Technical Appendices

- Appendix E – Activity Levels
- Appendix F – Regional Transportation
- Appendix G – Ground Access
- Appendix H – Noise Abatement
- Appendix I – Air Quality/Emissions Reduction
- Appendix J – Water Quality/Environmental Compliance and Management
- Appendix K – 2014 Peak Period Pricing Monitoring Report
- Appendix L – Reduced/Single Engine Taxiing at Logan Airport Memorandum

This Page Intentionally Left Blank

E

Activity Levels

This appendix provides detailed tables in support of *Chapter 2, Activity Levels*:

- Table E-1 Logan Airport Historic Air Passenger and Operations Data
- Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier
- Table E-3 Logan Airport Changes in International Passenger Operations by Carrier
- Table E-4 Logan Airport Scheduled Passenger Departures by Destination

This Page Intentionally Left Blank

Table E-1 Logan Airport Historic Air Passenger and Operations Data

Year	Operations	Air Passengers	Year	Operations	Air Passengers
1980	258,167	14,722,363	1998	507,449	26,526,708
1981	251,961	14,827,684	1999	494,816	27,052,078
1982	244,468	15,867,722	2000	487,996	27,726,833
1983	288,956	17,848,797	2001	463,125	24,474,930
1984	318,959	19,417,971	2002	392,079	22,696,141
1985	349,518	20,448,424	2003	373,304	22,791,169
1986	363,995	21,862,718	2004	405,258	26,142,516
1987	414,968	23,369,002	2005	409,066	27,087,905
1988	407,479	23,732,959	2006	406,119	27,725,443
1989	388,797	22,272,860	2007	399,537	28,102,455
1990	424,568	22,878,191	2008	371,604	26,102,651
1991	430,403	21,450,143	2009	345,306	25,512,086
1992	474,378	22,723,138	2010	352,643	27,428,962
1993	493,093	23,579,726	2011	368,987	28,909,267
1994	458,623	24,468,178	2012	354,869	29,236,087
1995	466,327	24,192,095	2013	361,339	30,218,970
1996	456,226	25,134,826	2014	363,797	31,634,445
1997	482,542	25,567,888			

This Page Intentionally Left Blank

Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier

Airline	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
Scheduled Jet Carriers	233,993	190,991	203,081	207,369	203,376	211,176	214,854	3,678	1.7%
AirTran Airlines	3,090	14,580	13,672	12,869	10,883	7,764	3,442	-4,322	-55.7%
Alaska Airlines		1,088	1,733	1,757	1,873	2,661	3,090	429	16.1%
America West Airlines	5,116	4,467							
American Airlines	30,821	27,712	21,313	18,943	20,962	22,535	22,486	-49	-0.2%
American Trans Air	1,448	2,294							
Continental Airlines	16,894	13,546	10,869	11,074	1,546				
Delta Subtotal	52,954	36,388	28,980	25,429	23,270	21,139	23,614	2,475	11.7%
Delta Air Lines Mainline	*22,031*	*14,317*	*21,926*	*19,633*	*23,270*	*21,139*	*23,614*	*2,475*	*11.7%*
Delta Express	*13,746*								
Delta Shuttle	*17,177*	*9,588*	*7,054*	*5,796*					
Delta Song		*12,483*							
Frontier Airlines	1,052		1,094		275				
Independence Air		4,676							
JetBlue Airways		15,069	49,981	58,737	63,210	73,374	76,247	2,873	3.9%
Midway Airlines	4,096								
Midwest Airlines	3,726	3,570	1,961	2,786					
Northwest Airlines	13,147	9,685							
People Express							170		
Southwest Airlines			13,727	17,413	12,784	15,937	18,525	2,588	16.2%
Spirit Airlines			3,023	3,054	3,365	2,721	2,945	224	8.2%
Sun Country Airlines	723		313	509	596	926	1,027	101	10.9%
Trans World Airlines	6,280								
United Airlines	28,092	18,304	16,314	15,351	24,090	25,214	24,374	-840	-3.3%
US Airways	66,554	39,612	36,678	36,421	36,633	35,613	35,736	123	0.3%
Virgin America			3,394	3,026	3,889	3,292	3,198	-94	-2.9%

Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier (Continued)

Airline	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
Regional/Commuter Carriers	160,041	137,203	94,535	89,586	81,802	81,935	78,696	-3,239	-4.0%
America West Express	1,267								
American Airlines Subtotal									
Chautauqua Airlines (American Airlines)									
American Eagle Airlines	62,140	37,394	15,291	6,669	4	4	5	1	25.0%
Cape Air	31,026	25,018	35,899	35,940	37,184	37,194	35,080	-2,114	-5.7%
Continental Connection Subtotal			1,809	1,199	131				
Colgan Air (Continental Connection)			*1,809*	*1,199*	*131*				
Continental Express Subtotal		12,544	529	902	385				
Atlantic SE (Continental Express)				*134*					
Chautauqua Airlines (Continental Express)			*529*	*719*	*185*				
Commutair (Continental Express)		*12,544*							
Express Jet (Continental Express)					*86*				
Trans States Airlines (Continental Express)				*49*	*114*				
Delta Connection Subtotal	15,438	26,557	18,445	23,243	20,925	20,848	20,265	-583	-2.8%
ACJet (Delta Connection)	*2,258*								
Atlantic SE (Delta Connection)			*943*	*4,948*					
Big Sky Airlines (Delta Connection)									
Chautauqua Airlines (Delta Connection)		*1,938*	*1,794*	*2,230*	*1,926*	*1,860*	*1,683*	*-177*	*-9.5%*
Comair Airlines (Delta Connection)	*520*	*24,619*	*10,255*	*7,857*	*5,824*				
Compass Airlines (Delta Connection)			*1,053*	*1,577*	*574*	*14*	*28*	*14*	*100.0%*
Express Jet (Delta Connection)					*1,648*	*3,771*	*1,489*	*-2,282*	*-60.5%*
Freedom Airlines (Delta Connection)									
Go Jet (Delta Connection)					*88*	*6*	*476*	*470*	*7833.3%*
Mesaba Airlines (Delta Connection)			*1,078*	*3,117*	*21*				
Pinnacle Airlines (Delta Connection)			*1,278*	*1,507*	*3,689*	*4,747*	*7,310*	*2,563*	*54.0%*
Shuttle America (Delta Connection)			*2,044*	*2,007*	*7,155*	*10,450*	*9,279*	*-1,171*	*-11.2%*
Trans States Airlines (Delta Connection)	*12,660*								
MidAtlantic Express									
Midwest/Republic			258						
Northwest Airlink Subtotal		5,034							
Compass Airlines (Northwest Airlink)									
Pinnacle Airlines (Northwest Airlink)		*5,034*							

Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier (Continued)

Airline	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
PenAir					2,268	4,384	4,382	-2	0.0%
Republic Airlines						58	53	-5	-8.6%
United Express Subtotal		3,178	2,802	2,763	4,342	5,829	5,628	-201	-3.4%
ACJet (United Express)									
Air Wisconsin (United Express)		*1,699*							
Atlantic SE (United Express)			*574*	*6*					
Chautauqua Airlines (United Express)		*103*			*976*	*1,527*	*187*	*-1,340*	*-87.8%*
Colgan Air (United Express)					*334*				
Express Jet (United Express)					*1,089*	*973*	*2,092*	*1,119*	*115.0%*
Mesa Airlines (United Express)		*1,376*	*434*	*258*	*18*	*886*	*1,404*	*518*	*58.5%*
Republic Airlines (United Express)						*196*	*217*	21	10.7%
Shuttle America (United Express)			*1,561*	*1,941*	*1,023*	*1,597*	*416*	*-1,181*	*-74.0%*
SkyWest Airlines (United Express)						*469*	*1,152*	*683*	*145.6%*
Trans States Airlines (United Express)			*233*	*558*	*902*	*181*	*160*	*-21*	*-11.6%*
US Airways Express Subtotal	50,170	27,478	19,502	18,870	14,551	11,605	11,269	-336	-2.9%
Air Wisconsin (US Airways Express)		*174*	*6,266*	*6,499*	*6,664*	*6,440*	*6,165*	*-275*	*-4.3%*
Allegheny (US Airways Express)	*9,537*								
Chautauqua Airlines (US Airways Express)	*0*	*7,852*	*3*						
Colgan Air (US Airways Express)	*11,390*	*12,583*	*9,256*	*8,302*	*2,114*				
Commutair (US Airways Express)	*25,774*								
Mesa Airlines (US Airways Express)	*3,469*	*4*							
MidAtlantic Express (US Airways Express)		*150*							
Piedmont Airlines (US Airways Express)		*3,165*	*963*	*1,325*	*2,428*	*1,951*	*1,858*	*-93*	*-4.8%*
PSA (US Airways Express)		*526*	*2*	*5*					
Republic (US Airways Express)		*46*	*3,012*	*2,739*	*3,345*	*3,214*	*3,246*	*32*	*1.0%*
Trans States Airlines (US Airways Express)		*2,978*							
Non-Scheduled Operations (Incl. Charter)	1,008	325	501	106	-1,831	-1,813	-1,850	-37	2.0%
Total Domestic Operations	395,042	328,519	298,117	297,061	283,347	291,298	291,700	402	0.1%

Note: Excludes general aviation and all-cargo operations.
Source: Massport

Table E-3 Logan Airport Changes in International Passenger Operations by Carrier

Airline	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
Scheduled Jet Carriers	27,427	24,550	20,771	26,984	27,645	25,314	27,079	1,765	7.0%
Aer Lingus	1,160	1,016	1,097	1,130	1,273	1,513	1,933	420	27.8%
Aeromexico		534							
Air Canada	10,047	5,782	3,895	4,125	4,517	1,747	1,084	-663	-38.0%
Air France	1,046	1,334	995	1,013	974	955	899	-56	-5.9%
Air Jamaica		349							
Air One									
Alitalia	729	986	624	604	530	542	550	8	1.5%
American Airlines	4,657	4,672	2,422	2,149	1,901	447	139	-308	-68.9%
Astraeus				100					
British Airways	2,159	2,151	2,082	2,161	2,149	2,573	2,678	105	4.1%
Canadian Airlines	417								
Copa Airlines						347	730	383	110.4%
Delta Air Lines	733	749	1,614	3,280	2,531	2,851	3,008	157	5.5%
Emirates							600	600	100.0%
Finnair		44							
FlyGlobespan									
Frontier Airlines									
Hainan Airlines							280	280	100.0%
Iberia Airlines			435	445	441	404	332	-72	-17.8%
Icelandair	726	811	816	928	938	1,120	1,227	107	9.6%
Japan Airlines					474	646	731	85	13.2%
JetBlue			2,262	5,173	5,902	6,138	6,348	210	3.4%
Korean Air Lines	314								
LACSA Airlines									
Lufthansa	1,140	1,564	1,657	1,734	1,784	1,723	1,712	-11	-0.6%
Northwest Airlines	744	727	61						

Table E-3 Logan Airport Changes in International Passenger Operations by Carrier (Continued)

Airline	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
Olympic Airways	256								
Sabena	724								
SATA International Airlines		315	403	400	412	466	533	67	14.4%
SWISS International	926	704	720	725	716	720	722	2	0.3%
TACA		327							
TACV - Cabo Verde		154	240	236	234	214	186	-28	-13.1%
TAP - Air Portugal	200								
Trans World Airlines									
Turkish Airlines							452	452	100.0%
United Airlines	728								
US Airways		1,607	667	49	146	186	205	19	10.2%
VG Airlines									
Virgin Atlantic Airways	721	724	707	721	711	709	716	7	1.0%
Regional/Commuter Carriers	15,594	13,112	12,494	12,153	12,270	14,378	14,720	342	2.4%
Air Canada Regional	4,088	5,120	7,065	6,803	7,058	9,563	10,364	801	8.4%
Jazz Air (Air Canada Regional)						*6,422*	*6,381*	-41	-0.6%
Sky Regional Airlines (Air Canada Regional)						*3,141*	*3,983*	842	26.8%
American Eagle Airlines	8,975	4,637	2,480	2,206					
Delta Connection Subtotal	2,531	3,355	81	1	1,489	1,082	56	-1,026	-94.8%
ACJet (Delta Connection)									
Big Sky Airlines (Delta Connection)									
Comair Airlines (Delta Connection)	*2,531*	*3,355*	*81*	*1*					
Endeavor Air (Delta Connection)					*1,489*	*1,082*	*0*	*-1,082*	*-100.0%*
Shuttle America (Delta Connection)							*56*	*56*	100.0%
Porter Airlines			2,868	3,143	3,723	3,733	4,300	567	15.2%
Non-Scheduled Operations	2,141	1,068	305	300	268	277	185	-92	-33.2%
Total International Operations	45,162	38,643	33,570	39,437	40,183	39,969	41,984	2,015	5.0%

Note: Excludes general aviation and all-cargo operations.
Source: Massport

Table E-4 Logan Airport Scheduled Passenger Departures by Destination

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
Domestic		210,068	163,684	149,962	152,303	145,883	149,091	151,222	2,130	1.4%
New York La Guardia	LGA	11,872	13,350	11,705	11,489	9,564	9,255	9,056	-199	-2.1%
Washington National	DCA	8,474	10,680	9,419	9,793	8,543	8,360	8,645	285	3.4%
Philadelphia	PHL	11,785	7,014	6,548	7,985	6,301	7,305	8,092	787	10.8%
Chicago O'Hare	ORD	10,063	7,412	7,403	7,635	7,461	7,733	7,822	89	1.2%
New York J F Kennedy	JFK	9,899	4,985	7,054	5,969	5,428	5,919	6,139	219	3.7%
New York Newark	EWR	5,206	5,626	3,666	4,608	5,228	5,702	5,532	-171	-3.0%
Atlanta	ATL	7,110	6,003	5,548	5,569	5,574	5,501	5,454	-48	-0.9%
Baltimore	BWI	1,773	5,029	7,053	6,755	5,910	5,737	5,060	-678	-11.8%
San Francisco	SFO	3,526	2,591	3,711	3,884	4,198	4,038	4,305	268	6.6%
Los Angeles	LAX	3,647	2,655	3,382	3,164	3,544	3,603	4,080	477	13.2%
Charlotte	CLT	2,758	3,288	4,180	3,976	3,991	3,911	3,916	5	0.1%
Dallas/Fort Worth	DFW	5,002	3,544	2,938	2,781	3,790	4,147	3,705	-442	-10.7%
Raleigh/Durham	RDU	3,775	4,110	3,259	2,867	3,059	3,313	3,634	321	9.7%
Nantucket	ACK	5,022	3,452	3,884	3,382	3,469	3,601	3,567	-34	-0.9%
Detroit	DTW	2,937	2,827	2,353	2,437	2,314	2,340	3,354	1,015	43.4%
Orlando	MCO	4,914	3,517	3,179	3,580	3,496	3,399	2,883	-516	-15.2%
Martha's Vineyard	MVY	3,863	2,231	3,218	2,829	2,774	2,740	2,793	53	1.9%
Washington Dulles	IAD	8,625	6,139	4,625	3,910	3,014	2,974	2,714	-260	-8.8%
Pittsburgh	PIT	3,086	2,021	2,312	3,179	2,498	2,641	2,678	37	1.4%
Miami	MIA	2,068	2,072	2,238	2,555	2,610	2,555	2,551	-4	-0.2%
Richmond	RIC	1,537	1,404	1,431	1,525	1,481	1,723	2,450	727	42.2%
Denver	DEN	2,628	1,990	2,812	2,640	2,518	2,433	2,446	13	0.6%
Buffalo	BUF	950	1,226	2,181	2,183	2,264	2,468	2,433	-35	-1.4%
Minneapolis	MSP	3,078	1,791	1,927	2,031	2,062	2,200	2,322	122	5.6%
Fort Lauderdale/Hollywood	FLL	3,327	3,065	2,370	2,517	2,371	2,379	2,173	-206	-8.7%
Provincetown	PVC	2,023	1,659	2,410	2,086	2,054	1,982	1,929	-52	-2.6%
Houston Intercontinental	IAH	1,995	1,752	1,717	1,697	1,704	1,789	1,822	33	1.8%
Fort Myers	RSW	949	1,525	1,587	1,620	1,738	1,806	1,734	-72	-4.0%
Seattle/Tacoma	SEA	458	610	1,001	993	1,051	1,378	1,607	229	16.6%
Phoenix	PHX	1,386	944	1,348	1,895	1,773	1,413	1,557	144	10.2%
Chicago Midway	MDW	868	1,339	1,756	1,751	1,690	1,617	1,542	-76	-4.7%
Lebanon	LEB			1,734	1,460	1,464	1,460	1,460	0	0.0%
West Palm Beach	PBI	1,674	1,126	1,450	1,380	1,161	1,235	1,389	153	12.4%
Houston Hobby	HOU						664	1,325	660	100.0%
Rockland	RKD	1,152	1,374	1,301	1,279	1,282	1,279	1,279	0	0.0%
Cleveland	CLE	2,797	1,260	1,369	1,326	1,455	1,501	1,260	-241	-16.1%
Augusta	AUG	584	621	1,000	1,187	1,091	1,248	1,248	0	0.0%
Cincinnati	CVG	2,235	2,637	1,364	1,308	1,272	1,269	1,239	-30	-2.4%
Tampa	TPA	2,502	1,946	1,246	1,255	1,266	1,195	1,182	-13	-1.1%
Bar Harbor	BHB	1,196	1,154	815	1,030	1,213	1,283	1,156	-127	-9.9%
Albany	ALB	3,433	1,073	647	2,180	1,523	1,183	1,095	-88	-7.4%
Saranac Lake	SLK		800	1,174	1,157	1,222	1,157	1,095	-62	-5.4%
Rutland	RUT	1,259	643	1,095	1,148	1,160	1,095	1,095	0	0.0%
San Diego	SAN	366	365	571	535	476	859	1,030	172	20.0%
Presque Isle	PQI	1,835	1,017	991	991	993	991	991	0	0.0%
Jacksonville	JAX		428	365	544	619	593	984	391	66.1%
Rochester	ROC	3,644	1,181	908	886	889	878	882	4	0.5%
Indianapolis	IND	765	2,076	1,121	977	936	895	844	-51	-5.7%
Columbus	CMH	2,708	2,114	972	1,048	972	871	844	-27	-3.1%
Las Vegas	LAS	1,098	1,679	756	904	737	813	819	6	0.7%
Plattsburgh International	PBG			1,025	899	623	639	787	149	23.3%

Table E-4 Logan Airport Scheduled Passenger Departures by Destination (Continued)

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
Hyannis	HYA	2,274	1,059	1,165	1,047	1,028	705	731	26	3.8%
St. Louis	STL	2,187	1,461	934	713	815	748	722	-26	-3.5%
Milwaukee	MKE	1,189	2,182	2,213	1,941	1,069	880	674	-206	-23.5%
Kansas City	MCI	597	241	313	536	571	515	669	154	29.9%
Nashville	BNA	642				153	588	628	39	6.7%
Syracuse	SYR	3,876	1,762	991	964	784	626	617	-9	-1.4%
Salt Lake City	SLC	1,094	730	669	438	370	584	597	13	2.2%
Portland	PDX			352	440	528	615	494	-121	-19.7%
Charleston	CHS		61				398	474	76	100.0%
Akron/Canton	CAK		730	475	488	497	557	457	-100	-18.0%
Harrisburg	MDT	1,307	886	551	574	540	469	434	-35	-7.5%
Myrtle Beach	MYR	105	265	365	365	366	378	383	4	1.2%
Austin	AUS			365	365	366	352	352	0	0.0%
New Orleans	MSY		191	348	304	335	339	344	5	1.4%
Islip	ISP	4,222	1,581				293	324	31	100.0%
Savannah	SAV		78					306	306	100.0%
Long Beach	LGB		853	459	296	292	274	270	-4	-1.5%
San Jose	SJC	842	245	232	292	227	205	214	9	4.3%
Sarasota/Bradenton	SRQ		30	82	242	248	348	181	-167	-47.9%
Atlantic City Pomona Field	ACY			536	326	355	123	153	30	24.4%
Oakland	OAK		853	195	105	83	83	83	0	0.0%
Norfolk	ORF	838	1,032		511	667	613	71	-541	-88.3%
Newport News	PHF		671	549	549	60		31	31	n/a
Memphis	MEM	972	1,034	1,048	1,029	688	313		-313	-100.0%
Bangor	BGR	6,644	2,946							
Westchester County	HPN	6,065	2,256							
Greensboro	GSO	415	1,120							
Trenton	TTN									
Watertown	ART									
Burlington	BTV	5,913	1,632							
Allentown/Bethlehem	ABE	780	626							
Louisville	SDF									
Manchester	MHT									
Massena	MSS									
Dayton	DAY									
Plattsburgh	PLB									
Portland (ME)	PWM	6,267	1,394							
Wilkes-Barre Scranton	AVP	584	420							
Columbia	CAE									
Ithaca	ITH	872								
Elmira/Corning	ELM	441								
Hartford	BDL									
Binghamton	BGM									
Providence	PVD	91								

Table E-4 Logan Airport Scheduled Passenger Departures by Destination (Continued)

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
International		23,711	19,837	18,764	19,641	21,552	21,106	22,386	1,280	6.1%
Toronto	YYZ	3,691	3,876	3,603	3,737	3,529	3,306	2,715	-591	-17.9%
Toronto Island Apt	YTZ			1,535	1,687	2,009	2,009	2,310	301	15.0%
London Heathrow	LHR	2,187	2,133	2,331	2,833	2,642	2,134	2,069	-65	-3.0%
Montreal-Trudeau	YUL	3,401	2,578	2,008	2,021	2,009	1,833	1,948	115	6.3%
San Juan	SJU	1,750	1,237	1,294	1,130	1,031	1,038	1,018	-20	-1.9%
Paris De Gaulle	CDG	898	853	710	946	619	784	780	-4	-0.5%
Halifax	YHZ	3,210	1,891	852	744	745	704	704	0	0.0%
Dublin	DUB	223		348	457	480	605	653	48	7.9%
Ottawa	YOW	2,575	864	744	696	623	652	635	-17	-2.6%
Reykjavik Keflavik Apt	KEF	393	361	404	531	467	561	614	53	9.4%
Amsterdam	AMS	366	365	457	553	558	575	536	-39	-6.8%
Frankfurt	FRA	580	575	548	544	572	545	532	-13	-2.4%
Bermuda	BDA	550	518	532	540	511	501	523	22	4.3%
Aruba	AUA	9	338	407	426	405	408	417	9	2.2%
Santo Domingo	SDQ		174	305	275	358	339	401	62	18.3%
Zurich	ZRH	523	356	365	365	366	365	365	0	0.0%
Tokyo Narita	NRT					236	352	365	13	3.8%
Panama City	PTY							365	365	n/a
Munich	MUC		210	313	335	357	348	357	8	2.4%
Shannon	SNN	366	737	213	118	144	166	348	182	109.5%
Dubai	DXB							306	306	n/a
Cancun	CUN		207	307	270	217	225	273	49	21.6%
Rome Leonardo Da Vinci-Fiumicino	FCO		135	313	314	266	271	258	-13	-4.8%
Santiago	STI				92	201	214	248	34	15.8%
Istanbul	IST							236	236	n/a
Ponta Delgada	PDL	30	39	165	170	148	179	209	30	17.0%
Saint Thomas	STT	78	108	125	117	156	173	176	4	2.2%
Madrid	MAD			218	231	222	209	166	-43	-20.6%
Punta Cana	PUJ			95	92	139	134	160	26	19.5%
Nassau	NAS		100	180	134	142	108	139	31	28.8%
Beijing	PEK							136	136	n/a
Praia	RAI		9	121	122	109	104	92	-13	-12.2%
Providenciales	PLS	4	43	39	26	69	52	82	31	59.4%
Montego Bay	MBJ		238	126	52	69	56	73	17	30.9%
Saint Maarten	SXM			39	43	61	61	52	-9	-14.4%
Lisbon	LIS	44		26	26	48	39	39	0	0.0%
Grand Cayman	GCM		31	17		9	26	26	0	0.0%
Terceira	TER	44		17	17	17	17	17	0	0.0%
Puerto Plata	POP	4						9	9	n/a
	UVF							9	9	n/a
	LIR							9	9	n/a
Sao Vicente	VXE			4		4				
Charlottetown	YYG									
Helsinki	HEL									
Milan Malpensa	MXP	366	343							

Table E-4 Logan Airport Scheduled Passenger Departures by Destination (Continued)

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2014	2013-2014 Change	2013-2014 Percent Change
Fredericton	YFC		686							
Quebec	YQB	1,229	30							
Manchester	MAN	26	241							
Glasgow	GLA									
Connaught	NOC									
Stockholm Arlanda	ARN									
Mexico City	MEX		234							
Las Palmas	LPA									
San Salvador	SAL		178							
Vancouver	YVR	366	62							
Ilha Do Sal	SID		56							
Nykoping	NYO		31							
Port Au Prince	PAP									
Lerwick Sumburgh Apt	LSI									
Freeport	FPO									
London Gatwick	LGW	362								
Brussels	BRU	362								
Gander	YQX									
Athens	ATH	74								
Total Scheduled Carrier Operations		233,779	183,520	168,726	171,945	167,435	170,197	173,607	3,410	2.0%

Source: OAG Schedules.

This Page Intentionally Left Blank

F

Regional Transportation

This appendix provides detailed tables in support of *Chapter 4, Regional Transportation*:

- Table F-1 Aircraft Operations by Classification for New England's Airports, 2000 to 2014
- Table F-2 Percentage Change in Aircraft Operations by Classification for New England's Airports, 2000 to 2014
- Scheduled Passenger Operations by Market and Carrier for New England's Regional Airports
  - Table F-3 Bradley International Airport, Connecticut
  - Table F-4 T.F. Green Airport, Rhode Island
  - Table F-5 Manchester-Boston Regional Airport, New Hampshire
  - Table F-6 Portland International Jetport, Maine
  - Table F-7 Burlington International Airport, Vermont
  - Table F-8 Bangor International Airport, Maine
  - Table F-9 Tweed-New Haven Airport, Connecticut
  - Table F-10 Worcester Regional Airport, Massachusetts
  - Table F-11 Hanscom Field, Massachusetts
  - Table F-12 Portsmouth International Airport, New Hampshire

This Page Intentionally Left Blank

Table F-1 Aircraft Operations by Classification for New England's Airports, 2000 to 2014

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2000													
Commercial	132,062	103,750	61,506	47,609	45,745	21,446	5,260	4,029	6,104	6,572	434,083	452,763	886,846
General Aviation[1]	31,863	52,184	45,740	56,571	59,377	34,831	56,200	46,518	31,601	204,512	619,397	35,233	654,630
Military & Other	5,811	2,764	586	2,072	10,241	26,507	328	495	9,973	1,287	60,064	0	60,064
Total	169,736	158,698	107,832	106,252	115,363	82,784	61,788	51,042	47,678	212,371	1,113,544	487,996	1,601,540
2001													
Commercial	128,638	100,606	61,669	47,770	47,261	18,286	4,581	5,631	4,485	6,414	425,341	434,386	859,727
General Aviation[1]	30,478	45,095	44,358	62,014	61,986	35,230	56,092	45,464	30,148	197,770	608,635	28,739	637,374
Military & Other	5,913	2,635	607	2,259	11,821	26,623	437	917	8,221	1,252	60,685	0	60,685
Total	165,029	148,336	106,634	112,043	121,068	80,139	61,110	52,012	42,854	205,436	1,094,661	463,125	1,557,786
2002													
Commercial	113,194	96,595	62,346	45,899	38,929	24,412	3,827	4,062	5,059	6,603	400,926	366,476	767,402
General Aviation[1]	27,838	45,473	29,549	57,720	59,679	35,711	62,163	52,277	28,333	210,221	608,964	25,596	634,560
Military & Other	6,085	2,587	376	2,162	12,167	27,297	593	418	8,220	1,424	61,329	0	61,329
Total	147,117	144,655	92,271	105,781	110,775	87,420	66,583	56,757	41,612	218,248	1,071,219	392,072	1,463,291
2003													
Commercial	103,917	84,301	68,184	42,658	38,293	25,626	3,705	868	4,552	2,956	375,060	344,644	719,704
General Aviation[1]	27,115	42,878	29,552	44,036	50,461	36,706	54,224	55,972	24,866	190,789	556,599	28,660	585,259
Military & Other	4,214	2,496	324	1,449	11,466	32,938	776	378	7,720	1,142	62,903	0	62,903
Total	135,246	129,675	98,060	88,143	100,220	95,270	58,705	57,218	37,138	194,887	994,562	373,304	1,367,866
2004													
Commercial	108,823	83,496	75,360	46,474	41,719	24,970	4,501	0	3,981	4,308	393,632	374,022	767,654
General Aviation[1]	32,269	34,878	27,438	41,547	54,709	29,884	58,881	61,343	25,962	175,301	542,212	31,236	573,448
Military & Other	4,100	346	749	1,338	12,404	29,676	1,010	530	7,797	1,195	59,145	0	59,145
Total	145,192	118,720	103,547	89,359	108,832	84,530	64,392	61,873	37,740	180,804	994,989	405,258	1,400,247
2005													
Commercial	119,048	88,374	76,342	42,661	43,987	25,976	6,137	2,727	3,197	3,627	412,076	377,830	789,906
General Aviation[1]	33,341	28,138	26,369	36,191	49,888	30,016	60,893	62,743	25,446	165,424	518,449	31,236	549,685
Military & Other	3,701	241	479	1,405	11,468	24,154	1,063	519	7,669	904	51,603	0	51,603
Total	156,090	116,753	103,190	80,257	105,343	80,146	68,093	65,989	36,312	169,955	982,128	409,066	1,391,194

Table F-1 Aircraft Operations by Classification for New England's Airports, 2000 to 2014 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2006													
Commercial	111,341	81,282	67,326	38,663	41,342	23,466	5,177	3,793	3,981	3,057	379,428	374,675	754,103
General Aviation[1]	34,548	25,510	25,074	35,572	44,471	29,848	51,702	56,770	25,962	167,560	497,017	31,444	528,461
Military & Other	4,348	229	738	1,536	9,299	22,359	1,157	609	7,797	1,433	49,505	0	49,505
Total	150,237	107,021	93,138	75,771	95,112	75,673	58,036	61,172	37,740	172,050	925,950	406,119	1,332,069
2007													
Commercial	107,097	80,525	69,134	41,450	39,928	22,571	4,594	3,162	4,270	3,477	376,208	370,905	747,113
General Aviation[1]	29,308	22,984	23,959	31,724	47,521	25,542	51,200	61,296	27,000	160,992	481,526	28,632	510,158
Military & Other	5,097	242	644	1,384	9,528	20,949	944	879	8,017	1,438	49,122	0	49,122
Total	141,502	103,751	93,737	74,558	96,977	69,062	56,738	65,337	39,287	165,907	906,856	399,537	1,306,393
2008													
Commercial	98,194	73,096	63,505	40,834	37,832	19,282	4,013	2,553	1,347	104	340,760	347,784	688,544
General Aviation[1]	22,908	19,470	16,198	31,869	46,391	27,143	44,642	43,763	31,051	164,195	447,630	23,820	471,450
Military & Other	3,637	187	840	974	9,688	20,449	243	886	7,993	1,590	46,487	0	46,487
Total	124,739	92,753	80,543	73,677	93,911	66,874	48,898	47,202	40,391	165,889	834,877	371,604	1,206,481
2009													
Commercial	82,021	62,233	54,336	35,909	31,153	16,485	3,096	2,527	422	0	288,182	333,064	621,246
General Aviation[1]	19,586	19,438	14,354	25,473	32,872	19,558	37,722	41,700	25,161	148,696	384,560	12,242	396,802
Military & Other	2,726	260	1,163	778	8,628	16,267	486	17	6,851	1,215	38,391	0	38,391
Total	104,333	81,931	69,853	62,160	72,653	52,310	41,304	44,244	32,434	149,911	711,133	345,306	1,056,439
2010													
Commercial	80,418	60,128	53,971	35,035	29,538	16,190	3,201	1,629	1,516	0	281,626	337,961	619,587
General Aviation[1]	18,759	21,096	13,636	24,776	36,106	20,142	31,884	41,843	25,674	161,942	395,858	14,682	410,540
Military & Other	3,028	347	933	446	4,776	15,525	381	572	7,707	1,795	35,510	0	35,510
Total	102,205	81,571	68,540	60,257	70,420	51,857	35,466	44,044	34,897	163,737	712,994	352,643	1,065,637
2011													
Commercial	86,838	57,194	51,379	35,157	29,166	16,177	3,367	2,017	1,717	750	283,762	340,757	624,519
General Aviation[1]	16,483	21,774	12,497	21,453	42,562	19,503	33,919	44,050	27,056	160,840	400,137	28,230	428,367
Military & Other	3,630	369	874	533	5,890	13,220	310	634	8,158	1,409	35,027	0	35,027
Total	106,951	79,337	64,750	57,143	77,618	48,900	37,596	46,701	36,931	162,999	718,926	368,987	1,087,913

Table F-1 Aircraft Operations by Classification for New England's Airports, 2000 to 2014 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2012													
Commercial	79,704	50,301	45,379	33,118	27,067	14,826	3,936	1,639	502	635	257,107	326,755	583,862
General Aviation[1]	15,589	24,781	12,504	20,864	42,352	18,069	34,775	42,655	30,186	164,841	406,616	28,114	434,730
Military & Other	3,726	434	1,073	584	7,079	11,503	416	740	7,917	738	34,210	0	34,210
Total	99,019	75,516	58,956	54,566	76,498	44,398	39,127	45,034	38,605	166,214	697,933	354,869	1,052,802
2013													
Commercial	78,213	48,340	43,572	31,076	26,814	14,707	4,094	173	560	0	247,549	334,657	582,206
General Aviation[1]	15,192	24,729	11,432	20,021	40,413	15,535	28,794	35,064	28,951	155,469	375,600	26,682	402,282
Military & Other	2,558	435	1,224	471	6,972	11,045	423	593	7,573	612	31,906	0	31,906
Total	95,963	73,504	56,228	51,568	74,199	41,287	33,311	35,830	37,084	156,081	655,055	361,339	1,016,394
2014													
Commercial	78,968	43,888	38,674	29,538	26,057	14,428	4,795	2,521	8,278	0	247,147	337,381	584,528
General Aviation[1]	14,709	16,105	12,293	16,535	40,858	15,466	26,273	28,565	24,440	133,684	328,928	26,416	355,344
Military & Other	2,660	622	908	560	6,842	11,527	529	978	7,621	604	32,851	0	32,851
Total	96,337	60,615	51,875	46,633	73,757	41,421	31,597	32,064	40,339	134,288	608,926	363,797	972,723

1 Includes itinerant and local general aviation (GA) operations at the regional airports. There are no local (touch-and-go training) operations at Logan Airport.
2 Commercial operations at Hanscom Field include scheduled commercial operations only; other air taxi operations counted as GA.
3 Operations at Logan Airport include international operations.
Source: Massport, Federal Aviation Administration (FAA) Tower Counts, and individual airport records.

Table F-2 Percentage Change in Aircraft Operations by Classification for New England's Airports, 2000 to 2014

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2000 to 2001													
Commercial	(2.59%)	(3.03%)	0.27%	0.34%	3.31%	(14.73%)	(12.91%)	39.76%	(26.52%)	(2.40%)	(2.01%)	(4.06%)	(3.06%)
General Aviation[1]	(4.35%)	(13.58%)	(3.02%)	9.62%	4.39%	1.15%	(0.19%)	(2.27%)	(4.60%)	(3.30%)	(1.74%)	(18.43%)	(2.64%)
Military & Other	1.76%	(4.67%)	3.58%	9.03%	15.43%	0.44%	33.23%	85.25%	(17.57%)	(2.72%)	1.03%	-	1.03%
Total	(2.77%)	(6.53%)	(1.11%)	5.45%	4.95%	(3.20%)	(1.10%)	1.90%	(10.12%)	(3.27%)	(1.70%)	(5.10%)	(2.73%)
2001 Percent of Total	10.59%	9.52%	6.85%	7.19%	7.77%	5.14%	3.92%	3.34%	2.75%	13.19%	70.27%	29.73%	100.00%
2001 to 2002													
Commercial	(12.01%)	(3.99%)	1.10%	(3.92%)	(17.63%)	33.50%	(16.46%)	(27.86%)	12.80%	2.95%	(5.74%)	(15.63%)	(10.74%)
General Aviation[1]	(8.66%)	0.84%	(33.39%)	(6.92%)	(3.72%)	1.37%	10.82%	14.99%	(6.02%)	6.30%	0.05%	(10.94%)	(0.44%)
Military & Other	2.91%	(1.82%)	(38.06%)	(4.29%)	2.93%	2.53%	35.70%	(54.42%)	(0.01%)	13.74%	1.06%	-	1.06%
Total	(10.85%)	(2.48%)	(13.47%)	(5.59%)	(8.50%)	9.09%	8.96%	9.12%	(2.90%)	6.24%	(2.14%)	(15.34%)	(6.07%)
2002 Percent of Total	10.05%	9.89%	6.31%	7.23%	7.57%	5.97%	4.55%	3.88%	2.84%	14.91%	73.21%	26.79%	100.00%
2002 to 2003													
Commercial	(8.20%)	(12.73%)	9.36%	(7.06%)	(1.63%)	4.97%	(3.19%)	(78.63%)	(10.02%)	(55.23%)	(6.45%)	(5.96%)	(6.22%)
General Aviation[1]	(2.60%)	(5.71%)	0.01%	(23.71%)	(15.45%)	2.79%	(12.77%)	7.07%	(12.24%)	(9.24%)	(8.60%)	11.97%	(7.77%)
Military & Other	(30.75%)	(3.52%)	(13.83%)	(32.98%)	(5.76%)	20.67%	30.86%	(9.57%)	(6.08%)	(19.80%)	2.57%	-	2.57%
Total	(8.07%)	(10.36%)	6.27%	(16.67%)	(9.53%)	8.98%	(11.83%)	0.81%	(10.75%)	(10.70%)	(7.16%)	(4.79%)	(6.52%)
2003 Percent of Total	9.89%	9.48%	7.17%	6.44%	7.33%	6.96%	4.29%	4.18%	2.72%	14.25%	72.71%	27.29%	100.00%
2003 to 2004													
Commercial	4.72%	(0.95%)	10.52%	8.95%	8.95%	(2.56%)	21.48%	(100.00%)	(12.54%)	45.74%	4.95%	8.52%	6.66%
General Aviation[1]	19.01%	(18.66%)	(7.15%)	(5.65%)	8.42%	(18.59%)	8.59%	9.60%	4.41%	(8.12%)	(2.58%)	8.99%	(2.02%)
Military & Other	(2.71%)	(86.14%)	131.17%	(7.66%)	8.18%	(9.90%)	30.15%	40.21%	1.00%	4.64%	(5.97%)	-	(5.97%)
Total	7.35%	(8.45%)	5.60%	1.38%	8.59%	(11.27%)	9.69%	8.14%	1.62%	(7.23%)	0.04%	8.56%	2.37%
2004 Percent of Total	10.37%	8.48%	7.39%	6.38%	7.77%	6.04%	4.60%	4.42%	2.70%	12.91%	71.06%	28.94%	100.00%
2004 to 2005													
Commercial	9.40%	5.84%	1.30%	(8.20%)	5.44%	4.03%	36.35%	-	(19.69%)	(15.81%)	4.69%	1.02%	2.90%
General Aviation[1]	3.32%	(19.32%)	(3.90%)	(12.89%)	(8.81%)	0.44%	3.42%	2.28%	(1.99%)	(5.63%)	(4.38%)	0.00%	(4.14%)
Military & Other	(9.73%)	(30.35%)	(36.05%)	5.01%	(7.55%)	(18.61%)	5.25%	(2.08%)	(1.64%)	(24.35%)	(12.75%)	-	(12.75%)
Total	7.51%	(1.66%)	(0.34%)	(10.19%)	(3.21%)	(5.19%)	5.75%	6.65%	(3.78%)	(6.00%)	(1.29%)	0.94%	(0.65%)
2005 Percent of Total	11.22%	8.39%	7.42%	5.77%	7.57%	5.76%	4.89%	4.74%	2.61%	12.22%	70.60%	29.40%	100.00%

Table F-2 Percentage Change in Aircraft Operations by Classification for New England's Airports, 2000 to 2014 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2005 to 2006													
Commercial	(6.47%)	(8.02%)	(11.81%)	(9.37%)	(6.01%)	(9.66%)	(15.64%)	39.09%	24.52%	(15.72%)	(7.92%)	(0.84%)	(4.53%)
General Aviation[1]	3.62%	(9.34%)	(4.91%)	(1.71%)	(10.86%)	(0.56%)	(15.09%)	(9.52%)	2.03%	1.29%	(4.13%)	0.67%	(3.86%)
Military & Other	17.48%	(4.98%)	54.07%	9.32%	(18.91%)	(7.43%)	8.84%	17.34%	1.67%	58.52%	(4.07%)	-	(4.07%)
Total	(3.75%)	(8.34%)	(9.74%)	(5.59%)	(9.71%)	(5.58%)	(14.77%)	(7.30%)	3.93%	1.23%	(5.72%)	(0.72%)	(4.25%)
2006 Percent of Total	11.28%	8.03%	6.99%	5.69%	7.14%	5.68%	4.36%	4.59%	2.83%	12.92%	69.51%	30.49%	100.00%
2006 to 2007													
Commercial	(3.81%)	(0.93%)	2.69%	7.21%	(3.42%)	(3.81%)	(11.26%)	(16.64%)	7.26%	13.74%	(0.85%)	(1.01%)	(0.93%)
General Aviation[1]	(15.17%)	(9.90%)	(4.45%)	(10.82%)	6.86%	(14.43%)	(0.97%)	7.97%	4.00%	(3.92%)	(3.12%)	(8.94%)	(3.46%)
Military & Other	17.23%	5.68%	(12.74%)	(9.90%)	2.46%	(6.31%)	(18.41%)	44.33%	2.82%	0.35%	(0.77%)	-	(0.77%)
Total	(5.81%)	(3.06%)	0.64%	(1.60%)	1.96%	(8.74%)	(2.24%)	6.81%	4.10%	(3.57%)	(2.06%)	(1.62%)	(1.93%)
2007 Percent of Total	10.83%	7.94%	7.18%	5.71%	7.42%	5.29%	4.34%	5.00%	3.01%	12.70%	69.42%	30.58%	100.00%
2007 to 2008													
Commercial	(8.31%)	(9.23%)	(8.14%)	(1.49%)	(5.25%)	(14.57%)	(12.65%)	(19.26%)	(68.45%)	(97.01%)	(9.42%)	(6.23%)	(7.84%)
General Aviation[1]	(21.84%)	(15.29%)	(32.39%)	0.46%	(2.38%)	6.27%	(12.81%)	(28.60%)	15.00%	1.99%	(7.04%)	(16.81%)	(7.59%)
Military & Other	(28.64%)	(22.73%)	30.43%	(29.62%)	1.68%	(2.39%)	(74.26%)	0.80%	(0.30%)	10.57%	(5.36%)	-	(5.36%)
Total	(11.85%)	(10.60%)	(14.08%)	(1.18%)	(3.16%)	(3.17%)	(13.82%)	(27.76%)	2.81%	(0.01%)	(7.94%)	(6.99%)	(7.65%)
2008 Percent of Total	10.34%	7.69%	6.68%	6.11%	7.78%	5.54%	4.05%	3.91%	3.35%	13.75%	69.20%	30.80%	100.00%
2008 to 2009													
Commercial	(16.47%)	(14.86%)	(14.44%)	(12.06%)	(17.65%)	(14.51%)	(22.85%)	(1.02%)	(68.67%)	(100.00%)	(15.43%)	(4.23%)	(9.77%)
General Aviation[1]	(14.50%)	(0.16%)	(11.38%)	(20.07%)	(29.14%)	(27.94%)	(15.50%)	(4.71%)	(18.97%)	(9.44%)	(14.09%)	(48.61%)	(15.83%)
Military & Other	(25.05%)	39.04%	38.45%	(20.12%)	(10.94%)	(20.45%)	100.00%	(98.08%)	(14.29%)	(23.58%)	(17.42%)	-	(17.42%)
Total	(16.36%)	(11.67%)	(13.27%)	(15.63%)	(22.64%)	(21.78%)	(15.53%)	(6.27%)	(19.70%)	(9.63%)	(14.82%)	(7.08%)	(12.44%)
2009 Percent of Total	9.88%	7.76%	6.61%	5.88%	6.88%	4.95%	3.91%	4.19%	3.07%	14.19%	67.31%	32.69%	100.00%
2009 to 2010													
Commercial	(1.95%)	(3.38%)	(0.67%)	(2.43%)	(5.18%)	(1.79%)	3.39%	(35.54%)	259.24%	-	(2.27%)	1.47%	(0.27%)
General Aviation[1]	(4.22%)	8.53%	(5.00%)	(2.74%)	9.84%	2.99%	(15.48%)	0.34%	2.04%	8.91%	2.94%	19.93%	3.46%
Military & Other	11.08%	33.46%	(19.78%)	(42.67%)	(44.65%)	(4.56%)	(21.60%)	3264.71%	12.49%	47.74%	(7.50%)	-	(7.50%)
Total	(2.04%)	(0.44%)	(1.88%)	(3.06%)	(3.07%)	(0.87%)	(14.13%)	(0.45%)	7.59%	9.22%	0.26%	2.12%	0.87%
2010 Percent of Total	9.59%	7.65%	6.43%	5.65%	6.61%	4.87%	3.33%	4.13%	3.27%	15.37%	66.91%	33.09%	100.00%
2010 to 2011													
Commercial	7.98%	(4.88%)	(4.80%)	0.35%	(1.26%)	(0.08%)	5.19%	23.82%	13.26%	-	0.76%	0.83%	0.80%
General Aviation[1]	(12.13%)	3.21%	(8.35%)	(13.41%)	17.88%	(3.17%)	6.38%	5.27%	5.38%	(0.68%)	1.08%	92.28%	4.34%
Military & Other	19.88%	6.34%	(6.32%)	19.51%	23.32%	(14.85%)	(18.64%)	10.84%	5.85%	(21.50%)	(1.36%)	-	(1.36%)
Total	4.64%	(2.74%)	(5.53%)	(5.17%)	10.22%	(5.70%)	6.01%	6.03%	5.83%	(0.45%)	0.83%	4.63%	2.09%
2011 Percent of Total	9.83%	7.29%	5.95%	5.25%	7.13%	4.49%	3.46%	4.29%	3.39%	14.98%	66.08%	33.92%	100.00%

Table F-2 Percentage Change in Aircraft Operations by Classification for New England's Airports, 2000 to 2014 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2011 to 2012													
Commercial	(8.22%)	(12.05%)	(11.68%)	(5.80%)	(7.20%)	(8.35%)	16.90%	(18.74%)	(70.76%)	-	(9.39%)	(4.11%)	(6.51%)
General Aviation[1]	(5.42%)	13.81%	0.06%	(2.75%)	(0.49%)	(7.35%)	2.52%	(3.17%)	11.57%	2.49%	1.62%	(0.41%)	1.49%
Military & Other	2.64%	17.62%	22.77%	9.57%	20.19%	(12.99%)	34.19%	16.72%	(2.95%)	(47.62%)	(2.33%)	NA	(2.33%)
Total	(7.42%)	(4.82%)	(8.95%)	(4.51%)	(1.44%)	(9.21%)	4.07%	(3.57%)	4.53%	1.97%	(2.92%)	(3.83%)	(3.23%)
2012 Percent of Total	9.41%	7.17%	5.60%	5.18%	7.27%	4.22%	3.72%	4.28%	3.67%	15.79%	66.29%	33.71%	100.00%
2012 to 2013													
Commercial	(1.87%)	(3.90%)	(3.98%)	(6.17%)	(0.93%)	(0.80%)	4.01%	(89.44%)	11.55%	-	(3.72%)	2.42%	(0.28%)
General Aviation[1]	(2.55%)	(0.21%)	(8.57%)	(4.04%)	(4.58%)	(14.02%)	(17.20%)	(17.80%)	(4.09%)	(5.69%)	(7.63%)	(5.09%)	(7.46%)
Military & Other	(31.35%)	0.23%	14.07%	(19.35%)	(1.51%)	(3.98%)	1.68%	(19.86%)	(4.35%)	(17.07%)	(6.73%)	NA	(6.73%)
Total	(3.09%)	(2.66%)	(4.63%)	(5.49%)	(3.01%)	(7.01%)	(14.86%)	(20.44%)	(3.94%)	(6.10%)	(6.14%)	1.82%	(3.46%)
2013 Percent of Total	9.44%	7.23%	5.53%	5.07%	7.30%	4.06%	3.28%	3.53%	3.65%	15.36%	64.45%	35.55%	100.00%
2013 to 2014													
Commercial	0.97%	(9.21%)	(11.24%)	(4.95%)	(2.82%)	(1.90%)	17.12%	1357.23%	1378.21%	NA	(0.16%)	0.81%	0.40%
General Aviation[1]	(3.18%)	(34.87%)	7.53%	(17.41%)	1.10%	(0.44%)	(8.76%)	(18.53%)	(15.58%)	(14.01%)	(12.43%)	(1.00%)	(11.67%)
Military & Other	3.99%	42.99%	(25.82%)	18.90%	(1.86%)	4.36%	25.06%	64.92%	0.63%	(1.31%)	2.96%	NA	2.96%
Total	0.39%	(17.54%)	(7.74%)	(9.57%)	(0.60%)	0.32%	(5.15%)	(10.51%)	8.78%	(13.96%)	(7.04%)	0.68%	(4.30%)
2014 Percent of Total	9.90%	6.23%	5.33%	4.79%	7.58%	4.26%	3.25%	3.30%	4.15%	13.81%	62.60%	37.40%	100.00%

1 Includes itinerant and local general aviation (GA) operations at the regional airports. There are no local (touch-and-go training) operations at Logan Airport.
2 Commercial operations at Hanscom Field include scheduled commercial operations only; other air taxi operations counted as GA.
3 Operations at Logan Airport include international operations.
Source: Massport, Federal Aviation Administration (FAA) Tower Counts, and individual airport records.

Table F-3 Scheduled Passenger Operations by Market and Carrier for Bradley International Airport

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Jet Carriers																				
AirTran	Atlanta	ATL						174	912	738	423.3%						20,391	106,704	86,313	423.3%
Alaska	Chicago O'Hare	ORD	30							-	-	4,050							-	-
America West	Columbus	CMH	149							-	-	18,441							-	-
America West	Las Vegas	LAS	210							-	-	27,469							-	-
America West	Phoenix	PHX	275	365						-	-	37,772	54,570						-	-
American	Chicago O'Hare	ORD	2,139	1,570						-	-	304,855	203,929						-	-
American	Dallas/Fort Worth	DFW	1,343	1,052	1,052	1,078	1,068	1,069	1,008	-61	-5.7%	185,922	136,897	160,983	172,457	170,811	171,017	157,952	-13,065	-7.6%
American	Los Angeles	LAX	214					122	243	121	99.2%	31,244					19,520	38,880	19,360	99.2%
American	Miami	MIA	366	365	413	516	366	396	476	80	20.2%	51,427	49,990	63,559	82,560	58,560	63,360	74,981	11,621	18.3%
American	New York J F Kennedy	JFK								-	-								-	-
American	San Juan	SJU	366	365	365	365	91			-	-	69,348	84,425	55,856	58,400	14,560			-	-
American	St. Louis	STL								-	-								-	-
Boston-Maine Airways	Fort Lauderdale/Hollywood	FLL		13						-	-		1,993						-	-
Continental	Cleveland	CLE	582	131						-	-	68,974	16,262						-	-
Continental	Houston Intercontinental	IAH	366	313						-	-	45,790	34,072						-	-
Continental	New York Newark	EWR	331							-	-	38,916							-	-
Delta	Atlanta	ATL	2,192	3,098	2,099	2,094	2,105	2,109	2,391	282	13.4%	392,835	479,098	300,185	310,149	317,331	319,290	355,968	36,678	11.5%
Delta	Boston	BOS	4							-	-	634							-	-
Delta	Cancun	CUN			35	35	17	13	17	4	32.2%			5,470	5,397	2,735	1,973	2,571	598	30.3%
Delta	Cincinnati	CVG	1,464	1,373						-	-	244,837	196,741						-	-
Delta	Detroit	DTW			1,003	658	506	753	1,053	300	39.9%			129,228	91,657	73,117	110,361	145,867	35,506	32.2%
Delta	Fort Lauderdale/Hollywood	FLL	732	673	237	210				-	-	87,108	133,927	33,674	29,280				-	-
Delta	Fort Myers	RSW			99	90				-	-			13,104	12,780				-	-
Delta	Las Vegas	LAS			9					-	-			1,394					-	-
Delta	Los Angeles	LAX		100	83					-	-		19,928	13,257					-	-
Delta	Minneapolis	MSP			758	576	511	549	605	56	10.2%			99,431	79,418	75,291	82,545	87,377	4,832	5.9%
Delta	New York J F Kennedy	JFK	183							-	-	39,894							-	-
Delta	Orlando	MCO	1,838	1,095	704	608		57		-57	-100.0%	218,705	217,905	99,129	88,041		8,514		-8,514	-100.0%
Delta	Salt Lake City	SLC		27						-	-		3,986						-	-
Delta	Tampa	TPA		678	252	120				-	-		134,894	33,625	15,420				-	-
Delta	West Palm Beach	PBI	732	516	283	120				-	-	87,108	102,684	37,536	16,500				-	-
Frontier Airlines	Denver	DEN								-	-								-	-
jetBlue	Washington National	DCA							402	402	-							40,229	40,229	-
jetBlue	Fort Lauderdale/Hollywood	FLL			101	599	627	612	590	-22	-3.6%			15,086	90,231	94,029	91,800	87,836	-3,964	-4.3%
jetBlue	Fort Myers	RSW						61	181	120	196.7%						9,150	27,150	18,000	196.7%
jetBlue	Orlando	MCO			101	730	723	730	747	17	2.3%			15,086	109,860	108,300	109,500	112,071	2,571	2.3%
jetBlue	San Juan	SJU					366	365	405	40	10.9%					54,900	54,793	60,729	5,936	10.8%
jetBlue	Tampa	TPA						61	365	304	498.4%						9,150	44,693	35,543	388.4%
jetBlue	West Palm Beach	PBI					366	365	365	-	0.0%					45,700	54,750	44,907	-9,843	-18.0%
Laker Airways (Bahamas)	Freeport	FPO	39							-	-	5,850							-	-
Midway Airlines	Raleigh/Durham	RDU	683							-	-	69,213							-	-
Midwest/Republic	Milwaukee	MKE	619							-	-	44,455							-	-
Northwest	Amsterdam	AMS								-	-								-	-
Northwest	Detroit	DTW	1,699	1,451						-	-	215,750	192,679						-	-
Northwest	Fort Myers	RSW								-	-								-	-
Northwest	Minneapolis	MSP	1,177	1,042						-	-	135,570	140,194						-	-

Table F-3 Scheduled Passenger Operations by Market and Carrier for Bradley International Airport (Continued)

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Northwest	Orlando	MCO								-	-								-	-
Northwest	Tampa	TPA								-	-								-	-
Northwest	West Palm Beach	PBI								-	-								-	-
Southwest	Atlanta	ATL							174	174	-							24,923	24,923	-
Southwest	Baltimore	BWI	2,841	3,094	2,700	2,708	2,658	2,610	2,448	-162	-6.2%	389,158	423,878	367,534	367,414	362,995	372,650	353,791	-18,859	-5.1%
Southwest	Chicago Midway	MDW	723	953	923	979	964	967	961	-6	-0.6%	99,090	130,541	126,412	133,267	133,533	146,270	142,513	-3,757	-2.6%
Southwest	Denver	DEN			306	365	366	365	374	9	2.5%			41,922	50,005	50,982	54,860	58,570	3,710	6.8%
Southwest	Fort Lauderdale/Hollywood	FLL			70	365	366	348	369	21	6.1%			9,551	50,005	50,272	49,521	53,381	3,860	7.8%
Southwest	Fort Myers	RSW					147	203	216	13	6.3%					20,413	28,917	30,949	2,032	7.0%
Southwest	Las Vegas	LAS	52	365	361	365	270	245	245	-	0.0%	7,163	50,005	49,398	50,005	40,466	34,876	35,035	159	0.5%
Southwest	Nashville	BNA	672	365	361	304				-	-	92,064	50,005	49,398	41,648				-	-
Southwest	Orlando	MCO	375	1,108	1,016	1,003	997	944	975	31	3.3%	51,336	151,816	139,212	137,411	137,843	136,115	140,866	4,751	3.5%
Southwest	Philadelphia	PHL		1,590						-	-		217,850						-	-
Southwest	Tampa	TPA		695	570	656	623	629	656	27	4.2%		95,156	78,129	89,852	85,873	90,219	93,662	3,443	3.8%
Southwest	West Palm Beach	PBI				61				-	-				8,357				-	-
Sunworld International	Philadelphia	PHL								-	-								-	-
Trans World Airlines	Portland (ME)	PWM	305							-	-	43,310							-	-
Trans World Airlines	St. Louis	STL	1,460							-	-	206,109							-	-
United	Chicago O'Hare	ORD	2,034	1,812	1,296	1,077	697	593	800	207	34.9%	299,522	259,437	198,709	159,738	104,725	86,911	112,864	25,953	29.9%
United	Denver	DEN	366							-	-	46,901							-	-
United	New York Newark	EWR						18		-18	-100.0%						2,126		-2,126	-100.0%
United	San Francisco	SFO	366							-	-	45,384							-	-
United	Washington Dulles	IAD	1,455	726	1,192	812	514	180	222	42	23.6%	173,869	81,631	155,750	108,500	66,780	25,418	32,132	6,714	26.4%
US Airways	Baltimore	BWI	488							-	-	41,760							-	-
US Airways	Charlotte	CLT	1,464	2,188	1,588	1,664	1,665	1,734	1,763	29	1.6%	214,719	350,776	228,119	238,508	241,320	255,885	257,645	1,760	0.7%
US Airways	Fort Lauderdale/Hollywood	FLL	366	123						-	-	39,232	15,161						-	-
US Airways	Orlando	MCO	1,098	30						-	-	117,696	3,842						-	-
US Airways	Philadelphia	PHL	2,148	2,102	361	317	340	365	265	-100	-27.4%	310,118	301,242	49,914	44,595	46,989	49,083	29,004	-20,079	-40.9%
US Airways	Phoenix	PHX								-	-								-	-
US Airways	Pittsburgh	PIT	1,800	27						-	-	278,575	3,189						-	-
US Airways	Washington Dulles	IAD	732							-	-	86,376							-	-
US Airways	Washington National	DCA	1,329	1,064	361	365	335	208	103	-105	-50.5%	171,891	141,068	51,434	52,210	46,511	25,610	12,536	-13,074	-51.0%
US Airways	West Palm Beach	PBI	366							-	-	39,232							-	-
USA 3000 Airlines	Cancun	CUN		26						-	-		4,336						-	-
USA 3000 Airlines	Punta Cana	PUJ		13						-	-		2,128						-	-
Subtotal			38,171	30,507	18,695	18,841	16,686	16,845	21,345	4,500	26.7%	5,179,671	4,486,236	2,622,086	2,693,666	2,404,036	2,484,577	2,767,800	283,223	11.4%
Regional/Commuter Carriers																				
Air Canada Express	Montreal Dorval	YUL	1,385	1,038	1,021	986	976	952	996	44	4.6%	19,392	19,475	19,399	18,739	18,549	17,144	17,925	781	4.6%
Air Canada Express	Toronto	YYZ	1,589	1,342	1,287	1,308	1,294	1,295	1,313	18	1.4%	61,991	38,242	36,960	38,342	33,044	28,103	25,102	-3,001	-10.7%
America West Express	Columbus	CMH	450							-	-	22,493							-	-
American Connection	St. Louis	STL		947						-	-		44,356						-	-
American Eagle	Chicago O'Hare	ORD			1,501	1,630	1,613	1,630	1,622	-8	-0.5%			79,594	95,985	80,413	90,663	115,856	25,193	27.8%
American Eagle	New York J F Kennedy	JFK	1,460							-	-	48,166							-	-
American Eagle	Raleigh/Durham	RDU		1,364	257					-	-		54,521	10,774					-	-
American Eagle	St. Louis	STL								-	-								-	-
Continental Connection	Albany	ALB		51						-	-		961						-	-

Table F-3 Scheduled Passenger Operations by Market and Carrier for Bradley International Airport (Continued)

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Continental Connection	Binghamton	BGM								-	-								-	-
Continental Connection	Boston	BOS								-	-								-	-
Continental Connection	Buffalo	BUF	89							-	-	1,683							-	-
Continental Connection	Burlington	BTV	4							-	-	84							-	-
Continental Connection	New York J F Kennedy	JFK								-	-								-	-
Continental Connection	New York Newark	EWR			608	901	782	642	368	-274	-42.7%			22,485	33,353	31,055	27,097	14,537	-12,560	-46.4%
Continental Connection	Philadelphia	PHL								-	-								-	-
Continental Connection	Rochester	ROC	93							-	-	1,767							-	-
Continental Connection	Syracuse	SYR	97							-	-	1,851							-	-
Continental Express	Cleveland	CLE	803	1,102	1,208	1,200	307			-	-	39,357	54,951	60,400	59,979	15,336			-	-
Continental Express	New York Newark	EWR	1,747	1,351	465	258	65			-	-	82,365	67,455	23,264	12,879	3,264			-	-
Delta Connection	Atlanta	ATL				48	9	4	4	0	-6.7%				3,396	647	279	288	9	3.4%
Delta Connection	Cincinnati	CVG			1,218	1,251	902	895	839	-56	-6.3%			61,642	66,559	45,181	44,757	43,557	-1,200	-2.7%
Delta Connection	Cleveland	CLE							170	170	-							11,898	11,898	-
Delta Connection	Columbus	CMH		994						-	-		49,196						-	-
Delta Connection	Detroit	DTW			1,004	1,323	1,429	1,195	659	-536	-44.9%			54,265	82,915	100,525	80,351	45,421	-34,930	-43.5%
Delta Connection	Fort Lauderdale/Hollywood	FLL								-	-								-	-
Delta Connection	Fort Myers	RSW		612						-	-		42,840						-	-
Delta Connection	Minneapolis	MSP			481	814	858	812	738	-74	-9.1%			36,567	61,731	64,643	61,035	55,233	-5,802	-9.5%
Delta Connection	Myrtle Beach	MYR	61							-	-	3,057							-	-
Delta Connection	New York J F Kennedy	JFK			365	304	183			-	-			18,250	15,200	9,216			-	-
Delta Connection	Orlando	MCO							43	43	-							3,156	3,156	-
Delta Connection	Raleigh/Durham	RDU			100	569	454	270	257	-13	-4.8%			6,136	28,436	22,686	13,500	12,850	-650	-4.8%
Delta Connection	Tampa	TPA								-	-								-	-
Delta Connection	Washington National	DCA			166	929	360			-	-			11,324	51,524	18,074			-	-
Delta Connection	West Palm Beach	PBI								-	-								-	-
Frontier Express	Milwaukee	MKE			140	417				-	-			6,313	18,746				-	-
Independence Air	Washington Dulles	IAD		1,966						-	-		98,307						-	-
Midway Airlines	Raleigh/Durham	RDU	1,348							-	-	67,393							-	-
Midwest Connect	Milwaukee	MKE	4	965						-	-	142	30,871						-	-
Northwest Airlink	Detroit	DTW								-	-								-	-
Northwest Airlink	Indianapolis	IND		638						-	-		31,907						-	-
Northwest Airlink	Memphis	MEM								-	-								-	-
Northwest Airlink	Minneapolis	MSP		31						-	-		1,550						-	-
Shuttle America	Albany	ALB	66							-	-	3,286							-	-
Shuttle America	Bedford	BED	233							-	-	11,671							-	-
Shuttle America	Buffalo	BUF	337							-	-	16,857							-	-
Shuttle America	Islip	ISP	27							-	-	1,329							-	-
Shuttle America	Wilmington	ILG	159							-	-	7,936							-	-
Swissair	New York J F Kennedy	JFK	31							-	-	1,023							-	-
Trans World Airlines	New York J F Kennedy	JFK	1,098							-	-	31,842							-	-
United Express	Chicago O'Hare	ORD		691	548	685	1,038	1,045	877	-168	-16.1%		48,370	36,797	43,701	63,807	59,896	47,419	-12,477	-20.8%
United Express	Cleveland	CLE					818	1,127	235	-892	-79.1%					40,409	56,436	11,750	-44,686	-79.2%
United Express	Houston	IAH							96	96	-							7,521	7,521	-
United Express	New York Newark	EWR					499	627	485	-142	-22.7%					22,468	34,243	23,780	-10,463	-30.6%
United Express	Washington Dulles	IAD		1,519	494	889	928	1,280	1,224	-56	-4.4%		84,484	30,270	54,707	59,507	72,861	68,684	-4,177	-5.7%
US Airways Express	Baltimore	BWI	1,185							-	-	43,850							-	-
US Airways Express	Buffalo	BUF	1,032	839						-	-	38,200	28,607						-	-

Table F-3 Scheduled Passenger Operations by Market and Carrier for Bradley International Airport (Continued)

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
US Airways Express	Charlotte	CLT		4	537	452	462	364	366	2	0.4%		221	45,043	37,510	39,235	28,392	28,940	548	1.9%
US Airways Express	New York La Guardia	LGA			139	1,057	364			-	-			5,159	39,098	13,468			-	-
US Airways Express	New York Newark	EWR								-	-								-	-
US Airways Express	Philadelphia	PHL		439	2,404	2,430	2,356	2,260	2,234	-26	-1.2%		27,685	183,838	163,675	151,526	133,663	136,683	3,020	2.3%
US Airways Express	Pittsburgh	PIT		1,646	939	939	941	939	939	0	0.0%		84,598	46,929	46,929	47,057	77,901	67,549	-10,352	-13.3%
US Airways Express	Rochester	ROC	937	574	478					-	-	34,658	19,555	16,242					-	-
US Airways Express	Syracuse	SYR	732	478						-	-	27,084	9,077						-	-
US Airways Express	Washington National	DCA		551	1,334	1,411	1,574	1,825	2,119	294	16.1%		34,454	89,629	89,940	109,321	115,989	141,783	25,794	22.2%
Subtotal			14,968	19,143	16,694	19,799	18,212	17,164	19,612	2,448	14.3%	567,477	871,682	901,282	1,063,342	989,430	942,310	883,960	-58,350	-6.2%
Total			53,139	49,651	35,389	38,640	34,898	34,009	40,957	6,948	20.4%	5,747,148	5,357,918	3,523,368	3,757,008	3,393,466	3,426,886	3,651,760	224,874	6.6%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-4 Scheduled Passenger Operations by Market and Carrier for T.F. Green Airport

			Departures										Departing Seats								
Carrier	Market	Code	2000	2001	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'12-'13 Change	'12-'13 Pct. Change
Jet Carriers																					
American	Chicago O'Hare	ORD	1,464	1,460	1,113						-	-	203,104	143,522						-	-
American	Dallas/Fort Worth	DFW			365						-	-		47,085						-	-
Continental	Cleveland	CLE	569	167	13						-	-	69,771	1,630						-	-
Continental	Houston Intercontinental	IAH	366	243							-	-	45,946							-	-
Continental	New York Newark	EWR	738	1,170	282						-	-	96,448	34,808						-	-
Delta	Atlanta	ATL	1,464	1,460	1,976	510	1,043	990	978	993	15	1.5%	207,888	290,915	72,461	150,526	147,729	145,241	148,012	2,771	1.9%
Delta	Cincinnati	CVG	732	730	695						-	-	103,944	89,235						-	-
Delta	Detroit	DTW				414	58		218	476	258	118.5%			50,065	7,139		30,414	62,046	31,632	104.0%
Delta	Fort Lauderdale/Hollywood	FLL		306							-	-								-	-
Delta	Minneapolis	MSP				74					-	-			9,211					-	-
Delta	Orlando	MCO	732	730							-	-	87,108							-	-
jetBlue	Fort Lauderdale/Hollywood	FLL						31	365	365	-	0.0%					4,650	54,750	54,750	-	0.0%
jetBlue	Orlando	MCO						62	713	713	0	0.1%					9,300	103,786	106,886	3,100	3.0%
Laker Airways (Bahamas)	Freeport	FPO									-	-								-	-
Northwest	Detroit	DTW	1,682	1,631	1,550						-	-	200,509	202,255						-	-
Northwest	Minneapolis	MSP			539						-	-		68,977						-	-
Sata Internacional	Ponta Delgada	PDL									-	-								-	-
Southwest	Baltimore	BWI	3,913	3,877	4,180	3,260	3,043	3,128	3,004	2,820	-184	-6.1%	535,911	572,699	442,637	415,554	433,081	429,658	411,154	-18,504	-4.3%
Southwest	Chicago Midway	MDW	1,072	1,022	1,349	1,135	1,095	1,094	992	975	-17	-1.8%	146,844	184,813	153,121	149,877	150,303	154,633	156,543	1,910	1.2%
Southwest	Denver	DEN						366	304	9	-295	-97.0%					51,110	44,281	1,246	-43,035	-97.2%
Southwest	Fort Lauderdale/Hollywood	FLL	9	30		594	590	500	479	474	-5	-1.0%	1,194		81,378	80,791	68,347	70,413	68,401	-2,012	-2.9%
Southwest	Fort Myers	RSW						86	40	44	4	10.8%					11,743	5,520	6,292	772	14.0%
Southwest	Houston	HOU	152								-	-	20,824							-	-
Southwest	Islip	ISP	608	1,369							-	-	83,237							-	-
Southwest	Kansas City	MCI	366	365	365						-	-	50,142	50,005						-	-
Southwest	Las Vegas	LAS			31	365	365	362			-	-		4,247	50,005	50,005	49,932			-	-
Southwest	Nashville	BNA	706	700	721	296	123				-	-	96,702	98,816	39,578	16,067				-	-
Southwest	Orlando	MCO	955	1,095	1,821	1,799	1,659	1,585	1,423	1,419	-4	-0.3%	130,855	249,418	245,156	225,244	216,998	210,082	204,947	-5,135	-2.4%
Southwest	Philadelphia	PHL			1,773	1,402	1,298				-	-		238,366	192,054	177,001				-	-
Southwest	Phoenix	PHX	366	703	726	361	365				-	-	50,142	99,403	49,398	50,005				-	-
Southwest	Tampa	TPA	745	730	1,086	813	808	763	753	748	-5	-0.6%	102,065	148,821	111,231	109,572	104,140	107,959	107,481	-478	-0.4%
Southwest	West Palm Beach	PBI							31	35	4	12.9%						4,433	5,046	613	13.8%
Spirit Airlines	Detroit	DTW			120						-	-		18,000						-	-
Spirit Airlines	Fort Lauderdale/Hollywood	FLL			568						-	-		84,117						-	-
Spirit Airlines	Fort Myers	RSW			365						-	-		54,750						-	-
United	Chicago O'Hare	ORD	1,477	1,491	1,460	644	626	388	334	320	-14	-4.3%	239,076	200,677	82,802	78,487	48,697	46,258	42,658	-3,600	-7.8%
US Airways	Baltimore	BWI	2,462	2,101							-	-	263,921							-	-
US Airways	Charlotte	CLT	977	1,309	1,858	1,643	1,599	1,726	1,608	1,275	-333	-20.7%	128,984	274,039	233,886	226,854	238,503	225,454	196,644	-28,810	-12.8%
US Airways	Fort Lauderdale/Hollywood	FLL			17						-	-		2,186						-	-
US Airways	Orlando	MCO	52	48	43						-	-	5,605	5,831						-	-
US Airways	Philadelphia	PHL	1,830	1,794	2,182	1,299	1,012	399	313	347	34	10.9%	253,015	312,890	130,008	101,987	39,529	30,973	34,381	3,408	11.0%
US Airways	Pittsburgh	PIT	1,339	1,460	31						-	-	185,109	4,446						-	-
US Airways	Washington National	DCA	1,333	1,147	1,270	365	313	182	124	77	-47	-38.1%	167,278	170,009	49,501	44,006	24,350	14,997	9,566	-5,431	-36.2%
Subtotal			26,108	27,136	26,499	14,974	13,998	11,661	11,677	11,090	-587	-5.0%	3,475,622	3,651,961	1,992,492	1,883,114	1,598,412	1,678,851	1,616,053	-62,798	-3.7%

Table F-4 Scheduled Passenger Operations by Market and Carrier for T.F. Green Airport (Continued)

			Departures										Departing Seats								
Carrier	Market	Code	2000	2001	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'12-'13 Change	'12-'13 Pct. Change
Regional/Commuter Carriers																					
Air Canada Express	Toronto	YYZ	989	991	734	625	591	593	84		-84	-85.8%	37,482	13,783	11,880	11,232	11,262	1,517		-1,517	-100.0%
American Eagle	Chicago O'Hare	ORD									-	-								-	-
American Eagle	Detroit	DTW						12			-	-100.0%					808			-	-
American Eagle	New York J F Kennedy	JFK	1,291	1,404							-	-	42,589							-	-
American Eagle	New York La Guardia	LGA	2,756	1,788							-	-	90,957							-	-
American Eagle	Raleigh/Durham	RDU			343						-	-		13,081						-	-
Cape Air	Block Island	BID								538	538	-							4,846	4,846	-
Cape Air	Hyannis	HYA									-	-								-	-
Cape Air	Martha's Vineyard	MVY	1,762	1,871	1,015	747	672	659	501	285	-216	-23.9%	15,861	9,132	6,722	6,048	5,930	4,513	2,561	-1,952	-43.3%
Cape Air	Nantucket	ACK	2,453	2,653	1,199	681	668	576	501	271	-230	-13.0%	22,073	10,787	6,128	6,012	5,181	4,510	2,438	-2,072	-45.9%
Continental Connection	Albany	ALB		944	51						-	-		961						-	-
Continental Connection	Boston	BOS		51							-	-								-	-
Continental Connection	New York Newark	EWR				427	171	684	517	262	-255	-24.4%			31,630	6,316	28,916	21,608	11,386	-10,222	-47.3%
Continental Connection	Plattsburgh	PLB		22							-	-								-	-
Continental Connection	Washington Dulles	IAD						21		79	79	-100.0%					1,533		3,331	3,331	-
Continental Express	Cleveland	CLE	699	1,190	1,238	1,217	1,079	190			-	-100.0%	34,936	61,900	60,836	53,943	9,507			-	-
Continental Express	New York Newark	EWR	1,482	465	1,455	1,028	1,268	85			-	-100.0%	86,552	71,185	51,407	63,407	4,243			-	-
Delta Connection	Atlanta	ATL			31	724	9	43	70	51	-19	61.3%		1,550	52,959	662	3,279	4,522	3,380	-1,142	-25.3%
Delta Connection	Cincinnati	CVG		275	373	43					-	-		19,109	2,150					-	-
Delta Connection	Detroit	DTW				1,324	1,995	2,054	1,748	871	-877	-14.9%			78,701	111,901	113,630	90,191	45,809	-44,382	-49.2%
Delta Connection	Minneapolis	MSP				347	392	266	240	170	-70	-10.0%			26,192	29,553	20,189	17,380	12,878	-4,502	-25.9%
Delta Connection	New York J F Kennedy	JFK									-	-								-	-
Delta Connection	New York La Guardia	LGA	610	155							-	-	19,520							-	-
Delta Connection	Raleigh/Durham	RDU					131				-	-				6,557				-	-
Delta Connection	Washington National	DCA					685	225			-	-100.0%				34,243	11,271			-	-
Independence Air	Washington Dulles	IAD			1,509						-	-		75,429						-	-
Midway Airlines	Raleigh/Durham	RDU		510							-	-								-	-
Northwest Airlink	Detroit	DTW									-	-								-	-
Northwest Airlink	Minneapolis	MSP		302	31						-	-		1,550						-	-
Swissair	New York J F Kennedy	JFK	31								-	-	1,023							-	-
United Express	Chicago O'Hare	ORD			262	455	375	309	306	325	19	-1.1%		18,330	29,820	24,079	19,900	19,896	19,443	-453	-2.3%
United Express	Cleveland	CLE						695	875	102	-773	25.8%					33,484	43,757	5,100	-38,657	-88.3%
United Express	New York Newark	EWR						577	695	732	37	20.6%					28,009	44,028	46,172	2,144	4.9%
United Express	Washington Dulles	IAD	1,468	1,507	1,716	1,569	1,421	1,136	1,035	952	-83	-8.9%	52,832	85,821	99,719	89,593	71,937	65,632	63,746	-1,886	-2.9%
US Airways Express	Albany	ALB	679								-	-	12,898							-	-
US Airways Express	Boston	BOS	48								-	-	909							-	-
US Airways Express	Charlotte	CLT			18	126	147	65	166	175	9	155.7%		879	10,047	12,035	5,423	12,857	13,971	1,114	8.7%
US Airways Express	Hyannis	HYA									-	-								-	-
US Airways Express	Nantucket	ACK									-	-								-	-
US Airways Express	New York La Guardia	LGA	2,298	2,233	1,669	1,222	957	286			-	-100.0%	84,116	55,077	45,225	33,141	10,582			-	-
US Airways Express	New York Newark	EWR	1,569	1,507							-	-	31,176							-	-
US Airways Express	Philadelphia	PHL	366	365	716	1,526	1,713	2,206	2,347	2,213	-134	6.4%	13,542	45,199	107,790	122,386	152,816	154,401	150,139	-4,262	-2.8%
US Airways Express	Pittsburgh	PIT			1,360						-	-		72,808						-	-
US Airways Express	Plattsburgh	PLB	26								-	-	497							-	-
US Airways Express	Washington National	DCA			482	1,373	1,304	1,479	1,492	1,609	117	0.9%		30,996	92,151	95,527	110,451	107,775	111,183	3,408	3.2%
Subtotal			18,527	18,233	14,200	13,436	13,577	12,161	10,577	8,635	-1,942	-13.0%	546,963	587,576	713,356	706,634	648,351	592,587	496,383	-96,204	-16.2%
Total			44,635	45,369	40,699	28,409	27,575	23,822	22,255	19,725	-2,530	-6.6%	4,022,585	4,239,537	2,705,848	2,589,748	2,246,763	2,271,438	2,112,436	-159,002	-7.0%

Source: OAG Schedules.

Note: All Northwest operations included in Delta from 2010 onwards

Table F-5 Scheduled Passenger Operations by Market and Carrier for Manchester Airport

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Jet Carriers																				
Boston-Maine Airways	Myrtle Beach	MYR								-	-								-	-
Boston-Maine Airways	Portsmouth	PSM								-	-								-	-
Boston-Maine Airways	Sanford	SFB								-	-								-	-
Continental	Cleveland	CLE	130							-	-	16,151							-	-
Continental	New York Newark	EWR	462	286						-	-	62,358	30,953						-	-
Delta	Atlanta	ATL	244	668	275	565	514	463	459	-4	-0.8%	34,648	94,856	39,050	81,600	76,629	69,307	68,468	-839	-1.2%
Delta	Cincinnati	CVG		664						-	-		86,583						-	-
Delta	Detroit	DTW			796					-	-			89,289					-	-
Northwest	Detroit	DTW	1,609	1,399						-	-	194,058	180,879						-	-
Northwest	Minneapolis	MSP		365						-	-		46,933						-	-
Southwest	Baltimore	BWI	2,828	3,850	2,891	2,761	2,775	2,726	2,494	-232	-8.5%	387,397	527,405	393,093	376,945	385,044	387,879	364,979	-22,900	-5.9%
Southwest	Chicago Midway	MDW	706	1,355	1,144	1,244	1,168	1,010	984	-26	-2.6%	96,702	185,481	155,466	169,440	161,822	158,820	157,501	-1,319	-0.8%
Southwest	Denver	DEN				92	366	304		-304	-100.0%				12,604	50,379	43,211		-43,211	-100.0%
Southwest	Fort Lauderdale/Hollywood	FLL			9	9	152	90		-90	-100.0%			1,194	1,194	21,190	12,793		-12,793	-100.0%
Southwest	Kansas City	MCI	366							-	-	50,142							-	-
Southwest	Las Vegas	LAS		365	365	365	122	61	9	-52	-85.2%		50,005	50,005	50,005	16,766	8,723	1,246	-7,477	-85.7%
Southwest	Nashville	BNA	397	730						-	-	54,389	99,879						-	-
Southwest	Orlando	MCO	410	1,468	1,125	977	906	831	752	-79	-9.5%	56,111	201,175	154,145	133,829	125,620	123,873	109,202	-14,671	-11.8%
Southwest	Philadelphia	PHL		1,786	1,411	1,325				-	-		244,356	192,456	180,871				-	-
Southwest	Phoenix	PHX			322	273				-	-			44,114	37,401				-	-
Southwest	Tampa	TPA		1,099	782	629	579	466	470	4	0.9%		150,165	107,173	86,212	79,639	68,120	67,509	-611	-0.9%
United	Chicago O'Hare	ORD	1,403	1,339						-	-	221,523	179,151						-	-
United	Portland (ME)	PWM	57							-	-	7,241							-	-
US Airways	Baltimore	BWI	1,782							-	-	191,078							-	-
US Airways	Charlotte	CLT		1,308	365	51				-	-		178,836	52,560	7,406				-	-
US Airways	Orlando	MCO	52							-	-	5,605							-	-
US Airways	Philadelphia	PHL	1,821	2,021	365	313	187	351		-351	-100.0%	222,331	274,215	33,132	30,973	18,499	34,791		-34,791	-100.0%
US Airways	Pittsburgh	PIT	1,085							-	-	139,837							-	-
US Airways	Washington National	DCA	675	575						-	-	82,085	77,461						-	-
Subtotal			14,026	19,279	9,850	8,604	6,769	6,302	5,168	-1,134	-18.0%	1,821,657	2,608,335	1,311,677	1,168,481	935,588	907,518	768,905	-138,613	-15.3%
Regional/Commuter Carriers																				
Air Canada Express	Montreal Dorval	YUL								-	-								-	-
Air Canada Express	Toronto	YYZ	339	930	707	403				-	-	5,616	17,439	13,441	7,652				-	-
American Eagle	New York La Guardia	LGA	1,833							-	-	60,480							-	-
Boston-Maine Airways	Bangor	BGR								-	-								-	-
Boston-Maine Airways	Martha's Vineyard	MVY								-	-								-	-
Boston-Maine Airways	Nantucket	ACK								-	-								-	-
Boston-Maine Airways	New London/Groton	GON								-	-								-	-
Boston-Maine Airways	Portsmouth	PSM								-	-								-	-
Boston-Maine Airways	Saint John	YSJ								-	-								-	-
Continental Connection	Albany	ALB	80	313						-	-	1,515	5,944						-	-
Continental Connection	New York J F Kennedy	JFK								-	-								-	-
Continental Connection	New York Newark	EWR			141	175	548	246	380	134	54.7%			9,483	6,486	25,658	10,897	17,117	6,220	57.1%
Continental Connection	Plattsburgh	PLB								-	-								-	-
Continental Connection	Rochester	ROC	44							-	-	841							-	-
Continental Connection	Syracuse	SYR	22							-	-	421							-	-
Continental Connection	Westchester County	HPN								-	-								-	-

Table F-5 Scheduled Passenger Operations by Market and Carrier for Manchester Airport (Continued)

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Continental Express	Cleveland	CLE	593	1,186	1,178	926	190			-	-	29,614	58,991	58,921	46,293	9,500			-	-
Continental Express	New York Newark	EWR	1,028	1,165	1,267	1,215	129			-	-	64,944	58,140	63,336	60,764	6,471			-	-
Delta Connection	Atlanta	ATL	488	485	90			51	59	8	16.7%	24,400	26,620	6,300			3,843	4,484	641	16.7%
Delta Connection	Bangor	BGR	244							-	-	12,200							-	-
Delta Connection	Cincinnati	CVG	1,673	735						-	-	83,657	38,426						-	-
Delta Connection	Detroit	DTW			499	1,858	1,609	1,510	1,296	-214	-14.2%			32,795	95,802	80,786	75,507	69,261	-6,246	-8.3%
Delta Connection	New York J F Kennedy	JFK								-	-								-	-
Delta Connection	New York La Guardia	LGA	727	486			586	1,165	1,140	-25	-2.2%	36,357	24,300			31,216	66,132	63,202	-2,930	-4.4%
Independence Air	Washington Dulles	IAD		1,568						-	-		78,379						-	-
Northwest Airlink	Detroit	DTW								-	-								-	-
Northwest Airlink	Minneapolis	MSP		233						-	-		11,664						-	-
United Express	Chicago O'Hare	ORD		31	1,040	983	867	695	857	162	23.3%		2,170	67,675	62,096	45,929	39,114	49,854	10,740	27.5%
United Express	Cleveland	CLE				9	569	740	111	-629	-85.0%				443	26,546	36,986	5,564	-31,422	-85.0%
United Express	New York Newark	EWR					620	874	585	-289	-33.1%					27,919	43,707	27,707	-16,000	-36.6%
United Express	Washington Dulles	IAD		1,760	1,104	658	427	90		-90	-100.0%		90,419	55,951	33,514	20,788	5,444		-5,444	-100.0%
US Airways Express	Boston	BOS								-	-								-	-
US Airways Express	Charlotte	CLT		307	153	318	366	417	496	79	18.8%		21,863	13,146	27,181	31,476	32,885	37,761	4,876	14.8%
US Airways Express	New York La Guardia	LGA	2,583	2,499	1,381	1,269	594			-	-	96,936	86,492	49,420	43,737	21,962			-	-
US Airways Express	Philadelphia	PHL		562	2,116	2,068	2,092	2,004	2,295	291	14.5%		30,239	140,277	135,156	134,567	126,552	149,598	23,046	18.2%
US Airways Express	Pittsburgh	PIT		1,022						-	-		51,107						-	-
US Airways Express	Washington National	DCA		508	1,039	1,043	1,002	1,252	1,198	-54	-4.3%		25,379	81,095	81,683	78,512	84,499	77,065	-7,434	-8.8%
Subtotal			9,655	13,788	10,716	10,925	9,600	9,045	10,431	1,386	15.3%	416,980	627,572	591,840	600,808	541,331	525,567	503,627	-21,940	-4.2%
Total			23,681	33,067	20,566	19,529	16,369	15,347	15,599	252	1.6%	2,238,636	3,235,907	1,903,517	1,769,288	1,476,919	1,433,085	1,272,532	-160,553	-11.2%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-6 Scheduled Passenger Operations by Market and Carrier for Portland International Jetport

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'12-'13 Change	'12-'13 Pct. Change
Jet Carriers																				
AirTran	Atlanta	ATL			92	167				-	-			10,764	19,522				-	-
AirTran	Baltimore	BWI			944	927	1,016	207		-207	-100.0%			112,951	109,024	119,112	24,169		-24,169	-100.0%
AirTran	Orlando	MCO			52	52	13			-	-			6,503	6,355	1,521			-	-
Continental	Cleveland	CLE								-	-								-	-
Continental	New York Newark	EWR								-	-								-	-
Delta	Atlanta	ATL	732	486	424	793	751	737	693	-44	-6.0%	103,944	61,229	60,167	114,597	110,397	109,750	103,571	-6,179	-5.6%
Delta	Cincinnati	CVG	1,089	486						-	-	154,658	69,012						-	-
Delta	New York La Guardia	LGA					184	239	79	-160	-66.9%					24,256	35,374	11,750	-23,624	-66.8%
Independence Air	Washington Dulles	IAD		307						-	-		40,524						-	-
jetBlue	New York J F Kennedy	JFK			1,201	1,323	1,239	1,307	1,332	25	1.9%			128,936	135,379	124,571	130,671	133,200	2,529	1.9%
jetBlue	Orlando	MCO			212	181				-	-			21,214	21,344				-	-
Northwest	Detroit	DTW	523	427						-	-	52,105	42,700						-	-
Southwest	Baltimore	BWI						799	1,084	285	35.7%						112,419	152,939	40,520	36.0%
Southwest	Orlando	MCO							4	4	-							633	633	-
Southwest	Chicago Midway	MDW							9	9	-							1,246	1,246	-
Trans World Airlines	Hartford	BDL	305							-	-	43,310							-	-
United	Chicago O'Hare	ORD	728							-	-	88,996							-	-
United	Manchester	MHT	366							-	-	53,802							-	-
US Airways	Charlotte	CLT			395	352	366	365	374	9	2.5%			48,688	47,130	49,044	45,260	46,341	1,081	2.4%
US Airways	Philadelphia	PHL	1,312	154		217	18		92	92	-	163,051	19,404		21,525	1,895		9,108	9,108	-
US Airways	Pittsburgh	PIT	1,081							-	-	137,472							-	-
US Airways	Washington National	DCA		52						-	-		6,668						-	-
Subtotal			6,135	1,912	3,320	4,013	3,587	3,653	3,667	14	0.4%	797,338	239,537	389,224	474,876	430,796	457,644	458,788	1,144	0.2%
Regional/Commuter Carriers																				
Air Canada Express	Montreal Dorval	YUL	344							-	-	4,734							-	-
Air Canada Express	Toronto	YYZ			481	783	671	97		-97	-100.0%			9,142	14,872	12,749	1,741		-1,741	-100.0%
America West	New York Newark	EWR	52							-	-	2,457							-	-
American Eagle	Boston	BOS	3,804							-	-	125,518							-	-
American Eagle	Chicago O'Hare	ORD								-	-								-	-
American Eagle	New York La Guardia	LGA	2,033							-	-	67,084							-	-
Continental Conenction	Albany	ALB		291						-	-		5,537						-	-
Continental Conenction	Boston	BOS	204	241						-	-	3,871	4,576						-	-
Continental Conenction	New York Newark	EWR			1,426	1,343	69			-	-			105,503	99,361	5,074			-	-
Continental Conenction	Presque Isle	PQI								-	-								-	-
Continental Express	Cleveland	CLE	425	223	188	166				-	-	20,378	11,021	9,400	8,321				-	-
Continental Express	New York Newark	EWR	1,429	1,394	4	83	394			-	-	70,393	69,605	200	4,150	19,686			-	-
Delta Connection	Atlanta	ATL		700	350					-	-		48,440	25,532					-	-
Delta Connection	Boston	BOS		1,153						-	-		57,650						-	-
Delta Connection	Cincinnati	CVG		600						-	-		31,166						-	-
Delta Connection	Detroit	DTW			1,217	1,314	1,264	1,249	1,061	-188	-15.0%			62,320	65,686	64,758	62,436	60,448	-1,988	-3.2%
Delta Connection	New York J F Kennedy	JFK			270					-	-			13,500					-	-
Delta Connection	New York La Guardia	LGA	475	1,095	786	1,034	1,050	1,202	1,231	29	2.4%	15,191	54,750	41,440	57,437	67,453	80,898	80,103	-795	-1.0%
Independence Air	Washington Dulles	IAD		1,384						-	-		69,186						-	-
Lufthansa German Airlines	Washington Dulles	IAD	31							-	-	1,550							-	-
Northwest Airlink	Detroit	DTW	484	915						-	-	33,366	53,132						-	-
Northwest Airlink	Minneapolis	MSP		404						-	-		20,186						-	-

Table F-6 Scheduled Passenger Operations by Market and Carrier for Portland International Jetport (Continued)

Carrier	Market	Code	Departures 2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	Departing Seats 2000	2005	2010	2011	2012	2013	2014	'12-'13 Change	'12-'13 Pct. Change
Starlink Aviation	Yarmouth	YQI			521	521	217			-	-			9,386	9,386	3,909			-	-
Swissair	Boston	BOS	31							-	-	1,023							-	-
United Express	Chicago O'Hare	ORD		1,095	1,249	1,176	1,125	1,045	1,038	-7	-0.6%		67,590	82,273	72,457	59,896	65,872	63,099	-2,773	-4.2%
United Express	Cleveland	CLE				22	249	298		-298	-100.0%					11,906	14,886		-14,886	-100.0%
United Express	New York Newark	EWR					1,133	1,630	1,470	-160	-9.8%					56,694	102,156	92,953	-9,203	-9.0%
United Express	Washington Dulles	IAD	996	1,456	1,078	1,066	885	750	689	-61	-8.2%	49,779	83,730	64,767	62,493	43,839	39,624	37,949	-1,675	-4.2%
US Airways Express	Bangor	BGR	231							-	-	8,558							-	-
US Airways Express	Boston	BOS	2,229							-	-	42,359							-	-
US Airways Express	Charlotte	CLT		365	88	18	31	35	26	-9	-25.1%		23,710	5,323	1,364	2,542	2,777	2,065	-712	-25.6%
US Airways Express	New York La Guardia	LGA	1,218	1,665	1,647	1,526	598			-	-	43,901	77,909	78,477	68,755	26,013			-	-
US Airways Express	Philadelphia	PHL		1,913	1,947	1,987	2,153	2,131	1,986	-145	-6.8%		100,307	133,521	129,133	139,908	137,137	125,325	-11,812	-8.6%
US Airways Express	Pittsburgh	PIT		219						-	-		10,971						-	-
US Airways Express	Plattsburgh	PLB	48							-	-	909							-	-
US Airways Express	Presque Isle	PQI								-	-								-	-
US Airways Express	Washington National	DCA	1,089	1,149	1,043	1,043	1,260	1,408	1,426	18	1.3%	33,976	75,568	83,302	87,190	102,160	100,248	99,757	-491	-0.5%
US Airways Express	Westchester County	HPN	65							-	-	1,235							-	-
Subtotal			15,187	16,261	12,296	12,081	11,098	9,843	10,941	1,098	11.2%	526,282	865,033	724,086	681,682	616,586	607,775	563,713	-44,062	-7.2%
Total			21,322	18,174	15,615	16,094	14,684	13,496	14,608	1,112	8.2%	1,323,619	1,104,570	1,113,310	1,156,558	1,047,382	1,065,419	1,022,501	-42,918	-4.0%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-7 Scheduled Passenger Operations by Market and Carrier for Burlington Airport

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Jet Carriers																				
AirTran	Baltimore	BWI								-	-								-	-
Allegiant Air	Sanford	SFB							94	94	-							15,873	15,873	-
Continental	New York Newark	EWR								-	-								-	-
Delta	Atlanta	ATL						153	92	-61	-39.9%						21,394	13,708	-7,686	-35.9%
jetBlue	New York J F Kennedy	JFK	244	1,126	1,434	1,405	1,363	1,365	1,244	-121	-8.8%	39,528	173,920	180,286	163,839	163,821	143,907	124,357	-19,550	-13.6%
jetBlue	Orlando	MCO			330	339	326			-	-			33,014	33,871	32,643			-	-
Northwest	Detroit	DTW		174						-	-		17,429						-	-
United	Chicago O'Hare	ORD	815	365						-	-	105,509	42,379						-	-
United	Portland (ME)	PWM								-	-								-	-
US Airways	Philadelphia	PHL	1,098	365				26	116	90	351.1%	150,338	46,170				2,546	11,470	8,924	350.6%
US Airways	Pittsburgh	PIT	732							-	-	103,568							-	-
US Airways	Washington National	DCA		4						-	-		558						-	-
Subtotal			2,889	2,035	1,764	1,744	1,690	1,543	1,546	3	0.2%	398,943	280,456	213,300	197,710	196,464	167,847	165,408	-2,439	-1.5%
Regional/Commuter Carriers																				
America West	New York Newark	EWR	166							-	-	7,889							-	-
American Eagle	Boston	BOS	3,094							-	-	102,111							-	-
American Eagle	Chicago O'Hare	ORD								-	-								-	-
Continental Connection	Albany	ALB								-	-								-	-
Continental Connection	Boston	BOS	244	634						-	-	4,628	12,054						-	-
Continental Connection	Buffalo	BUF	4							-	-	84							-	-
Continental Connection	Hartford	BDL								-	-								-	-
Continental Connection	New York Newark	EWR			405	975	259			-	-			30,002	72,161	19,166			-	-
Continental Connection	Plattsburgh	PLB	213	367						-	-	4,039	6,970						-	-
Continental Connection	Plattsburgh International	PBG								-	-								-	-
Continental Connection	Poughkeepsie	POU	66							-	-	1,262							-	-
Continental Connection	Washington Dulles	IAD					17			-	-					1,226			-	-
Continental Connection	Westchester County	HPN								-	-								-	-
Continental Express	Cleveland	CLE	322	509	366	348	95			-	-	16,064	25,351	18,286	17,421	4,750			-	-
Continental Express	New York Newark	EWR	1,458	1,455	1,020	450	208			-	-	70,203	72,707	51,000	22,514	10,386			-	-
Continental Express	Westchester County	HPN								-	-								-	-
Delta Connection	Atlanta	ATL		62				61	273	212	347.5%		3,100				4,636	20,701	16,065	346.5%
Delta Connection	Boston	BOS		1,002						-	-		50,100						-	-
Delta Connection	Cincinnati	CVG		1,060						-	-		52,979						-	-
Delta Connection	Detroit	DTW			1,227	1,309	1,282	1,223	1,201	-22	-1.8%			61,417	65,443	64,114	61,224	60,043	-1,181	-1.9%
Delta Connection	New York J F Kennedy	JFK			1,336	1,338	221			-	-			67,071	81,259	14,884			-	-
Delta Connection	New York La Guardia	LGA	355				781	1,279	1,248	-31	-2.4%	11,351				50,144	83,899	82,592	-1,307	-1.6%
Independence Air	Washington Dulles	IAD		1,903						-	-		95,136						-	-
Lufthansa German Airlines	Washington Dulles	IAD	31							-	-	1,550							-	-
Northwest Airlink	Detroit	DTW		1,159						-	-		61,983						-	-
Northwest Airlink	Minneapolis	MSP		61						-	-		3,050						-	-
Porter Airlines	Toronto Island Apt	YTZ				9	31	56	47	-9	-15.9%				620	2,150	3,910	3,308	-602	-15.4%
Swissair	Boston	BOS	31							-	-	1,023							-	-
United Express	Chicago O'Hare	ORD		1,003	1,353	1,565	1,391	1,396	1,402	6	0.4%		59,930	84,431	88,435	81,204	84,669	85,350	681	0.8%
United Express	Cleveland	CLE					236	409	73	-336	-82.2%					10,626	20,464	3,636	-16,828	-82.2%
United Express	New York Newark	EWR					958	1,456	1,281	-175	-12.0%					50,709	85,373	82,670	-2,703	-3.2%

Table F-7 Scheduled Passenger Operations by Market and Carrier for Burlington Airport (Continued)

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
United Express	Washington Dulles	IAD	1,477	1,456	1,130	1,112	984	910	892	-18	-1.9%	73,843	72,786	61,988	69,793	57,439	48,930	50,633	1,703	3.5%
US Airways Express	Boston	BOS	2,404							-	-	48,139							-	-
US Airways Express	Charlotte	CLT								-	-								-	-
US Airways Express	New York La Guardia	LGA	2,074	2,175	1,680	1,487	650			-	-	76,749	80,491	62,144	55,008	24,050			-	-
US Airways Express	Philadelphia	PHL		1,980	1,903	1,956	1,873	1,803	1,823	20	1.1%		97,288	128,140	131,727	121,653	111,615	110,129	-1,486	-1.3%
US Airways Express	Pittsburgh	PIT								-	-								-	-
US Airways Express	Plattsburgh	PLB	2,427							-	-	46,116							-	-
US Airways Express	Poughkeepsie	POU	718							-	-	13,639							-	-
US Airways Express	Saranac Lake	SLK	44							-	-	841							-	-
US Airways Express	Washington National	DCA	988	990	1,043	1,043	1,072	1,347	1,276	-71	-5.3%	31,574	61,458	77,625	82,974	85,623	100,348	89,462	-10,886	-10.8%
US Airways Express	Wilkes-Barre Scranton	AVP	22							-	-	415							-	-
Subtotal			16,138	15,816	11,461	11,593	10,058	9,941	11,530	1,589	16.0%	511,521	755,382	642,104	687,357	598,123	605,069	590,538	-14,531	-2.4%
Total			19,028	17,851	13,225	13,336	11,748	11,484	13,076	1,592	13.9%	910,464	1,035,838	855,404	885,067	794,588	772,916	755,946	-16,970	-2.2%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-8 Scheduled Passenger Operations by Market and Carrier for Bangor Airport

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Jet Carriers																				
Allegiant Air	Punta Gorda	PGD							33	33	-							5,478	5,478	-
Allegiant Air	Sanford	SFB			181	150	156	165	153	-12	-7.3%			27,150	22,500	23,912	27,335	26,536	-799	-2.9%
Allegiant Air	St. Petersburg/Clearwater	PIE			107	93	112	115	119	4	3.5%			16,050	13,950	16,944	19,090	20,501	1,411	7.4%
Pan American Airways	Allentown/Bethlehem	ABE								-	-								-	-
Pan American Airways	Baltimore	BWI								-	-								-	-
Pan American Airways	Pittsburgh	PIT	285							-	-	42,729							-	-
Pan American Airways	Portsmouth	PSM	389							-	-	58,414							-	-
Pan American Airways	Sanford	SFB								-	-								-	-
Subtotal			674	0	288	243	268	280	305	25	8.9%	101,143	0	43,200	36,450	40,856	46,425	52,515	6,090	13.1%
Regional/Commuter Carriers																				
American Eagle	Boston	BOS	4,670	1,530						-	-	154,115	56,594						-	-
American Eagle	New York La Guardia	LGA	382	518						-	-	12,606	19,166						-	-
Boston-Maine Airways	Halifax	YHZ								-	-								-	-
Boston-Maine Airways	Manchester	MHT								-	-								-	-
Boston-Maine Airways	Portsmouth	PSM								-	-								-	-
Boston-Maine Airways	Saint John	YSJ								-	-								-	-
Continental Connection	Albany	ALB		189						-	-		3,583						-	-
Continental Express	New York Newark	EWR		481						-	-		22,698						-	-
Delta Connection	Atlanta	ATL								-	-								-	-
Delta Connection	Boston	BOS		1,416						-	-		70,800						-	-
Delta Connection	Cincinnati	CVG	1,342	1,394						-	-	67,100	82,439						-	-
Delta Connection	Detroit	DTW			975	871	703	706	711	5	0.6%			50,540	54,640	46,260	46,371	47,269	898	1.9%
Delta Connection	New York J F Kennedy	JFK			180					-	-			9,000					-	-
Delta Connection	New York La Guardia	LGA			537	844	1,043	1,153	975	-178	-15.4%			26,958	49,368	62,868	71,955	59,239	-12,716	-17.7%
Northwest Airlink	Boston	BOS	27							-	-	797							-	-
Northwest Airlink	Detroit	DTW		1,012						-	-		55,222						-	-
Northwest Airlink	Minneapolis	MSP		61						-	-		3,050						-	-
Pan American Airways	Portsmouth	PSM								-	-								-	-
Pan American Airways	Saint John	YSJ								-	-								-	-
United Express	Chicago O'Hare	ORD							245	245	-							16,170	16,170	-
US Airways Express	Boston	BOS	1,942							-	-	36,906							-	-
US Airways Express	New York La Guardia	LGA	35	158	1,017	1,230	299			-	-	1,295	7,914	44,051	53,371	14,950			-	-
US Airways Express	Philadelphia	PHL	428	1,179	1,156	1,405	1,543	1,564	1,496	-68	-4.4%	15,836	58,943	68,510	89,548	99,457	101,167	94,849	-6,318	-6.2%
US Airways Express	Pittsburgh	PIT								-	-								-	-
US Airways Express	Portland (ME)	PWM	231							-	-	8,558							-	-
US Airways Express	Presque Isle	PQI	299							-	-	6,224							-	-
US Airways Express	Washington National	DCA			31	52	589	883	791	-92	-10.4%			1,529	2,607	29,464	47,981	41,033	-6,948	-14.5%
Subtotal			9,357	7,937	3,896	4,402	4,178	4,307	4,218	-89	-2.1%	303,436	380,408	200,587	249,535	253,000	267,474	258,560	-8,914	-3.3%
Total			10,031	7,937	4,184	4,645	4,446	4,587	4,523	-64	-1.4%	404,579	380,408	243,787	285,985	293,856	313,899	311,075	-2,824	-0.9%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards
Note: Allegiant stopped reporting to the OAG in 2009, so Allegiant 2009-2011 statistics from the T100 database.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-9 Scheduled Passenger Operations by Market and Carrier for Tweed-New Haven Airport

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Regional/Commuter Carriers																				
Delta Connection	Cincinnati	CVG		1,025						-	-		51,236						-	-
Boston-Maine Airways	Baltimore	BWI								-	-								-	-
Boston-Maine Airways	Bedford	BED								-	-								-	-
Boston-Maine Airways	Elmira/Corning	ELM								-	-								-	-
Boston-Maine Airways	Portsmouth	PSM								-	-								-	-
US Airways Express	Philadelphia	PHL	1,773	1,904	1,608	1,535	1,381	1,399	1,356	-43	-3.1%	65,612	76,208	59,491	56,806	52,972	51,768	50,161	-1,607	-3.1%
US Airways Express	Washington National	DCA	937							-	-	34,658							-	-
Total			2,710	2,929	1,608	1,535	1,381	1,399	1,356	-43	-3.1%	100,270	127,444	59,491	56,806	52,972	51,768	50,161	-1,607	-3.1%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-10 Scheduled Passenger Operations by Market and Carrier for Worcester Regional Airport

Departures

Carrier	Market	Code	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Jet Carriers															
Allegiant Air	Sanford	SFB			182									-	-
Boston-Maine Airways	Allentown/Bethlehem	ABE												-	-
Boston-Maine Airways	Portsmouth	PSM												-	-
Boston-Maine Airways	Sanford	SFB												-	-
Direct Air	Myrtle Beach	MYR						63	73	96				-	-
Direct Air	Orlando/Sanford	SFB					17	140	144	148				-	-
Direct Air	Punta Gorda	PGD					17	67	94	105				-	-
Direct Air	West Palm Beach	PBI							13	51				-	-
jetBlue	Fort Lauderdale/Hollywood	FLL										61	365	304	498.4%
jetBlue	Orlando	MCO										61	365	304	498.4%
Subtotal			0	0	182	0	34	270	324	400	0	122	730	608	498.4%
Regional/Commuter Carriers															
American Eagle	Chicago O'Hare	ORD												-	-
American Eagle	New York J F Kennedy	JFK	552											-	-
Delta Connection	Atlanta	ATL	670											-	-
US Airways Express	Philadelphia	PHL	1,464											-	-
Subtotal			2,686	0	0	0	0	0	0	0	0	0	0	-	-
Total			2,686	0	182	0	34	270	324	400	0	122	730	608	498.4%

Departing Seats

Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Jet Carriers											
Allegiant Air	Sanford	SFB								-	-
Boston-Maine Airways	Allentown/Bethlehem	ABE								-	-
Boston-Maine Airways	Portsmouth	PSM								-	-
Boston-Maine Airways	Sanford	SFB								-	-
Direct Air	Myrtle Beach	MYR			9,782	14,120				-	-
Direct Air	Orlando/Sanford	SFB			21,937	24,339				-	-
Direct Air	Punta Gorda	PGD			14,541	17,287				-	-
Direct Air	West Palm Beach	PBI			1,872	7,444				-	-
jetBlue	Fort Lauderdale/Hollywood	FLL						6,100	36,500	30,400	498.4%
jetBlue	Orlando	MCO						6,100	36,500	30,400	498.4%
Subtotal			0	0	48,132	63,190	0	12,200	73,000	60,800	498.4%
Regional/Commuter Carriers											
American Eagle	Chicago O'Hare	ORD								-	-
American Eagle	New York J F Kennedy	JFK	18,216							-	-
Delta Connection	Atlanta	ATL	33,500							-	-
US Airways Express	Philadelphia	PHL	54,168							-	-
Subtotal			105,884	0	0	0	0	0	0	-	-
Total			105,884	0	48,132	63,190	0	12,200	73,000	60,800	498.4%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-11 Scheduled Passenger Operations by Market and Carrier for Hanscom Field

Departures

Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Regional/Commuter Carriers											
Boston-Maine Airways	Elmira/Corning									-	-
Boston-Maine Airways	Hyannis	HYA								-	-
Boston-Maine Airways	Manchester	MHT								-	-
Boston-Maine Airways	Martha's Vineyard	MVY								-	-
Boston-Maine Airways	Nantucket	ACK								-	-
Boston-Maine Airways	New Haven	HVN								-	-
Boston-Maine Airways	New London/Groton	GON		9						-	-
Boston-Maine Airways	Portsmouth	PSM		193						-	-
Boston-Maine Airways	Trenton	TTN		867						-	-
Pan American Airways	Atlantic City Pomona Fielc	ACY								-	-
Pan American Airways	Martha's Vineyard	MVY								-	-
Pan American Airways	New York Newark	EWR								-	-
Pan American Airways	Portsmouth	PSM								-	-
Pan American Airways	Westchester County	HPN								-	-
Shuttle America	Buffalo	BUF	1,119							-	-
Shuttle America	Hartford	BDL	173							-	-
Shuttle America	New York La Guardia	LGA	523							-	-
Shuttle America	Trenton	TTN	2,062							-	-
Streamline	Trenton	TTN				155				-	-
US Airways	Martha's Vineyard	MVY								-	-
US Airways	Nantucket	ACK								-	-
US Airways	New York La Guardia	LGA								-	-
US Airways	Philadelphia	PHL								-	-
US Airways	Trenton	TTN								-	-
US Airways	Westchester County	HPN								-	-
Total			3,876	1,069	0	155	0	0	0	0	-

Departing Seats

Carrier	Market	Code	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Regional/Commuter Carriers															
Boston-Maine Airways	Elmira/Corning				2,366	6,994								-	-
Boston-Maine Airways	Hyannis	HYA												-	-
Boston-Maine Airways	Manchester	MHT												-	-
Boston-Maine Airways	Martha's Vineyard	MVY												-	-
Boston-Maine Airways	Nantucket	ACK												-	-
Boston-Maine Airways	New Haven	HVN				2,029								-	-
Boston-Maine Airways	New London/Groton	GON		159										-	-
Boston-Maine Airways	Portsmouth	PSM		3,482	4,569	3,975	463							-	-
Boston-Maine Airways	Trenton	TTN		15,606	17,859	18,841	463							-	-
Pan American Airways	Atlantic City Pomona Fielc	ACY												-	-
Pan American Airways	Martha's Vineyard	MVY												-	-
Pan American Airways	New York Newark	EWR												-	-
Pan American Airways	Portsmouth	PSM												-	-
Pan American Airways	Westchester County	HPN												-	-
Shuttle America	Buffalo	BUF	55,950											-	-
Shuttle America	Hartford	BDL	8,636											-	-
Shuttle America	New York La Guardia	LGA	26,143											-	-
Shuttle America	Trenton	TTN	103,093											-	-
Streamline	Trenton	TTN								4,650				-	-
US Airways	Martha's Vineyard	MVY												-	-
US Airways	Nantucket	ACK												-	-
US Airways	New York La Guardia	LGA												-	-
US Airways	Philadelphia	PHL												-	-
US Airways	Trenton	TTN												-	-
US Airways	Westchester County	HPN												-	-
Total			193,821	19,247	24,794	31,839	926	0	0	4,650	0	0	0	0	-

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-12 Scheduled Passenger Operations by Market and Carrier for Portsmouth International Airport

			Departures									Departing Seats								
Carrier	Market	Code	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change	2000	2005	2010	2011	2012	2013	2014	'13-'14 Change	'13-'14 Pct. Change
Jet Carriers																				
Alliegiant Airways	Orlando/Sanford	SFB		35				16	83	67	418.8%		5,229				2,656	14,242	11,586	436.2%
Alliegiant Airways	Punta Gorda	PGD							22	22	-							3,652	3,652	-
Boston-Maine Airways	Fort Lauderdale/Hollywood	FLL		13						-	-		1,993						-	-
Boston-Maine Airways	Hartford	BDL		13						-	-		1,993						-	-
Boston-Maine Airways	Newburgh	SWF		48						-	-		7,179						-	-
Boston-Maine Airways	Sanford	SFB		57						-	-		8,593						-	-
Pan American Airways	Allentown/Bethlehem	ABE	93							-	-	13,950							-	-
Pan American Airways	Bangor	BGR	389							-	-	58,414							-	-
Pan American Airways	Gary	GYY	51							-	-	7,714							-	-
Pan American Airways	Manchester	MHT								-	-								-	-
Pan American Airways	New York Newark	EWR								-	-								-	-
Pan American Airways	Pittsburgh	PIT	261							-	-	39,171							-	-
Pan American Airways	Sanford	SFB	296							-	-	44,400							-	-
Pan American Airways	Santo Domingo	SDQ								-	-								-	-
Pan American Airways	St. Petersburg/Clearwater	PIE								-	-								-	-
Pan American Airways	Worcester	ORH								-	-								-	-
Skybus	Columbus	CMH								-	-								-	-
Skybus	Greensboro	GSO								-	-								-	-
Skybus	Punta Gorda	PGD								-	-								-	-
Skybus	Saint Augustine	UST								-	-								-	-
Subtotal			1,091	167	0	0	0	16	105	89	556.3%	163,650	24,986	0	0	0	2,656	17,894	15,238	573.7%
Regional/Commuter Carriers																				
Boston-Maine Airways	Baltimore	BWI								-	-								-	-
Boston-Maine Airways	Bangor	BGR								-	-								-	-
Boston-Maine Airways	Bedford	BED		171						-	-		3,083						-	-
Boston-Maine Airways	Hyannis	HYA								-	-								-	-
Boston-Maine Airways	Manchester	MHT								-	-								-	-
Boston-Maine Airways	Martha's Vineyard	MVY								-	-								-	-
Boston-Maine Airways	Nantucket	ACK								-	-								-	-
Boston-Maine Airways	New Haven	HVN								-	-								-	-
Boston-Maine Airways	New London/Groton	GON								-	-								-	-
Boston-Maine Airways	Saint John	YSJ								-	-								-	-
Boston-Maine Airways	Trenton	TTN		22						-	-		399						-	-
Boston-Maine Airways	Westchester County	HPN								-	-								-	-
Pan American Airways	Atlantic City Pomona Field	ACY								-	-								-	-
Pan American Airways	Baltimore	BWI								-	-								-	-
Pan American Airways	Bangor	BGR								-	-								-	-
Pan American Airways	Bedford	BED								-	-								-	-
Pan American Airways	Martha's Vineyard	MVY								-	-								-	-
Pan American Airways	Saint John	YSJ								-	-								-	-
Subtotal			0	193	0	0	0	0	0	-	-	0	3,482	0	0	0	0	0	-	-
Total			1,091	360	0	0	0	16	105	89	556.3%	163,650	28,467	0	0	0	2,656	17,894	15,238	573.7%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

This Page Intentionally Left Blank

G

Ground Access

This appendix provides information in support of *Chapter 5, Ground Access to and from Logan Airport*:

- Table G-1A Logan Express Bus Service Ridership (Annual)
- Table G-1B Logan Express Back Bay Service Ridership (Annual)
- Table G-2 Water Transportation Services Ridership (Annual)
- Table G-3 Massachusetts Bay Transportation Authority (MBTA) Airport Station Passengers
- Table G-4 Annual Taxi Dispatches (Tickets Sold)
- Table G-5 Logan Airport Employee Parking Supply
- Table G-6 Logan Airport Commercial Parking Supply
- Table G-7 2014 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment, and Vehicle Miles Traveled (VMT) Summary
- VISSIM Traffic Roadway Network
- March 2014 Logan Airport Parking Space Inventory, submitted to Massachusetts Department of Environmental Protection (also known as the *Parking Freeze Report*)
- September 2014 Logan Airport Parking Space Inventory, submitted to Massachusetts Department of Environmental Protection (also known as the *Parking Freeze Report*)

This Page Intentionally Left Blank

Table G-1A Logan Express Bus Service Ridership

	Ridership			Percent Change		
Service Year	Air Passengers	Employees	Total	Air Passengers	Employees	Total
Framingham						
1992	207,847	7,573	215,420	4.3%	21.3%	4.8%
1993	229,064	12,307	241,371	10.2%	62.5%	12.0%
1994	250,342	17,352	267,694	9.3%	41.0%	10.9%
1995	274,754	21,129	295,883	9.8%	21.8%	10.5%
1996	325,665	22,932	348,597	18.5%	8.5%	17.8%
1997	316,306	29,871	346,175	(2.9)%	30.3%	(0.7)%
1998	337,007	33,971	370,978	6.5%	13.7%	7.2%
1999	345,715	31,946	380,661	3.5%	(6.0)%	2.6%
2000	371,560	34,508	406,068	6.6%	8.0%	6.7%
2001	354,521	38,740	393,261	(4.6)%	12.3%	(3.2)%
2002	342,746	42,441	385,187	(3.3)%	8.7%	(2.1)%
2003	310,024	55,979	366,003	(9.5)%	31.9%	(5.0)%
2004	323,931	54,763	378,694	4.5%	(2.2%)	3.5%
2005	318,125	57,569	375,694	(1.8%)	5.1%	(0.8%)
2006	349,022	60,764	409,789	9.7%	5.5%	9.1%
2007	311,299	57,252	368,551	(2.1%)[5]	(0.6%)[5]	(1.9%)[5]
2008	276,112	57,797	333,909	(11.3%)	1.0%	(9.4%)
2009	264,233	59,840	324,073	(4.3%)	3.5%	(2.9%)
2010	272,190	62,226	334,416	3.0%	4.0%	3.2%
2011[1]	272,301	68,228	340,529	0.0%	9.6%	1.8%
2012	279,603	82,951	362,554	2.7%	21.6%	6.5%
2013	295,654	84,008	379,662	5.7%	1.3%	4.7%
2014	**303,646**	**87,488**	**391,134**	**2.7%**	**4.1%**	**3.0%**

Table G-1A Logan Express Bus Service Ridership (Continued)

	Ridership			Percent Change		
Service Year	**Air Passengers**	**Employees**	**Total**	**Air Passengers**	**Employees**	**Total**
Braintree						
1992	186,217	9,694	195,911	10.6%	16.6%	10.8%
1993	205,209	22,768	227,977	10.2%	134.9%	16.4%
1994	247,636	37,489	285,125	20.7%	64.7%	25.1%
1995	264,579	70,723	335,302	6.8%	88.7%	17.6%
1996	335,232	103,519	438,751	26.7%	46.4%	30.1%
1997	300,006	135,340	435,346	(10.5)%	30.7%	(0.8)%
1998	300,005	156,105	456,110	0.0%	15.3%	4.8%
1999	328,818	125,286	454,105	9.6%	(19.7)%	(0.5)%
2000	355,932	149,687	505,619	8.2%	19.5%	11.3%
2001	345,249	156,240	501,489	(3.0)%	4.4%	(0.8)%
2002	323,115	190,360	513,475	(6.4)%	21.8%	2.4%
2003	301,013	216,765	517,778	(6.8)%	13.9%	0.8%
2004	318,100	208,566	526,666	5.7%	(3.8%)	1.7%
2005	307,659	189,531	497,190	(3.2%)	(9.1%)	(5.5%)
2006	333,413	202,983	536,396	8.4%	7.1%	7.9%
2007	300,715	196,955	497,670	(2.3%)[5]	3.9%[5]	0.1%[5]
2008	252,289	221,591	473,880	(16.1%)	12.5%	(4.8%)
2009	231,151	234,908	466,059	(8.4%)	6.0%	(1.7%)
2010	231,422	251,443	482,865	0.1%	7.0%	3.6%
2011[1]	233,521	285,515	519,036	0.9%	13.6%	7.5%
2012	247,346	314,542	561,888	5.9%	10.2%	8.3%
2013	268,154	320,329	588,483	8.4%	1.8%	4.7%
2014	**296,975**	**313,334**	**610,309**	**10.7%**	**(2.2%)**	**3.7%**

Table G-1A Logan Express Bus Service Ridership (Continued)

	Ridership			Percent Change		
Service Year	Air Passengers	Employees	Total	Air Passengers	Employees	Total
Woburn[2]						
1992[3]	3,052	91	3,143	NA	NA	-
1993	59,635	5,027	64,662	NA	NA	-
1994	119,567	9,082	128,649	100.5%	80.7%	99.0%
1995	150,147	13,376	163,523	25.6%	47.3%	27.1%
1996	190,566	17,322	207,888	26.9%	29.5%	27.1%
1997	199,715	20,018	219,733	4.8%	15.6%	5.7%
1998	208,286	22,876	231,162	4.3%	14.3%	5.2%
1999	191,454	23,495	214,949	(8.1)%	2.7%	(7.0)%
2000	195,744	27,522	223,266	2.2%	17.1%	3.9%
2001	177,375	38,318	215,530	(9.4)%	39.2%	(3.4)%
2002	161,145	73,277	234,422	(9.2)%	91.0%	8.7%
2003	164,980	103,963	268,943	(2.4)%	41.9%	14.7%
2004	172,110	111,326	283,436	4.3%	7.1%	5.4%
2005	163,227	110,961	274,188	(5.1%)	(0.3%)	(3.2%)
2006	167,341	121,672	289,013	2.5%	9.7%	5.4%
2007	149,149	123,066	272,215	(8.6%)[5]	10.9%[5]	(0.7%)[5]
2008	129,385	122,777	252,162	(13.3%)	(0.2%)	(7.4%)
2009	113,607	121,633	235,240	(12.2%)	(0.9%)	(6.7%)
2010	115,257	127,120	242,377	1.5%	4.5%	3.0%
2011[1]	118,232	151,029	269,261	2.6%	18.8%	11.1%
2012	126,549	188,747	315,296	7.0%	25.0%	17.1%
2013	140,407	192,289	332,696	11.0%	1.9%	5.5%
2014	**156,045**	**194,341**	**350,386**	**11.1%**	**1.1%**	**5.3%**
Peabody						
2001[4]	8,151	3,097	11,248	NA	NA	NA
2002	28,626	20,629	49,255	NA	NA	NA
2003	32,318	23,425	55,743	21.4%	13.6%	13.2%
2004	43,389	33,642	77,031	34.3%	43.6%	38.2%
2005	51,023	39,599	87,622	17.6%	17.7%	13.7%
2006	42,142	32,632	74,774	(17.4%)	(17.6%)	(14.7%)
2007	36,367	26,949	63,316	(28.7%)[5]	(31.9%)[5]	(27.7%)[5]
2008	30,887	30,596	61,483	(15.1%)	13.5%	(2.9%)
2009	27,856	32,220	60,076	(9.8%)	5.3%	(2.3%)
2010	25,543	26,231	51,744	(8.3%)	(18.6%)	(13.8%)
2011[1]	25,555	31,741	57,296	0.0%	21.0%	10.7%
2012	27,542	37,909	65,451	7.8%	19.4%	14.2%
2013	28,790	38,067	66,857	4.5%	0.4%	2.1%
2014	**31,485**	**36,848**	**68,333**	**9.4%**	**(3.2%)**	**2.2%**

Table G-1A Logan Express Bus Service Ridership (Continued)

	Ridership			Percent Change		
Service Year	Air Passengers	Employees	Total	Air Passengers	Employees	Total
Total System Ridership						
1992	397,116	17,358	414,474	8.0%	19.2%	8.5%
1993	493,908	39,832	533,740	24.4%	129.5%	28.8%
1994	617,545	63,923	681,468	25.0%	60.5%	27.7%
1995	689,480	105,228	794,708	11.6%	64.6%	16.6%
1996	851,463	143,773	995,236	23.4%	36.6%	25.2%
1997	816,015	185,229	1,001,254	(4.2)%	28.8%	0.6%
1998	845,598	212,952	1,058,550	3.6%	15.0%	5.7%
1999	868,987	180,727	1,049,714	2.7%	(15.2)%	(0.8)%
2000	923,236	211,717	1,134,953	6.2%	17.1%	8.1%
2001	885,296	236,395	1,121,691	(4.1)%	11.7%	(1.2)%
2002	855,632	326,707	1,182,339	(3.4)%	38.2%	5.4%
2003	808,335	400,132	1,208,467	(5.5%)	22.5%	2.2%
2004	857,530	408,297	1,265,827	6.1%	2.0%	2.2%
2005	837,034	397,660	1,234,694	(2.4%)	(2.6%)	(2.4%)
2006	891,918	418,051	1,309,969	6.6%	5.1%	6.1%
2007	797,530	404,222	1,201,752	(4.7%)[5]	1.7%[5]	(2.7%)[5]
2008	688,673	432,761	1,121,434	(13.6%)	7.1%	(6.7%)
2009	636,847	448,601	1,085,448	(7.5%)	3.7%	(3.2%)
2010	644,412	467,020	1,111,432	1.2%	4.1%	2.4%
2011[1]	649,609	536,513	1,186,122	0.8%	14.9%	6.7%
2012	681,040	624,149	1,305,189	4.8%	16.3%	10.0%
2013	733,005	634,693	1,367,698	8.0%	2.0%	5.0%
2014	**788,151**	**632,011**	**1,420,162**	**7.5%**	**(0.4%)**	**3.8%**

NA Not applicable.
Notes: Jan. 23, 2008: I-90/Ted Williams Tunnel opens to all traffic. The last toll increase for Ted Williams Tunnel was Jan. 1, 2008.
1 Changes to employee parking and bus fares were implemented in October 2011.
2 Woburn Express moved from Mishawum Station to the Anderson Regional Transportation Center (ARTC) in Woburn in May 2001.
3 Reflects a partial year of operation; Woburn Logan Express service was implemented in November 1992.
4 Reflects a partial year of operation. The Peabody Logan Express service commenced in September 2001.
5 Percent comparison between 2007 and 2005. The I-90 Ted Williams Tunnel closures in 2006 resulted in atypical ridership.

Table G-1B Logan Express Back Bay Service Ridership[1]

Service Year	Ridership	Percent Change
2014	**152,892**	**NA**

1 Back Bay Logan Express service commenced in April 2014. Only total ridership available.

Table G-2 Water Transportation Services Ridership to and from Logan Airport					
	Rowes Wharf/Fan Pier Water Shuttle	Private Water Taxi (on-demand)[1]	Harbor Express (Long Wharf/Quincy/Hull)	Boston-Logan Water Shuttle (Long Wharf)	Total
1990	181,530	NS	NS	NS	181,530
1991	142,500	NS	NS	NS	142,500
1992	133,297	NS	NS	NS	133,297
1993	159,525	NS	NS	NS	159,525
1994	209,057	NS	NS	NS	209,057
1995	203,829	NS	NS	NS	203,829
1996	159,992	3,364	11,781	NS	175,137
1997	132,542	6,299	71,309	NS	210,150
1998	124,836	9,243	101,174	NS	235,253
1999	122,211	17,252	98,539	NS	238,002
2000	128,097	26,335	83,243	NS	237,675
2001	107,400	29,642	82,704	NS	219,746
2002	75,304	36,736	66,471	NS	178,511
2003	26,480[2]	35,724[3]	61,849	5,722[4]	129,775
2004	NS	54,540	58,788	3,202[5]	116,530
2005	NS	44,975	51,960	NS	96,935
2006	NS	63,639	70,998	NS	134,637
2007	NS	50,737	59,460	NS	110,197
2008	NS	48,630	48,003	NS	96,633
2009	NS	50,734	37,861	NS	88,595
2010	NS	54,382	34,794	NS	89,176
2011	NS	58,879	33,403	NS	92,282
2012	NS	60,840	31,197	NS	92,037
2013	NS	70,378	NA	NS	70,378
2014	**NS**	**67,479**	**NA**	**NS**	**67,479**

Note: Figures from 2003 – 2007 have been revised from previous documents.
1 Operates April-October only.
2 Rowes Wharf Water Shuttle operated from January to June only in 2003.
3 Operated from May to October only in 2003.
4 Long Wharf Boston-Logan Water Shuttle operated from August to December in 2003.
5 Joint operation with City Water Taxi began on August 16, 2003.
NA Data not available.
NS Operation not in service.

Table G-3 Massachusetts Bay Transportation Authority (MBTA) Airport Station Passengers

Year	Entrances	Exits	Total Turnstile Count[1]	Percent Change
1990	NA	NA	2,854,317	-
1991	NA	NA	2,515,293	(11.9)%
1992	NA	NA	2,626,572	4.2%
1993	NA	NA	2,604,980	(0.8)%
1994	NA	NA	3,108,734	19.3%
1995	NA	NA	3,040,868	(2.2)%
1996	NA	NA	2,974,850	(2.2)%
1997[2]	NA	NA	2,774,268	(6.7)%
1998	NA	NA	2,850,367	2.7%
1999	NA	NA	2,974,045	4.3%
2000	NA	NA	3,019,086	1.5%
2001	NA	NA	2,896,638	(4.1)%
2002	NA	NA	2,670,594	(7.8)%
2003[3]	1,300,272	1,275,627	2,575,899	(3.6)%
2004	1,373,861	1,366,511	2,740,372	6.4%
2005	NA	NA	NA	NA
2006	NA	NA	NA	NA
2007[4]	1,412,055	--	2,524,079	--
2008[4]	2,212,111	--	3,647,394	56.7%
2009	2,329,370	--	3,750,549	5.3%
2010	2,270,241	--	3,629,193	(2.5%)
2011	2,277,311	NA	NA	0.3%
2012	2,442,085	NA	NA	7.2%
2013	2,597,306	NA	NA	6.3%
2014	**2,378,965**	**NA**	**NA**	**(8.4%)[6]**

Source: MBTA.
Note: Turnstile counts include both Logan Airport bound (turnstile exits) and non-Logan Airport bound (turnstile entrances) passengers.
1 As stated in the *Logan Airport 1999 ESPR*, Massport believes that ridership estimates through 2005 from the old Airport Station were actually understated because many travelers that were destined for the Airport with baggage had been observed to avoid the turnstiles and exit the old Airport Station via the wide gate (designed for handicapped access) that did not have the capability to count passengers.
2 Airport Station was closed on six weekends during September and October 1997 due to construction.
3 Airport Station was closed on eight weekend days during 2003.
4 Automated fare collection and new fare gates implemented beginning January 2007. Station access to Bremen Street Park opened June 2007. Exits are undercounted.
5 Exits are undercounted, as some exits occur through exit doors rather than turnstiles.
6 Due to the closure of Government Center Station in 2014, it is possible that passengers who would normally take the Blue Line to the Green Line have switched to alternate modes for their trip.
NA Data not available

Table G-4 Annual Taxi Dispatches (Tickets Sold)		
Year	**Total[1]**	**Percent Change**
1990	1,330,418	
1991	1,208,611	(9.2)%
1992	1,266,033	4.8%
1993	1,336,603	5.6%
1994	1,409,505	5.5%
1995	1,499,869	6.4%
1996	1,721,093	14.7%
1997	1,827,244	6.2%
1998	1,888,281	3.3%
1999	1,955,895	3.6%
2000	2,140,724	9.4%
2001	1,789,736	(16.4)%
2002	1,679,508	(6.2)%
2003	1,562,076	(7.0)%
2004	1,713,696	9.7%
2005	1,769,876	3.3%
2006	1,857,609	5.0%
2007	1,925,817	3.7%
2008	1,749,730	(9.1)%
2009	1,630,333	(6.8)%
2010	1,829,961	12.1%
2011	1,937,743	6.0%
2012	2,022,239	4.4%
2013	2,131,371	5.0%
2014	**2,237,793**	**5.0%**

1 Represents yearly total of tickets sold

Table G-5 Logan Airport Employee Parking Supply

Location	Number of Spaces March 2013	September 2013	**March 2014**	**September 2014**
Terminal Area	879	879	**857**	**868**
North Service Area	966	964	**883**	**883**
Southwest Service Area	0	0	**4**	**4**
South Service Area	808	808	**681**	**681**
Airside (Fire/Rescue)	5	5	**0**	**0**
Total spaces in service	**2,658**	**2,656**	**2,425**	**2,436**
Total spaces out of service	**15**	**17**	**248**	**237**
Total employee spaces	**2,673**	**2,673**	**2,673**	**2,673**

Source: Logan Airport Parking Space Inventory submitted to Massachusetts Department of Environmental Protection (MassDEP), March and September 2013 and 2014.
Note: As of June 2013, the Logan Airport Parking Freeze sets a limit of 18,415 commercial spaces and 2,673 employee spaces at the Airport.

Table G-6 Logan Airport Commercial Parking Supply

Location	Number of Spaces March 2013	September 2013	**March 2014**	**September 2014**
Terminal Area				
Central Garage and West Garage	10,396	10,396	**10,267**	**10,267**
Terminal B Garage	2,553	2,553	**2,254**	**2,254**
Terminal E Lot 1	269	269	**275**	**275**
Terminal E Lot 2	251	251	**248**	**248**
Terminal E Lot 3 (Gulf Lot)	222	222	**219**	**219**
Signature (General Aviation)	35	35	**35**	**35**
Logan Airport Hilton	235	235	**235**	**235**
North Service Area				
Economy Garage	2,809	2,809	**2,809**	**2,809**
Overflow Green Lot (Wood Island)	0	0	**0**	**0**
South Service Area				
Harborside Hyatt Conference Center and Hotel	270	270	**270**	**270**
Overflow Blue Lot (Harborside Dr.)	0	0	**0**	**0**
Southwest Service Area				
Overflow Red Lot (Tomahawk Dr.)	0	0	**0**	**0**
Total spaces in service	17,040	17,040	**16,612**	**16,612**
Total spaces out of service	1,225	1,375	**1,803**	**1,803**
Total commercial spaces	18,265	18,415	**18,415**	**18,415**

Source: Logan Airport Parking Space Inventory submitted to MassDEP, March and September 2013 and 2014.
Note: Logan Airport Parking Freeze sets a limit of 21,088 spaces on Airport. As of June 2013, the allocation is 18,415 commercial and 2,673 employee spaces.

Table G-7 2014 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
1	344	25	895	1,109	7,830	17,386	58.32	72.26	510.22	1,132.91
2	496	27	630	781	5,514	12,244	59.18	73.36	517.95	1,150.12
3	1,347	21	499	618	4,364	9,688	127.31	157.67	1,113.37	2,471.65
4	1,166	27	871	1,079	7,619	16,916	192.33	238.26	1,682.41	3,735.36
5	378	25	1,370	1,698	11,989	26,620	98.14	121.64	858.87	1,907.00
6	441	30	532	659	4,653	10,331	44.45	55.06	388.75	863.13
7	896	24	834	1,034	7,301	16,210	141.59	175.55	1,239.51	2,752.03
8	644	28	1,061	1,315	9,285	20,615	129.51	160.51	1,133.34	2,516.29
9	1,214	23	352	436	3,078	6,835	80.92	100.22	707.55	1,571.18
10	1,303	25	775	960	6,778	15,050	191.30	236.97	1,673.08	3,714.94
11	421	19	472	585	4,131	9,171	37.64	46.65	329.42	731.33
12	236	26	45	56	395	878	2.01	2.50	17.63	39.19
13	1,311	26	69	85	600	1,333	17.13	21.10	148.94	330.89
14	750	24	1,524	1,889	13,338	29,614	216.48	268.33	1,894.65	4,206.63
15	441	25	1,113	1,379	9,737	21,619	92.93	115.14	813.02	1,805.14
16	1,724	22	23	29	205	455	7.51	9.47	66.94	148.57
17	644	16	517	641	4,526	10,049	63.01	78.13	551.64	1,224.80
18	354	27	708	877	6,192	13,749	47.48	58.81	415.24	922.02
19	687	17	70	87	614	1,364	9.10	11.31	79.83	177.35
20	94	14	530	657	4,639	10,300	9.45	11.72	82.72	183.67
21	877	6	31	38	268	596	5.15	6.31	44.53	99.04
22	79	28	31	39	275	611	0.46	0.58	4.10	9.10
23	81	29	23	29	205	455	0.35	0.44	3.13	6.94
24	79	5	24	30	212	470	0.36	0.45	3.19	7.07
25	87	9	32	40	282	627	0.53	0.66	4.63	10.30
26	209	7	32	40	282	627	1.27	1.59	11.19	24.87
27	187	5	23	29	205	455	0.81	1.03	7.26	16.12
28	124	5	56	70	494	1,097	1.32	1.65	11.63	25.83
29	226	30	376	466	3,290	7,306	16.10	19.95	140.84	312.75
30	1,070	5	430	533	3,763	8,356	87.10	107.97	762.25	1,692.62
31	385	32	314	389	2,747	6,098	22.88	28.34	200.13	444.26
32	516	25	61	76	537	1,191	5.96	7.43	52.49	116.41
34	181	22	330	409	2,888	6,412	11.29	13.99	98.81	219.39
35	248	25	391	485	3,424	7,603	18.35	22.77	160.72	356.88
36	89	20	330	409	2,888	6,412	5.56	6.89	48.62	107.94
37	102	25	61	76	537	1,191	1.18	1.47	10.42	23.11
38	110	31	98	122	861	1,913	2.04	2.54	17.92	39.82
39	219	32	26	32	226	502	1.08	1.33	9.37	20.80
40	232	11	33	41	289	643	1.45	1.80	12.70	28.25
41	177	28	6	8	56	125	0.20	0.27	1.88	4.19
42	205	30	9	11	78	172	0.35	0.43	3.02	6.67
43	597	25	27	33	233	517	3.06	3.73	26.37	58.50
44	587	31	59	73	515	1,144	6.56	8.11	57.25	127.17
45	96	32	59	73	515	1,144	1.07	1.33	9.37	20.81
46	112	14	5	6	42	94	0.11	0.13	0.89	2.00
47	859	23	5	6	42	94	0.81	0.98	6.83	15.28
48	94	16	272	337	2,379	5,283	4.83	5.98	42.21	93.73
49	420	26	275	341	2,408	5,346	21.90	27.15	191.75	425.71
50	353	33	25	31	219	486	1.67	2.07	14.63	32.46
51	717	26	299	371	2,620	5,816	40.59	50.37	355.68	789.57
52	403	32	261	323	2,281	5,064	19.93	24.66	174.15	386.63
53	321	27	5	6	42	94	0.30	0.36	2.55	5.71
54	612	31	265	329	2,323	5,158	30.71	38.12	269.19	597.71

Table G-7 2014 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
55	194	26	466	577	4,074	9,046	17.09	21.17	149.45	331.84
56	101	5	0	0	0	0	0.00	0.00	0.00	0.00
57	97	32	124	154	1,087	2,414	2.29	2.84	20.04	44.50
58	103	5	0	0	0	0	0.00	0.00	0.00	0.00
59	105	5	0	0	0	0	0.00	0.00	0.00	0.00
60	331	26	590	731	5,161	11,460	36.93	45.76	323.05	717.34
61	224	8	129	160	1,130	2,508	5.46	6.77	47.83	106.16
62	218	23	209	259	1,829	4,060	8.65	10.72	75.68	168.00
63	242	23	41	51	360	800	1.88	2.34	16.51	36.70
64	232	5	41	51	360	800	1.80	2.24	15.85	35.21
65	593	26	670	830	5,860	13,012	75.29	93.27	658.48	1,462.13
66	465	25	16	20	141	314	1.41	1.76	12.41	27.63
67	483	22	10	12	85	188	0.92	1.10	7.78	17.21
68	487	5	0	0	0	0	0.00	0.00	0.00	0.00
69	361	14	31	38	268	596	2.12	2.60	18.32	40.74
90	582	5	431	534	3,770	8,372	47.52	58.87	415.64	923.00
103	85	33	14	17	120	267	0.22	0.27	1.93	4.29
104	85	5	0	0	0	0	0.00	0.00	0.00	0.00
105	95	5	0	0	0	0	0.00	0.00	0.00	0.00
106	95	5	0	0	0	0	0.00	0.00	0.00	0.00
107	260	18	123	152	1,073	2,383	6.06	7.49	52.89	117.46
108	389	20	83	103	727	1,615	6.11	7.59	53.55	118.95
109	114	14	29	36	254	564	0.63	0.78	5.49	12.18
110	169	16	28	35	247	549	0.89	1.12	7.89	17.54
111	261	5	0	0	0	0	0.00	0.00	0.00	0.00
112	237	28	17	21	148	329	0.76	0.94	6.65	14.79
113	565	17	29	36	254	564	3.11	3.86	27.20	60.40
114	609	32	20	25	177	392	2.31	2.88	20.41	45.20
115	451	28	265	329	2,323	5,158	22.64	28.10	198.42	440.58
116	399	20	29	36	254	564	2.19	2.72	19.19	42.62
117	283	20	44	54	381	847	2.36	2.90	20.43	45.42
118	295	28	275	341	2,408	5,346	15.36	19.04	134.47	298.53
119	240	14	199	247	1,744	3,872	9.05	11.23	79.29	176.04
120	365	28	56	69	487	1,082	3.87	4.77	33.68	74.83
121	356	15	86	107	755	1,677	5.80	7.22	50.93	113.12
122	486	19	79	98	692	1,536	7.27	9.02	63.68	141.34
123	486	17	91	113	798	1,772	8.37	10.39	73.39	162.96
124	280	20	50	62	438	972	2.65	3.29	23.21	51.51
125	280	18	69	86	607	1,348	3.66	4.56	32.17	71.44
126	631	18	123	152	1,073	2,383	14.70	18.17	128.25	284.83
127	652	20	82	102	720	1,599	10.13	12.60	88.92	197.49
128	257	32	22	27	191	423	1.07	1.31	9.29	20.58
129	257	23	29	36	254	564	1.41	1.75	12.36	27.44
130	422	5	0	0	0	0	0.00	0.00	0.00	0.00
131	493	30	5	6	42	94	0.47	0.56	3.92	8.77
132	361	21	141	175	1,236	2,743	9.64	11.96	84.48	187.49
133	236	24	74	92	650	1,442	3.31	4.11	29.04	64.43
134	1,521	27	196	243	1,716	3,810	56.45	69.98	494.18	1,097.22
135	1,542	24	69	86	607	1,348	20.16	25.12	177.31	393.76
136	384	5	15	19	134	298	1.09	1.38	9.75	21.68
137	354	16	10	12	85	188	0.67	0.80	5.70	12.61

Table G-7 2014 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
139	96	15	40	49	346	768	0.73	0.89	6.31	14.00
140	295	24	69	86	607	1,348	3.85	4.80	33.90	75.29
142	257	17	157	195	1,377	3,057	7.63	9.48	66.93	148.58
144	518	9	170	211	1,490	3,308	16.66	20.68	146.05	324.25
145	195	18	47	58	410	909	1.74	2.15	15.17	33.63
146	463	18	44	54	381	847	3.86	4.73	33.39	74.24
147	230	18	211	261	1,843	4,092	9.20	11.38	80.38	178.46
148	794	18	40	49	346	768	6.01	7.36	52.01	115.43
149	661	18	84	104	734	1,630	10.52	13.02	91.88	204.05
150	281	18	84	104	734	1,630	4.47	5.54	39.07	86.76
151	360	18	39	48	339	752	2.66	3.27	23.10	51.23
152	88	32	3	4	28	63	0.05	0.07	0.47	1.06
153	66	30	46	57	402	894	0.57	0.71	5.02	11.16
154	173	32	49	61	431	956	1.61	2.00	14.13	31.35
155	258	30	221	274	1,935	4,296	10.82	13.41	94.72	210.29
156	645	26	122	151	1,066	2,367	14.89	18.43	130.13	288.95
157	218	22	100	124	876	1,944	4.13	5.12	36.15	80.22
158	185	23	242	300	2,118	4,703	8.49	10.52	74.30	164.98
159	354	19	342	424	2,994	6,647	22.94	28.44	200.86	445.93
160	470	28	46	57	402	894	4.09	5.07	35.75	79.50
161	94	15	167	207	1,462	3,245	2.98	3.70	26.13	57.99
162	50	15	0	0	0	0	0.00	0.00	0.00	0.00
163	66	15	167	207	1,462	3,245	2.10	2.60	18.39	40.82
164	367	33	52	65	459	1,019	3.62	4.52	31.92	70.87
165	124	27	75	93	657	1,458	1.76	2.18	15.39	34.15
166	84	27	59	73	515	1,144	0.94	1.17	8.23	18.29
167	956	27	59	73	515	1,144	10.68	13.22	93.25	207.13
168	380	15	43	53	374	831	3.09	3.81	26.90	59.76
169	293	14	102	126	890	1,975	5.67	7.00	49.44	109.71
170	205	33	16	20	141	314	0.62	0.78	5.47	12.17
171	158	5	0	0	0	0	0.00	0.00	0.00	0.00
172	180	5	0	0	0	0	0.00	0.00	0.00	0.00
173	48	5	0	0	0	0	0.00	0.00	0.00	0.00
174	502	14	201	249	1,758	3,904	19.10	23.66	167.04	370.94
175	640	12	334	414	2,923	6,490	40.49	50.18	354.31	786.69
176	319	23	997	1,236	8,727	19,377	60.15	74.57	526.52	1,169.06
177	286	26	997	1,236	8,727	19,377	54.02	66.97	472.86	1,049.92
178	353	23	797	988	6,976	15,489	53.35	66.14	466.98	1,036.86
179	348	32	788	977	6,898	15,316	51.89	64.33	454.20	1,008.49
180	366	30	635	787	5,557	12,338	44.02	54.55	385.19	855.21
181	453	14	77	96	678	1,505	6.60	8.23	58.16	129.09
182	119	14	77	96	678	1,505	1.73	2.15	15.22	33.78
183	50	14	65	80	565	1,254	0.62	0.76	5.35	11.87
184	54	14	49	61	431	956	0.50	0.62	4.37	9.70
185	62	14	52	64	452	1,003	0.61	0.75	5.29	11.74
186	39	14	119	147	1,038	2,305	0.88	1.09	7.71	17.12
187	208	5	0	0	0	0	0.00	0.00	0.00	0.00
188	212	5	0	0	0	0	0.00	0.00	0.00	0.00
189	218	5	0	0	0	0	0.00	0.00	0.00	0.00
190	193	32	13	16	113	251	0.47	0.58	4.13	9.17
191	169	5	0	0	0	0	0.00	0.00	0.00	0.00
192	540	5	68	84	593	1,317	6.96	8.60	60.69	134.80
193	138	12	328	406	2,867	6,365	8.56	10.60	74.83	166.13
194	932	16	321	398	2,810	6,239	56.64	70.23	495.84	1,100.92

Table G-7 2014 Existing Conditions - Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
195	79	14	15	19	134	298	0.23	0.29	2.01	4.48
196	49	14	213	264	1,864	4,139	1.96	2.43	17.18	38.14
197	83	14	213	264	1,864	4,139	3.37	4.17	29.48	65.45
198	692	14	262	325	2,295	5,095	34.34	42.60	300.80	667.78
199	70	28	248	307	2,168	4,813	3.30	4.09	28.86	64.06
200	158	5	0	0	0	0	0.00	0.00	0.00	0.00
201	160	9	47	58	410	909	1.42	1.75	12.40	27.49
202	335	22	47	58	410	909	2.98	3.68	26.00	57.65
203	30	5	0	0	0	0	0.00	0.00	0.00	0.00
204	2,022	8	116	144	1,017	2,257	44.42	55.14	389.41	864.22
205	71	25	332	411	2,902	6,443	4.48	5.55	39.20	87.02
206	142	25	242	300	2,118	4,703	6.52	8.08	57.07	126.73
207	859	32	234	290	2,048	4,546	38.06	47.16	333.08	739.34
208	284	33	190	236	1,666	3,700	10.22	12.69	89.61	199.01
209	80	30	528	654	4,618	10,253	8.04	9.95	70.29	156.06
210	71	30	634	786	5,550	12,322	8.57	10.63	75.05	166.62
211	390	30	719	891	6,291	13,968	53.09	65.78	464.48	1,031.29
212	117	30	326	404	2,853	6,334	7.24	8.97	63.35	140.64
213	1,344	26	1,114	1,381	9,751	21,650	283.66	351.65	2,482.92	5,512.79
214	449	31	1,024	1,269	8,960	19,894	87.03	107.86	761.54	1,690.85
215	1,110	31	99	123	868	1,928	20.80	25.85	182.41	405.16
216	905	31	432	535	3,777	8,387	74.08	91.75	647.71	1,438.26
217	1,050	31	251	311	2,196	4,876	49.91	61.84	436.67	969.58
218	581	28	620	768	5,423	12,040	68.19	84.47	596.45	1,324.22
219	1,063	32	342	424	2,994	6,647	68.88	85.39	603.00	1,338.73
220	415	32	342	424	2,994	6,647	26.87	33.32	235.26	522.31
221	698	5	0	0	0	0	0.00	0.00	0.00	0.00
222	1,920	22	17	21	148	329	6.18	7.64	53.83	119.66
223	1,564	29	962	1,192	8,416	18,687	284.93	353.05	2,492.66	5,534.73
224	377	28	316	392	2,768	6,145	22.59	28.02	197.84	439.20
225	551	28	84	104	734	1,630	8.77	10.85	76.59	170.08
226	788	32	85	105	741	1,646	12.69	15.67	110.59	245.65
227	1,303	32	254	315	2,224	4,938	62.66	77.71	548.67	1,218.22
228	580	29	940	1,165	8,226	18,264	103.31	128.04	904.10	2,007.35
229	1,653	30	343	425	3,001	6,663	107.37	133.04	939.44	2,085.80
230	2,058	28	597	740	5,225	11,601	232.70	288.44	2,036.60	4,521.84
231	1,300	22	578	716	5,055	11,225	142.27	176.24	1,244.24	2,762.93
232	736	24	596	739	5,218	11,585	83.05	102.98	727.10	1,614.31
233	488	28	612	759	5,359	11,899	56.57	70.15	495.33	1,099.82
234	449	11	420	521	3,679	8,168	35.71	44.30	312.80	694.47
235	310	9	333	413	2,916	6,475	19.55	24.24	171.18	380.10
236	310	5	87	108	763	1,693	5.12	6.35	44.87	99.56
237	105	5	184	228	1,610	3,574	3.67	4.54	32.09	71.23
238	697	31	100	124	876	1,944	13.19	16.36	115.57	256.46
239	186	26	73	91	643	1,427	2.57	3.20	22.60	50.16
240	145	28	123	152	1,073	2,383	3.39	4.18	29.54	65.60
241	578	28	196	243	1,716	3,810	21.47	26.62	188.00	417.42
242	125	32	100	124	876	1,944	2.36	2.93	20.71	45.96
243	564	32	99	123	868	1,928	10.57	13.14	92.70	205.90
244	88	32	100	124	876	1,944	1.66	2.06	14.52	32.22
245	48	5	0	0	0	0	0.00	0.00	0.00	0.00
246	175	14	194	241	1,702	3,778	6.43	7.99	56.40	125.20
247	65	22	3	4	28	63	0.04	0.05	0.35	0.78

Table G-7 2014 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
248	39	14	297	368	2,598	5,769	2.18	2.70	19.08	42.36
249	128	14	198	245	1,730	3,841	4.79	5.93	41.87	92.95
250	484	14	206	255	1,800	3,998	18.90	23.40	165.16	366.84
251	388	5	0	0	0	0	0.00	0.00	0.00	0.00
252	308	16	307	380	2,683	5,957	17.94	22.20	156.75	348.02
253	54	13	10	12	85	188	0.10	0.12	0.87	1.92
254	51	5	0	0	0	0	0.00	0.00	0.00	0.00
255	290	31	3	4	28	63	0.17	0.22	1.54	3.47
256	377	31	44	55	388	862	3.14	3.93	27.72	61.58
257	215	31	27	33	233	517	1.10	1.34	9.49	21.07
258	321	28	0	0	0	0	0.00	0.00	0.00	0.00
259	203	28	0	0	0	0	0.00	0.00	0.00	0.00
260	362	28	2	3	21	47	0.14	0.21	1.44	3.22
261	219	31	21	26	184	408	0.87	1.08	7.64	16.95
262	218	13	6	7	49	110	0.25	0.29	2.02	4.53
263	177	33	23	29	205	455	0.77	0.97	6.86	15.23
264	157	5	0	0	0	0	0.00	0.00	0.00	0.00
265	2,458	26	104	129	911	2,022	48.41	60.05	424.08	941.25
266	752	26	136	169	1,193	2,649	19.37	24.07	169.90	377.26
267	1,323	26	204	253	1,786	3,966	51.10	63.38	447.39	993.47
268	1,252	30	419	519	3,665	8,136	99.32	123.03	868.77	1,928.59
269	302	30	19	23	162	361	1.09	1.32	9.28	20.68
270	1,005	16	644	798	5,634	12,510	122.57	151.89	1,072.33	2,381.06
271	954	14	530	657	4,639	10,300	95.74	118.68	837.95	1,860.51
272	656	18	532	659	4,653	10,331	66.10	81.88	578.17	1,283.69
273	485	6	536	664	4,688	10,410	49.24	61.00	430.70	956.40
274	1,244	26	149	185	1,306	2,900	35.11	43.59	307.70	683.26
275	419	5	0	0	0	0	0.00	0.00	0.00	0.00
276	649	26	136	169	1,193	2,649	16.71	20.77	146.59	325.50
277	2,473	24	102	126	890	1,975	47.78	59.02	416.92	925.19
278	573	31	256	317	2,238	4,970	27.79	34.41	242.95	539.53
279	458	18	290	360	2,542	5,644	25.14	31.21	220.38	489.31
280	295	25	220	273	1,928	4,280	12.30	15.26	107.79	239.28
281	440	14	212	263	1,857	4,123	17.65	21.90	154.60	343.25
282	76	14	141	175	1,236	2,743	2.04	2.53	17.89	39.71
283	697	14	303	376	2,655	5,895	39.97	49.60	350.24	777.65
284	690	19	503	624	4,406	9,782	65.69	81.49	575.41	1,277.51
285	91	19	489	606	4,279	9,500	8.42	10.44	73.71	163.65
286	464	19	822	1,019	7,195	15,975	72.25	89.56	632.40	1,404.11
287	229	26	789	978	6,905	15,332	34.25	42.45	299.70	665.47
288	500	10	787	975	6,884	15,285	74.46	92.24	651.27	1,446.07
289	738	22	1,530	1,897	13,394	29,739	213.87	265.17	1,872.23	4,156.96
290	190	26	1,359	1,685	11,897	26,416	48.84	60.55	427.55	949.32
291	494	32	394	488	3,446	7,650	36.88	45.68	322.58	716.12
292	689	21	967	1,198	8,459	18,781	126.11	156.23	1,103.16	2,449.27
293	325	27	1,384	1,716	12,116	26,902	85.21	105.65	745.93	1,656.25
294	396	19	261	324	2,288	5,079	19.59	24.32	171.74	381.25
295	1,017	29	1,125	1,395	9,850	21,869	216.72	268.73	1,897.51	4,212.86
296	162	16	170	211	1,490	3,308	5.22	6.48	45.76	101.59
297	140	16	170	211	1,490	3,308	4.50	5.59	39.47	87.63
298	951	7	200	248	1,751	3,888	36.03	44.68	315.49	700.52
299	805	17	126	156	1,101	2,446	19.21	23.79	167.88	372.96

Table G-7 2014 Existing Conditions - Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

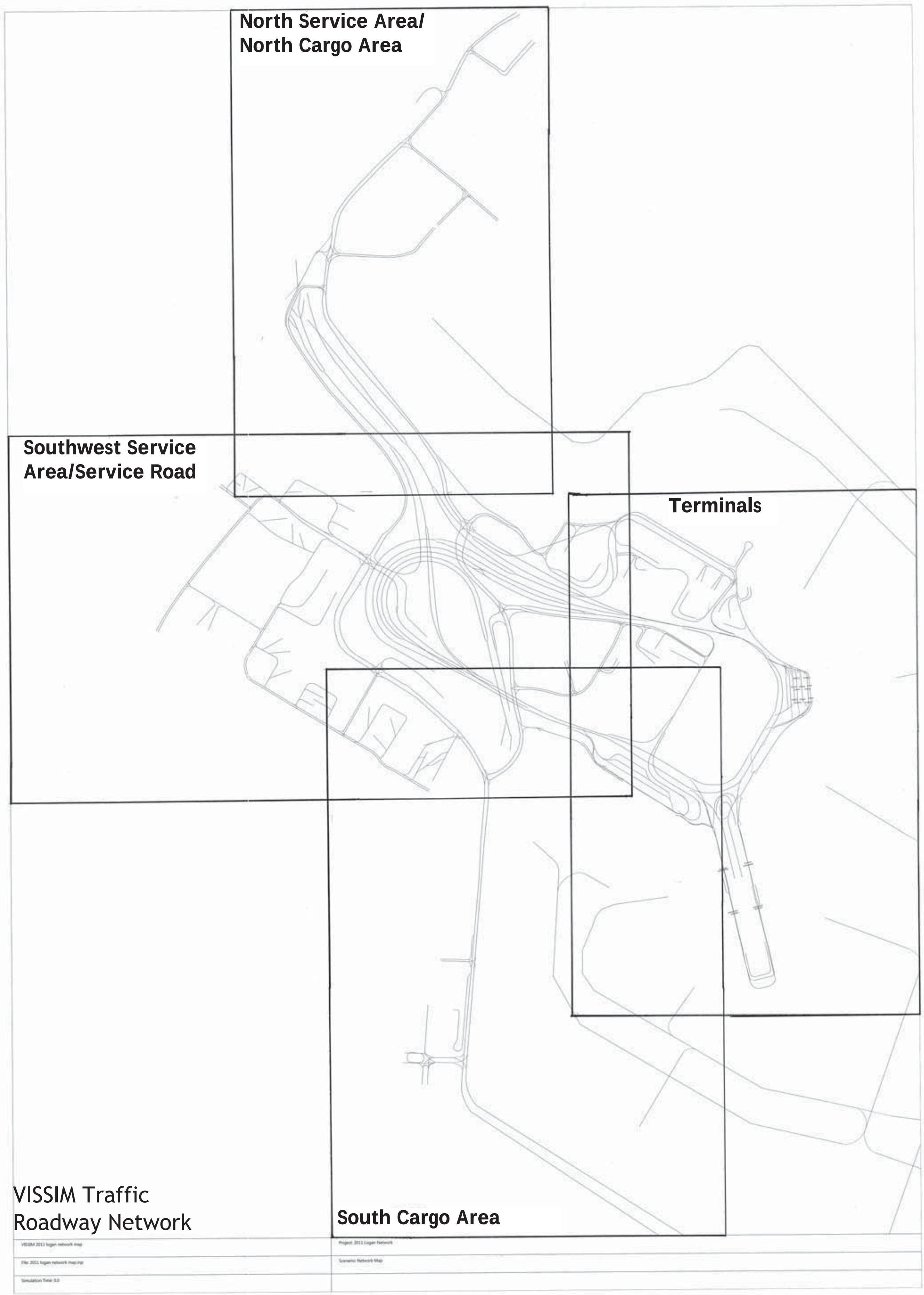
			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
299	805	17	126	156	1,101	2,446	19.21	23.79	167.88	372.96
300	518	15	70	87	614	1,364	6.87	8.54	60.27	133.88
301	749	6	103	128	904	2,007	14.61	18.16	128.27	284.77
302	652	8	262	325	2,295	5,095	32.35	40.13	283.39	629.14
303	547	5	58	72	508	1,129	6.00	7.45	52.59	116.88
304	406	10	34	42	297	658	2.61	3.23	22.83	50.58
305	442	5	19	23	162	361	1.59	1.93	13.57	30.23
306	207	5	52	65	459	1,019	2.04	2.55	18.00	39.97
307	70	5	111	137	967	2,148	1.47	1.82	12.82	28.48
308	319	9	61	75	530	1,176	3.69	4.53	32.03	71.07
309	281	6	86	107	755	1,677	4.58	5.69	40.16	89.21
310	555	29	387	480	3,389	7,525	40.65	50.41	355.94	790.34
311	208	27	387	480	3,389	7,525	15.25	18.91	133.51	296.44
312	125	27	938	1,163	8,212	18,232	22.21	27.53	194.41	431.63
313	332	24	704	872	6,157	13,670	44.31	54.88	387.51	860.37
314	440	24	1,139	1,412	9,970	22,136	94.96	117.72	831.21	1,845.50
315	215	19	691	856	6,044	13,420	28.14	34.86	246.15	546.56
316	543	13	119	148	1,045	2,320	12.24	15.23	107.51	238.68
317	180	8	207	257	1,815	4,029	7.06	8.76	61.88	137.36
318	221	9	207	257	1,815	4,029	8.65	10.74	75.87	168.43
319	2,544	10	306	379	2,676	5,942	147.43	182.60	1,289.26	2,862.78
320	552	11	377	467	3,297	7,321	39.39	48.79	344.49	764.93
321	628	10	98	121	854	1,897	11.66	14.40	101.63	225.74
322	181	7	372	461	3,255	7,227	12.75	15.81	111.60	247.79
323	58	9	324	402	2,838	6,302	3.58	4.44	31.33	69.57
324	387	12	21	26	184	408	1.54	1.91	13.50	29.93
325	406	9	344	427	3,015	6,694	26.43	32.81	231.65	514.32
326	89	5	73	90	635	1,411	1.23	1.51	10.67	23.70
327	463	10	351	435	3,071	6,820	30.78	38.15	269.31	598.07
328	79	19	407	505	3,566	7,917	6.09	7.56	53.40	118.55
329	103	19	407	505	3,566	7,917	7.91	9.81	69.30	153.85
330	323	12	26	32	226	502	1.59	1.96	13.82	30.69
331	179	10	283	351	2,478	5,503	9.59	11.90	83.98	186.49
332	993	8	465	576	4,067	9,030	87.43	108.31	764.72	1,697.91
333	384	13	15	18	127	282	1.09	1.31	9.24	20.52
334	366	20	415	514	3,629	8,058	28.74	35.60	251.32	558.05
335	583	27	674	835	5,896	13,090	74.42	92.19	650.99	1,445.30
336	428	27	727	901	6,362	14,125	58.97	73.08	516.02	1,145.68
337	94	24	211	261	1,843	4,092	3.77	4.66	32.89	73.03
338	366	5	156	193	1,363	3,026	10.81	13.37	94.43	209.64
339	311	5	55	68	480	1,066	3.23	4.00	28.23	62.70
340	273	18	20	25	177	392	1.03	1.29	9.14	20.25
341	66	15	20	25	177	392	0.25	0.31	2.21	4.88
342	48	5	0	0	0	0	0.00	0.00	0.00	0.00
343	52	22	47	58	410	909	0.46	0.57	4.04	8.95
344	82	12	35	43	304	674	0.54	0.67	4.73	10.48
345	25	5	73	90	635	1,411	0.35	0.43	3.01	6.68
346	121	5	73	91	643	1,427	1.67	2.08	14.68	32.59
347	303	9	108	134	946	2,101	6.20	7.69	54.27	120.53
348	146	9	465	576	4,067	9,030	12.87	15.94	112.58	249.96
349	67	9	194	241	1,702	3,778	2.45	3.05	21.52	47.76

Table G-7 2014 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

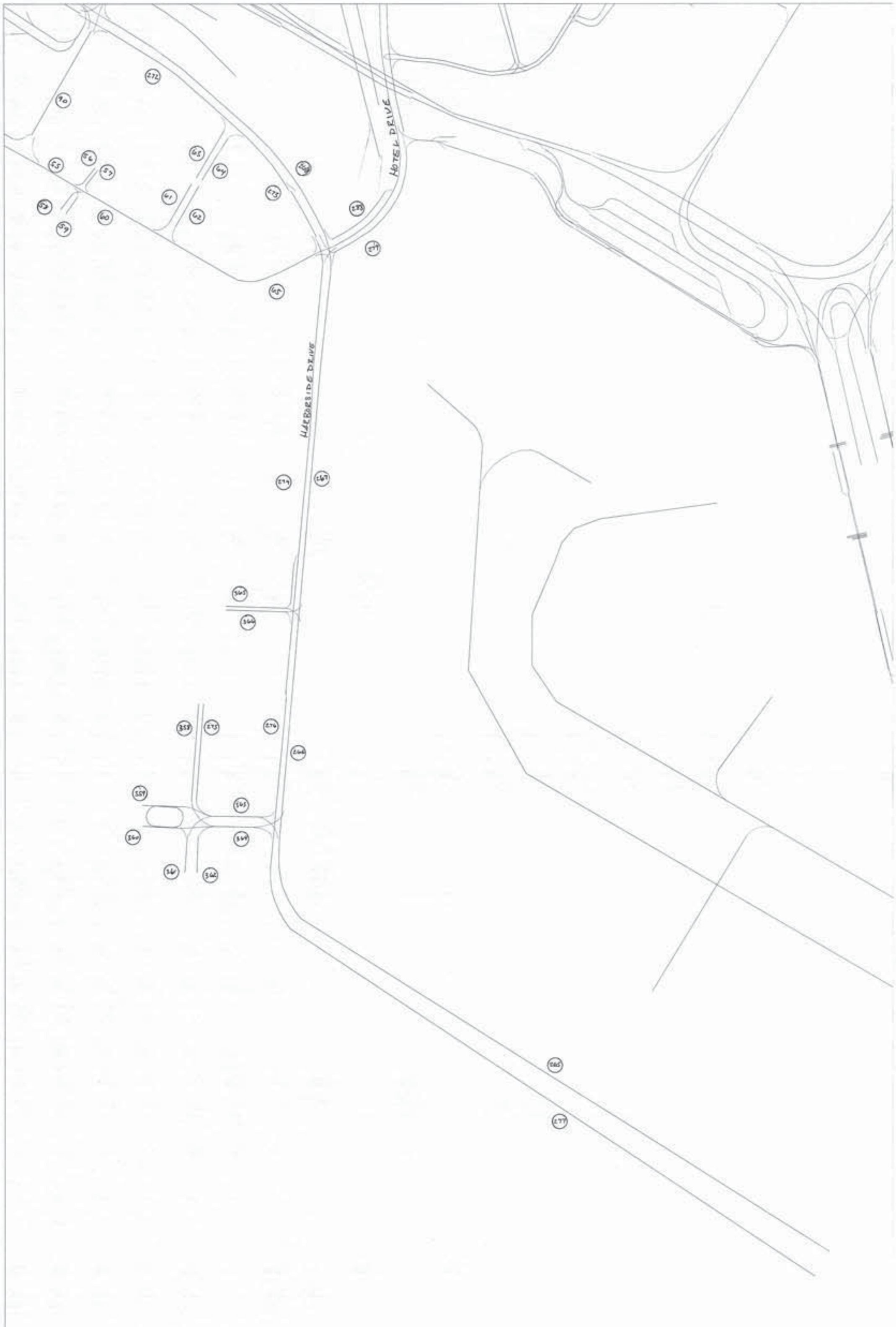
			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
350	446	5	194	240	1,695	3,762	16.38	20.26	143.09	317.59
351	335	5	32	40	282	627	2.03	2.54	17.92	39.84
352	430	5	226	280	1,977	4,390	18.39	22.78	160.87	357.22
353	360	5	47	58	410	909	3.20	3.95	27.92	61.89
354	50	14	109	135	953	2,116	1.03	1.28	9.02	20.04
355	88	5	191	237	1,673	3,715	3.19	3.96	27.94	62.04
356	113	5	459	569	4,018	8,920	9.83	12.18	86.02	190.96
358	463	5	0	0	0	0	0.00	0.00	0.00	0.00
359	229	13	4	5	35	78	0.17	0.22	1.52	3.39
360	245	14	4	5	35	78	0.19	0.23	1.63	3.63
361	248	17	35	43	304	674	1.64	2.02	14.27	31.63
362	199	9	32	40	282	627	1.21	1.51	10.64	23.65
363	230	22	39	48	339	752	1.70	2.09	14.75	32.73
364	256	19	36	45	318	705	1.75	2.18	15.43	34.20
365	201	23	15	19	134	298	0.57	0.72	5.10	11.33
366	201	11	71	88	621	1,380	2.71	3.35	23.66	52.59
367	337	31	682	845	5,966	13,247	43.54	53.94	380.85	845.66
368	868	11	476	590	4,166	9,249	78.29	97.04	685.20	1,521.22
369	167	9	439	544	3,841	8,528	13.92	17.24	121.76	270.34
370	96	10	273	338	2,387	5,299	4.95	6.12	43.25	96.00
371	141	26	571	708	4,999	11,099	15.24	18.90	133.42	296.22
372	283	17	248	307	2,168	4,813	13.29	16.45	116.14	257.83
373	283	24	109	135	953	2,116	5.84	7.23	51.05	113.35
				Logan Airport VMT			8,155	10,107	71,361	158,443

AWDT = Average annual weekday daily traffic

This Page Intentionally Left Blank

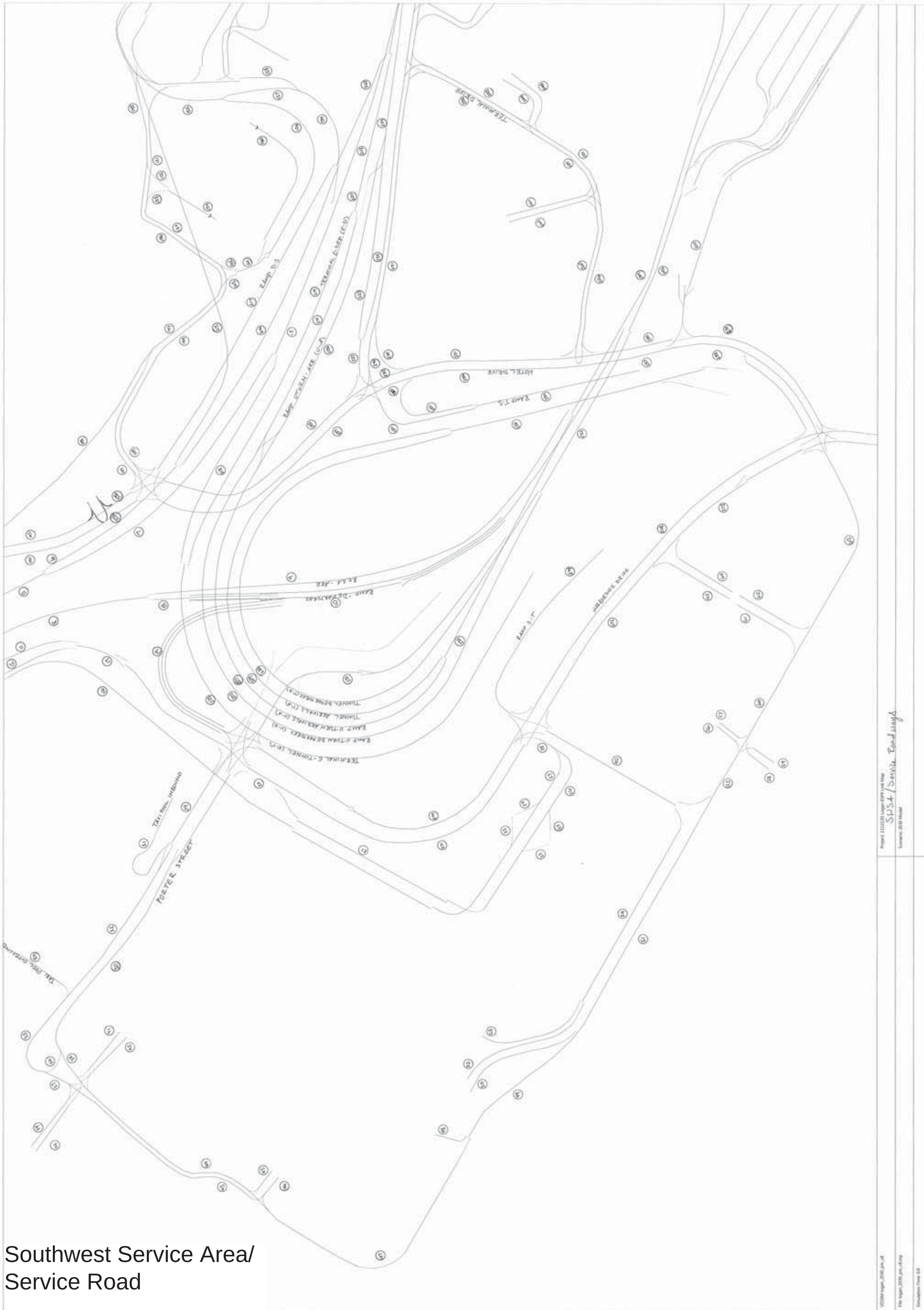

North Service Area/
North Cargo Area
Southwest Service
Area/Service Road
Terminals
South Cargo Area
VISSIM Traffic
Roadway Network
VISSIM 2011 logan network map
File: 2011 logan network map.inp
Simulation Time: 0.0
Project: 2011 Logan Network
Scenario: Network Map


North Service Area/
North Cargo Area
VISSIM logan_2030_pm_v8
File: logan_2030_pm_v8.inp
Simulation Time: 0.0
Project: 11122.05 Logan ESPR Link Map
NCA / NS1
Scenario: 2030 Model
FRANKFORT
LOVELL
PRESCOTT

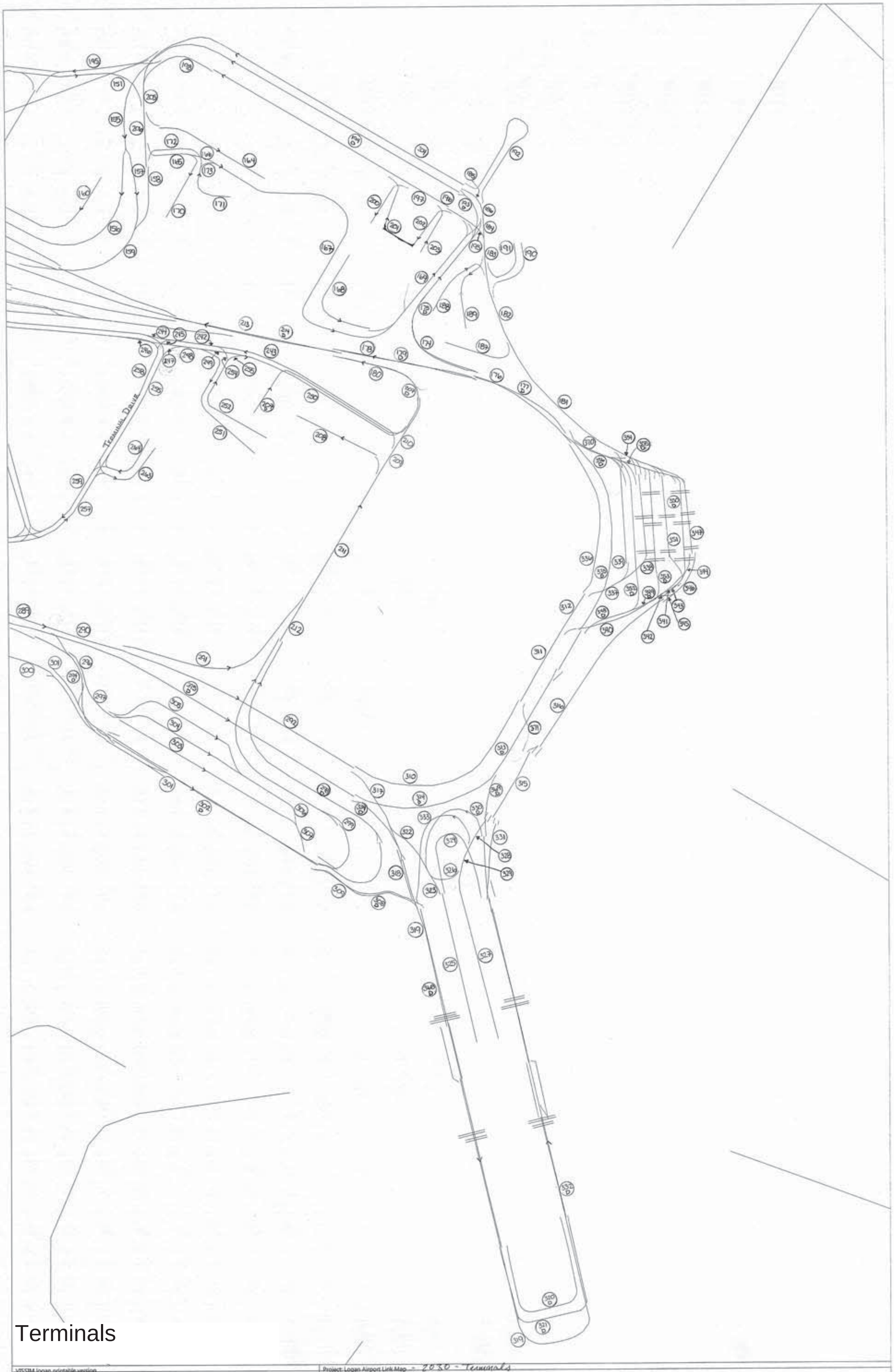


South Cargo Area

VISSIM logan_2030_pm_v8	Project: 11122.05 Logan ESPR Link Map SCA
File: logan_2030_pm_v8.inp	Scenario: 2030 Model
Simulation Time: 0.0	



Southwest Service Area/
Service Road


VISSIM logan printable version
File: logan printable version.inp
Simulation Time: 0.0
Project: Logan Airport Link Map - 2030 - Terminals
Scenario: Logan Tunnel Ramps, Rental Car Lots

Terminals

This Page Intentionally Left Blank

Massachusetts Port Authority
One Harborside Drive, Suite 200S
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

February 28th, 2014

Christine Kirby, Deputy Director
Department of Environmental Protection
Division of Consumer and Transportation Programs
Bureau of Waste Prevention
One Winter Street
Boston, MA 02108

Re: March 1st, 2014 Logan Airport Parking Space Inventory

Dear Ms. Kirby:

In compliance with the reporting requirements of 310 CMR 7.30 (3)(d), enclosed are the following March 1st, 2014 Massachusetts Port Authority submissions:

- Commercial Parking Space Inventory
- Employee Parking Space Inventory
- Location Map

Massport's parking program remains in compliance with the Aviation and Transportation Security Act of 2001 (ATSA) and supplemental FAA security directives, and our top priority continues to be the safe and secure operation of our transportation and parking facilities. We continue to provide information on rental car spaces as a courtesy.

The attachments provide the quantity, physical distribution and allocation of commercial and employee parking spaces as defined by 310 CMR 7.30, as amended. These inventory tables are based on information provided by the Aviation Department; the employee and commercial space counts are supported by comprehensive field checks and counts recently conducted in February 2014.

The Commercial Parking Space Inventory totals 18,415 spaces; the Employee Parking Space Inventory totals 2,673 employee parking spaces; the total inventory of spaces at Logan Airport is 21,088. This revised total reflects the additional 150 spaces transferred from Paul's Parking as confirmed in your June 4th, 2013 letter to Massport and the Boston Air Pollution Control Commission.

The new Rental Car Center opened in September of 2013; consequently, most rental car operations have been transferred to the new facility. This March 1st, 2014 submission includes a revised location map showing the footprint of the new facility; the map reference is R1. However, portions of the South West Service Area remain under construction as part of completing the Rental Car Center project; this activity may continue to affect the location of some rental car spaces.

As you may know, demand for commercial parking at Logan Airport continues to be strong. While the Aviation Department deploys operational innovations to accommodate passenger parking demand, a broader strategic planning effort is underway to plan for ground access needs at future passenger levels. As part of this effort, Massport is proposing to consolidate all remaining (i.e., designated) parking spaces allowed under the freeze by making structural additions to existing parking facilities located in the central terminal area. That proposal is the subject of a Request for Advisory Opinion (RAO) filed with the MEPA office on February 18th, 2014; the allocation of commercial parking spaces presented in Table 1 of that RAO is identical to those in the attached inventory.

The attached Logan Airport Parking Space Inventory reflects Massport's successful management of its parking program, within the requirements of 310 CMR 7.30, as amended. If you have any questions, please call me at (617) 568-3570.

Sincerely,

Craig Leiner

Craig Leiner
Economic Planning & Development Department

cc: L. Dantas
S. Dalzell
I. Wallach
B. Desrosiers
D. Conroy

Commercial Parking Space Inventory
Logan International Airport
March 1, 2014 Submission

Commercial Parking Spaces

Map ID#	Location of Commercial Parking Areas	Number of Spaces
Terminal Area and Economy Spaces		
C1	Central Garage	7,077
C2	West Garage	3,190
C3	Terminal B Garage	2,254
C5	Terminal E Lot 1	275
C6	Terminal E Lot 2	248
C7	Terminal E Lot 3 (fka "Gulf Station" Lot)	219
C8	Economy Garage	2,809
	subtotal	*16,072*
Hotel Spaces		
C4a & C4b	Logan Airport Hilton Hotel (two lots)	235
C10	Harborside Hyatt Conference Center	270
	subtotal	*505*
General Aviation Spaces		
C9	Signature (General Aviation Terminal)	35
	subtotal	*35*

Total In-Service Commercial Parking Spaces	**16,612**
Total Designated Commercial Parking Spaces	**1,803**
Total Commercial Parking Spaces	**18,415**
Total Employee Parking Spaces *(see table on next page)*	**2,673**
TOTAL PARKING FREEZE SPACES	**21,088**

Employee Parking Space Inventory
Logan International Airport
March 1, 2014 Submission

Employee Parking Spaces

Area	Map ID#	Location of Employee Parking Areas	Number of Spaces
Terminal Area	E81	West Garage	98
	E26	Airport Tower/Administration (parking in Central Garage)	513
	E20 a&b	Terminal C Pier A (Old Terminal D) (two lots)	122
	E18	Massport Facilities 1 (Heating Plant)	92
	E34	Hilton Hotel employee lot	28
	E86	Gulf Gas Station	4
North Service Area	E68a	LSG Sky Chefs (Bldg. 68), main lot	25
	E68b	LSG Sky Chefs (Bldg. 68), overflow lot	126
	E1	Flight Kitchen Building 1 (and nearby lot)	80
	E40	Lovell Street Lot (contractor trailer)	25
	E53	Green Bus Depot (Bus Maintenance Facility)	12
	E59	Temporary Limo Lot	2
	E11a	North Cargo Building 11, TSA lot	93
	E11b	North Cargo Building 11, State Police lot	136
	E43	North Gate & EMS Trailer (EMS Station A7)	26
	E8	North Cargo Building 8	114
	E5	US Airways Administration/Hangar (Bldg. 5)	75
	N/A	Massport Facilities 2 (airside, Bldg. 3)	0
	E4	Massport Facilities 3 (landside, Bldg. 4)	69
	E13	UPS (Cargo Building 13)	44
	E94	United Aircraft Maintenance (Buildings 93 & 94)	56
SW	E60	Rental Car Center (Customer Service Center)	4
South Service Area	E84	Bird Island Flats / Logan Office Center (LOC) Garage	425
	E72	Taxi Pool	7
	E63	South Cargo Building 63	16
	E62	South Cargo Building 62	43
	E58	South Cargo Building 58	23
	E57	South Cargo Building 57	44
	E56	South Cargo Building 56	39
	E78	Fire-Rescue HQ & Amelia Earhart Terminal/Hangar	84
	N/A	*ARFF Satellite Station* [1]	0

[1] This facility is located on the airfield and is not shown in the map. No employee parking spaces are provided.

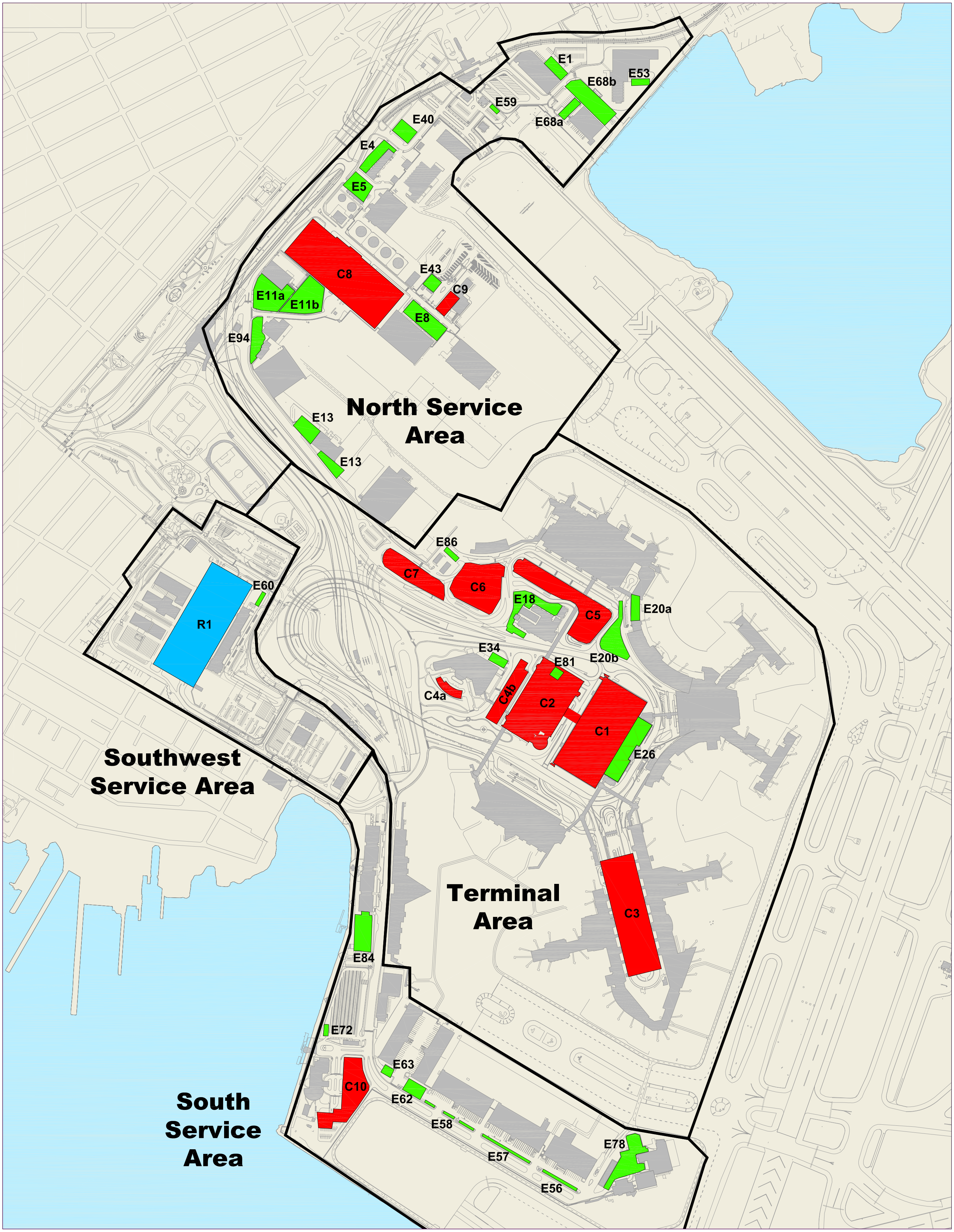
Total In-Service Employee Parking Spaces	**2,425**
Total Designated Employee Parking Spaces	**248**
Total Employee Parking Spaces	**2,673**
Total Commercial Parking Spaces *(see table on previous page)*	**18,415**
TOTAL PARKING FREEZE SPACES	**21,088**

For Information Only:
Rental Car Spaces Inventory
Logan International Airport
March 1, 2014 Submission

Rental Car Company Parking Spaces

Map ID#		Number of Spaces
R1	Rental Car Center (RCC)	5,020
Total Rental Car Spaces		**5,020**

T:\GIS\GISFILES\LOGAN\DEPARTMENTS\PLANNING\Parking Inventory\Parking Inventory022414.dwg



Logan Airport
Parking Space Inventory

Logan International Airport
East Boston, MA

massport
Massachusetts Port Authority
March 1, 2014

Legend:

- Logan Parking Service Area Zones
- Commercial Parking Space Locations
- Employee Parking Space Locations
- Rental Car Parking Space Locations

N

0 250 500 1000
in feet

Notes:

This plan is intended for informational purposes only and no use may be made of the same without the express written permission of the Massachusetts Port Authority ("Massport"). Massport does not certify the accuracy, information or title to the properties contained in this plan nor make any warranties of any kind, express or implied, in fact or by law, with respect to any boundaries, easements, restrictions, claims, overlaps or other encumbrances affecting such properties.

Massachusetts Port Authority
One Harborside Drive, Suite 200S
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

September 2, 2014

Christine Kirby, Deputy Director
Department of Environmental Protection
Division of Consumer and Transportation Programs
Bureau of Waste Prevention
One Winter Street
Boston, MA 02108

Re: September 1st, 2014, Logan Airport Parking Space Inventory

Dear Ms. Kirby:

In compliance with the reporting requirements of 310 CMR 7.30 (3)(d), enclosed are the following September 1st, 2014, Massachusetts Port Authority (Massport) submissions:

- Commercial Parking Space Inventory
- Employee Parking Space Inventory
- Location Map

The attachments provide the quantity, physical distribution, and allocation of commercial and employee parking spaces on the airport, as defined by 310 CMR 7.30, as amended. These inventory tables are based on information provided by the Aviation Department; the employee and commercial space counts are supported by comprehensive field checks and counts recently conducted in August 2014. We continue to provide information on rental car spaces as a courtesy.

Massport's parking program remains in compliance with the Aviation and Transportation Security Act of 2001 (ATSA) and supplemental FAA security directives, and our top priority continues to be the safe and secure operation of our transportation and parking facilities.

The Commercial Parking Space Inventory totals 18,415 spaces; the Employee Parking Space Inventory totals 2,673 parking spaces; the total inventory of spaces at Logan Airport is 21,088.

Demand for commercial parking at Logan Airport continues to be strong. While the Aviation Department deploys operational innovations to accommodate passenger parking demand, a broader strategic planning effort is underway to plan for ground access needs at future passenger levels. As part of this effort, Massport is planning to consolidate all remaining (i.e., designated) parking spaces allowed under the freeze by making structural additions to existing parking garages located in the central terminal area.

The attached Logan Airport Parking Space Inventory reflects Massport's successful management of its parking program, within the requirements of 310 CMR 7.30, as amended. If you have any questions, please call me at (617) 561-3425.

Sincerely,

Lourenço Dantas
Senior Transportation Planner
Planning Department

cc: C. Leiner, MPA
S. Dalzell, MPA
I. Wallach, MPA
B. Desrosiers, MPA
D. Conroy, EPA

Commercial Parking Spaces

Map ID#	Location of Commercial Parking Areas	Number of Spaces
Terminal Area and Economy Spaces		
C1	Central Garage	7,077
C2	West Garage	3,190
C3	Terminal B Garage	2,254
C5	Terminal E Lot 1	275
C6	Terminal E Lot 2	248
C7	Terminal E Lot 3 (fka "Gulf Station" Lot)	219
C8	Economy Garage	2,809
	subtotal	*16,072*
Hotel Spaces		
C4a & C4b	Logan Airport Hilton Hotel (two lots)	235
C10	Harborside Hyatt Conference Center	270
	subtotal	*505*
General Aviation Spaces		
C9	Signature (General Aviation Terminal)	35
	subtotal	*35*

Total In-Service Commercial Parking Spaces	**16,612**
Total Designated Commercial Parking Spaces	**1,803**
Total Commercial Parking Spaces	**18,415**
Total Employee Parking Spaces *(see table on next page)*	**2,673**
TOTAL PARKING FREEZE SPACES	**21,088**

Employee Parking Space Inventory
Logan International Airport
September 1, 2014 Submission

Employee Parking Spaces

Area	Map ID#	Location of Employee Parking Areas	Number of Spaces
Terminal Area	E81	West Garage	98
Terminal Area	E26	Airport Tower/Administration (parking in Central Garage)	524
Terminal Area	E20	Terminal C Pier A (Old Terminal D) (two lots)	122
Terminal Area	E18	Massport Facilities 1 (Heating Plant)	92
Terminal Area	E34	Hilton Hotel employee lot	28
Terminal Area	E86	Gulf Gas Station	4
North Service Area	E68a	LSG Sky Chefs (Bldg. 68), main lot	25
North Service Area	E68b	LSG Sky Chefs (Bldg. 68), overflow lot	126
North Service Area	E1	Flight Kitchen Building 1 (and nearby lot)	80
North Service Area	E40	Lovell Street Lot (contractor trailer)	25
North Service Area	E53	Green Bus Depot (Bus Maintenance Facility)	12
North Service Area	E59	Temporary Limo Lot	2
North Service Area	E11a	North Cargo Building 11, TSA lot	93
North Service Area	E11b	North Cargo Building 11, State Police lot	136
North Service Area	E43	North Gate & EMS Trailer (EMS Station A7)	26
North Service Area	E8	North Cargo Building 8	114
North Service Area	E5	US Airways Administration/Hangar (Bldg. 5)	75
North Service Area	*N/A*	Massport Facilities 2 (airside, Bldg. 3)	0
North Service Area	E4	Massport Facilities 3 (landside, Bldg. 4)	69
North Service Area	E13	UPS (Cargo Building 13)	44
North Service Area	E94	United Aircraft Maintenance (Buildings 93 & 94)	56
SW	E60	Rental Car Center (Customer Service Center)	4
South Service Area	E84	Bird Island Flats / Logan Office Center (LOC) Garage	425
South Service Area	E72	Taxi Pool	7
South Service Area	E63	South Cargo Building 63	16
South Service Area	E62	South Cargo Building 62	43
South Service Area	E58	South Cargo Building 58	23
South Service Area	E57	South Cargo Building 57	44
South Service Area	E56	South Cargo Building 56	39
South Service Area	E78	Fire-Rescue HQ & Amelia Earhart Terminal/Hangar	84
	N/A	*ARFF Satellite Station* [1]	0

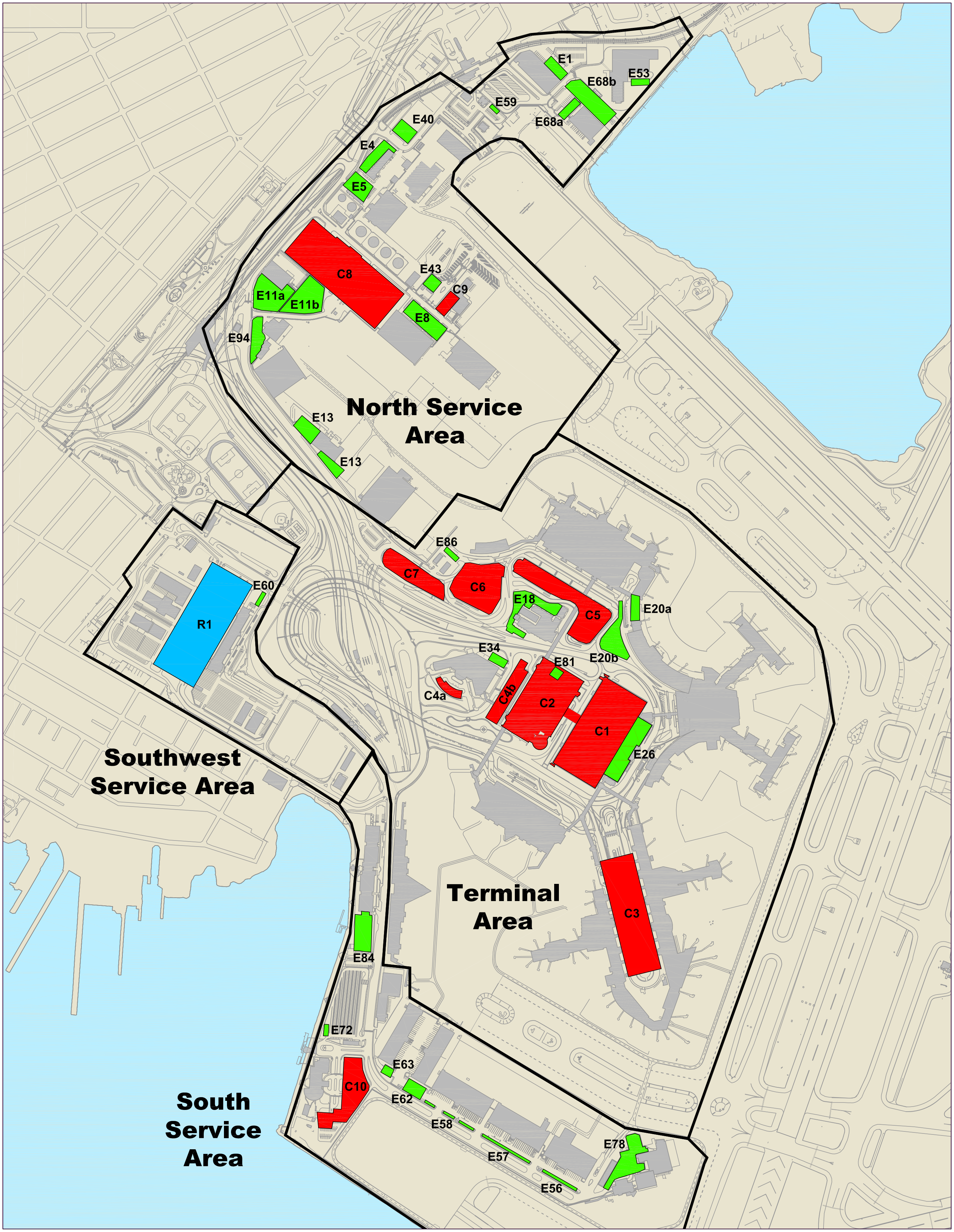
[1] This facility is located on the airfield and is not shown in the map. No employee parking spaces are provided.

Total In-Service Employee Parking Spaces	**2,436**
Total Designated Employee Parking Spaces	**237**
Total Employee Parking Spaces	**2,673**
Total Commercial Parking Spaces *(see table on previous page)*	**18,415**
TOTAL PARKING FREEZE SPACES	**21,088**

For Information Only:
Rental Car Spaces Inventory
Logan International Airport
September 1, 2014 Submission

Rental Car Company Parking Spaces

Map ID#		Number of Spaces
R1	Rental Car Center (RCC)	5,020
Total Rental Car Spaces		**5,020**



T:\GIS\GISFILES\LOGAN\DEPARTMENTS\PLANNING\Parking Inventory\Parking Inventory082814.dwg

Logan Airport
Parking Space Inventory

Logan International Airport
East Boston, MA

massport
Massachusetts Port Authority
September 1, 2014

Legend:

- Logan Parking Service Area Zones
- Commercial Parking Space Locations
- Employee Parking Space Locations
- Rental Car Parking Space Locations

N

0 250 500 1000
in feet

Notes:

This plan is intended for informational purposes only and no use may be made of the same without the express written permission of the Massachusetts Port Authority ("Massport"). Massport does not certify the accuracy, information or title to the properties contained in this plan nor make any warranties of any kind, express or implied, in fact or by law, with respect to any boundaries, easements, restrictions, claims, overlaps or other encumbrances affecting such properties.

H

Noise Abatement

This appendix provides detailed information, tables, and figures in support of *Chapter 6, Noise Abatement*:

- Fundamentals of Acoustics and Environmental Noise
  - Figure H-1 Frequency-Response Characteristics of Various Weighting Networks
  - Figure H-2 Common Environmental Sound Levels, in dBA
  - Figure H-3 Variations in the A-Weighted Sound Level Over Time
  - Figure H-4 Sound Exposure Level (SEL)
  - Figure H-5 Example of a One Minute Equivalent Sound Level (L_{eq})
  - Figure H-6 Daily Noise Dose
  - Figure H-7 Examples of Day-Night Average Sound Levels (DNL)
  - Figure H-8 Outdoor Speech Intelligibility
  - Figure H-9 Probability of Awakening at Least Once from Indoor Noise Event
  - Figure H-10 Percentage of People Highly Annoyed
  - Figure H-11 Community Reaction as a Function of Outdoor DNL

- Regulatory Framework

- Logan Airport RealContoursTM Data Inputs
  - Figure H-12 Schematic Noise Modeling Process (Standard INM vs. RealContours™)
  - Table H-1a 2013 Annual Modeled Operations
  - Table H-1b 2014 Annual Modeled Operations
  - Table H-2a 2013 Modeled Runway Use by Aircraft Group
  - Table H-2b 2014 Modeled Runway Use by Aircraft Group
  - Table H-3a Summary of Jet and Non-Jet Aircraft Runway Use: 2013
  - Table H-3b Summary of Jet and Non-Jet Aircraft Runway Use: 2014
  - Table H-4 Total 2013 and 2014 Modeled Runway Use by All Operations
  - Table H-5 Total Count of Flight Tracks Modeled in RealContours™ (2013 and 2014)
  - Table H-6 Modeled Daily Operations by Commercial & GA Aircraft – 1990 to 2014
  - Table H-7 Percentage of Commercial Jet Operations by Part 36 Stage Category – 1999 to 2014
  - Table H-8 Modeled Nighttime Operations at Logan Airport – 1990 to 2014
  - Table H-9 Summary of Jet Aircraft Runway Use – 1990 to 2014

- Annual Model Results and Status of Mitigation Programs
  - Table H-10 Noise-Exposed Population by Community
  - Table H-11 Residential Sound Insulation Program (RSIP) Status (1986-2014)
  - Table H-12 Schools Treated Under Massport Sound Insulation Program
  - Figure H-13 Number of Callers and Complaints between 2000 and 2014

Fundamentals of Acoustics and Environmental Noise

Introduction

This section introduces the fundamentals of acoustics and noise terminology as well as the effects of noise on human activity and community annoyance.

Introduction to Acoustics and Noise Terminology

Chapter 6, Noise Abatement of this *2014 Environmental Data Report (EDR)* relies largely on a measure of cumulative noise exposure over an entire calendar year, in terms of a metric called the Day-Night Average Sound Level (DNL). However, DNL does not always provide a sufficient description of noise for many purposes. Other measures are available to address essentially any issue of concern. This section introduces the following acoustic metrics, which are all related to DNL, but provide bases for evaluating a broad range of noise situations.

- Decibel (dB);
- A-Weighted Decibel (dBA);
- Sound Exposure Level (SEL);
- Equivalent Sound Level (Leq);
- Time Above (TA);
- Time Above, Night (TAN); and
- DNL.

The Decibel (dB)

All sounds come from a sound source – a musical instrument, a voice speaking, or an airplane that passes overhead. It takes energy to produce sound. The sound energy produced by any sound source is transmitted through the air in the form of sound waves – tiny, quick oscillations of pressure just above and just below atmospheric pressure. These oscillations, or sound pressures, impinge on the ear, creating the sound we hear.

Our ears are sensitive to a wide range of sound pressures. The loudest sounds that we hear without pain have about one million times more energy than the quietest sounds we hear. However, our ears are incapable of detecting small differences in these pressures. Thus, to match how we hear this sound energy, we compress the total range of sound pressures to a more meaningful range by introducing the concept of sound pressure level (SPL). SPL is a measure of the sound pressure of a given noise source relative to a standard reference value (typically the quietest sound that a young person with good hearing can detect). SPLs are measured in decibels (abbreviated dB). Decibels are logarithmic quantities – logarithms of the squared ratio of two pressures, the numerator being the pressure of the sound source of interest, and the denominator being the reference pressure (the quietest sound we can hear).

The logarithmic conversion of sound pressure to SPL means that the quietest sound we can hear (the reference pressure) has a SPL of about zero decibels, while the loudest sounds we hear without pain have SPLs of about 120 dB. Most sounds in our day-to-day environment have SPLs from 30 to 100 dB.

Because decibels are logarithmic quantities, they do not behave like regular numbers with which we are more familiar. For example, if two sound sources each produce 100 dB and they are operated together, they produce only 103 dB – not 200 dB as we might expect. Four equal sources operating simultaneously result in a total SPL of 106 dB. In fact, for every doubling of the number of equal sources, the SPL goes up another three decibels.

A tenfold increase in the number of sources makes the SPL go up 10 dB. A hundredfold increase makes the level go up 20 dB, and it takes a thousand equal sources to increase the level 30 dB.

If one source is much louder than another source, the two sources together will produce the same SPL (and sound to our ears) as if the louder source were operating alone. For example, a 100 dB source plus an 80 dB source produces 100 dB when operating together. The louder source "masks" the quieter one, but if the quieter source gets louder, it will have an increasing effect on the total SPL. When the two sources are equal, as described above, they produce a level three decibels above the sound of either one by itself.

From these basic concepts, note that one hundred 80 dB sources will produce a combined level of 100 dB; if a single 100 dB source is added, the group will produce a total SPL of 103 dB. Clearly, the loudest source has the greatest effect on the total decibel level.

A-Weighted Decibel, dBA

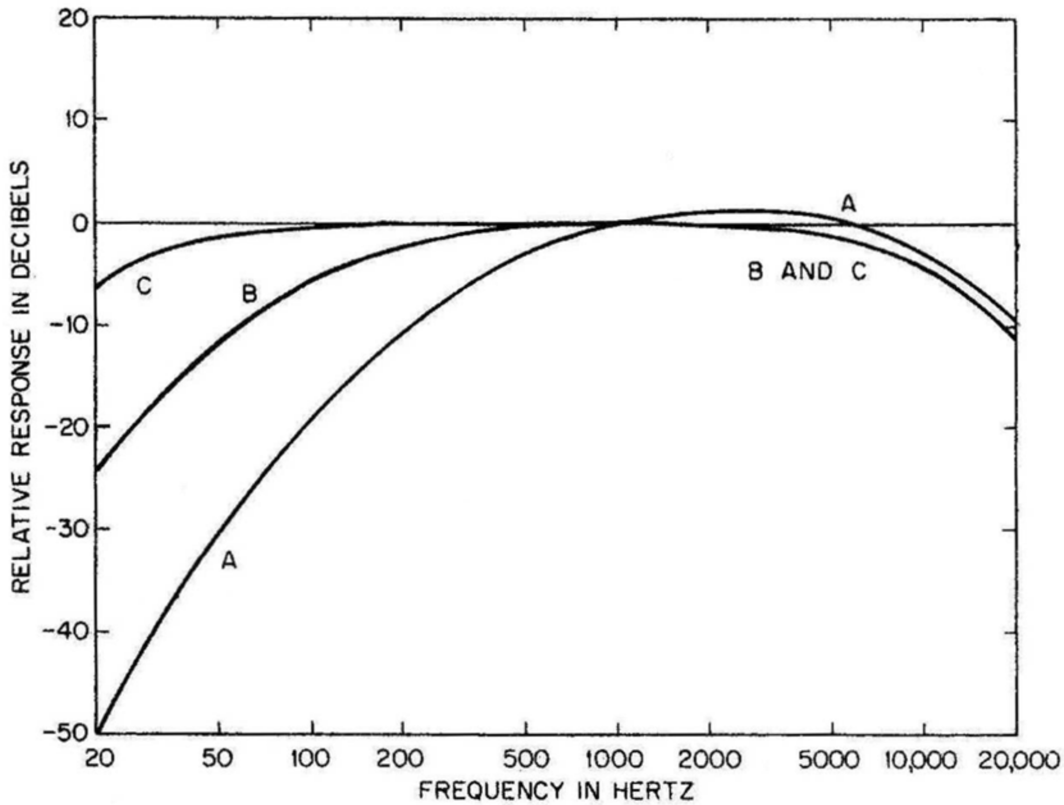
Another important characteristic of sound is its frequency, or "pitch." This is the rate of repetition of the sound pressure oscillations as they reach our ear. Formerly expressed in cycles per second, frequency is now expressed in units known as Hertz (Hz).

Most people hear from about 20 Hz to about 10,000 to 15,000 Hz. People respond to sound most readily when the predominant frequency is in the range of normal conversation, around 1,000 to 2,000 Hz. Acousticians have developed "filters" to match our ears' sensitivity and help us to judge the relative loudness of sounds made up of different frequencies. The so-called "A" filter does the best job of matching the sensitivity of our ears to most environmental noises. SPLs measured through this filter are referred to as A-weighted levels (dBA). A-weighting significantly de-emphasizes noise at low and very high frequencies (below about 500 Hz and above about 10,000 Hz) where we do not hear as well. Because this filter generally matches our ears' sensitivity, sounds having higher A-weighted sound levels are usually judged louder than those with lower A-weighted sound levels, a relationship which does not always hold true for unweighted levels. It is for these reasons that A-weighted sound levels are normally used to evaluate environmental noise.

Other weighting networks include the B and C filters. They correspond to different level ranges of the ear. The rarely used B-weighting attenuates low frequencies (those less than 500 Hz), but to a lesser degree than A-weighting. C weighting is nearly flat throughout the audible frequency range, hardly de-emphasizing low frequency noise. C-weighted levels can be preferable in evaluating sounds whose low-frequency components are responsible for secondary effects such as the shaking of a building, window rattle, or perceptible vibrations. Uses include the evaluation of blasting noise, artillery fire, and in some cases, aircraft noise inside buildings.

Figure H-1 compares these various weighting networks.

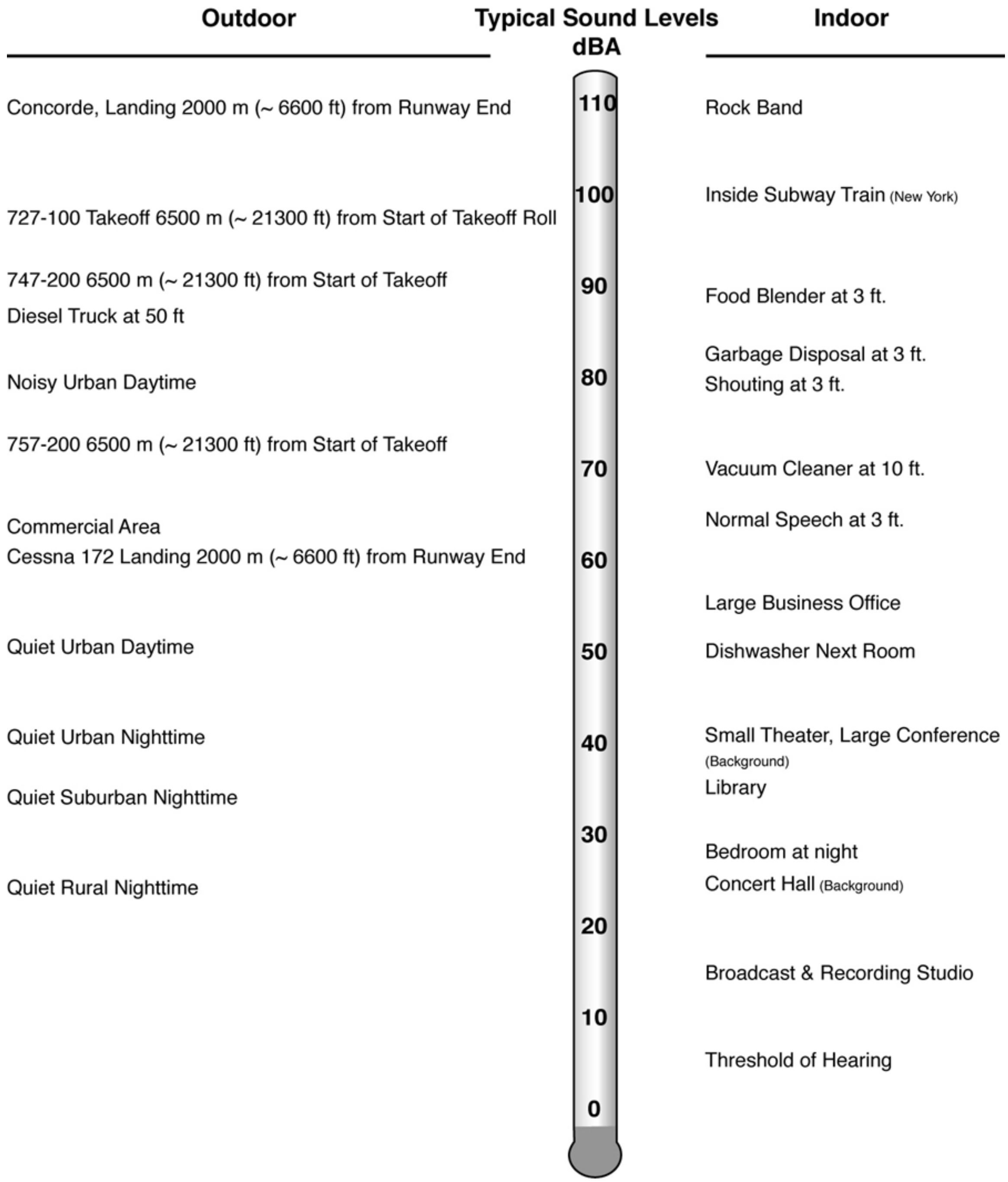
Figure H-1 Frequency-Response Characteristics of Various Weighting Networks



Source: Harris, Cyril M., editor; Handbook of Acoustical Measurements and Noise Control, (Chapter 5, "Acoustical Measurement Instruments"; Johnson, Daniel L.; Marsh, Alan H.; and Harris, Cyril M.); New York; McGraw-Hill, Inc.; 1991; p. 5.13.

Because of the correlation with our hearing, the A-weighted level has been adopted as the basic measure of environmental noise by the U.S. Environmental Protection Agency (EPA) and by nearly every other federal and state agency concerned with community noise. Figure H-2 presents typical A-weighted sound levels of several common environmental sources.

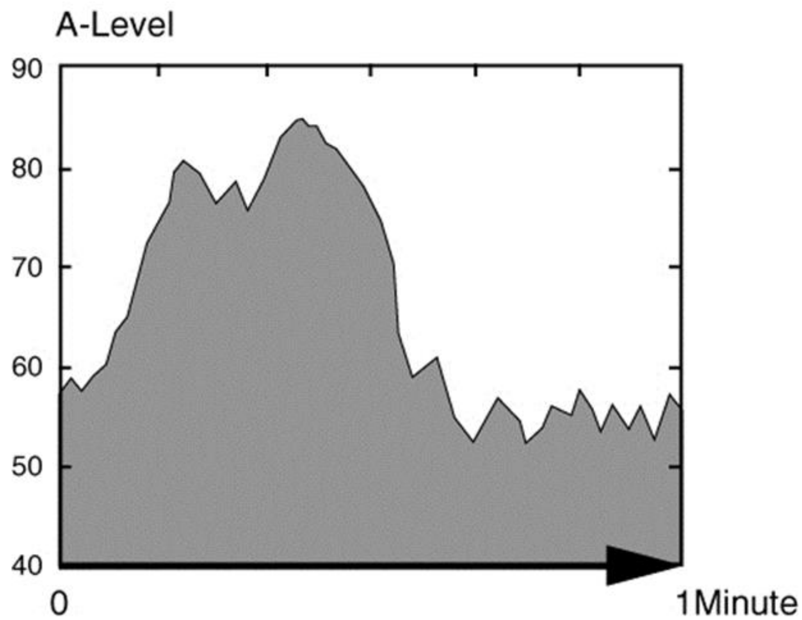
Figure H-2 Common Environmental Sound Levels, in dBA



Source: HMMH (Aircraft noise levels from FAA Advisory Circular 36-3H)

An additional dimension to environmental noise is that A-weighted levels vary with time. For example, the sound level increases as an aircraft approaches, then falls and blends into the background as the aircraft recedes into the distance (though even the background varies as birds chirp or the wind blows or a vehicle passes by). Figure H-3 illustrates this concept.

Figure H-3 Variations in the A-Weighted Sound Level Over Time



Source: HMMH

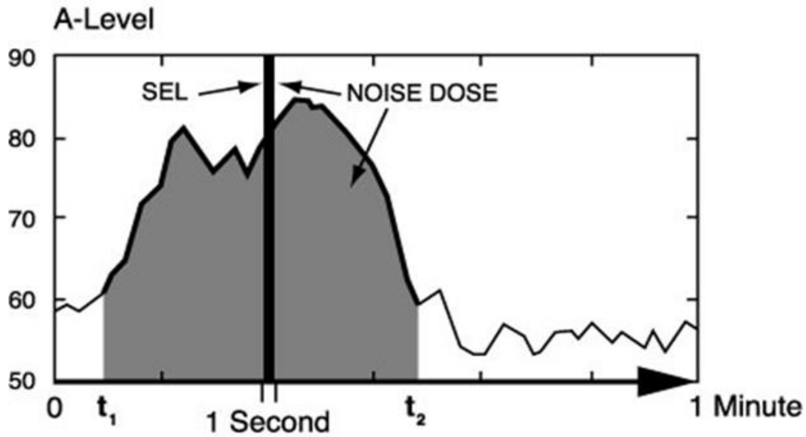
Maximum A-Weighted Noise Level, L_{max}
The variation in noise level over time often makes it convenient to describe a particular noise "event" by its maximum sound level, abbreviated as L_{max}. In the figure above, it is approximately 85 dBA.

The maximum level describes only one dimension of an event; it provides no information on the cumulative noise exposure. In fact, two events with identical maxima may produce very different total exposures. One may be of very short duration, while the other may continue for an extended period and be judged much more annoying. The next measure corrects for this deficiency.

Sound Exposure Level (SEL)
The most frequently used measure of noise exposure for an individual aircraft noise event (and the measure that Part 150 specifies for this purpose) is the SEL. SEL is a measure of the total noise energy produced during an event, from the time when the A-weighted sound level first exceeds a threshold level (normally just above the background or ambient noise) to the time that the sound level drops back down below the threshold. To allow comparison of noise events with very different durations, SEL "normalizes" the duration in every case to one second; that is, it is expressed as the steady noise level with just a one-second duration that includes the same amount of noise energy as the actual longer duration, time-varying noise. In lay terms, SEL "squeezes" the entire noise event into one second.

Figure H-4 depicts this transformation. The shaded area represents the energy included in an SEL measurement for the noise event, where the threshold is set to 60 dBA. The dark shaded vertical bar, which is 90 dBA high and just one second long (wide), contains exactly the same sound energy as the full event.

Figure H-4 Sound Exposure Level (SEL)



Source: HMMH

Because the SEL is normalized to one second, it will always be larger than the L_{max} for an event longer than one second. In this case, the SEL is 90 dB; the L_{max} is approximately 85 dBA. For most aircraft overflights, the SEL is normally on the order of 7 to 12 dB higher than L_{max}. Because SEL considers duration, longer exposure to relatively slow, quiet aircraft, such as propeller models, can have the same or higher SEL than shorter exposure to faster, louder planes, such as corporate jets.

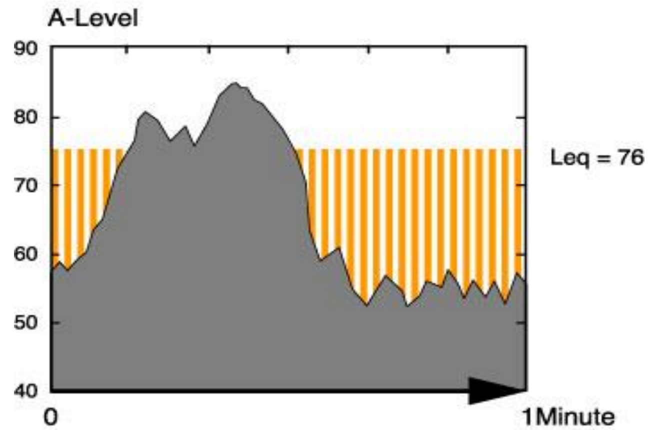
Equivalent Sound Level (L_{eq})

The L_{max} and SEL quantify the noise associated with individual events. The remaining metrics in this section describe longer-term cumulative noise exposure that can include many events.

The Equivalent Sound Level (L_{eq}) is a measure of exposure resulting from the accumulation of A-weighted sound levels over a particular period of interest (e.g., an hour, an eight-hour school day, nighttime, or a full 24-hour day). Because the length of the period can differ, the applicable period should always be identified or clearly understood when discussing the metric. Such durations are often identified through a subscript, for example $L_{eq(8)}$ or $L_{eq(24)}$.

L_{eq} is equivalent to the constant sound level over the period of interest that contains as much sound energy as the actual time-varying level. This is illustrated in Figure H-5. Both the solid and striped shaded areas have a one-minute L_{eq} value of 76 dB. It is important to recognize, however, that the two signals (the constant one and the time-varying one) would sound very different in real life. Also, be aware that the "average" sound level suggested by L_{eq} is not an arithmetic value, but a logarithmic, or "energy-averaged" sound level. Thus, loud events dominate L_{eq} measurements.

Figure H-5 Example of a One Minute Equivalent Sound Level (L_{eq})



Source: HMMH

In airport noise studies, L_{eq} is often presented for consecutive one-hour periods to illustrate how the exposure rises and falls throughout a 24-hour period, and how individual hours are affected by unusual activity, such as rush hour traffic or a few loud aircraft.

Time Above (TA)

TA is a metric that gives the duration, in minutes, for which aircraft-related noise exceeds a specified A-weighted sound level during a given period. The measure is referred to generally as TA. For this *2014 EDR*, three threshold sound levels are used in the analysis: 65, 75, and 85 dBA. These times are computed using the Federal Aviation Administration (FAA)-approved Integrated Noise Model (INM).

Time Above Night (TAN)

Identical to TA, except it is computed for only the 9-hour period between 10:00 PM and 7:00 AM. The TAN is also developed using three threshold sound levels 65, 75, and 85 dBA.

Day-Night Average Sound Level (DNL)

Virtually all studies of aircraft noise rely on a slightly more complicated measure of noise exposure that describes cumulative noise exposure during an average annual day: the DNL. The EPA identified DNL as the most appropriate means of evaluating airport noise based on the following considerations:[1]

- 1. The measure should be applicable to the evaluation of pervasive long-term noise in various defined areas and under various conditions over long periods.
- 2. The measure should correlate well with known effects of the noise environment and on individuals and the public.
- 3. The measure should be simple, practical, and accurate. In principal, it should be useful for planning as well as for enforcement or monitoring purposes.
- 4. The required measurement equipment, with standard characteristics, should be commercially available.
- 5. The measure should be closely related to existing methods currently in use.

1 Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," U. S. EPA Report No. 550/9-74-004, March 1974

- 6. The single measure of noise at a given location should be predictable, within an acceptable tolerance, from knowledge of the physical events producing the noise.
- 7. The measure should lend itself to small, simple monitors, which can be left unattended in public areas for long periods.

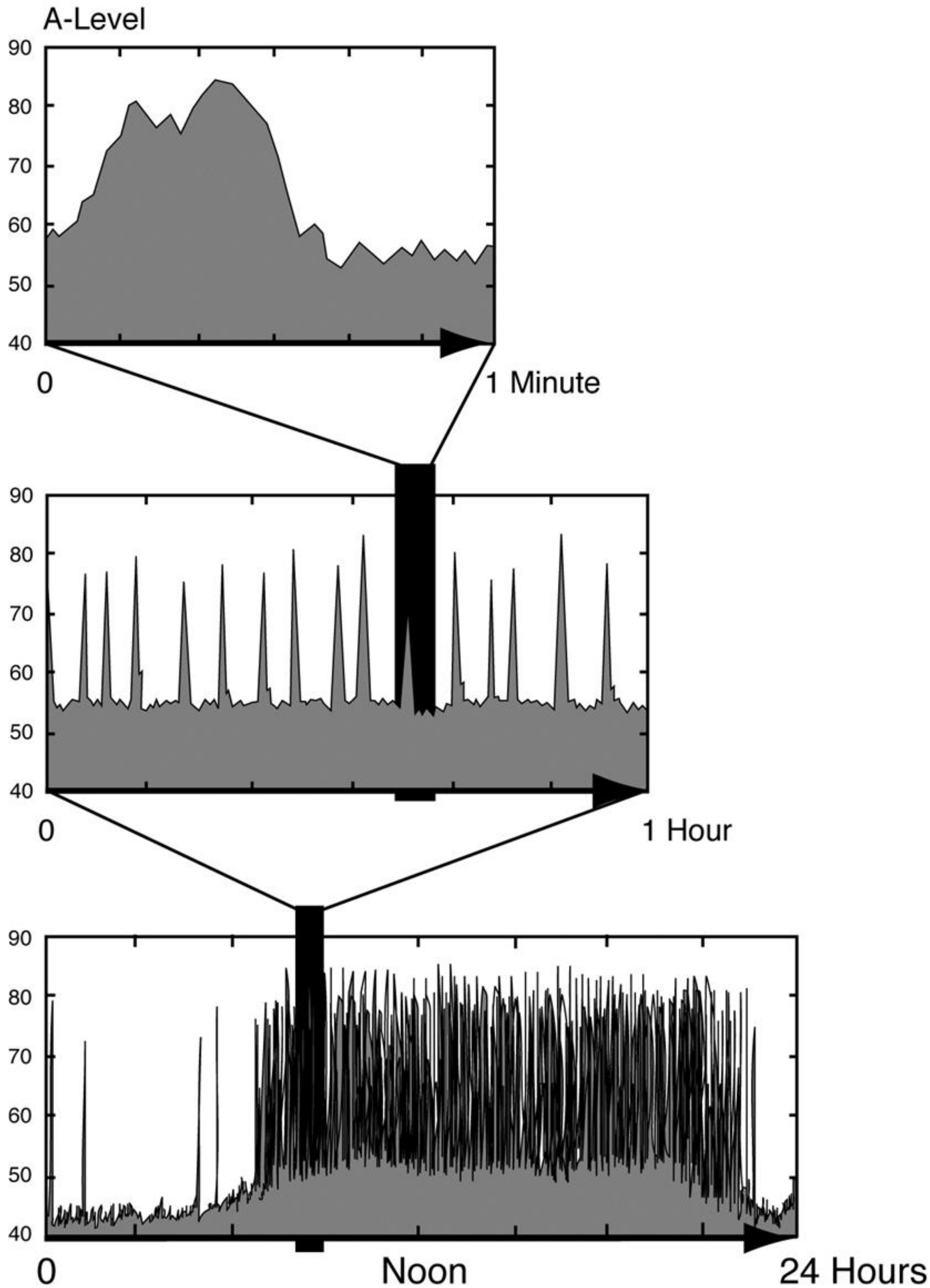
Most federal agencies dealing with noise have formally adopted DNL. The Federal Interagency Committee on Noise (FICON) reaffirmed the appropriateness of DNL in 1992. The FICON summary report stated; "There are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric."

The DNL represents noise as it occurs over a 24-hour period, with one important exception: DNL treats nighttime noise differently from daytime noise. In determining DNL, it is assumed that the A-weighted levels occurring at night (defined as 10:00 PM to 7:00 AM) are 10 dB louder than they really are. This 10 dB penalty is applied to account for greater sensitivity to nighttime noise, and the fact that events at night are often perceived to be more intrusive because nighttime ambient noise is less than daytime ambient noise.

Figure H-4 illustrated the A-weighted sound level due to an aircraft fly-over as it changed with time. The top frame of Figure H-6 repeats this figure. The shaded area reflects the noise dose that a listener receives during the one-minute period of the sample. The center frame of Figure H-4 includes this one-minute sample within a full hour. The shaded area represents the noise during that hour with 16 noise events, each producing an SEL. Similarly, the bottom frame includes the one-hour interval within a full 24 hours. Here the shaded area represents the listener's noise dose over a complete day. Note that several overflights occur at a time when the background noise drops some 10 dB, to approximately 45 dBA.

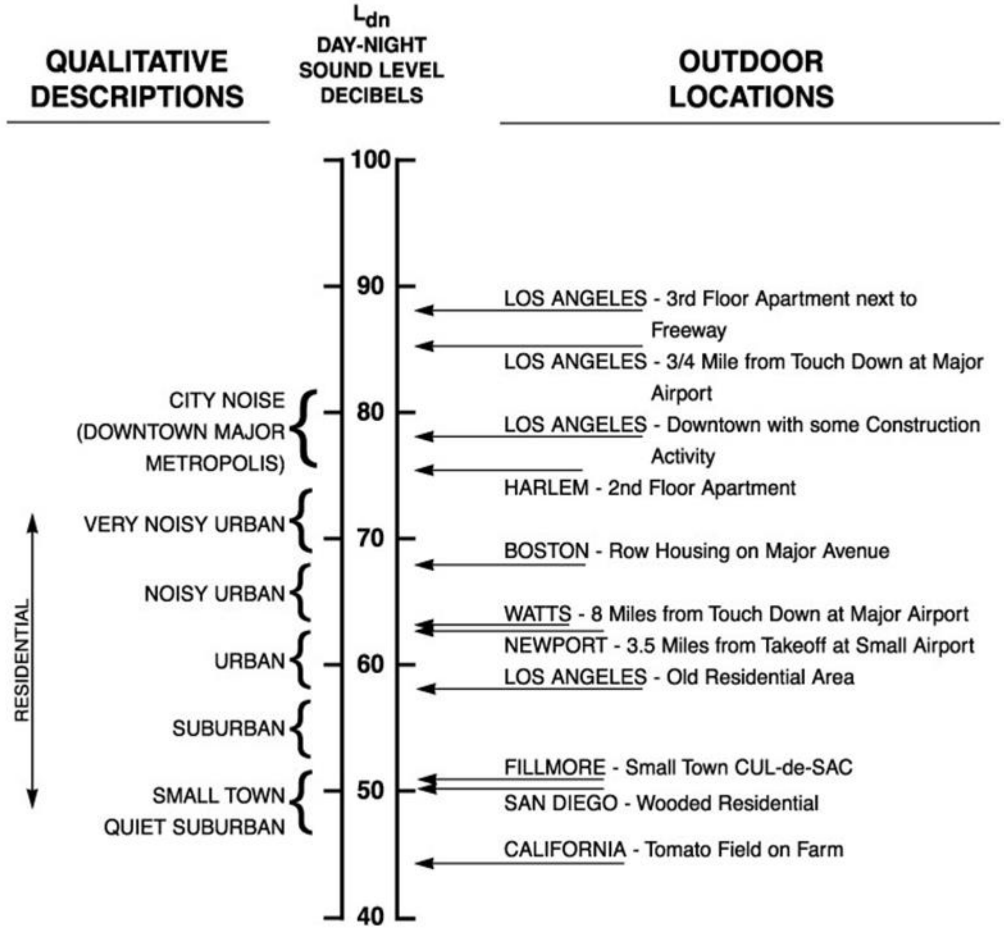
DNL can be measured or estimated. Measurements are practical only for obtaining DNL values for relatively limited numbers of points, and, in the absence of a permanently installed monitoring system, only for relatively short time periods. Most airport noise studies are based on computer-generated DNL estimates, determined by accounting for all of the SELs from individual events, which comprise the total noise dose at a given location. Computed DNL values are often depicted in terms of equal-exposure noise contours (much as topographic maps have contours of equal elevation). Figure H-7 depicts typical DNL values for a variety of noise environments.

Figure H-6 Daily Noise Dose



Source: HMMH

Figure H-7 Examples of Day-Night Average Sound Levels (DNL)



Source: EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974, p. 14.

As of May 2015, the FAA is beginning work on the next step in a multi-year Noise Research Program that will update the scientific evidence on the relationship between aircraft noise exposure and its effects on communities around airports. If changes are warranted, FAA will propose revised policy and related guidance and regulations, subject to interagency coordination, as well as public review and comment.

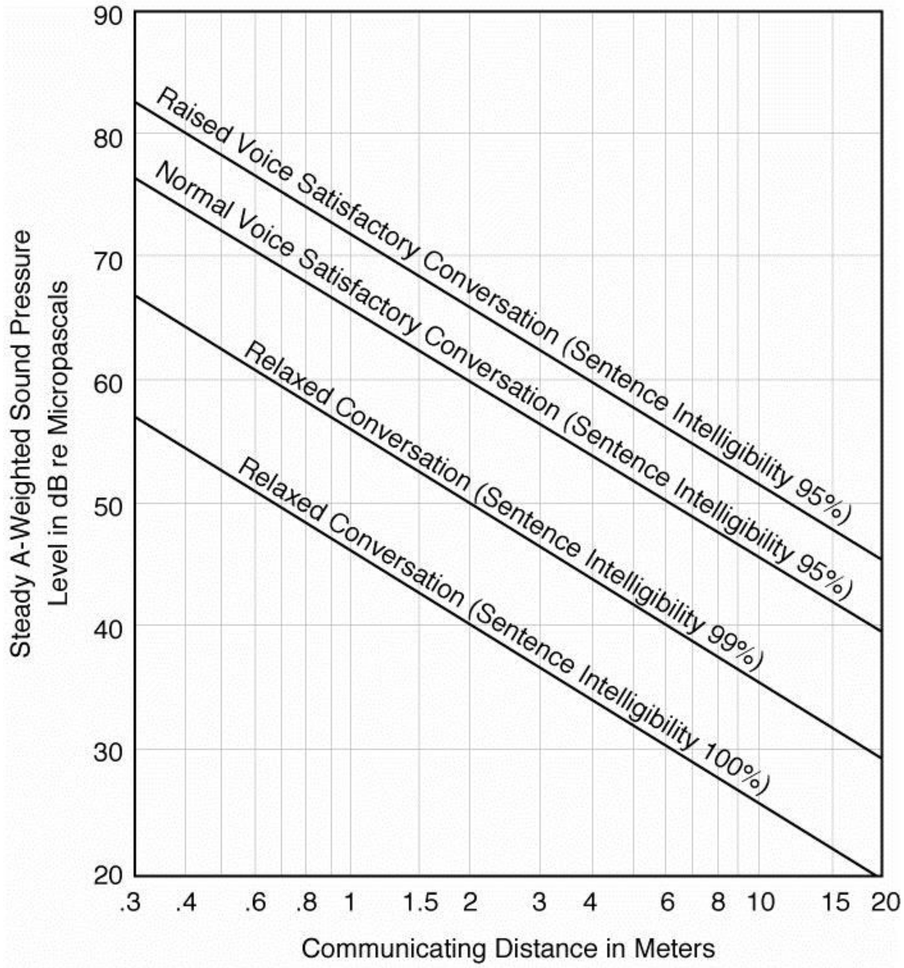
The Effects of Aircraft Noise on People

To residents around airports, aircraft noise can be an annoyance and a nuisance. It can interfere with conversation and listening to television, it can disrupt classroom activities in schools, and it can disrupt sleep. Relating these effects to specific noise metrics helps in the understanding of how and why people react to their environment.

Speech Interference

A primary effect of aircraft noise is its tendency to drown out or "mask" speech, making it difficult to carry on a normal conversation. The sound level of speech decreases as the distance between a talker and listener increases. As the background sound level increases, it becomes harder to hear speech. Figure H-8 presents typical distances between talker and listener for satisfactory outdoor conversations, in the presence of different steady A-weighted background noise levels for raised, normal, and relaxed voice effort. As the background level increases, the talker must raise his/her voice, or the individuals must get closer together to continue talking.

Figure H-8 Outdoor Speech Intelligibility



Source: EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974, p. D-5.

As indicated in the figure, "satisfactory conversation" does not always require hearing every word; 95 percent intelligibility is acceptable for many conversations. Listeners can infer a few unheard words when they occur in a familiar context. However, in relaxed conversation, we have higher expectations of hearing speech and generally require closer to 100 percent intelligibility. Any combination of talker-listener distances and background noise that falls below the bottom line in Figure H-8 (thus assuring 100 percent intelligibility) represents an ideal environment for outdoor speech communication and is considered necessary for acceptable indoor conversation as well.

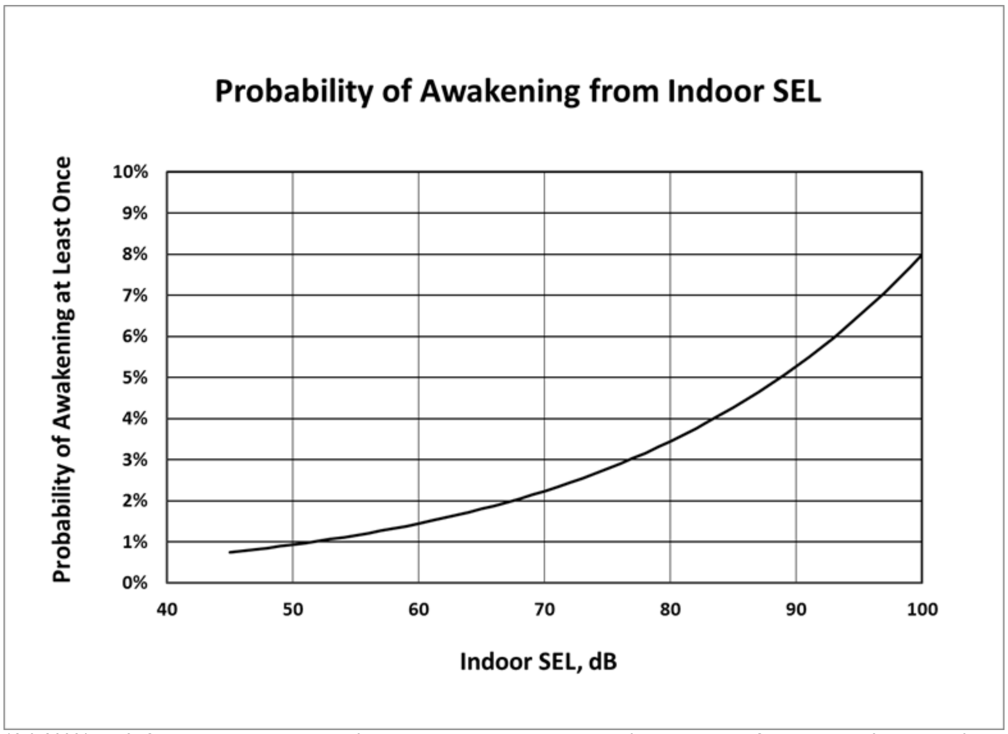
One implication of the relationships in Figure H-8 is that for typical communication at distances of 3 or 4 feet (1 to 1.5 meters), acceptable outdoor conversations can be carried on in a normal voice as long as the background noise outdoors is less than about 65 dBA. If the noise exceeds this level, as might occur when an aircraft passes overhead, intelligibility would be lost unless vocal effort were increased or communication distance were decreased.

Indoors, typical distances, voice levels, and intelligibility expectations generally require a background level less than 45 dBA. With windows partly open, housing generally provides about 12 dBA of interior-to-exterior noise level reduction. Thus, if the outdoor sound level is 60 dBA or less, there is a reasonable chance that the resulting indoor sound level will afford acceptable conversation inside. With windows closed, 24 dB of attenuation is typical.

Sleep Interference

Research on sleep disruption from noise has led to widely varying observations. In part, this is because (1) sleep can be disturbed without awakening, (2) the deeper the sleep the more noise it takes to cause arousal, and (3) the tendency to awaken increases with age, and other factors. Figure H-9 shows one such relationship from recent research conducted in the U.S. – the probability that a group of people will be awakened at least once when exposed to a given indoor SEL.

Figure H-9 Probability of Awakening at Least Once from Indoor Noise Event



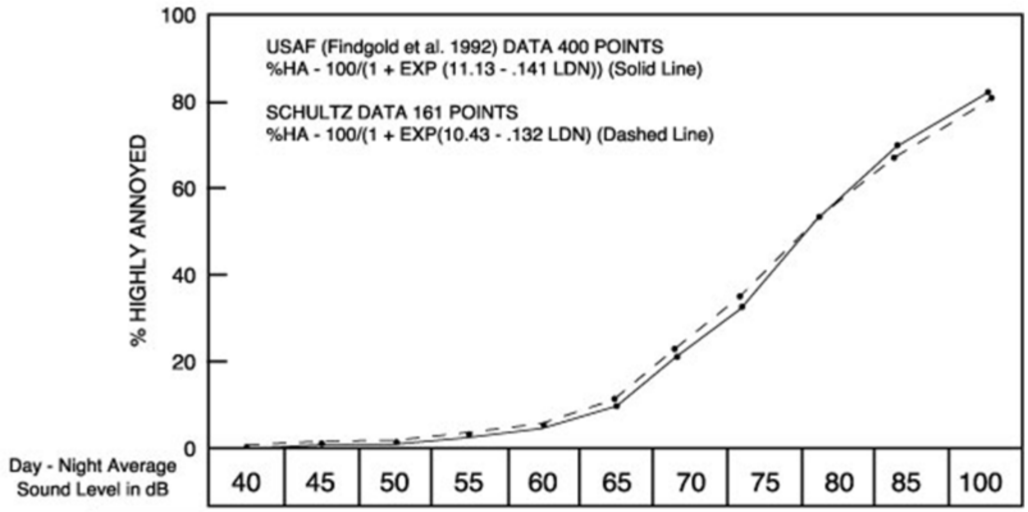
Source: ANSI S12.9-2008/Part 6, Quantities and Procedures for Description and Measurement of Environmental Sound — Part 6: Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes; Equation 1

For example, an indoor SEL of 80 dB results in approximately 3.5 percent of the exposed population being awakened. If windows are open in the bedroom on a warm evening and a house provides a typical outside-to-inside noise level reduction of around 15 dB, which suggests it takes an SEL of about 95 dB outdoors to awaken 3.5 percent of the population. The American National Standards Institute (ANSI) has extended this concept further and developed a standard (ANSI S12.9-2008/Part 6) for computing the percentage of the population that is likely to be awakened by multiple noise events occurring throughout the night. The Federal Interagency Committee on Aviation Noise (FICAN) subsequently endorsed the standard as the best available means of estimating behavioral awakenings from aircraft noise.[2]

2 http://www.fican.org/pdf/FICAN_Sleep_Dec08.pdf

Community Annoyance
Social survey data make it clear that individual reactions to noise vary widely for a given noise level. Nevertheless, as a group, people's aggregate response is predictable and relates well to measures of cumulative noise exposure such as DNL. Figure H-10 shows a widely recognized relationship between environmental noise and annoyance.

Figure H-10 Percentage of People Highly Annoyed



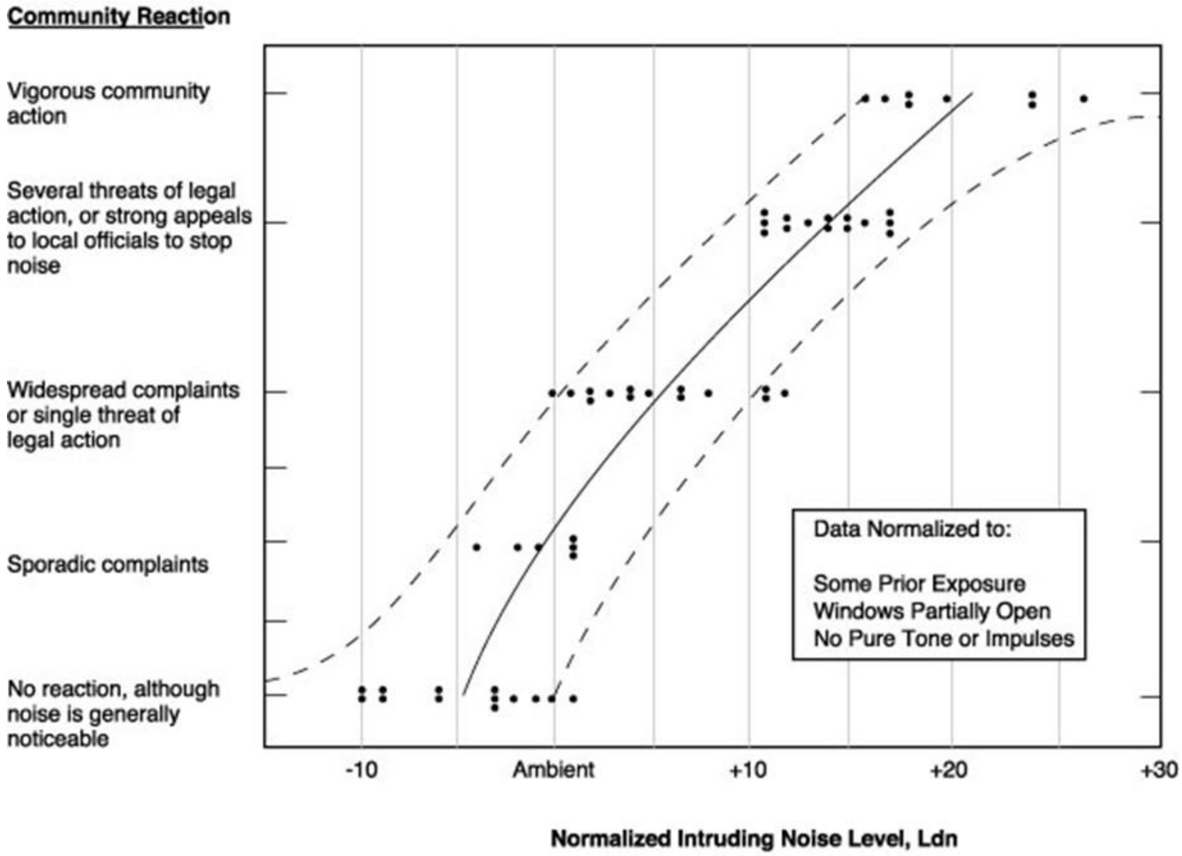
Calculated %HA Points	40	45	50	55	60	65	70	75	80	85	100
USAF	0.41	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81

Source: FICON. "Federal Agency Review of Selected Airport Noise Analysis Issues." August 1992. (From data provided by USAF Armstrong Laboratory). pp. 3-6.

Based on data from 18 surveys conducted worldwide, the curve indicates that at levels as low as DNL 55, approximately 5.0 percent of the people will still be highly annoyed, with the percentage increasing more rapidly as exposure increases above DNL 65.

Separate work by the EPA has shown that overall community reaction to a noise environment can also be related to DNL. This relationship is shown in Figure H-11. Levels have been normalized to the same set of exposure conditions to permit valid comparisons between ambient noise environments. Data summarized in Figure H-11 suggest that little reaction would be expected for intrusive noise levels five decibels below the ambient, while widespread complaints can be expected as intruding noise exceeds background levels by about five decibels. Vigorous action is likely when the background is exceeded by 20 dB.

Figure H-11 Community Reaction as a Function of Outdoor DNL



Source: Wyle Laboratories, "Community Noise," prepared for the U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, D.C., December 1971, pg. 63

Regulatory Framework

Logan Airport Noise Abatement Rules and Regulations

Massport's primary mechanism for reducing noise impacts from Logan Airport's operations is the Noise Rules.[3] The Noise Rules were designed to reduce noise impacts by encouraging use of quieter aircraft by requiring decreased use of noisier aircraft and by limiting nighttime activity by louder Stage 2 types. Many secondary goals aimed at limiting noise in specific areas also were stated.

Specific provisions of the Noise Rules, which continue to serve these goals, include:

- Limiting cumulative noise exposure at Logan Airport (as measured by Massport's CNI) to a maximum of 156.5 EPNdB
- Maximizing use of Stage 3 aircraft;
- Restricting nighttime operations by Stage 2 aircraft;
- Placing limitations on times and locations of engine run-ups and use of auxiliary power units (APU); and
- Restricting use of certain runways by noisier aircraft and time of day.

These restrictions and limitations are subject to FAA implementation and safe operation of the airport and airspace.

Federal Aviation Regulation (FAR) Part 36

Logan Airport operates within a framework of federal aviation regulations that limits an airport operator's ability to control noise. For example, the FAA's FAR Part 36[4] sets noise limits for aircraft certification and the procedures by which aircraft noise emission levels must be measured to determine compliance. The regulation defines noise emission limits for turbojets, turboprops, and helicopters, classifying turbojets into categories referred to as stages based on noise levels at each of three locations: takeoff, landing, and to the side of the runway during takeoff (sideline). The stages are:

- Stage 1 aircraft are the oldest and usually have the loudest operations, having preceded the existence of any noise emission regulation. Rare examples include old, restored civil or military aircraft. There are no Stage 1 aircraft operating at Logan Airport
- Stage 2 aircraft are less old and less noisy than Stage 1; they were the first aircraft types required to meet a noise limit. A subsequent regulation, FAR Part 91 (described in the next section), prohibits the operation of a Stage 2 aircraft in the continental U.S. unless its takeoff weight is 75,000 pounds or less. The FAA Reauthorization bill of 2012 also mandates the phase out of Stage 2 aircraft with a takeoff weight less than 75,000 pounds by 2015. In 2014, for the first time, there were no Stage 2 operations at Logan Airport which is a reduction from 2013 when less than 0.1 operations per day occurred (approximately 107 operations)
- Stage 3 aircraft were certified for service before 2006 and have relatively quiet jets, although some are Stage 2 aircraft that have been re-engined or have been fitted with hushkits that enable them to meet Stage 3 noise limits Stage 4 aircraft are the newest and quietest of the jets. These aircraft will be required to operate with noise levels at least 10 dB quieter than Stage 3 aircraft at three prescribed

3 The Logan International Airport Noise Abatement Rules and Regulations, effective July 1, 1986, are codified at 740 Code of Massachusetts Regulations (CMR) 24.01 et seq (also known as the Noise Rules).
4 14 CFR Part 36, "Noise Standards: Aircraft Type and Air Worthiness Certification."

measurement points. Jet aircraft certificated after January 1, 2006 must meet the Stage 4 limits. Although not required, the majority of aircraft in the 2014 Logan Airport fleet would also meet the new Stage 4 noise limits if they were recertificated.

FAR Part 150

First implemented in February 1981, FAR Part 150[5] defines procedures that an airport operator must follow if it chooses to conduct and implement an airport noise and land use compatibility plan. Part 150 Noise Compatibility studies require the use of DNL to evaluate the airport noise environment. FAR Part 150 identifies noise compatibility guidelines for different land uses depending on their sensitivity. Key values include a DNL of 75 dB, above which no residences, schools, hospitals, or churches are considered compatible, and a DNL of 65 dB, above which those land uses are considered compatible only if they are sound insulated.

Noise abatement or mitigation measures that an airport operator must consider in a Part 150 study include acquisition of incompatible land, construction of noise barriers, sound insulation of buildings, implementation of a preferential runway program, use of noise abatement flight tracks, implementation of airport use restrictions, and any other actions that would have a beneficial effect on the public.

While Massport has implemented variations of all of these and additional measures at Logan Airport, Massport has not filed an official Part 150 noise compatibility study with the FAA because all of Logan Airport's program elements, while regularly reviewed and updated, preceded the promulgation of Part 150 and are effectively grandfathered under the regulation.

FAR Parts 91 and 161

The Airport Noise and Capacity Act of 1990 (ANCA)[6] directed the U.S. Secretary of Transportation to undertake three key noise-related actions:

- Establish a schedule for a phase out of Part 36 Stage 2 aircraft by the year 2000
- Establish a program for FAA review of all new airport noise and access restrictions limiting operations of Stage 2 aircraft; and
- Establish a program for FAA review and approval of any restriction that limits operations of Stage 3 aircraft, including public notice requirements.

The FAA addressed these requirements through amendment of an existing federal regulation, "Part 91,"[7] and establishment of a new regulation, "Part 161."[8] ANCA effectively ended Massport's pursuit of any additional operational restrictions outside of this program.

Amendment to Part 91

The FAA establishes and regulates operating noise limits for civil aircraft operation in Subpart I, "Operating Noise Limits," of 14 CFR Part 91, "General Operating and Flight Rules." The noise limits are based on aircraft noise certification criteria set forth in 14 CFR Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification." For transport category "large" aircraft (with maximum takeoff weights of 12,500 pounds or more) and for all turbojet-powered aircraft, Part 36 identifies four "stages" of aircraft with respect to their relative noisiness:

5 14 CFR Part 150, "Airport Noise Compatibility Planning."
6 Pub. L. No. 101-508, 104 Stat. 1388, as recodified at 49 United States Code 47521- 47533.
7 14 CFR Part 91, "General Operating and Flight Rules."
8 14 CFR Part 161, "Notice and Approval of Airport Noise and Access Restrictions."

- Stage 1 aircraft, which have never been shown to meet any noise standards, because they have never been tested, or because they have been tested and failed to meet any established standards
- Stage 2 aircraft, which meet original noise limits, set in 1969
- Stage 3 aircraft, which meet more stringent limits, established in 1977; and
- Stage 4 aircraft, which meet the most stringent limits, established in 2005.

In 1976, the FAA ordered a phase out of all Stage 1 aircraft with a maximum gross takeoff weight (MGTOW) over 75,000 pounds, to be completed on January 1, 1985. After that date, Stage 1 civil aircraft over 75,000 pounds MGTOW were banned from operating in the U.S. (with limited exemptions related to commercial service at "small communities," which has since expired in 1988). ANCA required a similar phase out of Stage 2 aircraft over 75,000 pounds by December 31, 1999. The 75,000-pound weight limit exempts most "business" (or "corporate") jets and a very small number of the very smallest "air carrier" type jets until December 31, 2015 when a full ban will take effect.[9] Aircraft operators responded to the Stage 1 and 2 phase outs by retiring their non-compliant aircraft or modifying some of their aircraft to meet the more stringent standards. The modifications undertaken include installation of quieter engines, noise-reducing physical modifications to the airframe and/or existing engines, and limitation of operating weights and procedures to meet the applicable Part 36 limits. Some former Stage 2 airline aircraft that were "recertificated" as Stage 3 with these modifications still operate at Logan Airport, but are generally declining due to the aircrafts' age and high operating costs (in particular due to the generally low fuel efficiency of these older aircraft).

As airlines add new aircraft, Stage 4 aircraft have been added to their fleets. The new Stage 4 noise standard applies to any new jet aircraft type designs over 12,500 pounds requiring FAA approval after January 1, 2006. The International Civil Aviation Organization (ICAO) has already adopted a similar regulation for international operators, but neither the FAA nor ICAO have indicated there will be restrictions on the remaining recertificated Stage 3 aircraft from carrier fleets.

Part 161

FAA implemented the ANCA requirements related to notice, analysis, and approval of use restrictions affecting Stage 2 and 3 aircraft through the establishment of a new regulation, 14 CFR Part 161, "Notice and Approval of Airport Noise and Access Restrictions." In simple terms, Part 161 requires an airport operator that proposes to implement a restriction on Stage 2 or 3 aircraft operations to undertake, document, and publicize certain benefit-cost analyses, comparing the noise benefits of the restriction to its economic costs. Operators must obtain specific FAA approvals of the analysis, documentation, and notice processes, and – for Stage 3 restrictions – approval of the restriction itself.

Part 161 and ANCA define more demanding requirements and explicit guidance for Stage 3 restrictions. To implement a Stage 3 restriction, formal FAA approval is required. The FAA's role for Stage 2 restrictions is limited to commenting on compliance with Part 161 notice and analysis procedural requirements. Part 161 provides guidance regarding appropriate information to provide in support of these findings. While Part 161 does not require this information for a Stage 2 restriction, Part 161 states that it would be "useful." Moreover, the FAA has required airports to provide this same information for Stage 2 restrictions (and even for Stage 1 restrictions pursued under FAR Part 150), on the grounds that they are required for airports to comply with grant assurance 22(a), "Economic Nondiscrimination," which states that an airport operator "will make its airport available as an airport for public use on reasonable terms and without unjust discrimination to all

9 The FAA Modernization and Reform Act of 2012 sets a January 1, 2016 ban of Stage 2 aircraft less than 75,000 lbs.

types, kinds, and classes of aeronautical activities, including commercial aeronautical activities offering services to the public at the Airport."[10]

Although several (on the order of a dozen) airports have embarked on efforts to adopt both Stage 2 and 3 restrictions in the past two decades, the FAA has found that only one, Naples Municipal Airport, a GA airport in Naples, Florida, has fully complied with Part 161 analysis, notice, and documentation requirements for a ban on Stage 2 jet operations. FAA found the airport was in violation of prior FAA grant assurances. The airport operator successfully sued the FAA to overturn that ruling and has implemented the restriction.

ANCA and Part 161 specifically exempt Stage 3 use restrictions that were effective on or before October 1, 1990 and Stage 2 restrictions that were proposed before that date. The Logan Airport Noise Rules were promulgated in 1986; therefore, ANCA and Part 161 have no bearing on their continued implementation in their current form. Any future proposals to make the rules more stringent with regard to Stage 2 operations or to restrict Stage 3 operations in any way would almost certainly trigger Part 161 notice, analysis, and approval processes for Stage 3 restrictions. In 2006, Massport requested an opinion from the FAA regarding the pursuit of a Part 161 waiver or exemption to allow Massport to implement a curfew of nighttime operations of hush-kitted Stage 3 aircraft. FAA informed Massport that a waiver or exemption from the requirements of Part 161 is not authorized under, or consistent with, federal statutory and regulatory requirements. A copy of FAA's letter to Massport was provided in *Appendix H, Noise Abatement* in the *2005 EDR.*

10 FAA Order 5190.6(b),"Airport Compliance Manual" Chapter 13, Section 14, paragraph (a). To be approved, restrictions must meet the following six statutory criteria: 1) The proposed restriction is reasonable, nonarbitrary, and nondiscriminatory. 2) The proposed restriction does not create an undue burden on interstate or foreign commerce. 3) The proposed restriction maintains safe and efficient use of the navigable airspace. 4) The proposed restriction does not conflict with any existing federal statute or regulation. 5) The applicant has provided adequate opportunity for public comment on the proposed restriction. 6) The proposed restriction does not create an undue burden on the national aviation system.

Logan Airport RealContours™ Data Inputs

To relate portions of the foregoing discussion to the specific noise environment around Logan Airport, for this *2014 EDR*, the Massachusetts Port Authority (Massport) has produced a set of DNL noise contours, TA noise metrics, and population counts for 2014 using the pair of software packages RealProfiles™ and RealContours™. This software takes radar data from individual flights occurring throughout the year, processes the information and formats it into a form usable as input to the latest version of the FAA's INM, which serves as the computational "engine" for calculating noise. Version 7.0d was used for 2014, incorporating improvements in the updated version of the INM that became available at the end of that year. The RealProfiles™ and RealContours™ system used the individual flight tracks taken directly from the Massport Noise and Operations Management System (NOMS) rather than relying on consolidated data summaries. For 2013, the NOMS retained suitable data for 347,216 flights; all of these were used in the INM noise model directly. For 2014, the NOMS retained suitable data for 345,090 flights; all of these were used in the noise model directly.

Overview

Standard INM input methodology involves development of operational inputs and calculation of the DNL for a prototypical average annual day.[11] This approach requires manually collecting, refining, and entering the enormous amount of data averaged over a full year of activity at an airport. Typically, the model inputs may include an aircraft fleet mix with several dozen representative aircraft types, on the order of 100 to 300 representative flight tracks (common for a facility the size of Logan Airport), and runway use and flight track use percentages for three or four categories of aircraft types with similar performance characteristics.

This normal approach to noise modeling meets accepted professional standards, and reduces the effort and cost that would be associated with manually entering the parameters for every actual operation. However, it represents a significant simplification of the extraordinary diversity of actual aircraft operations over a year. It also does not take full advantage of the investment that Massport has made in installing and maintaining a state-of-the-art radar system,[12] which automatically collects flight track data and flight identification data for all operations at the Airport and feeds the NOMS.

Instead, for this report, Massport has utilized an INM pre-processor, RealContours™, which takes maximum possible advantage of both the INM's capabilities and the investment that Massport has made in operations monitoring. RealContours™ automates the process of preparing the INM inputs directly from the actual flight operations, and permits airports to model the full diversity of activity as precisely as possible, at a cost equivalent to the more simplified manual approach. RealContours™ improves the precision of modeling by utilizing operations monitoring results in five key areas:

- Directly converts the flight track for every identified aircraft operation to an INM track, rather than assigning multiple operations to a limited number of prototypical tracks.
- Models each operation on the specific runway that it actually used, rather than applying a generalized distribution to broad ranges of aircraft types.
- Models each operation in the period that it occurred, which takes into account delays at the Airport during the year.
- Selects the specific airframe and engine combination to model, on an operation-by-operation basis, based on the registration data for each flight wherever possible; otherwise, the published compositions of the fleets of the specific airlines operating at Logan Airport are used.

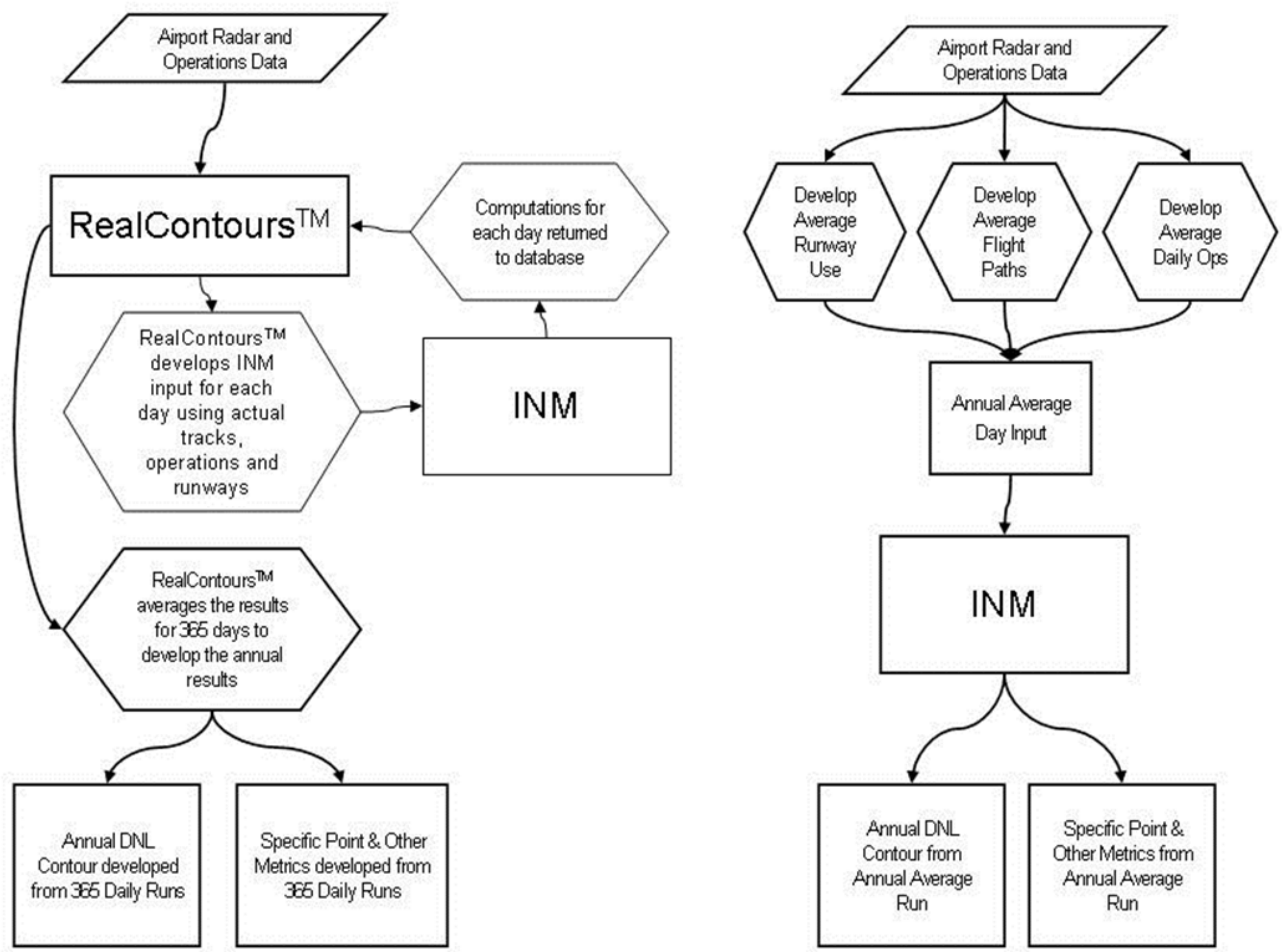
11 FAA INM Version 7.0 User's Guide, April 2007, p. 12.
12 Starting in 2010, the Massport system utilized the Airscene.com product of Era Corporation. The radar data remains the same but the system is now provided by Exelis.

- Uses each aircraft's actual performance and altitude profile to develop inputs to the model, which define the actual climb, descent, and speed profile for every operation.

RealContours™ completes the task of computing noise by running the INM in the middle of the night to obtain DNL or other noise metrics for the previous day's operations, and then averages the results to obtain the annual contour.

Figure H-12 provides a schematic representation of the RealContours™ noise modeling process compared to the standard INM process.

Figure H-12 Schematic Noise Modeling Process (Standard INM vs. RealContours™)



Source: FAA, HMMH

INM v7.0d Model

- The FAA's INMv7.0d was released for general use on May 23, 2013 with a Software Service Update on September 24, 2013. The latest version has been used for the 2013 and 2014 DNL contour in this report as the primary analytical tool to assess the noise environment at Logan Airport. This version of the model includes data for the Boeing 787-8R, Embraer E170, and Embraer E190, all types in use at Logan Airport.

The remaining sections of this appendix provide several tables describing the data for 2014. Where possible, the data for 2013 are included for comparison and in general the tables listed as (a) are for 2013 and (b) for 2014.

2014 Radar Data

- Logan Airport's radar data provide the key to the RealContours™ system. Since February 2004, Massport has collected Passive Surveillance Radar System (PASSUR) radar data, which supplies information to the Airport's web-based Airport Monitor software. This dataset was used for the *2004 Environmental Status and Planning Report (2004 ESPR)* through the *2008 EDR*. Beginning with the *2009 EDR*, Massport began utilizing the radar data from its Exelis NOMS system. These radar data are obtained from a multilateration system of eight sensors deployed around the Airport. The positioning data from all of these sensors are correlated to provide better, more accurate coverage of aircraft (in areas where the traditional FAA radar has limitations) and provide a more complete set of points to define each track. Traditional radar provides points every four to five seconds where the multilateration system provides data every second. The system was able to collect 365 complete days of data for 2014 with approximately 97 percent of these tracks usable for the development of the noise exposure contours.

Fleet Mix

The 2014 radar data was first processed to establish a baseline set of operations. After processing the 365 days of radar data (345,090 operations), flight tracks with sufficient operational information were identified to use as the baseline for the 2014 contours. The operations from these tracks were then scaled upwards by airline and aircraft type to match the reported totals provided by Massport for 2014. Tables H-1a (2013 for comparison) and H-1b (2014) provide the scaled annual operations, by INM aircraft type. Each INM type listed in Tables H-1a and H-1b is also mapped to a Runway Use group based on its weight and performance characteristics described in the Runway Use section below.

Runway Use

RealContours™ determines which runway was used by each aircraft type and whether it was a daytime or nighttime operation directly from the radar data. The summary of daytime and nighttime runway usages presented here is broken into six representative aircraft groups listed below, grouped in this format to allow comparison with prior years (see Tables H-2a and H-2b):

- Heavy Jet A – B747s, A340s, DC-8s;
- Heavy Jet B – B767s, B777s, A300s, A310s, A330s, DC-10s, L1011s, MD-11s;
- Light Jet A – B717s, B727s, DC-9s, F100s, MD-90s;
- Light Jet B – B737s, B757s, A319s, A320s, B-146s, MD-80s, E190;
- Regional Jet (RJ) – E135, E145, E170, CRJ2, CRJ7, CRJ9, J328 and Corporate Jets; and
- Turboprops and Piston Aircraft (non-jets).

Table H-1a 2013 Annual Modeled Operations

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations						
747400	Heavy Jet A	1,026.0	8.9	966.1	68.8	2,069.8
A340-211	Heavy Jet A	629.1	4.4	380.0	253.6	1,267.1
A340-642	Heavy Jet A	428.8	0.0	404.5	24.4	857.7
A380-841	Heavy Jet A	1.6	0.0	1.6	0.0	3.2
767300	Heavy Jet B	363.0	206.1	359.6	209.5	1,138.2
767400	Heavy Jet B	99.1	3.2	97.3	5.1	204.7
767CF6	Heavy Jet B	94.0	74.3	14.2	154.1	336.6
767JT9	Heavy Jet B	40.0	60.5	0.0	100.5	201.0
777200	Heavy Jet B	899.1	150.7	754.0	295.9	2,099.7
777300	Heavy Jet B	1.6	0.0	1.6	0.0	3.2
7773ER (New INMv7.0d type)	Heavy Jet B	14.0	0.0	5.7	8.2	27.9
7878R (New INMv7.0d type)	Heavy Jet B	227.1	0.0	227.1	0.0	454.2
A300-622R	Heavy Jet B	174.2	485.0	308.8	350.4	1,318.4
A310-304	Heavy Jet B	241.6	4.0	43.6	202.1	491.3
A330-301	Heavy Jet B	1,466.7	8.6	1,394.9	80.4	2,950.6
A330-343	Heavy Jet B	644.6	5.4	556.3	93.7	1,300.0
DC1010	Heavy Jet B	190.8	177.5	60.9	307.4	736.6
DC1030	Heavy Jet B	52.2	59.9	22.4	89.7	224.2
MD11GE	Heavy Jet B	198.5	155.3	175.9	177.9	707.6
MD11PW	Heavy Jet B	117.0	84.1	98.4	102.7	402.2
717200	Light Jet A	2,963.4	836.4	3,042.2	757.6	7,599.6
727EM2	Light Jet A	9.4	3.9	7.4	5.8	26.5
DC95HW	Light Jet A	6.1	0.0	6.1	0.0	12.2
F10062	Light Jet A	36.5	1.0	36.8	6.0	80.3
MD9025	Light Jet A	710.8	23.3	708.1	26.0	1,468.2
MD9028	Light Jet A	341.1	15.8	339.7	17.2	713.8
737300	Light Jet B	1,303.8	199.2	1,348.1	154.9	3006
7373B2	Light Jet B	79.6	12.3	77.9	14.0	183.8
737400	Light Jet B	173.0	38.4	171.2	40.2	422.8
737500	Light Jet B	42.3	0.0	38.3	4.0	84.6
737700	Light Jet B	5,808.8	1,553.0	6,626.2	735.7	14,723.7
737800	Light Jet B	12,504.3	4,214.7	14,542.0	2,177.1	33,438.1
737N17	Light Jet B	0.0	1.6	1.6	0.0	3.2
757300	Light Jet B	86.2	23.7	104.6	5.2	219.7
757PW	Light Jet B	2,853.7	692.6	2,975.0	570.2	7,091.5
757RR	Light Jet B	4,480.5	1,275.4	4,918.8	838.1	11,512.8
A319-131	Light Jet B	8,683.6	2,311.1	9,265.6	1,729.1	21,989.4
A320-211	Light Jet B	4,569.1	778.9	4,718.2	629.8	10,696.0
A320-232	Light Jet B	17,358.8	5,674.2	19,869.9	3,163.1	46,066.0
A321-232	Light Jet B	1,507.9	585.4	1697.0	396.3	4,186.6
EMB190 (New INMv7.0d type)	Light Jet B	25,687.9	2,380.4	24,967.2	3,101.1	56,136.6
EMB195 (New INMv7.0d type)	Light Jet B	15.2	1.1	13.2	3.0	32.5
MD82	Light Jet B	11.1	0.0	10.1	1.0	22.2

Note: Some totals may not match due to rounding.

Table H-1a 2013 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations (Continued)						
MD83	Light Jet B	994.1	43.8	966.5	71.4	2,075.8
CIT3	RJ	2.2	0.0	1.0	1.0	4.2
CL600	RJ	14.0	2.0	21.1	0.0	37.1
CL601	RJ	6,256.2	361.0	6,426.7	191.5	13,235.4
CNA525C	RJ	6.0	1.0	7.3	0.0	14.3
CNA55B	RJ	10.0	1.0	10.2	1.0	22.2
CNA560E	RJ	5.0	0.0	5.4	0.0	10.4
CNA560U	RJ	3.0	1.0	2.4	1.2	7.6
CNA560XL	RJ	7.3	0.0	4.0	1.0	12.3
CNA680	RJ	3.0	0.0	3.0	0.0	6.0
CNA750	RJ	3.0	0.0	3.0	0.0	6.0
CRJ9-ER	RJ	3,514.5	143.1	3,228.5	429.0	7,315.1
CRJ9-LR	RJ	986.6	51.9	907.2	131.2	2,076.9
EMB145	RJ	96.8	1.0	91.1	6.7	195.6
EMB14L	RJ	2,141.9	41.5	1,968.0	215.4	4,366.8
EMB170 (New INMv7.0d type)	RJ	5,315.0	395.8	5,208.1	502.7	11,421.6
EMB175 (New INMv7.0d type)	RJ	3,998.2	212.3	3,789.2	421.3	8,421.0
GIIB	RJ	2.0	0.0	2.3	0.0	4.3
GIV	RJ	30.0	2.0	28.8	3.0	63.8
GV	RJ	19.0	2.1	19.0	2.0	42.1
IA1125	RJ	3.1	0.0	3.0	0.0	6.1
LEAR25	RJ	0.0	1.0	0.0	0.0	1.0
LEAR35	RJ	34.9	30.0	43.4	29.0	137.3
MU3001	RJ	6.0	1.0	6.0	0.0	13.0
Commercial Jets Subtotal		**119,591.7**	**23401.8**	**124,102.3**	**18,906.2**	**286,002.0**
Commercial Non-Jet Operations						
BEC58P	Non-jet	17,981.3	627.2	18,445.8	163.2	37,217.5
CNA206	Non-jet	0.0	1.0	0.0	0.0	1.0
CNA208	Non-jet	230.6	2.1	226.8	1.0	460.5
CNA441	Non-jet	51.3	19.5	62.0	6.0	138.8
DHC6	Non-jet	8.4	9.6	14.0	3.0	35.0
DHC8	Non-jet	1,326.8	10.4	1,323.8	13.4	2,674.4
DHC830	Non-jet	2,193.6	71.5	2,083.2	181.9	4,530.2
DO228	Non-jet	4.2	0.0	5.0	1.0	10.2
DO328	Non-jet	4.2	0.0	4.2	0.0	8.4
GASEPF	Non-jet	1.0	0.0	0.0	1.0	2.0
PA31	Non-jet	1.0	2.0	2.4	3.6	9.0
SF340	Non-jet	2,147.3	44.7	2,183.7	8.3	4,384.0
Commercial Non-Jet Operations Subtotal		**23,951.9**	**788.0**	**24,351.9**	**383.4**	**49,475.2**
Commercial Aircraft Total		**143,543.6**	**24,189.8**	**148,454.2**	**19,289.6**	**335,477.2**

Table H-1a 2013 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
General Aviation Operations						
747200	Heavy Jet A	1.1	0.0	1.1	0.0	2.2
74720B	Heavy Jet A	2.2	0.0	2.2	0.0	4.4
767300	Heavy Jet B	4.3	0.0	2.2	2.2	8.7
767CF6	Heavy Jet B	1.1	0.0	1.1	0.0	2.2
A330-301	Heavy Jet B	2.2	0.0	2.2	0.0	4.4
C17	Heavy Jet B	4.3	0.0	4.3	0.0	8.6
KC135R	Heavy Jet B	1.1	0.0	1.1	0.0	2.2
727EM2	Light Jet A	1.1	2.2	0.0	3.3	6.6
DC93LW	Light Jet A	0.0	3.3	0.0	3.3	6.6
DC95HW	Light Jet A	1.1	0.0	0.0	1.1	2.2
737400	Light Jet B	13.0	0.0	6.5	6.5	26.0
737500	Light Jet B	1.1	0.0	1.1	0.0	2.2
737700	Light Jet B	19.4	1.2	17.4	3.3	41.3
737800	Light Jet B	21.7	6.5	26.0	2.2	56.4
757PW	Light Jet B	4.4	0.0	5.4	0.0	9.8
757RR	Light Jet B	7.6	0.0	4.4	2.2	14.2
A319-131	Light Jet B	4.3	0.0	4.3	0.0	8.6
A320-232	Light Jet B	8.0	4.0	10.9	1.1	24.0
A321-232	Light Jet B	6.2	2.5	5.4	3.3	17.4
EMB190	Light Jet B	34.7	3.3	34.6	3.4	76.0
MD81	Light Jet B	5.4	1.1	3.3	3.3	13.1
MD83	Light Jet B	0.0	2.2	0.0	2.2	4.4
1900D	Non-jet	2.2	0.0	2.2	0.0	4.4
BEC58P	Non-jet	474.0	37.6	465.5	45.6	1,022.7
C130	Non-jet	1.1	0.0	1.1	0.0	2.2
CIT3	Non-jet	53.8	3.5	51.0	6.5	114.8
CNA172	Non-jet	40.1	0.0	40.1	0.0	80.2
CNA182	Non-jet	62.9	1.2	64.0	0.0	128.1
CNA206	Non-jet	76.0	2.2	78.0	1.2	157.4
CNA208	Non-jet	760.2	91.9	761.6	95.5	1,709.2
CNA20T	Non-jet	2.2	0.0	2.2	0.0	4.4
CNA441	Non-jet	269.0	14.6	265.7	20.6	569.9
DHC6	Non-jet	0.0	0.0	1.0	0.0	1.0
DHC8	Non-jet	3.3	0.0	3.3	0.0	6.6
DHC830	Non-jet	18.1	1.4	15.2	4.3	39.0
DO228	Non-jet	190.4	10.1	178.0	20.6	399.1
DO328	Non-jet	5.4	0.0	5.4	0.0	10.8
EMB120	Non-jet	2.2	0.0	1.1	1.1	4.4
GASEPF	Non-jet	4.3	0.0	4.3	0.0	8.6
GASEPV	Non-jet	335.2	25.0	341.8	18.4	720.4
PA28	Non-jet	20.6	1.1	20	1.7	43.4
PA30	Non-jet	4.3	0.0	4.3	0.0	8.6
PA31	Non-jet	36.8	1.1	31.0	3.9	72.8

Table H-1a 2013 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
PA42	Non-jet	2.2	0.0	2.2	0.0	4.4
SD330	Non-jet	82.9	11.5	85.7	8.7	188.8
SF340	Non-jet	0.0	1.1	0.0	1.1	2.2
CL600	RJ	986.1	86.8	963.2	104.6	2,140.7
CL601	RJ	941.7	84.7	931.0	94.4	2,051.8
CNA500	RJ	84.9	29.0	84.6	29.3	227.8
CNA510	RJ	65.1	9.8	68.4	6.5	149.8
CNA525C	RJ	323.3	17.4	324.6	15.8	681.1
CNA55B	RJ	289.7	39.1	284.1	44.4	657.3
CNA560E	RJ	540.4	43.4	546.0	37.4	1,167.2
CNA560U	RJ	36.9	2.2	37.0	2.6	78.7
CNA560XL	RJ	932.4	68.9	923.3	80.3	2,004.9
CNA680	RJ	491.0	47.1	508.9	29.3	1,076.3
CNA750	RJ	684.7	81.4	694.5	71.5	1,532.1
ECLIPSE500	RJ	22.8	4.3	24.7	2.5	54.3
EMB145	RJ	61.9	9.8	67.3	4.3	143.3
F-18	RJ	1.1	0.0	1.1	0.0	2.2
F10062 (sub for the FA50 and F900)	RJ	405.1	39.8	401.7	38.0	884.6
FAL20	RJ	2.2	0.0	2.2	0.0	4.4
GII	RJ	2.2	0.0	2.2	0.0	4.4
GIIB	RJ	49.9	3.3	49.1	3.8	106.1
GIV	RJ	621.0	66.7	609.8	78.1	1,375.6
GV	RJ	540.3	61.8	550.1	52.1	1,204.3
IA1125	RJ	105.0	12.2	113.9	3.3	234.4
LEAR25	RJ	2.2	0.0	3.2	0.0	5.4
LEAR35	RJ	1,445	146.5	1,431.0	153.0	3,175.5
MU3001	RJ	586.8	40.4	577.2	51.0	1,255.4
General Aviation Total		**11,813.2**	**1,123.2**	**11,757.3**	**1,168.8**	**25,862.5**
Grand Total		**155,356.8**	**25,313.0**	**160,211.5**	**20,458.4**	**361,339.7**

Source: HMMH, 2014.
Notes: BEC58P is the INM substitution for the Cessna 402.
The CRJ9-ER in the RJ category is the CRJ700 aircraft.
Annual operations modeled in the 2013 Annual contour.
Some totals may not match due to rounding.

Table H-1b 2014 Annual Modeled Operations

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations						
747400	Heavy Jet A	1,222.8	8.7	858.7	372.8	2,463.0
7478	Heavy Jet A	1.5	0.0	0.0	1.5	3.0
A340-211	Heavy Jet A	700.7	3.5	347.7	356.5	1,408.4
A340-642	Heavy Jet A	398.3	1.2	206.7	192.8	799.0
A380-841	Heavy Jet A	1.0	0.0	1.0	0.0	2.0
767300	Heavy Jet B	356.0	242.9	330.5	268.5	1,197.9
767400	Heavy Jet B	203.2	1.0	201.2	3.0	408.4
767CF6	Heavy Jet B	12.8	13.5	13.1	13.2	52.6
767JT9	Heavy Jet B	165.4	79.1	1.1	243.4	489.0
777200	Heavy Jet B	775.4	87.6	726.2	136.8	1,726.0
7773ER	Heavy Jet B	308.1	0.0	10.5	297.5	616.1
7878R	Heavy Jet B	506.5	0.0	503.5	3.0	1,013.0
A300-622R	Heavy Jet B	184.9	480.7	317.8	347.8	1,331.2
A310-304	Heavy Jet B	265.6	6.8	34.1	238.3	544.8
A330-301	Heavy Jet B	1,441.0	9.7	1,173.5	277.2	2,901.4
A330-343	Heavy Jet B	646.4	0.8	468.5	178.7	1,294.4
DC1010	Heavy Jet B	255.6	171.0	137.3	289.3	853.2
DC1030	Heavy Jet B	71.6	62.8	50.1	84.3	268.8
MD11GE	Heavy Jet B	215.9	83.8	152.5	147.1	599.3
MD11PW	Heavy Jet B	124.5	60.4	93.4	91.5	369.8
717200	Light Jet A	2,501.1	457.9	2,608.2	350.9	5,918.1
727EM2	Light Jet A	5.0	0.0	1.0	4.0	10.0
MD9025	Light Jet A	885.6	73.0	878.6	80.0	1,917.2
MD9028	Light Jet A	449.7	41.4	455.2	35.9	982.2
737300	Light Jet B	1,607.1	166.4	1,625.3	148.1	3,546.9
7373B2	Light Jet B	109.6	12.0	106.6	14.9	243.1
737400	Light Jet B	59.6	25.4	63.2	21.8	170.0
737500	Light Jet B	6.0	1.0	7.0	0.0	14.0
737700	Light Jet B	6,031.8	2,492.7	7,070.5	1,453.9	17,048.9
737800	Light Jet B	13,590.9	5,544.2	16,369.7	2,765.4	38,270.2
737N17	Light Jet B	1.0	0.0	1.0	0.0	2.0
757300	Light Jet B	242.4	96.4	329.3	9.4	677.5
757PW	Light Jet B	2,832.9	571.6	3,007.0	397.5	6,809.0
757RR	Light Jet B	3,293.6	706.5	3,595.6	404.5	8,000.2
A319-131	Light Jet B	8,127.4	2,275.4	8,836.7	1,566.1	20,805.6

Note: Some totals may not match due to rounding.

Table H-1b 2014 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations (Continued)						
A320-211	Light Jet B	3,630.0	716.3	3,880.3	466.0	8,692.6
A320-232	Light Jet B	15,555.3	5,506.3	18,160.1	2,901.5	42,123.2
A321-232	Light Jet B	2,042.7	697.7	2,312.1	428.3	5,480.8
EMB190	Light Jet B	29,267.6	2,968.2	28,378.0	3,857.8	64,471.6
EMB195	Light Jet B	13.0	1.0	14.0	0.0	28.0
MD82	Light Jet B	9.0	0.0	6.0	3.0	18.0
MD83	Light Jet B	877.8	55.2	826.8	106.2	1,866.0
CL601	RJ	5,139.8	333.5	5,305.2	168.1	10,946.6
CRJ9-ER	RJ	3,488.7	284.7	3,341.8	431.6	7,546.8
CRJ9-LR	RJ	1,679.8	108.8	1,570.5	218.0	3,577.1
EMB145	RJ	60.0	1.0	55.0	6.0	122.0
EMB14L	RJ	1,946.7	64.3	1,797.7	213.3	4,022.0
EMB170	RJ	4,621.3	287.8	4,539.3	369.8	9,818.2
EMB175	RJ	3,945.9	125.7	3,860.7	210.9	8,143.2
LEAR35	RJ	20.7	6.3	21.8	5.2	54
Commercial Jets Subtotal		**119,899.2**	**24,934.2**	**124,651.6**	**20,181.3**	**289,666.3**
Commercial Non-Jet Operations						
BEC58P	Non-jet	17244.7	295.3	17413.6	126.4	35080
CNA182	Non-jet	2.0	0.0	2.0	0.0	4.0
CNA208	Non-jet	209.6	2.2	209.6	2.2	423.6
DHC8	Non-jet	1,518.7	12.9	1,519.2	12.5	3,063.3
DHC830	Non-jet	2,224.4	147.1	2,151.9	219.6	4,743.0
DO328	Non-jet	9.6	0.0	9.6	0.0	19.2
SF340	Non-jet	2,183.1	7.9	2,185.9	5.1	4,382.0
Commercial Non-Jet Operations Subtotal		**23,392.1**	**465.4**	**23,491.8**	**365.8**	**47,715.1**
Commercial Aircraft Total		**143,291.3**	**25,399.6**	**148,143.4**	**20,547.1**	**337,381.4**
General Aviation Operations						
74720B	Heavy Jet A	1.1	1.1	2.1	0.0	4.3
DC870	Heavy Jet A	7.5	0.0	7.5	0.0	15.0
767300	Heavy Jet B	1.1	1.1	2.1	0.0	4.3
7878R	Heavy Jet B	7.5	0.0	7.5	0.0	15.0
727EM1	Light Jet A	4.3	0.0	3.2	1.1	8.6
727EM2	Light Jet A	1.1	2.1	0.0	3.2	6.4
737400	Light Jet B	4.3	1.1	5.3	0.0	10.7
737700	Light Jet B	25.6	0.0	23.4	2.1	51.1
737800	Light Jet B	12.8	14.9	21.1	6.6	55.4
757PW	Light Jet B	3.2	1.1	4.3	0.0	8.6

Notes: BEC58P is the INM substitution for the Cessna 402.
The CRJ9-ER in the RJ category is the CRJ700 aircraft.
Some totals may not match due to rounding.

Table H-1b 2014 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
General Aviation Operations (continued)						
757RR	Light Jet B	3.2	0.0	1.1	2.1	6.4
A319-131	Light Jet B	5.3	0.0	5.3	0.0	10.6
A320-211	Light Jet B	5.3	4.3	9.6	0.0	19.2
A320-232	Light Jet B	8.5	0.0	6.4	2.1	17.0
A321-232	Light Jet B	4.0	1.3	4.3	1.1	10.7
EMB190	Light Jet B	9.6	0.0	4.8	4.8	19.2
EMB195	Light Jet B	0.0	1.1	1.1	0.0	2.2
MD81	Light Jet B	3.2	2.1	3.2	2.1	10.6
MD83	Light Jet B	5.3	2.1	4.6	2.8	14.8
1900D	Non-jet	4.3	0.0	4.3	0.0	8.6
BEC58P	Non-jet	345.8	15.5	341.0	20.2	722.5
CNA172	Non-jet	58.4	4.5	61.8	1.1	125.8
CNA182	Non-jet	29.8	0.0	28.8	1.1	59.7
CNA206	Non-jet	77.8	1.1	77.8	1.1	157.8
CNA208	Non-jet	841.7	100.4	842.4	99.6	1,884.1
CNA20T	Non-jet	3.2	0.0	3.2	0.0	6.4
CNA441	Non-jet	305.7	12.9	291.5	27.2	637.3
DC3	Non-jet	1.1	0.0	0.0	1.1	2.2
DHC6	Non-jet	1.1	1.1	1.1	1.1	4.4
DHC830	Non-jet	3.2	0.0	3.2	0.0	6.4
DO228	Non-jet	343.7	25.1	330.4	38.4	737.6
EMB120	Non-jet	0.0	1.1	0.0	1.1	2.2
GASEPF	Non-jet	7.5	0.0	6.4	1.1	15.0
GASEPV	Non-jet	416.4	32.2	434.7	13.9	897.2
HS748A	Non-jet	1.1	0.0	1.1	0.0	2.2
PA28	Non-jet	25.6	0.0	25.6	0.0	51.2
PA30	Non-jet	4.3	0.0	4.3	0.0	8.6
PA31	Non-jet	39.2	1.3	37.3	3.2	81.0
PA42	Non-jet	3.2	1.1	2.8	1.4	8.5
SD330	Non-jet	42.6	1.1	40.3	3.3	87.3
CIT3	RJ	36.9	4.7	40.5	1.1	83.2
CL600	RJ	1,121.8	83.5	1,127.1	78.2	2,410.6
CL601	RJ	1,042.8	81.5	1,058.9	65.4	2,248.6
CNA500	RJ	75.7	17.1	71.5	21.2	185.5
CNA510	RJ	36.8	9.1	35.5	10.3	91.7
CNA525C	RJ	282.1	12.1	279.2	14.9	588.3
CNA55B	RJ	255.8	22.4	259.6	18.6	556.4
CNA560E	RJ	425.9	33.4	428.5	30.8	918.6

Note: Some totals may not match due to rounding.

Table H-1b 2014 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
General Aviation Operations (Continued)						
CNA560U	RJ	127.9	16.0	133.6	10.2	287.7
CNA560XL	RJ	921.3	64.5	923.9	61.8	1,971.5
CNA680	RJ	495.5	40.5	498.3	37.8	1,072.1
CNA750	RJ	563.7	62.9	591.7	34.9	1,253.2
CRJ9-ER	RJ	6.4	0.0	6.4	0.0	12.8
ECLIPSE500	RJ	29.8	2.1	30.9	1.1	63.9
EMB145	RJ	73.5	14.9	73.6	14.9	176.9
F10062	RJ	455.0	46.9	470.3	31.6	1,003.8
GIIB	RJ	23.4	2.2	24.5	1.1	51.2
GIV	RJ	692.4	69.6	700.0	61.9	1,523.9
GV	RJ	686.2	77.8	690.0	74.1	1,528.1
IA1125	RJ	124.7	11.7	126.7	9.7	272.8
LEAR25	RJ	4.3	0.0	4.3	0.0	8.6
LEAR35	RJ	1,422.5	159.0	1,426.5	155.0	3,163.0
MU3001	RJ	536.7	37.7	541.7	32.7	1,148.8
General Aviation Total		**12,109.7**	**1,099.3**	**12,198.1**	**1,010.2**	**26,417.3**
Grand Total		**155,401.00**	**26,498.9**	**160,341.5**	**21,557.3**	**363,798.7**

Source: HMMH, 2014.
Notes: BEC58P is the INM substitution for the Cessna 402.
The CRJ9-ER in the RJ category is the CRJ700 aircraft
Annual operations modeled in the 2014 Annual contour.
Some totals may not match due to rounding.

RJs are defined as those aircraft with 90 or less seats, consistent with the categorization in *Chapter 2, Activity Levels*.[13] For years prior to 2010, the RJs in this report were classified as aircraft with less than 100 seats. When RJs first started gaining popularity, the aircraft types available were typically 50 seats or less with the traditional air carrier jet being 100 seats and higher. As newer aircraft types have become available, the smaller 35 to 50 seat types have been replaced by 70 to 99-seat types, with the 90 and above seat types flying many of the traditional air carrier routes. The majority of the newer types fall into two categories: the 70 to 75-seat category, which remain categorized as RJs, and the 91- to 99-seat category, which are categorized as air carrier jets. The Embraer 190 falls into this category and is now in the Light Jet B group.

Table H-2a shows the runway use that was used to model the 2013 noise conditions. Table H-2b shows the runway used to model the 2014 noise conditions. As described above, turbojet aircraft in the table were grouped into different categories for reporting purposes. Because the 2013 and 2014 contour developed using RealContours™ reflects the individual use of the runways by each INM aircraft type, it accurately represents Logan Airport's noisiest aircraft by modeling them on the actual runways that they used during the year. The modeled runway use for each particular aircraft type may be different from the overall group runway use presented in Table H-2a for 2013 and Table H-2b for 2014.

13 U.S. Code, 2006 Edition, Supplement 3, Title 49 – Transportation Subtitle VII – Aviation Programs Part A – Air Commerce and Safety, Subpart II, Economic Regulation, Chapter 417 - Operations or Carriers, Subchapter III - Regional Air Service Incentive Program, Sec. 41762 – Definitions – defines RJ air carrier service to be aircraft with a maximum of 75 seats. Therefore, this report categorizes aircraft with 70-75 seats and below as RJ and aircraft with 90 seats and higher aircraft as air carrier (Note: there are no types with 75 to 90 seats).

Comparing Table H-2b (2014) with the similar Table H-2a (2013) in this *2014 EDR*, departure use of Runways 33L and 27 increased in almost all categories and decreased for Runways 22L, and 22R. For departures, the largest increases were a 13.1 percent increase for Light Jet A night departures on 27 and an 8.0 percent increase on 33L for Heavy Jet A day departures.

For arrivals, Runways 4L, and 27 show decreases in almost all aircraft categories between 2014 and 2013. Runways 4R, 15R, and 22L show increases in almost all aircraft categories.

The most significant change was to Runway 04R, which showed a 26.9 percent increase in 2014 for Light Jet A night arrivals. Runway 22L also showed notable increases for Heavy Jet A night time arrivals, which increased by 12.2 percent, and Light Jet B arrivals which increased by 10.3 percent

Table H-2a 2013 Modeled Runway Use by Aircraft Group

	ARRIVALS											
	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
Runway	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)
04L	0.34	0.00	0.39	0.00	5.83	1.13	4.91	0.64	12.39	3.16	24.57	6.83
04R	37.24	0.00	37.61	21.96	31.68	23.09	31.63	23.00	24.33	22.95	11.48	18.12
09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00
15R	1.09	0.00	1.37	1.30	1.10	0.33	1.16	0.52	1.02	0.70	0.84	0.45
22L	28.46	33.08	19.40	24.80	9.12	31.85	12.59	30.44	14.02	28.25	23.14	31.61
22R	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.00	2.52	1.67
27	17.25	5.26	27.42	9.31	39.44	20.97	36.78	16.46	32.33	17.62	17.87	15.05
32	0.00	0.00	0.00	0.00	0.49	0.00	0.42	0.01	3.15	0.00	6.92	0.60
33L	15.62	61.65	13.80	42.63	12.35	22.61	12.48	28.92	12.74	27.31	8.37	20.60
33R	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.13	5.09
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	DEPARTURES											
	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
Runway	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)
04L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	20.02	12.34
04R	17.36	7.93	13.79	3.89	3.68	0.48	5.21	3.17	1.78	2.63	5.46	3.28
09	12.62	2.39	17.41	18.25	33.75	22.66	30.60	21.21	35.81	23.11	12.97	7.70
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.04	0.20
15L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
15R	14.00	36.45	7.71	20.33	1.12	29.98	1.97	24.75	0.57	22.90	0.88	21.14
22L	12.29	11.01	8.20	1.42	0.46	0.48	2.27	1.22	0.19	0.15	0.90	1.32
22R	26.79	24.65	28.84	34.08	37.26	23.67	35.76	24.29	37.87	26.73	43.29	33.58
27	1.09	0.58	6.03	4.33	11.94	15.32	11.65	14.98	11.79	13.94	3.94	3.72
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33L	15.85	16.98	18.01	17.70	11.80	7.41	12.54	10.38	11.97	10.47	12.38	16.72
33R	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Massport, HMMH. 2013.
Notes: Night for noise modeling is defined as 10:00 PM to 7:00 AM.
Nighttime runway restrictions are from 11:00 PM to 6:00 AM.
Values may not add to 100 percent due to rounding.

Table H-2b 2014 Modeled Runway Use by Aircraft Group

ARRIVALS

Runway	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)
04L	0.11	0.00	0.21	0.07	2.83	0.70	4.53	0.62	11.28	2.60	23.60	6.42
04R	40.88	26.86	41.56	24.41	32.38	24.16	32.33	22.47	25.78	25.15	13.56	25.24
09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00
15R	1.86	0.00	2.38	3.74	2.61	1.90	1.90	2.17	2.00	1.30	2.33	1.18
22L	28.13	45.31	23.90	26.43	17.89	32.24	22.86	34.61	22.27	34.95	25.98	34.13
22R	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.03	0.05	3.65	3.25
27	10.94	3.83	16.91	6.02	27.65	16.29	24.43	11.80	20.16	11.97	7.56	8.19
32	0.10	0.00	0.00	0.00	0.00	0.00	0.99	0.00	4.73	0.10	9.36	0.17
33L	17.98	24.01	15.04	39.33	16.63	24.72	12.94	28.33	13.75	23.89	10.32	19.15
33R	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.26	2.28
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

DEPARTURES

Runway	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)	Day (%)	Night (%)
04L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.67	14.30
04R	16.59	10.98	14.53	5.83	3.10	4.24	5.07	5.02	1.08	3.01	6.63	3.00
09	9.72	4.55	16.94	16.95	33.52	26.64	31.62	19.14	38.20	24.12	10.51	4.67
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
15L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
15R	18.12	30.27	10.20	17.22	2.28	10.92	2.67	17.31	1.07	13.51	2.37	13.52
22L	8.65	5.36	7.35	1.83	0.26	0.45	1.86	1.48	0.12	0.19	1.00	1.25
22R	22.13	22.42	22.20	28.73	27.07	24.51	28.75	26.62	29.76	28.75	35.28	36.17
27	0.93	3.43	7.34	6.78	16.55	28.40	12.17	18.70	12.87	19.30	4.84	5.15
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33L	23.86	22.99	21.45	22.65	17.21	4.83	17.87	11.72	16.89	11.13	16.59	21.94
33R	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Massport, HMMH. 2014.
Notes: Night for noise modeling is defined as 10:00 PM to 7:00 AM.
Nighttime runway restrictions are from 11:00 PM to 6:00 AM.
Values may not add to 100 percent due to rounding.

While Tables H-2a and H-2b present runway use by aircraft groups, Tables H-3a and H-3b present the total runway use (jets and non-jets) by runway and time of day. The first section of the table displays the operations by runway and time of day for an average day. The second section displays the same information for the year and the last section displays the percent that each runway is used by operation type and time of day. Table H-3a shows that on an average day Runway 22R has the most departures (163.23 per day) and Runway 27 has the most arrivals (137.03 per day). At night, Runway 22R has the most departures (14.53 per night) but Runway 22L has the most arrivals (20.82 per night). Table H-3b shows that on an average day Runway 22R has the most departures (146.62 per day) and Runway 4R had the most arrivals (137.42 per day). At night, Runway 22R has the most departures (16.03 per night) but Runway 22L has the most arrivals (24.81 per night).

Table H-3a Summary of Jet and Non-Jet Aircraft Runway Use: 2013

	Runway												
	4L	4R	9	14[2]	15L	15R	22L	22R	27	32	33L	33R	Total
2013 Daily Operations													
Departures Day	14.70	21.53	123.79	0.03	0.05	7.81	8.13	163.23	44.49	0.00	55.14	0.03	438.93
Departures Night	0.21	1.76	11.48	0.01	0.00	13.64	0.69	14.53	7.36	0.00	6.36	0.00	56.04
Arrivals Day	40.78	114.92	0.00	0.00	0.11	4.61	63.83	1.89	137.03	8.77	50.72	2.99	425.65
Arrivals Night	0.75	15.77	0.00	0.00	0.00	0.40	20.82	0.05	11.26	0.02	20.14	0.14	69.35
Total Daily Operations	56.44	153.98	135.27	0.04	0.17	26.45	93.47	179.70	200.14	8.78	132.36	3.16	989.96
2013 Annual Operations													
Departures Day	5,367	7,860	45,182	12	19	2,850	2,969	59,578	16,238	0	20,125	12	160,212
Departures Night	77	644	4,192	2	0	4,978	252	5,304	2,687	0	2,322	0	20,458
Arrivals Day	14,884	41,946	0	0	42	1,681	23,296	690	50,015	3,200	18,512	1,090	155,356
Arrivals Night	272	5,755	0	0	0	145	7,600	20	4,112	7	7,352	50	25,313
Total Annual Operations	20,600	56,204	49,374	14	61	9,655	34,117	65,591	73,052	3,207	48,311	1,152	361,338
2013 Operations Percentage													
Percentage Departures Day	3%	5%	28%	<1%	<1%	2%	2%	37%	10%	<1%	13%	<1%	100%
Percentage Departures Night	<1%	3%	20%	<1%	<1%	24%	1%	26%	13%	<1%	11%	<1%	100%
Percentage Arrivals Day	10%	27%	<1%	<1%	<1%	1%	15%	<1%	32%	2%	12%	1%	100%
Percentage Arrivals Night	1%	23%	<1%	<1%	<1%	1%	30%	<1%	16%	<1%	29%	<1%	100%

Source: Massport Noise Office and HMMH 2013.

Table H-3b Summary of Jet and Non-Jet Aircraft Runway Use: 2014

	Runway												
	4L	4R	9	14[2]	15L	15R	22L	22R	27	32	33L	33R	Total
2014 Daily Operations													
Departures Day	16.17	21.43	126.91	0.06	0.01	11.63	6.84	130.59	48.27	0.00	77.37	0.02	439.30
Departures Night	0.23	3.00	10.97	0.00	0.00	10.15	0.90	16.03	9.75	0.00	8.03	0.00	59.06
Arrivals Day	37.34	120.81	0.11	0.00	0.17	8.63	99.03	2.66	86.79	12.95	54.95	2.32	425.76
Arrivals Night	0.65	16.61	0.00	0.00	0.00	1.56	24.81	0.06	8.37	0.01	20.48	0.04	72.59
Total Daily Operations	54.38	161.85	137.99	0.06	0.18	31.97	131.58	149.34	153.20	12.96	160.82	2.38	996.71
2014 Annual Operations													
Departures Day	5,901	7,820	46,322	21	3	4,244	2,498	47,667	17,620	0	28,239	6	160,341
Departures Night	83	1,095	4,005	0	0	3,705	327	5,852	3,560	0	2,930	0	21,557
Arrivals Day	13,630	44,096	40	0	63	3,149	36,146	970	31,680	4,727	20,055	846	155,402
Arrivals Night	236	6,064	0	0	0	569	9,056	23	3,057	3	7,475	16	26,499
Total Annual Operations	19,850	59,075	50,367	21	65	11,668	48,026	54,511	55,917	4,730	58,699	868	363,797
2014 Operations Percentage													
Percentage Departures Day	4%	5%	29%	<1%	<1%	3%	2%	30%	11%	<1%	18%	<1%	100%
Percentage Departures Night	<1%	5%	19%	<1%	<1%	17%	2%	27%	17%	<1%	14%	<1%	100%
Percentage Arrivals Day	9%	28%	<1%	<1%	<1%	2%	23%	1%	20%	3%	13%	1%	100%
Percentage Arrivals Night	1%	23%	<1%	<1%	<1%	2%	34%	<1%	12%	<1%	28%	<1%	100%

Source: Massport Noise Office and HMMH 2014.
Notes: The data reflect actual percentages of aircraft operations on each runway end. They should not be confused with effective runway use, which is used by the Preferential Runway Advisory System (PRAS) to derive recommendations for use of a particular runway.
Runway 14-32 is unidirectional.
Values may not add to 100 percent due to rounding.

Runway use can also be presented in terms of percent of total operations as shown in Table H-4 for 2013 and 2014. Tables H-2a and H-2b total the runway use by aircraft group and time of day. Tables H-3a and H-3b total the runway use by operation type and time of day. Table H-4 presents the 2013 and 2014 Runway use for all operations which use Logan Airport.

In 2013, Runway 27 was the runway with the highest activity (primarily by jet arrivals), whereas in 2014, Runway 4R was the runway with the highest activity (primarily jet arrivals) with Runway 33L a very close second (primarily by jet departures).

Each year, non-jet activity makes up approximately 8.0 percent of the arrivals and 8.0 percent of the departures at Logan Airport.

Table H-4 Total 2013 and 2014 Modeled Runway Use by All Operations

	Jet Arrivals		Non-Jet Arrivals		Jet Departures		Non-Jet Departures		All Operations
	Day	Night	Day	Night	Day	Night	Day	Night	
Runway				2013 Operations					Total
04L	2.3%	<0.1%	1.8%	<0.1%	<0.1%	<0.1%	1.5%	<0.1%	5.7%
04R	10.8%	1.5%	0.8%	<0.1%	1.8%	<0.1%	<0.1%	<0.1%	15.6%
9	0.0%	0.0%	0.0%	0.0%	11.5%	1.1%	1.0%	<0.1%	13.7%
14	0.0%	0.0%	0.0%	0.0%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
15L	0.0%	0.0%	<0.1%	0.0%	0.0%	0.0%	<0.1%	0.0%	<0.1%
15R	<0.1%	<0.1%	<0.1%	<0.1%	0.7%	1.3%	<0.1%	<0.1%	2.7%
22L	4.8%	2.0%	1.7%	<0.1%	0.8%	<0.1%	<0.1%	<0.1%	9.4%
22R	<0.1%	<0.1%	<0.1%	<0.1%	13.3%	1.4%	3.2%	<0.1%	18.2%
27	12.5%	1.1%	1.3%	<0.1%	4.2%	0.7%	<0.1%	<0.1%	20.2%
32	<0.1%	<0.1%	0.5%	<0.1%	0.0%	0.0%	0.0%	0.0%	0.9%
33L	4.5%	2.0%	0.6%	<0.1%	4.7%	0.6%	0.9%	<0.1%	13.4%
33R	0.0%	0.0%	<0.1%	<0.1%	0.0%	0.0%	<0.1%	0.0%	<0.1%
Total	**35.7%**	**6.7%**	**7.3%**	**<0.1%**	**36.9%**	**5.5%**	**7.4%**	**<0.1%**	**100.0%**
Runway				2014 Operations					Total
04L	2.1%	<0.1%	1.7%	<0.1%	0.0%	0.0%	1.6%	<0.1%	5.5%
04R	11.2%	1.6%	1.0%	<0.1%	1.7%	<0.1%	<0.1%	<0.1%	16.2%
9	0.0%	0.0%	<0.1%	0.0%	12.0%	1.1%	0.8%	<0.1%	13.8%
14	0.0%	0.0%	0.0%	0.0%	<0.1%	0.0%	<0.1%	0.0%	<0.1%
15L	0.0%	0.0%	<0.1%	0.0%	0.0%	0.0%	<0.1%	0.0%	<0.1%
15R	0.7%	<0.1%	<0.1%	<0.1%	1.0%	1.0%	<0.1%	<0.1%	3.2%
22L	8.1%	2.4%	1.9%	<0.1%	0.6%	<0.1%	<0.1%	<0.1%	13.2%
22R	<0.1%	<0.1%	<0.1%	<0.1%	10.6%	1.6%	2.5%	<0.1%	15.0%
27	8.2%	0.8%	0.5%	<0.1%	4.5%	1.0%	<0.1%	<0.1%	15.4%
32	0.6%	<0.1%	0.7%	<0.1%	0.0%	0.0%	0.0%	0.0%	1.3%
33L	4.8%	2.0%	0.7%	<0.1%	6.6%	0.8%	1.2%	<0.1%	16.1%
33R	0.0%	<0.1%	<0.1%	<0.1%	0.0%	0.0%	<0.1%	0.0%	<0.1%
Total	**35.6%**	**7.1%**	**7.1%**	**<0.1%**	**36.9%**	**5.8%**	**7.2%**	**<0.1%**	**100.0%**

Flight Tracks

RealContours™ converts each radar track to an INM model track and then models the scaled aircraft operation on that track. This method keeps the lateral and vertical dispersion of the aircraft types consistent with the radar data, and ensures that anomalies in the departure paths are captured in the RealContours™ system. Table H-5 lists the number of flight tracks used in the RealContours™ modeling system for 2013 and 2014. Flight tracks from April 2014 are displayed in Figures 6-3 through 6-9 in *Chapter 6, Noise Abatement.*

Table H-5 Total Count of Flight Tracks Modeled in RealContours™ (2013 and 2014)

	Runway											
	4L	4R	9	14	15L	15R	22L	22R	27	32	33L	33R
2013												
Departures	4,838	8,180	47,822	12	16	7,624	3,121	62,126	18,400	0	21,644	10
Arrivals	14,111	46,200	0	0	36	1,768	29,528	619	52,211	2,928	25,045	977
2014												
Departures	5,984	8,915	50,327	21	3	7,950	2,825	53,518	21,180	0	31,169	6
Arrivals	13,866	50,160	39	0	63	3,718	45,201	993	34,736	4,730	27,530	862

Source: HMMH, 2013/2014; Exelis NOMS data.

Flight Profiles

To enhance the results from RealContours™, Massport elected to use the companion RealProfiles™ software. By using the actual radar information along with the equations developed for the INM, RealProfiles™ develops an altitude profile for each aircraft operation. This profile is then modeled in the RealContours™ system. As a result, the modeled aircraft follows both the actual radar track on the ground and the actual radar altitude profile in the sky.

RealProfiles™ provides several advantages over the standard INM profile modeling. The standard INM modeling uses a "Stagelength" to identify an aircraft's departure weight and then models a standard departure profile for that Stagelength. Using RealProfiles™, the RealContours™ system selects a weight similar to the standard modeling but then develops a profile to allow the INM aircraft to follow the actual path flown for that route. For example, if aircraft departing from a particular runway are required to remain level at 3,000 feet for a certain distance, RealProfiles™ will develop a profile that remains level for that distance along the track. In contrast, the standard modeling would use the standard INM profile and would not model the level segment.

For 2013, RealProfiles™ was able to compute profiles based on the actual radar data for 98.8 percent of the available departure tracks and 88.3 percent of the available arrivals. For 2014, RealProfiles™ was able to compute profiles based on the actual radar data for 98.6 percent of the available departure tracks and 94.8 percent of the available arrivals. RealProfiles™ uses the INM supplied aircraft performance database to develop its unique profiles; however, for several aircraft in the INM database the aircraft performance data are not available. For those profiles, the INM database contains fixed profiles, which are not modified and are used as supplied with the INM data.

Fleet Mix

As in the past, operations by aircraft types have been summarized into several key categories: commercial (passenger and cargo) operations, Stage 2 or Stage 3 jet aircraft, and turboprop and propeller (non-jet) aircraft. In addition, the operations are split into daytime and nighttime periods, where nighttime hours are defined as 10:00 PM to 7:00 AM, consistent with the definition of DNL. Table H-6 summarizes the numbers of operations by categories of aircraft operating at Logan Airport from 1990 through 2014. General aviation (GA) operations were not included in the noise modeling prior to 1998 and commercial jet operations were not separated until 1999.

Table H-6 Modeled Daily Operations by Commercial and General Aviation (GA) Aircraft[1] – 1990 to 2014

(Data for the years 2000 to 2014 are shown on the subsequent pages)

		1990	1992	1993	1994	1995	1996	1997	1998	1999
Commercial Aircraft										
Stage 2 Jets[2]	Day	312.40	228.89	203.34	189.40	156.90	132.40	108.46	84.93	83.30
	Night	19.99	13.13	7.44	10.10	5.50	4.79	7.75	5.92	6.66
	Total	**332.39**	**242.02**	**210.78**	**199.50**	**162.40**	**137.19**	**116.21**	**90.85**	**89.96**
Stage 3 Jets (All)	Day	288.89	384.49	418.99	425.70	429.40	439.81	505.08	541.43	597.28
	Night	57.25	58.29	65.47	62.80	69.00	80.16	85.06	95.54	98.59
	Total	**346.14**	**442.78**	**484.46**	**488.50**	**498.40**	**519.97**	**590.14**	**636.97**	**695.87**
Air Carrier Jets	Day	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	569.18
	Night	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	96.21
	Total	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	**665.39**
Regional Jets	Day	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	28.10
	Night	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	2.38
	Total	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	**30.48**
Non-Jets	Day	444.41	411.84	598.16	541.97	526.85	505.31	514.70	552.56	448.82
	Night	11.72	69.32	46.84	13.59	11.14	13.73	27.27	21.86	16.63
	Total	**456.13**	**481.16**	**645.00**	**555.56**	**537.99**	**519.04**	**541.97**	**574.42**	**465.45**
Total Commercial Operations	Day	1045.70	1025.22	1220.49	1157.07	1113.15	1077.52	1128.24	1178.92	1129.90
	Night	88.96	140.74	119.75	86.49	85.64	98.68	120.08	123.32	121.88
	Total	**1134.66**	**1165.96**	**1340.24**	**1243.56**	**1198.79**	**1176.20**	**1248.32**	**1302.24**	**1251.78**
GA Aircraft										
Stage 2 Jets[2]	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	5.25	9.89
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	0.40	0.74
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	**5.65**	**10.63**
Stage 3 Jets	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	30.54	48.46
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	4.21	6.55
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	**34.75**	**55.01**
Non-Jets	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	37.29	19.36
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	16.28	18.89
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	**53.57**	**38.25**
Total GA Operations	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	73.08	77.71
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	20.89	26.17
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	**93.97**	**103.88**
Total	Day	1045.70	1025.22	1220.49	1157.07	1113.15	1077.52	1128.24	1252.00	1207.61
	Night	88.96	140.74	119.75	86.49	85.64	98.68	120.08	144.21	148.05
	Total[3]	**1134.66**	**1165.96**	**1340.24**	**1243.56**	**1198.79**	**1176.20**	**1248.32**	**1396.21**	**1355.66**

Table H-6 Modeled Daily Operations by Commercial and General Aviation (GA) Aircraft[1] – 1990 to 2014 (Continued)

(Data for the years 1990 to 1999 are shown on the prior page)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Commercial Aircraft											
Stage 2 Jets[2]	Day	5.13	1.18	0.05	0.08	0.03	0.05	0.03	0.03	0.01	0.00
	Night	0.26	0.05	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00
	Total	**5.39**	**1.23**	**0.05**	**0.08**	**0.05**	**0.06**	**0.03**	**0.04**	**0.02**	**0.00**
Stage 3 Jets (All)	Day	727.09	756.24	740.75	717.85	772.39	765.76	767.55	748.13	699.39	668..32
	Night	103.66	109.77	97.04	92.69	113.24	113.66	114.81	118.29	114.30	103.11
	Total	**830.75**	**866.01**	**837.79**	**810.54**	**885.63**	**879.42**	**882.36**	**866.42**	**813.69**	**771.43**
Air Carrier Jets	Day	648.95	569.99	500.70	461.06	518.96	505.48	490.63	472.39	443.15	421.51
	Night	99.79	101.30	83.52	72.69	89.24	91.99	92.71	96.28	89.89	82.19
	Totals	**748.74**	**671.29**	**584.22**	**533.75**	**608.20**	**597.47**	**583.34**	**568.66**	**533.04**	**503.70**
Regional Jets	Day	78.14	186.25	240.05	256.80	253.43	260.34	276.95	275.77	256.24	246.81
	Night	3.87	8.47	13.52	19.99	24.00	21.68	22.11	22.03	24.40	20.93
	Total	**82.01**	**194.72**	**253.57**	**276.79**	**277.43**	**282.01**	**299.06**	**297.80**	**280.64**	**267.73**
Non-Jets	Day	409.62	317.62	165.45	135.18	133.24	148.77	140.81	145.27	132.52	136.45
	Night	21.58	10.97	3.45	2.41	3.03	3.02	3.26	3.47	4.00	5.54
	Total	**431.20**	**328.58**	**168.89**	**137.59**	**136.28**	**151.79**	**144.07**	**148.73**	**136.52**	**141.99**
Total Commercial Operations	Day	1141.84	1075.04	906.25	853.10	905.66	914.59	908.41	893.43	831.92	804.77
	Night	125.51	120.79	100.49	95.10	116.29	116.68	118.09	121.77	118.31	108.65
	Total	**1267.35**	**1195.82**	**1006.73**	**948.20**	**1021.95**	**1031.27**	**1026.51**	**1015.19**	**950.23**	**913.42**
GA Aircraft											
Stage 2 Jets[2]	Day	7.29	5.15	3.65	2.84	0.94	2.29	1.90	1.24	0.36	0.09
	Night	0.64	0.50	0.41	0.26	0.14	0.25	0.17	0.19	0.03	0.01
	Total	**7.93**	**5.65**	**4.08**	**3.10**	**1.08**	**2.54**	**2.07**	**1.43**	**0.38**	**0.10**
Stage 3 Jets	Day	40.08	34.23	37.83	46.21	53.72	58.84	61.08	54.82	43.98	22.31
	Night	3.21	3.28	6.42	6.98	8.37	9.33	6.57	6.39	4.52	2.28
	Total	**43.29**	**37.51**	**44.25**	**53.19**	**62.09**	**68.16**	**67.65**	**61.21**	**48.49**	**23.59**
Non-Jets	Day	34.57	37.31	17.36	17.81	16.95	14.00	15.05	11.98	15.13	8.19
	Night	1.83	1.92	4.45	4.40	5.20	4.75	1.39	3.61	1.08	0.74
	Total	**36.40**	**39.23**	**21.81**	**22.21**	**22.14**	**18.75**	**16.44**	**15.58**	**16.20**	**8.93**
Total GA Operations	Day	81.94	76.68	58.84	66.88	71.60	75.12	78.03	68.04	59.46	29.58
	Night	5.68	5.71	11.29	11.64	13.71	14.33	8.13	10.19	5.62	3.04
	Total	**87.62**	**82.39**	**70.13**	**78.52**	**85.31**	**89.46**	**86.15**	**78.22**	**65.05**	**32.62**
Total	Day	1223.78	1151.72	965.09	919.98	977.27	989.71	986.43	961.46	891.39	834.35
	Night	131.19	126.50	111.78	106.74	130.00	131.02	126.22	131.96	123.93	111.69
	Total[3]	**1354.97**	**1278.21**	**1076.86**	**1026.72**	**1107.26**	**1120.73**	**1112.66**	**1093.42**	**1015.31**	**946.04**

Table H-6 Modeled Daily Operations by Commercial and General Aviation (GA) Aircraft[1] – 1990 to 2014 (Continued)

(Data for the years 1990 to 2009 are shown on the prior pages)

		2010	2011	2012	2013	2014	Difference Between 2014 and 2013
Commercial Aircraft							
Stage 2 Jets[2]	Day	0.01	0.01	0.01	0.01	0.00	(0.01)
	Night	0.01	0.00	0.00	0.00	0.00	0.00
	Total	**0.02**	**0.01**	**0.01**	**0.01**	**0.00**	**(0.01)**
Stage 3 Jets (All)	Day	674.25	684.19	649.22	667.65	670.00	2.35
	Night	107.92	109.38	106.55	115.91	123.60	7.69
	Total	**782.17**	**793.57**	**755.77**	**783.56**	**793.61**	**10.04**
Air Carrier Jets	Day	521.64	571.03	530.76	546.27	556.59	10.32
	Night	93.98	99.17	98.68	107.17	115.84	8.66
	Total	**615.62**	**670.20**	**629.44**	**653.44**	**672.43**	**18.99**
Regional Jets	Day	152.61	113.16	118.46	121.38	113.41	(7.97)
	Night	13.94	10.21	7.87	8.74	7.77	(0.97)
	Total	**166.55**	**123.37**	**126.33**	**130.12**	**121.18**	**(8.95)**
Non-Jets	Day	138.53	135.18	133.92	132.33	128.45	(3.88)
	Night	5.21	4.73	3.06	3.21	2.28	(0.93)
	Total	**143.74**	**139.91**	**136.98**	**135.54**	**130.73**	**(4.81)**
Total Commercial Operations	Day	812.78	819.39	783.14	799.99	798.45	(1.54)
	Night	113.13	114.11	109.62	119.12	125.88	6.76
	Total	**925.91**	**933.50**	**892.76**	**919.12**	**924.33**	**5.22**
GA Aircraft							
Stage 2 Jets[2]	Day	0.27	0.08	0.25	0.31	0.00	(0.31)
	Night	0.04	0.00	0.04	0.02	0.00	(0.02)
	Total	**0.30**	**0.08**	**0.29**	**0.33**	**0.00**	**(0.33)**
Stage 3 Jets	Day	27.80	52.51	52.93	51.21	52.64	1.43
	Night	3.21	5.35	7.20	5.10	4.65	(0.45)
	Total	**31.01**	**57.87**	**60.13**	**56.31**	**57.29**	**0.98**
Non-Jets	Day	8.19	18.18	15.16	13.06	13.95	0.89
	Night	0.72	1.29	1.29	1.15	1.13	(0.03)
	Total	**8.92**	**19.48**	**16.45**	**14.22**	**15.08**	**0.87**
Total GA Operations	Day	70.78	68.35	64.58	66.59	70.78	2.02
	Night	6.65	8.52	6.28	5.78	6.65	-0.50
	Total	**77.43**	**76.86**	**70.85**	**72.37**	**77.43**	**1.52**
Total	Day	890.16	851.49	864.57	865.05	890.16	0.47
	Night	120.76	118.13	125.40	131.66	120.76	6.26
	Total[3]	**1010.92**	**969.61**	**989.97**	**996.70**	**1010.92**	**6.73**

Source: Massport's Noise Monitoring System and Revenue Office numbers, HMMH 2014.
Notes: Data from 1991 not available.
1 Includes scheduled and unscheduled operations.
2 Stage 2 aircraft are exempt from meeting newer federal Stage 3 noise limits when their maximum gross takeoff weight is less than or equal to 75,000 pounds.
3 RJ operations were not tracked separately prior to 1999.
4 Totals prior to 1998 do not include GA operations.
5 The definition of RJ for the EDR changed between 2009 and 2010. A RJ in 2010 is a jet in commercial service with less than 80 seats. Prior to 2010, a RJ was a jet in commercial service with 100 seats or less.

Commercial Jet Aircraft by Part 36 Stage Category

Jet aircraft currently operating at Logan Airport are categorized by the FAA into two groups: Stage 2 and Stage 3. As described in *Chapter 6, Noise Abatement*, the designation refers to a noise classification specified in Federal Aviation Regulation Part 36 that sets noise emission standards at three measurement locations – takeoff, landing, and sideline – based on an aircraft's maximum certificated weight. The heavier the aircraft, the more noise it is permitted to make within limits. Because of the substantial differences in noise between Stage 2, re-certificated Stage 3, and new Stage 3 aircraft, Massport tracks operations by these separate categories to follow their trends. Table H-7 shows the percentage of commercial jet operations by stage category from 1999 through 2014. One of the most significant changes occurring after the economic downturn in 2001 was the almost immediate retirement of the re-certificated aircraft from airlines' fleets due to their high operating costs. This type of accelerated retirement is not as prevalent during the 2008 to 2009 economic downturn since it is no longer the major airlines operating these aircraft. However, these aircraft still have high operating costs and are being replaced wherever possible.

Table H-7 Percentage of Commercial Jet Operations by Part 36 Stage Category – 1999 to 2014

	New Stage 3[1]	Recertificated Stage 3[2]	Stage 2	Total
1999	70.0%	21.0%	9.0%	100%
2000	75.0%	24.0%	1.0%	100%
2001	86.3%	13.6%	0.1%	100%
2002	92.8%	7.2%	0.0%	100%
2003	95.8%	4.1%	0.0%	100%
2004	97.8%	2.2%	0.0%	100%
2005	98.0%	2.0%	0.0%	100%
2006	98.6%	1.4%	0.0%	100%
2007	98.9%	1.1%	0.0%	100%
2008	99.1%	0.9%	0.0%	100%
2009	99.1%	0.9%	0.0%	100%
2010	98.9%	1.1%	0.0%	100%
2011	99.5%	0.5%	0.0%	100%
2012	99.9%	0.1%	0.0%	100%
2013	100.0%	<0.1%	<0.1%	100%
2014	100.0%	<0.1%	0.0%	100%

Source: Massport and FAA radar data.
Notes:
1 New Stage 3 aircraft are aircraft originally manufactured as a certified Stage 3 aircraft under Federal Regulation Part 36.
2 Recertificated Stage 3 aircraft are aircraft originally manufactured as a certified Stage 1 or 2 aircraft under Federal Regulation Part 36, which either have been treated with hushkits or have been re-engineered to meet Stage 3 requirements.

Nighttime Operations

Massport tracks flights that operate between the broader DNL nighttime periods of 10:00 PM to 7:00 AM, when each flight is penalized 10 dB in calculations of noise exposure. Table H-8 shows this nighttime activity by different groups of aircraft. Nighttime flights by commercial jet operators have decreased by 2.6 percent at Logan Airport in 2012 compared to 2011 then increased by 8.8 percent in 2013 compared to 2012 and by 6.6 percent in 2014 compared to 2013. In 2012, commercial non-jet operations decreased 35.3 percent and GA traffic went up 28.1 percent at night compared to 2011. In 2013, commercial non-jet operations increased by 4.9 percent and GA traffic went down 26.4 percent at night compared to 2012. In 2014, commercial non-jet operations increased by 29.0 percent and GA traffic went down 8.0 percent at night compared to 2013. Overall, nighttime operations at Logan Airport decreased by 2.2 percent in 2012, increased by 6.2 percent in 2013 and increased by 5.0 percent in 2014. The majority of nighttime operations (between 10:00 PM and 7:00 AM) occurred either before midnight or after 5:00 AM.

Table H-8 Modeled Nighttime Operations at Logan Airport – 1990 to 2014

	Commercial Jets	Commercial Non-Jets	General Aviation	Total
1990	77.24	11.72	NA	88.96
1991	NA	NA	NA	NA
1992	71.42	69.32	NA	140.74
1993	72.91	46.84	NA	119.75
1994	72.90	13.59	NA	86.49
1995	74.50	11.14	NA	85.64
1996	84.95	13.73	NA	98.68
1997	92.81	27.27	NA	120.08
1998	101.46	21.86	NA	123.32
1999	105.25	16.63	26.17	148.05
2000	103.92	21.58	5.68	131.19
2001	109.82	10.97	5.71	126.50
2002	97.04	3.45	11.29	111.78
2003	92.69	2.41	11.64	106.74
2004	113.26	3.03	13.71	130.00
2005	113.67	3.02	14.33	131.02
2006	114.81	3.26	8.13	126.22
2007	118.30	3.47	10.19	131.96
2008	114.31	4.00	5.62	123.93
2009	103.05	5.56	3.08	111.70
2010	107.93	5.21	3.97	117.10
2011	109.38	4.73	6.65	120.76
2012	106.55	3.06	8.52	118.13
2013	115.91	3.21	6.28	125.40
2014	123.60	2.28	5.78	131.66
Change (2013 to 2014)	**7.69**	**(0.93)**	**(0.50)**	**6.26**
Percent Change	**6.64%**	**(29.06%)**	**(7.99%)**	**4.99%**

Source: Massport, HMMH, 2014.
Note: NA = Not available.

Jet Runway Use

Table H-9 presents a summary of runway use by jets. Since 2009, the radar data have been analyzed with Massport's Exelis Noise and Operational Monitoring System (NOMS), data from 2001 through 2008 was compiled with Massport's PreFlight™ software. PreFlight™ was an analysis package used to compile fleet, day/night splits, and runway use information from radar data. Data prior to 2001 were derived from Massport's original noise monitoring system, supplemented with field records. Note that Logan Airport Noise Rules prevent arrivals to Runway 22R and departures from Runway 4L by jet aircraft.

Table H-9 Summary of Jet Aircraft Runway Use – 1990 to 2014

	Runway									
	4L	4R	9	14[1]	15R	22L	22R	27	32[1]	33L
1990										
Departures	0%[2]	3%	21%	NA	10%	2%	36%	20%	NA	7%
Arrivals	1%	25%	0%	NA	2%	14%	0%	28%	NA	29%
1992[2]										
Departures	0%	6%	31%	NA	7%	2%	38%	10%	NA	6%
Arrivals	1%	37%	0%	NA	3%	12%	0%	30%	NA	17%
1993										
Departures	0%	9%	33%	NA	7%	3%	40%	4%	NA	4%
Arrivals	2%	44%	0%	NA	1%	11%	0%	28%	NA	15%
1994										
Departures	0%	9%	33%	NA	4%	3%	32%	12%	NA	5%
Arrivals	3%	42%	0%	NA	1%	8%	0%	27%	NA	19%
1995										
Departures	0%	8%	36%	NA	5%	5%	29%	11%	NA	5%
Arrivals	3%	41%	0%	NA	2%	8%	0%	27%	NA	17%
1996										
Departures	0%	8%	32%	NA	5%	6%	33%	12%	NA	5%
Arrivals	2%	38%	0%	NA	2%	11%	0%	29%	NA	18%
1997										
Departures	0%	8%	30%	NA	5%	6%	31%	15%	NA	5%
Arrivals	2%	36%	0%	NA	2%	9%	0%	30%	NA	20%
1998										
Departures	0%	8%	35%	NA	6%	5%	28%	14%	NA	5%
Arrivals	2%	41%	0%	NA	2%	7%	0%	28%	NA	19%
1999										
Departures	0%	8%	31%	NA	5%	4%	30%	15%	NA	6%
Arrivals	3%	37%	0%	NA	2%	10%	0%	28%	NA	21%
2000										
Departures	0%	8%	35%	NA	4%	3%	30%	15%	NA	6%
Arrivals	4%	40%	0%	NA	1%	7%	0%	28%	NA	20%
2001										
Departures	0%	7%	34%	NA	4%	3%	35%	12%	NA	5%
Arrivals	5%	36%	0%	NA	1%	8%	0%	32%	NA	18%
2002										
Departures	0%	4%	31%	NA	6%	3%	35%	16%	NA	6%
Arrivals	6%	31%	0%	NA	1%	12%	0%	30%	NA	21%

Table H-9 Summary of Jet Aircraft Runway Use – 1990 to 2014 (Continued)

	Runway									
	4L	4R	9	14[1]	15R	22L	22R	27	32[1]	33L
2003										
Departures	0%	4%	33%	NA	7%	2%	34%	14%	NA	6%
Arrivals	7%	33%	0%	NA	1%	14%	0%	28%	NA	18%
2004										
Departures	0%	5%	34%	NA	10%	4%	24%	18%	NA	6%
Arrivals	6%	34%	0%	NA	1%	12%	0%	24%	NA	23%
2005										
Departures	0%	5%	36%	NA	7%	1%	31%	13%	NA	7%
Arrivals	8%	33%	0%	NA	1%	11%	0%	29%	NA	17%
2006										
Departures	0%	4%	33%	0%	3%	1%	40%	13%	-	6%
Arrivals	7%	29%	0%	-	1%	14%	0%	33%	0.2%	16%
2007										
Departures	0%	5%	31%	0%	4%	1%	33%	7%	-	19%
Arrivals	5%	31%	0%	-	1%	15%	0%	36%	2%	11%
2008										
Departures	0%	6%	33%	<1%	3%	<1%	36%	6%	-	16%
Arrivals	6%	30%	-	-	2%	17%	-	33%	2%	11%
2009										
Departures	0%	7%	32%[3]	0%	3%	2%	34%	6%[3]	-	16%
Arrivals	7%	31%	-	-	3%	17%	0%	30%[3]	1%	11%
2010										
Departures	0%	4%	28%	<1%	8%	2%	31%	10%	-	17%
Arrivals	5%	28%	-	-	1%	15%	0%	32%	1%	16%
2011										
Departures	0%	6%	36%	<1%	5%[4]	2%	36%	7%	-	7%[4]
Arrivals	7%	37%	-	-	<1%[4]	16%	0%	28%	1%	11%[4]
2012										
Departures	0%	6%	33%	<1%	5%[4]	3%	38%	6%	-	9%[4]
Arrivals	6%	34%	-	-	1%[4]	16%	0%	33%	<1%	9%[4]
2013										
Departures	<1%	5%	30%	<1%	5%	2%	35%	12%	--	12%
Arrivals	6%	29%	--	--	1%	16%	<1%	32%	1%	15%
2014										
Departures	0%	5%	31%	<1%	5%	2%	28%	13%	-	17%
Arrivals	5%	30%	0%	-	2%	25%	<1%	21%	1%	16%

Source: HMMH 2014, Massport Noise Office.

Notes: The data reflect actual percentages of jet aircraft operations on each runway end. They should not be confused with effective runway use, which is used by the PRAS to derive recommendations for use of a particular runway. Effective runway percentages include a factor of 10 applied to nighttime operations so that use of a runway at night more closely reflects its effect on total noise exposure.
Jet aircraft are not able to use Runway 15L or 33R due to its length of only 2,557 feet.
Values may not add to 100 percent due to rounding. NA = Not available.

1 Runway 14-32 opened in late November 2006. (Runway 14-32 is unidirectional with no arrivals to Runway 14 and no departures from Runway 32).

2 The *1990 Final Generic Environmental Impact Report* was published and submitted to the Secretary of Environmental Affairs in July 1993. It included modeled operations and resulting noise contours for 1987, 1990, and a 1996-forecast year. The *1993 Annual Update* published in July 1994 included operations and contours for 1992 and 1993. 1991 data are not available.

3 Runway 9-27 had extended weekend closings for resurfacing during 2009.

4 Runway 15R-33L was closed for 3 months in 2011 and in 2012.

Annual Model Results and Status of Mitigation Programs

Noise Exposed Population

Table H-10 presents the noise-exposed population by community through 2014. This table includes population within the DNL 60 to 65 dB contours, although a DNL of 65 dB is the federally-defined noise criterion used as a guideline to identify when residential land use is considered incompatible with aircraft noise.

Table H-10 Noise-Exposed Population by Community

Year	Census Data	80+ dB DNL	75+ dB DNL	70-75 dB DNL	65-70 dB DNL[1]	Total (65+)	60-65 dB DNL
BOSTON[2]							
1990	1980	0	0	1,778	28,970	30,748	NA
1992	1980	0	0	800	4,316	5,116	NA
1993	1980	0	0	264	2,820	3,084	NA
1994	1990	0	106	265	7,698	8,069	30,895
1995	1990	0	106	851	8,815	9,772	33,765
1996	1990	0	106	374	8,775	9,255	40,992
1997	1990	0	106	719	13,857	14,682	54,804
1998	1990	0	58	580	10,877	11,515	52,201
1999[3]	1990	0	58	364	11,632	12,054	45,948
2000[3]	1990	0	58	183	7,880	8,121	32,474
2000[3]	2000	0	0	234	9,014	9,248	35,785
2001[3]	2000	0	0	315	6,515	6,700	27,778
2002[3]	2000	0	0	132	2,625	2,757	23,225
2003[3]	2000	0	0	164	1,730	1,894	21,763
2004[3,4]	2000	0	65	192	4,142	4,399	24,473
2005[3,4]	2000	0	65	104	2,020	2,189	17,661
2006 [4]	2000	0	65	99	1,054	1,218	14,866
2007 (INMv7.0a) [4]	**2000**	**0**	**0**	**169**	**4,094**	**4,263**	**21,446**
2008 (INMv7.0b) [4]	**2000**	**0**	**5**	**0**	**3,487**	**3,492**	**18,890**
2009 (INMv7.0b) [4]	**2000**	**0**	**5**	**67**	**937**	**1,009**	**12,284**
2010 (INMv7.0b) [4]	**2000**	**0**	**0**	**67**	**644**	**711**	**14,900**
2010 (INMv7.0b) [4]	**2010**	**0**	**0**	**0**	**689**	**689**	**17,646**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**331**	**331**	**11,600**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**439**	**439**	**12,076**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**421**	**421**	**11,037**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**612**	**612**	**14,835**
2014 (INMv7.0d)[4]	**2010**	**0**	**0**	**34**	**4,151**	**4,185**	**23,343**
CHELSEA							
1990	1980	0	0	0	4,813	4,813	NA
1992	1980	0	0	0	3,952	3,952	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	8,510
1995	1990	0	0	0	95	95	9,750
1996	1990	0	0	0	0	0	8,744
1997	1990	0	0	0	0	0	10,001
1998	1990	0	0	0	0	0	9,222
1999	1990	0	0	0	95	95	9,249
2000	1990	0	0	0	0	0	5,622
2000	2000	0	0	0	0	0	7,361
2001	2000	0	0	0	0	0	4,508
2002	2000	0	0	0	0	0	3,995
2003	2000	0	0	0	0	0	3,591
2004[4]	2000	0	0	0	0	0	7,756

Table H-10 Noise-Exposed Population by Community (Continued)

Year	Census Data	80+ dB DNL	75-80 dB DNL	70-75 dB DNL	65-70 dB DNL[1]	Total (65+)	60-65 dB DNL
CHELSEA							
2005[4]	2000	0	0	0	0	0	5,772
2006[4]	2000	0	0	0	0	0	2,477
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**9,774**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**7,793**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**5,462**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**4,880**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**4,897**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**3,485**
2014 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**9,236**
EVERETT							
1990	1980	0	0	0	0	0	NA
1992	1980	0	0	0	0	0	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	0
1995	1990	0	0	0	0	0	0
1996	1990	0	0	0	0	0	0
1997	1990	0	0	0	0	0	0
1998	1990	0	0	0	0	0	0
1999[3]	1990	0	0	0	0	0	0
2000[3]	1990	0	0	0	0	0	0
2000[3]	2000	0	0	0	0	0	0
2001[3]	2000	0	0	0	0	0	0
2002[3]	2000	0	0	0	0	0	0
2003[3]	2000	0	0	0	0	0	0
2004[3,4]	2000	0	0	0	0	0	0
2005[3,4]	2000	0	0	0	0	0	0
2006[4]	2000	0	0	0	0	0	0
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2014 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**

Table H-10	Noise-Exposed Population by Community (Continued)						
Year	**Census Data**	**80+ dB DNL**	**75-80 dB**	**70-75 dB DNL**	**65-70 dB**	**Total (65+)**	**60-65 dB DNL**
MEDFORD							
1990	1980	0	0	0	0	0	NA
1992	1980	0	0	0	0	0	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	0
1995	1990	0	0	0	0	0	0
1996	1990	0	0	0	0	0	0
1997	1990	0	0	0	0	0	0
1998	1990	0	0	0	0	0	0
1999	1990	0	0	0	0	0	0
2000	1990	0	0	0	0	0	0
2000	2000	0	0	0	0	0	0
2001	2000	0	0	0	0	0	0
2002	2000	0	0	0	0	0	0
2003	2000	0	0	0	0	0	0
2004[4]	2000	0	0	0	0	0	0
2005[4]	2000	0	0	0	0	0	0
2006[4]	2000	0	0	0	0	0	0
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2014 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
QUINCY							
1990	1980	0	0	0	0	0	NA
1992	1980	0	0	0	0	0	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	0
1995	1990	0	0	0	0	0	0
1996	1990	0	0	0	0	0	0
1997	1990	0	0	0	0	0	0
1998	1990	0	0	0	0	0	0
1999	1990	0	0	0	0	0	0
2000	1990	0	0	0	0	0	0
2000	2000	0	0	0	0	0	636
2001	2000	0	0	0	0	0	610
2002	2000	0	0	0	0	0	610
2003	2000	0	0	0	0	0	610
2004[4]	2000	0	0	0	0	0	610
2005[4]	2000	0	0	0	0	0	610
2006[4]	2000	0	0	0	0	0	610
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**

Table H-10	Noise-Exposed Population by Community (Continued)						
Year	Census Data	80+ dB DNL	75-80 dB DNL	70-75 dB DNL	65-70 dB	Total (65+)	60-65 dB DNL
QUINCY							
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2014 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
REVERE							
1990	1980	0	0	0	4,274	4,274	NA
1992	1980	0	0	0	3,848	3,848	NA
1993	1980	0	0	0	4,617	4,617	NA
1994	1990	0	0	0	3,569	3,569	2,099
1995	1990	0	0	0	3,364	3,364	2,304
1996	1990	0	0	172	3,292	3,464	2,505
1997	1990	0	0	0	3,293	3,293	2,047
1998	1990	0	0	0	3,168	3,168	2,132
1999	1990	0	0	128	3,165	3,293	2,047
2000	1990	0	0	0	2,552	2,552	2,386
2000	2000	0	0	0	2,496	2,496	3,100
2001	2000	0	0	0	2,496	2,496	3,100
2002	2000	0	0	0	2,822	2,822	2,399
2003	2000	0	0	0	2,994	2,994	2,227
2004[4]	2000	0	0	82	2,969	3,051	2,678
2005[4]	2000	0	0	82	2,540	2,622	2,731
2006[4]	2000	0	0	82	2,540	2,622	2,698
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**2,450**	**2,450**	**2,853**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**2,434**	**2,434**	**1,802**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**2,512**	**2,512**	**1,452**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**2,505**	**2,505**	**1,385**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**0**	**2,413**	**2,413**	**2,473**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**2,547**	**2,547**	**3,123**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**2,772**	**2,772**	**3,236**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**2,762**	**2,762**	**3,191**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**2,505**	**2,505**	**2,791**
2014 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**2,832**	**2,832**	**3,829**
WINTHROP							
1990	1980	0	676	1,211	2,420	4,307	NA
1992	1980	0	626	1,146	2,488	4,262	NA
1993	1980	0	648	1,211	1,773	3,632	NA
1994	1990	0	417	1,343	5,154	6,914	7,512
1995	1990	0	482	1,611	5,757	7,850	7,077
1996	1990	0	417	1,376	5,930	7,723	7,333
1997	1990	0	417	1,659	6,386	8,462	6,839
1998	1990	0	519	1,522	6,572	8,613	6,507
1999	1990	0	353	1,408	5,946	7,707	7,135
2000	1990	0	277	991	5,240	6,508	7,296
2000	2000	0	247	1,070	4,684	6,001	7,776
2001	2000	0	244	683	4,123	5,050	8,104
2002	2000	0	2	481	2,247	2,730	7,921
2003	2000	0	0	339	1,956	2,295	7,386
2004[4]	2000	0	2	337	1,649	1,988	6,508
2005[4]	2000	0	39	347	1,280	1,666	6,353
2006[4]	2000	0	39	416	1,288	1,743	6,845
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**247**	**1,139**	**1,386**	**6,749**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**244**	**1,409**	**1,653**	**6,547**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**171**	**643**	**814**	**4,221**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**131**	**523**	**654**	**3,960**

Table H-10 Noise-Exposed Population by Community (Continued)							
Year	Census Data	80+ dB DNL	75-80 dB DNL	70-75 dB DNL	65-70 dB DNL[1]	Total (65+)	60-65 dB DNL
WINTHROP							
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**130**	**598**	**728**	**3,720**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**130**	**939**	**1069**	**4,303**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**200**	**1,325**	**1,525**	**5,564**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**200**	**1,186**	**1,386**	**5,305**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**130**	**1,060**	**1,190**	**5,466**
2014 (INMv7.0d)[4]	**2010**	**0**	**0**	**130**	**1,775**	**1,905**	**6,456**
All Communities							
1990	1980	0	676	2,989	40,477	44,142	NA
1992	1980	0	628	2,352	14,604	17,584	NA
1993	1980	0	648	1,475	9,210	11,333	NA
1994	1990	0	523	1,608	16,421	18,552	49,016
1995	1990	0	588	2,462	18,031	21,081	52,896
1996	1990	0	523	1,922	17,997	20,442	59,574
1997	1990	0	523	2,378	23,536	26,437	73,691
1998	1990	0	577	2,102	20,617	23,296	70,062
1999	1990	0	411	1,900	20,838	23,149	64,379
2000	1990	0	335	1,174	15,672	17,181	47,778
2000	2000	0	247	1,304	16,194	17,745	54,190
2001	2000	0	244	998	13,004	14,246	43,616
2002	2000	0	2	613	7,694	8,309	38,150
2003	2000	0	0	503	6,680	7,183	35,577
2004[4]	2000	0	67	611	8,760	9,438	41,975
2005[4]	2000	0	104	533	5,840	6,477	33,127
2006[4]	2000	0	104	597	4,882	5,583	27,496
2007(INMv7.01)[4]	**2000**	**0**	**0**	**416**	**7,683**	**8,099**	**40,822**
2008(INMv7.0b)[4]	**2000**	**0**	**5**	**244**	**7,330**	**7,579**	**35,122**
2009 (INMv7.0b)[4]	**2000**	**0**	**5**	**238**	**4,092**	**4,335**	**23,419**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**198**	**3,672**	**3,870**	**25,125**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**130**	**3,700**	**3,830**	**28,736**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**130**	**3,817**	**3,947**	**19,026**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**200**	**4,536**	**4,736**	**20,876**
2012(INMv7.0d)[4]	**2010**	**0**	**0**	**200**	**4,369**	**4,569**	**19,533**
2013(INMv7.0d)[4]	**2010**	**0**	**0**	**130**	**4,177**	**4,307**	**26,577**
2014(INMv7.0d)[4]	**2010**	**0**	**0**	**164**	**8,758**	**8,922**	**42,864**

Source: Data prepared for Massport by HMMH 2014.
Notes: South End is included in Boston totals.
NA = Not available.
1 65 dB DNL is the federally-defined noise criterion.
2 Portions of Dorchester, East Boston, Roxbury, South Boston
3 Boston population by community changed in 1999 due to employment of more accurate hill effects methodology and reporting change.
4 All results since 2004 are from the RealContoursTM modeling system.

Residential Sound Insulation Program (RSIP)

In 2014, Massport completed sound insulation of 48 residential buildings containing 106 dwelling units, resulting in 5,467 residential buildings and 11,515 dwelling units that have been sound insulated since 1986 when the program was first implemented. Table H-11 lists the yearly progress of this mitigation effort.

Following the FAA's approval of model adjustments based on the effects of terrain (discussed in the *1999 ESPR*), Massport submitted, and the New England Region of the FAA approved, a new sound insulation program. The revised contour, approved for a two-year period beginning in 1999, included dwelling units in East Boston, South Boston, and Winthrop that previously had not been eligible for insulation. Massport received notice of FAA funding for $5 million. Subsequently, Massport updated its program contour, first with the *2001 EDR* contour and more recently with the Logan Airside Improvements Project approved contour. These updates have allowed Massport to continue the program with additional funds every year since 1999. This latest update takes into account runway use changes due to the new Runway 14-32 which opened in late November 2006. This update expands the focus of the sound insulation program into Chelsea to satisfy the mitigation commitments made in the Airside Improvements Program Record of Decision (ROD). Massport has also utilized a program where they have contacted properties that are still eligible within the RSIP boundaries that had previously declined to participate. They have been offered a second chance to participate in the program.

Table H-11 Residential Sound Insulation Program (RSIP) Status (1986-2014)

Construction Year	Residential Buildings[1]	Dwelling Units[2]
1986	4	8
1987	43	51
1988	102	159
1989	94	133
1990	121	200
1991	175	360
1992	197	354
1993	318	654
1994	310	542
1995	372	753
1996	323	577
1997	364	808
1998	328	806
1999	330	718
2000	195	601
2001	260	278
2002	205	354
2003	230	468
2004	320	791
2005	314	471
2006	286	827
2007	160	548
2008	94	388
2009	111	287
2010	56	83
2011	62	114
2012[3]	0	0
2013	45	76
2014	48	106
Total	**5,467**	**11,515**

Source: Massport, 2014.
Notes:
1 Includes multiple units.
2 Individual units.
3 Federal funding was delayed in 2012

Table H-12 provides a list of all schools that have been treated under Massport's sound insulation program. To date, Massport has provided sound insulation to 36 schools at a cost of over $8 million.

Table H-12 Schools Treated Under Massport Sound Insulation Program

Boston:		
East Boston		
East Boston High		$381,948
St. Mary's Star of the Sea		$80,901
St. Dominic Savio High		$127,879
St. Lazarus		$46,092
James Otis		$46,092
Samuel Adams		$120,650
Curtis Guild		$180,572
Dante Alighieri		$97,750
P.J. Kennedy		$127,637
Donald McKay		$231,754
Hugh Roe O'Donnell		$113,564
E Boston Central Catholic		$391,768
Manassah Bradley		$237,500
13	**East Boston Schools**	**$2,184,107**
South Boston:		
St. Augustine		$92,855
Cardinal Cushing		$47,276
Patrick Gavin		$217,077
St. Bridgid's		$112,100
Oliver Hazard Perry		$337,538
Condon School		$294,481
6	**South Boston Schools**	**$1,101,327**
Roxbury and Dorchester:		
Samuel Mason		$192,401
Dearborn Middle		$248,238
Ralph Waldo Emerson		$155,851
Lewis Middle		$202,092
Nathan Hale Elem.		$92,302
Phillis Wheatley Elem.		$290,794
Davis Ellis Elem.		$253,663
Henry L. Higginson		$119,543
8	**Roxbury and Dorchester Schools**	**$1,554,884**
27	**Total Boston Schools**	**$4,840,318**
Winthrop		
Winthrop Jr. High School		$63,756
E. B. Newton		$184,674
A. T. Cummings (Ctr.) School		$800,000
3	**Total Winthrop Schools**	**$1,048,430**
Revere		
Beachmont School		$854,864
1	**Total Revere School**	**$854,864**
Chelsea		
Shurtleff School		$292,207
Williams School		$486,258
St. Rose Elementary		$46,396
St. Stanislaus		$66,298
Chelsea High School		$524,249
5	**Total Chelsea Schools**	**$1,415,408**
36	**Total Schools**	**$8,159,020**

Source: Massport, 2014.

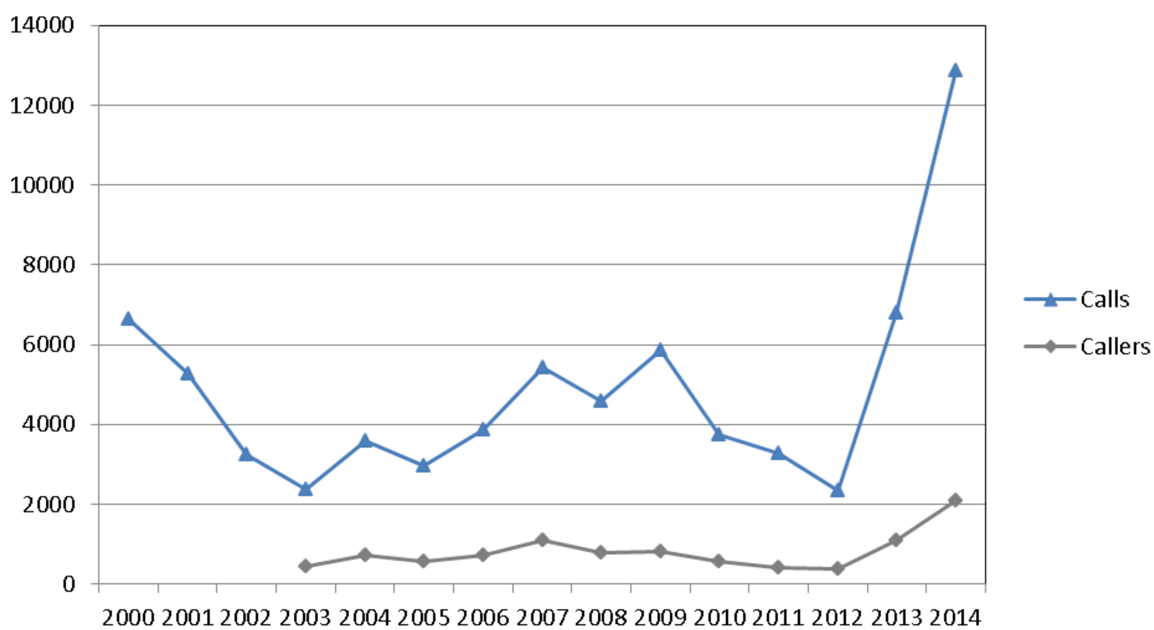
Noise Complaints

Table H-13 presents a detailed list by community of the total complaints made in 2013 and 2014, which can be filed either on Massport's Noise Complaint Line, through a form on Massport's website or through the PublicVue flight track portal. The Noise Complaint Line provides individuals the ability to express their concerns about aviation noise (activities) or to ask questions regarding noise at Logan Airport. Callers ask a range of questions such as "Why is this runway in use?"; "What times do the planes stop flying?" and "Was that aircraft off-course?"

The Noise Abatement Office (NAO) staff documents noise line complaints by obtaining information from the caller about the nature of the complaint, time of the occurrence, location of caller's residence, and the activity that was disturbed. The NAO uses the collected information to determine the probable activity responsible for the complaint and writes a letter report to the complainant. The letter includes the original complaint, a response that identifies the activity responsible for the call (arrivals, departures, run-up, etc.), meteorological information at the time of the call (a major factor in aviation activities), runways in use at the time of the call, and a notice that the FAA will receive a copy of the report.

In 2014, Massport received 12,855 noise complaints from 82 communities (Figure H-13) an increase of 88.8 percent. This large rise in complaints is due to the elimination of the head-to-head procedure at night and FAA changes that increased arrivals to Runway 22L. In addition the continued use of RNAV procedures have caused complaints. The RNAV procedure provides precise routing of departures so that they follow a very narrow path thus concentrating the flight track corridor. As a result, communities under these flight paths such as Belmont, Watertown, Cambridge, and Milton had significant increases in noise complaints in 2014. Higher use of Runway 33L and 15R in 2014 resulted in increased complaints from communities to the west of Logan Airport such as East Boston, Chelsea, Medford and Everett.

Figure H-13 Number of Callers and Complaints between 2000 and 2014



Source: Massport, HMMH 2014.
Notes: Number of callers is not available before 2003.

Massport's website, (www.massport.com/environment/environmental-reporting/noise-abatement/noise-complaints/), provides for additional general questions and answers regarding the Noise Complaint Line.

Table H-13 Noise Complaint Line Summary

Town	2013		2014		
	Calls	Callers	Calls	Callers	Change In Calls from 2013 to 2014
Allston	3	2	0	0	**-3**
Arlington	6	6	332	106	**326**
Athol	0	0	1	1	**1**
Auburn	1	1	0	0	**-1**
Belmont	605	65	1,658	116	**1,053**
Beverly	2	2	2	2	**0**
Billerica	2	2	0	0	**-2**
Boston	103	45	136	17	**33**
Braintree	6	3	2	2	**-4**
Brighton	1	1	1	1	**0**
Brockton	0	0	1	1	**1**
Brookline	3	2	3	2	**0**
Burlington	0	0	3	2	**3**
Cambridge	266	33	585	71	**319**
Canton	42	7	21	4	**-21**
Charlestown	9	8	5	3	**-4**
Chelsea	8	6	66	36	**58**
Cohasset	34	7	46	14	**12**
Dartmouth	0	0	1	1	**1**
Dedham	19	11	24	5	**5**
Dorchester	15	11	38	17	**23**
Durham	1	1	0	0	**-1**
Duxbury	2	1	1	1	**-1**
East Boston	124	42	354	106	**230**
Essex	0	0	27	1	**27**
Everett	50	15	270	54	**220**
Framingham	3	2	25	2	**22**
Gloucester	0	0	5	1	**5**
Hanover	10	3	1	1	**-9**
Harvard	0	0	1	1	**1**
Hingham	42	10	86	17	**44**
Holbrook	2	1	13	2	**11**
Hull	923	156	1,855	332	**932**

Table H-13 Noise Complaint Line Summary (Continued)

Town	2013		2014		Change In
	Calls	Callers	Calls	Callers	Calls from 2013 to 2014
Hyde Park	189	6	50	16	**-139**
Jamaica Plain	169	34	268	89	**99**
Kingston	1	1	1	1	**0**
Lawrence	1	1	0	0	**-1**
Leominster	0	0	2	2	**2**
Lexington	1	1	1	1	**0**
Lunenberg	0	0	3	2	**3**
Lynn	405	5	482	5	**77**
Lynnfield	0	0	2	1	**2**
Malden	1	1	8	5	**7**
Manchester	1	1	2	2	**1**
Marblehead	62	2	61	3	**-1**
Marshfield	7	2	7	6	**0**
Mattapan	0	0	1	1	**1**
Medford	49	33	742	154	**693**
Medway	0	0	1	1	**1**
Melrose	1	1	1	1	**0**
Middleton	0	0	3	2	**3**
Milton	1,925	222	2,669	189	**744**
Nahant	17	9	109	20	**92**
Natick	0	0	3	2	**3**
Newton	4	2	12	6	**8**
Norfolk	1	1	0	0	**-1**
North Andover	2	1	0	0	**-2**
Norwell	5	2	3	2	**-2**
Norwood	2	1	0	0	**-2**
Peabody	9	6	30	11	**21**
Quincy	22	14	27	17	**5**
Randolph	20	7	6	2	**-14**
Reading	3	3	2	2	**-1**
Revere	45	20	86	29	**41**
Rockland	1	1	0	0	**-1**
Roslindale	48	13	127	27	**79**
Roxbury	74	5	113	9	**39**
Ruxbury	0	0	2	2	**2**
Salem	2	2	20	13	**18**
Saugus	2	2	0	0	**-2**

Source: Massport, HMMH 2014.

Table H-13 Noise Complaint Line Summary (Continued)

Town	2013		2014		
	Calls	Callers	Calls	Callers	Change In Calls from 2013 to 2014
Scituate	1	1	4	4	**3**
Sherborn	1	1	0	0	**-1**
Shirley	0	0	6	2	**6**
Somerset	1	1	0	0	**-1**
Somerville	166	72	938	239	**772**
South Boston	438	22	67	26	**-371**
South Easton	0	0	1	1	**1**
South End	160	15	272	35	**112**
South Hamilton	0	0	2	1	**2**
Stoughton	1	1	1	1	**0**
Swampscott	1	1	5	3	**4**
Tewksbury	1	1	0	0	**-1**
Wakefield	1	1	1	1	**0**
Walpole	2	2	0	0	**-2**
Waltham	3	1	5	3	**2**
Watertown	196	44	541	72	**345**
Wellesley	0	0	1	1	**1**
Wenham	0	0	3	2	**3**
West Roxbury	8	5	24	9	**16**
Weston	0	0	1	1	**1**
Weymouth	217	7	83	7	**-134**
Wilmington	0	0	1	1	**1**
Winchendon	0	0	1	1	**1**
Winchester	6	4	246	31	**240**
Winthrop	252	86	237	98	**-15**
Woburn	2	1	8	3	**6**
Worcester	1	1	0	0	**-1**
Grand Total	**6,809**	**1,109**	**12,855**	**2,084**	**6,046**

Source: Massport, HMMH 2014.

Cumulative Noise Index (CNI)

Massport reports total annual fleet noise at Logan Airport, defined in the Logan Airport Noise Rules by a metric referred to as the CNI. The CNI is a single number representing the sum of the entire set of single-event noise levels experienced at the Airport over a full year of operation, weighted similarly to DNL so that activity occurring at night is penalized by adding an extra 10 dB to each event. This penalty is mathematically equivalent to multiplying the number of nighttime events by each aircraft by a factor of 10. The Logan Airport Noise Rules define CNI in terms of Effective Perceived Noise Level (EPNL) and require that the index be computed for the fleet of commercial aircraft operating at Logan Airport throughout the year. In addition, in EDRs and ESPRs, Massport reports partial CNI values of noise at Logan Airport, so that various subsets of the fleet (cargo, night operations, passenger jets, etc.) are identified (see Table H-14).

The Noise Rules, adopted by Massport following public hearings held in February 1986, established a CNI limit of 156.5 Effective Perceived Noise Decibels (EPNdB). The CNI generally has decreased since 1990, remaining below that cap, with changes from year to year on the order of a few tenths of a decibel. The 2012 and 2014 CNI remain well below the cap of 156.5 EPNL.

Table H-14 Cumulative Noise Index (EPNL) - 1990 to 2014

	Logan Airport CNI Cap – 156.5 EPNL									
Full CNI (Entire	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Commercial Jet Fleet)	156.4	155.8	155.5	155.3	155.4	155.3	155.1	154.8	154.7	154.9
Total Passenger Jets	155.2	154.8	154.6	154.4	154.4	154.2	154.1	153.9	153.7	153.9
Total Cargo Jets	150.1	148.9	148.0	147.9	148.3	148.8	148.6	147.5	147.9	148.0
Total Daytime	152.5	152.1	152.4	152.1	152.1	151.6	151.2	150.8	150.4	150.4
Total Nighttime	154.4	153.4	152.6	152.4	152.6	152.9	152.9	152.5	152.7	153.1
Total Stage 2 Jets	NA	NA	NA	NA	151.0	150.2	149.4	149.2	147.7	147.1
Total Stage 3 Jets	NA	NA	NA	NA	153.4	153.8	153.8	153.4	153.8	154.2
Daytime Stage 2	NA	NA	NA	NA	149.0	148.5	147.6	146.5	145.2	144.1
Nighttime Stage 2	NA	NA	NA	NA	146.7	145.1	144.8	145.8	144.1	144.0
Daytime Stage 3	NA	NA	NA	NA	149.1	148.8	148.7	148.8	148.9	149.2
Nighttime Stage 3	NA	NA	NA	NA	151.4	152.1	152.2	151.5	152.1	152.5
Passenger Jet Stage 2	NA	NA	NA	NA	150.5	149.9	149.2	148.9	147.5	146.8
Passenger Jet Stage 3	NA	NA	NA	NA	152.2	152.3	152.3	152.2	152.6	153.0
Cargo Jet Stage 2	NA	NA	NA	NA	141.5	137.4	136.8	137.4	139.0	134.5
Cargo Jet Stage 3	NA	NA	NA	NA	147.3	148.5	148.3	147.0	147.3	147.9
Daytime Passenger	NA	152.0	152.2	152.0	152.0	151.5	151.1	150.6	150.1	150.1
Nighttime Passenger	NA	151.6	150.9	150.6	150.8	151.0	151.0	151.1	151.2	151.6
Daytime Cargo	137.1	137.1	137.6	135.2	136.1	138.0	136.7	136.2	138.0	138.2
Nighttime Cargo	149.9	148.6	147.6	147.6	148.0	148.4	148.3	147.1	147.5	147.6
Daytime Passenger Stage 2	NA	NA	NA	NA	148.9	148.4	147.6	146.5	145.0	143.9
Daytime Passenger Stage 3	NA	NA	NA	NA	149.0	148.5	148.4	148.5	148.6	149.0
Nighttime Passenger Stage 2	NA	NA	NA	NA	149.0	148.5	148.4	148.5	142.8	143.7
Nighttime Passenger Stage 3	NA	NA	NA	NA	149.4	149.9	150.1	149.8	150.5	150.8
Daytime Cargo Stage 2	NA	NA	NA	NA	128.3	126.7	124.6	126.4	131.6	131.5
Daytime Cargo Stage 3	NA	NA	NA	NA	135.3	137.7	136.4	135.7	136.9	137.1
Nighttime Cargo Stage 2	NA	NA	NA	NA	141.3	137.0	136.5	137.0	138.2	131.5
Nighttime Cargo Stage 3	NA	NA	NA	NA	147.0	148.1	148.0	146.6	146.9	147.5

Table H-14 Cumulative Noise Index (EPNL) - 1990 to 2014 (Continued)

	Logan Airport CNI Cap – 156.5 EPNL									
Full CNI (Entire Commercial Jet Fleet)	2000 154.7	2001 154.1	2002 153.2	2003 152.7	2004 153.4	2005 153.2	2006 152.6	2007 152.7	2008 152.9	2009 152.3
Total Passenger Jets	153.6	152.9	151.8	151.3	152.2	152.1	151.4	151.5	151.9	151.1
Total Cargo Jets	148.2	147.8	147.4	147.1	147.0	146.6	146.5	146.4	146.1	145.9
Total Daytime	149.5	149.0	148.5	148.0	148.5	148.2	147.5	147.2	147.6	147.1
Total Nighttime	153.1	152.4	151.3	150.9	151.7	151.6	151.0	151.2	151.4	150.7
Total Stage 2 Jets	124.7	121.5	114.3	114.1	118.1	NA	NA	NA	NA	NA
Total Stage 3 Jets	154.7	154.1	153.2	152.7	153.4	153.2	152.6	152.7	152.9	152.3
Daytime Stage 2	122.6	119.3	111.2	113.7	109.4	NA	NA	NA	NA	NA
Nighttime Stage 2	120.5	117.3	111.4	103.2	117.5	NA	NA	NA	NA	NA
Daytime Stage 3	149.5	149.0	148.5	148.0	148.5	148.2	147.5	147.2	147.6	147.1
Nighttime Stage 3	153.1	152.4	151.3	150.9	151.7	151.6	151.0	151.2	151.4	150.7
Passenger Jet Stage 2	124.2	116.3	NA	NA	NA	NA	NA	NA	NA	NA
Passenger Jet Stage 3	153.6	152.9	151.8	151.3	152.2	152.1	151.4	151.5	151.9	151.1
Cargo Jet Stage 2	114.8	119.9	114.3	114.1	118.1	NA	NA	NA	NA	NA
Cargo Jet Stage 3	148.2	147.8	147.4	147.1	147.0	146.6	146.5	146.4	146.1	145.9
Daytime Passenger	149.3	148.7	148.2	147.7	148.2	147.9	147.2	146.9	147.3	146.8
Nighttime Passenger	151.6	150.8	149.4	148.8	150.0	150.1	149.3	149.7	150.0	149.1
Daytime Cargo	137.5	137.1	137.0	136.2	135.7	135.8	135.5	135.8	135.8	135.2
Nighttime Cargo	147.8	147.4	147.0	146.8	146.7	146.2	146.1	146.0	145.6	145.5
Daytime Passenger Stage 2	122.3	115.0	NA	NA	NA	NA	NA	NA	NA	NA
Daytime Passenger Stage 3	149.2	148.7	148.2	147.7	148.2	147.9	147.2	146.9	147.3	146.8
Nighttime Passenger Stage 2	119.8	110.2	NA	NA	NA	NA	NA	NA	NA	NA
Nighttime Passenger Stage 3	151.6	150.8	149.4	148.8	150.0	150.1	149.3	149.7	150.0	149.1
Daytime Cargo Stage 2	111.1	117.3	111.2	113.7	109.4	NA	NA	NA	NA	NA
Daytime Cargo Stage 3	137.5	137.0	137.0	136.1	135.7	135.8	135.5	135.8	135.8	135.2
Nighttime Cargo Stage 2	112.3	116.4	111.4	103.2	117.5	NA	NA	NA	NA	NA
Nighttime Cargo Stage 3	147.8	147.4	147.0	146.8	146.7	146.2	146.1	146.0	145.6	145.5

Table H-14	Cumulative Noise Index (EPNL) - 1990 to 2014 (Continued)					
	Logan Airport CNI Cap – 156.5 EPNL					
Full CNI (Entire Commercial Jet Fleet)	2010	2011	2012	2013	2014	Change 2013 to 2014
	151.9	**152.1**	**152.2**	**152.3**	**152.9**	**0.6**
Total Passenger Jets	150.9	150.6	151.3	151.4	152.2	0.8
Total Cargo Jets	145.1	146.7	144.9	145.1	144.5	-0.6
Total Daytime	146.8	146.9	147	147.0	147.5	0.5
Total Nighttime	150.3	150.6	150.6	150.8	151.3	0.5
Total Stage 2 Jets	113.6	110.8	104.9	111.3	NA	NA
Total Stage 3 Jets	151.9	152.1	152.2	152.3	152.9	0.6
Daytime Stage 2	103.6	NA	104.9	101.4	NA	NA
Nighttime Stage 2	113.1	110.8	NA	110.8	NA	NA
Daytime Stage 3	146.8	146.9	147	147.0	147.5	0.5
Nighttime Stage 3	150.3	150.6	150.6	150.8	151.3	0.5
Passenger Jet Stage 2	NA	NA	104.9	101.4	NA	NA
Passenger Jet Stage 3	150.9	150.6	151.3	151.4	152.2	0.8
Cargo Jet Stage 2	113.6	110.8	NA	110.8	NA	NA
Cargo Jet Stage 3	145.1	146.7	144.9	145.1	144.5	-0.6
Daytime Passenger	146.6	146.5	146.8	146.8	147.3	0.5
Nighttime Passenger	149.0	148.5	149.4	149.6	150.5	0.9
Daytime Cargo	134.5	136.6	134	133.6	134.9	1.3
Nighttime Cargo	144.7	146.3	144.5	144.8	144.0	-0.8
Daytime Passenger Stage 2	NA	NA	104.9	101.4	NA	NA
Daytime Passenger Stage 3	146.6	146.5	146.8	146.8	147.3	0.5
Nighttime Passenger Stage 2	NA	NA	NA	NA	NA	NA
Nighttime Passenger Stage 3	149.0	148.5	149.4	149.6	150.5	0.9
Daytime Cargo Stage 2	103.6	NA	NA	NA	NA	NA
Daytime Cargo Stage 3	134.4	136.6	134	133.6	134.9	1.3
Nighttime Cargo Stage 2	113.1	110.8	NA	110.8	NA	NA
Nighttime Cargo Stage 3	144.7	146.3	144.5	144.8	144.0	-0.8

Source: HMMH, 2014.
Notes: GA and non-jet aircraft are not included in the calculation.
NA = Not available.

Flight Track Monitoring Report

Introduction

As part of its ongoing commitment to mitigate noise at Logan Airport, Massport has undertaken evaluating the flight tracks of turbojet aircraft engaged in the implementation of established FAA noise abatement procedures. As is true for any airport operator, however, Massport has no authority to control where individual aircraft actually fly. That remains the responsibility of the FAA, while the individual pilots are responsible for safely executing the FAA's instructions. The flight procedures, which are used by the Air Traffic Control (ATC) staff at Boston Tower to achieve desired noise abatement tracks, are contained in the FAA's Tower Order (BOS TWR 7040.1).

This is the thirteenth annual report for flight track monitoring. Prior to 2002, Massport had issued semi-annual reports, an outgrowth of the Flight Track Monitoring Program study. That study was contained in the *Generic Environmental Impact Report* filed with Massachusetts Environmental Policy Act (MEPA) in July 1996, and was the subject of two Community Working Group workshops in September and October 1996. The twelfth annual report was published in *Appendix H, Noise Abatement* in the *2012*/2013 *EDR* and covered both 2012 and 2013. The information for 2013 is repeated in this report for reference. The period covered by this *2014 EDR* is January 1, 2014 through December 31, 2014.

The purpose of the ongoing monitoring program is to identify any systematic changes in flight tracks that may occur and to reduce flight track dispersion, where appropriate. The next report will cover the period January 1, 2015 through December 31, 2015, and will be included in the next EDR.

FAA Air Traffic Control (ATC) Procedures

FAA Tower Order BOS TWR 7040.1 entitled "Noise Abatement" describes the series of noise abatement policies, rules, regulations, and the procedures to be followed by the FAA air traffic controllers in meeting their designated responsibilities to be "a good neighbor, while meeting our operational objectives/responsibilities to the National Airspace System." Section 7.a.3 of the Order, subtitled "Turbojet Departure Noise Abatement Procedures," states that all turbojet departures shall be issued the Standard Instrument Departure (SID) procedure appropriate for the departure runway. They are paraphrased from the LOGAN SEVEN SID below.

Note in the descriptions that follow that terms such as "BOS 2 DME" are used frequently. Here, BOS refers to an aid to navigation known as the BOSTON VORTAC, a radio beacon physically located on Logan Airport near the eastern shoreline between the ends of Runways 27 and 33L (see Figure H-14). DME refers to "Distance Measuring Equipment," a co-located aid to navigation that provides pilots with a cockpit display of the number of nautical miles that the aircraft is from the designated radio beacon. Thus, BOS 2 DME means an aircraft should be two nautical miles away from the BOS. The term "vectored" means the pilot is assigned to fly a magnetic heading given by and at the discretion of the FAA air traffic controller to maintain the safe separation of aircraft. "MSL" is defined as feet above mean sea level and is the indicator of aircraft altitude used both by the pilot in the cockpit and the air traffic controller on the ground.

During 2010, several of the conventional-only (or radar vector) and RNAV procedures from the Boston Logan Airport Noise Study Categorical Exclusion (CATEX)[14] were implemented. There are eight new RNAV procedures

14 Federal Aviation Administration (FAA) Boston Logan Airport Noise Study Categorical Exclusion Record of Decision (CATEX ROD), Issued October 16, 2007

for departures from Logan Airport. These eight procedures are used by aircraft departing Runways 4R, 9, 15R, 22L, 22R, 27, and 33L (Runways 27 and 33L were added in 2014). These procedures primarily affected departures flying over the North and South shores and were designed to increase the amount of jet traffic crossing back over land above 6,000 feet to minimize noise impacts to communities. A ninth RNAV procedure, which is used by Runway 27, has been in use at the Airport and has been modified several times.

For departures, the conventional procedures (flown by non-RNAV equipped aircraft) from the LOGAN SEVEN SID are:

- For Runway 4R, climb heading 036 degrees to BOS 4 DME, then turn right to a heading of 090 degrees, and then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 9, climb heading 093 degrees, and then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 14, climb heading 142 degrees to BOS 1 DME, then turn left to heading 120 degrees, then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 15R, climb heading 151 degrees to BOS 1 DME then turn left to 120 degrees, then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runways 22R and 22L, climbing left turn to a heading of 140 degrees, then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 33L, climb heading 331 degrees to BOS 2 DME then turn left to 316 degrees, then expect radar vectors to assigned route/navaid/fix.
- For Runway 27, climb heading 273 to BOS 2.2 DME, then turn left heading 235 degrees, then expect radar vectors to assigned route/navaid/fix.

The RNAV procedures (used only by Turbojets) and the runways they serve:

- BLZZR TWO – Runways 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore near Cohasset and Scituate.
- BRUWN THREE – Runways 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean towards Cape Cod.
- CELTK THREE – Runways 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean.
- HYLND THREE – 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the North Shore near Beverly.
- LBSTA THREE – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the North Shore near Manchester and Gloucester.
- PATSS THREE – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore near Cohasset and Scituate.

- REVSS TWO – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore near Cohasset and Scituate.
- SSOXS THREE – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore over Marshfield.
- WYLYY ONE – 27: This procedure directs most jet traffic in a well-defined flight corridor on a heading of 273 degrees then a turn to 235 degrees over South Boston.

These brief procedural statements form the basis of the verbal instructions and flight clearances that are passed from controller to pilot to achieve reduced noise in the communities surrounding Logan Airport while also maintaining the safe and efficient flow of aircraft in and out of the Airport. However, consistency with which these procedures are used varies due to air traffic demands, controller workloads, weather conditions, and other operational factors, as noted in the Flight Track Monitoring Program Study.

Figure H-15 presents the gates used in the analysis for the Flight Track Monitoring Report. These gates are virtual vertical planes, which are used in the analysis to capture the aircraft flight paths. The gates are defined using a geographic coordinate for each end of the gate along with a floor and a ceiling altitude. The gates also capture direction of flights (in or out). The edges of each gate in Figure H-15 point in the direction that the aircraft is coming from. This information is used to evaluate the performance of the flight procedures off each runway end and is presented below. Figure H-15 also displays the BOS location, which is used for the distance measurements for the conventional procedures.

The RNAV procedures are still captured by the original flight track monitoring gates. Traffic crossing over the North Shore passes through the Marblehead Gate and traffic passing over the South Shore passes through the Hull 2, Hull 3, and Cohasset Gates. Turbojets departing Runway 27 on the RNAV pass through the Runway 27 gates and the new Runway 33L RNAV flight tracks still pass between the Somerville and Everett gates as expected.

Source: HMMH, MassGIS, USDA NAIP 2010

Logan Airport Flight Track Monitor Gates

Logan Flight Gates

Boston VOR/DME

Figure H-14

Statistical Analyses of Flight Tracks - Runway 4R

The Nahant Gate (Figure H-15) monitors aircraft after the first turn at 4 DME. The Swampscott and Marblehead Gates monitor northbound shoreline crossings, while the Hull 2, Hull 3, and Cohasset Gates monitor southbound shoreline crossings.

Tables H-15a and H-15b show that Runway 4R departures for 2014 were concentrated, with 99.0 percent "over the Causeway," and about 0.2 percent over the south end of the gate compared to 99.2 percent over the Causeway in 2013 and 0.1 percent over the south end of the gate. Departures through the north end of the gate increased from 0.7 percent in 2013 to 0.8 percent in 2014.

Table H-15a Runway 4R Nahant Gate Summary for 2013

	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North End of Gate	48	6,835	0.7%
Over Causeway	6,780	6,835	99.2%
South End of Gate	7	6,835	0.1%
Total	**6,835**	**6,835**	**100.0%**

Source: Massport, HMMH 2013.

Table H-15b Runway 4R Nahant Gate Summary for 2014

	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North End of Gate	54	6,787	0.8%
Over Causeway	6,717	6,787	99.0%
South End of Gate	16	6,787	0.2%
Total	**6,787**	**6,787**	**100.00%**

Source: Massport, HMMH 2014.

Table H-16a and H-16b show how many of the shoreline crossings from Runway 4R were above 6,000 feet. For 2014, 96.9 percent of the flights were above 6,000 feet compared to 98.4 percent in 2013. The Swampscott gate had 30.0 percent of flights above 6,000 feet in 2014 compared to 24.2 percent in 2013. The number of flights through the Swampscott gate increased in 2014 (60 in 2013, up to 124 in 2014). The crossing percentage for this gate is historically lower than most gates due to its proximity to the Nahant gate itself. As seen in Figure H-15, the Swampscott gate is adjacent to the Nahant gate and aircraft would have to climb very quickly to be above 6,000 feet when crossing the Swampscott gate.

Table H-16a Runway 4R Shoreline Crossings Above 6,000 Feet for 2013			
	Number of Tracks Through Gate	**Number Above 6,000 ft**	**Percentage Above 6,000 ft**
Swampscott Gate	60	18	30.0%
Marblehead Gate	2,826	2,801	99.1%
Hull 2 Gate	291	291	100.0%
Hull 3 Gate	1,213	1,208	99.6%
Cohasset Gate	223	223	100.0%
Total	**4,613**	**4,541**	**98.4%**

Source: Massport, HMMH 2013.

Table H-16b Runway 4R Shoreline Crossings Above 6,000 Feet for 2014			
	Number of Tracks Through Gate	**Number Above 6,000 ft**	**Percentage Above 6,000 ft**
Swampscott Gate	124	30	24.2%
Marblehead Gate	2,856	2,817	98.6%
Hull 2 Gate	280	280	100.0%
Hull 3 Gate	856	855	99.9%
Cohasset Gate	181	181	100.0%
Total	**4,297**	**4,163**	**96.9%**

Source: Massport, HMMH 2014.

Statistical Analyses of Flight Tracks - Runway 9

The Winthrop 1 and Winthrop 2 gates (Figure H-15) monitor early turns for departures off Runway 9. The Revere, Swampscott, or Marblehead gates monitor northbound shoreline crossings, while the Hull 2, Hull 3, or Cohasset gates monitor southbound shoreline crossings.

Tables H-17a and H-17b show how many tracks turned prior to the BOS 2 DME. Northbound turns before BOS 2 DME pass through the Winthrop 1 Gate. Southbound traffic would pass through the Winthrop 2 Gate. In 2014, between both gates there were a total of 52 such turns, 0.1 percent. In 2013 52 tracks or 0.1 percent of the total also crossed these gates.

Table H-17a Runway 9 Gate Summary — Winthrop Gates 1 and 2 for 2013			
	Number of Departure Tracks	**Number of Tracks Through Gate**	**Percent Turning Before BOS 2 DME**
Winthrop 1 Gate	44,851	20	<0.1%
Winthrop 2 Gate	44,851	32	0.1%
Total	**44,851**	**52**	**0.1%**

Source: Massport, HMMH 2013.

Table H-17b Runway 9 Gate Summary — Winthrop Gates 1 and 2 for 2014			
	Number of Departure Tracks	Number of Tracks Through Gate	Percent Turning Before BOS 2 DME
Winthrop 1 Gate	44,979	27	0.1%
Winthrop 2 Gate	44,979	25	0.1%
Total	**44,979**	**52**	**0.1%**

Source: Massport, HMMH 2014.

Table H-18a and H-18b indicate that 98.5 percent of Runway 9 departures were above 6,000 feet when crossing the shoreline in 2014, compared with 99.3 percent in 2013. The number of Runway 9 departures crossing back over the South Shore decreased from 34,370 in 2013 to 31,370 in 2014.

A decrease in the percentage above 6,000 feet occurred at the Revere gate (58.7 percent in 2013 to 43.7 percent in 2014) and a slight decrease at the Hull 2 gate (99.6 percent in 2013 to 99.0 percent in 2014).

The number of crossings decreased slightly for the Revere gate (46 in 2013 to 45 in 2014) and increased at the Swampscott gate (165 in 2013 to 316 in 2014). The Marblehead gate had a decrease in crossings (from 10,973 in 2013 to 10,596 in 2014), and an increase in the percent above 6,000 feet (from 99.5 percent in 2013 to 99.6 percent in 2014). Both the Hull 2 and Hull 3 gates had an increase in crossings compared to 2013. Hull 2 increased from 1,600 in 2013 to 1,920 in 2014 and Hull 3 increased from 3,640 in 2013 to 4,123 in 2014. The Hull 2 crossing percentage dropped slightly from 99.6 percent in 2013 to 99.0 percent in 2014, and the Hull 3 gate crossings decreased from 98.0 percent to 95.6 percent. The crossings through the Cohasset gate decreased (from 17,865 in 2013 to 14,156 in 2014) and the percent above 6,000 feet increased slightly from 98.6 percent in 2013 to 98.9 percent in 2014.

Table H-18a Runway 9 Shoreline Crossings Above 6,000 Feet for 2013			
	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Revere Gate	46	27	58.7%
Swampscott Gate	165	141	85.5%
Marblehead Gate	10,973	10,921	99.5%
Hull 2 Gate	1,607	1,600	99.6%
Hull 3 Gate	3,714	3,640	98.0%
Cohasset Gate	17,865	17,802	99.6%
Total	**34,370**	**34,131**	**99.3%**

Source: Massport, HMMH 2013.

Table H-18b Runway 9 Shoreline Crossings Above 6,000 Feet for 2014			
	Number of Tracks Through Gate	**Number Above 6,000 ft**	**Percentage Above 6,000 ft**
Revere Gate	45	21	46.7%
Swampscott Gate	316	278	88.0%
Marblehead Gate	10,596	10,552	99.6%
Hull 2 Gate	1,939	1,920	99.0%
Hull 3 Gate	4,318	4,126	95.6%
Cohasset Gate	14,156	13,994	98.9%
Total	**31,370**	**30,891**	**98.5%**

Source: Massport, HMMH 2014.

Statistical Analyses of Flight Tracks - Runway 15R

After takeoff, Runway 15R departures turn left approximately 30 degrees to avoid Hull, head out over Boston Harbor, and return back over the shore through the Swampscott and Marblehead Gates (Figure H-15) to the north, or through the Hull 2, Hull 3, and Cohasset Gates to the south. Tables H-19a and H-19b indicate that 98.2 percent of Runway 15R departures were above 6,000 feet when crossing the shoreline in 2014, compared with 99.5 percent in 2013. At 99.2 percent, the percent above 6,000 feet for the Swampscott Gate increased in 2014, from 95.8 percent in 2013. The Marblehead gate had an increase in crossings (from 1,598 in 2013 to 1,638 in 2014) and kept a constant 99.9 percent above 6,000 feet. The Hull 2 gate increased its percentage from 72.7 percent in 2013 to 100 percent in 2014, and the Hull 3 gate decreased from 93.1 percent in 2013 to 83.2 percent in 2014. The Cohasset gate had a decrease in crossings (from 2,853 in 2013 to 2,207 in 2015) and the percent above 6,000 feet decreased from 99.8 percent to 98.1 percent.

Table H-19a Runway 15R Shoreline Crossings Above 6,000 Feet for 2013			
	Number of Tracks Through Gate	**Number Above 6,000 ft**	**Percentage Above 6,000 ft**
Swampscott Gate	71	68	95.8%
Marblehead Gate	1,598	1,596	99.9%
Hull 2 Gate	11	8	72.7%
Hull 3 Gate	159	148	93.1%
Cohasset Gate	2,853	2,848	99.8%
Total	**4,692**	**4,668**	**99.5%**

Source: Massport, HMMH 2013.

Table H-19b Runway 15R Shoreline Crossings Above 6,000 Feet for 2014			
	Number of Tracks Through Gate	**Number Above 6,000 ft**	**Percentage Above 6,000 ft**
Swampscott Gate	120	119	99.2%
Marblehead Gate	1,638	1,636	99.9%
Hull 2 Gate	4	4	100.0%
Hull 3 Gate	191	159	83.2%
Cohasset Gate	2,207	2,166	98.1%
Total	**4,160**	**4,084**	**98.2%**

Source: Massport, HMMH 2014.

Statistical Analyses of Flight Tracks - Runways 22R and 22L

The Squantum 2 and Hull 1 Gates (Figure H-15) are used to monitor the turn to 140 degrees over Boston Harbor and north of Hull. The shoreline gates are used to monitor shoreline crossings, as for Runways 4R, 9, and 15R above.

Tables H-20a and H-20b show the dispersion of the jet departures from Runways 22R and 22L as they pass through the Squantum 2 Gate. The first segment of the gate is the northernmost segment and is primarily over Boston Harbor. The other segments extend southward toward Quincy. The percentage of tracks passing through the first two segments of this gate increased from 88.2 percent in 2013 to 89.5 percent in 2014.

Table H-20a Runways 22R and 22L Squantum 2 Gate Summary for 2013			
	Number of Tracks Through Gate Segment	**Total Number of Tracks Through All Gate Segments**	**Percentage of Tracks Through Gate Segment**
0 - 12,000 ft	6,143	55,064	11.2%
12,000 - 14,000 ft	42,424	55,064	77.0%
14,000 - 21,000 ft	6,453	55,064	11.7%
21,000 - 27,000 ft	44	55,064	0.1%
Total	**55,064**	**55,064**	**100.0%**

Source: Massport, HMMH 2013.
Note: Percentages sum to more than 100 percent due to rounding.

Table H-20b Runways 22R and 22L Squantum 2 Gate Summary for 2014

	Number of Tracks Through Gate Segment	Total Number of Tracks Through All Gate Segments	Percentage of Tracks Through Gate Segment
0 - 12,000 ft	2,297	44,093	5.2%
12,000 - 14,000 ft	37,161	44,093	84.3%
14,000 - 21,000 ft	4,594	44,093	10.4%
21,000 - 27,000 ft	41	44,093	0.1%
Total	**44,093**	**44,093**	**100.0%**

Source: Massport, HMMH 2014.
Note: Percentages sum to more than 100 percent due to rounding.

Tables H-21a and H-21b show that the percent of tracks crossing north of the Hull peninsula as they passed through the Hull 1 Gate remains constant at 98.9 percent in both 2013 and 2014.

Table H-21a Runways 15R, 22R, and 22L Hull 1 Gate Summary – North of Hull Peninsula for 2013

	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North of Hull Peninsula	61,493	62,199	98.9%
Over Hull	706	62,199	1.1%
Total	**62,199**	**62,199**	**100.0%**

Source: Massport, HMMH 2013

Table H-21b Runways 15R, 22R, and 22L Hull 1 Gate Summary – North of Hull Peninsula for 2014

	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North of Hull Peninsula	50,327	50,909	98.9%
Over Hull	582	50,909	1.1%
Total	**50,909**	**50,909**	**100.0%**

Source: Massport, HMMH 2014.

Tables H-22a and H-22b indicate that 98.9 percent of Runway 22R/22L departures were above 6,000 feet when crossing the shoreline in 2014, compared with 99.8 percent in 2013. For the Revere gate, the percent above 6,000 feet decreased from 98.1 percent in 2013 to 95.9 percent in 2014. The Swampscott gate increased from 95.8 percent in 2013 to 99.1 percent in 2014. The Marblehead gate had a decrease in crossings (from 14,362 in 2013 to 11,027 in 2014) and the percent above 6,000 feet remained the same as 2011 at nearly 100 percent. The Hull 2 gate decreased in percent above 6,000 feet from 96.3 percent in 2013 to 91.3 percent in 2014. The Hull 3 gate decreased in percent above 6,000 feet from 99.9 percent in 2013 to 93.1 percent in 2014. The number of crossings for the Cohasset gate decreased (24,108 in 2013 to 17,117 in 2014) and the percentage slightly decreased from 99.9 percent in 2013 to 98.8 percent in 2014.

Table H-22a Runways 22R and 22L Shoreline Crossings Above 6,000 Feet for 2013

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Revere Gate	54	53	98.1%
Swampscott Gate	343	338	98.5%
Marblehead Gate	14,362	14,357	100.0%
Hull 2 Gate	27	26	96.3%
Hull 3 Gate	1,027	997	97.1%
Cohasset Gate	24,108	24,072	99.9%
Total	**39,921**	**39,843**	**99.8%**

Source: Massport, HMMH 2013.

Table H-22b Runways 22R and 22L Shoreline Crossings Above 6,000 Feet for 2014

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Revere Gate	73	70	95.9%
Swampscott Gate	444	440	99.1%
Marblehead Gate	11,027	11,021	99.9%
Hull 2 Gate	23	21	91.3%
Hull 3 Gate	1,318	1227	93.1%
Cohasset Gate	17,117	16,904	98.8%
Total	**30,002**	**29,683**	**98.9%**

Source: Massport, HMMH 2014.

Runway 27

On September 15, 1996, the FAA implemented a new departure procedure for Runway 27 called the WYLYY RNAV procedure. In accordance with the provisions of the ROD issued for the Runway 27 Environmental Impact Statement, Massport has been providing on-going radar flight track data and analysis to the FAA with respect to the procedure.

In 2012, for the first time since 1997 when flight track monitoring began, each gate (Gates A through E) averaged over 68 percent for every month the Airport had all runways open and for the annual average. The percent of flight tracks through all gates (a number tracked but not required per the 1996 ROD) rounded up to 68 percent for the last two months of 2011 and continued for all of 2012. The FAA had discussed these data internally and concluded that acceptable flight track dispersion had been achieved and that no subsequent action by FAA is required per the 1996 ROD requirements.[15]

15 Logan Airport Runway 27 Advisory Committee Meeting - January 23, 2012 meeting minutes

Massport will continue to provide Tables H-23a and H-23b in the subsequent annual reports. Table H-23a presents the conformance results for the Runway 27 corridor for 2013 and Table H-23b for 2014. The average percentage of tracks through the corridor was 75.0 percent for 2013 and 76.8 percent for 2014.

Each gate is further from the runway and falls along the procedure. The gates also increase in width as the distance is increased along the flight path and they form a noise abatement corridor. A consistent percentage of traffic through each gate means that flights are not entering the corridor late or exiting the corridor too early. The average percent through each gate was 90.0 percent in 2013 and 92.2 percent in 2014, which means that the majority of the traffic remained in the corridor.

Table H-23a Runway 27 Corridor Percent of Tracks Through Each Gate for 2013

Month	Total # of Tracks	Total # of Tracks Through All Gates	Percent of Tracks Through All Gates	Gate A 1,400 ft[1]	Gate B 2,200 ft[1]	Gate C 2,900 ft[1]	Gate D 4,700 ft[1]	Gate E 6,300 ft[1]	Average Percent Through Each Gate
January	2,409	1,807	75.0%	80.7%	90.5%	95.4%	98.1%	95.6%	92.1%
February	1,152	846	73.4%	79.5%	88.8%	93.8%	97.3%	94.9%	90.9%
March	2,986	2,335	78.2%	82.6%	90.8%	96.2%	98.3%	97.5%	93.1%
April	1,364	1,093	80.1%	83.1%	91.9%	95.6%	97.1%	97.1%	93.0%
May	758	580	76.5%	81.8%	88.8%	95.0%	96.0%	95.7%	91.5%
June	981	728	74.2%	77.4%	85.2%	90.8%	92.1%	92.0%	87.5%
July[2]	439	292	66.5%	67.9%	78.4%	82.7%	86.6%	87.7%	80.6%
August[2]	799	595	74.5%	77.6%	87.9%	92.2%	93.6%	92.9%	88.8%
September[2]	540	394	73.0%	75.0%	85.4%	90.4%	91.9%	90.9%	86.7%
October	1,077	813	75.5%	77.4%	89.5%	93.9%	96.3%	95.8%	90.6%
November	2,454	1,901	77.5%	80.9%	92.2%	95.9%	97.8%	97.2%	92.8%
December	2,853	2,164	75.9%	79.4%	90.7%	96.1%	98.4%	97.7%	92.5%
Average[2]	**1,484**	**1129**	**75.0%**	**78.6%**	**88.3%**	**93.2%**	**95.3%**	**94.6%**	**90.0%**

Source: Massport, HMMH 2013.
Notes: Gray shading indicates the percentage rounds up to 68 percent or greater.
1 Width of each gate in feet.
2 Runway 33L completely closed June 16, 2012 - October 2, 2012, RSA project, reduced use of Runway 27 departures. Excluded from overall average.

Table H-23b Runway 27 Corridor Percent of Tracks Through Each Gate for 2014									
Month	Total # of Tracks	Total # of Tracks Through All Gates	Percent of Tracks Through All Gates	Gate A 1,400 ft[1]	Gate B 2,200 ft[1]	Gate C 2,900 ft[1]	Gate D 4,700 ft[1]	Gate E 6,300 ft[1]	Average Percent Through Each Gate
January	1,841	1,396	75.8%	78.0%	91.6%	95.8%	97.7%	97.3%	92.1%
February	2,132	1591	74.6%	78.0%	90.9%	95.2%	97.1%	96.1%	91.4%
March	1,461	1,134	77.6%	80.4%	92.0%	96.9%	98.0%	97.0%	92.9%
April	1,609	1,237	76.9%	80.1%	91.9%	95.3%	96.7%	96.1%	92.0%
May	1301	1045	80.3%	82.5%	93.4%	97.7%	98.6%	98.1%	94.1%
June	1135	863	76.0%	78.4%	91.0%	95.2%	97.4%	97.1%	91.8%
July	1192	876	73.5%	75.5%	89.1%	94.1%	96.5%	95.6%	90.2%
August	1033	770	74.5%	76.7%	89.5%	96.1%	98.4%	97.6%	91.6%
September	1381	1117	80.9%	83.1%	91.8%	94.7%	96.0%	95.9%	92.3%
October	1,836	1373	74.8%	78.2%	91.1%	95.0%	97.3%	96.2%	91.6%
November	2,797	2,194	78.4%	81.3%	92.8%	96.1%	97.6%	97.0%	92.9%
December	1,410	1,100	78.0%	80.6%	92.8%	96.8%	98.2%	97.3%	93.1%
Average	**1,594**	**1,225**	**76.8%**	**79.4%**	**91.5%**	**95.7%**	**97.5%**	**96.8%**	**92.2%**

Source: Massport, HMMH 2014.
Notes: Gray shading indicates the percentage rounds up to 68 percent or greater.
1 Width of each gate in feet.

Statistical Analyses of Flight Tracks — Runway 33L

The Somerville and Everett Gates (Figure H-15) extend from BOS 2 DME to BOS 5 DME and are used to monitor the departure procedure for Runway 33L. Turns to the left prior to the BOS 5 DME would pass through the Somerville Gate. Turns to the right prior to the BOS 5 DME would pass through the Everett Gate.

Tables H-24a and H-24b indicate the percentage of tracks turning before BOS 5 DME decreases from 4.1 percent in to 2.0 percent in 2014. The total number of tracks increased from 18,643 in 2013 to 25,412 in 2014.

Table H-24a Runway 33L Gates — Passages Below 3,000 Feet for 2013			
	Number of Departure Tracks	Number of Tracks Turning Before BOS 5 DME	Percentage of Tracks Turning Before BOS 5 DME
Everett Gate	18,643	404	2.2%
Somerville Gate	18,643	357	1.9%
Total	**18,643**	**761**	**4.1%**

Source: Massport, HMMH 2013.

Table H-24b Runway 33L Gates — Passages Below 3,000 Feet for 2014

	Number of Departure Tracks	Number of Tracks Turning Before BOS 5 DME	Percentage of Tracks Turning Before BOS 5 DME
Everett Gate	25,412	229	0.9%
Somerville Gate	25,412	285	1.1%
Total	**25,412**	**514**	**2.0%**

Source: Massport, HMMH 2014.

Table H-25 provides the level of traffic off each runway end in 2013 and 2014. These percent's represent the amount of activity experienced off each runway end for a given year.

Table H-25 Runway Usage by Runway End

		2013		2014	
By Runway End	**Operations(s)**	**Total Flights**	**% of Total**	**Total Flights**	**% of Total**
04L	R4L A + R22R D	80,038	22.2%	67,385	18.5%
04R	R4R A + R22L D	50,922	14.1%	52,984	14.6%
09	R9 A + R27 D	18,925	5.2%	21,220	5.8%
14	n/a	0	0.0%	0	0.0%
15L	R15L A + R33R D	54	0.0%	69	0.0%
15R	R15R A + R33L D	24,273	6.7%	34,887	9.6%
22L	R22L A + R4R D	39,399	10.9%	54,116	14.9%
22R	R22R A + R4L D	6,153	1.7%	6,977	1.9%
27	R27 A + R9 D	103,500	28.6%	85,064	23.4%
32	R32 A + R14 D	3,221	0.9%	4,751	1.3%
33L	R33L A + R15R D	33,692	9.3%	35,480	9.8%
33R	R33R A + R15L D	1,160	0.3%	865	0.2%
All		**361,338**	**100.0%**	**363,797**	**100.0%**

Notes: A=Arrivals
1 D=Departures

2014 DNL Levels for Census Block Group Locations

Table H-26 reports the DNL value for each Census block group down to the DNL 50 dB

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250250408013	Charlestown	2,011	1,296	54.3	54.3
250250408012	Charlestown	789	263	53.9	55.1
250250402001	Charlestown	775	304	53.9	54.0
250250408011	Charlestown	1,061	530	53.4	53.4
250250403001	Charlestown	739	334	53.0	53.0
250250402002	Charlestown	831	423	53.0	53.1
250250403004	Charlestown	617	320	52.6	52.6
250250401001	Charlestown	958	555	52.4	52.3
250250403002	Charlestown	1,247	662	52.4	52.3
250250403003	Charlestown	657	366	52.4	52.4
250250406002	Charlestown	1,581	843	52.1	52.2
250250403005	Charlestown	622	355	51.9	51.9
250250401002	Charlestown	1,210	684	51.9	52.0
250250404012	Charlestown	750	456	51.6	51.2
250250404011	Charlestown	1,689	766	51.5	51.4
250250406001	Charlestown	863	485	51.5	52.2
250251006032	Dorchester	598	284	59.5	59.7
250251007002	Dorchester	1,027	526	56.3	58.6
250251007003	Dorchester	672	290	55.7	55.8
250251006031	Dorchester	1,306	556	55.5	55.9
250250913002	Dorchester	1,131	388	55.0	55.0
250250907004	Dorchester	651	302	54.5	55.5
250251007001	Dorchester	1,050	484	54.0	53.8
250250913001	Dorchester	1,368	480	53.3	53.3
250250907002	Dorchester	1,253	644	52.9	53.0
250250914001	Dorchester	1,672	584	52.6	52.8
250251007004	Dorchester	856	371	52.5	52.5
250250909012	Dorchester	2,092	1,034	52.4	55.2
250251006011	Dorchester	1,094	488	51.9	51.8
250250907003	Dorchester	1,153	526	51.9	52.0
250251007005	Dorchester	717	303	51.9	51.8
250250912003	Dorchester	742	296	51.8	51.9
250250912001	Dorchester	1,081	451	51.6	51.7
250250907001	Dorchester	1,218	518	51.3	51.5
250250909011	Dorchester	1,627	606	50.8	50.4

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250250921011	Dorchester	1,113	467	50.7	50.8
250250915001	Dorchester	1,978	744	50.6	50.3
250250915002	Dorchester	1,494	547	50.5	50.5
250250911005	Dorchester	817	297	50.5	50.5
250250912002	Dorchester	1,411	492	50.5	50.6
250250918001	Dorchester	1,517	517	50.5	50.4
250251006012	Dorchester	898	382	50.4	50.2
250250918003	Dorchester	933	357	50.4	50.5
250250921013	Dorchester	729	321	50.3	51.8
250250919001	Dorchester	1,042	329	50.2	50.2
250251008004	Dorchester	1,117	666	50.2	52.7
250250918002	Dorchester	1,002	340	50.1	50.2
250251008003	Dorchester	899	412	50.0	50.0
250250911001	Dorchester	1,395	625	50.0	50.0
250250910013	Dorchester	682	335	49.5	50.7
250250701011	Downtown Boston	816	529	54.8	56.6
250250305001	Downtown Boston	650	442	54.2	53.9
250250303001	Downtown Boston	1,757	1,283	54.1	54.0
250250702002	Downtown Boston	1,133	444	54.0	54.1
250250305002	Downtown Boston	1,025	687	53.7	53.7
250250305003	Downtown Boston	809	527	53.6	53.5
250250701018	Downtown Boston	422	246	53.4	53.5
250250304001	Downtown Boston	1,519	994	53.3	53.2
250250702001	Downtown Boston	1,458	599	53.3	53.3
250250303002	Downtown Boston	963	696	53.3	53.0
250250304002	Downtown Boston	932	665	53.0	52.9
250250301001	Downtown Boston	1,053	790	52.9	52.9
250250701017	Downtown Boston	1,102	701	52.7	52.8
250250301002	Downtown Boston	901	587	52.5	52.5
250250302001	Downtown Boston	1,665	1,103	52.5	52.4
250250303004	Downtown Boston	548	465	52.1	52.2
250250701012	Downtown Boston	195	90	52.0	51.9
250250203032	Downtown Boston	512	365	51.7	51.1
250250702003	Downtown Boston	2,619	647	51.7	51.7
250250303003	Downtown Boston	1,192	503	51.6	51.7

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB

US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250250701016	Downtown Boston	366	325	51.6	51.6
250250701015	Downtown Boston	223	161	51.5	51.3
250250701013	Downtown Boston	494	381	51.2	51.2
250250701014	Downtown Boston	1,887	941	51.1	51.1
250250703002	Downtown Boston	733	449	51.0	50.9
250250203031	Downtown Boston	878	693	50.7	50.7
250250203033	Downtown Boston	1,179	789	50.6	50.6
250250203012	Downtown Boston	1,673	1,209	50.3	50.3
250250203011	**Downtown Boston**	**350**	**205**	**50.1**	**49.8**
250250509011	Eagle Hill East Boston	1,283	420	66.7	67.9
250250509012	Eagle Hill East Boston	1,964	717	64.2	64.0
250250509013	Eagle Hill East Boston	918	309	64.1	65.0
250250507003	Eagle Hill East Boston	1,476	505	62.5	62.8
250250502004	Eagle Hill East Boston	1,055	349	62.4	62.3
250250502003	Eagle Hill East Boston	836	283	62.1	62.0
250250507002	Eagle Hill East Boston	1,344	484	61.2	61.2
250250501011	Eagle Hill East Boston	1,713	534	60.7	61.2
250250501013	Eagle Hill East Boston	1,930	684	60.1	60.2
250250507001	Eagle Hill East Boston	1,684	617	59.9	60.2
250250502002	Eagle Hill East Boston	1,151	445	59.3	59.2
250250502001	Eagle Hill East Boston	2,189	757	59.3	59.3
250250501012	Eagle Hill East Boston	1,472	632	59.1	58.5
250251202012	Jamaica Plain	1,841	894	52.2	52.2
250251202013	Jamaica Plain	451	221	52.2	52.2
250251202011	Jamaica Plain	1,147	611	50.5	50.7
250251201041	**Jamaica Plain**	**516**	**252**	**50.0**	**49.7**
250251204002	Jamaica Plain	676	363	49.9	50.0
250250512001	Jefferies Point	32	19	60.9	59.7
250250512002	Jefferies Point	1,548	692	60.6	60.4
250250512003	Jefferies Point	799	449	59.4	59.6
250250924004	Mattapan	1,142	413	51.4	51.6
250259811004	Mattapan	187	128	51.1	51.9
250251001001	Mattapan	167	61	50.6	50.9
250250511013	Orient Heights	1,537	621	65.1	65.3
250250511014	Orient Heights	910	385	62.8	59.7

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB

US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250250511011	Orient Heights	1,602	598	62.1	61.3
250250511012	Orient Heights	1,949	741	61.3	61.1
250250510001	Other East Boston	2,039	855	66.3	66.3
250250510003	Other East Boston	1,088	467	64.1	64.0
250250510002	Other East Boston	962	462	63.7	60.8
250250505001	Other East Boston	1,857	702	60.5	60.4
250250506001	Other East Boston	1,248	494	59.1	59.2
250250506002	Other East Boston	815	312	58.6	58.9
250250504002	Other East Boston	1,735	797	58.5	58.5
250250504001	Other East Boston	637	237	57.9	57.9
250250503001	Other East Boston	727	282	57.8	57.0
250250503002	Other East Boston	1,524	759	57.0	56.7
250259813002	Other East Boston*	389	244	61.6	88.6
250251101031	Roslindale	568	325	52.9	52.8
250259811003	Roslindale	6	5	52.8	53.3
250251101036	Roslindale	583	271	52.4	52.4
250251101035	Roslindale	1,440	666	52.3	52.2
250251103012	Roslindale	1,271	552	52.1	52.5
250251101034	Roslindale	620	289	51.8	51.7
250251103011	Roslindale	1,134	403	51.7	52.0
250251101033	Roslindale	653	241	50.4	51.3
250251102011	Roslindale	2,051	874	50.1	50.8
250251104011	**Roslindale**	**1,185**	**417**	**50.0**	**49.8**
250250801001	Roxbury	1,096	450	57.0	57.5
250250906001	Roxbury	1,094	351	56.6	56.6
250250801002	Roxbury	738	294	56.6	56.6
250250818002	Roxbury	921	442	56.5	56.4
250250906002	Roxbury	1,254	442	56.4	56.6
250250904004	Roxbury	870	294	56.3	56.2
250250818003	Roxbury	820	369	56.1	56.1
250250818001	Roxbury	1,157	577	55.9	56.0
250250904003	Roxbury	763	254	55.7	55.7
250250820003	Roxbury	841	414	55.7	55.8
250250820002	Roxbury	682	298	55.5	55.6
250250803001	Roxbury	1,769	791	55.5	55.5

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250250817002	Roxbury	893	430	55.5	55.6
250250820001	Roxbury	1,292	566	55.4	55.5
250250821003	Roxbury	2,244	1,012	55.4	55.4
250250904001	Roxbury	871	311	55.3	55.2
250250819001	Roxbury	906	453	55.1	55.4
250250904002	Roxbury	1,155	435	55.1	55.0
250250821001	Roxbury	1,228	526	55.0	55.1
250250819004	Roxbury	992	428	54.9	54.9
250250817001	Roxbury	619	225	54.8	55.2
250250819003	Roxbury	600	257	54.7	54.7
250250821002	Roxbury	1,553	579	54.7	54.7
250250819002	Roxbury	617	259	54.7	54.9
250250903003	Roxbury	978	422	54.5	54.6
250250903002	Roxbury	1,310	513	54.3	53.6
250250817003	Roxbury	780	291	54.2	54.0
250259803001	Roxbury	2	2	54.1	53.9
250250817004	Roxbury	878	355	54.0	53.8
250250914002	Roxbury	1,047	355	53.9	53.9
250250804011	Roxbury	1,265	526	53.6	53.7
250250901001	Roxbury	1,631	655	53.4	53.5
250250817005	Roxbury	641	298	53.4	53.2
250250903001	Roxbury	891	333	53.3	53.0
250250902003	Roxbury	934	308	53.1	53.4
250250813001	Roxbury	1,661	806	53.1	53.1
250250815002	Roxbury	1,346	554	53.1	53.1
250251203013	Roxbury	1,543	554	52.8	53.1
250251203012	Roxbury	855	331	52.7	52.8
250250902002	Roxbury	626	278	52.5	53.1
250250901003	Roxbury	693	303	52.3	52.4
250250901002	Roxbury	531	237	52.1	52.1
250250902001	Roxbury	673	244	51.9	51.7
250250815001	Roxbury	788	351	51.6	51.5
250250806013	Roxbury	448	242	51.3	51.3
250250924005	Roxbury	721	276	51.2	51.2
250251203014	Roxbury	1,231	567	51.1	50.9

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250250901004	Roxbury	1,099	414	51.1	50.9
250250924003	Roxbury	1,688	711	51.0	50.9
250250804012	Roxbury	1,445	723	51.0	51.1
250251203011	Roxbury	1,166	443	51.0	50.6
250250814001	Roxbury	1,067	558	50.8	51.0
250250813002	Roxbury	1,749	690	50.5	50.6
250250813003	**Roxbury**	**874**	**335**	**50.7**	**49.9**
250250901005	Roxbury	617	249	50.4	50.4
250250612001	South Boston	1,702	1,158	59.8	59.7
250250601011	South Boston	881	441	59.2	59.4
250250601013	South Boston	981	496	59.1	59.0
250250607001	South Boston	741	253	59.1	59.0
250250606001	South Boston	2,357	1,530	58.9	62.6
250250601012	South Boston	633	350	58.8	58.7
250250607002	South Boston	1,152	383	58.5	58.6
250250601014	South Boston	721	397	58.0	58.0
250250608003	South Boston	886	470	57.1	57.1
250250608004	South Boston	1,666	943	56.7	57.0
250250605014	South Boston	631	295	56.5	56.1
250250608002	South Boston	757	396	56.1	56.1
250250605015	South Boston	656	333	56.0	55.9
250250612002	South Boston	627	383	55.9	57.5
250250602001	South Boston	821	419	55.6	55.7
250250608001	South Boston	655	333	55.5	55.5
250250605013	South Boston	717	431	55.2	55.2
250250605011	South Boston	699	375	55.0	55.0
250250602002	South Boston	1,095	580	55.0	54.6
250250605012	South Boston	868	508	54.8	54.8
250250612003	South Boston	911	470	54.7	54.7
250250604005	South Boston	678	336	54.5	54.3
250250610001	South Boston	1,033	544	54.5	54.4
250250610003	South Boston	901	393	54.5	54.1
250250603013	South Boston	1,092	561	54.2	54.0
250250610002	South Boston	1,164	471	54.2	54.1
250250603011	South Boston	1,285	741	53.9	53.7

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB

US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250250611011	South Boston	617	278	53.9	53.7
250250604001	South Boston	1,021	542	53.7	53.9
250250603012	South Boston	699	345	53.4	53.3
250250604004	South Boston	1,093	669	53.2	53.1
250250604002	South Boston	988	530	53.1	53.2
250250611012	South Boston	1,615	756	52.9	52.7
250250604003	South Boston	842	466	52.8	52.7
250250712011	South End	1,790	819	55.8	56.6
250250712012	South End	1,232	578	54.9	55.3
250250711011	South End	1,420	928	54.9	55.0
250250711012	South End	1,424	750	54.0	55.4
250250711013	South End	831	507	53.9	54.4
250250705001	South End	1,700	1,018	53.3	53.3
250250704021	South End	1,626	680	53.2	54.8
250250705003	South End	1,393	803	52.6	52.7
250250705002	South End	999	524	52.0	52.1
250250705004	South End	1,353	721	52.0	52.0
250250709001	South End	2,166	1,231	51.6	51.4
250250703004	South End	1,119	746	51.1	51.2
250250709002	South End	1,163	567	51.0	51.0
250250706001	South End	1,127	667	50.9	50.8
250250805002	South End	2,020	863	50.9	51.0
250250706002	South End	1,113	642	50.1	50.1
250250703003	South End	992	707	49.9	50.2
250250203021	Back Bay	1,181	721	50.5	50.4
250250703001	**Back Bay**	**1,065**	**804**	**50.1**	**49.8**
250250202001	Back Bay	1,266	897	49.9	50.0
250173521012	Cambridge	1,473	1,187	49.8	50.3
250251602003	Chelsea	1,497	494	63.6	63.9
250251601015	Chelsea	1,025	261	62.9	63.3
250251603002	Chelsea	596	366	62.5	60.1
250251602002	Chelsea	1,210	374	62.2	62.1
250251603001	Chelsea	1,469	913	60.8	59.9
250251601011	Chelsea	1,332	353	60.6	60.5
250251604002	Chelsea	1,783	683	60.6	60.1

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB

US Census 2010 Block Group					
Block ID	Neighborhood	Population	Housing Units	Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
250251601013	Chelsea	1,576	568	60.3	61.1
250251602001	Chelsea	1,336	357	60.0	60.0
250251604001	Chelsea	933	344	59.1	59.5
250251601012	Chelsea	1,372	438	58.6	58.4
250251601014	Chelsea	2,092	539	57.3	57.3
250251605022	Chelsea	1,359	477	56.0	57.3
250251605021	Chelsea	1,703	623	55.8	56.6
250251605013	Chelsea	774	233	55.7	55.6
250251605023	Chelsea	1,398	488	55.6	55.5
250251605012	Chelsea	1,231	396	55.1	55.1
250251605014	Chelsea	754	392	54.9	54.8
250251605015	Chelsea	748	304	54.2	54.2
250251606011	Chelsea	2,158	1,005	54.1	53.7
250251605011	Chelsea	2,097	646	54.0	53.8
250251606012	Chelsea	1,905	563	53.3	53.3
250251606024	Chelsea	780	271	52.1	52.1
250251606021	Chelsea	1,290	470	51.8	51.7
250251606025	Chelsea	985	409	51.8	51.8
250251606022	Chelsea	795	304	50.8	50.8
250251606023	Chelsea	825	346	50.6	50.7
250173424004	Everett	1,348	517	58.3	58.7
250173424003	Everett	905	346	57.6	55.9
250173424002	Everett	1,132	480	56.7	57.3
250173424001	Everett	1,878	847	55.9	55.8
250173425003	Everett	2,200	970	54.8	54.6
250173423003	Everett	2,137	858	53.4	53.3
250173426002	Everett	904	347	52.6	52.9
250173424005	Everett	792	363	52.0	51.8
250173423004	Everett	1,807	805	51.9	52.2
250173426003	Everett	2,336	941	51.8	51.7
250173425002	Everett	2,169	870	51.7	51.6
250173426001	Everett	1,125	395	51.3	51.2
250173423002	Everett	1,555	596	51.0	50.9
250173423001	**Everett**	**1,327**	**495**	**50.1**	**49.9**
250173421014	Everett	943	362	50.1	50.0

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250235001011	**Hull**	**1,502**	**828**	**54.8**	**49.1**
250235001012	**Hull**	**819**	**452**	**51.0**	**49.7**
250092072002	Lynn	1,727	789	56.7	56.8
250092071002	Lynn	992	307	56.6	56.7
250092070002	Lynn	1,235	456	56.4	56.8
250092061002	Lynn	2,051	665	56.3	56.4
250092072001	Lynn	1,211	391	55.9	58.5
250092055002	Lynn	2,552	961	55.8	55.8
250092060001	Lynn	1,443	478	55.5	55.7
250092071001	Lynn	1,446	444	55.1	55.5
250092061001	Lynn	1,793	797	55.0	55.1
250092062002	Lynn	2,267	786	54.9	55.4
250092052004	Lynn	1,435	511	54.9	55.0
250092070001	Lynn	876	585	54.6	52.5
250092052002	Lynn	714	277	54.2	54.4
250092060002	Lynn	1,916	642	54.1	54.5
250092071003	Lynn	1,075	342	54.0	54.1
250092051005	Lynn	637	264	53.9	54.2
250092052003	Lynn	1,510	564	53.7	53.7
250092062003	Lynn	1,859	573	53.4	53.0
250092051004	Lynn	1,527	556	52.9	53.5
250092062001	Lynn	1,128	327	52.9	52.9
250092051003	Lynn	919	361	52.5	52.7
250092052001	Lynn	806	410	52.0	53.1
250092052005	Lynn	854	385	51.9	54.4
250092058002	Lynn	1,089	342	51.9	52.0
250092063004	Lynn	1,040	367	51.9	51.9
250092055001	Lynn	2,054	736	51.7	50.7
250092059001	Lynn	1,743	598	51.5	51.6
250092068002	Lynn	1,792	914	51.4	51.3
250092058001	Lynn	1,044	362	51.2	51.7
250092059002	Lynn	1,262	443	50.7	50.6
250092058003	Lynn	1,179	435	50.6	50.3
250092051002	Lynn	1,077	413	50.5	50.6
250092063001	Lynn	712	250	50.4	50.9

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB

US Census 2010 Block Group					
Block ID	Neighborhood	Population	Housing Units	Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
250092063003	**Lynn**	**1,030**	**379**	**50.0**	**49.9**
250092051001	Lynn	1,192	534	49.9	50.5
250173412003	Malden	1,070	451	53.0	53.4
250173412004	Malden	978	383	52.9	53.0
250173412005	Malden	1,693	713	51.7	51.9
250173414005	Malden	769	389	51.1	52.1
250173412006	Malden	976	362	50.9	50.8
250173412002	Malden	976	386	50.4	50.5
250173398011	Medford	2,101	1,369	56.9	56.1
250173398012	Medford	617	263	56.2	56.2
250173398013	Medford	808	375	55.8	55.9
250173398021	Medford	1,308	586	55.4	56.0
250173398014	Medford	884	363	54.9	54.8
250173398022	Medford	2,498	1,096	54.7	54.9
250173397003	Medford	785	357	54.3	54.3
250173397001	Medford	552	280	54.0	54.9
250173397002	Medford	1,678	670	53.9	54.1
250173398023	Medford	751	294	53.8	53.9
250173396002	Medford	813	371	53.8	53.7
250173396003	Medford	757	369	53.5	53.6
250173396001	Medford	797	392	53.5	53.5
250173397004	Medford	863	377	53.5	53.4
250173396004	Medford	827	363	53.4	53.5
250173399002	Medford	950	380	53.4	53.3
250173399001	Medford	1,651	719	53.3	53.6
250173396005	Medford	885	377	53.1	53.1
250173399004	Medford	759	346	53.0	53.1
250173396006	Medford	945	443	52.8	52.8
250173395002	Medford	1,312	547	52.8	52.9
250173399003	Medford	939	425	52.5	52.5
250173399005	Medford	872	342	52.5	52.5
250173400003	Medford	713	303	52.4	52.4
250173400001	Medford	1,033	435	52.0	52.0
250173391003	Medford	1,169	691	51.9	52.2
250173400002	Medford	848	376	51.9	51.8

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250173401004	Medford	1,483	609	51.7	51.9
250173391002	Medford	1,460	603	51.5	51.5
250173395004	Medford	736	307	51.4	51.6
250173395003	Medford	641	283	51.2	51.1
250173395001	Medford	1,810	553	51.2	51.8
250173401006	Medford	826	310	51.0	51.1
250173391004	Medford	1,797	1,041	50.9	51.4
250173391005	Medford	1,216	446	49.5	50.1
250173391001	Medford	617	243	48.7	50.6
250214164005	Milton	1,028	348	55.0	55.7
250214164007	Milton	1,002	386	54.5	56.9
250214161012	Milton	1,969	732	53.9	54.7
250214164006	Milton	978	357	53.7	55.7
250214164001	Milton	789	302	53.4	56.0
250214164004	Milton	797	280	50.3	51.3
250214164002	Milton	664	267	49.5	50.8
250092011001	Nahant	629	319	50.1	52.8
250214173002	Quincy	900	630	53.6	57.3
250214173001	Quincy	1,781	1,180	53.5	58.4
250214172001	Quincy	2,743	1,256	52.2	52.3
250214175023	Quincy	887	337	50.7	51.0
250214174001	Quincy	1,125	485	47.5	57.4
250214176021	Quincy**	1,328	585	41.6	50.7
250251708001	Revere	1,815	797	65.1	63.7
250251708004	Revere	977	424	64.5	61.5
250251708002	Revere	1,359	577	64.5	65.5
250251708003	Revere	967	419	63.5	64.3
250251707012	Revere	1,311	622	61.1	62.5
250259815021	Revere	9	3	60.9	57.6
250251705022	Revere	1,684	998	58.8	59.4
250251705021	Revere	1,134	550	58.8	59.0
250251707011	Revere	788	431	57.6	56.7
250251707025	Revere	1,391	553	57.2	56.8
250251707022	Revere	1,474	509	56.8	56.7
250251705012	Revere	1,501	814	55.7	57.5

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB

US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250251705011	Revere	1,934	1,112	55.5	57.2
250251707021	Revere	1,146	352	55.4	55.3
250251706012	Revere	1,413	573	55.0	55.6
250251707024	Revere	959	358	54.9	55.0
250251707023	Revere	1,658	547	54.7	54.7
250251706014	Revere	952	380	54.1	54.1
250251706013	Revere	1,387	497	53.9	54.0
250251701003	Revere	773	320	53.5	53.6
250251701007	Revere	1,335	498	53.4	53.5
250251701002	Revere	1,012	384	53.3	53.4
250251706011	Revere	1,351	557	53.0	52.9
250251702002	Revere	1,395	499	52.7	52.8
250251704002	Revere	1,151	506	52.6	52.9
250251704001	Revere	1,102	485	52.6	51.2
250251702001	Revere	1,228	542	52.4	52.5
250251701001	Revere	1,671	769	52.2	53.0
250251701004	Revere	727	290	52.1	52.1
250251703007	Revere	729	300	52.0	52.1
250251704003	Revere	1,097	431	52.0	51.9
250251701005	Revere	1,320	514	51.9	51.9
250251703006	Revere	1,209	517	51.9	51.9
250251704004	Revere	2,025	910	51.4	51.3
250251703005	Revere	1,692	659	51.1	51.2
250251702004	Revere	1,335	533	50.9	50.9
250251702003	Revere	606	240	50.8	50.9
250251703004	Revere	1,609	637	50.7	50.9
250251701006	Revere	722	289	50.4	50.5
250251703003	Revere	946	338	50.0	50.1
250251703002	Revere	899	344	49.9	50.0
250092081021	Saugus	752	301	45.7	56.0
250173501032	Somerville	1,210	520	54.2	54.4
250173504001	Somerville	1,006	368	53.3	53.4
250173501042	Somerville	2,584	947	53.2	53.1
250173504005	Somerville	849	392	53.0	53.1
250173504002	Somerville	1,232	565	52.7	52.6

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250173501041	Somerville	2,119	793	52.3	52.4
250173503003	Somerville	849	390	52.3	52.4
250173504003	Somerville	1,017	462	52.2	52.2
250173501044	Somerville	1,384	673	52.1	52.2
250173503001	Somerville	965	454	52.1	51.6
250173501043	Somerville	1,188	485	51.7	52.0
250173503002	Somerville	627	304	51.6	51.7
250173502001	Somerville	1,376	586	51.6	51.7
250173504004	Somerville	1,464	721	51.6	51.6
250173502006	Somerville	1,044	502	51.6	51.6
250173510005	Somerville	1,056	484	51.5	51.5
250173514031	Somerville	763	309	51.4	51.4
250173509001	Somerville	803	398	51.4	52.1
250173502005	Somerville	749	315	51.2	51.2
250173514033	Somerville	587	321	51.0	51.0
250173510001	Somerville	1,236	595	51.0	51.0
250173506001	Somerville	117	2	50.9	51.0
250173502004	Somerville	1,410	594	50.9	50.9
250173514032	Somerville	1,017	391	50.9	50.8
250173514035	Somerville	619	288	50.9	50.9
250173514034	Somerville	1,042	369	50.8	50.8
250173502003	Somerville	1,385	533	50.7	50.8
250173511002	Somerville	912	465	50.7	50.7
250173510004	Somerville	1,813	870	50.7	50.6
250173502002	Somerville	603	233	50.7	50.6
250173506004	Somerville	1,164	487	50.7	50.6
250173510006	Somerville	1,018	523	50.6	50.5
250173506002	Somerville	939	371	50.4	50.4
250173505001	Somerville	818	390	50.4	50.2
250173514041	Somerville	1,147	448	50.3	50.3
250173511005	Somerville	1,146	540	50.2	50.3
250173511001	Somerville	1,601	747	50.2	50.2
250173505002	Somerville	811	382	50.2	50.2
250173514042	Somerville	1,335	527	50.2	50.2
250173514043	Somerville	1,026	396	50.1	50.1

Table H-26 2014 DNL Levels for Census Block Group Locations within the DNL 50 dB					
US Census 2010 Block Group				Average DNL from All Census Blocks within the Block Group	DNL at the Centriod Location
Block ID	Neighborhood	Population	Housing Units		
250173506003	Somerville	733	231	50.0	50.2
250251802004	Winthrop	1,343	549	63.8	65.3
250251802001	Winthrop	1,471	610	61.5	61.7
250251802003	Winthrop	648	336	61.0	61.3
250251804002	Winthrop	839	347	59.9	59.9
250251802002	Winthrop	647	299	59.5	59.4
250251804001	Winthrop	876	435	58.6	58.9
250251801013	Winthrop	2,344	1,194	57.0	57.9
250251801011	Winthrop	1,207	584	55.8	56.0
250251801012	Winthrop	1,215	724	54.4	53.7
250251803014	Winthrop Court Rd	760	297	66.9	67.2
250251803012	Winthrop Court Rd	778	322	63.8	64.0
250251803011	Winthrop Court Rd	652	258	63.1	63.1
250251803013	Winthrop Court Rd	834	351	62.2	62.0
250251805004	Point Shirley Winthrop	882	459	65.8	66.6
250251805002	Point Shirley Winthrop	572	271	64.7	67.7
250251805003	Point Shirley Winthrop	1,156	671	59.6	58.4
250251805001	Point Shirley Winthrop	1,273	613	56.9	57.2

Note:

* Centriod location on the Airport, the Block Group includes area off airport property.

** Centriod location displaced over Quincy Bay

Block group boundaries were modified to only include Land areas.

Noise levels reported do not include aircraft or helicopters not arriving to or departing from Logan Airport.

Only Census Blocks with population were used to compute the average.

Only locations within the 2014 EDR modeling were used.

Bold highlighted Groups Indicate Census Block Group Centorid is below 50dB, while census block centroid average is above 50dB

This Page Intentionally Left Blank

massport

Massachusetts Port Authority
One Harborside Drive
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

To: Boston Logan Air Carriers, Chief Pilots

From: Frank Iacovino
Manager, Noise Abatement Office

Date: September 10, 2015

RE: New BOS RNAV Charted Visual Procedure to R33L during the late night period

As a critical user of Boston Logan International Airport, you are aware that a key part of our success is efforts to reduce and minimize our environmental footprint. As a urban airport, being a "good neighbor" to the surrounding communities, provide direct benefits to those impacted by our operations, but also allows us (the airline, the FAA and Massport) to continue to invest on critical infrastructure and technology.

With input from pilots, the FAA and communities, Massport has developed a comprehensive noise mitigation strategy. One crucial component of this strategy is a noise abatement procedure during late night operations, the most sensitive time for our neighbors. Recently, JetBlue published a RNAV Charted Visual approach to Logan's Runway 33L. This special visual approach procedure for Runway 33L was tested by JetBlue during 2014 and has been made public.

Participation of your airlines, as a user of Boston Logan during the late night period, is critical for the success of this procedure. To attain a copy of this procedure, please see the attached link below:

http://fsims.faa.gov/PICResults.aspx?mode=Publication&doctype=Orders

This link will provide airlines with step-by-step instructions to attain the procedure. Please type Order number 7110.79D and hit search.

For additional information please contact William Gianetta FAA Flight Standards District Office via email william.gianetta@faa.gov or telephone 207-780-3263 Ext. 119.

Thank you for your continued support and in working with us to enhance Boston Logan's noise abatement efforts. If you have any questions or would like to discuss any aspect of this letter, please feel free to contact me at 617-561-1841 or Natalie Mohan 617-561-3305.

Sincerely,

Frank Iacovino
Manager, Noise Abatement Office

Cc: William Gianetta (FAA)
Flavio Leo (Massport)

This Page Intentionally Left Blank.

I

Air Quality/ Emissions Reduction

This appendix provides the following detailed information and data tables in support of *Chapter 7, Air Quality/ Emissions Reduction*:

- Fundamentals of Air Quality
  - Table I-1 National Ambient Air Quality Standards
  - Table I-2 Airport-Related Sources of Air Emissions
  - Table I-3 Attainment, Nonattainment, and Maintenance Areas
- Aircraft Fleet and Operational Data Used in EDMS v5.1.4.1
  - Table I-4 2014 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type
- Ground Service Equipment (GSE)/Alternative Fuels Conversion
  - Table I-5 Ground Service Equipment Alternative Fuel Conversion Summary (kg/day)
- Motor Vehicle Emissions
  - Table I-6 MOVES2014 Sample Input File for 2014
  - Table I-7 MOVES2014 Sample Output File for 2014
- Fuel Storage and Handling
  - Table I-8 Fuel Throughput by Fuel Category (gallons)
- Stationary Sources
  - Table I-9 Stationary Source Fuel Throughput by Fuel Category (gallons)
- 1993 – 2009 Emissions Inventories
  - Table I-10 Estimated VOC Emissions (in kg/day) at Logan Airport 1993-2001
  - Table I-11 Estimated VOC Emissions (in kg/day) at Logan Airport 2002-2009
  - Table I-12 Estimated NO_X Emissions (in kg/day) at Logan Airport 1993-2001
  - Table I-13 Estimated NO_X Emissions (in kg/day) at Logan Airport 2002-2009
  - Table I-14 Estimated CO Emissions (in kg/day) at Logan Airport 1993-2001
  - Table I-15 Estimated CO Emissions (in kg/day) at Logan Airport 2002-2009
  - Table I-16 Estimated $PM_{10}/PM_{2.5}$ Emissions (in kg/day) at Logan Airport 2005-2009

Fundamentals of Air Quality

This section contains a general summary of air quality and air emissions with a particular emphasis on airport-related emissions where appropriate. This material is intended to supplement and provide background information for the materials contained in *Chapter 7, Air Quality/Emissions Reduction*.

Pollutant Types and Standards

The United States (U.S.) Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for a select group of "criteria air pollutants" designed to protect public health, the environment, and the quality of life from the detrimental effects of air pollution. Listed alphabetically, these pollutants are briefly described below:

- **Carbon monoxide (CO)** is a colorless, odorless, tasteless gas. It may temporarily accumulate, especially in cool, calm weather conditions, when fuel use reaches a peak and CO is chemically most stable due to the low temperatures. CO from natural sources usually dissipates quickly, posing no threat to human health. Transportation sources (e.g., motor vehicles), energy generation, and open burning are among the predominant anthropogenic (i.e., man-made) sources of CO.
- **Lead (Pb)** in the atmosphere is generated from industrial sources including waste oil and solid waste incineration, iron and steel production, lead smelting, and battery and lead manufacturing. The lead content of motor vehicle emissions, which was the major source of lead in the past, has significantly declined with the widespread use of unleaded fuel. Low-lead fuel used in some general aviation (GA) aircraft is still a source of airport-related lead.
- **Nitrogen dioxide (NO_2)**, nitric oxide (NO), and the nitrate radical (NO_3) are collectively called oxides of nitrogen (NO_x). These three compounds are interrelated, often changing from one form to another in chemical reactions, and NO_2 is the compound commonly measured for comparison to the NAAQS. NO_x is generally emitted in the form of NO, which is oxidized to NO_2. The principal man-made source of NO_x is fuel combustion in motor vehicles and power plants – aircraft engines are also a source. Reactions of NO_x with other atmospheric chemicals can lead to formation of ozone (O_3) and acidic precipitation.
- **Ozone (O_3)** is a secondary pollutant, formed from daytime reactions of NO_x and volatile organic compounds (VOCs) in the presence of sunlight. VOCs, which are a subset of hydrocarbons (HC) and have no NAAQS, are released in industrial processes and from evaporation of gasoline and solvents. Sources of NO_x are discussed above.
- **Particulate matter (PM)** comprises very small particles of dirt, dust, soot, or liquid droplets called aerosols. The NAAQS for PM is segregated by sizes (i.e., less than 10 and less than 2.5 microns as PM_{10} and $PM_{2.5}$, respectively). PM is formed as an exhaust product in the internal combustion engine or can be generated from the breakdown and dispersion of other solid materials (e.g., fugitive dust).
- **Sulfur oxides (SO_x)** are primarily composed of sulfur dioxide (SO_2) which is emitted in natural processes and by man-made sources such as combustion of sulfur-containing fuels and sulfuric acid manufacturing.

The NAAQS for these criteria pollutants are subdivided into the Primary Standards (designed to protect human health) and the Secondary Standards (designed to protect the environment and human welfare) and are listed below in Table I-1. Exceedances of these values constitute violations of the NAAQS.

Table I-1 National Ambient Air Quality Standards

Pollutants	Averaging Time	Concentration	Condition of Violation
Ozone (O_3)	8-hour	0.075 ppm	3-year average of the fourth-highest daily maximum 8-hour average.
Carbon Monoxide (CO)	8-hour	9 ppm	No more than once per year.
	1-hour	35 ppm	
Nitrogen Dioxide (NO_2)	Annual Average	53 ppb	Annual mean.
	1-hour	100 ppb	3-year average of the 98th percentile of the daily maximum 1-hour average.
Sulfur Dioxide (SO_2)	3-hour	0.5 ppm	No more than once per year.
	1-hour	75 ppb	Three-year average of the 99th percentile of 1-hour daily maximum concentrations.
Particulate Matter (PM_{10})	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years.
Particulate Matter ($PM_{2.5}$)	Annual (primary)	12 $\mu g/m^3$	Annual mean, averaged over 3 years.
	Annual (secondary)	15 $\mu g/m^3$	Annual mean, averaged over 3 years.
	24-hour	35 $\mu g/m^3$	3-year average of the 98th percentile.
Lead (Pb)	Rolling 3 month average	0.15 $\mu g/m^3$	Not to be exceeded.

Source: U.S. EPA, 2015, http://www.epa.gov/air/criteria.html
Note: ppm - parts per million; ppb – parts per billion; $\mu g/m^3$ - micrograms per cubic meter

Sources of Airport Air Emissions

Almost all large metropolitan airports generate air emissions from the following general source categories: aircraft, ground service equipment (GSE), and motor vehicles traveling to, from, and moving about the airport; fuel storage and transfer facilities; a variety of stationary sources (e.g., steam boilers, back-up generators, snow melters, etc.); an assortment of aircraft maintenance activities (e.g., painting, cleaning, repair, etc.); routine airfield, roadway, and building maintenance activities (e.g., painting, cleaning, repair, etc.); and periodic construction activities for new projects or improvements to existing facilities. Table I-2 provides a summary listing of these sources of air emissions, the pollutants, and their characteristics.

Table I-2 Airport-related Sources of Air Emissions

Sources	Emissions	Characteristics
Aircraft	CO NO_2 PM SO_2 VOCs	Exhaust products of fuel combustion that vary depending on aircraft engine type, number of engines, power setting, and period of operation. Emissions are also emitted by an aircraft's auxiliary power unit (APU).
Motor vehicles	CO NO_2 PM SO_2 VOCs	Exhaust products of fuel combustion from patron and employee traffic approaching, departing, and moving about the airport site. Emissions vary depending on vehicle type, distance traveled, operating speed, and ambient conditions.
Ground service equipment	CO NO_2 PM SO_2 VOCs	Exhaust products of fuel combustion from service trucks, tow tugs, belt loaders, and other portable equipment.
Fuel storage and transfer	VOCs	Formed from the evaporation and vapor displacement of fuel from storage tanks and fuel transfer facilities. Emissions vary with fuel usage, type of storage tank, refueling method, fuel type, vapor recovery, climate, and ambient temperature.
Stationary sources	CO NO_2 PM SO_2 VOCs	Exhaust products of fossil fuel combustion from boilers dedicated to indoor heating requirements and emissions from incinerators used for waste reduction. Emissions are generally well controlled with operational techniques and post-burn collection methods. Sources include boilers and hot water generators, emergency generators, incinerators, paint booth and surface coating operations, welding operations, and fire fighting facilities.
Construction Activities	CO NO_2 PM SO_2 VOCs	Construction projects may have associated emissions from dust generated during excavation and land clearing, exhaust emissions from construction equipment and motor vehicles, and evaporative emissions from asphalt paving and painting. The amount of particulate emissions varies with the material type, the amount of area exposed, and meteorology. The construction of airport and airfield improvement projects at airports represents temporary sources of emissions.

Notes: CO - Carbon monoxide; VOC - Volatile organic compounds; PM - Particulate matter; NO_2 - Nitrogen dioxide; SO_2 - Sulfur dioxide.

The U.S. EPA, state, and local air quality agencies maintain outdoor air monitoring networks to measure air quality conditions and gauge compliance with the NAAQS. Based upon the data collected by these agencies, all areas throughout the country are designated by the U.S. EPA with respect to their compliance with the NAAQS. Table I-3 provides the definitions of each of these designations.

Table I-3 Attainment, Nonattainment, and Maintenance Areas

Attainment/Nonattainment Designations			
Attainment	**Attainment/Maintenance**	**Nonattainment Area**	**Unclassifiable**
Any area that meets the NAAQS established for all of the criteria air pollutants.	Any area that is in transition from formerly being a nonattainment area to an attainment area (also called Maintenance).	Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) one or more of the NAAQS.	Any area that cannot be classified on the basis of available information as meeting or not meeting the NAAQS.

Source: U.S. EPA

For O_3, CO, PM_{10}, and $PM_{2.5}$, the nonattainment designations are further classified by the severity, or degree, of the violation of the NAAQS. For example, in the case of O_3, these classifications range from highest to lowest as extreme, severe, serious, marginal, and moderate.

The nonattainment designation of an area has a bearing on the emission control measures required and the time periods allotted by which a State Implementation Plan (SIP) must demonstrate attainment of the NAAQS. It is also important to note that the degree of nonattainment determines the thresholds of emissions that are considered to be "*de minimis,*" or levels below (i.e., within) which a formal General Conformity determination is not required.

Finally, the boundaries of nonattainment areas are generally determined based on Core Based Statistical Areas (CBSA) as defined by U.S. census data (air monitoring station locations and contributing emission sources also play a role). However, nonattainment areas for localized pollutants such as lead and CO typically only comprise a partial CBSA or a local "hot-spot." By comparison, regional pollutants such as O_3 can encompass multiple CBSAs and can extend across state lines.

State Implementation Plans (SIP)

For the purposes of this summary explanation of SIPs, it is sufficient to characterize SIPs as the principal instrument by which a state formulates and implements its strategies for bringing nonattainment or maintenance areas into compliance with the NAAQS. In equally broad terms, the SIP contains the necessary emission limitations, control measures and timetables for achieving this objective. Therefore, the SIP development process is delegated to state air quality agencies that may in turn rely on regional, county, and local agencies to help prepare emission inventories that include airport-related emissions.

Aircraft Fleet and Operational Data used in EDMS Version 5.1.4.1

The Federal Aviation Administration (FAA) Emissions Dispersion System (EDMS) is the EPA-preferred and the FAA-required model for conducting airport air quality analyses. The most recent version of EDMS , Version 5.1.4.1 (EDMS v5.1.4.1), was used in support of the 2014 air quality analysis.

Table I-4 contains the data that were used in EDMS v5.1.4.1 to represent actual conditions at Logan Airport in 2014. These data include aircraft type, engine, landing takeoff cycles (LTOs), and taxi times. The aircraft are divided into four categories: air carrier, cargo, commuter, and GA.

Table I-4 2014 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Air Carrier Aircraft				
Airbus A310-200 Series	CF6-80C2A2 1862M39	267	AC SATA	24.85
Airbus A319-100 Series	CFM56-5A5	15	AC ACA	24.85
Airbus A319-100 Series	CFM56-5A5	1,776	AC DAL	24.85
Airbus A319-100 Series	V2524-A5	717	AC Spirit	24.85
Airbus A319-100 Series	V2522-A5	1,405	AC UAL	24.85
Airbus A319-100 Series	CFM56-5B6/P	6,306	AC USA	24.85
Airbus A319-100 Series	CFM56-5B6/P	185	AC Virgin America	24.85
Airbus A320-200 Series	CFM56-5-A1	2	AC ACA	24.85
Airbus A320-200 Series	CFM56-5A3	2,439	AC DAL	24.85
Airbus A320-200 Series	V2527-A5	17,117	AC JBU	24.85
Airbus A320-200 Series	V2527-A5	756	AC Spirit	24.85
Airbus A320-200 Series	V2527-A5	2,318	AC UAL	24.85
Airbus A320-200 Series	CFM56-5B4/P	1,365	AC USA	24.85
Airbus A320-200 Series	V2527-A5	1,414	AC Virgin America	24.85
Airbus A321-100 Series	V2533-A5	28	AC AAL	24.85
Airbus A321-100 Series	CFM56-5B3/P	2,709	AC USA	24.85
Airbus A330-200 Series	CF6-80E1A4 Low emissions	275	AC AZA	24.85
Airbus A330-200 Series	PW4168 Talon II	136	AC DAL	24.85
Airbus A330-200 Series	CF6-80E1A2 1862M39	165	AC EIN	24.85
Airbus A330-200 Series	Trent 772 Improved traverse	21	AC USA	24.85
Airbus A330-300 Series	PW4168A Talon II	389	AC DAL	24.85
Airbus A330-300 Series	PW4168A Talon II	115	AC DLH	24.85
Airbus A330-300 Series	CF6-80E1A4 Standard	545	AC EIN	24.85
Airbus A330-300 Series	CF6-80E1A4 Standard	82	AC Iberia	24.85
Airbus A330-300 Series	Trent 772 Improved traverse	177	AC SWR	24.85
Airbus A330-300 Series	Trent 772 Improved traverse	43	AC Turkish Airlines	24.85
Airbus A330-300 Series	PW4168A Talon II	3	AC USA	24.85
Airbus A330-300 Series	Trent 772 Improved traverse	143	AC VIR	24.85
Airbus A340-300 Series	CFM56-5C4/P	237	AC DLH	24.85
Airbus A340-300 Series	CFM56-5C4/P	82	AC Iberia	24.85
Airbus A340-300 Series	CFM56-5C4	184	AC SWR	24.85
Airbus A340-300 Series	CFM56-5C2	182	AC Turkish Airlines	24.85
Airbus A340-300 Series	CFM56-5C4/P	18	AC VIR	24.85
Airbus A340-600 Series	Trent 556-61 Phase5 Tiled	199	AC DLH	24.85
Airbus A340-600 Series	Trent 556-61 Phase5 Tiled	2	AC Iberia	24.85
Airbus A340-600 Series	Trent 556-61 Phase5 Tiled	197	AC VIR	24.85
Boeing 717-200 Series	BR700-715A1-30	1,199	AC DAL	24.85
Boeing 717-200 Series	BR700-715A1-30	1,721	AC TRS	24.85
Boeing 737-300 Series	CFM56-3-B1	70	AC People Express	24.85
Boeing 737-300 Series	CFM56-3-B1	1,825	AC SWA	24.85
Boeing 737-400 Series	CFM56-3B-2	12	AC Miami Air (charter)	24.85
Boeing 737-400 Series	CFM56-3C-1	15	AC People Express	24.85
Boeing 737-400 Series	CFM56-3B-2	41	AC Swift Air (charter)	24.85
Boeing 737-400 Series	CFM56-3B-2	17	AC USA	24.85
Boeing 737-500 Series	CFM56-3-B1	7	AC SWA	24.85

Table I-4 2014 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Air Carrier Aircraft (Cont'd.)				
Boeing 737-700 Series	CFM56-7B24	324	AC Copa	24.85
Boeing 737-700 Series	CFM56-7B26/2	14	AC DAL	24.85
Boeing 737-700 Series	CFM56-7B22	239	AC Sun Country	24.85
Boeing 737-700 Series	CFM56-7B24	7,023	AC SWA	24.85
Boeing 737-700 Series	CFM56-7B24	963	AC UAL	24.85
Boeing 737-800 Series	CFM56-7B26 (8CM051)	8,879	AC AAL	24.85
Boeing 737-800 Series	CFM56-7B24	1,089	AC ASA	24.85
Boeing 737-800 Series	CFM56-7B26 (8CM051)	41	AC Copa	24.85
Boeing 737-800 Series	CFM56-7B26 (8CM051)	2,708	AC DAL	24.85
Boeing 737-800 Series	CFM56-7B26 (8CM051)	12	AC Miami Air (charter)	24.85
Boeing 737-800 Series	CFM56-7B27	275	AC Sun Country	24.85
Boeing 737-800 Series	CFM56-7B26 (8CM051)	407	AC SWA	24.85
Boeing 737-800 Series	CFM56-7B26 (8CM051)	2,604	AC UAL	24.85
Boeing 737-900 Series	CFM56-7B27	456	AC ASA	24.85
Boeing 737-900 Series	CFM56-7B26 (8CM051)	157	AC DAL	24.85
Boeing 737-900 Series	CFM56-7B26 (8CM051)	2,503	AC UAL	24.85
Boeing 747-400 Series	PW4056 Reduced smoke	286	AC AFR	24.85
Boeing 747-400 Series	RB211-524H	641	AC BAW	24.85
Boeing 747-400 Series	CF6-80C2B1F 1862M39	306	AC DLH	24.85
Boeing 747-400 Series	PW4056 Reduced smoke	1	AC UAL	24.85
Boeing 757-200 Series	RB211-535E4B Phase 5	2,370	AC AAL	24.85
Boeing 757-200 Series	PW2037 (4PW072)	1,698	AC DAL	24.85
Boeing 757-200 Series	PW2040 (4PW073)	256	AC EIN	24.85
Boeing 757-200 Series	RB211-535E4 (3RR028)	614	AC ICE	24.85
Boeing 757-200 Series	PW2037 (4PW072)	93	AC TACV-Cabo Verde	24.85
Boeing 757-200 Series	PW2037 (4PW072)	2,052	AC UAL	24.85
Boeing 757-200 Series	RB211-535E4 (3RR028)	10	AC USA	24.85
Boeing 757-300 Series	RB211-535E4B Phase 5	339	AC UAL	24.85
Boeing 767-200 Series	CF6-80A1	7	AC AAL	24.85
Boeing 767-200 Series	CF6-80A	2	AC Swift Air (charter)	24.85
Boeing 767-200 Series	CF6-80C2B2 1862M39	5	AC USA	24.85
Boeing 767-300 Series	CF6-80C2B6 1862M39	14	AC AAL	24.85
Boeing 767-300 Series	CF6-80A2	235	AC DAL	24.85
Boeing 767-300 Series	CF6-80C2B6 1862M39	19	AC Other Charter (domestic)	24.85
Boeing 767-300 Series	PW4060 Reduced smoke	5	AC UAL	24.85
Boeing 767-400 ER	CF6-80C2B7F 1862M39	200	AC DAL	24.85
Boeing 767-400 ER	CF6-80C2B8FA	4	AC UAL	24.85
Boeing 777-200 Series	GE90-90B DAC I	164	AC AFR	24.85
Boeing 777-200 Series	GE90-90B DAC I	696	AC BAW	24.85
Boeing 777-200 Series	GE90-110B1	208	AC Emirates	24.85
Boeing 777-200 Series	GE90-90B DAC II (6GE090)	19	AC Other Charter (international)	24.85
Boeing 777-200 Series	PW4077	5	AC UAL	24.85
Boeing 777-300 ER	GE90-115B	2	AC BAW	24.85
Boeing 777-300 ER	GE90-115B	93	AC Emirates	24.85
Boeing 787-8 Dreamliner	GEnx-1B64 TAPS (11GE136)	140	AC Hainan Airlines	24.85
Boeing 787-8 Dreamliner	GEnx-1B64 TAPS (11GE136)	366	AC Japan Airlines JAL	24.85
Boeing MD-82	JT8D-217	9	AC AAL	24.85
Boeing MD-83	JT8D-219 Environmental Kit	6	AC AAL	24.85
Boeing MD-88	JT8D-219 Environmental Kit	927	AC DAL	24.85
Boeing MD-90	V2525-D5	1,450	AC DAL	24.85
Embraer ERJ170	CF34-8E5 LEC (8GE108)	35	AC ACA	24.85

Table I-4 2014 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Air Carrier Aircraft (Cont'd.)				
Embraer ERJ190	CF34-10E5A1 SAC	504	AC ACA	24.85
Embraer ERJ190	CF34-10E6 SAC	24,180	AC JBU	24.85
Embraer ERJ190	CF34-10E6 SAC	7,535	AC USA	24.85
Total Air Carrier Aircraft LTOs		**120,111**		
Cargo Aircraft				
Airbus A300F4-600 Series	CF6-80C2A5F	238	Cargo FDX	24.85
Airbus A300F4-600 Series	PW4158	427	Cargo UPS	24.85
Airbus A310-200 Series	JT9D-7R4E, -7R4E1	6	Cargo FDX	24.85
ATR 42-300	PW120	8	Cargo Mountain Air Cargo	24.85
ATR 72-200	PW127	10	Cargo Mountain Air Cargo	24.85
Boeing 757-200 Series	RB211-535E4 (3RR028)	254	Cargo FDX	24.85
Boeing 757-200 Series	PW2040 (4PW073)	58	Cargo UPS	24.85
Boeing 767-200 Series	CF6-80A	12	Cargo ABX Air	24.85
Boeing 767-200 Series	JT9D-7R4D, -7R4D1	244	Cargo Atlas Air	24.85
Boeing 767-300 ER	CF6-80C2B6F	233	Cargo UPS	24.85
Boeing 767-300 Series	CF6-80C2B6 1862M39	106	Cargo FDX	24.85
Boeing DC-10-10 Series	CF6-6D	561	Cargo FDX	24.85
Boeing MD-11	CF6-80C2D1F 1862M39	480	Cargo FDX	24.85
Bombardier Challenger 300	AE3007A1 Type 2	6	Cargo FDX	24.85
Cessna 208 Caravan	PT6A-114	5	Cargo Mountain Air Cargo	24.85
Cessna 208 Caravan	PT6A-114	207	Cargo Wiggins	24.85
Total Cargo Aircraft LTOs		**2,855**		
Commuter Aircraft				
Bombardier CRJ-100	CF34-3B	1	Comm JZA	24.85
Bombardier CRJ-200	CF34-3B	18	Comm Delta (Pinnacle)	24.85
Bombardier CRJ-200	CF34-3B	8	Comm Expressjet	24.85
Bombardier CRJ-200	CF34-3B	2,363	Comm JZA	24.85
Bombardier CRJ-200	CF34-3B	3,082	Comm USA Express (Air Wisc.)	24.85
Bombardier CRJ-700	CF34-8C1	2	Comm EGF	24.85
Bombardier CRJ-700	CF34-8C1	473	Comm Expressjet	24.85
Bombardier CRJ-700	CF34-8C5 LEC (8GE110)	238	Comm GoJet	24.85
Bombardier CRJ-700	CF34-8C5 LEC (8GE110)	123	Comm JZA	24.85
Bombardier CRJ-700	CF34-8C1	702	Comm Mesa	24.85
Bombardier CRJ-700	CF34-8C5 LEC (8GE110)	125	Comm SkyWest	24.85
Bombardier CRJ-900	CF34-8C5 LEC (8GE110)	3,636	Comm Delta (Pinnacle)	24.85
Bombardier CRJ-900	CF34-8C5 LEC (8GE110)	254	Comm Expressjet	24.85
Bombardier de Havilland Dash 8 Q100	PW120A	595	Comm JZA	24.85
Bombardier de Havilland Dash 8 Q100	PW120A	929	Comm Piedmont	24.85
Bombardier de Havilland Dash 8 Q300	PW123	106	Comm JZA	24.85
Bombardier de Havilland Dash 8 Q400	PW150A	2	Comm JZA	24.85
Bombardier de Havilland Dash 8 Q400	PW150A	2,150	Comm Porter Airlines	24.85
Bombardier de Havilland Dash 8 Q400	PW150A	113	Comm Republic Airlines	24.85
Cessna 402	TIO-540-J2B2	17,540	Comm Hyannis Air Service	24.85
Embraer ERJ135	AE3007A1/3 Type 3	1	Comm EGF	24.85
Embraer ERJ145	AE3007A1E	935	Comm Chautaugua	24.85
Embraer ERJ145	AE3007A1/1 Type 3	1,056	Comm Expressjet	24.85
Embraer ERJ145	AE3007A1E	80	Comm Trans States	24.85
Embraer ERJ170	CF34-8E5 LEC (8GE108)	1,991	Comm Air Canada Express	24.85

Table I-4 2014 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Commuter Aircraft (Cont'd.)				
Embraer ERJ170	CF34-8E5 LEC (8GE108)	14	Comm Delta (Compass)	24.85
Embraer ERJ170	CF34-8E5 LEC (8GE108)	1,615	Comm Republic Airlines	24.85
Embraer ERJ170	CF34-8E5 LEC (8GE108)	4,875	Comm Shuttle America	24.85
Embraer ERJ170	CF34-8E5 LEC (8GE108)	450	Comm SkyWest	24.85
Embraer ERJ190	CF34-10E6 SAC	30	Comm Republic Airlines	24.85
Saab 340-B-Plus	CT7-9B	2,191	Comm Peninsula Air	24.85
Total Commuter Aircraft LTOs		**45,698**		
General Aviation Aircraft				
Bombardier Challenger 300	AE3007A1 Type 2	455	GA	24.85
Bombardier Challenger 300	AE3007A1 Type 2	194	GA Bombardier Business Jet	24.85
Bombardier Challenger 300	AE3007A1 Type 2	7	GA Delta Air Elite Business Jets	24.85
Bombardier Challenger 300	AE3007A1 Type 2	20	GA Executive Jet	24.85
Bombardier Challenger 300	AE3007A1 Type 2	57	GA Xojet	24.85
Bombardier Challenger 600	CF34-3B	446	GA	24.85
Bombardier Challenger 600	ALF 502L-2	54	GA Bombardier Business Jet	24.85
Bombardier Challenger 600	CF34-3B	15	GA Delta Air Elite Business Jets	24.85
Bombardier Challenger 600	ALF 502L-2	29	GA Executive Jet	24.85
Bombardier CRJ-200	CF34-3B	291	GA	24.85
Bombardier Global Express	BR700-710A2-20	213	GA	24.85
Bombardier Learjet 35	TFE731-2-2B	256	GA	24.85
Bombardier Learjet 40	TFE731-2-2B	116	GA Bombardier Business Jet	24.85
Bombardier Learjet 45	TFE731-2-2B	288	GA	24.85
Bombardier Learjet 45	TFE731-2-2B	34	GA Bombardier Business Jet	24.85
Bombardier Learjet 60	TFE731-2/2A	288	GA	24.85
Bombardier Learjet 60	TFE731-2/2A	12	GA Bombardier Business Jet	24.85
Bombardier Learjet 60	PW306A	9	GA Delta Air Elite Business Jets	24.85
Bombardier Learjet 60	TFE731-2/2A	19	GA Executive Jet	24.85
Bombardier Learjet 60	TFE731-2/2A	6	GA Talon Air	24.85
Cessna 172 Skyhawk	TSIO-360C	30	GA Angel Flight	24.85
Cessna 182	IO-360-B	23	GA Angel Flight	24.85
Cessna 525 CitationJet	JT15D-1 series	7	GA Delta Air Elite Business Jets	24.85
Cessna 525 CitationJet	JT15D-1 series	106	GA Superior Air	24.85
Cessna 550 Citation II	JT15D-4 series (1PW036)	204	GA	24.85
Cessna 560 Citation Excel	JT15D-5, -5A, -5B	345	GA	24.85
Cessna 560 Citation Excel	JT15D-5, -5A, -5B	29	GA Delta Air Elite Business Jets	24.85
Cessna 560 Citation Excel	JT15D-5, -5A, -5B	745	GA Netjets Aviation	24.85
Cessna 560 Citation V	JT15D-5, -5A, -5B	331	GA	24.85
Cessna 560 Citation V	PW530	91	GA Flight Options	24.85
Cessna 560 Citation V	PW530	272	GA Netjets Aviation	24.85
Cessna 680 Citation Sovereign	PW308C	242	GA	24.85
Cessna 680 Citation Sovereign	PW308C	32	GA Executive Jet	24.85
Cessna 680 Citation Sovereign	PW308C	355	GA Netjets Aviation	24.85
Cessna 750 Citation X	AE3007C1 Type 2	11	GA Delta Air Elite Business Jets	24.85
Cessna 750 Citation X	AE3007C Type 2	49	GA Flight Options	24.85
Cessna 750 Citation X	AE3007C Type 2	367	GA Netjets Aviation	24.85
Cessna 750 Citation X	AE3007C Type 2	107	GA Xojet	24.85
Cirrus SR22	TIO-540-J2B2	305	GA	24.85
Cirrus SR22	TIO-540-J2B2	26	GA Angel Flight	24.85
Dassault Falcon 2000	PW308C	570	GA	24.85
Dassault Falcon 2000	PW308C	23	GA Executive Jet	24.85

Table I-4 2014 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
General Aviation Aircraft (Cont'd.)				
Dassault Falcon 2000	PW308C	237	GA Netjets Aviation	24.85
Dassault Falcon 900	TFE731-3	369	GA	24.85
Dassault Falcon 900	TFE731-3	16	GA Executive Jet	24.85
Embraer ERJ135	AE3007A1/3 Type 3	31	GA Flight Options	24.85
Gulfstream G400	TAY Mk611-8	819	GA	24.85
Gulfstream G400	TAY Mk611-8	53	GA Executive Jet	24.85
Gulfstream G400	TAY Mk611-8	152	GA Netjets Aviation	24.85
Gulfstream G400	TAY Mk611-8	7	GA Talon Air	24.85
Gulfstream G500	BR700-710A1-10 (4BR008)	590	GA	24.85
Gulfstream G500	BR700-710A1-10 (4BR008)	29	GA Executive Jet	24.85
Gulfstream G500	BR700-710A1-10 (4BR008)	49	GA Netjets Aviation	24.85
Israel IAI-1126 Galaxy	PW306A	23	GA Executive Jet	24.85
Israel IAI-1126 Galaxy	PW306A	173	GA Netjets Aviation	24.85
Mooney M20-K	TSIO-360C	10	GA Angel Flight	24.85
Pilatus PC-12	PT6A-67B	726	GA PlaneSense	24.85
Piper PA-28 Cherokee Series	O-320	9	GA Angel Flight	24.85
Piper PA-31 Navajo	TIO-540-J2B2	15	GA Angel Flight	24.85
Piper PA-32 Cherokee Six	TIO-540-J2B2	33	GA Angel Flight	24.85
Raytheon Beech Baron 58	TIO-540-J2B2	19	GA Angel Flight	24.85
Raytheon Beech Bonanza 36	TIO-540-J2B2	43	GA Angel Flight	24.85
Raytheon Beechjet 400	JT15D-5, -5A, -5B	719	GA	24.85
Raytheon Beechjet 400	JT15D-5, -5A, -5B	67	GA Flight Options	24.85
Raytheon Beechjet 400	JT15D-5, -5A, -5B	14	GA Talon Air	24.85
Raytheon Hawker 4000 Horizon	PW308A	160	GA Talon Air	24.85
Raytheon Hawker 800	TFE731-3	934	GA	24.85
Raytheon Hawker 800	TFE731-3	14	GA Executive Jet	24.85
Raytheon Hawker 800	TFE731-3	7	GA Flight Options	24.85
Raytheon Hawker 800	TFE731-3	195	GA Netjets Aviation	24.85
Raytheon Hawker 800	TFE731-3	11	GA Talon Air	24.85
Raytheon Super King Air 200	PT6A-42	207	GA	24.85
Raytheon Super King Air 200	PT6A-42	17	GA Talon Air	24.85
Raytheon Super King Air 300	PT6A-60A	371	GA	24.85
Raytheon Super King Air 300	PT6A-60A	18	GA Talon Air	24.85
Rockwell Commander 700	IO-360-B	19	GA Angel Flight	24.85
Total General Aviation Aircraft LTOs		**13,235**		
Total Fleet LTOs		**181,899**		

Source: KBE and Massport.

Notes: Due to rounding of the operations (1 LTO = 2 Operations) there may be some differences (+/-) between the values reported here and those reported in *Chapter 2, Activity Levels.*

Aircraft taxi times are based on Logan Airport data obtained from the FAA Aviation System Performance Metrics (ASPM) database for 2014.

Ground Service Equipment/Alternative Fuels Conversion

For the 2014 analyses, GSE emissions were calculated using EDMS emission factors which are based on the EPA NONROAD2005 model in combination with the GSE time-in-mode survey and the GSE fuel types obtained from the Logan Airport Vehicle Aerodrome Permit Application as part of the *2011 ESPR*. In this way, the most up-to-date GSE fleet operational, conversion, and emissions characteristics are used.

Table I-5 Ground Service Equipment Alternative Fuel Conversion Summary (kg/day)

Year	Pollutant	Percent Reduction	Calculated Emissions without Reduction	Reduction from AFVs	Calculated Emissions with Reduction
2000	Volatile Organic Compounds (VOCs)	13.72%	178	24	154
	Oxides of Nitrogen (NO_x)	9.87%	369	36	333
	Carbon Monoxide (CO)	12.88%	6,124	789	5,335
2001	VOCs	13.72%	166	23	143
	NO_x	9.87%	338	33	305
	CO	12.88%	5,960	768	5,193
2002	VOCs	13.6%	286	39	247
	NO_x	8.0%	350	28	322
	CO	16.3%	6,174	1,004	5,170
2003	VOCs	13.8%	263	36	227
	NO_x	8.0%	316	25	291
	CO	16.4%	5,692	934	4,758
2004	VOCs	11.9%	212	25	187
	NO_x	6.6%	357	24	333
	CO	15.4%	4,236	650	3,586
2005	VOCs	12.2%	203	25	178
	NO_x	6.9%	335	23	312
	CO	15.4%	4,175	643	3,531
	$PM_{10}/PM_{2.5}$	9.9%	11	1	10
2006	VOCs	10.7%	86	9	77
	NO_x	7.5%	324	24	300
	CO	13.8%	1,841	255	1,586
	$PM_{10}/PM_{2.5}$	10.8%	10	1	9
2007	VOCs	8.2%	85	7	78
	NO_x	5.1%	315	16	299
	CO	10.4%	2,124	220	1,904
	$PM_{10}/PM_{2.5}$	5.9%	10	<1	10
2008	VOCs	8.3%	72	6	66
	NO_x	4.8%	270	13	257
	CO	10.2%	1,792	183	1,609
	$PM_{10}/PM_{2.5}$	5.6%	16	<1	15
2009	VOCs	8.2%	61	5	56
	NO_x	4.8%	230	11	219
	CO	10.0%	1,516	152	1,364
	$PM_{10}/PM_{2.5}$	3.5%	14	<1	14

Table I-5 Ground Service Equipment Alternative Fuel Conversion Summary (kg/day) (Continued)

Year	Pollutant	Percent Reduction	Calculated Emissions without Reduction	Reduction from AFVs	Calculated Emissions with Reduction
2010	VOCs	7.5%	53	4	49
	NO_x	3.9%	206	8	198
	CO	8.5%	1,335	113	1,222
	$PM_{10}/PM_{2.5}$	2.5%	13	<1	13
2011	VOCs	13.2%	38	5	33
	NO_x	7.5%	188	14	173
	CO	16.7%	834	139	694
	$PM_{10}/PM_{2.5}$	5.5%	14	1	13
2012	VOCs	11.8%	34	4	30
	NO_x	6.8%	176	12	164
	CO	16.3%	738	120	618
	$PM_{10}/PM_{2.5}$	4.9%	13	<1	13
2013	VOCs	10.3%	29	3	26
	NO_x	6.5%	155	10	145
	CO	15.9%	634	101	533
	$PM_{10}/PM_{2.5}$	5.0%	12	<1	12
2014	VOCs	11.5%	26	3	23
	NO_x	5.6%	142	8	134
	CO	15.4%	572	88	484
	$PM_{10}/PM_{2.5}$	4.8%	12	<1	12

Source: KBE and Massport.
Notes: 2000 and 2001 analyses used EDMS v4.03. 2002 and 2003 analyses used EDMS v4.11, which used updated emission factors from the NONROAD2002 Model. 2004 analyses used EDMS v4.21, which again used emission factors from the EPA NONROAD2002 Model. 2005 analysis used EDMS v4.5, which used emission factors from the EPA NONROAD2002 Model. 2006 analysis used EDMS v5.0.1, which used emission factors from the EPA NONROAD2005 Model. 2007 analysis used EDMS v5.0.2, which used emission factors from the EPA NONROAD2005 Model. 2008 analysis used EDMS v5.1, which used emission factors from the EPA NONROAD2005 Model. 2009 analysis used EDMS v5.1.2, which used emission factors from the EPA NONROAD2005 Model. 2010, 2011, and 2012 analysis used EDMS v5.1.3, which used emission factors from the EPA NONROAD2005 Model. 2013 and 2014 used EDMS v5.1.4.1, which used emission factors from the EPA NONROAD2005 Model.

Motor Vehicle Emissions

For the 2014 analysis, the motor vehicle emission factor model MOVES2014 was used. The resultant emission factors were multiplied by average daily vehicle miles to calculate daily emissions. The on-airport traffic data are summarized in the vehicle miles traveled (VMT) analyses of *Appendix G, Ground Access.* Due to the new roadway configuration of the Ted Williams Tunnel, through-traffic no longer traverses Airport property. Therefore, as of 2003, emissions from these vehicles are no longer included as part of the Logan Airport emissions inventory. Further, MOVES2014 was used to obtain vehicle emissions at idle to estimate parking and curbside motor vehicle emissions. Idling emissions are determined for a unit of time and multiplied by total idling time to reach the associated emissions. The input and output files of MOVES2014 are included as Tables I-6 and I-7.

Table I-6 MOVES2014 Sample Input File for 2014


```
<runspec version="MOVES2014-20141021">
	<description><![CDATA[BOS 2014 EDR - Winter (January)
Passenger Car/Passenger Truck
(LPG, CNG, Diesel, Gasoline)
at idle, 5, 10, 15, 20, 25, 30, and 35 mph.]]></description>
	<models>
		<model value="ONROAD"/>
	</models>
	<modelscale value="Inv"/>
	<modeldomain value="PROJECT"/>
	<geographicselections>
		<geographicselection type="COUNTY" key="25025" description="MASSACHUSETTS - Suffolk County"/>
	</geographicselections>
	<timespan>
		<year key="2014"/>
		<month id="1"/>
		<day id="5"/>
		<beginhour id="7"/>
		<endhour id="7"/>
		<aggregateBy key="Hour"/>
	</timespan>
	<onroadvehicleselections>
		<onroadvehicleselection fueltypeid="3" fueltypedesc="Compressed Natural Gas (CNG)" sourcetypeid="21" sourcetypename="Passenger
Car"/>
		<onroadvehicleselection fueltypeid="3" fueltypedesc="Compressed Natural Gas (CNG)" sourcetypeid="31" sourcetypename="Passenger
Truck"/>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="21" sourcetypename="Passenger Car"/>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="31" sourcetypename="Passenger Truck"/>
		<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="21" sourcetypename="Passenger Car"/>
		<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="31" sourcetypename="Passenger Truck"/>
		<onroadvehicleselection fueltypeid="4" fueltypedesc="Liquefied Petroleum Gas (LPG)" sourcetypeid="21" sourcetypename="Passenger
Car"/>
		<onroadvehicleselection fueltypeid="4" fueltypedesc="Liquefied Petroleum Gas (LPG)" sourcetypeid="31" sourcetypename="Passenger
Truck"/>
	</onroadvehicleselections>
	<offroadvehicleselections>
	</offroadvehicleselections>
	<offroadvehiclesccs>
	</offroadvehiclesccs>
	<roadtypes separateramps="false">
		<roadtype roadtypeid="1" roadtypename="Off-Network" modelCombination="M1"/>
		<roadtype roadtypeid="2" roadtypename="Rural Restricted Access" modelCombination="M1"/>
		<roadtype roadtypeid="3" roadtypename="Rural Unrestricted Access" modelCombination="M1"/>
		<roadtype roadtypeid="4" roadtypename="Urban Restricted Access" modelCombination="M1"/>
		<roadtype roadtypeid="5" roadtypename="Urban Unrestricted Access" modelCombination="M1"/>
	</roadtypes>
	<pollutantprocessassociations>
		<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="1" processname="Running Exhaust"/>
		<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="2" processname="Start Exhaust"/>
		<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="15" processname="Crankcase
Running Exhaust"/>
```

<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="118" pollutantname="Composite - NonECPM" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="118" pollutantname="Composite - NonECPM" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="118" pollutantname="Composite - NonECPM" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="118" pollutantname="Composite - NonECPM" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Elemental Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Elemental Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Elemental Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Elemental Carbon" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="119" pollutantname="H2O (aerosol)" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="119" pollutantname="H2O (aerosol)" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="119" pollutantname="H2O (aerosol)" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="119" pollutantname="H2O (aerosol)" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="11" processname="Evap Permeation"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="13" processname="Evap Fuel Leaks"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="18" processname="Refueling Displacement Vapor Loss"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="19" processname="Refueling Spillage Loss"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="17" processname="Crankcase Extended Idle Exhaust"/>

<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="106" pollutantname="Primary PM10 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
<pollutantprocessassociation pollutantkey="107" pollutantname="Primary PM10 - Tirewear Particulate" processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="116" pollutantname="Primary PM2.5 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
<pollutantprocessassociation pollutantkey="117" pollutantname="Primary PM2.5 - Tirewear Particulate" processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Sulfate Particulate" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Sulfate Particulate" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Sulfate Particulate" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Sulfate Particulate" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="16" processname="Crankcase Start Exhaust"/>

<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="11" processname="Evap Permeation"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="13" processname="Evap Fuel Leaks"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="18" processname="Refueling Displacement Vapor Loss"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="19" processname="Refueling Spillage Loss"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="91" processname="Auxiliary Power Exhaust"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="11" processname="Evap Permeation"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="13" processname="Evap Fuel Leaks"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="18" processname="Refueling Displacement Vapor Loss"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="19" processname="Refueling Spillage Loss"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="91" processname="Auxiliary Power Exhaust"/>

</pollutantprocessassociations>
<databaseselections>
<databaseselection servername="" databasename="mylevs" description=""/>
</databaseselections>
<internalcontrolstrategies>
<internalcontrolstrategy classname="gov.epa.otaq.moves.master.implementation.ghg.internalcontrolstrategies.rateofprogress.RateOfProgressStrategy"><![CDATA[
useParameters No

]]></internalcontrolstrategy>
</internalcontrolstrategies>
<inputdatabase servername="" databasename="" description=""/>
<uncertaintyparameters uncertaintymodeenabled="false" numberofrunspersimulation="0" numberofsimulations="0"/>
<geographicoutputdetail description="LINK"/>
<outputemissionsbreakdownselection>
<modelyear selected="false"/>
<fueltype selected="false"/>
<emissionprocess selected="false"/>
<onroadoffroad selected="true"/>
<roadtype selected="false"/>
<sourceusetype selected="true"/>
<movesvehicletype selected="false"/>
<onroadscc selected="false"/>
<estimateuncertainty selected="false" numberOfIterations="2" keepSampledData="false" keepIterations="false"/>
<sector selected="false"/>
<engtechid selected="false"/>
<hpclass selected="false"/>
<regclassid selected="false"/>
</outputemissionsbreakdownselection>
<outputdatabase servername="" databasename="out_BOS2014edrw" description=""/>
<outputtimestep value="Hour"/>
<outputvmtdata value="true"/>
<outputsho value="true"/>
<outputsh value="true"/>
<outputshp value="true"/>
<outputshidling value="true"/>
<outputstarts value="true"/>
<outputpopulation value="true"/>
<scaleinputdatabase servername="localhost" databasename="inp_bos2014edrw" description=""/>
<pmsize value="0"/>
<outputfactors>
<timefactors selected="true" units="Hours"/>
<distancefactors selected="true" units="Miles"/>
<massfactors selected="true" units="Grams" energyunits="Million BTU"/>
</outputfactors>
<savedata>

</savedata>

<donotexecute>

</donotexecute>

<generatordatabase shouldsave="false" servername="" databasename="" description=""/>
<donotperformfinalaggregation selected="false"/>
<lookuptableflags scenarioid="" truncateoutput="true" truncateactivity="true" truncatebaserates="true"/>
</runspec>

Source: KBE and Massport.

Table I-7 MOVES2014 Sample Output Files for 2014

MasterKey	MOVESRunID	iterationID	yearID	monthID	dayID	hourID	stateID	countyID	zoneID	linkID	pollutantID	
	processID	sourceTypeIDregClassId		fuelTypeID	modelYearID	roadTypeID	SCC	emissionQuant		activityTypeID		
	activity	emissionRate	massUnits	distanceUnits								
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	22
	119	NULL	31	0	0	0	0	0	0	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	21
	119	NULL	21	0	0	0	0	0	0	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	20
	119	NULL	31	0	0	0	0	0	0	1	0.851981997	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
	119	NULL	21	0	0	0	0	0	0	1	0.952619016	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
	119	NULL	31	0	0	0	0	0	0	1	0.851981997	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	119	NULL	21	0	0	0	0	0	0	1	0.952619016	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
	119	NULL	31	0	0	0	0	0	0	1	0.851981997	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	15
	119	NULL	21	0	0	0	0	0	0	1	0.952619016	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	14
	119	NULL	31	0	0	0	0	0	0	1	0.851981997	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	13
	119	NULL	21	0	0	0	0	0	0	1	0.952619016	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	12
	119	NULL	31	0	0	0	0	0	0	1	0.851981997	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	11
	119	NULL	21	0	0	0	0	0	0	1	0.952619016	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
	119	NULL	31	0	0	0	0	0	0	1	0.851981997	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
	119	NULL	21	0	0	0	0	0	0	1	0.952619016	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
	119	NULL	31	0	0	0	0	0	0	1	0.851981997	0
	g mi											
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	7
	119	NULL	21	0	0	0	0	0	0	1	0.952619016	0
	g mi											

1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 6
119 NULL 31 0 0 0 0 0 0 1 0.851981997 0
g mi
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 5
119 NULL 21 0 0 0 0 0 0 1 0.952619016 0
g mi
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 4
119 NULL 31 0 0 0 0 0 0 1 0.851981997 0
g mi
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 3
119 NULL 21 0 0 0 0 0 0 1 0.952619016 0
g mi
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 2
119 NULL 31 0 0 0 0 0 0 1 0.851981997 0
g mi
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 1
119 NULL 21 0 0 0 0 0 0 1 0.952619016 0
g mi
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 22
118 NULL 31 0 0 0 0 0 0.0349911 1 0
NULL g mi
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 21
118 NULL 21 0 0 0 0 0 0.0882532 1 0
NULL g mi
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 20
118 NULL 31 0 0 0 0 0 0.00772099 1 0.851981997
0.009062386 g mi
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 19
118 NULL 21 0 0 0 0 0 0.00989211 1 0.952619016
0.01038412 g mi
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 18
118 NULL 31 0 0 0 0 0 0.0077695 1 0.851981997
0.009119324 g mi
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 17
118 NULL 21 0 0 0 0 0 0.00984229 1 0.952619016
0.010331821 g mi
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 16
118 NULL 31 0 0 0 0 0 0.00805424 1 0.851981997
0.009453533 g mi
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 15
118 NULL 21 0 0 0 0 0 0.0101777 1 0.952619016
0.010683914 g mi
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 14
118 NULL 31 0 0 0 0 0 0.0085563 1 0.851981997
0.010042818 g mi
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 13
118 NULL 21 0 0 0 0 0 0.0108502 1 0.952619016
0.011389863 g mi
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00 1 1 2014 1 5 7 25 25025 250250 12
118 NULL 31 0 0 0 0 0 0.0092438 1 0.851981997
0.01084976 g mi

1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	11
	118	NULL	21	0	0	0	0	0	0.0116535	1	0.952619016	
	0.012233117	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
	118	NULL	31	0	0	0	0	0	0.0103875	1	0.851981997	
	0.012192159	g	mi									
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
	118	NULL	21	0	0	0	0	0	0.0125229	1	0.952619016	
	0.013145759	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
	118	NULL	31	0	0	0	0	0	0.0135801	1	0.851981997	
	0.015939421	g	mi									
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	7
	118	NULL	21	0	0	0	0	0	0.0165752	1	0.952619016	
	0.017399611	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	6
	118	NULL	31	0	0	0	0	0	0.0149146	1	0.851981997	
	0.017505769	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	5
	118	NULL	21	0	0	0	0	0	0.0189452	1	0.952619016	
	0.019887489	g	mi									
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	4
	118	NULL	31	0	0	0	0	0	0.0152072	1	0.851981997	
	0.017849204	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	3
	118	NULL	21	0	0	0	0	0	0.021072101	1	0.952619016	
	0.022120177	g	mi									
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	2
	118	NULL	31	0	0	0	0	0	0.0160852	1	0.851981997	
	0.018879742	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	1
	118	NULL	21	0	0	0	0	0	0.0274527	1	0.952619016	
	0.028818131	g	mi									
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	22
	117	NULL	31	0	0	0	0	0	0	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	21
	117	NULL	21	0	0	0	0	0	0	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	20
	117	NULL	31	0	0	0	0	0	0.00105666	1	0.851981997	
	0.001240237	g	mi									
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
	117	NULL	21	0	0	0	0	0	0.00117077	1	0.952619016	
	0.001229001	g	mi									
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
	117	NULL	31	0	0	0	0	0	0.00113835	1	0.851981997	
	0.00133612	g	mi									
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	117	NULL	21	0	0	0	0	0	0.00126127	1	0.952619016	
	0.001324003	g	mi									

1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	16
117	NULL	31	0	0	0	0	0	0.00122689	1	0.851981997	
0.001440042	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	15
117	NULL	21	0	0	0	0	0	0.00135939	1	0.952619016	
0.001427003	g	mi									
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	14
117	NULL	31	0	0	0	0	0	0.00132146	1	0.851981997	
0.001551042	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	13
117	NULL	21	0	0	0	0	0	0.00146418	1	0.952619016	
0.001537005	g	mi									
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	12
117	NULL	31	0	0	0	0	0	0.00142379	1	0.851981997	
0.00167115	g	mi									
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	11
117	NULL	21	0	0	0	0	0	0.00157754	1	0.952619016	
0.001656003	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	10
117	NULL	31	0	0	0	0	0	0.00153383	1	0.851981997	
0.001800308	g	mi									
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	9
117	NULL	21	0	0	0	0	0	0.00169947	1	0.952619016	
0.001783998	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	8
117	NULL	31	0	0	0	0	0	0.00165248	1	0.851981997	
0.001939571	g	mi									
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	7
117	NULL	21	0	0	0	0	0	0.00183093	1	0.952619016	
0.001921996	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	6
117	NULL	31	0	0	0	0	0	0.00178057	1	0.851981997	
0.002089915	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	5
117	NULL	21	0	0	0	0	0	0.00197288	1	0.952619016	
0.002071006	g	mi									
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	4
117	NULL	31	0	0	0	0	0	0.00191814	1	0.851981997	
0.002251386	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	3
117	NULL	21	0	0	0	0	0	0.00212529	1	0.952619016	
0.002230997	g	mi									
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	2
117	NULL	31	0	0	0	0	0	0.00206688	1	0.851981997	
0.002425967	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	1
117	NULL	21	0	0	0	0	0	0.0022901	1	0.952619016	
0.002404004	g	mi									
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	22
116	NULL	31	0	0	0	0	0	0	1	0	
NULL	g	mi									

1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	21
	116	NULL	21	0	0	0	0	0	0	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	20
	116	NULL	31	0	0	0	0	0	0.00177388	1	0.851981997	
	0.002082063	g	mi									
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
	116	NULL	21	0	0	0	0	0	0.00122215	1	0.952619016	
	0.001282937	g	mi									
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
	116	NULL	31	0	0	0	0	0	0.0027828	1	0.851981997	
	0.003266266	g	mi									
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	116	NULL	21	0	0	0	0	0	0.00188696	1	0.952619016	
	0.001980813	g	mi									
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
	116	NULL	31	0	0	0	0	0	0.00389543	1	0.851981997	
	0.004572197	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	15
	116	NULL	21	0	0	0	0	0	0.00262482	1	0.952619016	
	0.002755372	g	mi									
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	14
	116	NULL	31	0	0	0	0	0	0.00523586	1	0.851981997	
	0.006145506	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	13
	116	NULL	21	0	0	0	0	0	0.00351699	1	0.952619016	
	0.003691917	g	mi									
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	12
	116	NULL	31	0	0	0	0	0	0.0070093	1	0.851981997	
	0.008227052	g	mi									
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	11
	116	NULL	21	0	0	0	0	0	0.00470166	1	0.952619016	
	0.004935509	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
	116	NULL	31	0	0	0	0	0	0.00928219	1	0.851981997	
	0.01089482	g	mi									
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
	116	NULL	21	0	0	0	0	0	0.00624219	1	0.952619016	
	0.006552662	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
	116	NULL	31	0	0	0	0	0	0.0104746	1	0.851981997	
	0.012294391	g	mi									
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	7
	116	NULL	21	0	0	0	0	0	0.00710217	1	0.952619016	
	0.007455415	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	6
	116	NULL	31	0	0	0	0	0	0.0124926	1	0.851981997	
	0.014662986	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	5
	116	NULL	21	0	0	0	0	0	0.00846614	1	0.952619016	
	0.008887226	g	mi									

1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	4
	116	NULL	31	0	0	0	0	0	0.016546899	1	0.851981997	
	0.019421654	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	3
	116	NULL	21	0	0	0	0	0	0.0111527	1	0.952619016	
	0.011707408	g	mi									
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	2
	116	NULL	31	0	0	0	0	0	0.028709801	1	0.851981997	
	0.033697661	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	1
	116	NULL	21	0	0	0	0	0	0.019212499	1	0.952619016	
	0.020168083	g	mi									
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	22
	115	NULL	31	0	0	0	0	0	0.00129779	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	21
	115	NULL	21	0	0	0	0	0	0.00327516	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	20
	115	NULL	31	0	0	0	0	0	0.000286261	1	0.851981997	
	0.000335994	g	mi									
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
	115	NULL	21	0	0	0	0	0	0.000365349	1	0.952619016	
	0.000383521	g	mi									
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
	115	NULL	31	0	0	0	0	0	0.000288076	1	0.851981997	
	0.000338125	g	mi									
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	115	NULL	21	0	0	0	0	0	0.000363547	1	0.952619016	
	0.000381629	g	mi									
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
	115	NULL	31	0	0	0	0	0	0.000298692	1	0.851981997	
	0.000350585	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	15
	115	NULL	21	0	0	0	0	0	0.000375982	1	0.952619016	
	0.000394682	g	mi									
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	14
	115	NULL	31	0	0	0	0	0	0.000317404	1	0.851981997	
	0.000372548	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	13
	115	NULL	21	0	0	0	0	0	0.000400881	1	0.952619016	
	0.00042082	g	mi									
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	12
	115	NULL	31	0	0	0	0	0	0.000342994	1	0.851981997	
	0.000402584	g	mi									
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	11
	115	NULL	21	0	0	0	0	0	0.000430632	1	0.952619016	
	0.000452051	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
	115	NULL	31	0	0	0	0	0	0.000385399	1	0.851981997	
	0.000452356	g	mi									

1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
	115	NULL	21	0	0	0	0	0	0.000462848	1	0.952619016	
	0.000485869	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
	115	NULL	31	0	0	0	0	0	0.000503843	1	0.851981997	
	0.000591378	g	mi									
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	7
	115	NULL	21	0	0	0	0	0	0.000612419	1	0.952619016	
	0.000642879	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	6
	115	NULL	31	0	0	0	0	0	0.000553331	1	0.851981997	
	0.000649463	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	5
	115	NULL	21	0	0	0	0	0	0.000700105	1	0.952619016	
	0.000734927	g	mi									
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	4
	115	NULL	31	0	0	0	0	0	0.000564136	1	0.851981997	
	0.000662145	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	3
	115	NULL	21	0	0	0	0	0	0.000779149	1	0.952619016	
	0.000817902	g	mi									
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	2
	115	NULL	31	0	0	0	0	0	0.000596551	1	0.851981997	
	0.000700192	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	1
	115	NULL	21	0	0	0	0	0	0.00101628	1	0.952619016	
	0.001066827	g	mi									
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	22
	112	NULL	31	0	0	0	0	0	0.0059621	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	21
	112	NULL	21	0	0	0	0	0	0.015037	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	20
	112	NULL	31	0	0	0	0	0	0.00131559	1	0.851981997	
	0.001544152	g	mi									
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
	112	NULL	21	0	0	0	0	0	0.00168578	1	0.952619016	
	0.001769627	g	mi									
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
	112	NULL	31	0	0	0	0	0	0.00132385	1	0.851981997	
	0.001553847	g	mi									
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	112	NULL	21	0	0	0	0	0	0.00167729	1	0.952619016	
	0.001760714	g	mi									
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
	112	NULL	31	0	0	0	0	0	0.00137236	1	0.851981997	
	0.001610785	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	15
	112	NULL	21	0	0	0	0	0	0.00173444	1	0.952619016	
	0.001820707	g	mi									

1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	14
112	NULL	31	0	0	0	0	0	0.00145789	1	0.851981997	
0.001711175	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	13
112	NULL	21	0	0	0	0	0	0.00184904	1	0.952619016	
0.001941007	g	mi									
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	12
112	NULL	31	0	0	0	0	0	0.00157502	1	0.851981997	
0.001848654	g	mi									
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	11
112	NULL	21	0	0	0	0	0	0.00198592	1	0.952619016	
0.002084695	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	10
112	NULL	31	0	0	0	0	0	0.00176988	1	0.851981997	
0.002077368	g	mi									
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	9
112	NULL	21	0	0	0	0	0	0.00213405	1	0.952619016	
0.002240193	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	8
112	NULL	31	0	0	0	0	0	0.00231387	1	0.851981997	
0.002715867	g	mi									
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	7
112	NULL	21	0	0	0	0	0	0.00282465	1	0.952619016	
0.002965141	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	6
112	NULL	31	0	0	0	0	0	0.00254125	1	0.851981997	
0.002982751	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	5
112	NULL	21	0	0	0	0	0	0.00322851	1	0.952619016	
0.003389088	g	mi									
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	4
112	NULL	31	0	0	0	0	0	0.00259113	1	0.851981997	
0.003041297	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	3
112	NULL	21	0	0	0	0	0	0.00359087	1	0.952619016	
0.003769471	g	mi									
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	2
112	NULL	31	0	0	0	0	0	0.00274075	1	0.851981997	
0.003216911	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	1
112	NULL	21	0	0	0	0	0	0.00467798	1	0.952619016	
0.004910652	g	mi									
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	22
110	NULL	31	0	0	0	0	0	0.0409532	1	0	
NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	21
110	NULL	21	0	0	0	0	0	0.103289999	1	0	
NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	20
110	NULL	31	0	0	0	0	0	0.00903658	1	0.851981997	
0.010606539	g	mi									

1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
	110	NULL	21	0	0	0	0	0	0.0115779	1	0.952619016	
	0.012153757	g	mi									
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
	110	NULL	31	0	0	0	0	0	0.00909335	1	0.851981997	
	0.010673171	g	mi									
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	110	NULL	21	0	0	0	0	0	0.0115196	1	0.952619016	
	0.012092557	g	mi									
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
	110	NULL	31	0	0	0	0	0	0.0094266	1	0.851981997	
	0.011064319	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	15
	110	NULL	21	0	0	0	0	0	0.0119122	1	0.952619016	
	0.012504684	g	mi									
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	14
	110	NULL	31	0	0	0	0	0	0.0100142	1	0.851981997	
	0.011754004	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	13
	110	NULL	21	0	0	0	0	0	0.0126993	1	0.952619016	
	0.013330933	g	mi									
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	12
	110	NULL	31	0	0	0	0	0	0.0108188	1	0.851981997	
	0.01269839	g	mi									
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	11
	110	NULL	21	0	0	0	0	0	0.0136395	1	0.952619016	
	0.014317896	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
	110	NULL	31	0	0	0	0	0	0.0121573	1	0.851981997	
	0.014269432	g	mi									
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
	110	NULL	21	0	0	0	0	0	0.014657	1	0.952619016	
	0.015386004	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
	110	NULL	31	0	0	0	0	0	0.015893999	1	0.851981997	
	0.018655323	g	mi									
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	7
	110	NULL	21	0	0	0	0	0	0.019399799	1	0.952619016	
	0.020364699	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	6
	110	NULL	31	0	0	0	0	0	0.0174558	1	0.851981997	
	0.020488461	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	5
	110	NULL	21	0	0	0	0	0	0.022173701	1	0.952619016	
	0.023276568	g	mi									
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	4
	110	NULL	31	0	0	0	0	0	0.0177984	1	0.851981997	
	0.020890582	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	3
	110	NULL	21	0	0	0	0	0	0.024662999	1	0.952619016	
	0.025889678	g	mi									

1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	2
	110	NULL	31	0	0	0	0	0	0.018826	1	0.851981997	
	0.022096711	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	1
	110	NULL	21	0	0	0	0	0	0.0321307	1	0.952619016	
	0.033728803	g	mi									
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	22
	107	NULL	31	0	0	0	0	0	0	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	21
	107	NULL	21	0	0	0	0	0	0	1	0	
	NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	20
	107	NULL	31	0	0	0	0	0	0.00704443	1	0.851981997	
	0.008268285	g	mi									
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
	107	NULL	21	0	0	0	0	0	0.00780517	1	0.952619016	
	0.00819338	g	mi									
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
	107	NULL	31	0	0	0	0	0	0.00758907	1	0.851981997	
	0.008907548	g	mi									
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	107	NULL	21	0	0	0	0	0	0.00840849	1	0.952619016	
	0.008826708	g	mi									
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
	107	NULL	31	0	0	0	0	0	0.00817928	1	0.851981997	
	0.009600297	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	15
	107	NULL	21	0	0	0	0	0	0.00906263	1	0.952619016	
	0.009513384	g	mi									
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	14
	107	NULL	31	0	0	0	0	0	0.0088098	1	0.851981997	
	0.01034036	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	13
	107	NULL	21	0	0	0	0	0	0.00976122	1	0.952619016	
	0.010246719	g	mi									
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	12
	107	NULL	31	0	0	0	0	0	0.00949199	1	0.851981997	
	0.011141069	g	mi									
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	11
	107	NULL	21	0	0	0	0	0	0.010517	1	0.952619016	
	0.011040091	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
	107	NULL	31	0	0	0	0	0	0.0102256	1	0.851981997	
	0.012002131	g	mi									
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
	107	NULL	21	0	0	0	0	0	0.0113299	1	0.952619016	
	0.011893422	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
	107	NULL	31	0	0	0	0	0	0.0110166	1	0.851981997	
	0.012930555	g	mi									

1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	7
107	NULL	21	0	0	0	0	0	0.0122063	1	0.952619016	
0.012813412	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	6
107	NULL	31	0	0	0	0	0	0.0118705	1	0.851981997	
0.013932806	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	5
107	NULL	21	0	0	0	0	0	0.0131526	1	0.952619016	
0.013806779	g	mi									
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	4
107	NULL	31	0	0	0	0	0	0.0127877	1	0.851981997	
0.015009354	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	3
107	NULL	21	0	0	0	0	0	0.0141687	1	0.952619016	
0.014873417	g	mi									
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	2
107	NULL	31	0	0	0	0	0	0.0137793	1	0.851981997	
0.016173229	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	1
107	NULL	21	0	0	0	0	0	0.0152674	1	0.952619016	
0.016026764	g	mi									
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	22
106	NULL	31	0	0	0	0	0	0	1	0	
NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	21
106	NULL	21	0	0	0	0	0	0	1	0	
NULL	g	mi									
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	20
106	NULL	31	0	0	0	0	0	0.0141911	1	0.851981997	
0.016656573	g	mi									
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	19
106	NULL	21	0	0	0	0	0	0.00977724	1	0.952619016	
0.010263537	g	mi									
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	18
106	NULL	31	0	0	0	0	0	0.0222624	1	0.851981997	
0.02613013	g	mi									
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	17
106	NULL	21	0	0	0	0	0	0.0150957	1	0.952619016	
0.015846523	g	mi									
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	16
106	NULL	31	0	0	0	0	0	0.0311634	1	0.851981997	
0.036577533	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	15
106	NULL	21	0	0	0	0	0	0.020998601	1	0.952619016	
0.022043021	g	mi									
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	14
106	NULL	31	0	0	0	0	0	0.0418869	1	0.851981997	
0.049164067	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	13
106	NULL	21	0	0	0	0	0	0.028135899	1	0.952619016	
0.029535312	g	mi									

1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	12
106	NULL	31	0	0	0	0	0	0.0560744	1	0.851981997
0.065816414	g	mi								
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	11
106	NULL	21	0	0	0	0	0	0.037613299	1	0.952619016
0.039484094	g	mi								
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	10
106	NULL	31	0	0	0	0	0	0.0742575	1	0.851981997
0.087158532	g	mi								
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	9
106	NULL	21	0	0	0	0	0	0.049937502	1	0.952619016
0.052421273	g	mi								
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	8
106	NULL	31	0	0	0	0	0	0.083796903	1	0.851981997
0.098355251	g	mi								
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	7
106	NULL	21	0	0	0	0	0	0.056817301	1	0.952619016
0.059643257	g	mi								
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	6
106	NULL	31	0	0	0	0	0	0.099940903	1	0.851981997
0.117304009	g	mi								
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	5
106	NULL	21	0	0	0	0	0	0.067729101	1	0.952619016
0.071097784	g	mi								
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	4
106	NULL	31	0	0	0	0	0	0.132376	1	0.851981997
0.155374175	g	mi								
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	3
106	NULL	21	0	0	0	0	0	0.089221902	1	0.952619016
0.093659585	g	mi								
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	2
106	NULL	31	0	0	0	0	0	0.229679003	1	0.851981997
0.269581991	g	mi								
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	1
106	NULL	21	0	0	0	0	0	0.153699994	1	0.952619016
0.161344663	g	mi								
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	22
100	NULL	31	0	0	0	0	0	0.0462947	1	0
NULL	g	mi								
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	21
100	NULL	21	0	0	0	0	0	0.116761997	1	0
NULL	g	mi								
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	20
100	NULL	31	0	0	0	0	0	0.0102152	1	0.851981997
0.011989924	g	mi								
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	19
100	NULL	21	0	0	0	0	0	0.013088	1	0.952619016
0.013738966	g	mi								
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	18
100	NULL	31	0	0	0	0	0	0.0102794	1	0.851981997
0.012065279	g	mi								

1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
	100	NULL	21	0	0	0	0	0	0.0130221	1	0.952619016	
	0.013669788	g	mi									
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
	100	NULL	31	0	0	0	0	0	0.0106561	1	0.851981997	
	0.012507424	g	mi									
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	15
	100	NULL	21	0	0	0	0	0	0.0134659	1	0.952619016	
	0.014135662	g	mi									
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	14
	100	NULL	31	0	0	0	0	0	0.0113203	1	0.851981997	
	0.013287018	g	mi									
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	13
	100	NULL	21	0	0	0	0	0	0.0143556	1	0.952619016	
	0.015069613	g	mi									
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	12
	100	NULL	31	0	0	0	0	0	0.0122299	1	0.851981997	
	0.014354646	g	mi									
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	11
	100	NULL	21	0	0	0	0	0	0.0154184	1	0.952619016	
	0.016185274	g	mi									
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
	100	NULL	31	0	0	0	0	0	0.013743	1	0.851981997	
	0.016130623	g	mi									
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
	100	NULL	21	0	0	0	0	0	0.0165687	1	0.952619016	
	0.017392787	g	mi									
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
	100	NULL	31	0	0	0	0	0	0.017967001	1	0.851981997	
	0.021088474	g	mi									
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	7
	100	NULL	21	0	0	0	0	0	0.0219301	1	0.952619016	
	0.023020851	g	mi									
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	6
	100	NULL	31	0	0	0	0	0	0.0197326	1	0.851981997	
	0.023160818	g	mi									
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	5
	100	NULL	21	0	0	0	0	0	0.0250658	1	0.952619016	
	0.026312513	g	mi									
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	4
	100	NULL	31	0	0	0	0	0	0.020119799	1	0.851981997	
	0.023615287	g	mi									
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	3
	100	NULL	21	0	0	0	0	0	0.0278797	1	0.952619016	
	0.029266369	g	mi									
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	2
	100	NULL	31	0	0	0	0	0	0.021281499	1	0.851981997	
	0.024978813	g	mi									
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	1
	100	NULL	21	0	0	0	0	0	0.036321498	1	0.952619016	
	0.038128043	g	mi									

1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	22
91 NULL	31	0	0	0	0	0	0.046670325	1	0	NULL	g
mi											
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	21
91 NULL	21	0	0	0	0	0	0.039284363	1	0	NULL	g
mi											
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	20
91 NULL	31	0	0	0	0	0	0.00456881	1	0.851981997	0.005362566	g
mi											
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	19
91 NULL	21	0	0	0	0	0	0.003710173	1	0.952619016	0.003894708	g
mi											
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	18
91 NULL	31	0	0	0	0	0	0.004652569	1	0.851981997	0.005460877	g
mi											
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	17
91 NULL	21	0	0	0	0	0	0.003790339	1	0.952619016	0.003978862	g
mi											
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	16
91 NULL	31	0	0	0	0	0	0.004763823	1	0.851981997	0.00559146	g
mi											
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	15
91 NULL	21	0	0	0	0	0	0.003906343	1	0.952619016	0.004100635	g
mi											
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	14
91 NULL	31	0	0	0	0	0	0.004910858	1	0.851981997	0.00576404	g
mi											
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	13
91 NULL	21	0	0	0	0	0	0.004065064	1	0.952619016	0.004267251	g
mi											
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	12
91 NULL	31	0	0	0	0	0	0.005166352	1	0.851981997	0.006063921	g
mi											
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	11
91 NULL	21	0	0	0	0	0	0.004313554	1	0.952619016	0.004528099	g
mi											
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	10
91 NULL	31	0	0	0	0	0	0.005783428	1	0.851981997	0.006788204	g
mi											
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	9
91 NULL	21	0	0	0	0	0	0.004822342	1	0.952619016	0.005062193	g
mi											
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	8
91 NULL	31	0	0	0	0	0	0.006437166	1	0.851981997	0.007555518	g
mi											
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	7
91 NULL	21	0	0	0	0	0	0.005417827	1	0.952619016	0.005687296	g
mi											
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00		1	1	2014	1	5	7	25	25025	250250	6
91 NULL	31	0	0	0	0	0	0.007430459	1	0.851981997	0.008721381	g
mi											

1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	5
91 NULL 21	0	0	0	0	0	0.006291818	1	0.952619016	0.006604758	g
mi										
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	4
91 NULL 31	0	0	0	0	0	0.009359627	1	0.851981997	0.01098571	g
mi										
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	3
91 NULL 21	0	0	0	0	0	0.007969161	1	0.952619016	0.008365527	g
mi										
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	2
91 NULL 31	0	0	0	0	0	0.015147159	1	0.851981997	0.017778731	g
mi										
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	1
91 NULL 21	0	0	0	0	0	0.013001207	1	0.952619016	0.013647856	g
mi										
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	22
87 NULL 31	0	0	0	0	0	0.872647405	1	0	NULL	g
mi										
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	21
87 NULL 21	0	0	0	0	0	1.148899317	1	0	NULL	g
mi										
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	20
87 NULL 31	0	0	0	0	0	0.076620907	1	0.851981997	0.089932542	g
mi										
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	19
87 NULL 21	0	0	0	0	0	0.083071336	1	0.952619016	0.087203105	g
mi										
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	18
87 NULL 31	0	0	0	0	0	0.079071701	1	0.851981997	0.092809121	g
mi										
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	17
87 NULL 21	0	0	0	0	0	0.085127674	1	0.952619016	0.08936172	g
mi										
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	16
87 NULL 31	0	0	0	0	0	0.082631588	1	0.851981997	0.096987481	g
mi										
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	15
87 NULL 21	0	0	0	0	0	0.08887922	1	0.952619016	0.093299859	g
mi										
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	14
87 NULL 31	0	0	0	0	0	0.087509662	1	0.851981997	0.102713041	g
mi										
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	13
87 NULL 21	0	0	0	0	0	0.094418868	1	0.952619016	0.099115036	g
mi										
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	12
87 NULL 31	0	0	0	0	0	0.093938179	1	0.851981997	0.110258409	g
mi										
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	11
87 NULL 21	0	0	0	0	0	0.101622738	1	0.952619016	0.106677209	g
mi										

1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	10
87	NULL	31	0	0	0	0	0	0.102523491	1	0.851981997	0.120335278	g
mi												
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	9
87	NULL	21	0	0	0	0	0	0.11087092	1	0.952619016	0.116385374	g
mi												
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	8
87	NULL	31	0	0	0	0	0	0.11445646	1	0.851981997	0.134341407	g
mi												
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	7
87	NULL	21	0	0	0	0	0	0.124963917	1	0.952619016	0.131179322	g
mi												
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	6
87	NULL	31	0	0	0	0	0	0.130961746	1	0.851981997	0.153714217	g
mi												
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	5
87	NULL	21	0	0	0	0	0	0.144667283	1	0.952619016	0.151862686	g
mi												
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	4
87	NULL	31	0	0	0	0	0	0.161955908	1	0.851981997	0.19009311	g
mi												
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	3
87	NULL	21	0	0	0	0	0	0.181817725	1	0.952619016	0.190860903	g
mi												
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	2
87	NULL	31	0	0	0	0	0	0.25493893	1	0.851981997	0.299230419	g
mi												
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	1
87	NULL	21	0	0	0	0	0	0.293268859	1	0.952619016	0.307855349	g
mi												
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	22
79	NULL	31	0	0	0	0	0	0.82478869	1	0	NULL	g
mi												
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	21
79	NULL	21	0	0	0	0	0	1.082221508	1	0	NULL	g
mi												
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	20
79	NULL	31	0	0	0	0	0	0.073057733	1	0.851981997	0.085750325	g
mi												
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	19
79	NULL	21	0	0	0	0	0	0.078240208	1	0.952619016	0.082131689	g
mi												
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	18
79	NULL	31	0	0	0	0	0	0.075457253	1	0.851981997	0.088566722	g
mi												
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	17
79	NULL	21	0	0	0	0	0	0.080149218	1	0.952619016	0.084135648	g
mi												
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00			1	1	2014	1	5	7	25	25025	250250	16
79	NULL	31	0	0	0	0	0	0.078974403	1	0.851981997	0.09269492	g
mi												

1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	15
79 NULL 21	0	0	0	0	0	0.083712734	1	0.952619016	0.087876405	g
mi										
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	14
79 NULL 31	0	0	0	0	0	0.083810419	1	0.851981997	0.098371115	g
mi										
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	13
79 NULL 21	0	0	0	0	0	0.089008555	1	0.952619016	0.093435627	g
mi										
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	12
79 NULL 31	0	0	0	0	0	0.090141989	1	0.851981997	0.105802692	g
mi										
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	11
79 NULL 21	0	0	0	0	0	0.09587761	1	0.952619016	0.100646332	g
mi										
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	10
79 NULL 31	0	0	0	0	0	0.098405369	1	0.851981997	0.115501699	g
mi										
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	9
79 NULL 21	0	0	0	0	0	0.104620121	1	0.952619016	0.109823675	g
mi										
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	8
79 NULL 31	0	0	0	0	0	0.109912589	1	0.851981997	0.129008112	g
mi										
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	7
79 NULL 21	0	0	0	0	0	0.118045226	1	0.952619016	0.123916512	g
mi										
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	6
79 NULL 31	0	0	0	0	0	0.125646874	1	0.851981997	0.147475973	g
mi										
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	5
79 NULL 21	0	0	0	0	0	0.136663437	1	0.952619016	0.143460748	g
mi										
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	4
79 NULL 31	0	0	0	0	0	0.155062407	1	0.851981997	0.182001976	g
mi										
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	3
79 NULL 21	0	0	0	0	0	0.171659991	1	0.952619016	0.180197947	g
mi										
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	2
79 NULL 31	0	0	0	0	0	0.24330838	1	0.851981997	0.28557925	g
mi										
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	1
79 NULL 21	0	0	0	0	0	0.276649535	1	0.952619016	0.290409419	g
mi										
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	22
31 NULL 31	0	0	0	0	0	0.070541501	1	0	NULL	g
mi										
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	21
31 NULL 21	0	0	0	0	0	0.059377801	1	0	NULL	g
mi										

1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	20
31 NULL 31	0	0	0	0	0	0.00690569	1	0.851981997	0.008105441	g
mi										
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	19
31 NULL 21	0	0	0	0	0	0.00560787	1	0.952619016	0.005886792	g
mi										
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	18
31 NULL 31	0	0	0	0	0	0.00703229	1	0.851981997	0.008254036	g
mi										
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	17
31 NULL 21	0	0	0	0	0	0.00572904	1	0.952619016	0.006013989	g
mi										
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	16
31 NULL 31	0	0	0	0	0	0.00720045	1	0.851981997	0.008451411	g
mi										
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	15
31 NULL 21	0	0	0	0	0	0.00590438	1	0.952619016	0.00619805	g
mi										
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	14
31 NULL 31	0	0	0	0	0	0.0074227	1	0.851981997	0.008712273	g
mi										
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	13
31 NULL 21	0	0	0	0	0	0.00614428	1	0.952619016	0.006449882	g
mi										
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	12
31 NULL 31	0	0	0	0	0	0.00780888	1	0.851981997	0.009165546	g
mi										
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	11
31 NULL 21	0	0	0	0	0	0.00651987	1	0.952619016	0.006844153	g
mi										
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	10
31 NULL 31	0	0	0	0	0	0.00874157	1	0.851981997	0.010260275	g
mi										
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	9
31 NULL 21	0	0	0	0	0	0.0072889	1	0.952619016	0.007651433	g
mi										
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	8
31 NULL 31	0	0	0	0	0	0.00972969	1	0.851981997	0.011420065	g
mi										
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	7
31 NULL 21	0	0	0	0	0	0.00818898	1	0.952619016	0.00859628	g
mi										
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	6
31 NULL 31	0	0	0	0	0	0.011231	1	0.851981997	0.013182203	g
mi										
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	5
31 NULL 21	0	0	0	0	0	0.00951	1	0.952619016	0.009983005	g
mi										
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	4
31 NULL 31	0	0	0	0	0	0.014147	1	0.851981997	0.016604811	g
mi										

1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	3	31	NULL	21	0	0	0	0	0	0.0120453	1	0.952619016	0.012644404	g	mi
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	2	31	NULL	31	0	0	0	0	0	0.022894699	1	0.851981997	0.02687228	g	mi
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	1	31	NULL	21	0	0	0	0	0	0.0196511	1	0.952619016	0.020628499	g	mi
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	22	3	NULL	31	0	0	0	0	0	0.558390379	1	0	NULL	g	mi
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	21	3	NULL	21	0	0	0	0	0	0.71452558	1	0	NULL	g	mi
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	20	3	NULL	31	0	0	0	0	0	0.36871174	1	0.851981997	0.432769402	g	mi
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	19	3	NULL	21	0	0	0	0	0	0.300691038	1	0.952619016	0.315646689	g	mi
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	18	3	NULL	31	0	0	0	0	0	0.359299362	1	0.851981997	0.421721777	g	mi
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	17	3	NULL	21	0	0	0	0	0	0.294334769	1	0.952619016	0.308974274	g	mi
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	16	3	NULL	31	0	0	0	0	0	0.350273997	1	0.851981997	0.411128401	g	mi
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	15	3	NULL	21	0	0	0	0	0	0.294197768	1	0.952619016	0.308830459	g	mi
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	14	3	NULL	31	0	0	0	0	0	0.340330631	1	0.851981997	0.399457537	g	mi
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	13	3	NULL	21	0	0	0	0	0	0.298757941	1	0.952619016	0.313617444	g	mi
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	12	3	NULL	31	0	0	0	0	0	0.334090352	1	0.851981997	0.392133112	g	mi
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	11	3	NULL	21	0	0	0	0	0	0.308412343	1	0.952619016	0.323752033	g	mi
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	10	3	NULL	31	0	0	0	0	0	0.356348246	1	0.851981997	0.418257953	g	mi
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	9	3	NULL	21	0	0	0	0	0	0.336796463	1	0.952619016	0.35354791	g	mi

1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	8	3	NULL	31	0	0	0	0	0	0.363296539	1	0.851981997	0.426413398	g	mi
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	7	3	NULL	21	0	0	0	0	0	0.351820081	1	0.952619016	0.369318768	g	mi
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	6	3	NULL	31	0	0	0	0	0	0.373091936	1	0.851981997	0.437910586	g	mi
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	5	3	NULL	21	0	0	0	0	0	0.365177602	1	0.952619016	0.383340659	g	mi
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	4	3	NULL	31	0	0	0	0	0	0.391618669	1	0.851981997	0.459656038	g	mi
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	3	3	NULL	21	0	0	0	0	0	0.384929419	1	0.952619016	0.404074884	g	mi
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	2	3	NULL	31	0	0	0	0	0	0.447199881	1	0.851981997	0.52489358	g	mi
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	1	3	NULL	21	0	0	0	0	0	0.444185764	1	0.952619016	0.466278498	g	mi
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	22	2	NULL	31	0	0	0	0	0	17.19623756	1	0	NULL	g	mi
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	21	2	NULL	21	0	0	0	0	0	8.406899452	1	0	NULL	g	mi
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	20	2	NULL	31	0	0	0	0	0	1.867800713	1	0.851981997	2.19230068	g	mi
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	19	2	NULL	21	0	0	0	0	0	1.503711581	1	0.952619016	1.578502587	g	mi
1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	18	2	NULL	31	0	0	0	0	0	1.864228964	1	0.851981997	2.188108398	g	mi
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	17	2	NULL	21	0	0	0	0	0	1.519069552	1	0.952619016	1.594624427	g	mi
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	16	2	NULL	31	0	0	0	0	0	1.920638204	1	0.851981997	2.254317825	g	mi
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	15	2	NULL	21	0	0	0	0	0	1.60879612	1	0.952619016	1.688813778	g	mi
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	14	2	NULL	31	0	0	0	0	0	2.0300951	1	0.851981997	2.382791076	g	mi

1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	13
2 NULL 21	0	0	0	0	0	1.766948342	1	0.952619016	1.854832113	g
mi										
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	12
2 NULL 31	0	0	0	0	0	2.158792019	1	0.851981997	2.533846989	g
mi										
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	11
2 NULL 21	0	0	0	0	0	1.940628648	1	0.952619016	2.03715086	g
mi										
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	10
2 NULL 31	0	0	0	0	0	2.275952816	1	0.851981997	2.671362567	g
mi										
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	9
2 NULL 21	0	0	0	0	0	2.030775547	1	0.952619016	2.131781449	g
mi										
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	8
2 NULL 31	0	0	0	0	0	2.717482328	1	0.851981997	3.189600645	g
mi										
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	7
2 NULL 21	0	0	0	0	0	2.477797747	1	0.952619016	2.601037461	g
mi										
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	6
2 NULL 31	0	0	0	0	0	3.058719873	1	0.851981997	3.590122658	g
mi										
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	5
2 NULL 21	0	0	0	0	0	2.813952446	1	0.952619016	2.953911688	g
mi										
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	4
2 NULL 31	0	0	0	0	0	3.505972147	1	0.851981997	4.115077733	g
mi										
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	3
2 NULL 21	0	0	0	0	0	3.242535114	1	0.952619016	3.40381103	g
mi										
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	2
2 NULL 31	0	0	0	0	0	4.847739697	1	0.851981997	5.689955552	g
mi										
1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	1
2 NULL 21	0	0	0	0	0	4.52829361	1	0.952619016	4.753520067	g
mi										
1,1,2014,1,5,7,25,25025,250250,22,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	22
1 NULL 31	0	0	0	0	0	0.840692699	1	0	NULL	g
mi										
1,1,2014,1,5,7,25,25025,250250,21,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	21
1 NULL 21	0	0	0	0	0	1.107412457	1	0	NULL	g
mi										
1,1,2014,1,5,7,25,25025,250250,20,31,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	20
1 NULL 31	0	0	0	0	0	0.075618528	1	0.851981997	0.088756016	g
mi										
1,1,2014,1,5,7,25,25025,250250,19,21,0,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	19
1 NULL 21	0	0	0	0	0	0.080881208	1	0.952619016	0.084904045	g
mi										

1,1,2014,1,5,7,25,25025,250250,18,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	18
1 NULL 31	0	0	0	0	0	0.07812155	1	0.851981997	0.091693898	g
mi										
1,1,2014,1,5,7,25,25025,250250,17,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	17
1 NULL 21	0	0	0	0	0	0.082780324	1	0.952619016	0.086897619	g
mi										
1,1,2014,1,5,7,25,25025,250250,16,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	16
1 NULL 31	0	0	0	0	0	0.081833899	1	0.851981997	0.096051207	g
mi										
1,1,2014,1,5,7,25,25025,250250,15,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	15
1 NULL 21	0	0	0	0	0	0.086457632	1	0.952619016	0.090757828	g
mi										
1,1,2014,1,5,7,25,25025,250250,14,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	14
1 NULL 31	0	0	0	0	0	0.086961009	1	0.851981997	0.102069068	g
mi										
1,1,2014,1,5,7,25,25025,250250,13,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	13
1 NULL 21	0	0	0	0	0	0.091976151	1	0.952619016	0.096550824	g
mi										
1,1,2014,1,5,7,25,25025,250250,12,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	12
1 NULL 31	0	0	0	0	0	0.093631081	1	0.851981997	0.109897957	g
mi										
1,1,2014,1,5,7,25,25025,250250,11,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	11
1 NULL 21	0	0	0	0	0	0.099106297	1	0.952619016	0.104035606	g
mi										
1,1,2014,1,5,7,25,25025,250250,10,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	10
1 NULL 31	0	0	0	0	0	0.102139272	1	0.851981997	0.119884308	g
mi										
1,1,2014,1,5,7,25,25025,250250,9,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	9
1 NULL 21	0	0	0	0	0	0.108060725	1	0.952619016	0.113435406	g
mi										
1,1,2014,1,5,7,25,25025,250250,8,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	8
1 NULL 31	0	0	0	0	0	0.114066094	1	0.851981997	0.133883221	g
mi										
1,1,2014,1,5,7,25,25025,250250,7,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	7
1 NULL 21	0	0	0	0	0	0.12202172	1	0.952619016	0.128090787	g
mi										
1,1,2014,1,5,7,25,25025,250250,6,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	6
1 NULL 31	0	0	0	0	0	0.130200177	1	0.851981997	0.152820339	g
mi										
1,1,2014,1,5,7,25,25025,250250,5,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	5
1 NULL 21	0	0	0	0	0	0.141151547	1	0.952619016	0.148172087	g
mi										
1,1,2014,1,5,7,25,25025,250250,4,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	4
1 NULL 31	0	0	0	0	0	0.160237208	1	0.851981997	0.188075814	g
mi										
1,1,2014,1,5,7,25,25025,250250,3,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	3
1 NULL 21	0	0	0	0	0	0.176943779	1	0.952619016	0.185744538	g
mi										
1,1,2014,1,5,7,25,25025,250250,2,31,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	2
1 NULL 31	0	0	0	0	0	0.250348389	1	0.851981997	0.293842346	g
mi										

1,1,2014,1,5,7,25,25025,250250,1,21,0,0,0,0,00	1	1	2014	1	5	7	25	25025	250250	1
1 NULL 21 mi	0	0	0	0	0	0.284320533	1	0.952619016	0.298461954	g

Source: KBE and Massport.

Fuel Storage and Handling

As in previous years, VOC emissions from fuel storage and handling were calculated using methods based on EPA's AP-42[1] document. Calculations account for evaporative emissions from breathing losses, working losses, and spillage from aboveground storage tanks, underground storage tanks, and aircraft refueling. In 2003, additional information became available on the fire training fuel, Tek-Flame®. Emissions of VOCs from this fuel were estimated by EDMS. Table I-8 presents Logan Airport's fuel throughput by category.

Stationary Sources

Stationary sources include the Central Heating and Cooling Plant, emergency generators, snow melters, space heaters, and boilers. Emission factors from EPA's AP-42 or NO_x Reasonably Available Control Technology (RACT) compliance testing were combined with the actual 2014 fuel throughput of the stationary sources to obtain emissions of VOCs, NO_X, CO, and PM with a diameter of less than or equal to 10 micrograms or 2.5 micrograms (PM_{10}/$PM_{2.5}$).

Title V of the 1990 Clean Air Act (CAA) Amendments requires facilities with air emissions to document their emissions and obtain a single permit combining all sources. The permitting program ensures that all emission sources are accounted for, the proper permits have been received, and permit conditions are being followed. A Title V Air Operating Permit covers all of the stationary sources at Logan Airport including boilers, emergency generators, snow melters, fire training, cooling towers, paint booths, deicing facilities, and storage tanks. Table I-9 presents Logan Airport's stationary source fuel throughput by fuel category.

1 Compilation of Air Pollutant Emission Factors, AP-42, Office of Air Quality Planning and Standards, EPA, Fifth Edition, 1995.

Table I-8 Fuel Throughput by Fuel Category (gallons)

Fuel Category	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Jet Fuel	354,095,516	441,901,932	416,748,819	358,190,362	319,439,910	373,996,141	368,645,392	364,450,864	367,585,187	345,631,788	327,358,619	335,693,997	340,421,373	343,731,127	349,397,940	370,222,342
Fire Training Fuel[1]	NA	NA	NA	NA	13,719	12,227	8,105	5,000	8,631	5,971	3,510	800	3,810	2,587	5,400	3,753
Aviation Gas	99,726	90,922	60,691	35,111	32,515	34,717	52,487	35,098	29,067	25,037	18,238	15,268	14,064	12,306	14,422	12,514
Auto Gas	7,200,000	7,569,206	6,181,472	5,754,740	5,436,322	5,803,442	5,903,424	6,028,931	6,022,237	5,693,178	5,736,724	5,696,505	5,487,952	6,694,626	6,800,936	7,007,591
Diesel	768,106	839,751	1,239,904	1,067,847	1,030,185	1,078,665	1,567,688	1,164,493	1,141,335	1,071,707	1,121,241	1,168,761	1,099,720	878,499	1,094,714	1,178,805
Heating Oil No.2	480,733	494,500	582,283	340,492	370,903	381,852	367,899	259,768	423,181	303,143	409,049	319,727	384,906	210,794	289,665	289,956
Heating Oil No.6	1,600,893	1,555,527	1,641,693	1,079,283	1,122,975	2,940,752	3,098,126	1,396,529	1,073,260	16,385	368,690	9,010	11,285	6,786	17,721	77,146

Source: Massport, 2014.

1 Fire Training Fuel used in 1999-2002 was Jet A Fuel while in 2003 through 2014 it was Tek-Flame®. 2012 includes 100 gallons of avgas, 2013 includes 400 gallons of avgas, and 2014 includes 338 gallons of avgas.

NA Not available.

Table I-9 Stationary Source Fuel Throughput by Fuel Category (gallons)

Fuel Category	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Natural Gas (ft^3)	183,943,000	283,720,049	199,500,000	268,359,282	201,714,114	62,610,000	92,460,000	112,390,000	338,430,000	458,680,000	430,810,000	449,640,000	479,830,000	360,523,000	402,496,000	418,805,000
Heating Oil No. 2	480,733	494,500	582,283	340,492	370,903	381,852	367,899	259,768	423,181	303,143	409,050	319,727	384,906	210,794	289,665	289,956
Heating Oil No. 6	1,600,893	1,555,527	1,641,693	1,079,283	1,122,975	2,940,752	3,098,126	1,396,529	1,073,260	16,385	368,690	9,010	11,285	6,786	17,721	77,146
Diesel Fuel[1]	57,441	NA	NA	NA	NA	67,198	77,848	77,848	258,606	146,718	145,778	116,511	218,081	42,109	231,130	124,480
Fire Training Fuel[2]	23,000	NA	NA	NA	13,719	12,227	8,105	5,000	8,631	5,971	3,510	800	3,810	2,587	5,400	3,753

Source: Massport, 2014.

NA Not available.

1 Diesel fuel was from the stationary snow melter usage. Starting in 2007, portable snow melter usage was also included.

2 Fire Training Fuel used in 1999-2002 was Jet A Fuel while in 2003 through 2014 it was Tek-Flame®. 2012 includes 100 gallons of avgas, 2013 includes 400 gallons of avgas, and 2014 includes 338 gallons of avgas.

1993 Through 2009 Emissions Inventories

Tables I-10 through I-16 contain the 1993 through 2009 Emissions Inventory summary tables for Logan Airport.

Table I-10 Estimated VOC Emissions (in kg/day) at Logan Airport 1993-2001[1]

Aircraft/GSE Model:	**Logan Dispersion Modeling System (LDMS)**					**EDMS v3.22**	**EDMS v4.21**	**EDMS v4.03**	
Motor Vehicle Model:	**MOBILE5a**					**MOB5a_h**	**MOB 6.2.03**	**MOBILE 6.0**	
Year:	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999[2]**	**2000**	**2001**
Aircraft Sources									
Air carriers	1,958	1,554	1,407	1,390	1,227	736	653	514	374
Commuter aircraft	943	543	531	622	498	154	196	140	113
Cargo aircraft	89	244	236	214	207	43	318	207	149
General aviation	51	48	36	24	27	13	141	42	43
Total aircraft sources	3,041	2,389	2,210	2,250	1,959	946	1,308	903	679
Ground Service Equipment[3]	636	533	521	497	530	145	243	153	143
Motor Vehicles									
Ted Williams Tunnel	NA	NA	NA	NA	NA	NA	15		
through-traffic								12	10
Parking/curbside	173	148	127	102	102	118	101	89	77
On-airport vehicles[4]	238	215	179	223	205	258	256	206	170
Total motor vehicle sources	411	363	306	325	307	376	372	307	257
Other Sources									
Fuel storage/handling	408	434	318	356	381	372	352	412	372
Miscellaneous sources[5]	5	5	5	6	6	2	16	2	2
Total other sources	413	439	323	362	387	374	368	414	374
Total Airport Sources	4,501	3,724	3,360	3,434	3,183	1,841	2,291	1,777	1,453

Source: KBE and Massport.
kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Not available.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2.03=MOBILE6.2 version .03)
1 The emissions inventory for 1990 is shown in Chapter 7. Emission inventories for 1991 and 1992 were not prepared.
2 Year 1999 emissions were last re-calculated using EDMS v4.21 in the 2004 ESPR Air Quality Analysis.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels. APU emissions are also included.
4 1999 emissions inventory include reductions attributable to CNG shuttle buses.
5 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999. Diesel snow melter usage was added in 1999.

Table I-11 Estimated VOC Emissions (in kg/day) at Logan Airport 2002-2009

Aircraft/GSE Model:	EDMS v4.11		EDMS v4.21	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1		EDMS v5.1.2
Motor Vehicle Model:	**MOBILE 6.0**	**MOB 6.2.01**	**MOBILE 6.2.03**									
Year:	**2002**	**2003**	**2004**	**2005**	**2006**		**2007**		**2008**		**2009**	
Aircraft Sources												
Air carriers	248	208	292	271	227	511	435	381	324	286	237	235
Commuter aircraft	75	95	127	140	125	371	479	409	253	176	131	133
Cargo aircraft	127	94	110	41	19	46	129	112	107	70	71	71
General aviation	52	61	127	147	147	236	226	206	201	171	78	78
Total aircraft sources	502	458	656	599	518	1,164[1]	1,269	1,108	885	703	517	517
Ground Service Equipment[2]	247	227	187	178	167	77	78	78	66	66	56	56
Motor Vehicles												
Ted Williams Tunnel through-traffic	9	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]
Parking/curbside[4]	51	45	38	37	33	33	31	31	25	25	22	22
On-airport vehicles	152	135	129	118	106	106	104	104	82	82	71	71
Total motor vehicle sources	212	180	167	155	139	139	135	135	107	107	93	93
Other Sources												
Fuel storage/handling	329	297	341	340	336	336	338	338	320	320	307	307
Miscellaneous sources[5]	2	3	9	13	8	8	14	14	13	12	7	7
Total other sources	331	300	350	353	344	344	352	352	333	332	314	314
Total Airport Sources	1,292	1,165	1,360	1,285	1,168	1,724	1,834	1,673	1,391	1,208	980	980

Source: KBE and Massport
Notes: Years 2006 to 2009 were computed with previous years EDMS version to provide for a common basis of comparison.
kg/day kilograms per day. 1 kg/day is equivalent to approximately 0.40234 tons per year (tpy).
1 The 2006 increase in aircraft VOC emissions is largely attributable to the addition of aircraft main engine startup emissions.
2 GSE emissions include aircraft APUs as well as vehicles and equipment converted to alternative fuels.
3 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.
4 Parking/curbside is based on VMT analysis.
5 Includes the Central Heating and Cooling Plant, emergency electricity generation, snow melter usage, and other stationary sources.

Table I-12 Estimated NO_X Emissions (in kg/day) at Logan Airport 1993-2001[1]

Aircraft/GSE Model:	Logan Dispersion Modeling System (LDMS)					EDMS v3.22	EDMS v4.21	EDMS v4.03	
Motor Vehicle Model:	**MOBILE5a**					**MOB5a_h**	**MOB 6.2.03**	**MOBILE 6.0**	
Year:	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999[2]**	**2000**	**2001**
Aircraft Sources									
Air carriers	4,271	4,317	3,861	3,781	4,150	4,471	4,183	4,202	3,707
Commuter aircraft	202	158	192	137	159	203	166	125	233
Cargo aircraft	213	257	332	363	262	254	286	284	267
General aviation	13	13	17	18	21	5	12	49	34
Total aircraft sources	4,699	4,745	4,402	4,299	4,592	4,933	4,647	4,660	4,241
Ground Service Equipment[3]	722	617	607	588	622	317	444	333	305
Motor Vehicles									
Ted Williams Tunnel	NA	NA	NA	NA	NA	NA	28		
through-traffic								26	22
Parking/curbside	25	24	24	24	24	37	39	52	46
On-airport vehicles[4]	240	239	229	257	244	372	449	425	369
Total motor vehicle sources	265	263	253	281	268	409	516	503	437
Other Sources									
Fuel storage/handling	0	0	0	0	0	0	0	0	0
Miscellaneous sources[5]	278	330	320	275	244	284	165	211	185
Total other sources	278	330	320	275	244	284	165	211	185
Total Airport Sources	5,964	5,955	5,582	5,443	5,726	5,943	5,772	5,707	5,168

Source: KBE and Massport.
Kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Not available.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2.03=MOBILE6.2 version .03)
1 The emissions inventory for 1990 is shown in Chapter 7. Emission inventories for 1991 and 1992 were not prepared.
2 Year 1999 emissions were last re-calculated using EDMS v4.21 in the 2004 ESPR Air Quality Analysis.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels. APU emissions are also included.
4 1999 emissions inventory include reductions attributable to CNG shuttle buses.
5 Fuel storage and handling facilities are not sources of Nox emissions.
6 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999. Diesel snow melter usage was added in 1999.

Table I-13 Estimated NO_X Emissions (in kg/day) at Logan Airport 2002-2009

Aircraft/GSE Model:	EDMS v4.11		EDMS v4.21	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1		EDMS v5.1.2
Motor Vehicle Model:	**MOBILE 6.0**	**MOB 6.2.01**	**MOBILE 6.2.03**									
Year:	**2002**	**2003**	**2004**	**2005**	**2006**		**2007**		**2008**		**2009**	
Aircraft Sources												
Air carriers	2,721	2,479	2,949	2,880	2,849	3,044	3,120	3,121	3,031	3,031	2,944	2,952
Commuter aircraft	208	185	245	225	195	256	353	354	319	319	309	234
Cargo aircraft	246	213	215	211	192	125	248	248	233	233	215	204
General aviation	38	45	49	50	49	60	56	56	43	43	27	23
Total aircraft sources	3,213	2,922	3,458	3,366	3,285	3,485	3,777	3,779	3,626	3,626	3,495	3,413
Ground Service Equipment[2]	322	291	333	312	280	300	299	299	257	257	219	219
Motor Vehicles												
Ted Williams Tunnel through-traffic	20	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[3]	0[3]
Parking/curbside[4]	32	28	21	22	19	19	18	18	15	15	13	13
On-airport vehicles	341	302	267	269	238	238	233	233	182	182	153	153
Total motor vehicle sources	393	330	288	291	257	257	251	251	197	197	166	166
Other Sources												
Fuel storage/handling	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous sources[5]	175	151	211	218	109	109	128	128	124	124	181	181
Total other sources	175	151	211	218	109	109	128	128	124	124	181	181
Total Airport Sources	4,103	3,694	4,290	4,187	3,931	4,151	4,455	4,457	4,204	4,204	4,061	3,979

Source: KBE and Massport
Notes: Years 2006 to 2009 were computed with previous years EDMS version to provide for a common basis of comparison.
Kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
1 GSE emissions include APUs as well as vehicles and equipment converted to alternative fuels.
2 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.
3 Parking/curbside data is based on VMT analysis.
4 Fuel storage/handling facilities are not a source of NO_x emissions.
5 Includes the Central Heating and Cooling Plant, emergency electricity generation, snow melter usage, and other stationary sources.

Table I-14 Estimated CO Emissions (in kg/day) at Logan Airport 1993-2001[1]									
Aircraft/GSE Model:	Logan Dispersion Modeling System (LDMS)					EDMS v3.22	EDMS v4.21	EDMS v4.03	
Motor Vehicle Model:	MOBILE5a					MOB5a_h	MOB 6.2.03	MOBILE 6.0	
Year:	1993	1994	1995	1996	1997	1998	1999[2]	2000	2001
Aircraft Sources									
Air carriers	5,663	4,660	4,691	4,812	4,698	3,079	3,754	2,994	2,475
Commuter aircraft	1,309	927	934	859	770	482	1,404	1,188	1,072
Cargo aircraft	344	572	598	580	514	218	503	400	323
General aviation	353	356	339	549	654	269	940	295	407
Total aircraft sources	7,669	6,515	6,562	6,800	6,636	4,048	6,601	4,877	4,277
Ground Service Equipment[3]	7,482	6,187	6,029	5,740	6,098	5,113	4,532	5,335	5,193
Motor Vehicles									
Ted Williams Tunnel through-traffic	NA	NA	NA	NA	NA	NA	151	133	121
Parking/curbside	952	820	650	644	586	772	437	495	440
On-airport vehicles[4]	1,575	1,451	1,087	1,514	1,283	1,883	2,547	2,245	2,001
Total motor vehicle sources	2,527	2,271	1,737	2,158	1,869	2,655	3,135	2,873	2,562
Other Sources									
Fuel storage/handling	0	0	0	0	0	0	0	0	0
Miscellaneous sources[5]	26	30	29	39	37	37	168	27	24
Total other sources	26	30	29	39	37	37	168	27	24
Total Airport Sources	17,704	15,003	14,357	14,737	14,640	11,853	14,436	13,112	12,056

Source: KBE and Massport.
Kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Not available.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2.03=MOBILE6.2 version .03)
1 The emissions inventory for 1990 is shown in Chapter 7. Emission inventories for 1991 and 1992 were not prepared.
2 Year 1999 emissions were last re-calculated using EDMS v4.21 in the 2004 ESPR Air Quality Analysis.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels. APU emissions are also included.
4 1999 emission inventory include reductions attributable to CNG shuttle buses.
5 Fuel storage and handling facilities are not sources of CO emissions.
6 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999. Diesel snow melter usage was added in 1999.

Table I-15 Estimated CO Emissions (in kg/day) at Logan Airport 2002-2009

Aircraft/GSE Model:	EDMS v4.11		EDMS v4.21	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1		EDMS v5.1.2
Motor Vehicle Model:	MOBILE 6.0	MOB 6.2.01	MOBILE 6.2.03									
Year:	2002	2003	2004	2005	2006		2007		2008		2009	
Aircraft Sources												
Air carriers	2,156	2,128	2,985	2,895	2,828	3,167	2,973	2,973	2,710	2,710	2,460	2,448
Commuter aircraft	783	846	1,010	1,010	950	1,587	2,484	2,484	2,436	2,436	2,364	2,795
Cargo aircraft	285	209	229	174	138	158	241	241	255	255	256	266
General aviation	256	276	416	437	398	442	401	403	345	345	145	150
Total aircraft sources	3,480	3,459	4,640	4,516	4,314	5,354	6,099	6,101	5,746	5,746	5,225	5,659
Ground Service Equipment[2]	5,170	4,758	3,586	3,531	3,409	1,586	1,904	1,904	1,609	1,609	1,364	1,364
Motor Vehicles												
Ted Williams Tunnel through-traffic	112	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[3]	0[3]
Parking/curbside[4]	295	253	180	179	144	144	139	139	117	117	107	107
On-airport vehicles	1,872	1,685	1,412	1,290	1,036	1,036	1,038	1,038	834	834	740	740
Total motor vehicle sources	2,279	1,938	1,592	1,469	1,180	1,180	1,177	1,177	951	951	847	847
Other Sources												
Fuel storage/handling	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous sources[5]	23	22	33	40	24	24	51	51	55	55	55	55
Total other sources	23	22	33	40	24	24	51	51	55	55	55	55
Total Airport Sources	10,952	10,177	9,851	9,556	8,927	8,144	9,231	9,233	8,361	8,361	7,491	7,925

Source: KBE and Massport
Notes: Years 2006 to 2009 were computed with previous years EDMS version to provide for a common basis of comparison.
Kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
1 GSE emissions include APUs as well as vehicles and equipment converted to alternative fuels.
2 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.
3 Parking/curbside information is based on VMT analysis.
4 Fuel storage/handling facilities are not a source of CO emissions.
5 Includes the Central Heating and Cooling Plant, emergency electricity generation, snow melter usage, and other stationary sources.

Table I-16 Estimated $PM_{10}/PM_{2.5}$ Emissions (in kg/day) at Logan Airport, 2005-2009[1]

Aircraft/GSE Model:	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1		EDMS v5.1.2
Motor Vehicle Model:	MOBILE 6.2.03								
Year:	2005	2006		2007		2008		2009	
Aircraft Sources									
Air carriers	25	25	38	35	67	63	42	43	36
Commuter aircraft	1	1	2	6	14	11	6	5	5
Cargo aircraft	2	3	2	3	6	5	4	4	3
General aviation	2	2	2	2	5	5	4	2	2
Total aircraft sources	30	31	44	46	92	84	56	54	46
Ground Service Equipment[2]	11	9	9	10	10	8	15	14	14
Motor Vehicles									
Ted Williams Tunnel through-traffic	0[4]	0[4]	0[4]	0[4]	0[4]	0[4]	0[4]	0[3]	0[3]
Parking/curbside[4]	1	1	1	<1	<1	<1	<1	<1	<1
On-airport vehicles	8	8	8	9	9	7	7	6	6
Total motor vehicle sources	9	9	9	9	9	7	7	6	6
Other Sources									
Fuel storage/handling	0	0	0	0	0	0	0	0	0
Miscellaneous sources[5]	34	16	16	17	17	3	3	5	5
Total other sources	34	16	16	17	17	3	3	5	5
Total Airport Sources	84	65	78	82	128	102	81	79	71

Source: KBE and Massport
Notes: Years 2006 to 2009 were computed with previous years EDMS version to provide for a common basis of comparison.
Kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy); PM – particulate matter
1 It is assumed that all PM are less than 2.5 microns in diameter ($PM_{2.5}$).
2 2005 is the first year that $PM_{10}/PM_{2.5}$ emissions were included in the Logan Airport ESPR/EDR emission inventories.
3 GSE emissions include APUs as well as vehicles and equipment converted to alternative fuels.
4 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.
5 Parking/curbside is based on VTM analysis.
6 Fuel storage and handling facilities are not sources of PM emissions.
7 Includes the Central Heating and Cooling Plant, emergency electricity generation, fire training, snow melters, and other stationary sources.

Greenhouse Gas Emissions Inventory for 2014

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) has published the *MEPA Greenhouse Gas Emissions Policy and Protocol*.[2] These guidelines require that certain projects undergoing review under the Massachusetts Environmental Policy Act (MEPA) quantify the greenhouse gas (GHG) emissions generated by proposed projects, and identify measures to avoid, minimize, or mitigate such emissions.[3] Even though the *2014 EDR* does not assess any proposed projects and is therefore not subject to the GHG policy, Massport has voluntarily prepared an emission inventory of GHG emissions directly and indirectly associated with Logan Airport.

In April 2009, the Transportation Research Board Airport Cooperative Research Program (ACRP); published the *Guidebook on Preparing Airport Greenhouse Gas Emission Inventories (ACRP Report 11)*, which provides recommended instructions to airport operators on how to prepare an airport-specific GHG emissions inventory.[4] The 2014 GHG emissions estimates include aircraft (within the ground taxi/delay and up to 3,000 feet), GSE, APU, motor vehicles, a variety of stationary sources, and electricity usage. Aircraft cruise emissions over the 3,000-foot level were not included. This work was accomplished following the EEA guidelines and uses widely-accepted emission factors that are considered appropriate for this application, including International Organization for Standardization New England electricity-based values.

Methodology

Airport GHG emissions are calculated in much the same way as criteria pollutants,[5] through the use of input data such as activity levels or material throughput rates (i.e., fuel usage, VMT, electrical consumption) that are applied to appropriate emission factors (i.e., in units of GHG emissions per gallon of fuel).

In this case, the input data were either based on Massport records, or data and information derived from the latest version of the FAA EDMS (EDMS v5.1.4.1). Table I-17 summarizes the data and information used in the 2014 GHG inventory.

Massport will update the GHG Emissions Inventory for Logan Airport annually.

2 Revised *MEPA Greenhouse Gas Emissions Policy and Protocol*, Massachusetts Executive Office of Energy and Environmental Affairs, effective May 10, 2010.
3 These GHGs are comprised primarily of carbon dioxide (CO_2), methane (CH_4), nitrous oxides (N_2O), and three groups of fluorinated gases (i.e., sulfur hexafluoride [SF_6], hydrofluorocarbons [HFCs], and perfluorocarbons [PFCs]). GHG emission sources associated with airports are generally limited to CO_2, CH_4, and N_2O.
4 Transportation Research Board, Airport Cooperative Research Panel, ACRP Report 11, Project 02-06, *Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories* (in production). See http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_011.pdf for the full report.
5 Criteria pollutants are pollutants for which there are National Ambient Air Quality Standards (i.e., carbon monoxide, sulfur dioxide, nitrogen dioxide, etc.).

Table I-17 Logan GHG Inventory Input Data and Information

Activity	Fuel Type	Usage	Units	Source
Aircraft				
Aircraft Taxi	Jet A[1]	19,741,374	gallons	EDMS v5.1.4
	AvGas[2]	667	gallons	EDMS v5.1.4
Engine Startup	Jet A	215,235	gallons	EDMS v5.1.4
Aircraft Ground up to 3,000 feet	Jet A[1]	17,354,194	gallons	EDMS v5.1.4
	AvGas[2]	587	gallons	EDMS v5.1.4
Aircraft Support Equipment				
GSE	Diesel	749,053	gallons	Massport
	Gasoline	618,706	gallons	Massport
	Propane	1,710	gallons	EDMS v5.1.4
	CNG	416,275	ft^3	EDMS v5.1.4
APU	Jet A	802,658	gallons	EDMS v5.1.4
Motor Vehicles				
On-airport Vehicles	Composite[3]	57,967,179	VMT	Massport
On-airport Parking/Curbsides	Composite[3]	1,292,000	Idle hours	Massport
Massport Shuttle Bus	CNG	256,595	GEG	Massport
	Diesel	326,342	gallons	Massport
Massport Express Bus	Diesel	343,018	gallons	Massport
Masspoort Fire Rescue	Diesel	20,000	gallons	Massport
Aquircultural Equipment	Diesel	106,821	gallons	Massport
Massport Fleet Vehicles (Honda Civic)	CNG	1,956	GEG	Massport
Massport Fleet Vehicles (Fueled Onsite)	Gasoline	130,931	gallons	Massport
Massport Fleet Vehicles (Fueled Offsite)	Gasoline	83,443	gallons	Massport
Massport Fleet Vehicles (Fueled Onsite)	Diesel	134,868	gallons	Massport
Off-airport Vehicles (Public)	Composite[3]	146,884,278	VMT	Massport
Off-airport Vehicles (Airport Employees)	Composite[3]	2,632,372	VMT	Massport
Off-airport Vehicles (Tenant Employees)	Composite[3]	35,554,640	VMT	Massport
Stationary and Portable Sources				
Boilers and Space Heaters	No 2 Oil	289,956	gallons	Massport
	No 6 Oil	77,146	gallons	Massport
	Natural Gas	416	million ft^3	Massport
Generators	Diesel	61,923	gallons	Massport
Snow melters	ULSD	124,480	gallons	Massport
	CNG	2.6	million ft^3	Massport
Fire Training Facility	Tekflame	3,415	gallons	Massport
	AvGas	338	gallons	Massport
Electrical Consumption – Massport	-	16,221,846	kWh	Massport
Electrical Consumption – Tenent/Common Area	-	168,854,349	kWh	Massport

Sources: Massport and KBE.
Notes: APU – Auxiliary power units; CNG – compressed natural gas; GEG – gasoline equivalent gallons; GSE – ground support equipment; kWh – kilowatt hours; VMT – vehicle miles traveled; ULSD – ultra low sulfur diesel.
1 Jet A density of 6.84 pounds per gallon.
2 AvGas density of 6.0 pounds per gallon.
3 Composite means gasoline, diesel, CNG, and liquefied petroleum gas (LPG) fueled motor vehicles.

Emission factors were obtained from the U.S. Energy Information Administration, the International Panel on Climate Change (IPCC), EPA's MOVES, and the most recent version of EPA's GHG Emission Factors Hub (April 2014).[6,7,8,9] Table I-18 presents emission factors for CO_2, nitrous oxide (N_2O), and methane (CH_4) for 2014.

Table I-18 Greenhouse Gas (GHG) Emission Factors for 2014

Sources	Fuel	CO_2	N_2O	CH_4	Units
Aircraft[1]	Jet A	21.5	0.00066	-[5]	lb/gallon
	AvGas	18.3	0.00024	0.01556	lb/gallon
Ground Support Equipment/ Auxiliary Power Units[1]	Diesel	22.5	0.00057	0.00126	lb/gallon
	Gasoline	19.4	0.00049	0.00110	lb/gallon
	CNG	120.0	0.00023	0.00226	lb/1000 ft^3
	Propane	12.6	0.00011	0.00060	lb/gallon
	Jet A	21.5	0.00066	-[5]	lb/gallon
Motor Vehicles[1,2]	Composite	492	0.00324	0.00473	g/mile
	Composite	4,237	0.04824	0.02283	g/hour
	CNG	120.0	0.00023	0.00226	lb/1000 ft^3
	Diesel	22.5	0.00057	0.00126	lb/gallon
	Gasoline	19.4	0.00049	0.00110	lb/gallon
Stationary and Portable[1]	No. 2 Oil	22.5	0.00018	0.00090	lb/gallon
	No. 6 Oil	24.8	0.00020	0.00099	lb/gallon
	Natural Gas	120.0	0.00023	0.00226	lb/1000 ft^3
	ULSD	22.5	0.00018	0.00090	lb/gallon
Fire Training Facility[1]	Tekflame[3]	12.6	0.00011	0.00060	lb/gallon
	AvGas	18.3	0.00024	0.01556	lb/gallon
Electrical Consumption[4]	-	0.72	0.00001	0.00007	lb/kW-hr

Sources: Massport and KBE.

Notes: CH_4 – methane; CNG – compressed natural gas; CO_2 – carbon dioxide; g- grams; kWh – kilowatt hour; lb – pound; N_2O – nitrous oxides; ULSD – Ultra Low Sulfur Diesel.

1 Environmental Protection Agency, GHG Emissions Factors Hub (April 2014), www.epa.gov/climateleadership/inventory/ghg-emissions.html.

2 Environmental Protection Agency, MOVES2014, http://www.epa.gov/otaq/models/moves/.

3 As propane.

4 Environmental Protection Agency, Emissions & Generation Resource Integrated Database (eGRID) 9th edition Version 1.0, February 2014, http://www.epa.gov/climateleadership/documents/emission-factors.pdf.

5 Contributions of CH_4 emissions from commercial aircraft are reported as zero. Years of scientific measurement campaigns conducted at the exhaust exit plane of commercial aircraft gas turbine engines have repeatedly indicated that CH_4 emissions are consumed over the full emission flight envelope [Reference: Aircraft Emissions of Methane and Nitrous Oxide during the Alternative Aviation Fuel Experiment, Santoni et al., Environ. Sci. Technol., July 2011, Volume 45, pp. 7075-7082]. As a result, the EPA published that: "*…methane is no longer considered to be an emission from aircraft gas turbine engines burning Jet A at higher power settings and is, in fact, consumed in net at these higher powers*." [Reference: EPA, Recommended Best Practice for Quantifying Speciated Organic Gas Emissions from Aircraft Equipped with Turbofan, Turbojet, and Turboprop Engines, May 27, 2009 [EPA-420-R-09-901], http://www.epa.gov/otaq/aviation.htm]. In accordance with the following statements in the 2006 IPCC Guidelines (IPCC 2006), the FAA does not calculate CH_4 emissions for either the domestic or international bunker commercial aircraft jet fuel emissions inventories. "*Methane (CH_4) may be emitted by gas turbines during idle and by older technology engines, but recent data suggest that little or no CH_4 is emitted by modern engines*." "*Current scientific understanding does not allow other gases (e.g., N_2O and CH_4) to be included in calculation of cruise emissions*." (IPCC 1999).

---

6 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, 2006, www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

7 U.S. Energy Information Administration, *Voluntary Reporting of Greenhouse Gases Program. Fuel and Energy Source Codes and Emission Coefficients,* www.eia.doe.gov/oiaf/1605/coefficients.html.

8 U.S. Environmental Protection Agency, GHG Emissions Factors Hub (April 2014), www.epa.gov/climateleadership/inventory/ghg-emissions.html. The most recent version of the Emission Factors Hub includes updates to emission factors for stationary and mobile combustion sources, new electricity emission factors from EPA's Emissions & Generation Resource Integrated Database (eGRID) and the IPCC Fourth and Fifth Assessment Report (AR4/AR5).

9 U.S. Environmental Protection Agency, MOVES Emissions Model, http://www.epa.gov/otaq/models/moves/.

Results

Table I-19 presents the results of the 2014 GHG emissions inventory for Logan Airport by emission source (i.e., aircraft, GSE, motor vehicles, and stationary sources) and compound (i.e., CO_2, N_2O, and CH_4), respectively.

Table I-19 Greenhouse Gas (GHG) Emissions (MMT CO_2 Eq)[1] for 2014

Activity	CO_2	N_2O	CH_4	Total
Aircraft Sources				
Aircraft Taxi	0.19	<0.01	-[2]	0.19
Engine Startup	<0.01	<0.01	<0.01	<0.01
Aircraft AGL to 3,000 feet	0.17	<0.01	<0.01	0.17
Aircraft Support Equipment				
GSE	0.01	<0.01	<0.01	0.01
APU	0.01	<0.01	-[2]	0.01
Motor Vehicles				
On-airport Vehicles	0.03	<0.01	<0.01	0.03
On-airport Parking/Curbsides	0.01	<0.01	<0.01	0.01
Massport Shuttle Buses	0.01	<0.01	<0.01	0.01
Massport Fleet Vehicles	0.01	<0.01	<0.01	0.01
Off-airport Vehicles (Public)	0.05	<0.01	<0.01	0.05
Off-airport Vehicles (Airport Employees)	<0.01	<0.01	<0.01	<0.01
Off-airport Vehicles (Tenant Employees)	0.02	<0.01	<0.01	0.02
Stationary Sources				
Boilers	0.03	<0.01	<0.01	0.03
Generators, Snow melters, etc.	<0.01	<0.01	<0.01	<0.01
Fire Training Facility	<0.01	<0.01	<0.01	<0.01
Electrical Consumption	0.06	<0.01	<0.01	0.06

Sources: Massport and KBE.

1 Units expressed as million metric tons of CO_2 equivalent (MMT CO_2 Eq): 1 metric ton = 1.1 short tons.

2 Contributions of CH_4 emissions from commercial aircraft are reported as zero. Years of scientific measurement campaigns conducted at the exhaust exit plane of commercial aircraft gas turbine engines have repeatedly indicated that CH_4 emissions are consumed over the full emission flight envelope [Reference: Aircraft Emissions of Methane and Nitrous Oxide during the Alternative Aviation Fuel Experiment, Santoni et al., Environ. Sci. Technol., July 2011, Volume 45, pp. 7075-7082]. As a result, the EPA published that: "…methane is no longer considered to be an emission from aircraft gas turbine engines burning Jet A at higher power settings and is, in fact, consumed in net at these higher powers." [Reference: EPA, Recommended Best Practice for Quantifying Speciated Organic Gas Emissions from Aircraft Equipped with Turbofan, Turbojet, and Turboprop Engines, May 27, 2009 [EPA-420-R-09-901], http://www.epa.gov/otaq/aviation.htm]. In accordance with the following statements in the 2006 IPCC Guidelines (IPCC 2006), the FAA does not calculate CH_4 emissions for either the domestic or international bunker commercial aircraft jet fuel emissions inventories. "Methane (CH_4) may be emitted by gas turbines during idle and by older technology engines, but recent data suggest that little or no CH_4 is emitted by modern engines." "Current scientific understanding does not allow other gases (e.g., N_2O and CH_4) to be included in calculation of cruise emissions." (IPCC 1999).

Table I-20 compares the total GHG emission from Logan Airport to the total GHG emissions for Massachusetts for the year 2014.

Table I-20 Logan Airport Greenhouse Gas (GHG) Emissions Compared to Massachusetts Totals[1]

	CO_2	N_2O	CH_4	Totals
Logan Airport Emissions (2014)[2]	0.59	<0.01	<0.01	0.60
Massachusetts[3]	82.1	1.3	1.2	84.6
Percent of Logan Airport to Massachusetts[4]	<1%	<1%	<1%	<1%

Sources: Massport and KBE.
1 Units expressed as million metric tons of CO_2 equivalents (MMT CO_2 Eq): 1 metric ton = 1.1 short tons.
2 Total from Massport, tenants, and public categories.
3 Climate Analysis Indicators Tool (CAIT US) Version 4.0. (Washington, DC: World Resources Institute, 2010)
4 Percentages represent the relative amount Logan-related emissions compared to the state totals.

Table I-21 provides a comparison between Airport-related GHG emissions from 2007 through 2014. Total GHG emissions in 2014 were slightly higher (7.1 percent) than 2010 levels. To equally compare to previous years, the 2014 emissions are summarized in a manner similar to previous years.

Table I-21 Comparison of Estimated Total Greenhouse Gas (GHG) Emissions (MMT of CO_2eq) at Logan Airport – 2007 through 2014

Source	2007	2008	2009	2010	2011	2012	2013	2014
Direct Emissions[2]								
Aircraft[3]	0.22	0.21	0.19	0.18	0.19	0.19	0.19	0.20
GSE/APUs	0.08	0.08	0.02	0.02	0.02	0.02	0.02	0.02
Motor vehicles[4]	0.03	0.03	0.03	0.03	0.04	0.03	0.05	0.05
Other sources[5]	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.03
Total Direct Emissions	0.37	0.35	0.27	0.27	0.28	0.26	0.29	0.29
Indirect Emissions[6]								
Aircraft[7]	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Motor vehicles[8]	0.05	0.05	0.05	0.05	0.06	0.05	0.08	0.07
Electrical consumption[9]	0.09	0.08	0.07	0.07	0.08	0.08	0.06	0.06
Total Indirect Emissions	0.32	0.30	0.29	0.29	0.30	0.30	0.31	0.30
Total Emissions[10]	0.69	0.65	0.56	0.56	0.58	0.57	0.60	0.60
Percent of State Totals[11]	<1	<1	<1	<1	<1	<1	<1	<1

Sources: Massport and KBE.
1 MMT – million metric tons of CO_2 equivalents (1 MMT = 1.1M Short Tons). CO_2 equivalents (CO_2eq) are bases for reporting the three primary GHGs (e.g., CO_2, N_2O and CH_4) in common units. Quantities are reported as “rounded” and truncated values for ease of addition.
2 Direct emissions are those that occur in areas located within the Airport’s geographic boundaries.
3 Direct aircraft emissions based engine start-up, taxi-in, taxi-out and ground-based delay emissions.
4 Direct motor vehicle emissions based on on-site vehicle miles traveled (VMT).
5 Other sources include Central Heating and Cooling Plant, emergency generators, snow melters and live fire training facility.
6 Indirect emissions are those that occur off the Airport site.
7 Indirect aircraft emissions are based on take-off, climb-out and landing emissions which occur up to an altitude of 3,000 ft., the limits of the landing/take-off (LTO) cycle
8 Indirect motor vehicle emissions based on off-site Airport-related VMT and an average round trip distance of approximately 60 miles.
9 Electrical consumption emissions occur off-airport at power generating plants.
10 Total Emissions = Direct +Indirect.
11 Percentage based on relative amount of Airport total of direct emissions to statewide total from World Resources Institute (cait.wri.org).

Measured NO_2 Concentrations

This section presents the results of Massport's long-term ambient (i.e., outdoor) air quality monitoring program for NO_2 – a pollutant associated with aircraft activity and other fuel combustion sources. Between 1982 and 2011, Massport collected NO_2 concentration data at numerous locations both on the Airport and in neighboring residential communities. The purpose of this monitoring program was to track long-term trends in NO_2 levels and to compare the results to the NAAQS for this pollutant. In 2011, Massport determined that the Logan NO_2 Monitoring Program had achieved its objectives with the significant and stable decrease in NO_2 emissions since 1999 and thus discontinued the program in 2011.

When it was operational, this monitoring program used passive diffusion tube technology for a period of one week each month for 12 months of the year at each of the monitoring stations. The samples of NO_2, along with Quality Assurance/Quality Control (QA/QC) samples, were then analyzed in a laboratory.

Table I-22 presents the final year NO_2 monitoring data (i.e., 2011). For comparative purposes, historical data from 1999 are similarly shown in Table I-22. The table also includes NO_2 data collected under a separate effort by MassDEP using continuous monitors at four Boston-area locations.

As shown on Table I-22, the 2011 NO_2 levels were somewhat higher than in 2010. However, this occurrence is consistent with the cyclical trend of the average levels over the past several years[10]. Importantly, there remains a long-term trend of decreasing NO_2 concentrations at both the Massport and MassDEP monitoring sites since 1999. Other notable observations of the 2011 data reveal the following:

- Annual NO_2 concentrations at all Massport and MassDEP monitoring locations were below the annual NO_2 NAAQS of 100 micrograms per cubic meter ($\mu g/m^3$) in 2011.
- The Massport-collected data compare relatively closely with data collected by the MassDEP. The average of all Massport monitoring sites was 29.8 $\mu g/m^3$ compared to 32.3 $\mu g/m^3$ for the four MassDEP Boston-area monitors.
- The highest NO_2 concentrations in 2011 from the Massport program occurred in areas characterized by high levels of motor vehicle traffic (i.e., Main Terminal Area [Site 8] and Maverick Square [Site 12]).

10 Spatial and temporal changes in measured NO_2 levels from year to year are typical and should not be used to define short-term results. Rather, NO_2 levels are better assessed by looking at the trends over several years.

Table I-22 Massport and MassDEP Annual NO_2 Concentration Monitoring Results (μg/m^3)

Monitoring Site	Site No.	Year												
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Massport Monitoring Sites														
Runway 9	**1**	61.0	58.2	41.6	45.8	33.9	30.1	35.0	31.9	17.3	31.3	32.2	32.3	38.7
Runway 4R	**2**	55.6	44.6	41.4	36.9	32.5	30.9	30.7	29.0	17.2	20.2	19.2	21.9	25.7
Runway 33L	**3**	47.7	42.6	39.4	33.3	30.8	25.4	24.5	26.3	24.2	21.6	16.9	25.0	29.8
Runway 27	**4**	42.9	37.8	35.8	30.3	25.5	24.1	22.7	22.3	16.9	18.3	17.6	19.4	23.3
Runaway 22L	**5**	47.5	39.8	38.2	33.8	27.8	23.7	22.1	24.9	17.1	21.3	20.1	21.9	29.0
Runway 22R	**6**	60.6	59.2	51.6	45.0	32.3	29.7	32.9	25.1	24.8	29.7	27.8	33.1	30.6
Runway 15R	**7**	47.0	43.4	44.3	42.6	40.8	28.7	27.7	28.7	20.5	24.2	23.9	26.7	29.7
Main Terminal Area	**8**	70.8	87.0	80.7	69.3	44.3	44.7	46.2	43.5	29.5	41.7	37.7	43.9	49.0
Webster St., Jeffries Point	**11**	52.4	45.5	43.4	39.1	32.5	28.3	31.3	31.3	22.7	25.2	23.9	27.0	30.1
Maverick Square, E. Bos	**12**	81.2	72.2	68.5	61.3	47.9	46.5	41.4	45.6	36.0	41.3	38.2	42.5	43.5
Bremen St., E. Boston	**13**	59.1	52.6	52.0	46.2	39.1	35.7	37.6	37.1	27.8	30.1	28.6	31.9	35.3
Shore St. E. Boston	**14**	45.7	38.5	38.8	35.0	27.2	24.0	24.9	22.4	18.1	19.7	18.3	20.7	26.7
Orient Heights Yacht Club	**15**	45.1	46.9	47.7	43.1	29.4	25.2	25.5	25.1	19.6	21.1	18.3	22.5	26.7
Bayswater St. E. Boston	**16**	45.2	45.5	48.3	41.2	28.4	22.8	30.4	23.1	18.4	20.2	17.8	21.0	25.9
Annavoy St. E. Boston	**17**	40.8	39.2	44.4	33.7	24.7	21.4	23.3	21.0	18.2	19.6	17.3	20.9	25.8
Pleasant St. Winthrop	**18**	42.0	39.3	37.8	32.3	27.9	22.6	23.4	21.4	17.8	20.2	17.7	20.1	24.4
Court Road, Winthrop	**19**	40.0	36.1	33.8	27.4	24.0	19.2	22.3	21.0	16.3	17.1	16.7	18.4	22.7
Cottage Park Yacht Club	**20**	37.1	50.9	45.9	36.7	22.5	19.1	27.7	21.4	16.3	18.4	17.8	17.8	22.5
Winthrop, Point Shirley	**21**	33.1	37.7	38.6	24.4	22.7	17.4	17.2	20.2	15.7	15.6	14.9	17.5	21.6
Deer Island	**22**	36.3	31.9	33.8	33.1	21.3	17.8	16.9	17.8	13.0	17.0	14.7	16.7	20.7
Runway 4R–9	**23**	42.2	66.0	42.3	33.4	28.6	24.1	27.1	26.3	19.2	22.4	21.2	21.6	26.5
Runway 33L–4R	**24**	44.3	41.7	41.8	33.5	28.1	24.3	22.3	25.7	20.9	25.2	20.0	23.6	26.2
Runway 22R–33L	**25**	62.4	50.3	49.4	42.2	33.8	31.7	29.4	34.5	22.9	25.1	25.3	29.5	34.9
Jeffries Point Park/Marginal St.	**26**	68.6	49.8	45.0	42.0	35.2	30.5	32.5	31.7	24.4	27.0	25.6	28.6	33.1
Harborwalk	**27**	54.3	48.5	47.4	43.5	35.6	35.5	29.3	34.2	24.2	26.1	24.5	28.3	34.9
Logan Athletic Fields	**29**	NA	69.1	67.6	54.9	41.9	40.2	37.5	37.0	24.6	28.8	26.8	30.8	37.8
Brophy Park, Jeffries Point	**30**	NA	48.0	45.2	41.0	36.5	31.2	32.9	31.3	24.8	26.6	24.6	26.8	30.8
Average of all Monitoring Sites		**50.5**	**50.5**	**47.5**	**40.0**	**31.7**	**28.0**	**28.7**	**28.7**	**21.0**	**24.3**	**22.5**	**25.6**	**29.8**
MassDEP Monitoring Sites[1]														
Long Island Road	**A**	20.7	24.4	22.6	22.6	16.9	12.6	13.2	13.2	13.2	13.2	11.3	13.6	13.4
Harrison Avenue	**B**	NA	45.1	47.0	45.1	43.2	37.4	35.8	35.8	37.7	37.7	33.9	32.1	33.1
Kenmore Square	**C**	56.4	54.5	56.8	47.0	47.0	51.7	43.3	43.3	39.6	41.5	37.7	36.0	38.4
East First Street	**D**	39.5	37.6	43.2	39.5	39.5	36.8	33.9	39.6	37.7	30.2	28.3	24.0	25.4

Notes: The NAAQS is 100 μg/m^3.
Massport determined that the Logan NO_2 Monitoring Program had achieved its objectives with the significant and stable decrease in NO_2 emissions since 1999 and thus discontinued the program in 2011.

μg/m^3 micrograms/cubic meter.
NA Not available.
1 NO_2 monitoring sites operated by the MassDEP.

J

Water Quality/ Environmental Compliance and Management

This appendix provides detailed information in support of *Chapter 8, Water Quality/Environmental Compliance and Management:*

- Table J-1 National Pollutant Discharge Elimination System (NPDES) Permit Stormwater Outfall Monitoring Requirements (2007)
- Table J-2 Logan Airport 2014 Monthly Monitoring Results for First Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-3 Logan Airport 2014 Monthly Monitoring Results for First Quarter — Porter Street Stormwater Outfall
- Table J-4 Logan Airport 2014 Monthly Monitoring Results for Second Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-5 Logan Airport 2014 Monthly Monitoring Results for Second Quarter — Porter Street Stormwater Outfall
- Table J-6 Logan Airport 2014 Monthly Monitoring Results for Third Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-7 Logan Airport 2014 Monthly Monitoring Results for Third Quarter — Porter Street Stormwater Outfall
- Table J-8 Logan Airport 2014 Monthly Monitoring Results for Fourth Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-9 Logan Airport 2014 Monthly Monitoring Results for Fourth Quarter — Porter Street Stormwater Outfall
- Table J-10 Logan Airport 2014 Quarterly Wet Weather Monitoring Results — North, West, Maverick Street, and Porter Street Stormwater Outfalls

- Table J-11 Logan Airport 2014 Quarterly Wet Weather Monitoring Results – Northwest and Runway/Perimeter Stormwater Outfalls
- Table J-12 Logan Airport 2014 Wet Weather Deicing Monitoring Results – North, West, Porter Street, and Runway/Perimeter Stormwater Outfalls
- Table J-13 Logan Airport Stormwater Outfall NPDES Water Quality Monitoring Results – 1993 to 2014
- Table J-14 Logan Airport Oil and Hazardous Material Spills and Jet Fuel Handling – 1990 to 2014
- Table J-15 Type and Quantity of Oil and Hazardous Material Spills at Logan Airport – 1999 to 2014
- Table J-16 MCP Activities Status of Massport Sites at Logan Airport
- EnviroNews Vol. 40, Issue 1 – March 2014
  Vol. 40, Issue 2 – July 2014
  Vol. 40, Issue 3 – October 2014

Table J-1 NPDES Permit Stormwater Outfall Monitoring Requirements (2007)

	North Outfall 001		West Outfall 002		Maverick Outfall 003	
Monitoring Event	Field Measurement	Laboratory Analysis	Field Measurement	Laboratory Analysis	Field Measurement	Laboratory Analysis
Monthly Dry Weather	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*
Monthly Wet Weather	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*
Quarterly Wet Weather	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene
Deicing Episode (2/Deicing Season)	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole	Not Required	Not Required
Whole Effluent Toxicity (1st and 3rd Year Deicing Season)	Not Required	Menidia beryllina Arbacia punctulata	Not Required	Menidia beryllina Arbacia punctulata	Not Required	Not Required
Treatment System Sampling (Internal Outfalls)[7]	pH Quantity, Gallons	Oil and Grease TSS[1] Benzene[2]	Not Required	Not Required	Not Required	Not Required

Table J-1 NPDES Permit Stormwater Outfall Monitoring Requirements (2007) (Continued)

	Northwest Outfall 005		Porter Outfall 003 (3 upstream locations)		Select Runway/Perimeter Outfalls	
Monitoring Event	Field Measurement	Laboratory Analysis	Field Measurement	Laboratory Analysis	Field Measurement	Laboratory Analysis
Monthly Dry Weather	Not Required	Not Required	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*	Not Required	Not Required
Monthly Wet Weather	Not Required	Not Required	pH Flow Rate	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*	Not Required	Not Required
Quarterly Wet Weather	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2]	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene	pH	Oil and Grease TSS[1] Benzene[2]
Deicing Episode (2/Deicing Season)	Not Required	Not Required	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole
Whole Effluent Toxicity (1st and 3rd Year Deicing Season)	Not Required	Not Required	Not Required	Menidia beryllina Arbacia punctulata	Not Required	Not Required
Treatment System Sampling (Internal Outfalls)[7]	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required

Source: Massport
Notes: Requirements are from NPDES Permit MA0000787, issued July 31, 2007.
1 TSS - Total Suspended Solids
2 Benzene must be collected with HDPE bailer.
3 PAH - Polycyclic Aromatic Hydrocarbons
4 BOD - Biological Oxygen Demand
5 COD - Chemical Oxygen Demand
6 Flow Rate will be estimated based on measured precipitation and the hydraulic model developed for the Logan Airport drainage system.
7 Outfalls 001D and 001E samples collected by Swissport.

Table J-2 Logan Airport 2014 Monthly Monitoring Results for First Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	1/18/2014	Wet Weather	2.37	0.55	7.94	<4.0	22	<1.0	0.120	960	22	NA
002A – West Outfall	1/18/2014	Wet Weather	9.12	1.95	7.60	<4.0	41	<1.0	0.070	1,800	320	NA
004A – Maverick Street Outfall	1/18/2014	Wet Weather	0.71	0.11	7.61	<4.0	15	<1.0	0.060	45	34	NA
001C – North Outfall	1/27/2014	Dry Weather				<4.0	31	<1.0	0.150	8,200	5,000	2,800
002C – West Outfall	1/27/2014	Dry Weather				<4.0	29	<1.0	0.110	5,200	<10	NA
004C – Maverick Street Outfall	1/27/2014	Dry Weather				<4.0	35	<1.0	0.070	50	30	NA
001A – North Outfall	2/13/2014	Wet Weather	2.53	0.86	6.12	12	87	<1.0	0.300	460	50	NA
002A – West Outfall	2/13/2014	Wet Weather	11.31	2.40	6.21	11	72	<1.0	0.400	2,200	1,400	NA
004A – Maverick Street Outfall	2/13/2014	Wet Weather	1.02	0.15	6.29	<4.0	56	<1.0	0.090	13,000	400	NA
001C – North Outfall	2/11/2014	Dry Weather				<4.0	34	<1.0	0.130	240	240	NA
002C – West Outfall	2/11/2014	Dry Weather				<4.0	32	<1.0	0.070	3,500	110	NA
004C – Maverick Street Outfall	2/11/2014	Dry Weather				<4.0	36	<1.0	<0.050	3,100	680	NA
001A – North Outfall	3/20/2014	Wet Weather	8.72	0.72	7.67	<4.0	18	<1.0	0.310	40	40	NA
002A – West Outfall	3/20/2014	Wet Weather	34.94	2.80	7.22	<4.0	45	<1.0	0.430	2,600	250	NA
004A – Maverick Street Outfall	3/20/2014	Wet Weather	2.08	0.16	7.07	<4.0	7.0	<1.0	0.110	14,000	2,800	NA
001C – North Outfall	3/4/2014	Dry Weather				<4.0	28	<1.0	<0.050	130	70	NA
002C – West Outfall	3/4/2014	Dry Weather				<4.0	35	<1.0	<0.050	30	4,500	NA
004C – Maverick Street Outfall	3/4/2014	Dry Weather				<4.0	11	<1.0	<0.050	640	470	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	

Source: Massport.

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.

For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

NA Not Analyzed.

TSS Total Suspended Solids.

Table J-3 Logan Airport 2014 Monthly Monitoring Results for First Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	1/18/2014	Wet Weather	-	-	7.47	<4.0	38	<1.0	0.110	<10	69
003 - Porter Street Outfall 2	1/18/2014	Wet Weather	-	-	8.49	<4.0	13	<1.0	0.090	<10	2.0
003 - Porter Street Outfall 3	1/18/2014	Wet Weather	-	-	8.19	<4.0	10	<1.0	0.070	210	170
003 - Porter Street Outfall Average		Wet Weather	2.08	0.36	8.05	0.0	20	0.0	0.090	5.9	29
003 - Porter Street Outfall 1	1/27/2014	Dry Weather				<4.0	11	<1.0	0.130	<10	10
003 - Porter Street Outfall 2	1/28/2014	Dry Weather				<4.0	18	<1.0	0.230	<10	<10
003 - Porter Street Outfall 3	1/27/2014	Dry Weather				<4.0	160	<1.0	0.170	<10	20
003 - Porter Street Outfall Average		Dry Weather				0.0	63	0.0	0.177	1.0	5.8
003 - Porter Street Outfall 1	2/13/2014	Wet Weather	-	-	6.90	22	310	<1.0	0.270	<10	130
003 - Porter Street Outfall 2	2/13/2014	Wet Weather	-	-	6.14	11	130	<1.0	0.150	<10	10
003 - Porter Street Outfall 3	2/13/2014	Wet Weather	-	-	6.50	<4.0	30	<1.0	0.130	<10	<10
003 - Porter Street Outfall Average		Wet Weather	3.28	0.46	6.51	11.0	157	0.0	0.183	1.0	11
003 - Porter Street Outfall 1	2/11/2014	Dry Weather				13	250	<1.0	<0.050	10	60
003 - Porter Street Outfall 2	2/11/2014	Dry Weather				<4.0	58	<1.0	0.070	<10	<10
003 - Porter Street Outfall 3	2/11/2014	Dry Weather				<4.0	7.3	<1.0	<0.050	<10	<10
003 - Porter Street Outfall Average		Dry Weather				4.3	105	0.0	0.023	2.2	3.9
003 - Porter Street Outfall 1	3/20/2014	Wet Weather	-	-	7.50	<4.0	10	<1.0	0.200	20	710
003 - Porter Street Outfall 2	3/20/2014	Wet Weather	-	-	7.49	<4.4	12	<1.0	0.140	20	20
003 - Porter Street Outfall 3	3/20/2014	Wet Weather	-	-	7.35	<4.0	6.2	<1.0	0.150	10	40
003 - Porter Street Outfall Average		Wet Weather	7.20	0.48	7.45	0.0	9.4	0.0	0.163	16	83
003 - Porter Street Outfall 1	3/4/2014	Dry Weather				<4.0	<5.0	<1.0	<0.050	<10	<10
003 - Porter Street Outfall 2	3/4/2014	Dry Weather				<4.0	15	<1.0	0.180	<10	<10
003 - Porter Street Outfall 3	3/4/2014	Dry Weather				<4.0	<5.0	<1.0	0.050	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	5.0	0.0	0.077	0.0	0.0
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport.

Notes: Flow rates were estimated for outfall 003 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

TSS Total Suspended Solids.

Table J-4 Logan Airport 2014 Monthly Monitoring Results for Second Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	4/15/2014	Wet Weather	3.10	0.69	NM	<4.0	44	<2.0	0.670	17,000	820	13,000
002A – West Outfall	4/15/2014	Wet Weather	12.97	3.13	NM	<4.0	22	<1.0	0.120	90	160	NA
004A – Maverick Street Outfall	4/15/2014	Wet Weather	0.74	0.19	NM	<4.0	130	<1.0	0.170	3,800	900	NA
001C – North Outfall	4/21/2014	Dry Weather				<4.0	26	<1.0	0.080	10	80	NA
002C – West Outfall	4/21/2014	Dry Weather				<4.0	20	<1.0	0.060	40	230	NA
004C – Maverick Street Outfall	4/21/2014	Dry Weather				<4.4	31	<1.0	0.060	25,000	6,700	NA
001A – North Outfall	-	Wet Weather	2.19	0.38	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	-	Wet Weather	7.95	1.55	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	-	Wet Weather	0.58	0.09	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	5/16/2014	Dry Weather				<4.0	26	<1.0	0.210	46,000	1,300	31,000
002C – West Outfall	5/16/2014	Dry Weather				<4.0	24	<1.0	0.090	3,300	820	NA
004C – Maverick Street Outfall	5/16/2014	Dry Weather				<4.0	30	<1.0	0.080	7,600	1,100	NA
001A – North Outfall	6/4/2014	Wet Weather	2.71	0.34	7.54	<4.0	19	<1.0	0.850	100	410	NA
002A – West Outfall	6/4/2014	Wet Weather	8.40	1.33	7.65	<4.0	11	<1.0	0.190	13,000	3,200	NA
004A – Maverick Street Outfall	6/4/2014	Wet Weather	0.66	0.08	7.18	<4.0	22	<1.0	0.090	2,200	1,700	NA
001C – North Outfall	6/3/2014	Dry Weather				<4.0	11	<1.0	0.230	460	110	NA
002C – West Outfall	6/3/2014	Dry Weather				<4.0	6.4	<1.0	0.140	380	110	NA
004C – Maverick Street Outfall	6/3/2014	Dry Weather				<4.0	25	<1.0	0.100	2,300	450	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	

Source: Massport.
Notes: Bold values exceed maximum daily discharge limitation.
Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.
1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.
NA Not Analyzed.
NM Due to pH probe malfunction, pH measurements were not reported.
NS Not Sampled. A wet weather sampling event was not conducted during the month of May 2014. There were a total of four storms in May 2014 with at least 0.1 inches of rain, which would qualify as wet weather events. Two storms occurred on weekends and two storms occurred overnight or outside low tide windows. Due to laboratory closure on weekends and evenings and low tide sampling requirements, a wet weather sampling event could not be completed.
TSS Total Suspended Solids

Table J-5 Logan Airport 2014 Monthly Monitoring Results for Second Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	4/15/2014	Wet Weather	-	-	NM	<4.0	50	<1.0	0.240	40	20
003 - Porter Street Outfall 2	4/15/2014	Wet Weather	-	-	NM	<4.0	28	<1.0	0.070	<10	120
003 - Porter Street Outfall 3	4/15/2014	Wet Weather	-	-	NM	<4.0	85	<1.0	0.130	4,500	260
003 - Porter Street Outfall Average		Wet Weather	2.53	0.44	NM	0.0	54	0.0	0.147	56	85
003 - Porter Street Outfall 1	4/21/2014	Dry Weather				<4.0	<5.0	<1.0	0.100	<10	<10
003 - Porter Street Outfall 2	4/21/2014	Dry Weather				<4.0	11	<1.0	<0.050	<10	<10
003 - Porter Street Outfall 3	4/21/2014	Dry Weather				<4.4	<5.0	<1.0	0.130	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	3.7	0.0	0.077	1.0	1.0
003 - Porter Street Outfall 1	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		Wet Weather	1.18	0.24	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	5/16/2014	Dry Weather				<4.0	43	<1.0	0.170	<10	<10
003 - Porter Street Outfall 2	5/16/2014	Dry Weather				<4.0	72	<1.0	0.140	<10	<10
003 - Porter Street Outfall 3	5/16/2014	Dry Weather				<4.0	8.0	<1.0	0.120	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	41	0.0	0.143	1.0	1.0
003 - Porter Street Outfall 1	6/4/2014	Wet Weather	-	-	7.76	<4.0	22	<1.0	0.540	16,000	230
003 - Porter Street Outfall 2	6/4/2014	Wet Weather	-	-	8.08	<4.0	<5.0	<1.0	0.080	50	310
003 - Porter Street Outfall 3	6/4/2014	Wet Weather	-	-	8.01	<4.0	13	<1.0	0.310	60	310
003 - Porter Street Outfall Average		Wet Weather	2.34	0.21	7.95	0.0	11.7	0.0	0.310	363	281
003 - Porter Street Outfall 1	6/3/2014	Dry Weather				<4.0	39	<1.0	0.250	20	<10
003 - Porter Street Outfall 2	6/3/2014	Dry Weather				<4.0	19	<1.0	0.060	<10	10
003 - Porter Street Outfall 3	6/3/2014	Dry Weather				<4.0	12	<1.0	0.150	<10	40
003 - Porter Street Outfall Average		Dry Weather				0.0	23	0.0	0.153	2.71	7.37
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport.

Notes: Flow rates were estimated for outfall 003 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

TSS Total Suspended Solids.

NM Due to pH probe malfunction, pH measurements were not reported.

NS Not Sampled. A wet weather sampling event was not conducted during the month of May 2014. There were a total of four storms in May 2014 with at least 0.1 inches of rain, which would qualify as wet weather events. Two storms occurred on weekends and two storms occurred overnight or outside low tide windows. Due to laboratory closure on weekends and evenings and low tide sampling requirements, a wet weather sampling event could not be completed.

Table J-6 Logan Airport 2014 Monthly Monitoring Results for Third Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	-	Wet Weather	6.31	0.45	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	-	Wet Weather	22.17	1.61	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	-	Wet Weather	1.56	0.10	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	7/8/2014	Dry Weather				<4.0	20	<1.0	0.280	1,400	150	NA
002C – West Outfall	7/8/2014	Dry Weather				<4.0	14	<1.0	0.160	26,000	250	NA
004C – Maverick Street Outfall	7/8/2014	Dry Weather				<4.0	7.2	<1.0	0.080	23,000	2,100	NA
001A – North Outfall	8/13/2014	Wet Weather	2.93	0.18	8.34	<4.0	5.0	<1.0	0.180	70	1,800	NA
002A – West Outfall	8/13/2014	Wet Weather	10.12	0.62	7.91	13	250	<1.0	0.210	20,000	4,000	NA
004A – Maverick Street Outfall	8/13/2014	Wet Weather	0.88	0.03	7.60	<4.0	18	<1.0	0.180	>80,000	4,000	NA
001C – North Outfall	8/5/2014	Dry Weather				<4.0	12	<1.0	0.120	30	90	NA
002C – West Outfall	8/5/2014	Dry Weather				<4.0	15	<1.0	0.080	32,000	260	NA
004C – Maverick Street Outfall	8/5/2014	Dry Weather				<4.0	24	<1.0	0.060	21,000	250	NA
001A – North Outfall	-	Wet Weather	0.50	0.08	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	-	Wet Weather	3.36	0.30	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	-	Wet Weather	0.17	0.01	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	9/4/2014	Dry Weather				<4.0	17	<1.0	0.230	230	160	NA
002C – West Outfall	9/4/2014	Dry Weather				<4.0	14	<1.0	0.100	14,000	130	NA
004C – Maverick Street Outfall	9/4/2014	Dry Weather				<4.0	26	<1.0	0.070	21,000	2,500	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	----	Report	Report	Report	Report	Report	Report

Source: Massport

Notes: Bold values exceed maximum daily discharge limitation.
Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

TSS Total Suspended Solids.

NA Not Analyzed.

NS Not Sampled. A wet weather sampling event was not conducted during the month of July 2014. There were a total of three storms in July 2014 that met the wet weather requirements of 0.1 inches of rain. Rainfall during two storms occurred during the evening and sampling could not be conducted in the morning due to tides. Sampling could not be conducted during the third event due to laboratory closure on the weekend. . A wet weather sampling event was not conducted during the month of September 2014 due to dry conditions.

Table J-7 Logan Airport 2014 Monthly Monitoring Results for Third Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		Wet Weather	2.52	0.29	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	7/8/2014	Dry Weather				<4.0	18	<1.0	0.160	640	110
003 - Porter Street Outfall 2	7/8/2014	Dry Weather				<4.0	<5.0	<1.0	0.120	<10	50
003 - Porter Street Outfall 3	7/8/2014	Dry Weather				<4.0	<5.0	<1.0	0.150	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	6.0	0.0	0.143	9	18
003 - Porter Street Outfall 1	8/13/2014	Wet Weather	-	-	7.77	<4.0	21	<1.0	0.210	23,000	16,000
003 - Porter Street Outfall 2	8/13/2014	Wet Weather	-	-	8.44	<4.0	<5.0	<1.0	<0.050	10	20
003 - Porter Street Outfall 3	8/13/2014	Wet Weather	-	-	7.97	<4.0	<5.0	<1.0	0.090	220	1,200
003 - Porter Street Outfall Average		Wet Weather	1.90	0.08	8.06	0.0	7.0	0.0	0.100	370	727
003 - Porter Street Outfall 1	8/5/2014	Dry Weather				<4.0	25	<1.0	0.070	<10	60
003 - Porter Street Outfall 2	8/5/2014	Dry Weather				<4.0	<5.0	<1.0	0.200	20	10
003 - Porter Street Outfall 3	8/5/2014	Dry Weather				<4.0	31	<1.0	0.120	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	19	0.0	0.130	2.71	8.43
003 - Porter Street Outfall 1	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		Wet Weather	0.22	0.01	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	9/4/2014	Dry Weather				<4.0	77	<1.0	0.080	140	80
003 - Porter Street Outfall 2	9/4/2014	Dry Weather				<4.0	<5.0	<1.0	<0.050	<10	10
003 - Porter Street Outfall 3	9/4/2014	Dry Weather				<4.0	<5.0	<1.0	0.250	180	60
003 - Porter Street Outfall Average		Dry Weather				0.0	26	0.0	0.110	29	36
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport.
Notes: Flow rates were estimated for outfall 003 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.
TSS Total Suspended Solids.
NS Not Sampled. A wet weather sampling event was not conducted during the month of July 2014. There were a total of three storms in July 2014 that met the wet weather requirements of 0.1 inches of rain. Rainfall during two storms occurred during the evening and sampling could not be conducted in the morning due to tides. Sampling could not be conducted during the third event due to laboratory closure on the weekend. A wet weather sampling event was not conducted during the month of September 2014 due to dry conditions.

Table J-8 Logan Airport Monthly Monitoring Results for Fourth Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	10/16/2014	Wet Weather	9.67	0.64	6.53	<4.4	11	<1.0	0.100	2,100	170	NA
002A – West Outfall	10/16/2014	Wet Weather	37.34	2.36	6.87	<4.0	38	<1.0	0.080	1,200	270	NA
004A – Maverick Street Outfall	10/16/2014	Wet Weather	2.11	0.16	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	10/10/2014	Dry Weather				<4.0	12	<1.0	0.070	2,600	70	NA
002C – West Outfall	10/10/2014	Dry Weather				<4.0	46	<1.0	0.070	1,600	80	NA
004C – Maverick Street Outfall	10/10/2014	Dry Weather				<4.0	29	<1.0	0.060	220	40	NA
001A – North Outfall	11/6/2014	Wet Weather	5.7	0.6	7.17	<4.0	9.3	<1.0	0.160	480	520	NA
002A – West Outfall	11/6/2014	Wet Weather	19.2	2.4	7.16	<4.0	19	<1.0	0.150	6,900	490	NA
004A – Maverick Street Outfall	11/6/2014	Wet Weather	1.4	0.1	6.82	<4.0	14	<1.0	0.100	30,000	740	NA
001C – North Outfall	11/11/2014	Dry Weather				<4.0	17	<1.0	0.160	100	170	NA
002C – West Outfall	11/11/2014	Dry Weather				<4.0	22	<1.0	0.200	240	10	NA
004C – Maverick Street Outfall	11/11/2014	Dry Weather				<4.0	17	<1.0	0.210	190	20	NA
001A – North Outfall	12/9/2014	Wet Weather	11.1	0.9	7.65	<4.0	71	<1.0	0.120	2,100	330	NA
002A – West Outfall	12/9/2014	Wet Weather	37.0	3.3	6.88	<4.0	34	<1.0	0.150	910	240	NA
004A – Maverick Street Outfall	12/9/2014	Wet Weather	02.8	0.2	7.62	<4.0	32	<1.0	0.120	1,200	360	NA
001C – North Outfall	12/15/2014	Dry Weather				<4.0	12	<1.0	0.070	10	130	NA
002C – West Outfall	12/15/2014	Dry Weather				<4.0	42	<1.0	<0.050	140	40	NA
004C – Maverick Street Outfall	12/15/2014	Dry Weather				<4.0	38	<1.0	<0.050	1,200	140	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	Report

Source: Massport.
Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.
1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.
TSS Total Suspended Solids.
NA Not Analyzed.
NS Not Sampled. Due to construction, the Maverick Street Outfall could not be sampled during the October wet weather event.

Table J-9 Logan Airport 2014 Monthly Monitoring Results for Fourth Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	10/16/2014	Wet Weather	-	-	7.23	<4.4	6.5	<1.0	0.110	<10	170
003 - Porter Street Outfall 2	10/16/2014	Wet Weather	-	-	7.44	<4.4	6.8	<1.0	0.130	<10	410
003 - Porter Street Outfall 3	10/16/2014	Wet Weather	-	-	7.88	<4.4	<5.0	<1.0	0.260	<10	11,000
003 - Porter Street Outfall Average		Wet Weather	7.81	0.44	7.52	0.0	4.4	0.0	0.167	1.0	915
003 - Porter Street Outfall 1	10/10/2014	Dry Weather				<4.0	<5.0	<1.0	0.060	<10	320
003 - Porter Street Outfall 2	10/10/2014	Dry Weather				<4.0	8.1	<1.0	<0.050	<10	30
003 - Porter Street Outfall 3	10/10/2014	Dry Weather				<4.0	7.6	<1.0	0.070	<10	1,500
003 - Porter Street Outfall Average		Dry Weather				0.0	5.2	0.0	0.043	1.0	243
003 - Porter Street Outfall 1	11/6/2014	Wet Weather	-	-	6.57	<4.0	32	<1.0	0.210	1,100	2,300
003 - Porter Street Outfall 2	11/6/2014	Wet Weather	-	-	7.69	<4.0	<5.0	<1.0	0.070	330	60
003 - Porter Street Outfall 3	11/6/2014	Wet Weather	-	-	7.60	<4.4	<5.0	<1.0	0.080	190	1,500
003 - Porter Street Outfall Average		Wet Weather	3.5	0.4	7.29	0.0	11	0.0	0.120	410	592
003 - Porter Street Outfall 1	11/11/2014	Dry Weather				<4.0	8.6	<1.0	0.120	20	80
003 - Porter Street Outfall 2	11/11/2014	Dry Weather				<4.4	5.7	<1.0	0.050	10	<10
003 - Porter Street Outfall 3	11/11/2014	Dry Weather				<4.0	<5.0	<1.0	0.140	<10	50
003 - Porter Street Outfall Average		Dry Weather				0.0	4.8	0.0	0.103	5.8	16
003 - Porter Street Outfall 1	12/9/2014	Wet Weather	-	-	7.36	<4.0	89	<1.0	<0.050	820	4,600
003 - Porter Street Outfall 2	12/9/2014	Wet Weather	-	-	6.42	<4.0	26	<1.0	<0.050	<10	150
003 - Porter Street Outfall 3	12/9/2014	Wet Weather	-	-	6.57	<4.0	10	<1.0	<0.050	40	230
003 - Porter Street Outfall Average		Wet Weather	7.2	0.6	6.78	0.0	42	0.0	0.0	32	541
003 - Porter Street Outfall 1	12/15/2014	Dry Weather				<4.0	13	<1.0	0.160	<10	<10
003 - Porter Street Outfall 2	12/15/2014	Dry Weather				16	14	<1.0	0.090	10	130
003 - Porter Street Outfall 3	12/15/2014	Dry Weather				<4.0	<5.0	<1.0	0.080	<10	<10
003 - Porter Street Outfall Average		Dry Weather				5.3	9.0	0.0	0.110	2.2	5.1
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport.
Notes: Flow rates were estimated for outfall 003 using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.
TSS Total Suspended Solids.
NS Not Sampled. Due to weather and tidal conditions, a wet weather event was not conducted in October 2013.

Table J-10 Logan Airport 2014 Quarterly Wet Weather Monitoring Results – North, West, Maverick Street, and Porter Street Stormwater Outfalls

		Wet Weather									
	Date	pH (S.U.)	Benzo(a)-anthracene (µg/L)	Benzo(a)-pyrene (µg/L)	Benzo(b)-fluoranthene (µg/L)	Benzo(k)-fluoranthene (µg/L)	Chrysene (µg/L)	Dibenzo(a,h,)-anthracene (µg/L)	Indeno(1,2,3-cd)-pyrene (µg/L)	Naphthalene (µg/L)	Total PAHs (µg/L)
001 - North Outfall	3/20/2014	7.67	<10	<10	<10	<10	<10	<10	<10	<10	ND
002 - West Outfall	3/20/2014	7.22	<10	<10	<10	<10	<10	<10	<10	<10	ND
004 - Maverick Street Outfall	3/20/2014	7.07	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 1	3/20/2014	7.50	<10	<10	<10	<10	<10	<10	<10	<10	ND
003 - Porter Street Outfall 2	3/20/2014	7.49	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	3/20/2014	7.35	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average		7.45	ND	ND	ND	ND	ND	ND	ND	ND	ND
001 - North Outfall	6/4/2014	7.54	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
002 - West Outfall	6/4/2014	7.65	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
004 - Maverick Street Outfall	6/4/2014	7.18	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 1	6/4/2014	7.76	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 2	6/4/2014	8.08	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	6/4/2014	8.01	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average		7.95	ND	ND	ND	ND	ND	ND	ND	ND	ND
001 - North Outfall	10/16/2014	6.53	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
002 - West Outfall	10/16/2014	6.87	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
004 - Maverick Street Outfall	10/16/2014	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	10/16/2014	7.23	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 2	10/16/2014	7.44	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	10/16/2014	7.88	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average	10/16/2014	7.52	ND	ND	ND	ND	ND	ND	ND	ND	ND
001 - North Outfall	12/9/2014	7.65	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
002 - West Outfall	12/9/2014	6.88	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
004 - Maverick Street Outfall	12/9/2014	7.62	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 1	12/9/2014	7.36	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 2	12/9/2014	6.42	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	12/9/2014	6.57	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average		6.78	ND	ND	ND	ND	ND	ND	ND	ND	ND
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily		6.0 to 8.5	Report	Report	Report	Report	Report	Report	Report	Report	Total

Source: Massport

Notes: ND Not Detected; NS Not Sampled.
Due to construction, the Maverick Street Outfall could not be sampled during the 3rd Quarter wet weather event.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit.
PAH Polynuclear Aromatic Hydrocarbons.

Table J-11 Logan Airport 2014 Quarterly Wet Weather Monitoring Results – Northwest and Runway/Perimeter Stormwater Outfalls

	Date	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (SU)	Oil and Grease (mg/L)	Total Suspended Solids (mg/L)	Benzene (µg/L)
005 - Northwest Outfall	3/20/2014	1.14	0.08	7.17	<4.0	23	<1.0
006- Runway/ Perimeter Outfall (A9)	3/20/2014	0.68	0.06	7.41	<4.0	8.8	<1.0
006- Runway/ Perimeter Outfall (A17)	3/20/2014	0.26	0.02	7.34	<4.0	7.1	<1.0
006- Runway/ Perimeter Outfall (A20)	3/20/2014	0.30	0.03	7.14	<4.0	7.5	<1.0
006- Runway/ Perimeter Outfall (A21)	3/20/2014	5.82	0.52	7.11	<4.0	7.1	<1.0
006- Runway/ Perimeter Outfall (A23)	3/20/2014	0.53	0.05	7.15	<4.0	5.7	<1.0
006- Runway/ Perimeter Outfall (A33)	3/20/2014	0.35	0.04	7.16	<4.0	17	<1.0
006- Runway/ Perimeter Outfall (A38)	3/20/2014	0.81	0.05	7.18	<4.0	<5.0	<1.0
006- Runway/Perimeter Outfall Average		1.25	0.11	7.21	0.0	7.6	0.0
005 - Northwest Outfall	6/4/2014	0.37	0.04	7.32	<4.0	33	<1.0
006- Runway/ Perimeter Outfall (A9)	6/4/2014	0.18	0.03	7.96	<4.0	5.0	<1.0
006- Runway/ Perimeter Outfall (A15)	6/4/2014	0.08	0.01	7.83	<4.0	21	<1.0
006- Runway/ Perimeter Outfall (A17)	6/4/2014	0.08	0.01	8.14	<4.0	190	<1.0
006- Runway/ Perimeter Outfall (A21)	6/4/2014	1.50	0.22	7.58	<4.0	9.8	<1.0
006- Runway/ Perimeter Outfall (A23)	6/4/2014	0.15	0.02	7.59	<4.0	12	<1.0
006- Runway/ Perimeter Outfall (A33)	6/4/2014	0.13	0.02	7.78	<4.0	7.4	<1.0
006- Runway/ Perimeter Outfall (A38)	6/4/2014	0.20	0.02	7.26	<4.0	8.9	<1.0
006- Runway/Perimeter Outfall Average		0.33	0.05	7.73	0.0	36	0.0
005 - Northwest Outfall	10/16/2014	1.19	0.08	6.41	<4.0	13	<1.0
006- Runway/ Perimeter Outfall (A8)	10/16/2014	0.72	0.04	6.47	<4.0	11	<1.0
006- Runway/ Perimeter Outfall (A21)	10/16/2014	6.00	0.34	6.81	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A22)	10/16/2014	3.11	0.19	6.76	<4.0	8.5	<1.0
006- Runway/ Perimeter Outfall (A29)	10/16/2014	2.29	0.11	7.29	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A31)	10/16/2014	0.46	0.03	6.74	<4.0	5.4	<1.0
006- Runway/ Perimeter Outfall (A34)	10/16/2014	2.41	0.12	6.61	<4.0	12	<1.0
006- Runway/ Perimeter Outfall (A38)	10/16/2014	0.88	0.04	6.73	<4.0	17	<1.0
006- Runway/Perimeter Outfall Average		2.27	0.12	6.77	0.0	7.7	0.0
005 - Northwest Outfall	12/9/2014	1.5	0.1	7.27	<4.0	68	<1.0
006- Runway/ Perimeter Outfall (A9)	12/9/2014	0.8	0.1	7.80	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A18)	12/9/2014	0.1	0.0	6.94	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A19)	12/9/2014	0.1	0.0	7.11	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A21)	12/9/2014	6.7	0.5	6.99	<4.0	19	<1.0
006- Runway/ Perimeter Outfall (A23)	12/9/2014	0.6	0.0	6.74	<4.0	60	<1.0
006- Runway/ Perimeter Outfall (A33)	12/9/2014	0.3	0.0	7.54	<4.0	5.3	<1.0
006- Runway/ Perimeter Outfall (A38)	12/9/2014	1.0	0.0	7.54	<4.0	94	<1.0
006- Runway/Perimeter Outfall Average		1.4	0.1	7.24	0.0	25	0.0
Discharge Limitations		Report	Report	Report	Report	Report	Report

Source: Massport; Notes: Requirements are from NPDES Permit MA 0000787, issued July 31, 2007

Table J-12 Logan Airport 2014 Wet Weather Deicing Monitoring Results – North, West, Porter Street and Runway/Perimeter Stormwater Outfalls

	Date	Ethylene Glycol, Total (mg/L)	Propylene Glycol, Total (mg/L)	BOD_5 (mg/L)	COD (mg/L)	Total Ammonia Nitrogen (mg/L of N)	Chloride (mg/L)	Nonylphenol (µg/L)	4-Methyl-1-H-benzotriazole (µg/L)	5-Methyl-1-H-benzotriazole (µg/L)	Tolytriazole (µg/L)	Whole Effluent Toxicity
001 - North Outfall	2/13/2014	170	1,900	2,500	4,400	0.468	NA	<0.02	81.99	103.22	185.21	NA
002 - West Outfall	2/13/2014	600	14,000	15,000	24,000	1.32	NA	<0.02	237.40	330.60	568.00	NA
003B - Porter Street 1	2/13/2014	22	93	70	1,300	0.843	NA	<0.02	6.36	5.01	11.37	NA
003B - Porter Street 2	2/13/2014	7.1	28	240	420	0.111	NA	1.91	42.19	87.48	129.67	NA
003B - Porter Street 3	2/13/2014	<7.0	<7.0	200	1,400	0.508	NA	<0.02	2.45 J	3.01	5.46 J	NA
003B - Porter Street Outfall Average		9.7	40.3	170	1,040	0.487	NA	0.64	17.00 J	31.83	48.83 J	NA
006- Runway/ Perimeter (A9)	2/13/2014	<7.0	<7.0	5.3	100	0.445	NA	<0.02	7.33	2.66	9.99	NA
006- Runway/ Perimeter (A15)	2/13/2014	<7.0	<7.0	3.5	<40	2.47	NA	<0.02	9.07	3.40	12.47	NA
006- Runway/ Perimeter (A18)	2/13/2014	<7.0	<7.0	30	74	5.75	NA	<0.02	16.30	5.61	21.91	NA
006- Runway/ Perimeter (A21)	2/13/2014	<7.0	<7.0	170	1,400	0.992	NA	0.23 J	10.60	8.91	19.51	NA
006- Runway/ Perimeter (A23)	2/13/2014	<7.0	<7.0	3.8	160	2.89	NA	<0.02	18.08	4.40	22.48	NA
006- Runway/ Perimeter (A33)	2/13/2014	NS	NS	NS	NS	NS	NA	NS	NS	NS	NS	NA
006- Runway/ Perimeter (A38)	2/13/2014	NS	NS	NS	NS	NS	NA	NS	NS	NS	NS	NA
006- Runway/Perimeter Outfall												NA
Average		0.0	0.0	42.5	347	2.51	NA	0.046 J	12.28	5.00	17.27	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge												
Limitations												
Maximum Daily		Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report

Source: Massport.

Notes: For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit.
J = Value is an estimate calculated by the lab from the response factors of the other two triazole compounds.
Tolytriazole concentrations calculated as sum of 4-Methly-1-H-benzotriazole and 5-Methyl-1-H-benzotriazole.

BOD_5 Five-day Biochemical Oxygen Demand
COD Chemical Oxygen Demand
NA Not Analyzed
NS Not Sampled. Locations were inaccessible due to snowy road conditions and visibility issues.

Table J-13 Logan Airport Stormwater Outfall NPDES Water Quality Monitoring Results – 1993 to 2014

	1993	1994	1995	1996	1997	1998	1999	2000	2001[1]	2002	2003[1]	2004	2005	2006	2007	2008	2009	2010[1,2]	2011[2]	2012	2013	2014
# / # = Number of samples at or below NPDES limits / Total number of samples taken																						
Oil and Grease (mg/L)																						
North Outfall	30/31	35/36	33/35	29/35	30/35	35/36	29/30	34/36	28/28	36/36	30/32	32/34	33/35	33/33	29/29	23/23	24/24	24/24	24/24	21/21	20/20	21/21
West Outfall	29/30	36/36	34/34	36/36	34/35	36/36	30/30	35/35	27/28	36/36	31/32	33/34	35/35	32/33	28/28	22/23	24/24	24/24	22/24	21/21	21/21	21/21
Porter Street Outfall[2]	30/30	35/36	34/34	36/36	35/35	34/36	30/30	35/36	28/28	34/36	32/32	33/34	34/35	33/33	22/22	50/50	72/72	50/50	49/49	62/62	63/63	63/63
Maverick Street Outfall	29/29	36/36	35/35	36/36	35/35	35/36	30/30	34/34	26/28	35/36	32/32	34/34	35/35	32/33	29/29	22/23	20/21	19/19	23/23	15/15	4/4	20/20
Settleable Solids[3] (mg/L)																						
North Outfall	19/19	34/35	34/35	32/35	31/34	34/36	30/30	34/36	29/29	32/36	32/32	34/34	33/35	32/34	22/22	n/a	n/a	n/a	n/a	n/a	n/a	n/a
West Outfall	19/19	32/36	34/34	35/36	34/34	35/36	29/30	36/36	27/28	36/36	31/32	34/34	32/35	33/33	22/22	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TSS (mg/L)																						
North Outfall	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6/6	24/24	24/24	22/23	24/24	21/21	20/21	21/21
West Outfall	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5/6	24/24	24/24	23/23	22/24	20/22	21/21	20/21
Maverick Street Outfall	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4/6	22/24	20/21	18/19	20/23	14/15	4/4	19/20
pH																						
North Outfall	34/35	33/36	35/35	35/35	35/35	36/36	30/30	36/36	29/29	36/36	32/32	34/34	35/35	34/34	26/26	12/12	16/16	11/11	12/12	9/9	8/8	8/8
West Outfall	34/34	28/36	33/34	35/36	35/35	36/36	30/30	36/36	29/29	36/36	32/32	34/34	35/35	33/33	26/26	12/12	16/16	11/11	12/12	9/9	9/9	8/8
Porter Street Outfall[2]	35/35	30/36	34/34	36/36	35/35	36/36	30/30	36/36	28/28	36/36	32/32	34/34	35/35	33/33	22/22	21/21	48/48	24/24	23/23	26/27	24/27	24/24
Maverick Street Outfall	35/35	35/36	35/35	36/36	34/35	36/36	30/30	35/35	28/28	36/36	32/32	34/34	35/35	33/33	26/26	10/10	16/16	10/10	11/11	6/6	2/2	7/7

Source: Massport

Notes: Sampling requirements changed in 2007 with the issuance of a new NPDES permit. Results through 2007 are based on NPDES Permit MA0000787, issued March 1, 1978. Stormwater outfall water quality monitoring results collected in accordance with the requirements of former NPDES permit. A portion of the Porter Street Drainage Area was incorporated into the West Drainage Area as part of roadway construction projects at Logan Airport.

1 In 2001, 2003, and 2010, exceptional weather, tidal conditions, or insufficient discharge precluded the collection of some samples, leading to a fewer number of samples collected than in other years.

2 In 2010 and 2011, Porter Street Outfall 1 and Porter Street Outfall 3 were not accessible due to construction, leading to a fewer number of samples collected than in other years. A new sampling location was established for Porter Street Outfall 3 and it was sampled for the first time on February 18, 2011. Porter Street Outfall 1 was accessible again in December 2011.

3 In 2013, due to construction, a fewer number of samples were collected at the Maverick Street outfall than in other years.

4 Settleable solids analyses were replaced with TSS in 2008.

Table J-14 Logan Airport Oil and Hazardous Material Spills[1] and Jet Fuel Handling – 1990 to 2014

Year	Total Number of all Spills	Total Number of all Spills >10 gallons	Total Volume of all Spills (Gallons)	Estimated Volume of Jet Fuel Handled (Gallons)	Total Volume of Jet Fuel Spilled (Gallons)
1990	173	NA	NA	438,100,000	3,745
1991	186	NA	NA	NA	2,471
1992	195	NA	NA	NA	4,355
1993	188	NA	NA	451,900,000	3,131
1994	217	NA	NA	476,700,000	4,046
1995	161	NA	NA	309,200,000	21,412[2]
1996	159	NA	NA	346,700,000	1,321
1997	147	NA	NA	377,488,161	2,029[3]
1998	191	NA	NA	387,224,004	10,047[4]
1999	196	43	7,151	425,937,051	7,012[5]
2000	136	20	1,318	441,901,932	1,227
2001	139	37	1,924	416,748,819	1,771
2002	101	16	653	358,190,362	559
2003	128	19	10,364	319,439,910	10,188[6]
2004	126	18	894	373,996,141	574
2005	97	15	2,319	368,645,932	585
2006	92	11	752	364,450,864	644
2007	108	7	604	367,585,187	361
2008	99	20	944	345,631,788	662
2009	95	6	1004	327,358,619	915
2010	87	15	476	335,693,997	360
2011	108	12	572	340,421,373	337
2012	132	5	593	343,731,127	439
2013	94	6	452	349,397,940	351
2014	129	17	2,785	370,222,342	785

Source: Massport Fire-Rescue Department.
NA Not available.
1 Materials include: jet fuel, hydraulic oil, diesel fuel, gasoline, and other materials such as glycol and paint.
2 One tenant spill, which occurred on October 15, 1995, totaled 18,000 gallons (84 percent of the annual spill total). The spill did not enter the Airport's storm drain system.
3 On October 23, 1997, a fuel line on an aircraft failed, resulting in the release of approximately 2,500 gallons, all but 60 gallons of which were recovered in drums before reaching the ground. Only the 60 gallons is included in the 1997 total.
4 Includes a 7,200-gallon spill that was discovered on September 2, 1998, and a 1,300-gallon spill that occurred on June 3, 1998. Neither spill entered the Airport's storm drain system.
5 Includes a 5,000-gallon spill, none of which entered the Airport's storm drainage system.
6 In 2003, one fuel spill comprised 9,460 gallons or 94 percent of the total volume of the MassDEP/MCP reportable spills that year. The fuel spill was contained and did not enter the drainage system.

Table J-15 Type and Quantity of Oil and Hazardous Material Spills at Logan Airport – 1999 to 2014

	Jet Fuel			Hydraulic Oil			Diesel Fuel			Gasoline			Other		
Year	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons
1999	151	7,012	40	24	67	1	13	49	2	5	7	0	3	16	0
2000	115	1,227	18	8	59	2	3	11	0	8	16	0	2	5	0
2001	104	1,771	32	21	92	3	5	30	1	6	26	1	3	5	0
2002	79	559	15	7	38	0	8	37	1	4	8	0	3	11	0
2003	89	10,188	15	15	91	3	15	30	0	7	24	0	2	31	1
2004	82	574	12	17	189	4	14	52	0	7	26	0	6[1]	53[2]	2[3]
2005	66	585	12	14	78	1	7	1,610	2	7	45	0	3[4]	1	0
2006	65	644	9	10	25	0	6	57	1	4	9	0	7	17	1
2007	66	361	4	16	37	0	16	57	1	3	8	0	7	141[5]	2
2008	74	662	19	15	56	2	5	14	0	1	7	0	4	205[6]	1
2009	95	915	6	21	51	0	9	20	0	3	3	0	11	15	0
2010	54	360	12	17	50	1	5	56	2	2	3	0	7	7	0
2011	69	337	10	21	149	1	7	55	1	4	16	0	7	15	0
2012	80	439	4	25	79	1	17	38	0	2	12	0	8	25	0
2013	56	351	5	15	51	0	13	32	0	2	<2	0	7	10	0
2014	81	785	13	24	98	1	17	1,810	2	4	9	0	3	83	1

Source: Massport
Notes:
1 Includes two Unknown spills (14 gallons), plus one spill of each of the following: Ethylene Glycol, Propylene Glycol, AVGAS, and Paint.
2 Ethylene Glycol (25 gallons), Propylene Glycol (10 gallons), AVGAS (1 gallon) and Paint (3 gallons).
3 One spill of Ethylene Glycol; one spill of Propylene Glycol.
4 Includes two spills of an unknown substance and volume.
5 Includes one spill of motor oil (4 gallons); one spill of kerosene (5 gallons); one spill of cooking oil (120 gallons); one spill of fuel oil (10 gallons); one spill from a battery (1 gallon); two spills of an unknown substance (1 gallon).
6 Includes one spill of transformer oil (200 gallons).

Table J-16 MCP Activities Status of Massport Sites at Logan Airport

Location (Release Tracking Number) and MassDEP Reporting Status	Action/Status
1. Fuel Distribution System (3-1287) (continued)	
2007	Inspection and Monitoring Status Reports were submitted to the MassDEP detailing monitoring and product recovery efforts along the FDS between September 2006 and September 2007. A Periodic Evaluation Report was submitted in January 2008 which indicated that a Condition of No Substantial Hazard existed at the FDS and a permanent solution was not currently feasible. Massport coordinated with BOSFUEL who prepared construction documents for replacing a portion of the FDS. Construction was conducted under a RAM Plan.
2008	Inspection and monitoring reports were submitted to the MassDEP detailing monitoring and product recovery efforts along the FDS between September 2007 and September 2008. Massport coordinated with BOSFUEL during construction to replace a portion of the FDS. The work was conducted under a RAM Plan that was submitted to the MassDEP in May 2008. A RAM Status Report was submitted in September 2008. Construction of the pipeline replacement was approximately 90 percent complete.
2009	Inspection and monitoring reports were submitted to the MassDEP detailing monitoring and product recovery efforts along the FDS between September 2008 and December 2009. The BOSFUEL project to replace a portion of the FDS continued, with work being completed on pipeline connections, testing of the new fuel line, and abandonment of the old fuel line. RAM Status Reports for the BOSFUEL Project were submitted in February and September 2009.
2010	Inspection and monitoring reports were submitted to the MassDEP detailing monitoring and product recovery efforts along the FDS between September 2009 and September 2010. A RAM Completion Report for the BOSFUEL Project was submitted in February, and the report was revised in March 2010.
2011	A Periodic Review of the Temporary Solution for the FDS was submitted in April 2011. Additionally, three Post-Class C RAO Status Reports were submitted for the FDS in February, June, and December 2011, summarizing the routine inspection and monitoring activities.
2012	Post-Class C RAO Status Reports were submitted in May and November 2012, summarizing the routine inspection and monitoring activities.
2013	Post-Class C RAO Status Reports were submitted in May and November 2013, summarizing the routine inspection and monitoring activities.
2014	Post-Class C RAO Status Reports were submitted in May and November 2014, summarizing the routine inspection and monitoring activities. In addition, a RAM Plan was submitted in April 2014 to address construction in the area of the FDS followed by a RAM Completion Report submitted in August 2014.
2. North Outfall (3-4837)	
Phase II and Phase III Reports filed in March 1997	Indicated petroleum contamination present at the site was likely the result of decades of airport operation; risk assessment reported no significant risk to human health, or to the aquatic and avian community.
RAO submitted in March 1998	Class C RAO using a Temporary Solution (periodic site monitoring and assessment); remediation steps included (not limited to) installation of a new fuel distribution system and decommissioning of certain fuel lines, and natural biodegradation processes; goal is to have petroleum contamination reduced to an area less than 1,000 square feet. Installation of the new fuel distribution system and decommissioning of sections of the old system were completed.
	Massport initiated site evaluation to document the reduction of petroleum contamination following the decommissioning of the North Fuel Farm and fuel distribution system.
Post Class C RAO evaluation report submitted in December 2002	Massport has eliminated substantial hazards at this site and submitted a Class C RAO statement. In accordance with applicable regulations, Massport will conduct a periodic evaluation at five-year intervals until a Permanent Solution has been achieved. The next periodic evaluation was scheduled for 2007.

Table J-16	MCP Activities Status of Massport Sites at Logan Airport (Continued)
Location (Release Tracking Number) and MassDEP Reporting Status	Action/Status
2. North Outfall (3-4837) (continued)	
2004	Evaluation report indicated that a "Condition of No Significant Risk" has not been achieved at this site. Massport scheduled another assessment in 2007.
2005	No change in status for 2005.
2006	Massport prepared the five-year review of the Class C RAO for this site, which was due in December 2007.
2007	Massport completed its five-year review of the Class C RAO and transmitted it to MassDEP in December 2007. It was determined that a "Condition of No Significant Risk" has not been achieved at this site at this time. The next five-year re-evaluation will be conducted in 2012.
2008	No change in status.
2009	No change in status.
2010	No change in status.
2011	No change in status. Massport provided updated data for the MassDEP website.
2012	Response Action Outcome submitted to DEP on December 27, 2012. No further MCP response action is required.
3. Former Robie Park (3-10027)	
2005	A Phase I was completed in 2005 with an RAO retraction. The RAO had been completed by the former property owner.
2006	No change in status for 2006.
2007	No change in status for 2007.
2008	A Phase II Scope of Work was prepared on May 9, 2008. A RAM Plan was submitted to MassDEP on September 16, 2008.
2009	A Phase V Remedy Operation Status Plan was submitted on March 31, 2010.
2010	Two Remedy Operation Status Reports were submitted on September 29, 2010 and March 28, 2011. The next status report was scheduled for September 30, 2011.
2011	Phase IV Project Status Reports 2 and 3 were submitted in March and September 2011, respectively.
2012	Phase V Status Reports 4 and 5 were submitted in March and September, 2012, respectively.
2013	Phase V Status Reports 6 and 7 were submitted in March and September, 2013, respectively.
2014	Phase V Status Reports 8 and 9 were submitted in March and September, 2014, respectively.
4. Former Robie Property (3-23493)	
2005	A Phase I was completed in 2005.
2006	No change in status for 2006.
2007	No change in status for 2007.
2008	A Phase II was submitted to MassDEP on October 21, 2008.
2009	An Activity and Use Limitation (AUL) was recorded with the Suffolk County Registry of Deeds for the site on December 16, 2009.

Table J-16 MCP Activities Status of Massport Sites at Logan Airport (Continued)

Location (Release Tracking Number) and MassDEP Reporting Status	Action/Status
2010	A Class A-3 RAO was submitted on January 4, 2010, corresponding with the recording of an AUL. On May 21, 2010, a RAM Plan for the Economy Parking Structure was submitted. The first RAM Status Report was submitted on September 21, 2010. An AUL Amendment was recorded on December 9, 2010.
2011	A RAM Completion Statement was submitted on March 15, 2011. Regulatory closure has been achieved. No further response actions are required.
5. Tomahawk Drive (3-27068)	
2007	Release notification form submitted in August 2007.
2008	A Class B-1 RAO was submitted to MassDEP on January 9, 2009. No further response actions were required.
2009	No further response actions were required.
2010	No further response actions were required.
2011	No further response actions required.
6. Fire Training Facility (3-28199)	
2008	Oral notification of release was provided to MassDEP/BWSC on December 10, 2008
2009	A Phase I/Tier classification was submitted on December 17, 2009.
2010	A RAM Plan was submitted to MassDEP on August 6, 2010. A RAM Status Report was submitted to MassDEP on December 3, 2010.
2011	A RAM Completion Statement was submitted on April 25, 2011.
	A Phase II Scope of Work was prepared and submitted to MassDEP on January 18, 2011. Phase II and Phase III Reports were submitted on December 8, 2011. A RAM Completion Statement was submitted on April 25, 2011.
2012	Phase 4 Status Report transmitted in June 2012; the Phase IV Remedy Implementation Plan was submitted in December 2012.
2013	Phase 4 Status Report transmitted in June 2013, the Phase IV Completion Report was transmitted in December 2013.
2014	Phase 5 Remedy Operation Status Reports submitted in June and December, 2014.
7. Southwest Service Area (3-28792)	
2009	Release notification form was submitted to MassDEP/BWSC on October 8, 2009.
2010	A Class B-1 RAO was submitted to MassDEP on October 18, 2010. No further response actions required.
2011	No further response actions required.
8. Airfield Duct Bank Site (3-29716)	
2010	Release notification form was submitted on December 22, 2010.
2011	A Class A-1 RAO was submitted on December 23, 2011. No further response actions required.
9. West Outfall Release (3-29792) 2011	Release notification form was submitted on April 8, 2011. Two IRA Status Reports were submitted to MassDEP on June 9 and December 5, 2011. An RAO was submitted on February 13, 2012. No further response actions required.

Table J-16 MCP Activities Status of Massport Sites at Logan Airport (Continued)

Location (Release Tracking Number) and MassDEP Reporting Status	Action/Status
10. Hertz Parking Lot Site (3-30260)	Release notification form was submitted on August 29, 2011.
2011	A RAM Plan was submitted to MassDEP on September 1, 2011.
2012	A Class A-2 RAO was submitted on September 10, 2012. No further response actions required.
11. Former Butler Aviation Hangar (3-30654)	Verbal notification of a release was provided to the DEP on February 14, 2012, when RCC construction encountered an unidentified underground storage, and a Release Notification Form was submitted on April 23, 2012.
2012	An IRA Plan was submitted on May 21, and IRA Status Reports were submitted on June 18 and December 26, 2012.
2013	Phase I Report and Tier Classification submitted February 21, 2013 and IRA Completion Report submitted on July 11, 2013
2014	A Permanent Solution Statement was submitted in October 2014. No further response actions required.
12. Hangar 16 (3-32351)	Release Notification Form submitted August 4, 2014.

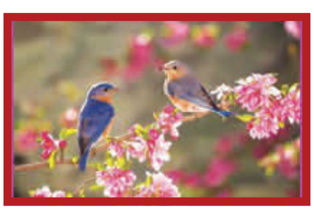
Capital Programs and Environmental Affairs

ENVIRONEWS

A Massport Tenant Newsletter

Volume 40, Issue 1
March 2014

INSIDE THIS ISSUE:



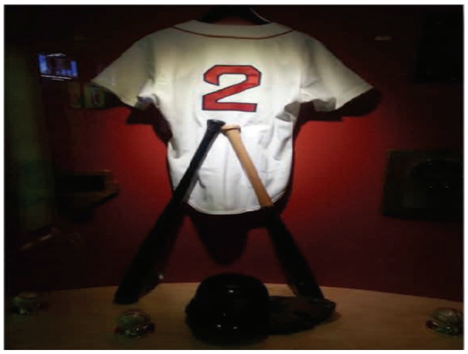
EnviroNews is a newsletter published quarterly for Massport and its Tenants. Your comments and suggestions are welcome. Please contact Brenda Enos (benos@massport.com) at 617-568-5963.

Material Safety Data Sheets (MSDS) will soon be Safety Data Sheets (SDS). What's the Difference?

You may remember that the OSHA Hazard Communication Standard requires chemical manufacturers or distributors to provide Material Safety Data Sheets (MSDS) to communicate the hazards of chemical products. Based on the MSDS provisions in HazCom 1994, there are currently a number of different MSDS styles and formats in use in the United States; the most common being the "8 section OSHA MSDS" and the "16 section ANSI MSDS". OSHA's adoption of Globally Harmonized System (GHS) via HazCom 2012, mandates the use of a single GHS format for safety data sheets, a format which features 16 sections in a strict ordering beginning June 1, 2015. The new format includes the following sections as well as the pictograms to the below:

1. **Identification** includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
2. **Hazard(s) identification** includes all hazards regarding the chemical; required label elements.
3. **Composition/information on ingredients** includes information on chemical ingredients; trade secret claims.
4. **First-aid measures** includes important symptoms/ effects, acute, delayed; required treatment.
5. **Fire-fighting measures** lists suitable extinguishing techniques, equipment; chemical hazards from fire.
6. **Accidental release measures** lists emergency procedures; protective equipment; proper methods of containment and cleanup.
7. **Handling and storage** lists precautions for safe handling and storage, including incompatibilities.
8. **Exposure controls/personal protection** lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).
9. **Physical and chemical properties** lists the chemical's characteristics.
10. **Stability and reactivity** lists chemical stability and possibility of hazardous reactions.
11. **Toxicological information** includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
12. **Ecological information**
13. **Disposal considerations**
14. **Transport information**
15. **Regulatory information**
16 **Other information,** includes the date of preparation or last revision.

Continued on Page 2



Massport Scavenger Hunt!

Opening day at Fenway is right around the corner. Check out famous Red Sox memorabilia at Logan Airport!

Find its location and take a picture next to it and send the picture to obrazoban@massport.com. The first submission will get some great giveaways!

Good Luck!

Material Safety Data Sheets (MSDS) will soon be Safety Data Sheets SDS. What's the Difference? (cont..from page 1)

There are other requirements for the new OSHA HazCom. The table below summarizes the phase-in dates required under the revised Standard.

Effective Completion Date	Requirement(s)	Who
December 1, 2013	Train employees on the new label elements and safety data sheet (SDS) format.	Employers
June 1, 2015* December 1, 2015	Compliance with all modified provisions of this final rule, except: The Distributor shall not ship containers labeled by the chemical manufacturer or importer unless it is a GHS label.	Chemical manufacturers, importers, distributors and employers
June 1, 2016	Update alternative workplace labeling and hazard communication program as necessary, and provide additional employee training for newly identified physical or health hazards.	Employers
Transition Period to the effective completion dates noted above	May comply with either 29 CFR 1910.1200 (the final standard), or the current standard, or both.	Chemical manufacturers, importers, distributors, and employers

For more information, you can visit the OSHA website at: https://www.osha.gov/dsg/hazcom/ghs.html.

Recycling Program Update

New Recycling Images,

Separating paper and plastic is a thing of the past here at Massport, wth the roll out of our new Single Stream program. "Single Stream" recycling also known as "Fully Commingled" or "Single Sort" allows paper, plastic, cardboard, glass and metals to be recycled in the same container. "Single Stream" recycling makes it easier for passengers and employees to recycle.

Many of you may have noticed the recycling barrels inside the terminals wrapped with a new beautiful Boston background. The blue on the top of the background makes the recycling barrels easy to spot. The new recycling wrap displays what is acceptable and not acceptable under the Single Stream program.

The new dumpsters compact trash and recyclables with just a push of a button. The dumpsters are designed to compress what's inside 3 times over, eliminating wasted space from large items, e.g., boxes and large pieces of cardboard. Aside from the advanced features, we also applied a simple yet significant mechanism to the dumpster doors. The "switched" door works exactly like a mailbox door. It will only take objects in after the door is closed back up, preventing birds from opening up the bags and debris from flying out. The "Safety Switch" door on the other side has a sensor that informs the compactor whether the door is closed or open. The dumpsters will not compact unless the sensor door is closed, this will prevent serious injuries if workers ever try to get into the dumpster to push in the bags.

massport

2014 Earth Day
Household Hazardous Waste Collection

Airport Locations

Logan- Massport Fire Rescue Station 1
April 22nd 9am-2pm

Worcester- Gate 18 (Near Maintenance Facility)
April 30th 9am-12pm

Hanscom- Civil Air Terminal Parking Lot
May 7th 9am-1pm

Accepted Items

Dry and wet chemicals like Oiled Based Paint, Cleaners, and Pesticides

E-Waste (36" in size) like Televisions, Monitors, Computers

Laptops, Projectors, Cell-phones, Scanners, Fax Machines etc...

**Detailed list on the back

For more information contact
Glenn Adams: gadams@Massport.com
Oscar Brazoban: obrazoban@Massport.com

*NO COMMERCIALLY GENERATED WASTE, HOUSEHOLD ONLY**

WE RESERVE THE RIGHT TO REJECT ANY MATERIALS.

Acceptable Items

- Aerosol Products
- Antifreeze
- Appliances with Chlorofluorocarbons (CFC's)
  - Refrigerators, freezers, air conditioners and dehumidifiers containing CFC's
- Automotive Batteries
- Household Batteries
  - Lithium batteries should be taped
- Driveway Sealer
- Electronics & Cathode Ray Tubes
- Empty Fire Extinguishers
- Propane Tanks (empty or full) with no valves
- Fluorescent Light Bulbs
- Mercury Devices and Liquid Mercury
- Microwaves
- Motor Oil
- Muriatic (Hydrochloric)Acid
- Thinners and Solvents

Not Acceptable

- Ammunition
- Compressed Gas Cylinders (except propane)
- Fireworks
- Gun Powder
- Latex Paint
- Lead Acid Batteries
- Medical Wastes
- Prescription Drugs
- Radioactive Wastes
- Smoke Detectors
- Stereos
- Tires

Logan Airport's Sustainability Management Plan – Project Update

The Project Team met with Bill Crowley to discuss Fleet sustainability on November 5, 2013.

Since our last Sustainability Management Plan (SMP) update, the Massport Sustainability Working Group (SWG) and the Project Team have made significant progress. One of the first action items for the SMP was to conduct a thorough baseline assessment of Logan Airport's current sustainability performance; an initial draft of the document was completed in February 2014. The Project Team interviewed over 30 Massport staff members between November 2013 and January 2014, as part of the data gathering effort for this assessment. Staff members represented many departments, including Aviation Administration, Capital Programs, the Airport Business Office, Economic Planning and Development, Facilities, Fleet, Landscaping, Risk Management, Human Resources, Purchasing, Utilities Control, Administration and Finance, Aviation Customer Service, Legal, Information Technology, and Community Relations.

In addition to completing an initial draft of the baseline assessment, the Project Team held a second SWG meeting at Massport on December 12, 2013. At this meeting, the SWG heard from Leith Sharp, Founding Director of the Harvard Green Campus Initiative. Leith Sharp discussed how sustainability can be successful at Massport and how Harvard, as an institution, has many parallels to Massport. The next SWG meeting is scheduled for spring 2014. At this meeting, the SWG will work toward developing goals, crafting a sustainability mission statement, and identifying potential sustainability initiatives.

During this most recent reporting period, the Project Team also met with Capital Programs staff to brief them on the SMP and sustainability.

As part of the Baseline Assessment, the consultant team identified Massport's notable achievements. Notable achievements from the key resource areas include:

- ◊ Massport has used warm mix asphalt (WMA) for many runway and roadway paving projects. This process produces 20 percent less greenhouse gas (GHG) emissions than standard hot mix asphalt. Benefits also include fewer fumes for workers.
- ◊ Logan Airport's Terminal A was the first LEED™-certified airport terminal in the world. LEED™, or Leadership in Energy & Environmental Design, provides third-party certification of green buildings.
- ◊ Recycled water is used at the Green Bus Depot for airport shuttle bus washing. This initiative reduces the demand for potable water sources.
- ◊ Massport's Residential Sound Insulation Program (RSIP) is one of the longest running and most extensive sound insulation programs in the country. RSIP was initiated in 1984 as a pilot program; in 1986 it graduated to a long-range program. The program has retrofitted thousands of homes and dozens of schools since its inception.
- ◊ Massport's recently constructed Rental Car Center (RCC) streamlined rental car operations by providing a centralized location and covered parking for all rental car companies. The RCC is served by the Airport's clean fleet of shuttle buses rather than the individual company shuttles.
- ◊ In an effort to protect bird species while enhancing safety at the Airport, Massport works closely with the Massachusetts Audubon Society to trap and relocate snowy owls that stop at the Airport during their migration north. The owls are relocated north of the Airport on Plum Island, where they can continue their migration.

Questions about Environmental/Safety Issues

Who should you contact?

Contact	Phone Number	Email Address
Auditing/General EMS/Sustainability		
Brenda Enos	(617) 568-5963	benos@massport.com
Recycling/Universal Waste		
Glenn Adams	(617) 568-3542	gadams@massport.com
Safety		
Brian Dinneen	(617) 568-7427	bdinneen@massport.com
Michael McAveeney	(617) 561-3390	mmcaveeney@massport.com
Karisa Morin	(617) 568-7434	kmorin@massport.com
Spill Follow-Up		
James Stolecki	(617) 568-3552	jstolecki@massport.com
NPDES Permitting		
Rosanne Joyce	(617) 568-3516	rjoyce@massport.com
Underground/Aboveground Storage Tanks		
Erik Bankey	(617) 568-3514	ebankey@massport.com
Air Quality/Hazardous Waste		
Ian Campbell	(617) 568-3508	icampbell@massport.com

Capital Programs and Environmental Affairs

EnviroNews

A Massport Newsletter

Volume 40, Issue 2
July 2014

INSIDE THIS ISSUE:

EnviroNews is a newsletter published quarterly for Massport and its Tenants. Your comments and suggestions are welcome. Please contact Brenda Enos (benos@massport.com) at 617-568-5963.

Logan Airport's Sustainability Management Plan Update

The Logan Airport Sustainability Management Plan (SMP) has come a long way over the last few months, and a lot of excitement is building as we start to communicate our sustainability successes and approach to the Massport organization. In March 2014, the Project Team held a four-hour long workshop with Capital Programs to explore ways of sharing information regarding sustainability efforts. During the workshop, participants brainstormed ways to promote sustainability internally as well as to the traveling public.

In addition to crafting a sustainability message, the Project Team is developing a Sustainability Index that Massport will be able to use to assess annual progress. Progress on implementing sustainability initiatives will be assessed by tracking key performance indicators, such as water use and recycling rates.

In May 2014, the Sustainability Working Group (SWG) met to draft a sustainability mission statement and to identify goals, objectives, metrics, and targets.

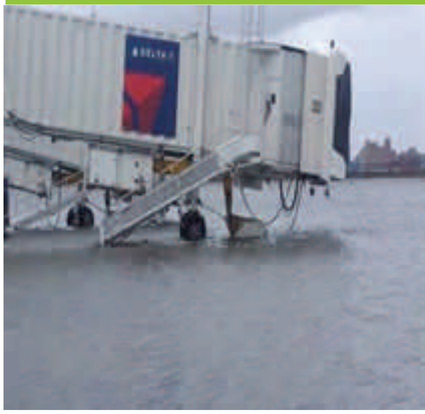
Mission statement options were developed based on input received from the SWG during the December 2013 meeting and from a survey conducted through MindMixer, an online engagement tool. The mission statement will serve as a guide for Massport along its sustainability path.

After completion of a baseline assessment in February 2014, goals and targets were drafted for the following six priority categories:

- Energy;
- Greenhouse Gas Reduction;
- Climate Change Adaptation;
- Water Conservation;
- Waste Management; and
- Community.

Photos from the March 2014 workshop with Capital Programs. Attendees were divided into four groups, and asked to develop a "pitch for sustainability."

Resiliency Program Update



Hurricane Sandy: LaGuardia Airport flooded

The term “resiliency” refers to the ability of a system to withstand a major disruption within acceptable degradation parameters, recover within an acceptable time, and balance composite costs and risks; think Superstorm Sandy and New York/New Jersey. As part of Massport’s strategic planning process, a group of staff and consultants have been incorporating resiliency thinking into Massport’s long range planning. A Resiliency Chapter will be in Massport’s Strategic Plan to be released this summer. In addition, Massport has been working with consultants to create a Disaster and Infrastructure Resiliency Planning Study (DIRP) to determine short and long term susceptibility to climate-influenced events such as increased storm surges, sea level rise, and extreme precipitation. Based on historical data, future weather and sea level rise projections, they are looking at protecting existing assets at Massport to the level of a Category 2 Hurricane that would hit Boston at Mean High High Water - the highest of the two high tides. (Superstorm Sandy was a Category 1 Hurricane and hit Boston at low tide).

The DIRP Short-term Adaptation Plan will address concerns for climate preparedness over the next 5 years. It will also include recommendations for the longer term – considering how climate may change over the planning horizon of 30 years. The DIRP involves several tasks: conducting a climate hazard and threat analysis to the both the general area and to specific assets, analyzing vulnerability, and creating resiliency action plans based on projections and scenario modeling. The study currently is focusing on Logan and Maritime. Preliminary findings were presented at the March 20, 2014 Massport Board meeting and final findings and reports were due by June 30, 2014. A series of sector-specific facility meetings are currently underway with building managers and operational staff to review and provide input into the consultants’ draft recommendations.

The Resiliency Program hopes to create a culture of resiliency thinking at Massport – from an infrastructure as well as operational perspective. As the months unfold we hope to bring in speakers from other airports and ports that have gone through significant and disruptive natural events to share lessons-learned and convene colleagues who are dealing with similar issues for knowledge sharing. The Resiliency Program’s goals include: becoming an innovative and national model for resiliency planning and implementation within a port authority; improving our overall infrastructure and operational resilience; increasing our business value and contextual community responsibilities through improved resiliency; engaging our stakeholders to better understand our mutual needs; and incorporating resilience design and construction practices in the development of our airports, maritime systems, and real estate. For further information, please contact the Program Manager of Resiliency, Robbin Peach at rpeach@massport.com.

Household Hazardous Waste Collection-Logan, Worcester & Hanscom Airports

Massport kicked off the 44th annual Earth Day celebration by hosting free household hazardous waste collection events. Massport encouraged employees and tenants to clean their garage, basements, and attics in order to prevent harmful chemicals from making their way into the environment.

This year’s events were held at Logan, Hanscom, and Worcester. Massport collected a total of 11,000 pounds of hazardous waste which included paints, pesticides, mercury and flammables and a total of approximately 14,040 pounds of electronic such as computers, monitors, televisions and printers. Thanks to all who participated!

MassDOT Energy Conference

On Tuesday May 13, Massport was invited to participate on a renewable energy panel on behalf of the MassDOT Office of Energy, Technology and Management. This year's theme focused on renewables and energy resiliency in Massachusetts. MassDOT's one-day, three session event invited multi-sector industry leaders and stakeholders to network and join in conversations about current renewable energy topics and solutions. Participants of the Expo where challenged to explore renewable energy projects in the transportation sector and its current renewable technologies.

The Energy Conference also hosted panels throughout the day to update the audience on their company's progress for a better, more resilient transportation system. The renewable energy panel titled "Renewable and Alternative Energy Projects: Challenges and Lessons Learned" addressed perspectives related to Federal and State renewable targets and legislation as well as alternative financing mechanisms for renewable power development and lessons learned from existing renewable installations. The five person panel included Representative John Keenan, Eric Friedman, Director of MA Lead by Example Programs, Oliver Hongyan, DOT Renewable Energy Specialist, Teresa Civic, Massport, Utilities Manager, and Katie Servis, MassDot Aeronautics Division, Aviation Planner. The session highlighted MassDOT's current renewable, green and alternative energy projects. Massport specifically referenced its development of approximately one (1) Megawatt of new renewable installations across its properties and conveyed several lessons learned from early system design, maintenance and operations.

FUN FACTS ABOUT SUSTAINABILITY

Water

- A hot water faucet that leaks one drop per second can add up to 165 gallons a month. That's more than one person use in two weeks.
- An energy-smart clothes washer can save more water in one year than one person drinks in an entire lifetime.
- An automatic dishwasher uses less hot water than doing dishes by hand - an average of six gallons less, or more than 2,000 gallons per year.
- An American family of four uses up to 260 gallons of water in the home per day.
- Running tap water for two minutes is equal to 3-5 gallons of water.
- A 5-minute shower is equal to 20-35 gallons of water.
- A full bath is equal to approximately 60 gallons of water.

Questions about Environmental/Safety Issues

Who should you contact?

Contact	Phone Number	Email Address
Auditing/General EMS/Sustainability		
Brenda Enos	(617) 568-5963	benos@massport.com
Recycling/Universal Waste		
Glenn Adams	(617) 568-3542	gadams@massport.com
Safety		
Brian Dinneen	(617) 568-7427	bdinneen@massport.com
Michael McAveeney	(617) 561-3390	mmcaveeney@massport.com
Karisa Morin	(617) 568-7434	kmorin@massport.com
Spill Follow-Up		
James Stolecki	(617) 568-3552	jstolecki@massport.com
NPDES Permitting		
Rosanne Joyce	(617) 568-3516	rjoyce@massport.com
Underground/Aboveground Storage Tanks		
Erik Bankey	(617) 568-3514	ebankey@massport.com
Air Quality/Hazardous Waste		
Ian Campbell	(617) 568-3508	icampbell@massport.com

Capital Programs and Environmental Affairs

ENVIRONEWS

A Massport Newsletter

Volume 40, Issue 3
October 2014

INSIDE THIS ISSUE:

EnviroNews is a newsletter published quarterly for Massport and its tenants. Your comments and suggestions are welcome. Please contact Brenda Enos (benos@massport.com) at 617-568-5963.

Elementary School Art Contest

Massport's Capital Programs and Environmental Affairs partnered with the Community Relations department to engage 5th graders to challenge themselves in a recycling art contest. The art contest involved Elementary schools from East Boston, South Boston, and Winthrop.

Massport received 21 astonishing images. After reviewing the submittals, four images were chosen as winners. These images exemplify what the students envision when they think about "Recycling", how the future will look if everyone recycled more often and how the earth will benefit from recycling. The winning schools had their images wrapped on a pre-security recycling barrel at each terminal at Logan. Make sure to check them out, take a picture and share it with friends.

Conley Terminal Goes Green With Cleaning Products

After attending a seminar on Executive Order 515, Massport's Maritime department had a goal to switch to environmentally preferable cleaning products, and eliminate the use of harsh chemical cleaners.

The AccuDose system provides benefits in three main ways:

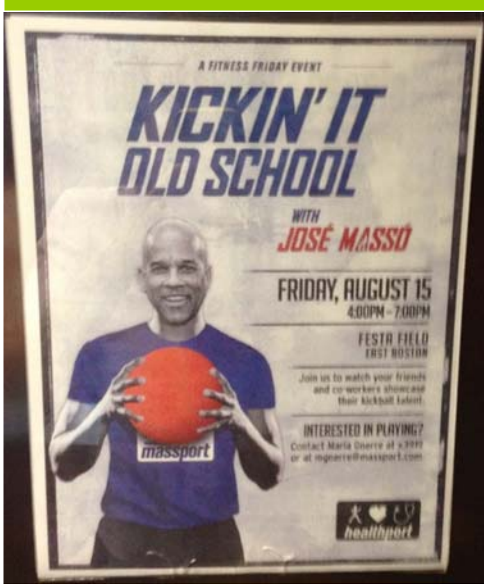
1. Eliminated the need for 13 different cleaning products and only 5 are required now.

2. The system prevents employees from over-dosing by pre-measuring the amount of chemical needed at the push of a button.

3. Minimized the addition to solid waste stream by eliminating unnecessary bottles. The existing bottles are constantly reused.

This switch has helped to conserve natural resources, reduce waste, safeguard the environment and promote the use of clean technologies.

What do People have to do with Sustainability?



People are the keystone to sustainability at Massport; the success of sustainability efforts at Massport depends on the cooperation and active involvement of the Airport's passengers, employees, tenants, and community organizations. The following examples illustrate just a few ways of how Massport supports the sustainability of its people.

Employees

Massport knows that a dynamic workforce and employee morale are critical to delivering high levels of service. This goes beyond standard benefits, inclusiveness, and training incentives to include the physical health and wellness of individual employees.

As an example, Massport offered Fitbit activity trackers to all employees who participated in an organized walking program. In addition, its "On the Move" program, in partnership with the YMCA of East Boston, includes regularly scheduled on-site fitness classes like yoga, kickboxing, and meditation that take place at the Logan Office Center. Offering these types of programs is just another way Massport strives to enhance employee satisfaction and wellness, which contributes to the overall sustainability of Massport as an organization.

Passengers

Logan is dedicated to providing a superior travel experience that welcomes visitors and provides a convenient and smooth passage for travelers. Some of the notable amenities provided to Logan Airport's visitors include multilingual signs, free Wi-Fi and charging stations, children's play spaces, a chapel, and even several pet relief areas!

One of the latest improvements to the passenger experience at Logan Airport was the renovation of the food court in Terminal E. Beyond upgrades to the shops, eateries, and general amenities, the new area includes the addition of several "Living Walls," which are five-foot-tall sections of wall holding potted plants. The plants symbolize the life that travels through Logan's spaces, and help to purify the air, remove toxins from the environment, and provide sound insulation. The purpose is to provide a calm, healthy, and supportive experience for travelers.

Fire Prevention Week 2014

Did You Know? Here's How Long it Takes for Certain Products to Decompose

- Banana Peel: 3-4 weeks
- Paper Bag: 1 month
- Cardboard: 2 months
- Wool Sock: 1 year
- Tinned Steel Can: 50 years
- Aluminum Can: 200-500 years (But if recycled, it can be reused within 6 weeks!)
- Disposable Diapers: 550 years
- Plastic Bags : 20-1,000 years
- Plastic Jug: 1 million years
- Glass: 1-2 million years
- Styrofoam: 1+ million years

Fire Prevention Week was October 5-11, 2014. It was established to commemorate the Great Chicago Fire in 1871 that killed more than 250 people, left 100,000 homeless, destroyed more than 17,400 structures and burned more than 2,000 acres. The theme of this year's week was, "Smoke Alarms Save Lives: Test Yours Every Month!"

When was the last time you tested the smoke alarms in your home? If you're like many people, you may not even remember. Smoke alarms have become such a common feature of U.S. households that they're often taken for granted. Many smoke detectors aren't tested and maintained as they should.

Working smoke alarms are a critical fire safety tool that can mean the difference between life and death in a home fire. According to the nonprofit National Fire Protection Association (NFPA), smoke alarms can cut the chance of dying in a home fire in half. Meanwhile, NFPA data shows that home fires killed more than 2,300 people in 2012; many of these deaths could have been prevented with the proper smoke alarm protection.

There are many devastating effects of fire; burns, the loss of homes, loss of possessions or worse. It is important that you make sure there are working smoke alarms installed throughout your home. These simple steps can help make a life-saving difference, and prevent the potentially life-threatening impact of fire.

Here are some smoke alarm tips:

- Install smoke alarms in every bedroom, outside each separate sleeping area and on every level of the home, including the basement.
- Interconnect all smoke alarms throughout the home. When one sounds, they all sound.
- Test alarms each month by pushing the test button.
- Replace all smoke alarms, including alarms that use 10-year batteries and hard-wired alarms, when they are 10 year old (or sooner if they do not respond properly).
- Make sure everyone in the home knows the sound and understands what to do when they hear the smoke alarm.

To learn more about the "Working Smoke Alarms Save Lives: Test Yours Every Month!" campaign; visit NFPA's Web site at www.firepreventionweek.org.

Fire Prevention and Cooking

…at Home

U.S. Fire Departments responded to an estimated annual average of 156,600 cooking-related fires between 2007-2011, resulting in 400 civilian deaths, 5,080 civilian injuries and $853 million in direct damage. It is important that you never leave cooking food unattended. Keep loose clothing away from the heat source. Be careful when opening microwaves. Although they don't often cause fires, they are a significant source of scalding burns.

…In Restaurants

In 2012, there were 381 building fires in restaurants and other eating and drinking establishments that caused three civilian and three firefighter injuries and $2.6 million in property damage. Proper maintenance of commercial cooking equipment and extinguishing systems is critical in preventing devastating fires.

<u>Commercial Cooking Operations Requirements for Exhaust Hood Inspections</u>

Commercial cooking exhaust hoods require frequent cleaning and inspection. Grease can build up on the surface of the exhaust hood or in the duct system. Cleaning eliminates that grease and removes the fire hazard.

Dirty Hood

Clean Hood

<u>Fire Suppression Systems for Commercial Cooking Operations</u>
Fixed Extinguishing Systems 527 CMR 11.00, NFPA 96 states that cooking that produces grease-laden vapors are required to have a fixed extinguishing system. These systems are required to be inspected periodically by a licensed company.

Commercial Fire Suppression System

If you have any questions about fire prevention, required fire safety equipment or inspections please contact Assistant Fire Chief Gerald "Jay" Drumm of the Massport Fire Rescue Department at 617-561-3415 or at GDrumm@massport.com.

Questions about Environmental/Safety Issues

Who should you contact?

Contact	Phone Number	Email Address
Auditing/General		
Brenda Enos	(617) 568-5963	benos@massport.com
Recycling/Universal Waste		
Glenn Adams	(617) 568-3542	gadams@massport.com
Safety		
Brian Dinneen	(617) 568-7427	bdinneen@massport.com
Michael McAveeney	(617) 561-3390	mmcaveeney@massport.com
Karisa Morin	(617) 568-7434	kmorin@massport.com
Spill Follow-Up		
James Stolecki	(617) 568-3552	jstolecki@massport.com
NPDES Permitting		
Rosanne Joyce	(617) 568-3516	rjoyce@massport.com
Underground/Aboveground Storage Tanks		
Erik Bankey	(617) 568-3514	ebankey@massport.com
Air Quality/Hazardous Waste		
Ian Campbell	(617) 568-3508	icampbell@massport.com
EMS/Sustainability		
Jacob Glickel	(617) 568-3558	jglickel@massport.com

This Page Intentionally Left Blank.

K

2014 Peak Period Pricing Monitoring Report

This Page Intentionally Left Blank

BOSTON-LOGAN INTERNATIONAL AIRPORT MONITORING REPORT ON SCHEDULED AND NON-SCHEDULED FLIGHT ACTIVITY

Peak Period Surcharge Regulation 740 CMR 27:00: Massachusetts Port Authority

Report Number:	**011**
Monitoring Period:	**Through Sept. 2014**
Report Issue Date:	**June 2014**

Note: This report reflects the Boston-Logan Airport flight activity monitoring under 740 CMR 27.03 Peak Period Surcharge Regulation on Aircraft Operations at Boston-Logan International Airport.

Findings: This report includes actual and projected activity data **through September 2014**. Current and projected near-term flight levels at Boston Logan are well below Logan's good weather (VFR) throughput of approximately 120 flights per hour. **As a result, average VFR delays are projected to be minimal and well below the 15 minutes threshold through September 2014.**

In the event demand conditions at the airport change significantly from the current projection, Massport will issue updates to this report.

Attachments

Table 1: Summary Overview of Peak Period Surcharge Program

Table 2: Summary Overview of Forecast Methodology

Table 3: Projected Aircraft Operations at Logan Airport Projected

Table 4: Projected Hourly Operations, Average Weekday

Table 5: Forecast Logan Average Weekday Operations

Massport Contact:

Mr. Flavio Leo
Deputy Director, Aviation Planning and Strategy
617-568-3528
fleo@massport.com

Table 1: Summary Overview of Peak Period Surcharge Program

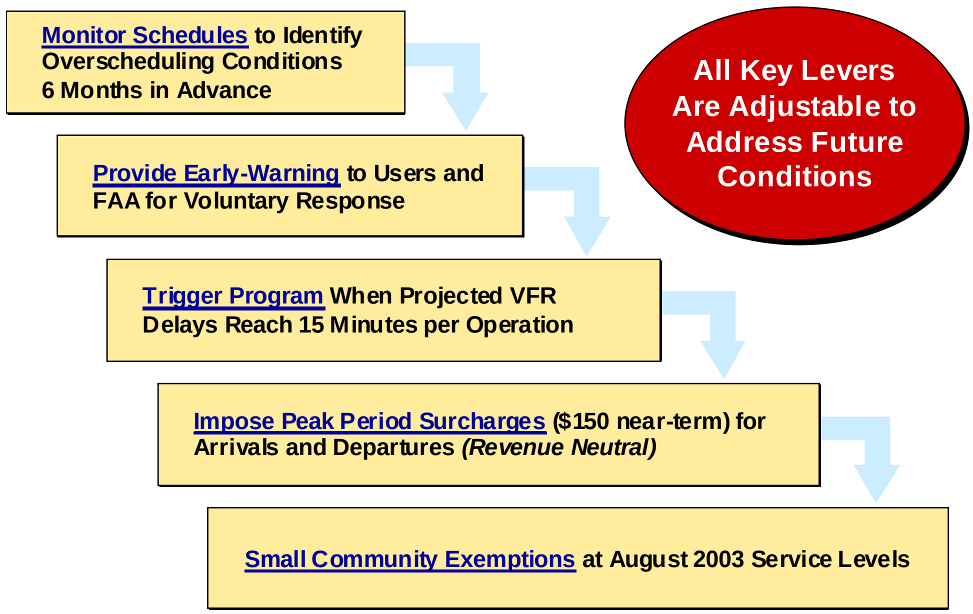
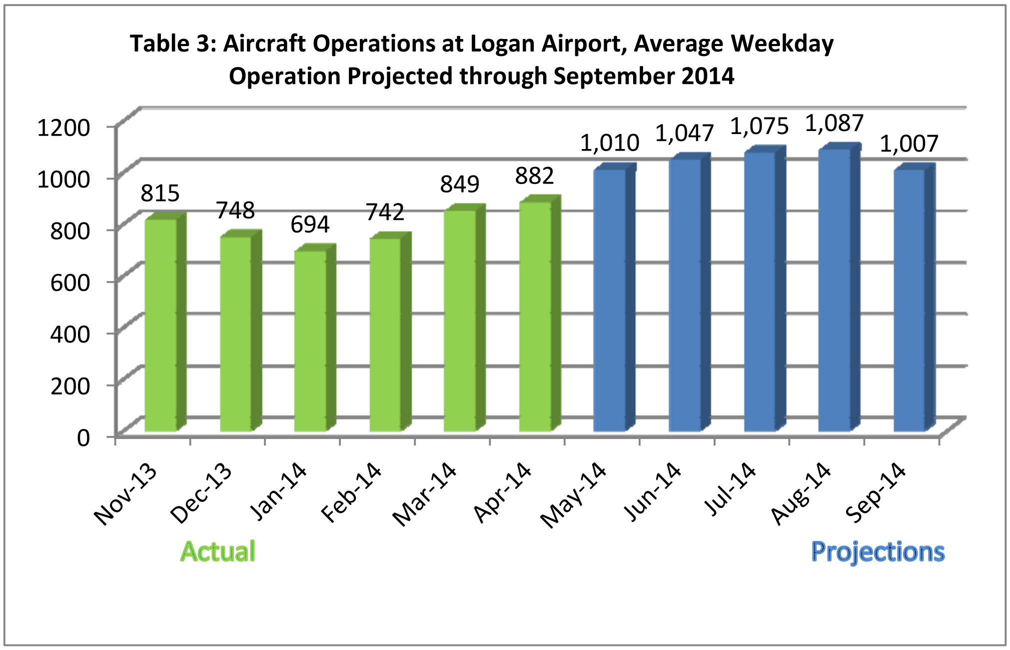


Table 2: Summary Overview of Forecast Methodology

- Scheduled passenger airline flights represent more than 93 percent of total aircraft operations. Passenger airline activity for the Spring and Summer periods were projected based on published advance airline schedules
- Forecasts of monthly activity for other segments (GA, Cargo, Charter) are based on the past three months of actual flight volume and historic patterns of monthly seasonality
- Day-of-week and time of day distributions for non-scheduled segments are based on analysis of Logan radar data
- Projections for each segment were combined to produce the forecast pattern of hourly flight activity for an average weekday, Saturday, and Sunday for the period from February through September

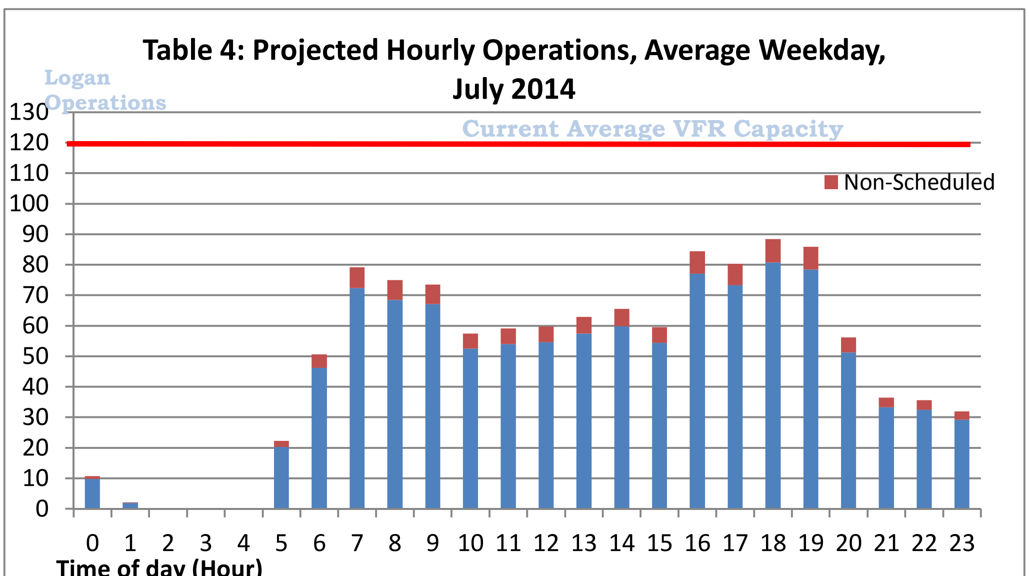
Table 3: Aircraft Operations at Logan Airport, *Average Weekday Operations Projected Through September*



Actual	Projections

Note: Actual Operations are based on Massport data/air carrier reports and reflect flight cancellations due to weather and other operational impacts.

Table 4: Projected Hourly Operations, *Average Weekday, August*



Note: Includes projected services by scheduled airlines plus non-scheduled activity including GA, charters etc.

Table 5: Forecast Logan Average Weekday Operations, *Feb. – Sep.*

Forecast Daily Operations								
Hour Range	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14
0	9	12	13	10	9	10	8	6
1	2	2	3	2	3	2	2	1
2	1	0	1	0	1	0	0	0
3	0	0	0	0	0	0	0	0
4	1	2	1	0	0	0	0	0
5	8	9	11	15	18	20	18	12
6	35	42	45	47	48	46	46	47
7	45	53	56	67	72	72	74	68
8	46	49	55	65	66	68	68	63
9	48	53	53	60	64	67	69	59
10	43	49	49	48	49	52	51	47
11	40	44	47	55	56	54	57	58
12	32	38	43	59	55	55	57	56
13	33	41	46	48	53	57	57	54
14	36	46	44	56	57	60	61	55
15	40	50	49	51	54	54	59	60
16	46	54	54	70	75	77	76	66
17	49	56	56	76	69	73	77	80
18	52	56	57	81	84	81	81	76
19	50	57	58	64	71	78	77	66
20	46	47	49	47	50	51	53	46
21	35	37	38	34	33	33	36	35
22	25	28	29	31	32	32	34	30
23	20	24	24	24	29	29	27	22
Total	**742**	**849**	**882**	**1,010**	**1,047**	**1,075**	**1,087**	**1,007**

February - April are actual data

May - September is forecast data

This Page Intentionally Left Blank

L

Reduced/Single Engine Taxiing at Logan Airport Memorandum

This Appendix provides detailed information in support of *Chapter 7, Air Quality/ Emissions Reduction:*

- Memorandum from Edward C. Freni, Massport Director of Aviation, to the Boston Logan Airline Committee, Regarding Single/Reduced Engine Taxiing at Boston Logan, Dated May 8, 2014
- Memorandum from Edward C. Freni, Massport Director of Aviation, to the Boston Logan Airline Committee, Regarding Single/Reduced-Engine Taxiing and the Use of Idle Reverse Thrust as Strategies to Reduce Aircraft-Generated Emissions and Noise at Boston Logan, Dated May 4, 2015
- Simaiakis, I, Khadilkar, H., Balakrishnan, H., Reynolds, T.G., Hansman, R.J., Reilly, B., and Urlass, S. "Demonstration of Reduced Airport Congestion Through Pushback Rate Control." *Ninth USA/Europe Air Traffic Management Research and Development Seminar (ATM2011).*

This Page Intentionally Left Blank

massport
Massachusetts Port Authority
One Harborside Drive
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

To: Boston Logan Air Carriers, Chief Pilots

From: Edward C. Freni
Director of Aviation

Date: May 8, 2014

RE: Single/Reduced-Engine Taxiing and the Use of Idle Reverse Thrust as Strategies to Reduce Aircraft-Generated Emissions and Noise at Boston Logan

As an important user of Boston-Logan International Airport ("Boston Logan"), you are essential to our efforts to ensure that Boston Logan is the safest, most dependable and environmentally responsible airport it can be. Working together, we have successfully implemented safety technologies and new airside facilities at Boston Logan. Our partnership with the air carriers, the FAA, and aviation industry organizations continues with the full, successful implementation of ADSB transponder technology to enhance situational awareness of ground vehicle drivers on the airfield. As you know, ADSB is the FAA's surveillance backbone for NextGen and Boston Logan, with your support, has been one of the key test beds for the FAA. Under a joint partnership with the FAA Technical Center, we are also testing FOD detection technology on runway 9/27 using video and radar to automatically detect and alert for FOD. This array was installed last fall and is now fully operational.

Our success in implementing physical and technological improvements and conducting cutting-edge safety research at Boston Logan is based, in part, on continuing to evaluate and promote operational measures with the potential to reduce environmental impacts from various landside and airside operations. Two such important operational measures that have been identified are single/reduced- engine taxiing and the use of idle-reverse thrust.

I have written to you before to encourage your use of single-engine taxiing when operationally appropriate and consistent with your safety procedures. Based on our outreach to the air carrier community serving Boston Logan and survey information, it is clear that single- or reduced-engine taxiing is being voluntarily utilized by the vast majority of air carriers at Boston Logan. I write to you again to encourage continued use of this fuel saving and emissions reduction strategy subject to pilot discretion and consistent with air carrier operating safety procedures.

I also encourage your use of idle reverse thrust (or minimize the use of reverse thrust) on landing, as a second operational measure, again, only at the discretion of the pilot and when consistent with air carrier operational safety procedures. This measure would provide noise relief to our closest neighbors and, at the same time, provide companion benefits to you, such as reducing fuel burn and engine wear. Clearly, the use of this procedure must also be consistent with operational conditions at Boston Logan, including runway surface conditions, whether LAHSO is in use, and acceptable runway occupancy time.

I encourage you to share this letter with your flight crews and I thank you for the continued work with Massport on enhancing Boston Logan's operational safety and efficiency while improving its environmental footprint. If you have any questions or would like to discuss any aspect of this letter, please feel free to contact me or Mr. Flavio Leo, Deputy Director of Planning and Strategy, at 617-568-3528.

Edward C. Freni
Director of Aviation

Massachusetts Port Authority
One Harborside Drive
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

TO: Boston Logan Air Carriers, Chief Pilots

FROM: Edward C. Freni
Director of Aviation

DATE: May 4, 2015

RE: Single/Reduced-Engine Taxiing and the Use of Idle Reverse Thrust as Strategies to Reduce Aircraft-Generated Emissions and Noise at Boston Logan

As an important user of Boston-Logan International Airport ("Boston Logan"), you are an essential partner in our efforts to ensure that Boston Logan operates in the safest, most dependable and environmentally responsible manner possible. Working together, we have successfully implemented many safety technologies and airfield improvements at Boston Logan and we look forward to continuing these collaborative relationships.

Our success in implementing physical and technological improvements and conducting cutting-edge safety research at Boston Logan is based, in part, on continuing to evaluate and promote operational measures with the potential to reduce environmental impacts from various landside and airside operations. Two important operational measures that have been identified are single/reduced-engine taxiing and the use of idle-reverse thrust.

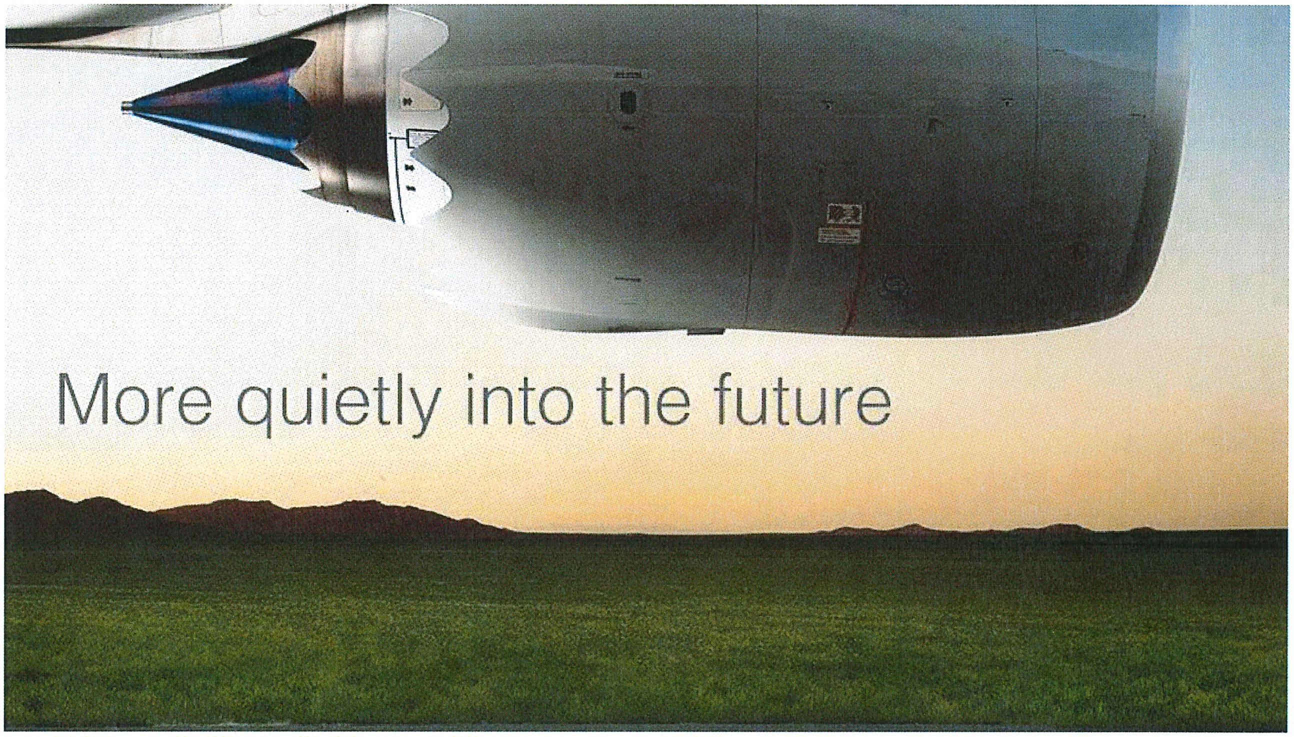
Based on our outreach to the air carrier community serving Boston Logan and survey information, it is clear that single- or reduced-engine taxiing is being voluntarily utilized by the vast majority of air carriers at Boston Logan. I write to you again to encourage your continued use of this fuel saving and emissions reduction strategy subject to pilot discretion and consistent with air carrier operating safety procedures.

I also encourage your use of idle reverse thrust (or minimize the use of reverse thrust) on landing, as a second operational measure, again, only at the discretion of the pilot and when consistent with air carrier operational safety procedures. This measure provides noise relief to our closest neighbors and, at the same time, provides companion benefits to you, such as reducing fuel burn and engine wear. Clearly, the use of this procedure must be consistent with operational conditions at Boston Logan, including runway surface conditions and whether LAHSO is in use.

On a related note, I want to share with you information regarding recent industry efforts to retrofit A320 aircraft with "vortex generators" to reduce aircraft noise. Although the A320 is a fully compliant/modern aircraft, this is an excellent example of additional, incremental actions we can take as an industry to reduce operational impacts on the environment. Attached please find more information related to this technology.

I encourage you to share this letter with your flight crews and thank you for your continued work to enhance Boston Logan's operational safety and efficiency, while improving its environmental footprint. If you have any questions or would like to discuss any aspect of this letter, please feel free to contact me or Mr. Flavio Leo, Deputy Director of Planning and Strategy, at 617-568-3528.

Edward C. Freni
Director of Aviation



Retrofitting the existing fleet

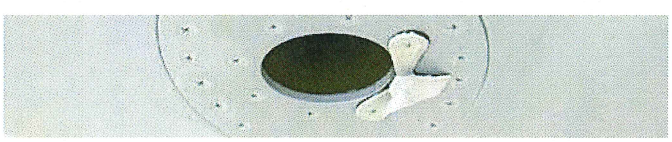
The Lufthansa Group is also retrofitting older aircraft in its fleet with noise-reducing technologies. In this connection the Group is working closely with the German Aerospace Center (DLR) and the various aircraft manufacturers.

Lufthansa is retrofitting more than 200 aircraft with vortex generators so that they will fly more quietly in the future.

In February 2014 Lufthansa became the first airline in the world to take delivery of an Airbus A320 equipped with vortex generators. A total of 157 aircraft in the existing fleet will be equipped with the new noise-reducing component, so that, when the expected new deliveries are added in, more than 200 A320 aircraft in total will be flying more quietly. As result, every second Lufthansa landing in Frankfurt and one in three in Munich will become audibly quieter. Overfly measurements revealed that the vortex generators are able to eliminate two unpleasant tones and thereby lower the aircraft's total noise level on approach by up to four decibels at distances between 17 and 10 kilometers from the runway. Thus the Lufthansa Group has realized a key objective of the "Alliance for More Noise Protection", a joint initiative of the Lufthansa Group, Fraport, the airline association BARIG, DFS, the Airport and Region Forum (FFR), and the government of the State of Hesse.

A320 audio tests

A320 audio tests with and without vortex generators on the **final approach at Frankfurt Airport** from the Offenbach-Lauterborn monitoring point



Further information

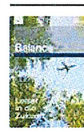
Refitting existing aircraft
→ Active noise protection – More than 200 Lufthansa Airbus A320 aircraft will become quieter from February 2014

Video: Active noise protection at Frankfurt Airport
→ Retrofitting of the Boeing 737 fleet

Press Releases

29.10.13
→ Lufthansa to make majority of short-haul aircraft quieter

Sustainability Report



To find out more about responsibility within the Lufthansa Group, read the latest sustainability report Balance (E-Paper).

Order or download the report.

Weitersagen

More Themes

→ Overview

Without vortex generators **With vortex generators**

A320 audio tests with and without vortex generators on the **final approach at Munich Airport** from the Massenhausen monitoring point

Without vortex generators **With vortex generators**

Demonstration of Reduced Airport Congestion Through Pushback Rate Control

I. Simaiakis, H. Khadilkar, H. Balakrishnan, T. G. Reynolds and R. J. Hansman
Department of Aeronautics and Astronautics
Massachusetts Institute of Technology
Cambridge, MA, USA

B. Reilly
Boston Airport Traffic Control Tower
Federal Aviation Administration
Boston, MA, USA

S. Urlass
Office of Environment and Energy
Federal Aviation Administration
Washington, DC, USA

***Abstract*—Airport surface congestion results in significant increases in taxi times, fuel burn and emissions at major airports. This paper describes the field tests of a congestion control strategy at Boston Logan International Airport. The approach determines a suggested rate to meter pushbacks from the gate, in order to prevent the airport surface from entering congested states and to reduce the time that flights spend with engines on while taxiing to the runway. The field trials demonstrated that significant benefits were achievable through such a strategy: during eight four-hour tests conducted during August and September 2010, fuel use was reduced by an estimated 12,000-15,000 kg (3,900-4,900 US gallons), while aircraft gate pushback times were increased by an average of only 4.3 minutes for the 247 flights that were held at the gate.**

Keywords- departure management, pushback rate control, airport congestion control, field tests

I. Introduction

Aircraft taxiing on the surface contribute significantly to the fuel burn and emissions at airports. The quantities of fuel burned, as well as different pollutants such as Carbon Dioxide, Hydrocarbons, Nitrogen Oxides, Sulfur Oxides and Particulate Matter, are proportional to the taxi times of aircraft, as well as other factors such as the throttle settings, number of engines that are powered, and pilot and airline decisions regarding engine shutdowns during delays.

Airport surface congestion at major airports in the United States is responsible for increased taxi-out times, fuel burn and emissions [1]. Similar trends have been noted in Europe, where it is estimated that aircraft spend 10-30% of their flight time taxiing, and that a short/medium range A320 expends as much as 5-10% of its fuel on the ground [2]. Domestic flights in the United States emit about 6 million metric tonnes of CO_2, 45,000 tonnes of CO, 8,000 tonnes of NOx, and 4,000 tonnes of HC taxiing out for takeoff; almost half of these emissions are at the 20 most congested airports in the country. The purpose of the Pushback Rate Control Demonstration at Boston Logan International Airport (BOS) was to show that a significant portion of these impacts could be reduced through measures to limit surface congestion.

This work was supported by the Federal Aviation Administration's Office of Environment and Energy through MIT Lincoln Laboratory and the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER).

A simple airport congestion control strategy would be a state-dependent pushback policy aimed at reducing congestion on the ground. The *N-control* strategy is one such approach, and was first considered in the Departure Planner project [3]. Several variants of this policy have been studied in prior literature [4, 5, 6, 7]. The policy, as studied in these papers, is effectively a simple threshold heuristic: if the total number of departing aircraft on the ground exceeds a certain threshold, further pushbacks are stopped until the number of aircraft on the ground drops below the threshold. By contrast, the *pushback rate control* strategy presented in this paper does not stop pushbacks once the surface is in a congested state; instead it regulates the rate at which aircraft pushback from their gates during high departure demand periods so that the airport does not reach undesirable highly congested states.

A. Motivation: Departure throughput analysis

The main motivation for our proposed approach to reduce taxi times is an observation of the performance of the departure throughput of airports. As more aircraft pushback from their gates onto the taxiway system, the throughput of the departure runway initially increases because more aircraft are available in the departure queue. However, as this number, denoted N, exceeds a threshold, the departure runway capacity becomes the limiting factor, and there is no additional increase in throughput. We denote this threshold as N^*. This behavior can be further parameterized by the number of arrivals. The dependence of the departure throughput on the number of aircraft taxiing out and the arrival rate is illustrated for one runway configuration in Figure 1 using 2007 data from FAA's Aviation System Performance Metrics (ASPM) database. Beyond the threshold N^*, any additional aircraft that pushback simply increase their taxi-out times [8]. The value of N^* depends on the airport, arrival demand, runway configuration, and meteorological conditions. During periods of high demand, the pushback rate control protocol regulates pushbacks from the gates so that the number of aircraft taxiing out stays close to a specified value, N_{ctrl}, where $N_{\mathrm{ctrl}} > N^*$, thereby ensuring that the airport does not reach highly-congested states. While the choice of N_{ctrl} must be large enough to maintain runway utilization, too large a value will be overly conservative, and result in a loss of benefit from the control strategy.

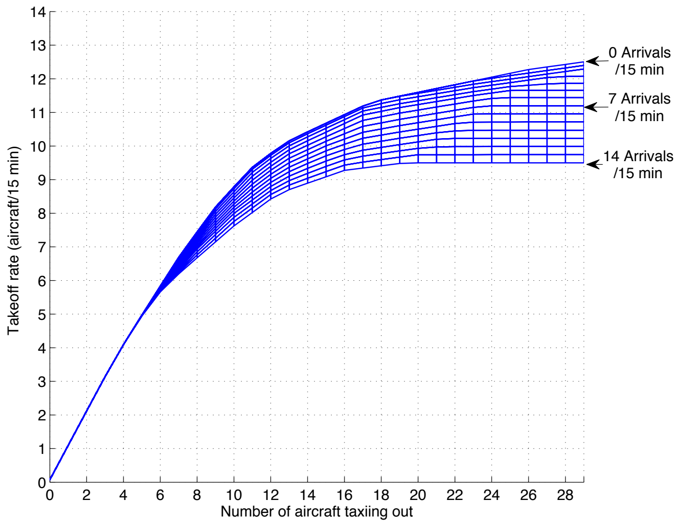


Fig. 1: Regression of the departure throughput as a function of the number of aircraft taxiing out, parameterized by the arrival rate for 22L, 27 | 22L, 22R configuration, under VMC [9].

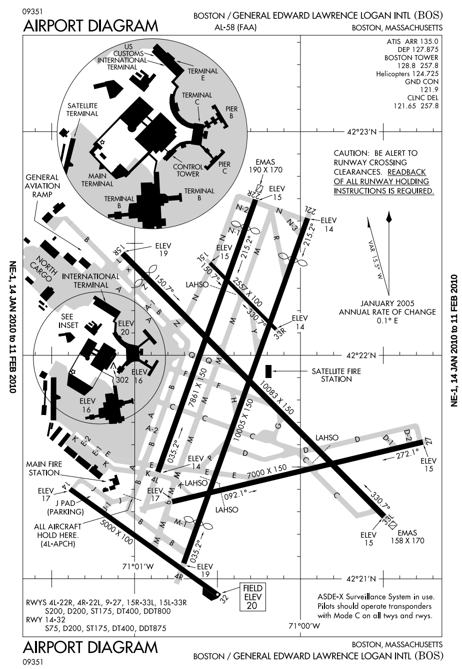


Fig. 2: BOS airport diagram, showing alignment of runways.

II. Design of the pushback rate control protocol

The main design consideration in developing the pushback rate control protocol was to incorporate effective control techniques into current operational procedures with minimal additional controller workload and procedural modifications. After discussions with the BOS facility, it was decided that suggesting a rate of pushbacks (to the BOS Gate controller) for each 15-min period was an effective strategy that was amenable to current procedures.

The two important parameters that need to be estimated in order to determine a robust control strategy are the N^* threshold and the departure throughput of the airport for different values of N. These parameters can potentially vary depending on meteorological conditions, runway configuration and arrival demand (as seen in Figure 1), but also on the fleet mix and the data sources we use.

A. Runway configurations

BOS experiences Visual Meteorological Conditions (VMC) most of the time (over 83% of the time in 2007). It has a complicated runway layout consisting of six runways, five of which intersect with at least one other runway, as shown in Figure 2. As a result, there are numerous possible runway configurations: in 2007, 61 different configurations were reported. The most frequently-used configurations under VMC are 22L, 27 | 22L, 22R; 4L, 4R | 4L, 4R, 9; and 27, 32 | 33L, where the notation 'R1, R2 | R3, R4' denotes arrivals on runways R1 and R2, and departures on R3 and R4. The above configurations accounted for about 70% of times under VMC.

We note that, of these frequently used configurations, 27, 32 | 33L involves taxiing out aircraft across active runways. Due to construction on taxiway "November" between runways 15L and 22R throughout the duration of the demo, departures headed to 22R used 15L to cross runway 22R onto taxiway "Mike". This resulted in departing aircraft crossing active runways in the 27, 22L | 22L, 22R configuration as well.

During our observations prior to the field tests as well as during the demo periods, we found that under Instrument Meteorological Conditions (IMC), arrivals into BOS are typically metered at the rate of 8 aircraft per 15 minutes by the TRACON. This results in a rather small departure demand, and there was rarely congestion under IMC at Boston during the evening departure push. For this reason, we focus on configurations most frequently used during VMC operations for the control policy design.

B. Fleet mix

Qualitative observations at BOS suggest that the departure throughput is significantly affected by the number of propeller-powered aircraft (props) in the departure fleet mix. In order to determine the effect of props, we analyze the tradeoff between takeoff and landing rates at BOS, parameterized by the number of props during periods of high departure demand.

Figure 3 shows that under Visual Meteorological Conditions (VMC), the number of props has a significant impact on the departure throughput, resulting in an increase at a rate of nearly one per 15 minutes for each additional prop departure. This observation is consistent with procedures at BOS, since air traffic controllers fan out props in between jet departures, and therefore the departure of a prop does not significantly interfere with jet departures. The main implication of this observation for the control strategy design at BOS was that props could be exempt from both the pushback control as well as the counts of aircraft taxiing out (N). Similar analysis also shows that heavy departures at BOS do not have a significant

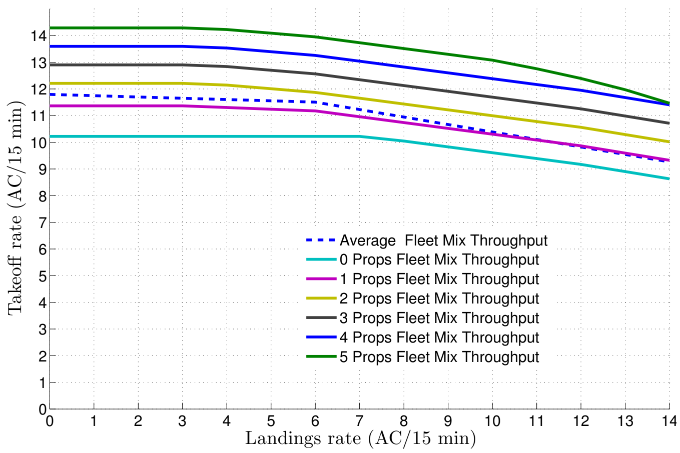


Fig. 3: Regression of the takeoff rate as a function of the landing rate, parameterized by the number of props in a 15-minute interval for 22L, 27 | 22L, 22R configuration, under VMC [9].

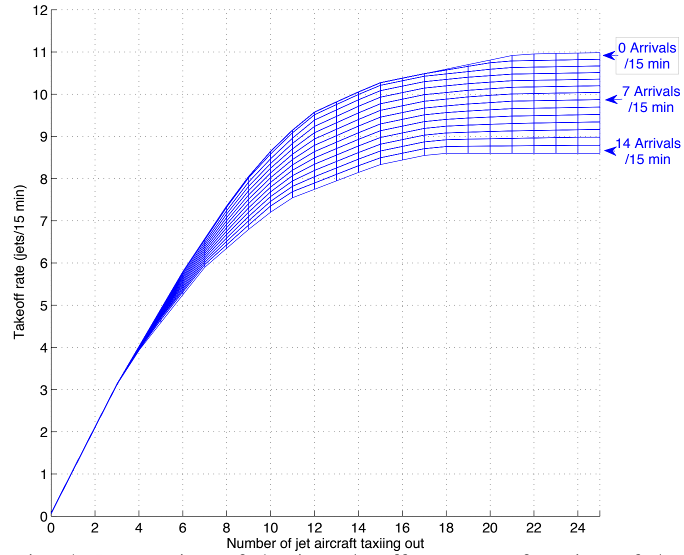


Fig. 4: Regression of the jet takeoff rate as a function of the number of departing jets on the ground, parameterized by the number of arrivals for 22L, 27 | 22L, 22R configuration, under VMC [9].

impact on departure throughput, in spite of the increased wake-vortex separation that is required behind heavy weight category aircraft. This can be explained by the observation that air traffic controllers at BOS use the high wake vortex separation requirement between a heavy and a subsequent departure to conduct runway crossings, thereby mitigating the adverse impact of heavy weight category departures [9].

Motivated by this finding, we can determine the dependence of the jet (i.e., non-prop) departure throughput as a function of the number of jet aircraft taxiing out, parameterized by the number of arrivals, as illustrated in Figure 4. This figure illustrates that during periods in which arrival demand is high, the jet departure throughput saturates when the number of jets taxiing out exceeds 17 (based on ASPM data).

C. Data sources

It is important to note that Figure 1, Figure 3 and Figure 4 are determined using ASPM data. Pushback times in ASPM are determined from the brake release times reported through the ACARS system, and are prone to error because about 40% of the flights departing from BOS do not automatically report these times [10]. Another potential source of pushback and takeoff times is the Airport Surface Detection Equipment Model X (or ASDE-X) system, which combines data from airport surface radars, multilateration sensors, ADS-B, and aircraft transponders [11]. While the ASDE-X data is likely to be more accurate than the ASPM data, it is still noisy, due to factors such as late transponder capture (the ASDE-X tracks only begin after the pilot has turned on the transponder, which may be before or after the actual pushback time), aborted takeoffs (which have multiple departure times detected), flights cancelled after pushback, etc. A comparison of both ASDE-X and ASPM records with live observations made in the tower on August 26, 2010 revealed that the average difference between the number of pushbacks per 15-minutes as recorded by ASDE-X and by visual means is 0.42, while it is -3.25 for ASPM and visual observations, showing that the ASPM records differ considerably from ASDE-X and live observations. The above comparison motivates the recalibration of airport performance curves and parameters using ASDE-X data in addition to ASPM data. This is because ASPM data is not available in real-time and will therefore not be available for use in real-time deployments, and the ASDE-X data is in much closer agreement to the visual observations than ASPM.

We therefore conduct similar analysis to that shown in Figure 4, using ASDE-X data. The results are shown in Figure 5. We note that the qualitative behavior of the system is similar to what was seen with ASPM data, namely, the jet throughput of the departure runway initially increases because more jet aircraft are available in the departure queue, but as this number exceeds a threshold, the departure runway capacity becomes the limiting factor, and there is no additional increase in throughput. By statistically analyzing three months of ASDE-X data from Boston Logan airport using the methodology outlined in [9], we determine that the average number of active jet departures on the ground at which the surface saturates is 12 jet aircraft for the 22L, 27 | 22L, 22R configuration, during periods of moderate arrival demand. This value is close to that deduced from Figure 5, using visual means.

D. Estimates of N^*

Table I shows the values of N^* for the three main runway configurations under VMC, that were used during the field tests based on the ASDE-X data analysis. For each runway configuration, we use plots similar to Figure 5 to determine the expected throughput. For example, if the runway configuration is 22L, 27 | 22L, 22R, 11 jets are taxiing out, and the expected arrival rate is 9 aircraft in the next 15 minutes, the expected departure throughput is 10 aircraft in the next 15 minutes.

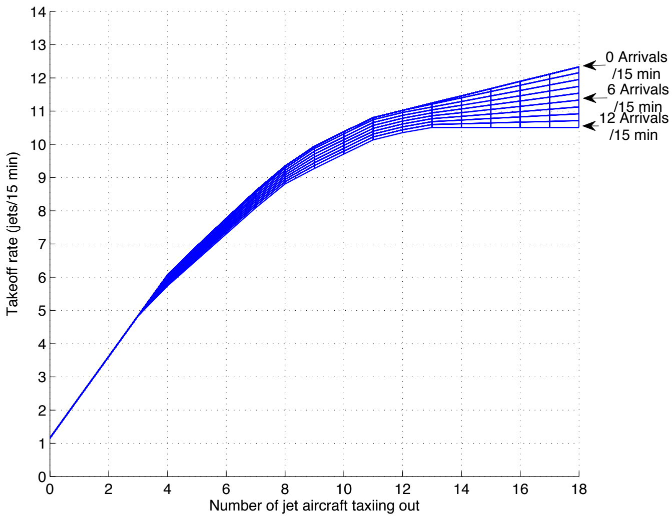


Fig. 5: Regression of the takeoff rate as a function of the number of jets taxiing out, parameterized by the number of arrivals, using ASDE-X data, for the 22L, 27 | 22L, 22R configuration.

III. Implementation of Pushback Rate Control

The pushback rate was determined so as to keep the number of jets taxiing out near a suitable value (N_{ctrl}), where N_{ctrl} is greater than N^*, in order to mitigate risks such as under-utilizing the runway, facing many gate conflicts, or being unable to meet target departure times. Off-nominal events such as gate-use conflicts and target departure times were carefully monitored and addressed. Figure 6 shows a schematic of the decision process to determine the suggested pushback rate.

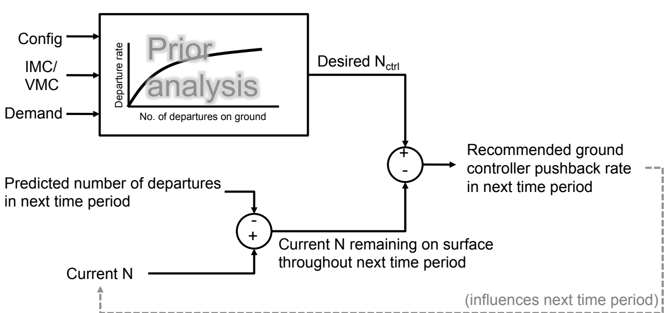


Fig. 6: A schematic of the pushback rate calculation.

The determination of the pushback rate is conducted as follows. Prior to the start of each 15-minute period, we:

1) Observe the operating configuration, VMC/IMC, and the predicted number of arrivals in the next 15 minutes (from ETMS) and using these as inputs into the appropriate departure throughput saturation curves (such as Figure 5), determine the expected jet departure throughput.
2) Using visual observations, count the number of departing jets currently active on the surface. We counted a departure as active once the pushback tug was attached to the aircraft and it was in the process of pushing back.
3) Calculate the difference between the current number of active jet departures and the expected jet departure throughput. This difference is the number of currently active jets that are expected to remain on the ground through the next 15 min.
4) The difference between N_{ctrl} and the result of the previous step provides us with the additional number of pushbacks to recommend in next 15 minutes.
5) Translate the suggested number of pushbacks in the next 15 minutes to an approximate pushback rate in a shorter time interval more appropriate for operational implementation (for example, 10 aircraft in the next 15 minutes would translate to a rate of "2 per 3 minutes.").

TABLE I
Values of N^* estimated from the analysis of ASDE-X data.

Configuration	N^*
22L, 27 | 22L, 22R	12
27, 32 | 33L	12
4L, 4R | 4L, 4R, 9	15

A. Communication of recommended pushback rates and gate-hold times

During the demo, we used color-coded cards to communicate suggested pushback rates to the air traffic controllers, thereby eliminating the need for verbal communications. We used one of eight 5 in × 7.5 in cards, with pushback rate suggestions that ranged from "1 per 3 minutes" (5 in 15 minutes) to "1 aircraft per minute" (15 in 15 minutes), in addition to "Stop" (zero rate) and "No restriction" cards, as shown in Figure 7 (left). The setup of the suggested rate card in the Boston Gate controllers position is shown in Figure 7 (right).

Fig. 7: (Left) Color-coded cards that were used to communicate the suggested pushback rates. (Right) Display of the color-coded card in the Boston Gate controller's position.

The standard format of the gate-hold instruction communicated by the Boston Gate controller to the pilots included both the current time, the length of the gate-hold, and the time at which the pilot could expect to be cleared. For example:
Boston Gate: "AAL123, please hold push for 3 min. Time is now 2332, expect clearance at 2335. Remain on my frequency, I will contact you."

In this manner, pilots were made aware of the expected gate-holds, and could inform the controller of constraints such as gate conflicts due to incoming aircraft. In addition, ground crews could be informed of the expected gate-hold time, so that they could be ready when push clearance was given. The post-analysis of the tapes of controller-pilot communications showed that the controllers cleared aircraft for push at the times they had initially stated (i.e., an aircraft told to expect to push at 2335 would indeed be cleared to push at 2335), and that they also accurately implemented the push rates suggested by the cards.

B. Handling of off-nominal events

The implementation plan also called for careful monitoring of off-nominal events and system constraints. Of particular concern were gate conflicts (for example, an arriving aircraft is assigned a gate at which a departure is being held), and the ability to meet controlled departure times (Expected Departure Clearance Times or EDCTs) and other constraints from Traffic Management Initiatives. After discussions with the Tower and airlines prior to the field tests, the following decisions were made:

1) Flights with EDCTs would be handled as usual and released First-Come-First-Served. Long delays would continue to be absorbed in the standard holding areas. Flights with EDCTs did not count toward the count of active jets when they pushed back; they counted toward the 15-minute interval in which their departure time fell. An analysis of EDCTs from flight strips showed that the ability to meet the EDCTs was not impacted during the field tests.
2) Pushbacks would be expedited to allow arrivals to use the gate if needed. Simulations conducted prior to the field tests predicted that gate-conflicts would be relatively infrequent at BOS; there were only two reported cases of potential gate-conflicts during the field tests, and in both cases, the departures were immediately released from the gate-hold and allowed to pushback.

C. Determination of the time period for the field trials

The pushback rate control protocol was tested in select evening departure push periods (4-8PM) at BOS between August 23 and September 24, 2010. Figure 8 shows the average number of departures on the ground in each 15-minute interval using ASPM data. There are two main departure pushes each day. The evening departure push differs from the morning one because of the larger arrival demand in the evenings. The morning departure push presents different challenges, such as a large number of flights with controlled departure times, and a large number of tow-ins for the first flights of the day.

IV. Results of field tests

Although the pushback rate control strategy was tested at BOS during 16 demo periods, there was very little need to control pushbacks when the airport operated in its most

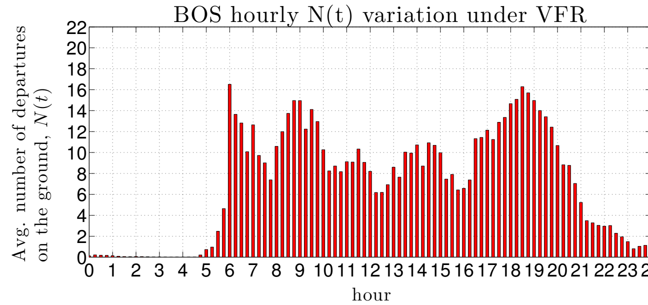


Fig. 8: Variation of departure demand (average number of active departures on the ground) as a function of the time of day.

efficient configuration (4L, 4R | 4L, 4R, 9), and in only eight of the demo periods was there enough congestion for gate-holds to be experienced. There was insufficient congestion for recommending restricted pushback rates on August 23, September 16, 19, 23, and 24. In addition, on September 3 and 12, there were no gate-holds (although departure demand was high, traffic did not build up, and no aircraft needed to be held at the gate). For the same reason, only one aircraft received a gate-hold of 2 min on September 17. The airport operated in the 4L, 4R | 4L, 4R, 9 configuration on all three of these days. In total, pushback rate control was in effect during the field tests for over 37 hours, with about 24 hours of test periods with significant gate-holds.

A. Data analysis examples

In this section, we examine three days with significant gate-holds (August 26, September 2 and 10) in order to describe the basic features of the pushback rate control strategy.

Figure 9 shows taxi-out times from one of the test periods, September 2. Each green bar in Figure 9 represents the actual taxi-out time of a flight (measured using ASDE-X as the duration between the time when the transponder was turned on and the wheels-off time). The red bar represents the gate-hold time of the flight (shown as a negative number). In practice, there is a delay between the time the tug pushes them from the gate and the time their transponder is turned on, but statistical analysis showed that this delay was random, similarly distributed for flights with and without gate-holds, and typically about 4 minutes. We note in Figure 9 that as flights start incurring gate-holds (corresponding to flights departing at around 1900 hours), there is a corresponding decrease in the active taxi-out times, i.e., the green lines. Visually, we notice that as the length of the gate-hold (red bar) increases, the length of the taxi-out time (green bar) proportionately decreases. There are still a few flights with large taxi-out times, but these typically correspond to flights with EDCTs. These delays were handled as in normal operations (i.e., their gate-hold times were not increased), as was agreed with the tower and airlines. Finally, there are also a few flights with no gate-holds and very short taxi-out times, typically corresponding to props.

The impact of the pushback rate control strategy can be further visualized by using ASDE-X data, as can be seen in

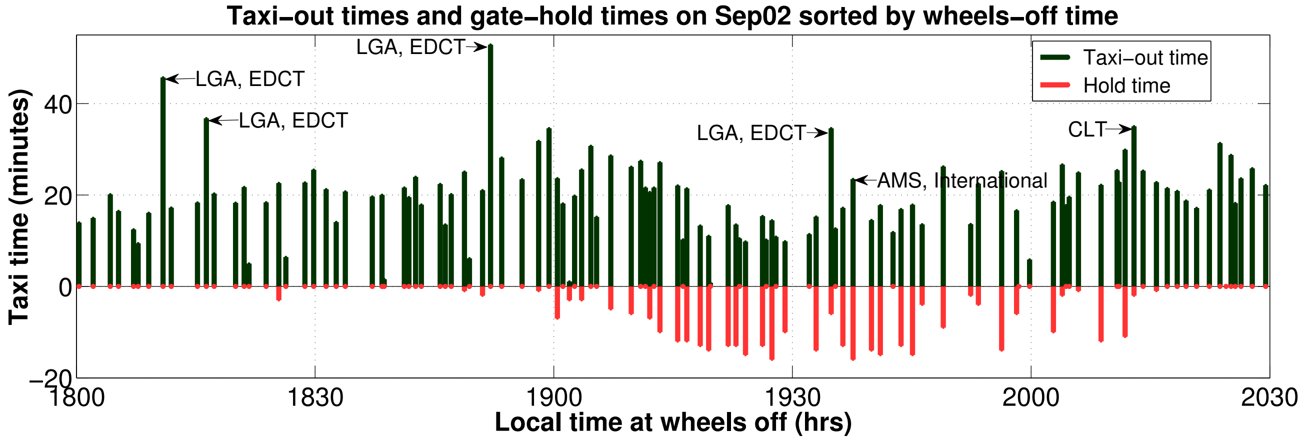


Fig. 9: Taxi-out and gate-hold times from the field test on September 2, 2010.

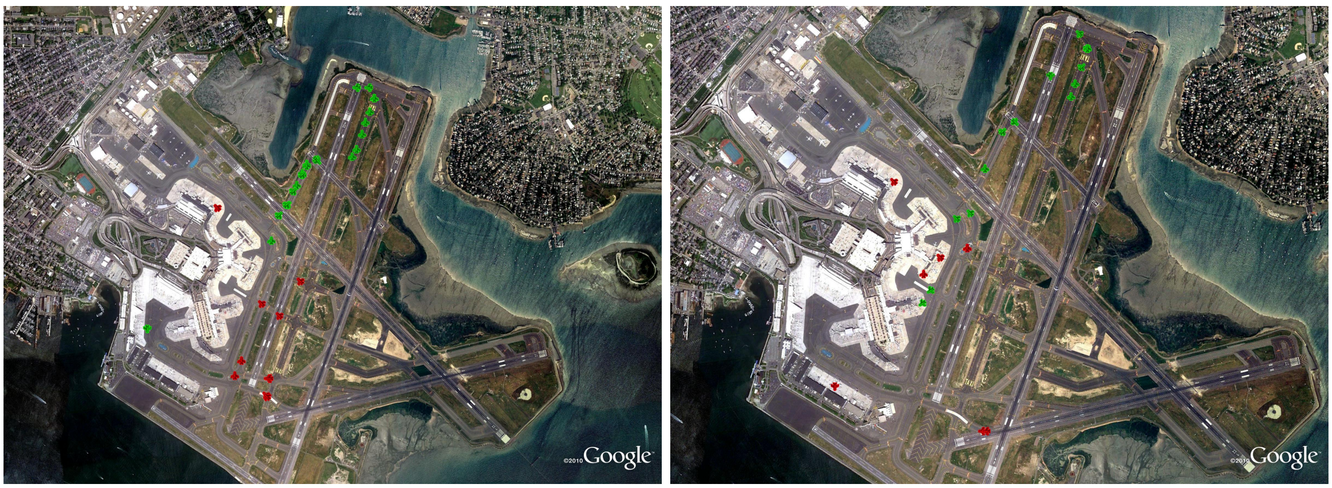


Fig. 10: Snapshots of the airport surface, (left) before gate-holds started, and (right) during gate-holding. Departing aircraft are shown in green, and arrivals in red. We note that the line of 15 departures between the ramp area and the departure runway prior to commencement of pushback rate control reduces to 8 departures with gate-holds. The white area on the taxiway near the top of the images indicates the closed portion of taxiway "November".

the Figure 10, which shows snapshots of the airport surface at two instants of time, the first before the gate-holds started, and the second during the gate-holds. We notice the significant decrease in taxiway congestion, in particular the long line of aircraft between the ramp area and the departure runway, due to the activation of the pushback rate control strategy.

Looking at another day of trials with a different runway configuration, Figure 11 shows taxi-out times from the test period of September 10. In this plot, the flights are sorted by pushback time. We note that as flights start incurring gate-holds, their taxi time stabilizes at around 20 minutes. This is especially evident during the primary departure push between 1830 and 1930 hours. The gate-hold times fluctuate from 1-2 minutes up to 9 minutes, but the taxi-times stabilize as the number of aircraft on the ground stabilizes to the specified N_{ctrl} value. Finally, the flights that pushback between 1930 and 2000 hours are at the end of the departure push and derive the most benefit from the pushback rate control strategy: they have longer gate holds, waiting for the queue to drain and then taxi to the runway facing a gradually diminishing queue.

Figure 12 further illustrates the benefits of the pushback rate control protocol, by comparing operations from a day with pushback rate control (shown in blue) and a day without it (shown in red), under similar demand and configuration. The upper plot shows the average number of jets taxiing-out, and the lower plot the corresponding average taxi-out time, per 15-minute interval. We note that after 1815 hours on September 10, the number of jets taxiing out stabilized at around 15. As a result, the taxi-out times stabilized at about 16 minutes. Pushback rate control smooths the rate of the pushbacks so as to bring the airport state to the specified state, N_{ctrl}, in a controlled manner. Both features of pushback rate control, namely, smoothing of demand and prevention of congestion can be observed by comparing the evenings of September 10 and September 15. We see that on September 15, in the absence of pushback rate control, as traffic started accumulating at 1745 hours, the average taxi-out time grew to over 20 minutes. During the main departure push (1830 to

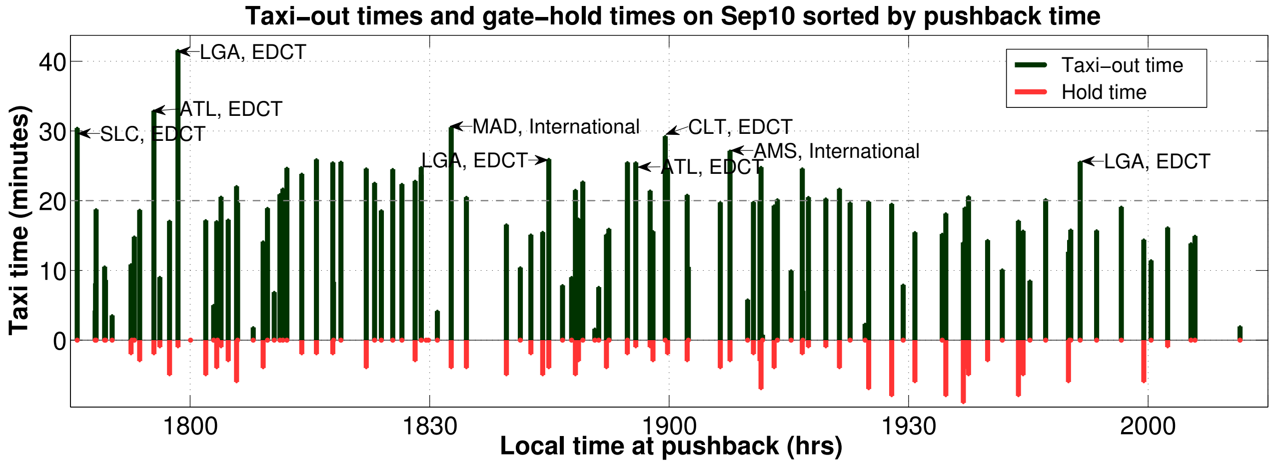


Fig. 11: Taxi-out and gate-hold times from the field test on September 10, 2010.

1930), the average number of jets taxiing out stayed close to 20 and the average taxi-out time was about 25 minutes.

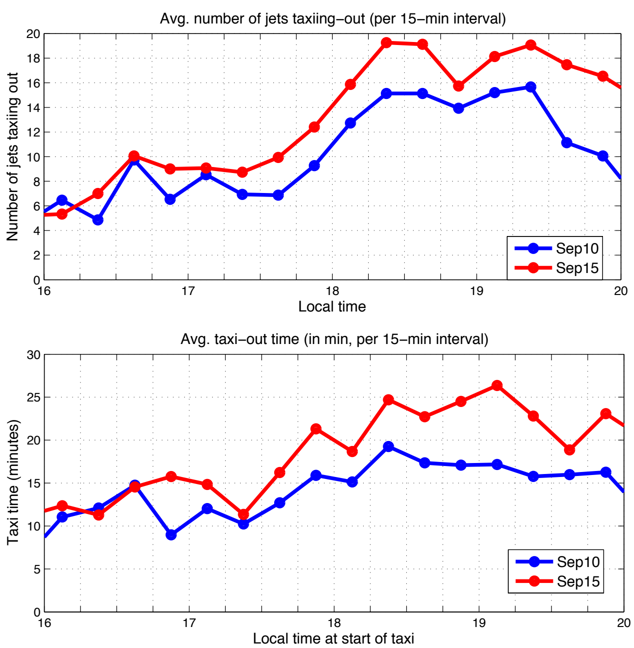


Fig. 12: Surface congestion (top) and average taxi-out times (bottom) per 15-minutes, for (blue) a day with pushback rate control, and (red) a day with similar demand, same runway configuration and visual weather conditions, but without pushback rate control. Delay attributed to EDCTs has been removed from the taxi-out time averages.

Similarly, Figure 13 compares the results of a characteristic pushback rate control day in runway configuration 27, 22L | 22L, 22R, August 26, to a similar day without pushback rate control. We observe that for on August 26, the number of jets taxiing out during the departure push between 1830 and 1930 hours stabilized at 15 with an average taxi-out time of about 20 minutes. On August 17, when pushback rate control was not in effect, the number of aircraft reached 20 at the peak of the push and the average taxi-out times were higher than those of August 26.

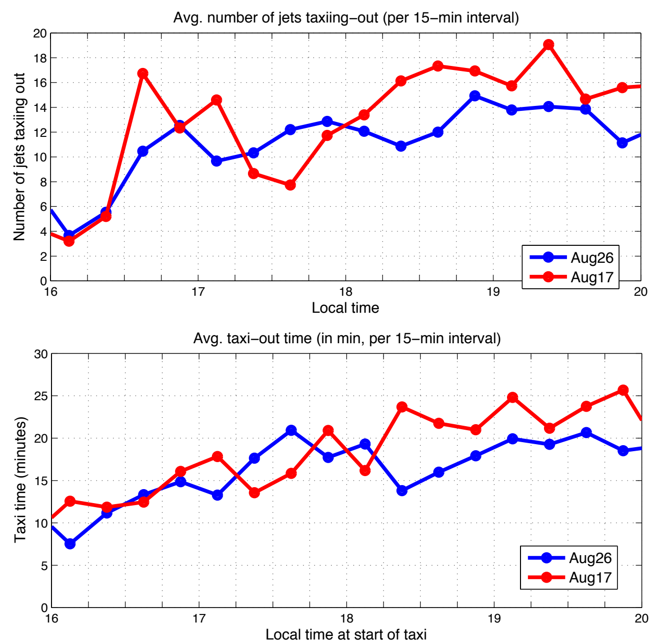


Fig. 13: Ground congestion (top) and average taxi-out times (bottom) per 15-minutes, for (blue) a day with pushback rate control, and (red) a day with similar demand, same runway configuration and weather conditions, but without pushback rate control. Delay attributed to EDCTs has been removed from the taxi-out time averages.

B. Runway utilization

The overall objective of the field test was to maintain pressure on the departure runways, while limiting surface congestion. By maintaining runway utilization, it is reasonable to expect that gate-hold times translate to taxi-out time reduction, as suggested by Figure 9. We therefore also carefully analyze runway utilization (top) and departure queue sizes (bottom) during periods of pushback rate control, as illustrated in Figure 14.

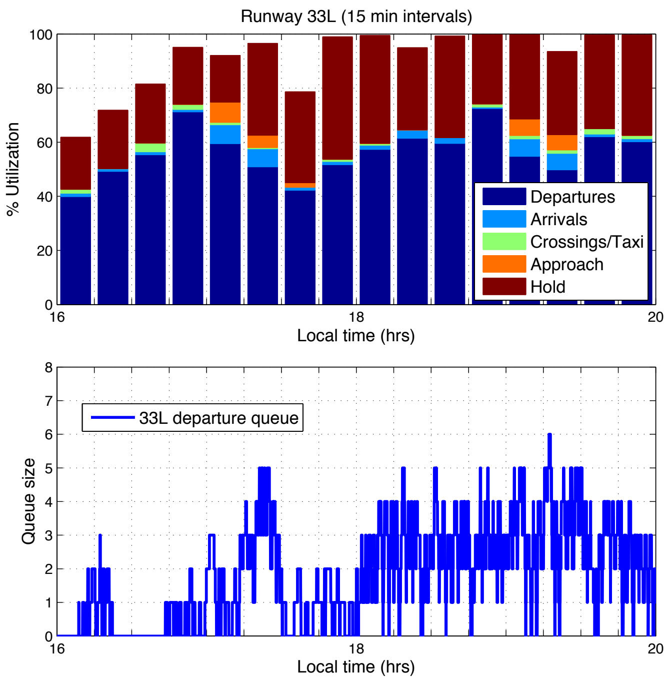


Fig. 14: Runway utilization plots (top) and queue sizes (bottom) for the primary departure runway (33L) during the field test on September 10, 2010. These metrics are evaluated through the analysis of ASDE-X data.

In estimating the runway utilization, we determine (using ASDE-X data) what percentage of each 15-min interval corresponded to a departure on takeoff roll, to aircraft crossing the runway, arrivals (that requested landing on the departure runway) on final approach, departures holding for takeoff clearance, etc. We note that between 1745 and 2000 hours, when gate-holds were experienced, the runway utilization was kept at or close to 100%, with a persistent departure queue as well.

Runway utilization was maintained consistently during the demo periods, with the exception of a three-minute interval on the third day of pushback rate control. On this instance, three flights were expected to be at the departure runway, ready for takeoff. Two of these flights received EDCTs as they taxied (and so were not able to takeoff at the originally predicted time), and the third flight was an international departure that had longer than expected pre-taxi procedures. Learning from this experience, we were diligent in ensuring that EDCTs were gathered as soon as they were available, preferably while the aircraft were still at the gate. In addition, we incorporated the longer taxi-out times of international departures into our predictions. As a result of these measures, we ensured that runway utilization was maintained over the remaining duration of the trial. It is worth noting that the runway was "starved" in this manner for only 3 minutes in over 37 hours of pushback rate control, demonstrating the ability of the approach to adapt to the uncertainties in the system.

V. Benefits analysis

Table II presents a summary of the gate-holds on the eight demo periods with sufficient congestion for controlling pushback rates. As mentioned earlier, we had no significant congestion when the airport was operating in its most efficient configuration (4L, 4R | 4L, 4R, 9).

TABLE II
SUMMARY OF GATE-HOLD TIMES FOR THE EIGHT DEMO PERIODS WITH SIGNIFICANT GATE-HOLDS.

	Date	Period	Configuration	No. of gate-holds	Average gate-hold (min)	Total gate-hold (min)
1	8/26	4.45-8PM	27,22L | 22L,22R	63	4.06	256
2	8/29	4.45-8PM	27,32 | 33L	34	3.24	110
3	8/30	5-8PM	27,32 | 33L	8	4.75	38
4	9/02	4.45-8PM	27,22L | 22L,22R	45	8.33	375
5	9/06	5-8PM	27,22L | 22L,22R	19	2.21	42
6	9/07	5-7.45PM	27,22L | 22L,22R	11	2.09	23
7	9/09	5-8PM	27,32 | 33L	11	2.18	24
8	9/10	5-8PM	27,32 | 33L	56	3.7	207
Total				247	4.35	1075

A total of 247 flights were held, with an average gate-hold of 4.3 min. During the most congested periods, up to 44% of flights experienced gate-holds. By maintaining runway utilization, we traded taxi-out time for time spent at the gate with engines off, as illustrated in Figures 9 and 11.

A. *Translating gate-hold times to taxi-out time reduction*

Intuitively, it is reasonable to use the gate-hold times as a surrogate for the taxi-out time reduction, since runway utilization was maintained during the demonstration of the control strategy. We confirm this hypothesis through a simple "what-if" simulation of operations with and without pushback rate control. The simulation shows that the total taxi-out time savings equaled the total gate-hold time, and that the taxi time saving of each flight was equal, in expectation, to its gate holding time. The total taxi-out time reduction can therefore be approximated by the total gate-hold time, or 1077 minutes (18 hours).

In reality, there are also second-order benefits due to the faster travel times to the runway due to reduced congestion, but these effects are neglected in the preliminary analysis.

B. *Fuel burn savings*

Supported by the analysis presented in Section V-A, we conduct a preliminary benefits analysis of the field tests by using the gate-hold times as a first-order estimate of taxi-out time savings. This assumption is also supported by the taxi-out time data from the tests, such as the plot shown in Figure 9. Using the tail number of the gate-held flights, we determine the aircraft and engine type and hence its ICAO taxi fuel burn index [12]. The product of the fuel burn rate index, the number of engines, and the gate-hold time gives us an estimate of the fuel burn savings from the pushback rate control strategy. We can also account for the use of Auxiliary Power Units (APUs) at the gate by using the appropriate fuel burn rates

[13]. This analysis (not accounting for benefits from reduced congestion) indicates that the total taxi-time savings were about 17.9 hours, which resulted in fuel savings of 12,000-15,000 kg, or 3,900-4,900 US gallons (depending on whether APUs were on or off at the gate). This translates to average fuel savings per gate-held flight of between 50-60 kg or 16-20 US gallons, which suggests that there are significant benefits to be gained from implementing control strategies during periods of congestion. It is worth noting that the per-flight benefits of the pushback rate control strategy are of the same order-of-magnitude as those of Continuous Descent Approaches in the presence of congestion [14], but do not require the same degree of automation, or modifications to arrival procedures.

C. Fairness of the pushback rate control strategy

Equity is an important factor in evaluating potential congestion management or metering strategies. The pushback rate control approach, as implemented in these field tests, invoked a First-Come-First-Serve policy in clearing flights for pushback. As such, we would expect that there would be no bias toward any airline with regard to gate-holds incurred, and that the number of flights of a particular airline that were held would be commensurate with the contribution of that airline to the total departure traffic during demo periods. We confirm this hypothesis through a comparison of gate-hold share and total departure traffic share for different airlines, as shown in Figure 15. Each data-point in the figure corresponds to one airline, and we note that all the points lie close to the 45-degree line, thereby showing no bias toward any particular airline.

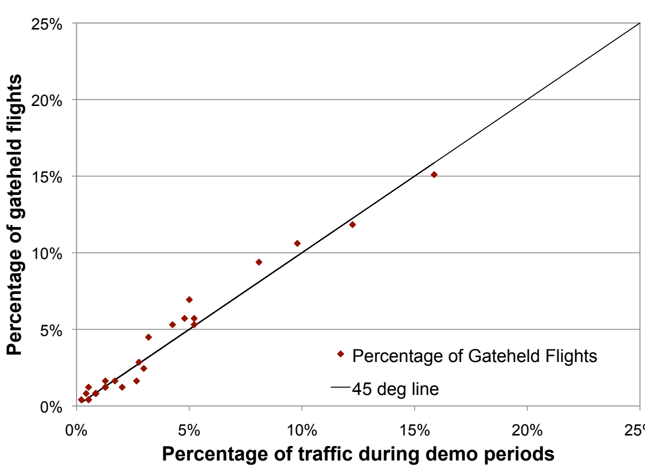


Fig. 15: Comparison of gate-hold share and total departure traffic share for different airlines.

We note, however, that while the number of gate-holds that an airline receives is proportional to the number of its flights, the actual fuel burn benefit also depends on its fleet mix. Figure 16 shows that while the taxi-out time reductions are similar to the gate-holds, some airlines (for example, Airlines 3, 4, 5, 19 and 20) benefit from a greater proportion of fuel savings. These airlines are typically ones with several heavy jet departures during the evening push.

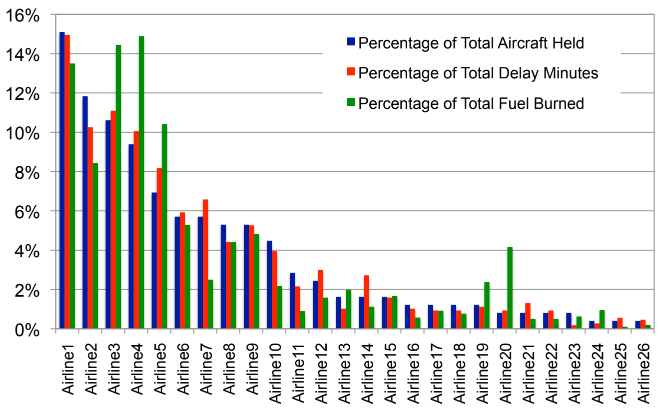


Fig. 16: Percentage of gate-held flights, taxi-out time reduction and fuel burn savings incurred by each airline.

VI. Observations and lessons learned

We learned many important lessons from the field tests of the pushback rate control strategy at BOS, and also confirmed several hypotheses through the analysis of surveillance data and qualitative observations. Firstly, as one would expect, the proposed control approach is an aggregate one, and requires a minimum level of traffic to be effective. This hypothesis is further borne by the observation that there was very little control of pushback rates in the most efficient configuration (4L, 4R | 4L, 4R, 9). The field tests also showed that the proposed technique is capable of handling target departure times (e.g., EDCTs), but that it is preferable to get EDCTs while still at gate. While many factors drive airport throughput, the field tests showed that the pushback rate control approach could adapt to variability. In particular, the approach was robust to several perturbations to runway throughput, caused by heavy weight category landings on departure runway, controllers' choice of runway crossing strategies, birds on runway, etc. We also observed that when presented with a suggested pushback rate, controllers had different strategies to implement the suggested rate. For example, for a suggested rate of 2 aircraft per 3 minutes, some controllers would release a flight every 1.5 minutes, while others would release two flights in quick succession every three minutes. We also noted the need to consider factors such as ground crew constraints, gate-use conflicts, and different taxi procedures for international flights. By accounting for these factors, the pushback rate control approach was shown to have significant benefits in terms of taxi-out times and fuel burn.

VII. Summary

This paper presented the results of the demonstration of a pushback rate control strategy at Boston Logan International Airport. Sixteen demonstration periods between August 23 and September 24, 2010 were conducted in the initial field trial phase, resulting in over 37 hours of research time in the BOS tower. Results show that during eight demonstration periods (about 24 hours) of controlling pushback rates, over 1077 minutes (nearly 18 hours) of gate holds were experienced during the demonstration period across 247 flights, at an average of 4.3 minutes of gate hold per flight (which correlated well to the observed decreases in taxi-out time). Preliminary fuel burn savings from gate-holds with engines off were estimated to be between 12,000-15,000 kg (depending on whether APUs were on or off at the gate).

ACKNOWLEDGMENTS

We would like to acknowledge the cooperation and support of the following individuals who made the demo at BOS possible: Deborah James, Pat Hennessy, John Ingaharro, John Melecio, Michael Nelson and Chris Quigley at the BOS Facility; Vincent Cardillo, Flavio Leo and Robert Lynch at Massport; and George Ingram and other airline representatives at the ATA. Alex Nakahara provided assistance in computing the preliminary fuel burn savings from the gate-hold data, and Regina Clewlow, Alex Donaldson and Diana Michalek Pfeil helped with tower observations before and during the trials. We are also grateful to Lourdes Maurice (FAA) and Ian Waitz (MIT) for insightful feedback on the research, and James Kuchar, Jim Eggert and Daniel Herring of MIT Lincoln Laboratory for their support and help with the ASDE-X data.

REFERENCES

[1] I. Simaiakis and H. Balakrishnan, “Analysis and control of airport departure processes to mitigate congestion impacts,” *Transportation Research Record: Journal of the Transportation Research Board*, pp. 22–30, 2010.

[2] C. Cros and C. Frings, “Alternative taxiing means – Engines stopped,” Presented at the Airbus workshop on Alternative taxiing means – Engines stopped, 2008.

[3] E. R. Feron, R. J. Hansman, A. R. Odoni, R. B. Cots, B. Delcaire, W. D. Hall, H. R. Idris, A. Muharremoglu, and N. Pujet, “The Departure Planner: A conceptual discussion,” Massachusetts Institute of Technology, Tech. Rep., 1997.

[4] N. Pujet, B. Delcaire, and E. Feron, “Input-output modeling and control of the departure process of congested airports,” *AIAA Guidance, Navigation, and Control Conference and Exhibit, Portland, OR*, pp. 1835–1852, 1999.

[5] F. Carr, “Stochastic modeling and control of airport surface traffic,” Master’s thesis, Massachusetts Institute of Technology, 2001.

[6] P. Burgain, E. Feron, J. Clarke, and A. Darrasse, “Collaborative Virtual Queue: Fair Management of Congested Departure Operations and Benefit Analysis,” *Arxiv preprint arXiv:0807.0661*, 2008.

[7] P. Burgain, “On the control of airport departure processes,” Ph.D. dissertation, Georgia Institute of Technology, 2010.

[8] I. Simaiakis and H. Balakrishnan, “Queuing Models of Airport Departure Processes for Emissions Reduction,” in *AIAA Guidance, Navigation and Control Conference and Exhibit*, 2009.

[9] ——, “Departure throughput study for Boston Logan International Airport,” Massachusetts Institute of Technology, Tech. Rep., 2011, No. ICAT-2011-1.

[10] I. Simaiakis, “Modeling and control of airport departure processes for emissions reduction,” Master’s thesis, Massachusetts Institute of Technology, 2009.

[11] Federal Aviation Administration, “Fact Sheet Airport Surface Detection Equipment, Model X (ASDE-X),” October 2010.

[12] International Civil Aviation Organization, “ICAO Engine Emissions Databank,” July 2010.

[13] Energy and Environmental Analysis, Inc., “Technical data to support FAA’s circular on reducing emissions for commercial aviation,” September 1995.

[14] S. Shresta, D. Neskovic, and S. Williams, “Analysis of continuous descent benefits and impacts during daytime operations,” in *8th USA/Europe Air Traffic Management Research and Development Seminar (ATM2009)*, Napa, CA, June 2009.

AUTHOR BIOGRAPHIES

Ioannis Simaiakis is a PhD candidate in the Department of Aeronautics and Astronautics at MIT. He received his BS in Electrical Engineering from the National Technical University of Athens, Greece and his MS in Aeronautics and Astronautics from MIT. His research focuses on modeling and predicting taxi-out times and airport operations planning under uncertainty.

Harshad Khadilkar is a graduate student in the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology. He received his Bachelors degree in Aerospace Engineering from the Indian Institute of Technology, Bombay. His research interests include algorithms for optimizing air traffic operations, and stochastic estimation and control.

Hamsa Balakrishnan is an Assistant Professor of Aeronautics and Astronautics at the Massachusetts Institute of Technology. She received her PhD in Aeronautics and Astronautics from Stanford University. Her research interests include ATM algorithms, techniques for the collection and processing of air traffic data, and mechanisms for the allocation of airport and airspace resources.

Tom Reynolds has joint research appointments with MIT’s Department of Aeronautics & Astronautics and Lincoln Laboratory. He obtained his Ph.D. in Aerospace Systems from the Massachusetts Institute of Technology. His research interests span air transportation systems engineering, with particular focus on air traffic control system evolution and strategies for reducing environmental impacts of aviation.

R. John Hansman is the T. Wilson Professor of Aeronautics and Astronautics at the Massachusetts Institute of Technology where he is the Director of the MIT International Center for Air Transportation.

Brendan Reilly is currently the Operations Manager at Boston Airport Traffic Control Tower. He is responsible for the day to day operations of the facility as well as customer service. He has been involved in aviation throughout New England for over twenty years as both an Air Traffic Controller and a Pilot.

Steve Urlass is an environmental specialist and a national resource for airports in the FAA’s Office of Environment and Energy. He is responsible for research projects and developing environmental policy for the Agency. He has been involved with a variety of environmental, airport development, and system performance monitoring for the FAA. He received his degree in Air Commerce from Florida Tech.

Boston-Logan International Airport

EDR

2014 Environmental Data Report