7

Air Quality/ Emissions Reduction

Introduction

This chapter describes the air quality conditions at Logan Airport in 2005 and compares the findings to air quality conditions in 2004. The chapter contains an air emissions inventory of on-airport emissions of volatile organic compounds (VOCs), oxides of nitrogen (NO_x), carbon monoxide (CO), and particulate matter (PM). It contains an update of air quality monitoring data collected by Massport and the Massachusetts Department of Environmental Protection (MDEP). The chapter also includes a status report on Massport's Air Quality Initiative (AQI), which is a long-range, 15-year program with the goal of maintaining NO_x emissions at, or below, 1999 levels.

Key Findings

Highlights for 2005 are:

- The emissions inventory results are driven by the small increase in aircraft operations at Logan Airport compared to 2004 levels. Associated changes in ground service equipment (GSE) activity and surface traffic volumes were also contributing factors. However, the resultant increases in emissions were partially offset due to the change in the aircraft fleet mix and the improved efficiencies of aircraft, motor vehicle, and GSE engines. The in-place air quality initiatives at Logan Airport and other ongoing efforts by Massport to minimize emissions also played a role.
- Compared to 2004 levels, total emissions of VOCs decreased by approximately 6 percent to 1,285 kilograms per day (kg/day).
- In 2005, total emissions of NO_x were 4,187 kg/day, which is a 2 percent decrease from 2004 levels.
- Total emissions of CO in 2005 were 9,556 kg/day, or 3 percent lower than 2004 levels.
- Total emissions of $PM_{2.5}$ at Logan Airport in 2005 were approximately 83 kg/day [33 tons/year (tpy)].

- NO_x emissions at Logan Airport in 2005 were approximately 662 tpy lower than 1999 levels—a 28 percent decrease.
- There was a continuing trend of decreasing nitrogen dioxide (NO_2) concentrations at both the Massport and MDEP monitoring sites located in the general vicinity of Logan Airport. In addition, annual NO_2 concentrations at all monitoring locations were well below the NO_2 air quality standards in 2005.

Regulatory Framework

The federal Clean Air Act (CAA), the National Ambient Air Quality Standards (NAAQS), and other similar state regulations govern air quality issues in Massachusetts and the area around Logan Airport. The NAAQS and the Massachusetts State Implementation Plan (SIP) promulgated pursuant to, and in compliance with the CAA, also regulate air quality issues in this area. Updates to both the NAAQS and the SIP are briefly discussed below.

National Ambient Air Quality Standards

The United States (US) Environmental Protection Agency (EPA) established NAAQS for a group of criteria air pollutants to protect public health, the environment, and the quality of life from the detrimental effects of air pollution. These NAAQS are set for the following six pollutants: CO, lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}), and sulfur oxides (SO_x). The NAAQS primary standards (designed to protect human health) and secondary standards (designed to protect human welfare) are contained in Table 7-1.

Based on air monitoring data and in accordance with the CAA, all areas within Massachusetts are designated with respect to the NAAQS as *attainment*, *nonattainment*, *maintenance*, or *unclassifiable*. An area with air quality better than the NAAQS is designated as attainment; an area with air quality worse than the NAAQS is designated as nonattainment. An area may be designated as unclassifiable when there is a temporary lack of data to form a basis of attainment status. Nonattainment areas are further classified as extreme, severe, serious, moderate, and marginal by the degree of non-compliance with the NAAQS. The current attainment/ nonattainment designations for the Boston metropolitan area are summarized in Table 7-2.

As shown in Table 7-2, the entire Boston metropolitan area is currently designated as in attainment for all the criteria pollutants except O_3, and is designated as moderate nonattainment for the eight-hour O_3 standard. The ozone nonattainment area, which includes Logan Airport, consists of 10 counties in Massachusetts (Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester).

Table 7-1 National Ambient Air Quality Standards

Pollutant	Averaging Time	Standard ppm	Standard $\mu g/m^3$	Notes:
Carbon Monoxide (CO)	1 hour	35	40,000	Not to be exceeded more than once a year.
	8 hour	9	10,000	Not to be exceeded more than once a year.
Lead (Pb)	Quarterly	-	1.5	Not to exceed this level.
Nitrogen Dioxide (NO_2)	Annual	0.053	100	Not to exceed this level.
Ozone (O_3)	1 hour	0.12	235	Number of exceedances averaged over three years must be less than or equal to 1. Standard was revoked by EPA in June 2005.
	8 hour	0.08	157	The average of the annual 4th highest daily 8-hour maximum over a three-year period is not to exceed this level.
Particulate Matter with a diameter $\leq$ 10 μm (PM_{10})	24 hour	—	150	Not to be exceeded more than once a year.
	Annual	—	50	The annual arithmetic mean at each monitor must not exceed this standard.
Particulate Matter with a diameter $\leq$ 2.5 μm ($PM_{2.5}$)	24 hour	—	65	The three-year average of the 98th percentile for each population-oriented monitor within an area is not to exceed this level.
	Annual	—	15	The three-year average of the annual arithmetic mean from single or multiple monitors within an area is not to exceed this level.
Sulfur Oxides (SO_x)	3 hour[1]	0.50	1300	Not to be exceeded more than once a year.
	24 hour	0.14	365	Not to be exceeded more than once a year.
	Annual	0.03	80	Not to exceed this level.

Source: EPA, 2005 (www.epa.gov/air/criteria.html)
1 Secondary standard designed to protect public welfare, where the rest are Primary standards, which protect public health.
ppm parts per million, $\mu g/m^3$ - micrograms per cubic meter.

Table 7-2 Attainment/Nonattainment Designations for the Boston Metropolitan Area

Pollutant	Designation
Carbon monoxide (CO)	Attainment
Nitrogen oxides (NO_x)	Attainment
Ozone (O_3) (1-hr)[1]	Nonattainment (Serious)
Ozone (O_3) (8-hr)	Nonattainment (Moderate)
Particulate matter (PM_{10})	Attainment
Particulate matter ($PM_{2.5}$)	Attainment
Sulfur oxides (SO_x)	Attainment
Lead (Pb)	Attainment

Source: EPA, 2005
1 The 1-hour Ozone standard was revoked by EPA effective June 15, 2005.

State Implementation Plan (SIP)

Because the Boston area did not meet the one hour NAAQS for O_3, a SIP has been developed to reduce O_3 levels to meet the NAAQS for this nonattainment pollutant. The SIP is the regulatory scheme for bringing nonattainment areas in Massachusetts into compliance with the NAAQS. Since the EPA recently designated the Boston area as moderate nonattainment for the new eight-hour O_3 standard, the MDEP is required to submit a new SIP to the EPA by June 2007 which demonstrates compliance being achieved by 2010. The current and future SIPs for the Boston area are summarized in Table 7-3.

Table 7-3 State Implementation Plan for Ozone Summary

Standard	Title	Status	Comments
One Hour	One-hour Ozone Attainment Demonstration for the Massachusetts Portion of the Boston-Lawrence-Worcester, Massachusetts-New Hampshire Ozone Nonattainment Area.	Published December 6, 2002 as final rule.	EPA approved this SIP revision and established an attainment date of November 15, 2007, for the entire multi-state nonattainment area. Focuses on the control of NO_X and VOCs as precursors to O_3. This is the "currently approved" SIP for the Boston area.
Eight-Hour	Eight-hour Ozone Attainment Demonstration for the Massachusetts Portion of the Boston-Lawrence-Worcester, Massachusetts-New Hampshire Ozone Nonattainment Area.	Under development.	To be submitted to the EPA in June 2007 for approval. Calls for the attainment of the new eight-hour NAAQS for O_3 by 2010. Focuses on the control of NO_X and VOCs as precursors to O_3.

Source: EPA website www.epa.gov
1 EPA 40 Code of Federal Regulations (CFR) Part 52, Federal Register, Vol. 67, No. 167, August 28, 2002, pp. 55121-55125.
2 EPA 40 CFR Part 52, Federal Register, Vol. 67, No. 235, December 6, 2002, pp. 72576-72579.

Logan Airport Air Quality Permits for Stationary Sources of Emissions

Massport received a Title V Air Operating Permit for Logan Airport in September 2004. This permit covers all of the Massport-operated stationary sources including the Central Heating and Cooling Plant, boilers, electrical generators, and fuel storage tanks. Two backup electricity generators were installed at the new Terminal A in 2004 and became operational in 2005.

Methodology for Emissions Inventory

The air quality analysis of air emissions associated with Logan Airport operations includes the following source categories. Each of the emissions sources has its own assessment methodology, database, and assumptions as described below:

- Aircraft Emissions — The Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) is the EPA-preferred and the FAA-required program for calculating aircraft emissions. Since the FAA continually improves the performance, precision and adaptability of the EDMS, the program is subject to regular updates and revisions. For this analysis, the most recent version, EDMSv4.5, was used to compute the 2005 Logan Airport emissions inventory. Compared to the last version (EDMSv4.21) used in

the 2004 ESPR, there are few changes; the most notable one being the updated aircraft engine database and emission factors.[1]

As with previous Environmental Status and Planning Reports (ESPRs) and Environmental Data Reports (EDRs), the actual aircraft fleet mix at Logan Airport was used to analyze 2005 conditions. In a few instances where the aircraft/engine type or combinations actually used at Logan Airport was not available in the EDMS database, consistent with FAA guidance, substitutions were made based on the closest match of aircraft type and engine performance characteristic. Table I-1 in *Appendix I, Air Quality/Emissions Reduction* contains the data that were used including aircraft type, engine, Landing-Take Off Cycles (LTOs), and aircraft taxi-times. The aircraft are grouped into four categories: commercial air carriers, commuter aircraft, general aviation, and cargo aircraft.

Aircraft taxi-times are based on data obtained from the FAA Aviation System Performance Metrics (ASPM) database for 2005.[2]

- **Ground Service Equipment —** Estimates of GSE emissions for 2005 were based on EDMS emission factors and continue to reflect emission reductions attributable to Massport's Alternative Fuel Vehicle (AFV) Program, and the conversion of Massport and tenant GSE and fleet vehicles to compressed natural gas (CNG) or electricity. Model input data are based on the 2001 AFV Survey conducted by Massport, and an on-site GSE Time-in-Mode (TIM) survey completed in 2004.

- **Motor Vehicles —** Motor vehicle emission factor data were obtained from the most recent version of EPA's MOBILE model (MOBILE6.2) combined with MDEP recommended motor vehicle fleet mix data, operating conditions, and other Massachusetts-specific input parameters. MOBILE6.2 is preferred by the MDEP and used to develop motor vehicle emissions budgets for the SIP. A copy of the MOBILE6.2 input/output files are included in *Appendix I, Air Quality/Emissions Reduction. Chapter 5, Ground Transportation Improvement*, of this *2005 EDR* provides a discussion of the vehicle miles traveled (VMT) data used for this air quality analysis.

- **Other Sources —** Emissions associated with the fuel storage and handling facilities, the Central Heating and Cooling Plant, and other stationary sources at Logan Airport were based on annual material use and fuel throughput records for 2005, combined with EPA emission factors (*Compilation of Air Pollution Emission Factors (AP-42)*.

- **Particulate Matter —** For the first time, estimates of PM emissions associated with Logan Airport are reported in this *2005 EDR* in response to the recent availability of an FAA-approved method (e.g., First Order Approximation) for computing PM emission factors for aircraft. In addition, because measurements of PM from aircraft engines indicated that most of the particles are less than 10 microns in diameter (PM_{10}), it is assumed for this analysis that they are all classifiable as $PM_{2.5}$ (i.e., particles less than 2.5 microns in diameter).[3] 2005 PM emissions will be compared to future years in subsequent EDRs/ESPRs in the same manner as VOC, NO_x, and CO emissions.

1 Between EDMS v4.21 and 4.5, the FAA released two other versions: versions: 4.3 and 4.4.
2 FAA Aviation System Performance Metrics (ASPM) database for 2005 (www.apo.data.faa.gov/).
3 Making the assumption that all particles are less than 2.5 microns in diameter is consistent with the Aircraft Particle Emissions eXperiment (APEX), www.particles.grc.nasa.gov/apex.html.

Emissions Inventory for 2005

This section provides a summary of the 2005 emissions inventory results for Logan Airport activities for the pollutants VOC, CO, NO_x and PM. Emissions of O_3 are not computed as it is a secondary pollutant formed from emissions of NO_x and VOCs. Emissions of SO_x and Pb are also not computed, as airport emission sources are very small generators of these two compounds. The emissions inventory was computed based on the actual number of aircraft operations and fleet mix, passenger enplanements, and employment levels at the airport in 2005. Correspondingly, emissions associated with GSE, motor vehicles, fuel storage and transfer facilities, and a variety of stationary sources (i.e., steam boilers, snow melters, live fire training, back-up generators, etc.) on the airport site were also computed. For the first time, PM emissions also have been included in the inventory in response to the recent availability of a method for calculating PM emissions for aircraft engines.

As in preceding EDRs, the outcomes of the 2005 emissions inventory are compared with the results for 2004 and other previous years. For consistency, the 2005 analysis was conducted using both versions of the EDMS available in 2004 (version 4.21) and 2005 (version 4.5), respectively. In this way, the changes in Logan Airport air quality conditions can be evaluated in both the short- and long-terms, and on a common basis. For the AQI, estimates of 2015 NO_x emissions are also provided as a means of monitoring the progress of this emission management program.

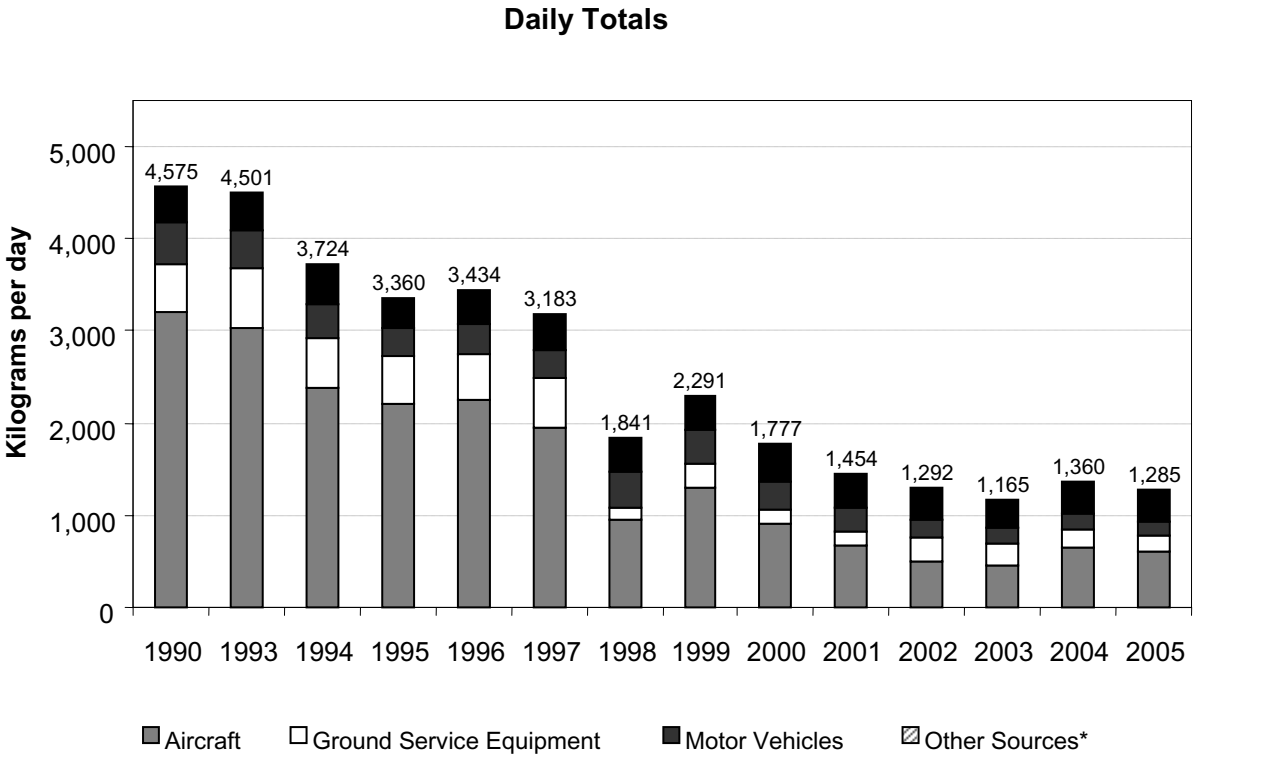
Volatile Organic Compounds

In 2005, total VOC emissions at Logan Airport were approximately 517 tons per year (tpy) (1,285 kg/day); an estimated decrease of about 6 percent from 2004 levels. Figure 7-1 depicts a long-term downward trend in VOC emissions at Logan Airport and Figure 7-2 shows the 2005 percent breakdown of these emissions, by source category. Similarly, Table 7-4 shows the computed VOC emissions in kg/day for each emission source from 1990 to 2005. Other significant findings include the following:

- Total aircraft-related VOC emissions were lower by approximately 9 percent in 2005, when compared to 2004. This decrease of was largely due to the change in the aircraft fleet mix at the airport and the resultant improvement in aircraft engines efficiencies. In particular, cargo aircraft emissions declined considerably (>50 percent) from the phase out of the aging DC-8 aircraft. The 50 percent decrease in cargo aircraft emissions is also due to other cargo aircraft engine emission factors having been updated in EDMS.
- GSE-related VOC emissions were lower in 2005 by 5 percent than in 2004 due to the continued changes in the GSE types supporting aircraft operations in 2005.
- Total VOC emissions from motor vehicles in 2005 also declined from 2004 levels by 7 percent. Since vehicle miles traveled (VMT) on the airport increased over 2004 levels, the reduction in motor vehicle emissions is attributable to the lower emission factors of the 2005 motor vehicle fleet.
- VOC emissions from stationary and other sources (e.g., fuel storage/handling, Central Heating/Cooling Plant, snowmelter usage and fire training) increased by less than 1 percent from 2004 to 2005.

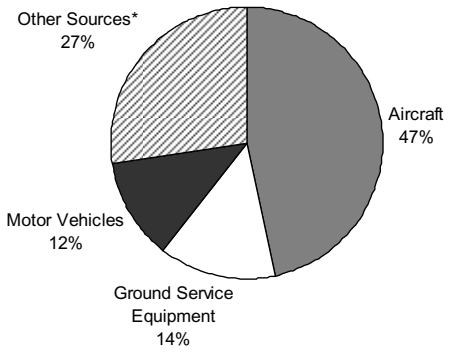
As shown in Figure 7-2, aircraft continue to represent the largest source (47 percent) of VOC emissions associated with Logan Airport followed by stationary sources (27 percent), GSE (14 percent), and motor vehicles (12 percent). Finally, the results for 2005 contained in Table 7-4 reveal very little difference (<1 percent) in the VOC emissions inventory results between EDMS versions 4.21 and 4.5. The small difference is attributed to EDMSv4.5 having an updated aircraft engine database and emission factors.

Figure 7-1 Emissions of VOCs at Logan Airport



* Other sources include stationary sources (e.g., Central Heating and Cooling Plant, snowmelter usage, fire training, etc.) and fueling sources.

Figure 7-2 Sources of VOC Emissions in 2005



* Other Sources include stationary sourc (e.g., Central Heating and Cooling Plant, snowmelter usage, fire training, etc.) and fueling sources.

Table 7-4 Estimated VOC Emissions (in kg/day) at Logan Airport

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]	2000	2001	2002	2003	2004	2005[2]	
Aircraft/GSE Model	**Logan Dispersion Modeling System (LDMS)**								**EDMS 3.22**	**EDMS 4.21**	**EDMS 4.03**		**EDMS 4.11**		**EDMS 4.21**	**EDMS 4.21**	**EDMS 4.5**
Motor Vehicle Model	**MOBILE5a**								**MOB5A_h**	**MOB6.2.03**	**MOBILE 6.0**			**MOB 6.2.01**	**MOB6.2.03**	**MOB6.2.03**	
Aircraft Sources																	
Air carriers	2,175			1,958	1,554	1,407	1,390	1,227	736	653	514	374	248	208	292	273	**271**
Commuter aircraft	681			943	543	531	622	498	154	196	140	113	75	95	127	140	**140**
Cargo aircraft	303			89	244	236	214	207	43	318	207	149	127	94	110	41	**41**
General aviation	44			51	48	36	24	27	13	141	42	43	52	61	127	147	**147**
Total aircraft sources	3,203			3,041	2,389	2,210	2,250	1,959	946	1,308	903	680	502	458	656	601	**599**
Ground Service Equipment[3]	518			636	533	521	497	530	145	243	153	143	247[4]	227	187	178	**178**
Motor Vehicles																	
Ted Williams Tunnel through-traffic	NA			NA	NA	NA	NA	NA	NA	15	12	10	9	0[5]	0[5]	0[5]	**0[5]**
Parking/curbside	192			173	148	127	102	102	118	101	89	77	51	45	38	37	**37**
On-airport vehicles[6]	258			238	215	179	223	205	258	256	206	170	152	135	129	118	**118**
Total motor vehicle sources	450			411	363	306	325	307	376	372	307	257	212	180	167	155	**155**
Other Sources																	
Fuel storage/handling	400			408	434	318	356	381	372	352	412	372	329	297	341	340	**340**
Miscellaneous sources[7]	4			5	5	5	6	6	2	16	2	2	2	3	9	13	**13**
Total other sources	404			413	439	323	362	387	374	368	414	374	331	300	350	353	**353**
Total Airport Sources	4,575	NA	NA	4,501	3,724	3,360	3,434	3,183	1,841	2,291	1,777	1,454	1,292	1,165	1,360	1,287	**1,285**

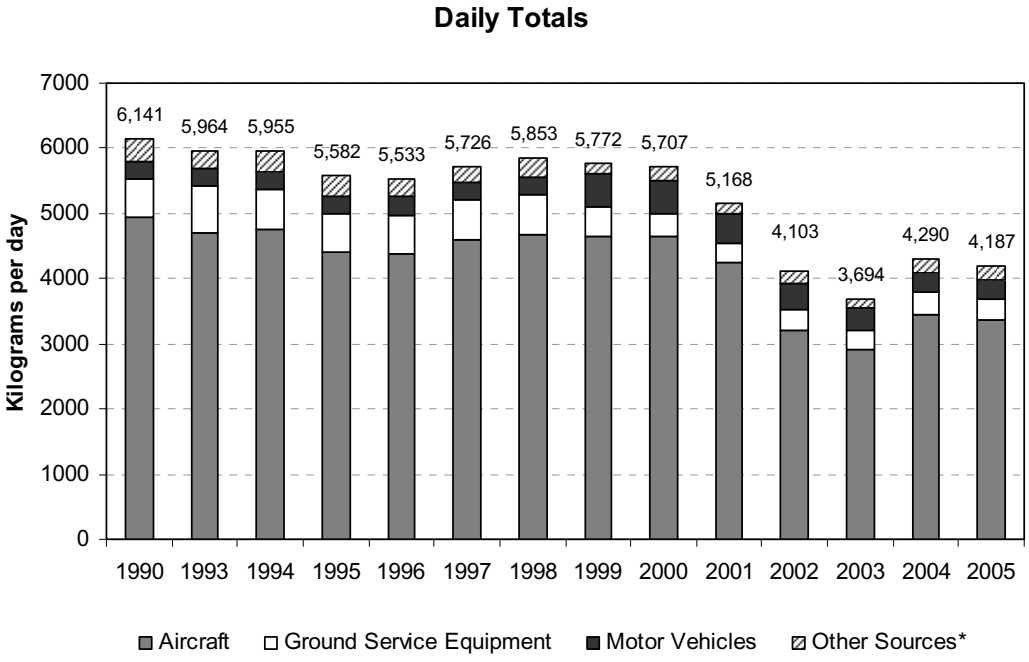
Kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Information not available. Emissions were not computed in 1991 and 1992.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2=MOBILE6.2 version .01 or version .03)
1 Year 1999 emissions were last re-calculated using EDMSv4.21 in the *2004 ESPR* Air Quality Analysis.
2 Year 2005 emissions are computed using the most recent version of EDMS (version 4.5) and the previous version (version 4.21) for comparison to 2004 results.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels.
4 Updates to the EDMS resulted in an increase of GSE VOC emissions between 2001 and 2002 as the result of new emission factors from the NONROAD emission factor database, which is used in EDMSv4.11 and EDMSv4.5.
5 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.
6 1999 – 2005 include reductions attributable to CNG shuttle buses. Since 2001, actual CNG Bus mileage is used to calculate the credit. An average mileage for 1999 CNG Bus usage was assumed, based on 2001 – 2004 data.
7 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999, and 2003 thru 2005. Diesel snowmelter usage was added in 1999, 2004, and 2005.

Oxides of Nitrogen

In 2005, total NO_x emissions from all airport-related sources were estimated to be approximately 1,685 tpy (4,187 kg/day), which is a decrease of about 2 percent from 2004 levels and a 27 percent decrease compared to 1999 levels. Figure 7-3 depicts these short- and long-term trends in NO_x emissions, and Table 7-5 shows the allotment for each emission source over this time period. Other findings include the following:

- When compared to 2004 levels, total aircraft-related NO_x emissions were lower in 2005 by about 3 percent. This decrease is due to the change in the fleet mix to lower emitting NO_x aircraft and the recorded reduction in ground-based taxi-in, taxi-out, and delay times at Logan Airport in 2005 when compared to 2004.[4]
- GSE emissions of NO_x decreased by about 6 percent in 2005 compared to 2004 due to the change in the aircraft fleet mix.
- NO_x emissions from motor vehicles increased by about 1 percent in response to the corresponding increases in aircraft operations and passenger levels over this time period.
- Stationary sources show an increase of 3 percent in NO_x emissions in 2005 compared to 2004. This is based on weather conditions that necessitated increased utilization of snowmelters, and the use of natural gas for space heating at the new Terminal A. In 2004, Terminal A was under construction and heating was not necessary.

Figure 7-3 Emissions of NO_x at Logan Airport



*Other Sources include stationary sources (e.g., Central Heating and Cooling Plant, snowmelter usage, fire training, etc.).

4 Taxi –in and taxi-out and delay times were obtained from the FAA Aviation System Performance Metrics (ASPM) database for 2005 (www.apo.data.faa.gov/).

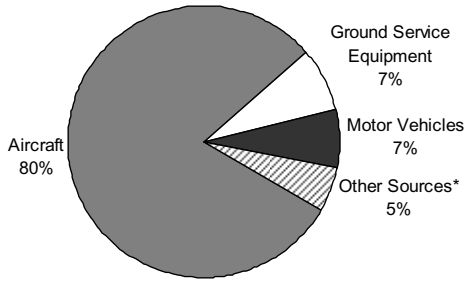
Table 7-5 Estimated NO_x Emissions (in kg/day) at Logan Airport

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]	2000	2001	2002	2003	2004	2005[2]	
	Logan Dispersion Modeling System (LDMS)								EDMS 3.22	EDMS 4.21	EDMS 4.03		EDMS 4.11		EDMS 4.11	EDMS 4.21	EDMS 4.5
	MOBILE5a								MOB5a_h	MOB6.2.03	MOBILE 6.0			MOB6.2.01	MOB6.2.03	MOB6.2.03	
Aircraft Sources																	
Air carriers	4,554			4,271	4,317	3,861	3,781	4,150	4,471	4,183	4,202	3,707	2,721	2,479	2,949	2,887	**2,880**
Commuter aircraft	133			202	158	192	137	159	203	166	125	233[2]	208	185	245	225	**225**
Cargo aircraft	237			213	257	332	363	262	254	286	284	267	246	213	215	211	**211**
General aviation	13			13	13	17	18	21	5	12	49	34	38	45	49	50	**50**
Total aircraft sources	4,937			4,699	4,745	4,402	4,389	4,592	4,933	4,647	4,660	4,241	3,212	2,922	3,458	3,373	**3,366**
Ground Service Equipment[3]	603			722	617	607	588	622	317	444	333	305	322[4]	291	333	312	**312**
Motor Vehicles																	
Ted Williams Tunnel through-traffic	NA			NA	NA	NA	NA	NA	NA	28	26	22	20	0[5]	0[5]	0[5]	0[5]
Parking/curbside	25			25	24	24	24	24	37	39	52	46	32	28	21	22	**22**
On-airport vehicles[6]	232			240	239	229	257	244	372	449	425	369	341	302	267	269	**269**
Total motor vehicle sources	257			265	263	253	281	268	409	516	503	437	393	330	288	291	**291**
Other Sources																	
Fuel storage/handling[7]	0			0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Miscellaneous sources[8]	344			278	330	320	275	244	284	165	211	185	175	151	211	218	**218**
Total other sources	344			278	330	320	275	244	284	165	211	185	175	151	211	218	**218**
Total Airport Sources	6,141	NA	NA	5,964	5,955	5,582	5,533	5,726	5,943	5,772	5,707	5,168	4,103	3,694	4,290	4,194	**4,187**

kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Information not available. Emissions were not computed in 1991 and 1992.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2=MOBILE6.2 version .01 or version .03)
1 Year 1999 emissions were last re-calculated using EDMSv4.21 in the *2004 ESPR* Air Quality Analysis.
2 Year 2005 emissions are computed using the most recent version of EDMS (version 4.5) and the previous version (ver.sion4.21) for comparison to 2004 results.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels.
4 Updates to the EDMS resulted in an increase of GSE NO_x emissions between 2001 and 2002 as the result of new emission factors from the NONROAD emission factor database, which is used in EDMSv4.11 and EDMSv4.5.
5 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.
6 1999 – 2005 include reductions attributable to CNG shuttle buses. Since 2001, actual CNG Bus mileage is used to calculate the credit. An average mileage for 1999 CNG Bus usage was assumed, based on 2001 – 2004 data.
7 Fuel storage and handling facilities are not sources of NO_x emissions.
8 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999, and 2003 thru 2005. Diesel snowmelter usage was added in 1999, 2004, and 2005.

As shown in Figure 7-4, in 2005, aircraft continued to represent the largest source (80 percent) of NO_x at Logan Airport, followed by GSE (7 percent), motor vehicles (7 percent), and stationary sources (5 percent). Again, there was very little difference (i.e., <1 percent) in the 2005 NO_x emissions inventory results between EDMS versions 4.21 and 4.5. The small difference is attributed to EDMSv4.5 having an updated aircraft engine database and emission factors.

Figure 7-4 Sources of NO_x Emissions in 2005



* Other Sources include stationary sources (e.g., Central Heating and Cooling Plant, snowmelter usage, fire training, etc.). Does not total 100 percent due to rounding.

Carbon Monoxide

Total CO emissions at Logan Airport in 2005 were approximately 3,844py (9,556 kg/day), or 3 percent lower than 2004 levels. However, Figure 7-5 depicts a long-term downward trend in CO emissions at the airport and Table 7-6 shows the breakdown of these emissions, by source category. Other findings of the analysis include the following:

- Aircraft-related CO emissions decreased in 2005 by about 3 percent compared to 2004 levels due mostly to the change in the fleet mix to aircraft that are equipped with more efficient engines.
- GSE CO emissions decreased by about 2 percent in 2005 in response to the GSE types supporting 2005 operations.
- CO emissions from motor vehicles declined in 2005 by 8 percent from 2004 levels. The reduction in motor vehicle emissions of CO is attributable to the lower emission rates of the motor vehicle fleet in 2005.
- Stationary source emissions of CO increased by 21 percent in 2005 compared to 2004 due to the increased use of in snow melters and natural gas for space heating. However, even when combined, stationary sources still represent less than 1 percent of the total airport-related CO emissions.

As shown in Figure 7-6, aircraft continued to represent the largest source (47 percent) of CO at Logan Airport in 2005, followed by GSE (37 percent), motor vehicles (15 percent), and stationary sources (<1 percent). As with VOCs and NO_x, there was very little difference (i.e., <1 percent) in the 2005 CO emissions inventory results between EDMS versions 4.21 and 4.5. The small difference is attributed to EDMSv4.5 having an updated aircraft engine database and emission factors.

Figure 7-5 Emissions of CO at Logan Airport

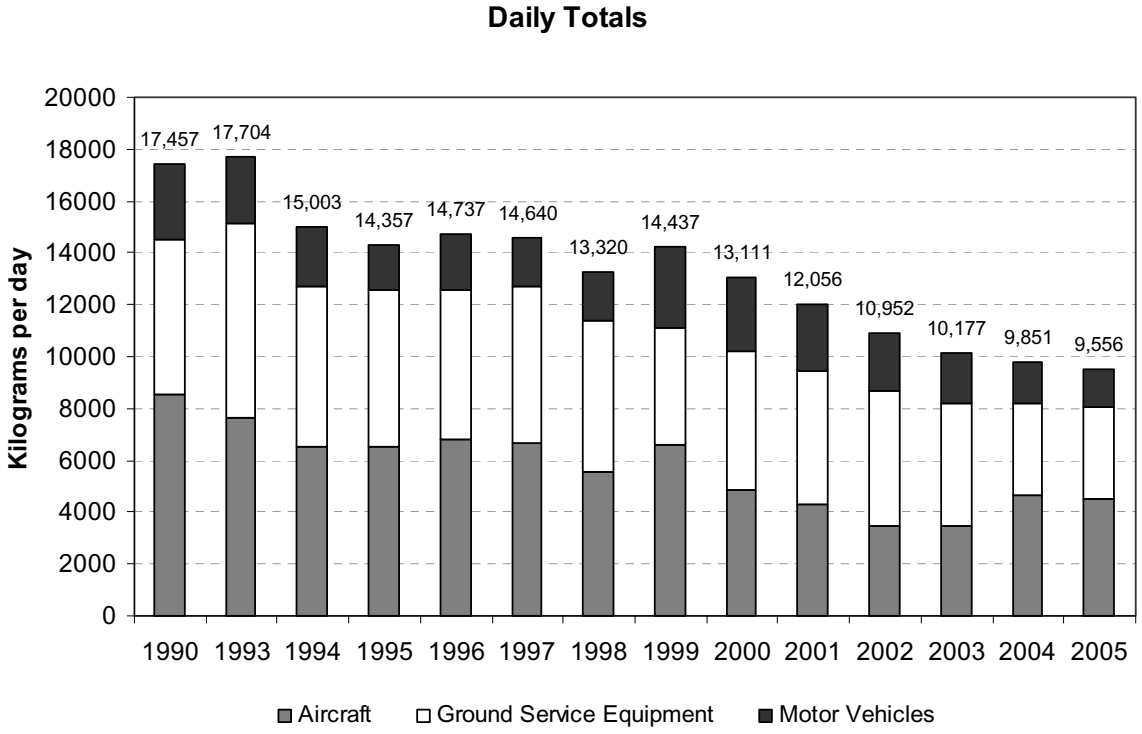
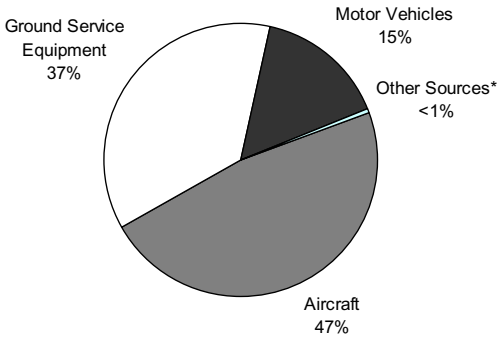


Figure 7-6 Sources of CO Emissions in 2005



* Other Sources including stationary sources (e.g., Central Heating and Cooling Plant, snowmelter usage, fire training, etc.) represent less than 1 percent of the total.

Table 7-6 Estimated CO Emissions (in kg/day) at Logan Airport

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]	2000	2001	2002	2003	2004	2005[2]	
	Logan Dispersion Modeling System (LDMS)								EDMS 3.22	EDMS 4.21	EDMS 4.03		EDMS 4.11		EDMS 4.21	EDMS 4.21	EDMS 4.5
	MOBILD 5a								MOB5a_h	MOB6.2.03	MOBILE 6.0			MOB 6.2.01	MOB6,2,01	MOB6.2.03	
Aircraft Sources																	
Air carriers	6,613			5,663	4,660	4,691	4,812	4,698	3,079	3,754	2,994	2,475	2,156	2,128	2,985	2,898	**2,895**
Commuter aircraft	977			1,309	927	934	859	770	482	1,404	1,188	1,072	783	846	1,010	1,010	**1,010**
Cargo aircraft	576			344	572	598	580	514	218	503	400	323	285	209	229	174	**174**
General aviation	352			353	356	339	549	654	269	940	295	407[2]	256	276	416	437	**437**
Total aircraft sources	8,518			7,669	6,515	6,562	6,800	6,636	4,048	6,601	4,876	4,277	3,480	3,459	4,640	4,519	**4,516**
Ground Service Equipment[3]	6,001			7,482	6,187	6,029	5,740	6,098	5,113	4,532	5,335	5,193	5,170	4,758	3,586	3,531	**3,531**
Motor Vehicles																	
Ted Williams Tunnel through-traffic	NA			NA	NA	NA	NA	NA	NA	151	133	121	112	0[4]	0[4]	0[4]	**0[4]**
Parking/curbside	1,218			952	820	650	644	586	772	437	495	440	295	253	180	179	**179**
On-airport vehicles[5]	1,689			1,575	1,451	1,087	1,514	1,283	1,883	2,547	2,245	2,001	1,872	1,685	1,412	1,290	**1,290**
Total motor vehicle sources	2,907			2,527	2,271	1,737	2,158	1,869	2,655	3,135	2,873	2,562	2,279	1,938	1,592	1,469	**1,469**
Other Sources																	
Fuel storage/handling	0			0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Miscellaneous sources[6]	31			26	30	29	39	37	37	168	27	24	23	22	33	40	**40**
Total other sources	31			26	30	29	39	37	37	168	27	24	23	22	33	40	**40**
Total Airport Sources	17,457	NA	NA	17,704	15,003	14,357	14,737	14,640	11,853	14,436	13,111	12,056	10,952	10,177	9,851	9,559	**9,556**

kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Information not available:. Emissions were not computed in 1991 and 1992.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2=MOBILE6.2 version .01 or version .03)
1 Year 1999 emissions were last re-calculated using EDMSv4.21 in the *2004 ESPR* Air Quality Analysis.
2 Year 2005 emissions are computed using the most recent version of EDMS (version4.5) and the previous version (version 4.21) for comparison to 2004 results.
3 Beginning in 1996 and later, emissions include 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 1999 – 2005 include reductions attributable to CNG shuttle buses. Since 2001, actual CNG Bus mileage is used to calculate the credit. An average mileage for 1999 CNG Bus usage was assumed, based on 2001 – 2004 data.
6 Fuel storage and handling facilities are not sources of CO emissions.
7 Includes the Central Heating/Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999, and 2003 thru 2005. Diesel snowmelter usage was added in 1999, 2004, and 2005.

Particulate Matter

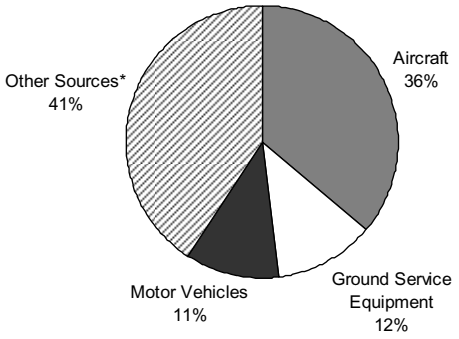
As stated previously, it is assumed for this analysis that all particulate matter are classifiable as $PM_{2.5}$. Table 7-7 shows that total $PM_{2.5}$ emissions at Logan Airport in 2005 were approximately 83 kg/day (33 tpy) and Figure 7-7 provides a breakdown of these emissions by source. As shown, stationary sources (e.g., Central Heating and Cooling Plant, snowmelter usage, fire training, etc.) represent the largest (41 percent) source of $PM_{2.5}$ followed by aircraft (36 percent), GSE (12 percent), and motor vehicles (11 percent). Since this is first reporting year, no comparison to previous years is possible for particulate matter.

Table 7-7 Estimated 2005 $PM_{2.5}$ Emissions at Logan Airport[1,2]

Aircraft Sources	**kg/day[3]**
Air carriers	25
Commuter aircraft	1
Cargo aircraft	2
General aviation	2
Total aircraft sources	30
Ground Service Equipment	10
Motor Vehicles	
Ted Williams Tunnel through-traffic[4]	0
Parking/curbside	1
On-airport vehicles	8
Total motor vehicle sources	9
Other Sources	
Fuel storage/handling[5]	0
Miscellaneous sources[6]	34
Total other sources	34
Total Airport Sources	83

1 Emissions computed using EDMSv4.5 MOBILE6.2 version .03.
2 It is assumed that all PM are less than 2.5 microns in diameter ($PM_{2.5}$).
3 kg/day = kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
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 Fuel storage and handling facilities are not sources of PM emissions.
6 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources.

Figure 7-7 Sources of $PM_{2.5}$ Emissions in 2005



* Other sources include stationary sources (e.g., Central Heating and Cooling Plant, emergency electricity generator).

Measured NO_2 Concentrations

This section presents the results of Massport's ambient (i.e., outdoor) air quality monitoring program for NO_2; a pollutant associated with aircraft activity. Since 1982, Massport has been collecting NO_2 concentration data at numerous locations both on the airport and in neighboring residential communities. The purpose of this monitoring program is to track long-term trends in NO_2 levels and to compare the results to the NAAQS for this pollutant.

The protocol for this monitoring program calls for the collection of samples using passive diffusion tube technology over a one-week period, every month of the year and at each of the monitoring stations. The samples, along with Quality Assurance/Quality Control (QA/QC) samples, are then analyzed in a laboratory.

Table 7-8 presents the 2005 NO_2 monitoring data in micrograms/cubic meter ($\mu g/m^3$) and Figure 7-8 depicts the locations of the 27 sites currently in the Massport NO_2 monitoring network. For comparative purposes, historic data from 1999 to 2004 are also shown in Table 7-5. The table also includes NO_2 data collected separately by the MDEP using continuous monitors at four Boston-area stations, none of which are located on, or adjacent to, Logan Airport.

Table 7-8 Massport Annual NO_2 Concentration Monitoring Results ($\mu g/m^3$)

Monitoring Site	Site No.	Year 1999	2000	2001	2002	2003	2004	2005
Massport Monitoring Sites								
Runway 9	**1**	61.0	58.2	41.6	45.8	33.9	30.1	**29.2**
Runway 4R	**2**	55.6	44.6	41.4	36.9	32.5	30.9	**30.7**
Runway 33L	**3**	47.7	42.6	39.4	33.3	30.8	25.4	**24.5**
Runway 27	**4**	42.9	37.8	35.8	30.3	25.5	24.1	**22.7**
Runaway 22L	**5**	47.5	39.8	38.2	33.8	27.8	23.7	**22.1**
Runway 22R	**6**	60.6	59.2	51.6	45.0	32.3	29.7	**32.9**
Runway 15R	**7**	47.0	43.4	44.3	42.6	40.8	28.7	**27.7**
Logan Statue	**8**	70.8	87.0	80.7	69.3	44.3	44.7	**46.2**
Webster St., Jeffries Point	**11**	52.4	45.5	43.4	39.1	32.5	28.3	**31.3**
Maverick Square, E. Boston	**12**	81.2	72.2	68.5	61.3	47.9	46.5	**41.4**
Bremen St., E. Boston	**13**	59.1	52.6	52.0	46.2	39.1	35.7	**37.6**
Shore St. E. Boston	**14**	45.7	38.5	38.8	35.0	27.2	24.0	**24.9**
Orient Heights Yacht Club	**15**	45.1	46.9	47.7	43.1	29.4	25.2	**25.5**
Bayswater St. E. Boston	**16**	45.2	45.5	48.3	41.2	28.4	22.8	**30.4**
Annavoy St. E. Boston	**17**	40.8	39.2	44.4	33.7	24.7	21.4	**23.3**
Pleasant St. Winthrop	**18**	42.0	39.3	37.8	32.3	27.9	22.6	**23.4**
Court Road, Winthrop	**19**	40.0	36.1	33.8	27.4	24.0	19.2	**22.3**
Cottage Park Yacht Club	**20**	37.1	50.9	45.9	36.7	22.5	19.1	**27.7**
Winthrop, Point Shirley	**21**	33.1	37.7	38.6	24.4	22.7	17.4	**17.2**
Deer Island	**22**	36.3	31.9	33.8	33.1	21.3	17.8	**16.9**
Runway 4R–9	**23**	42.2	66.0	42.3	33.4	28.6	24.1	**27.1**
Runway 33L–4R	**24**	44.3	41.7	41.8	33.5	28.1	24.3	**22.3**
Runway 22R–33L	**25**	62.4	50.3	49.4	42.2	33.8	31.7	**29.4**
Jeffries Point Park/Marginal St.	**26**	68.6	49.8	45.0	42.0	35.2	30.5	**32.5**
Harborwalk	**27**	54.3	48.5	47.4	43.5	35.6	35.5	**29.3**
Logan Athletic Fields	**29**	-	69.1	67.6	54.9	41.9	40.2	**37.5**
Brophy Park, Jeffries Point	**30**	-	48.0	45.2	41.0	36.5	31.2	**32.9**
Average of all Massport Monitoring Sites		**50.5**	**50.5**	**47.5**	**40.0**	**31.7**	**28.0**	**27.5**
MDEP Monitoring Sites								
Long Island Rd (MDEP)[1]	**A**	20.7	24.4	22.6	22.6	16.9	12.6	**13.2**
Harrison Ave. (MDEP)[1]	**B**	N/A	45.1	47.0	45.1	43.2	37.4	**35.8**
Kenmore Square (MDEP)[1]	**C**	56.4	54.5	56.8	47.0	47.0	51.7	**43.3**
East First Street (MDEP)[1]	**D**	39.5	37.6	43.2	39.5	39.5	36.8	**33.9**

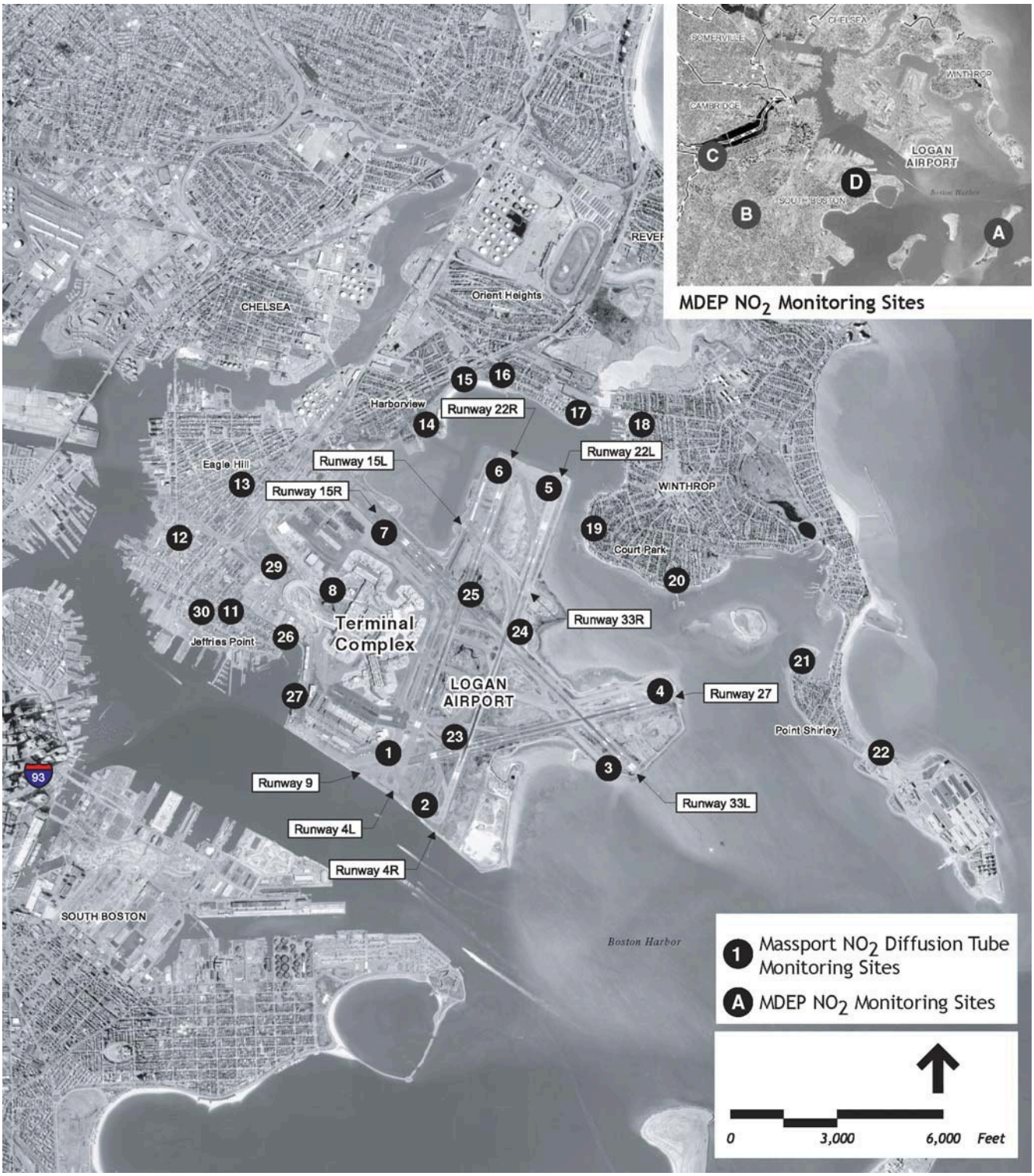
($\mu g/m^3$) micrograms/cubic meter.

1 NO_2 monitoring sites operated by the MDEP.

Notes: The NAAQS is 100 $\mu g/m^3$

The site identification labels in Figure 7-8 are keyed to the site labels in this table.

Figure 7-8 Massport NO_2 Monitoring Sites



As shown in Table 7-8, there has been an ongoing trend of decreasing NO_2 concentrations at both the Massport and MDEP monitoring sites. Other observations of the 2005 data show that:

- Annual NO_2 concentrations at all monitoring locations were below the annual NO_2 NAAQS of 100 $\mu g/m^3$ in 2005.
- The highest NO_2 concentrations in 2005 occurred in areas characterized by high levels of motor vehicle traffic (i.e., Logan Statue (Site 8) and Maverick Square (Site 12).
- As in previous years, the 2005 NO_2 values in residential communities were generally lower than at the monitors located at the runway ends, with the exception of Site 5 (Runway 22L).

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_x levels should be assessed by looking at the results over a period of several years.

Air Quality Emissions Reduction

As part of the in-place and ongoing Air Quality Management Plan, Massport has established a number of goals and objectives to address the impacts associated with air emissions from airport operations; including the minimization of airport-related emissions through the Air Quality Initiative (AQI) and the reduction of GSE and Massport fleet emissions with AFV. This section presents a 2005 update on the AQI and the Alternative Fuel Vehicle (AFV) Program at Logan Airport.

Air Quality Initiative

Massport developed the AQI as a long-range voluntary program with the overall goal to maintain NO_x emissions associated with Logan Airport at, or below, 1999 levels. The AQI has four primary objectives, shown below, along with Massport's progress in meeting the AQI criteria.

- **Expand on the initiatives already in-place at Logan Airport.** See Table 7-9 provided below.
- **As necessary to maintain NO_x emissions at or below 1999 levels, retire emissions credits, giving priority to mobile sources.** Massport updates the Logan Airport inventory of NO_x emissions annually to reflect new information and changing conditions associated with the airport's operations. Table 7-9 presents the updated emissions inventory and shows that, in 2005, it was not necessary to retire emission credits to maintain NO_x emissions at or below 1999 levels.
- **Report the status and progress of the AQI in the ESPR or EDR.** This section fulfills this goal.

- **Continue to work at international and national levels to decrease air emissions from aviation sources.** Massport maintains memberships and active participation in a number of organizations involved in addressing aviation-related environmental issues; including air quality. These include serving on environmental committees for the Transportation Research Board (TRB), American Association of Airport Executives (AAAE), and Airports Council International (ACI). Massport also hosted the University of California, Institute of Transportation Studies, Annual *Airport Noise and Air Quality Symposium* Planning Committee Meeting in June, 2006.

As shown in Table 7-9, NO_x emissions at Logan Airport in 2005 (net total with reductions and credits) were approximately 662 tpy lower than 1999 levels - a 28 percent decrease. Therefore, there was no need to purchase NO_x emissions credits in 2005 to meet the goals of the AQI. Between 1999 and 2005, the greatest reductions of NO_x emissions were associated with aircraft, GSE, and on-airport motor vehicles – a 28 percent, 24 percent, and 44 percent reduction, respectively.

Figure 7-9 compares the modeled NO_x emissions for 2001-2005 to the 1999 threshold level of 2,347 tpy. Cumulatively, as of December 31, 2005, NO_x emissions at Logan Airport were approximately 2,762 tons below the benchmark set by the AQI. As shown in Table 7-9, based upon current projections no credits will need to be purchased through the AQI period of 2015, since the emission inventory is projected to be below the 1999 baseline emission inventory through 2015.

Figure 7-9 NO_x Emissions Compared to AQI

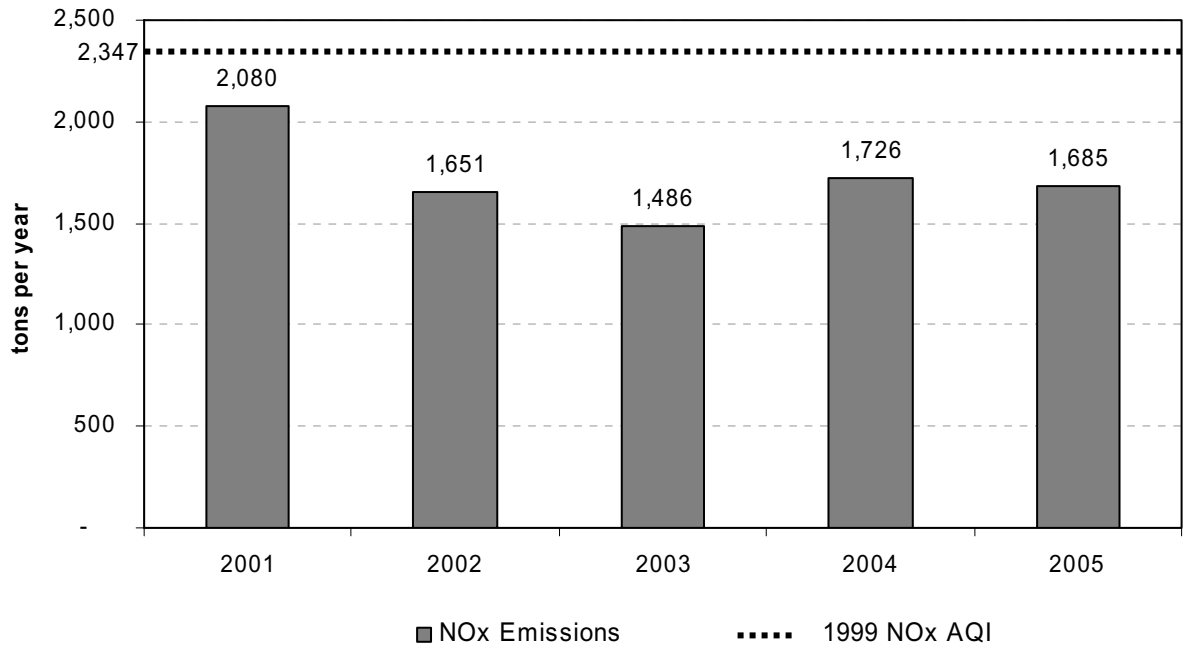


Table 7-9 AQI Inventory Tracking of NO_x Emissions (in tpy)[1] for Logan Airport

	Actual Conditions[2]							Forecasted Conditions[2]									
	1999[3]	2000	2001[4]	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Annual Emissions	**2,347[5]**	2,315	2,097	1,665	1,499	1,745	1,703	1,815	1,850	1,885	1,920	1,955	1,991	2,026	2,061	2,096	2,131
Above (Below) 1999 Levels Before Reductions	NA	(32)	(250)	(682)	(848)	(602)	(644)	(532)	(497)	(462)	(427)	(392)	(356)	(321)	(286)	(251)	(216)
Potential Reductions/Increases[6]																	
Alternative Fuel Vehicles/Shuttle Bus[7]	(11)	(4)	(4)	(3)	(3)	(10)	(9)	(8)	(7)	(6)	(5)	(4)	(3)	(2)	(1)	0	1
Electric Ground Service Equipment	(14)	(14)	(13)	(11)	(10)	(9)	(9)	(9)	(10)	(10)	(10)	(10)	(10)	(10)	(11)	(11)	(11)
Total Potential Reductions	(25)	(19)	(17)	(14)	(13)	(19)	(18)	(17)	(17)	(16)	(15)	(14)	(13)	(13)	(12)	(11)	(10)
Above (Below) 1999 Levels After Reduction	NA	(51)	(267)	(668)	(861)	(621)	(662)	(550)	(514)	(478)	(442)	(406)	(370)	(334)	(298)	(262)	(226)
Credit Trading[8]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Net Total w/Reductions and Credits	2,322	2,296	2,080	1,651	1,486	1,726	1,685	1,798	1,834	1,870	1,905	1,941	1,977	2,013	2,049	2,085	2,121

Notes: Values in parentheses, such as "(250)" are negative values. Values without parentheses are positive values.
"NA" means not applicable.

1 For consistency with the AQI, the NO_x emission values in this table are reported in tons/year. The EDR/ESPR Emissions Inventory values are reported in kg/day. A conversion factor of 0.40234 is used to convert kg/day to tons/year.

2 1999 and 2004 analysis years were updated in the *2004 ESPR* using EDMSv4.21. 2000 and 2001 were based on the *2001 EDR* analysis using EDMSv4.03 and MOBILE6. The 2002 to 2004 analyses were completed using EDMSv4.11 and MOBILE6. The year 2005 analysis was computed using EDMSv4.5. The years 2006 through 2015 were interpolated using the 2020 analysis provided in Table 7-9 of the *2004 ESPR*.

3 The year 1999 is the "baseline" year for the AQI. Thus, 2,347 tons/year is considered the AQI threshold for NO_x emissions.

4 The year 2002 is the inaugural year of the AQI.

5 The original value of 2,235 tons/year in the AQI was based on the *2001 EDR* results and EDMSv4.03. This value was updated in the *2004 ESPR* using EDMSv4.21.

6 Other initiatives that Massport and Logan Airport tenants may use for possible emission reductions include: Consolidated Car Rental Facility, Central Heating and Cooling Plant Boilers, 400-Hz power at gate and low NO_x fuels in Logan Express buses.

7 Massport's current plan for the conversion of GSE to alternative fuels is being re-evaluated based on the new diesel rule (2007). Therefore, to be conservative, GSE AFV credits were kept consistent and are based on the same percentages as the 2004 analysis.

8 Since the AQI threshold is not exceeded in 2005, nor are the emissions expected to exceed the threshold in the near future, no credits will need to be purchased in the immediate term. Emissions will be re-evaluated each year, with a revised projection for 2015 in the next ESPR.

As part of the reporting process, the AQI called for an itemization of NO_x emissions generated by Logan Airport activities according to the individual airline operator. Table 7-10 shows the amounts of NO_x air emissions generated by each airline in units of tons per year and tons per landing and take-off cycle (LTO). Each LTO consists of taxiing, queuing, takeoff, climb out, approach, and landing operations. Importantly, the comparison of air quality impacts based solely on emissions/LTO may not be directly relevant to any assessment of a specific airlines' overall environmental performance.

In August 2006, in an effort to reduce air quality emissions associated with taxiing, Massport sent letters to all airlines operating at Logan Airport encouraging the voluntary use of single-engine taxiing, consistent with safety requirements, pilot judgment and the requirements of federal laws (see *Appendix I, Air Quality Emissions Reduction*). Massport staff will follow up with airlines in relation to this request.

Table 7-10 Contribution of NO_x Air Emissions by Airline in 2005 (Estimated)

	Total Emissions (tons/year)		Normalized Emissions (tons/LTO)		Total Emissions (tons/year)		Normalized Emissions (tons/LTO)
Air Carrier, by Airline	LTOs	NO_x	NO_x per LTO	Air Carrier, by Airline	LTOs	NO_x	NO_x per LTO
Aer Lingus	506	14.27	0.028	Kalitta Charters	25	0.08	0.003
Aeromexico	267	1.96	0.007	Kitty Hawk Air Cargo	238	2.69	0.011
Air Canada[1]	5,449	15.84	0.003	LACSA	9	0.07	0.007
Air France	668	21.55	0.032	Lufthansa	781	30.66	0.039
Air Jamaica	173	1.83	0.011	Mesa Airlines	689	1.28	0.002
Airborne Express	423	5.74	0.014	Miami Air	1	0.01	0.012
Airtran Airways	7,290	48.18	0.007	Midwest Airlines	1,785	11.82	0.007
Alaska Airlines	546	5.42	0.010	North American	259	4.24	0.016
Alitalia	493	11.50	0.023	Northwest Airlines[5]	7,722	61.83	0.008
America West	2,233	17.55	0.008	Omni Air	17	0.26	0.015
American Airlines[2]	37,209	260.40	0.007	Other Charter	40	0.32	0.008
American Trans Air	1,160	11.78	0.010	Other International	9	0.31	0.035
Astar Air Cargo	359	5.02	0.014	Privatair	21	0.27	0.013
Boston-Maine Airways	79	0.25	0.003	Ryan International	196	2.62	0.013
British Airways	1,075	77.71	0.072	SATA International	158	2.70	0.017
Cape Air	12,137	0.48	0.000	Skylink Aviation	125	0.07	0.001
Capital Cargo International	208	2.71	0.013	South Winds Cargo	6	0.00	0.000
Cayman Airways	28	0.15	0.005	Swissair	352	8.56	0.024
Colgan Air	6,293	3.12	0.000	TACA	163	1.34	0.008
Continental[3]	13,417	52.78	0.004	Transmeridian	5	0.06	0.011
Custom Air Transport	235	2.66	0.011	Trans States Airlines	1,489	3.81	0.003
Delta[4]	33,525	220.25	0.007	United Airlines[6]	10,051	92.72	0.009
Federal Express	2,252	52.35	0.023	UPS Airlines	711	13.55	0.019
Finnair	23	0.29	0.013	US Airways[7]	26,567	165.76	0.006
GA	16,344	20.13	0.001	Virgin	363	17.25	0.048
Icelandair	482	7.90	0.016	World Airways	4	0.15	0.037
Independence Air	2,338	9.32	0.004	**Totals**	204,533	1,354.32	0.007
JetBlue	7,535	60.78	0.008				

Notes: Other Charter may include: Casino Express, Falcon Air Express, Pace Airlines, etc.
Other International may include: Caymen Airways, Mexicana, Saudi Arabian Airlines, etc.
The "Other" Categories may include airlines with less than 10 operations.
Normalized emissions are based on a Landing and Take-Off Cycle (LTO).
This list combines the major airlines with their commuters (i.e., ComAir with Delta Air Lines, American Eagle with American, etc.)

1 Includes Jazz.
2 Includes American Eagle.
3 Includes Expressjet and Commutair.
4 Includes Chautauqua and Comair Airlines.
5 Includes Pinnacle Airlines.
6 Includes Chautauqua and Air Wisconsin.
7 Includes Chautauqua, Air Wisconsin, Piedmont Airlines, Pennsylvania Commuter Airlines, PSA Airlines, and Republic Airlines.

Based on the information shown in Table 7-10, international carriers are the higher NO_x emitters per LTO because their longer stage lengths require aircraft equipped with larger and/or additional engines. Overall, international carriers emit 16 percent of the total aircraft NO_x emissions at Logan Airport. Other results include:

- Carriers with the greatest number of flights tended to generate the highest percentage of NO_x emissions.
- Combined, the four largest air carriers (by LTO), emitted 52 of the aircraft NO_x emissions in 2005.
- Commercial airlines (excludes cargo and GA) accounted for 92 percent of aircraft NO_x emissions.
- Cargo aircraft operators accounted for 6 percent of aircraft NO_x emissions.
- General aviation aircraft accounted for 2 percent of aircraft NO_x emissions.

Alternative Fuel Vehicles (AFV) Program

The second main component of Massport's Air Quality Management initiative is the AFV Program. The AFV Program is designed to phase out conventionally-fueled vehicles and replace them with alternative fuel vehicles when feasible to help with emission reductions at Logan Airport. To support its growing fleet of alternative fueled vehicles, Massport has developed and maintains an extensive infrastructure for electric vehicles with numerous charging spaces and inductive chargers located in key locations at the airport. For the past 11 years, Massport has also had a privately operated CNG station on site (located on the north side of the airport near the Economy Parking Lot). This station primarily supports Massport's fleet of 32 shuttle buses and is also open to the public. The amount dispensed at the CNG station is approximately 41,500 gallon equivalents per month. Table 7-11 reports the number of Massport AVFs by vehicle type and the number of vehicles Massport added to its fleet in 2005.

Table 7-11 Massport's Alternative Fuel Vehicle Fleet Inventory at Logan Airport as of December 31, 2005

Fuel Type	Vehicle	Number
Electric	Mini-Bus	2
	Solectria Citivan Stepvan	5
	Solectria Force Sedan	4
	Pick-Up Truck	1
	Off-road vehicles	28
Compressed Natural Gas (CNG)	Ford Crown Victoria	4
	Econoline Van	6
	Pick-Up Truck	10
	Honda Civic	1
	Shuttle Bus	32
	Wheelchair Lift Cut Away Bus	1
CNG/Electric Hybrid	Solectria Citivan Stepvan	1
	Non-Road Vehicles	10
Gasoline/Electric Hybrid	Ford Escape	1
Propane	Non-Road Vehicles (Forklifts)	2
	Total	**108**
	Total acquired in 2005	**3**
	Total disposed of in 2005	**8**

Source: Massport

One gasoline/electric hybrid Ford Escape and two propane powered forklifts were acquired in 2005. Eight electric pick-up trucks were disposed of in 2005.

Massport now operates 108 vehicles powered by natural gas, propane, electricity or hybrids using gasoline and alternate fuels. Massport continues to purchase alternative fuel vehicles as opportunities arise.

Due to the airlines' continuing focus on security and overall cost recovery, GSE conversion has not been a priority for Massport's tenants since late 2001. However, Massport will continue with its efforts to encourage the airlines to introduce AFVs at Logan Airport when they are economically and operationally viable. Massport will also continue to track GSE fleets for Logan Airport tenants through periodic surveys and will present the results in future EDRs/ESPRs.

Air Quality Management Status

Massport's multifaceted air quality management practices focus on decreasing emissions when feasible from all airport-related sources in addition to studying innovative means to achieve emissions reductions. Massport's air quality improvement goals, the measures proposed to accomplish them, and some 2005 milestones are presented in Table 7-12.

Table 7-12 Air Quality Management Plan Status

Air Quality Emissions Reduction Goals	Plan Elements	2005 Status
Reduce emissions from Massport fleet vehicles	Convert Massport fleet vehicles to electricity or compressed natural gas (CNG) by retrofitting or procurement.	Massport continues to procure alternative fuel vehicles (AFVs) and substitute them for conventionally fueled vehicles. Three new AFVs were acquired in 2005 (including two non-road vehicles), and eight vehicles were disposed of, for a total of 108.
		Massport uses the Energy Policy Act (EPAct) of 1992 to expedite Massport's AFV program. Under EPAct, Massport is required to purchase 75 percent of its light-duty vehicles as AVFs. Public safety vehicles are excluded from this requirement. Total accrued banked EPAct credits are 36 in 2005.
Encourage use of alternative-fuel vehicles by private fleet and airside service vehicle owners	Provide infrastructure to support alternative fuels including CNG and electricity.	Massport continues to operate New England's largest CNG station, which is open to the public. The CNG station operates at approximately 500,000 gallon equivalents per year, serving over 100 vehicles daily. Massport also continues to maintain an extensive electric vehicle charging infrastructure. The electric charging infrastructure has grown to include 15 inductive charging stations and 14 dedicated conductive charging parking spaces.
	Work with ground access fleet and airside service-vehicle owners to encourage conversion.	Massport encourages conversion to AFVs through such policies as 50 percent discounts in AFV ground access fees to taxis, limousines, etc.

Table 7-12 Air Quality Management Plan Status (Continued)

Air Quality Emissions Reduction Goals	Plan Elements	2005 Status
Encourage use of alternative-fuel vehicles by private fleet and airside service vehicle owners (continued)	Use of pre-conditioned air (PCA) at new and renovated terminals.	As of 2005, 100 percent of the gates have PCA and 400-Hz power. This reduces the need for APUs and, consequently, reduces associated emissions.
Minimize emissions from motor vehicles	Implement a program to increase HOV ridership by air passengers.	Overall high occupancy vehicle (HOV) mode share (including transit) for air passengers increased from 25.8 percent in 1990 to 30.3 percent in 2004. Updated HOV mode share data will be available when the next air passenger survey is conducted in 2007. Refer to *Chapter 5, Ground Transportation Improvement* for details.
	Expand the Logan Airport Employee Transportation Management Association (Logan TMA) for airport employees.	The TMA provides commuting information to all airport employees. Massport recently provided resources to revitalize the TMA and to provide greater outreach and benefits to members.
Minimize emissions from Construction Equipment	Incorporated Clean Air Construction Initiative (CACI) into major earthwork construction projects.	For all construction projects (i.e., Terminal A, Central Garage, and Runway 14-32) heavy construction equipment is required to be retrofitted with diesel particulate filters or diesel oxidation catalysts in accordance with CACI.
Reduce emissions from fuel vapor loss	Provide state-of-the-art fuel storage and distribution equipment.	The Fuel Storage and Distribution System is in operation.
	Implement Tank Management Program.	Refer to *Chapter 8, Water Quality/Environmental Compliance*. Tank management focuses on proper maintenance.
Reduce emissions from stationary sources	Employ Reasonable Available Control Technologies (RACT) for NO_x at Central Heating/Cooling Plant.	RACT policies have been implemented.
	Use alternative fuels in snow melters.	Ultra Low Sulfur Diesel (ULSD) fuel is used in all snowmelters.
	Incorporate green building technologies and energy use reduction strategies.	Massport participates in the State Sustainability Program. Terminal A is LEED™-Certified and Terminal E incorporates green building elements. An overview of sustainability initiatives is presented in *Chapter 1, Introduction/Executive Summary*.
Reduce aircraft emissions	Work with the FAA to study and implement airfield-improvement concepts and operational changes that may have air quality benefits.	Massport promoted such concepts through the *Logan Airside Improvements Planning Project Environmental Impact Report/Statement*.

In addition to measures described in Table 7-12, Massport, through its involvement in the Massachusetts Clean Cities Program, has supported the education of the general public with respect to sustainable transportation through its sponsorship of the Altwheels Transportation Festival since its inception in 2003.

Updates on Other Air Quality Initiatives

In 2004, the Massachusetts Legislature appropriated funds for the Department of Public Health (DPH) to undertake an assessment of potential health impacts of Logan Airport in the East Boston section of the city and any other communities located within a five-mile radius of the airport. With the focus on noise and air quality, this study is presently underway and consists of an epidemiological survey combined with computed modeling of noise levels and air pollution concentrations. Massport has voluntarily provided DPH with airport operational data in support of the assessment, which is likely to be completed in 2007.

As a condition of the Massachusetts Environmental Policy Act (MEPA) requirements outlined in the Logan Airside Improvement Project Environmental Impact Report/Statement, Massport is also required to conduct an air quality monitoring study in the vicinity of the airport in connection with the Centerfield Taxiway project. The purpose of this study is to measure ambient concentrations of hazardous air pollutants (HAPs) associated with airport operations. Massport has allocated funding for the work, selected a contractor, and air monitoring is expected to commence in 2007.

Advancements on the national and international levels to decrease airport-related air emissions focused primarily on three initiatives in 2005: the measurement of emissions from aircraft engines; improved combustion efficiency of aircraft engines; and the continued phasing in of AFV. These initiatives are briefly described below:

- In late 2005, FAA developed and published its First Order Approximation (FOA) for computing PM emissions from aircraft engines. This methodology was used for the first time in this EDR to compute PM emissions from aircraft engines. Conducted separately and under the newly formed FAA/NASA/Transport-Canada Center of Excellence (COE), research is also now underway to measure PM and HAPs emissions from aircraft engines and to evaluate their potential health effects. Similarly, NASA is conducting measurements to better characterize PM emissions from aircraft engines as part of their Aircraft Particle Emissions eXperiment (APEX). All of these measurement activities are being tracked and coordinated as part of the FAA's Aircraft National PM Roadmap. Massport continues to closely track these issues through its involvement in aviation industry organizations such as Airports Council International (ACI).

- The EPA amended the existing emission standards for NOx for new commercial aircraft engines in 2005. These new standards are equivalent to the NOx emission standards of the United Nations International Civil Aviation Organization (ICAO), and will bring the U.S. aircraft standards into alignment with the international standards. NASA's Ultra-Efficient Engine Technology (UEET) project, also underway in 2005, is intended to achieve a 70 percent reduction in future aircraft engine emissions. Other ongoing initiatives by aircraft and aircraft engine manufactures as well as airlines are aimed at reducing fuel use and other airport-related emissions.

- Airlines and other GSE-providers are continually replacing their older fossil-fueled vehicles and equipment with low- and no-emitting technologies. Airport-fleet vehicles are also being converted to alternative fuels. In response, GSE and automobile manufactures are offering a wider selection of AFVs, many of which are designed specifically for airport use. Massport's AFV Program is an example of these initiatives. In 2005, FAA also launched an incentive program called Voluntary Airport Low Emission (VALE) to encourage airports nationwide to accelerate this conversion process.

- Massport was one of 15 state agencies and authorities that participated in the development of the Climate Protection Plan: the Commonwealth's initial step towards reducing greenhouse gases (GHG). Specifically, Massport is participating on two of the Plan's teams: Transportation System Planning and transportation Technologies and Operations, with a focus on GNG emission reductions associated with airport operations. Several reduction strategies that are already in place include the following:

  - Include energy use and GHG emission data as criteria in transportation decisions
  - Maintain and update public transit systems
  - Expand programs to promote efficient travel
  - Seek opportunities to reduce emissions at Logan Airport
  - Improve aircraft movement efficiency
  - Promote the use of cleaner vehicles and fuels in public transit fleets

- Continue to promote the use of clean diesel equipment on state-funded construction projects
- Eliminate unnecessary idling of buses
- Advocate aircraft efficiency at regional and national levels

- Massport maintains memberships and active participation in a number of organizations involved in addressing aviation-related environmental issues; including air quality. These include serving on environmental committees for the Transportation Research Board (TRB), AAAE and ACI. Massport also hosted the University of California, Institute of Transportation Studies, Annual Airport Noise and Air Quality Symposium Planning Committee Meeting in June, 2006.

- Massport has selected an air quality consultant to conduct the centerfield taxiway air quality monitoring study.

Massport will continue to monitor these initiatives and will report on their progress in the *2006 EDR*.