



Appeal by: Bristol Airport Limited

Appeal Reference: APP/D0121/W/20/3259234

North Somerset Council Application Reference: 18/P/5118/OUT

**Appendices to proof of evidence of
Dr Mark Broomfield BA DPhil MIAQM
Air Quality**

Reference: NSC/W3/2

Ricardo Energy and Environment



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Energy & Environment

Appendices to Proof of Evidence of Dr Mark Broomfield on behalf of North Somerset Council: Air Quality

Section 78 Town and Country Planning Act 1990 Appeal by Bristol Airport Ltd against the refusal of application 18/P/5118/OUT for the development of Bristol Airport to accommodate 12 million passengers per annum

PINS Appeal ref APP/D0121/W/20/3259234

Report ref. ED14606100 for North Somerset Council

Customer:

North Somerset Council

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Contact:

Dr Mark Broomfield
Ricardo Energy & Environment
Bright Building, Manchester Science Park,
Manchester, M15 6GZ, United Kingdom

t: +44 (0) 1235 75 3493
e: mark.broomfield@ricardo.com

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and OHSAS18001

Author:

Dr Mark Broomfield

Date:

15 June 2021

Ricardo Energy & Environment reference:

ED14606100- Volume 3_Final

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Table A.1: Aircraft fleet mix data provided by Jacobs UK Ltd, 15 January 2021 (LTO movements per year)

Aircraft	York Aviation Ltd data for 2030	Jacobs UK Ltd data for 2030	Variation between Jacobs & YAL
Aircraft used by Jet2.com			
Boeing 737-800 (winglets) Passenger	2,380	13,781	11,401
Next Generation Aircraft			
Airbus A320neo	20,200	24,538	4,338
Airbus A321neo	15,720	9,887	-5,833
Boeing 737 MAX 10	2,050	2,097	47
Boeing 737 MAX 8	14,360	11,684	-2,676
All other existing generation aircraft			
Airbus A319	-	-	-
Airbus A320	6,540	2,828	-3,712
Airbus A321	-	-	-
ATR 72	8,360	5,225	-3,135
Boeing 737 Passenger	-	-	-
Boeing 737-700 (winglets) Passenger	750	2,397	1,647
Boeing 737-800 Passenger	-	-	-
Boeing 757-200 (winglets) Passenger	-	-	-
Boeing 767-400	-	300	300
Boeing 777	-	300	300
Boeing 787-8	510	599	89
Canadair Regional Jet 900	-	-	-
Embraer 175	-	-	-
Embraer 190	2,240	599	-1,641
Embraer 195-E2	2,240	-	-2,240
Embraer RJ145	-	1,115	1,115
Total	75,350	75,350	-

Table A.2: Aircraft emissions data (kg/s/engine) derived from ICAO Aircraft Engine Emissions Databank Issue 28 (5 April 2021)

Aircraft type	Engine type	Number of Engines	FUEL TAKEOFF	FUEL APPROACH	FUEL IDLE	FUEL CLIMBOUT	NOX TAKEOFF	NOX APPROACH	NOX IDLE	NOX CLIMBOUT
B738 (Boeing 737-800)	8CM051	2	1.221	0.338	0.113	0.999	0.03516	0.00365	0.0005311	0.02248
B738 (Boeing 737-800)	8CM051	2	1.221	0.338	0.113	0.999	0.03516	0.00365	0.0005311	0.02248
Airbus A320neo	01P20CM128	2	0.861	0.244	0.091	0.71	0.0265188	0.002135	0.0004195	0.0094998
Airbus A321neo	01P20CM132	2	1.062	0.284	0.098	0.869	0.0634439	0.0028258	0.0004753	0.0281122
Boeing 737 MAX 10	01P20CM140	2	1.075	0.285	0.097	0.873	0.069187	0.0033972	0.000454	0.0258321
Boeing 737 MAX 8	01P20CM136	2	1.014	0.273	0.095	0.826	0.0560336	0.0031641	0.0004361	0.0192128
A319 (Airbus A-319)	3CM027	2	0.891	0.26	0.094	0.742	0.01951	0.002262	0.0003572	0.01373
A320 (Airbus A-320)	3CM026	2	1.132	0.312	0.104	0.935	0.0317	0.00312	0.0004472	0.02169
A321 (Airbus A-321)	3IA008	2	1.426	0.3901	0.1363	1.145	0.05202	0.004225	0.0007142	0.03282
ATR72	PW127E	2	0.1503	0.0776	0.0333219	0.1460099	0.0025852	0.0007682	0.0001592	0.0024452
B737 (Boeing 737-700)	3CM032	2	1.103	0.316	0.109	0.91	0.02791	0.003192	0.0004796	0.01866
B737 (Boeing 737-700)	3CM032	2	1.103	0.316	0.109	0.91	0.02791	0.003192	0.0004796	0.01866
B738 (Boeing 737-800)	8CM051	2	1.221	0.338	0.113	0.999	0.03516	0.00365	0.0005311	0.02248
B752 (Boeing 757-200)	5RR038	2	1.85	0.52	0.18	1.5	0.04127	0.004358	0.000792	0.02634
B752 (Boeing 757-200)	5RR038	2	1.85	0.52	0.18	1.5	0.04127	0.004358	0.000792	0.02634
B763 (Boeing 767-300)	12PW101	2	2.567	0.696	0.206	2.036	0.08148	0.008289	0.0007663	0.05096
B772 (Boeing 777-200)	8GE100	2	3.514	0.908	0.296	2.848	0.1982	0.01578	0.001803	0.1189
B788 (Boeing 787-8 Dreamliner)	11GE136	2	2.265	0.604	0.199	1.861	0.05622	0.005454	0.0008438	0.02719

Aircraft type	Engine type	Number of Engines	FUEL TAKEOFF	FUEL APPROACH	FUEL IDLE	FUEL CLIMBOUT	NOX TAKEOFF	NOX APPROACH	NOX IDLE	NOX CLIMBOUT
E190 (Embraer ERJ-190)	11GE146	2	0.87	0.239	0.088	0.717	0.01712	0.001898	0.0003247	0.01163
A320 (Airbus A-320)	3CM026	2	1.132	0.312	0.104	0.935	0.0317	0.00312	0.0004472	0.02169

Aircraft type	Engine type	Number of Engines	PMTotal TAKEOFF	PMTotal APPROACH	PMTotal IDLE	PMTotal CLIMBOUT	PMVolatile TAKEOFF	PMVolatile APPROACH	PMVolatile IDLE	PMVolatile CLIMBOUT	PMNonvolatile TAKEOFF
B738 (Boeing 737-800)	8CM051	2	0.0001575	1.845E-05	6.857E-06	0.0001161	1.404E-05	1.901E-06	1.325E-06	7.592E-06	8.364E-05
B738 (Boeing 737-800)	8CM051	2	0.0001575	1.845E-05	6.857E-06	0.0001161	1.404E-05	1.901E-06	1.325E-06	7.592E-06	8.364E-05
Airbus A320neo	01P20CM128	2	4.53E-05	1.298E-05	4.67E-06	3.661E-05	1.98E-06	5.49E-07	1.628E-07	1.079E-06	1.169E-06
Airbus A321neo	01P20CM132	2	6.126E-05	1.591E-05	4.986E-06	4.505E-05	6.107E-06	6.39E-07	1.27E-07	1.321E-06	3.16E-06
Boeing 737 MAX 10	01P20CM140	2	5.887E-05	1.584E-05	5.044E-06	4.541E-05	6.181E-06	8.016E-07	2.753E-07	2.654E-06	5.986E-08
Boeing 737 MAX 8	01P20CM136	2	5.551E-05	1.502E-05	4.969E-06	4.296E-05	5.831E-06	7.678E-07	2.989E-07	2.511E-06	3.592E-08
A319 (Airbus A-319)	3CM027	2	8.185E-05	2.323E-05	8.487E-06	5.133E-05	2.049E-05	1.024E-05	3.596E-06	1.128E-05	1.774E-05
A320 (Airbus A-320)	3CM026	2	0.000104	2.424E-05	8.299E-06	7.496E-05	2.604E-05	8.775E-06	2.952E-06	1.421E-05	2.253E-05
A321 (Airbus A-321)	3IA008	2	0.0002056	8.645E-05	1.931E-05	0.0002237	7.708E-06	1.141E-06	8.41E-08	3.741E-06	0.0001281
ATR72	PW127E	2	0	0	0	0	0	0	0	0	0
B737 (Boeing 737-700)	3CM032	2	0.0001292	1.725E-05	6.951E-06	0.0001029	1.268E-05	1.778E-06	1.614E-06	6.916E-06	6.247E-05
B737 (Boeing 737-700)	3CM032	2	0.0001292	1.725E-05	6.951E-06	0.0001029	1.268E-05	1.778E-06	1.614E-06	6.916E-06	6.247E-05
B738 (Boeing 737-800)	8CM051	2	0.0001575	1.845E-05	6.857E-06	0.0001161	1.404E-05	1.901E-06	1.325E-06	7.592E-06	8.364E-05
B752 (Boeing 757-200)	5RR038	2	0.0003644	3.296E-05	1.113E-05	0.0002984	6.383E-06	1.17E-06	2.999E-07	1.14E-08	0.0002674
B752 (Boeing 757-200)	5RR038	2	0.0003644	3.296E-05	1.113E-05	0.0002984	6.383E-06	1.17E-06	2.999E-07	1.14E-08	0.0002674

Aircraft type	Engine type	Number of Engines	PMTotal TAKEOFF	PMTotal APPROACH	PMTotal IDLE	PMTotal CLIMBOUT	PMVolatile TAKEOFF	PMVolatile APPROACH	PMVolatile IDLE	PMVolatile CLIMBOUT	PMNonvolatile TAKEOFF
B763 (Boeing 767-300)	12PW101	2	0.0002323	3.901E-05	2.494E-05	0.0001569	2.362E-05	3.915E-06	1.478E-05	9.284E-06	8.299E-05
B772 (Boeing 777-200)	8GE100	2	0.0002321	6.429E-05	2.053E-05	0.0001778	1.616E-05	2.554E-06	7.488E-07	8.658E-06	4.387E-05
B788 (Boeing 787-8 Dreamliner)	11GE136	2	0.0001161	5.424E-05	1.077E-05	9.394E-05	5.21E-06	2.039E-06	9.945E-07	2.829E-06	0
E190 (Embraer ERJ-190)	11GE146	2	9.754E-05	1.311E-05	6.707E-06	6.187E-05	5.003E-06	1.344E-06	2.183E-06	4.904E-06	4.995E-05
A320 (Airbus A-320)	3CM026	2	0.000104	2.424E-05	8.299E-06	7.496E-05	2.604E-05	8.775E-06	2.952E-06	1.421E-05	2.253E-05

Aircraft type	Engine type	Number of Engines	PMNonvolatile TAKEOFF	PMNonvolatile APPROACH	PMNonvolatile IDLE	PMNonvolatile CLIMBOUT	PMSul TAKEOFF	PMSul APPROACH	PMSul IDLE	PMSul CLIMBOUT
B738 (Boeing 737-800)	8CM051	2	8.364E-05	0	0	5.958E-05	5.978E-05	1.655E-05	5.532E-06	4.891E-05
B738 (Boeing 737-800)	8CM051	2	8.364E-05	0	0	5.958E-05	5.978E-05	1.655E-05	5.532E-06	4.891E-05
Airbus A320neo	01P20CM128	2	1.169E-06	4.816E-07	5.225E-08	7.685E-07	4.215E-05	1.195E-05	4.455E-06	3.476E-05
Airbus A321neo	01P20CM132	2	3.16E-06	1.366E-06	6.094E-08	1.185E-06	5.2E-05	1.39E-05	4.798E-06	4.255E-05
Boeing 737 MAX 10	01P20CM140	2	5.986E-08	1.086E-06	1.96E-08	1.244E-08	5.263E-05	1.395E-05	4.749E-06	4.274E-05
Boeing 737 MAX 8	01P20CM136	2	3.592E-08	8.836E-07	1.885E-08	1.091E-08	4.965E-05	1.337E-05	4.651E-06	4.044E-05
A319 (Airbus A-319)	3CM027	2	1.774E-05	2.666E-07	2.887E-07	3.72E-06	4.362E-05	1.273E-05	4.602E-06	3.633E-05
A320 (Airbus A-320)	3CM026	2	2.253E-05	1.94E-07	2.551E-07	1.497E-05	5.542E-05	1.528E-05	5.092E-06	4.578E-05
A321 (Airbus A-321)	3IA008	2	0.0001281	6.621E-05	1.255E-05	0.000164	6.982E-05	0.0000191	6.673E-06	5.604E-05
ATR72	PW127E	2	0	0	0	0	0	0	0	0
B737 (Boeing 737-700)	3CM032	2	6.247E-05	0	0	5.147E-05	0.000054	1.547E-05	5.337E-06	4.455E-05
B737 (Boeing 737-700)	3CM032	2	6.247E-05	0	0	5.147E-05	0.000054	1.547E-05	5.337E-06	4.455E-05

Aircraft type	Engine type	Number of Engines	PMNonvolatile TAKEOFF	PMNonvolatile APPROACH	PMNonvolatile IDLE	PMNonvolatile CLIMBOUT	PMsul TAKEOFF	PMsul APPROACH	PMsul IDLE	PMsul CLIMBOUT
B738 (Boeing 737-800)	8CM051	2	8.364E-05	0	0	5.958E-05	5.978E-05	1.655E-05	5.532E-06	4.891E-05
B752 (Boeing 757-200)	5RR038	2	0.0002674	6.335E-06	2.017E-06	0.000225	9.058E-05	2.546E-05	8.813E-06	7.344E-05
B752 (Boeing 757-200)	5RR038	2	0.0002674	6.335E-06	2.017E-06	0.000225	9.058E-05	2.546E-05	8.813E-06	7.344E-05
B763 (Boeing 767-300)	12PW101	2	8.299E-05	1.018E-06	6.934E-08	0.0000479	0.0001257	3.408E-05	1.009E-05	9.968E-05
B772 (Boeing 777-200)	8GE100	2	4.387E-05	1.728E-05	5.29E-06	2.975E-05	0.000172	4.446E-05	1.449E-05	0.0001394
B788 (Boeing 787-8 Dreamliner)	11GE136	2	0	2.263E-05	2.848E-08	0	0.0001109	2.957E-05	9.743E-06	9.111E-05
E190 (Embraer ERJ-190)	11GE146	2	4.995E-05	6.318E-08	2.158E-07	2.186E-05	0.0000426	0.0000117	4.308E-06	0.0000351
A320 (Airbus A-320)	3CM026	2	2.253E-05	1.94E-07	2.551E-07	1.497E-05	5.542E-05	1.528E-05	5.092E-06	4.578E-05



Ricardo
Energy & Environment

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR
United Kingdom

t: +44 (0)1235 753000
e: enquiry@ricardo.com

ee.ricardo.com