-80C2A2	A310-304	6	6	13	13
Airbus A319-131/V2522-A5	A319-131	67	67	136	136
Airbus A320-211/CFM56-5A1	A320-211	101	101	204	204
Airbus A330-301/CF6-80 E1A2	A330-301	0	6	0	13
Airbus A340-211/CFM 56-5C2	A340-211	17	17	34	34
Boeing 737-800	737800	101	101	204	204
Boeing 747-400	747400	45	45	92	92
Boeing 757-200/RB211-535E4	757RR	34	34	68	68
De Havilland DHC-6 Twin Otter	DHC6	0	50	0	102
Douglas DC8-60	DC860	13	13	26	26
McDonnell Douglas DC10-10	DC1010	19	19	39	39
McDonnell Douglas MD-11	MD11GE	26	26	53	53
Shorts 330	SD330	65	0	133	0
	Totals	**501**	**492**	**1017**	**999**

Table 5 – Aircraft types used in Night-time contours INM study (including subs. and modifications)

5.0 CONTOUR AREAS AND POPULATION COUNTS

The areas of, and the population and dwelling numbers under, the $L_{Aeq,8h}$ night-time contours is given in Table 6.

Dwelling counts and population numbers have been determined from a consideration of 2009 Census data by postcode location provided by CACI Ltd.

Level	Area, km^2	Population	Dwellings
48	14.4	13443	6386
51	8.5	8528	3964
54	4.9	2272	1088
57	2.8	548	318
60	1.6	0	0
63	1.0	0	0
66	0.7	0	0
69	0.4	0	0
72	0.3	0	0

Table 6 – Areas and population, dwellings counts for night-time contours (dB $L_{Aeq,8h}$)

The areas of, and the population and dwelling numbers under, the SEL footprints for the Boeing 737-800, the Boeing 747-400 and the McDonnell Douglas MD-11 are given in Table 7.

Operation	Level	Boeing 737-800			Boeing 747-400			McDonnell Douglas MD-11		
		Area, km^2	Population	Dwellings	Area, km^2	Population	Dwellings	Area, km^2	Population	Dwellings
Approach Runway 10	85	4.9	618	311	14.6	2883	1347	6.2	688	337
	90	1.5	45	32	5.3	667	331	1.8	45	32
	95	0.5	0	0	1.9	45	32	0.6	0	0
Departure Runway 10	85	11.5	17740	8062	20.5	30903	14299	11.1	14722	6704
	90	5.4	2168	1067	8.0	9059	4100	5.4	1089	531
	95	2.0	82	40	3.1	164	79	2.5	129	61
Approach Runway 28	85	4.9	11310	5396	14.6	18802	9027	6.2	11882	5696
	90	1.5	3660	1665	5.3	11669	5568	1.8	4836	2253
	95	0.5	68	29	1.9	5689	2598	0.6	68	29
Departure Runway 28	85	11.6	1941	944	20.5	2647	1250	11.2	1938	944
	90	5.4	625	313	8.1	974	482	5.4	699	346
	95	2.0	108	50	3.1	219	117	2.5	162	86

Table 7 – Areas and population/dwellings counts for aircraft noise footprints (dB SEL)