Ventura County Air Pollution Control District

OTHER MOBILE SOURCES
OTHER AIRCRAFT
2008 - ACTIVITY 48

EMISSION INVENTORY CODES (EIC/CES CODES) AND DESCRIPTION:

Piston Aircraft – Civil	810-804-1140-0000	(57331)
Agricultural Aircraft (Crop Dusting)	810-806-1140-0000	(47563)
Jet Aircraft – Commercial	810-810-1400-0000	(47555)
Jet Aircraft- Civil	810-812-1400-0000	(47589)

DESCRIPTION:

This activity is used to compile the combustion emissions from civil, commercial and agricultural aircraft.

2008 COUNTY TOTAL EMISSIONS:

	TOC	ROC	NOx	CO	SO_2	PM	PM10	PM2.5	Pb	CO2
Planning (tons/day):	0.07	0.06	0.02	2.80	0.01	0.01	0.00	0.00	0.00	14.30
Annual (tons/year):	23.58	20.89	7.65	970.86	2.21	0.14	0.13	0.11	0.76	4,988.14

COMMERCIAL and CIVIL AIRCRAFT

Piston Aircraft – Civil	**EIC 810-804-1140-0000**	**CES 57331**
Jet Aircraft – Commercial	**EIC 810-810-1400-0000**	**CES 47555**
Jet Aircraft – Civil	**EIC 810-812-1400-0000**	**CES 47589**

METHODOLOGY:

2008 commercial and civil aircraft emissions are represented in three emission categories: EIC 810-804-1140-0000/CES 57331 “Piston Aircraft Civil”, EIC 810-810-1400-0000/CES 47555 “Jet Aircraft Commercial” and EIC 810-812-1400-0000/CES 47589 “Jet Aircraft Civil”. “Piston Aircraft Civil” includes single and twin engine piston aircraft and helicopters, while “Jet Aircraft Commercial” and “Jet Aircraft Civil” both contain turbine engine and jet powered aircraft.

Beginning with the 2006 inventory, aircraft missions were estimated separately for each of the three large civilian airports in Ventura County: Santa Paula, Oxnard and Camarillo. Emissions had been estimated by aircraft type on an aggregated county-wide basis in previous inventory years. Each airport has annual operations activity for an individual population of aircraft and aircraft engine emission factors reflecting the landing and take-off (LTO) time-in-mode operating profiles specific to that airport. The LTO time-in-mode profile represents the duration in minutes

spent in four operational modes (taxi/idle, takeoff, climbout and approach) by four types of aircraft (business jet, commercial turboprop, civil helicopter and general aviation piston aircraft). 2008 aircraft operations data for each of the three large airports were allocated to aircraft types in the three emission categories based on the population of aircraft based at each airport. An aircraft operation represents either a landing or takeoff by an aircraft. Since a landing/take-off cycle accounts for two operations, aircraft operations are divided by two to determine the number of landing/takeoffs.

In March 2009, EPA identified 20,000 airport facilities nationwide that would be included in their 2008 National Emissions Inventory (NEI) Emission Inventory System (EIS) facility inventory. Included for Ventura County in addition to the three large airports were one small private civilian airport and 14 heliports. Although EPA did not specify operations data for these additional facilities, aggregated operations and emissions were estimated for them beginning with the 2008 inventory.

For Santa Paula airport, total operations are based on a Caltrans noise study in 1997, which is representative of total operations in 2008 according to the Santa Paula Airport Association manager (Reference 1). Santa Paula airport does not have a control tower like the other two airports, and there is no official Federal Aviation Administration (FAA) accounting of aircraft operations. All operations are assumed to be civil general aviation; there are no commercial operations. Total annual operations are allocated to piston aircraft civil (single and twin engine fixed wing aircraft), helicopters and jet aircraft civil (turboprop) aircraft types by the proportion of aircraft based at Santa Paula airport according to the FAA airport master record (Reference 2). Piston single engine aircraft operations are distributed by aircraft model based on the population of aircraft at one of the flight schools and information from the Santa Paula Airport Association (Reference 3). Operations are further distinguished as either a full LTO cycle of all four operational modes (75% of operations) or a touch and go (TGO) cycle without a taxi/idle mode associated with landing/takeoff practice at the flight schools (25% of operations), as suggested by the Santa Paula Airport Association (Reference 1). Helicopter operations were distributed between turbine powered (turboshaft) models (75%) and piston engine powered models (25%) based on EPA's presumed national default estimate described in their March 2009 document Calculating Aviation Gasoline Lead Emissions in the 2008 NEI (Reference 4). Only one aircraft model is assumed for piston twin engine aircraft, piston engine helicopters, turbine powered helicopters and turboprop aircraft, and all have full LTO cycles. Table 1 shows the allocation of 2008 annual LTOs and TGOs by aircraft type at Santa Paula airport.

For Oxnard airport, total monthly general aviation and air taxi operations during 2008 were obtained from the FAA Air Traffic Activity Data System (ATADS) database (Reference 5). The FAA ATADS "general aviation" category includes locally based and itinerant civilian and military aircraft, and the "air taxi" category is considered to be jet aircraft commercial aviation. General aviation operations are allocated to piston aircraft civil (single and twin engine aircraft), helicopters, and jet aircraft civil (turboprop and jet) aircraft types by the proportion of aircraft based at Oxnard airport according to the FAA airport master record (Reference 6). A special provision was made for jet aircraft civil because although the FAA master record lists no based

jet aircraft, there are itinerant civil jet operations at Oxnard, according to the Ventura County Department of Airports (Reference 7). Jet aircraft civil operations were estimated from total general aviation operations on the basis of the proportion of business jet aircraft operations at Oxnard airport in a 2000 county-wide survey data from the Ventura County Department of Airports (Reference 8). Piston single and twin engine aircraft operations are distributed to aircraft model subcategories representing the most predominant types of aircraft advertised for flight schools and charter services at the airport. Piston single engine operations are further distinguished as either a full LTO cycle of all four operational modes (75% of operations) or a touch and go (TGO) cycle without a taxi/idle mode associated with landing/takeoff practice at the flight schools (25% of operations), assuming the same distribution for Santa Paula airport is applicable at Oxnard. Piston twin engine aircraft, helicopters and other aircraft have full LTO cycles. Helicopter operations were distributed between turbine powered (turboshaft) models (75%) and piston engine powered models (25%). Only one aircraft model each is assumed for turbine and piston engine powered helicopters. Civil jet aircraft operations are distributed between turboprop (83%) and jet aircraft (17%) based on information from Ventura County Department of Airports (Reference 7). Civil turboprop aircraft operations are distributed to aircraft model subcategories representing the most predominant types of aircraft advertised for charter services at the airport. Jet aircraft operations are distributed by aircraft model based on the proportions from the 2000 county-wide survey (Reference 8). Air taxi jet aircraft commercial aviation was assumed to be a single model of turboprop aircraft on regularly scheduled flights operated by a commercial airline serving Los Angeles. Table 2 shows the allocation of 2008 annual operations by aircraft type at Oxnard airport.

A similar process was used for Camarillo Airport. FAA Air Traffic Activity Data System (ATADS) database 2008 operations (Reference 5) and FAA airport master record based aircraft (Reference 9) were used to determine general aviation (piston single and twin engine aircraft), helicopters and jet aircraft civil (turboprop and jet) aircraft types. The FAA ATADS "air taxi" category is considered to be jet aircraft commercial aviation. Piston single and twin engine aircraft operations were distributed to aircraft model subcategories representing the most predominant types of aircraft advertised for flight schools and charter services at the airport. Piston single engine operations are distinguished as 75% LTOs and 25% TGOs. Helicopter operations were distributed between turbine powered (turboshaft) models (75%) and piston engine powered models (25%). One aircraft model each is assumed for turbine and piston engine powered helicopters. Jet aircraft civil operations were distributed between turboprops (83%) and jet aircraft (17%), which were further distributed to individual aircraft models representing the most predominant types of aircraft advertised for charter services at the airport. Jet aircraft commercial ("air taxi") operations are assumed to be attributable to aircraft charters, not regularly scheduled service, and were distributed between turboprop and jet powered aircraft models similar to civil jet aircraft. Table 3 shows the allocation of 2008 annual operations by aircraft type at Camarillo airport.

Beginning with the 2008 inventory, aircraft operations were estimated for one small private civilian airport and 14 heliports in Ventura County, identified by EPA in March 2009 (Reference

10). Since aircraft operations are not reported to the FAA by these small facilities, assumptions used by EPA for facilities without reported operations were relied upon to estimate annual aircraft operations (Reference 4). The small private civilian airport was assumed to have 4,168 operations for the most common model of single engine piston aircraft at the three large airports (Cessna 172 SP). Heliports are assumed to have 282 operations annually, 75% for one turbine powered model and 25% for one piston powered model. All operations are assumed to be full LTOs. Table 4 shows the 2008 annual operations by aircraft type at these additional 15 facilities collectively referred to as Ventura County 'Other Facilities'. Individual facilities are listed in Table 5.

Prior to the 2006 inventory, the LTO time-in-mode profiles by aircraft type utilized the default time-in-mode values from EPA Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, Chapter 5.0 "Emissions from Aircraft" Table 5-1, intended to represent operations at large, congested, metropolitan airports which are not typical of local airports (Reference 11). Beginning with the 2006 aircraft inventory, time duration for the climbout and approach modes was adjusted for all three large airports from the default 3,000 foot mixing height to reflect the local mixing height, estimated to be 2,172 feet, based on an inversion study conducted at Point Mugu (Reference 12). Inversion study statistics used to estimate the local mixing height are shown in Table 6. Adjusted climbout and approach mode durations are about 30% less than the default values. Taxi/idle mode time was adjusted based on information for each airport (References 1 and 7). The EPA default duration for take-off mode was used for all three airports. Airport-specific and EPA default time-in-mode profiles by aircraft type are shown in Table 7. The Santa Paula airport operating profile was used for the Ventura County 'Other Facilities'.

The airport-specific time-in-mode profiles and aircraft operations were used in the FAA Emissions and Dispersion Modeling System (EDMS) model version 5.1.2 to estimate pollutant emissions and fuel consumption by aircraft for each airport (Reference 13). Each aircraft model in EDMS has a particular associated engine model and pollutant emission factors for each LTO profile operational mode. In some instances where there are no emission factors for a particular engine model in EDMS, substitute emission factors from similar or related engine models were used. EDMS emission factors are from the International Civil Aviation Organization (ICAO) Aircraft Engine Exhaust Emissions Data Bank (Reference 14), EPA AP-42 Compilation of Air Pollutant Emissions Factors, Volume II: Mobile Sources (Reference 15) and aircraft engine manufacturers. EDMS aircraft modal emission factors are expressed in units of grams/second/engine. The emission factor, number of engines per aircraft, airport time-in-mode profiles and number of annual LTOs and TGOs are used to calculate emissions except for lead (Pb) by aircraft type operational mode. Emissions at each airport are the summation of emissions occurring in each operational mode for aircraft operating at the airport.

Pb emissions result from the combustion of leaded aviation gasoline in piston engine powered aircraft. EDMS does not contain Pb emission factors and does not directly calculate Pb emissions. Instead, EDMS was used to calculate aviation gasoline consumption by operational mode for piston engine aircraft. Aviation gasoline consumed is multiplied by Pb concentration in

aviation gasoline (2.12 grams/gallon) and a factor accounting for Pb retention in the aircraft engine (5%) to estimate Pb emissions. These assumptions are described in EPA's Lead Emissions from the Use of Leaded Aviation Gasoline in the United States Technical Support Document (Reference 16). Airport Pb emissions are the summation of Pb emissions for piston engine aircraft operating at the airport. Jet fuel used by turbine engine powered aircraft does not contain lead and there are no associated lead emissions.

Emissions in the three emission categories by aircraft type for each of the three airports and Ventura County 'Other Facilities' are shown in Tables 8-11. The sum of emissions by emission category at all airports constitutes county-wide emissions in Table 12. ROG emissions were determined by multiplying total TOG emissions by the reactive organic fraction from the CARB organic profile for each emission category (Reference 17). PM emissions were determined by dividing total PM10 emissions by the PM10 particulate fraction from the CARB particulate profiles for each emission category and PM2.5 was determined from total PM by multiplying by the PM2.5 fraction (Reference 18).

Emission factors in Table 12 were back-calculated from total emissions using total LTOs and TGOs by emission category.

Temporal profiles for the three emission categories are shown in Table 13. FAA ATADS monthly operations data for Oxnard and Camarillo general aviation were allocated to piston aircraft civil and jet aircraft civil categories. Air taxi operations were assigned to the jet aircraft commercial category. Annual civil piston and jet (turboprop) operations at Santa Paula and Ventura County 'Other Facilities' are assumed to occur on an equivalent monthly basis.

TEMPORAL DISTRIBUTION:

Daily: Maximum activity during the day and evening hours; low activity in the early morning hours.

Weekly: Uniform activity seven days a week.

Annual:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PistonCiv	78	76	91	89	88	90	87	87	84	89	76	67
Jet Com	76	90	84	85	76	76	86	87	101	93	71	76
Jet Civ	76	73	88	86	85	88	89	89	87	90	78	69

SPATIAL DISAGGREGATION: Airport Location

GROWTH PARAMETER: Civilian Airport Operations.

ORGANIC REACTIVE FRACTION: 0.8845 for CES 57331 (Profile Number 413).
0.8921 for CES 47555, 47589 (Profile Number 586).

PM10 FRACTION: 0.9000 for CES 57331 (Profile Number 399).
0.9760 for CES 47555, 47589 (Profile Number 141).

PM2.5 FRACTION: 0.6800 for CES 57331 (Profile Number 399).
0.9670 for CES 47555, 47589 (Profile Number 141).

2008 PROCESS RATE: (LTOs)

	Annual
Piston Civil	136,772.0
Jet Commercial	4,966.0
Jet Civil	8,071.0
Total	149,809.0

EMISSION FACTORS: (pounds per LTO)

	TOC	ROC	NOx	CO	SO_2	PM	Pb	CO2
Piston Civil	0.283	0.250	0.035	13.806	0.016	0.000	0.009	38.931
Jet Commercial	0.556	0.496	1.206	4.139	0.229	0.009	0.000	558.687
Jet Civil	0.620	0.553	0.416	2.439	0.095	0.008	0.000	232.581

Composite emission factors from Table 12.

2008 COMMERCIAL and CIVIL AIRCRAFT EMISSIONS:

	TOC	ROC	NOx	CO	SO_2	PM	PM10	PM2.5	Pb	CO2
Planning (tons/day):										
Piston Civil	0.06	0.05	0.01	2.71	0.00	0.00	0.00	0.00	0.00	7.64
Jet Commercial	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	3.94
Jet Civil	0.01	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	2.72
Total	0.07	0.06	0.02	2.77	0.01	0.00	0.00	0.00	0.00	14.30
Annual (tons/year):										
Piston Civil	19.36	17.13	2.37	944.16	1.09	0.00	0.00	0.00	0.62	2,662.34
Jet Commercial	1.38	1.23	3.00	10.28	0.57	0.02	0.02	0.02	0.00	1,387.22
Jet Civil	2.50	2.23	1.68	9.84	0.38	0.03	0.03	0.03	0.00	938.58
Total	23.25	20.59	7.04	964.28	2.04	0.06	0.05	0.05	0.62	4,988.14

ASSUMPTIONS:

1. One landing/takeoff (LTO) cycle is equivalent to two aircraft operations.

2. Total operations from a 1997 Caltrans noise study at Santa Paula Airport are representative of 2008.

3. All operations at Santa Paula airport are civil general aviation, with no commercial operations.

4. Total annual aircraft operations at each airport can be allocated to aircraft classifications (piston aircraft civil single and twin engine aircraft and helicopters, and civil and commercial aircraft jet and turboprop aircraft) by the proportion of aircraft based at the airport from the FAA master record, with the exception of civil jet aircraft operations at Oxnard.

5. Civil piston single engine aircraft at Santa Paula can be distributed by aircraft model based on the population of aircraft at one of the flight schools at the airport.

6. 75% of civil piston single engine aircraft operations at Santa Paula airport are full Landing and Take-Off (LTO) cycles, and 25% are Touch and Go (TGO) cycles without a taxi/idle mode. All other aircraft have full LTO cycles.

7. 75% of helicopter operations are attributable to turbine powered (turboshaft) engine models and 25% to piston engine powered models.

8. One aircraft model is assumed for civil piston twin engine aircraft (Beechcraft Baron), turbine powered helicopters (Bell 206 B-III Jet Ranger), piston engine powered helicopters (Robinson R22) and civil jet turboprop aircraft (Beech King Air 200) at Santa Paula airport.

9. The FAA ATADS "general aviation" category includes locally based and itinerant civilian and military aircraft, and the "air taxi" category is considered to be commercial aviation.

10. Civil jet aircraft operations at Oxnard in 2008 can be estimated on the basis of the proportion of operations in the 2000 airport survey.

11. Civil piston single and twin engine aircraft operations at Oxnard and Camarillo airports are distributed to predominant types of aircraft advertised for flight schools and charter services at the airports.

12. The LTO/TGO distribution of civil piston single engine aircraft operations at Santa Paula airport applies to Oxnard and Camarillo airports.

13. One aircraft model is assumed for turbine powered helicopters (Bell 206 B-III Jet Ranger) and one model for piston engine powered helicopters (Robinson R22) at Oxnard and Camarillo airports.

14. Civil jet aircraft operations at Oxnard and Camarillo airports are 83% turboprop and 17% jet aircraft.

15. Civil turboprop aircraft operations at Oxnard are distributed to predominant types of aircraft advertised for charter services at the airports.

16. Civil jet aircraft operations at Oxnard are distributed to jet aircraft models on the basis of the populations in the 2000 airport survey.

17. Commercial jet aircraft operations at Oxnard airport are attributable to one turboprop aircraft model (Embraer EMB-120 Brasilia) used in regularly scheduled service.

18. Commercial and civil jet aircraft operations at Camarillo airport are attributable to aircraft charters and are 83% turboprop and 17% jet aircraft and are distributed to predominant types of aircraft advertised for flight schools and charter services at the airport.

19. EPA operation assumptions for small airports without operations data and heliports described in Calculating Aviation Gasoline Lead Emissions in the 2008 NEI (March 2009) are applicable to Ventura County civilian aircraft facilities other than Santa Paula, Oxnard and Camarillo. The Ventura County 'Other Facilities' include one small civilian private airport and 14 heliports.

20. One aircraft model is assumed for civil piston single engine aircraft (Cessna 172 SP), turbine powered helicopters (Bell 206 B-III Jet Ranger) and piston engine powered helicopters (Robinson R22) for the Ventura County 'Other Facilities' airport and heliports.

21. All operations at Ventura County 'Other Facilities' are LTOs.

22. LTO time-in-mode profile durations for climbout and approach mode are adjusted from the EPA default for all airports to reflect the local mixing height according to an inversion study conducted at Point Mugu.

23. LTO time-in-mode profile durations for taxi/idle mode are specific to each airport.

24. The EPA default LTO time-in-mode profile duration for take-off mode can be used for all airports.

25. The Santa Paula airport time-in-mode profile can be used for Ventura County 'Other Facilities'.

26. EDMS model version 5.1.2 aircraft engine modal emission factors can be used with airport-specific time-in-mode profiles and number of engines per aircraft to estimate emissions and fuel consumption for each aircraft at each airport.

27. Lead (Pb) emissions are attributable to combustion of leaded aviation gasoline in piston engine-powered aircraft.

28. Pb emissions are proportional to the lead content of aviation gasoline (2.12 grams/gallon) and a 5% retention factor in aircraft engines.

29. Jet fuel does not contain lead additives and there are no Pb emissions associated with its combustion.

30. Annual civil piston and jet (turboprop and helicopter) operations occur on an equivalent monthly basis at Santa Paula and Ventura County 'Other Facilities'.

REFERENCES:

1. Rowena Mason, Manager Santa Paula Airport Association, August 13, 2007.

2. U.S. Department of Transportation, Federal Aviation Administration Form 5010-1, Airport Master Record for Santa Paula Airport, October 22, 2009.

3. CP Aviation, Santa Paula Airport, August 23, 2007.

4. U.S. Environmental Protection Agency, Calculating Aviation Gasoline Lead Emissions in the 2008 NEI, (March 2009).

5. U.S. Department of Transportation, Federal Aviation Administration Air Traffic Activity Data System (ATADS) database, 2008 Operations for Oxnard and Camarillo Airports, November 20, 2009.

6. U.S. Department of Transportation, Federal Aviation Administration Form 5010-1, Airport Master Record for Oxnard Airport, October 22, 2009.

7. Chris Hastert, Deputy Director Ventura County Department of Airports, September 28, 2007.

8. 2000 Aircraft Operations Report for the County of Ventura Department of Airports, May 2001.

9. U.S. Department of Transportation, Federal Aviation Administration Form 5010-1, Airport Master Record for Camarillo Airport, October 22, 2009

10. U.S. Environmental Protection Agency, State Review of Aviation /Airport Activity Data, (March 2009).

11. U.S. Environmental Protection Agency Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources; Section 5.0, "Emissions from Aircraft" Table 5-1, December 1992.

12. George H. Taylor and Wayne P. Gibson, Inversion Characterization Study for San Diego and Point Mugu, California, SBS Corvallis, Oregon, November 1992.

13. Federal Aviation Administration, Emissions and Dispersion Modeling System (EDMS) version 5.1.2, Office of Environment and Energy, November 6, 2009.

14. International Civil Aviation Organization (ICAO) Aircraft Engine Exhaust Emissions Data Bank, July 16, 2007.

15. U.S. Environmental Protection Agency, Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources; Section 5.0, "Emissions from Aircraft" Table 5-1, December 1992.

16. U.S. Environmental Protection Agency, Lead Emissions from the Use of Leaded Aviation Gasoline in the United States Technical Support Document (EPA420-R-08-020), Assessment and Standards Division Office of Transportation and Air Quality U.S. Environmental Protection Agency, Agency, October 2008.

17. California Air Resources Board organic profiles #413 "Gasoline-non-cat-FTP Composite - ARB IUS summer 1994" and # 586 "Composite jet exhaust JP-5 (EPA 1097-1099).

18. California Air Resources Board particulate profiles #399 "Gasoline Vehicles-No Catalyst" and # 141 "Aircraft-Jet Fuel".

TABLE 1
2008 AIRCRAFT OPERATIONS AT SANTA PAULA AIRPORT

aircraft type aircraft model	engine model	engine type	# of engines	2008 Operations per year	2008 LTOs per year	2008 TGOs per year
Santa Paula (KSZP)						
piston single engine					75%	25%
Cessna 150	O-200	P	1	11,918	4,469	1,490
Cessna 152	O-320	P	1	2,979	1,117	372
Cessna 172	O-320	P	1	11,918	4,469	1,490
Cessna 172SP	IO-360-B	P	1	2,979	1,117	372
Piper Arrow	IO-360-B	P	1	2,979	1,117	372
Diamond Star DA 40	TSIO-360C	P	1	2,979	1,117	372
Citabria 7ECA	O-320	P	1	2,979	1,117	372
Decathalon	IO-320-D1AD	P	1	2,979	1,117	372
Super Decathalon	IO-360-B	P	1	2,979	1,117	372
Aviat Pitts S2B	TIO-540-J2B2	P	1	2,979	1,117	372
Total				47,668	17,874	5,956
piston twin engine						
Beechcraft Baron	TIO-540-J2B2	P	2	642	321	0
helicopter						
Bell 206 B-III Jet ranger	250B17B	TS	1	482	241	0
Robinson R-22 (piston engine)	O-320	P	1	161	80	0
Total				643	321	
turboprop						
Beech King Air 200	PT6A-41	TP	2	321	161	0
jet						
none				0	0	0
TOTAL ALL				**49,274**	**18,677**	**5,956**

Operations Data: Santa Paula Airport Association (2007).
Engine Types: P = piston, TS = turboshaft, TP = turboprop.

TABLE 2
2008 AIRCRAFT OPERATIONS AT OXNARD AIRPORT

aircraft type aircraft model	engine model	engine type	# of engines	2008 Operations per year	2008 LTOs per year	2008 TGOs per year
Oxnard (KOXR)						
piston single engine					75%	25%
Cessna 172	O-320	P	1	15,344	5,754	1,918
Cessna 152	O-320	P	1	3,069	1,151	384
Cessna 172SP	IO-360-B	P	1	15,344	5,754	1,918
Piper PA 28 Cherokee	O-320	P	1	921	345	115
Piper PA 38 Tomahawk	O-320	P	1	921	345	115
Cessna P210	TIO-540-J2B2	P	1	921	345	115
Piper Warrior	O-320	P	1	921	345	115
Diamond DA 20	O-200	P	1	921	345	115
Diamond Star DA 40	TSIO-360-C	P	1	3,069	1,151	384
Cessna 182	IO-360-B	P	1	15,344	5,754	1,918
Cessna 400	TIO-540-J2B2	P	1	921	345	115
Piper PA-46 Malibu Mirage	TIO-540-J2B2	P	1	921	345	115
EADS Socata TB-21 Trinidad	TIO-540-J2B2	P	1	921	345	115
Cirrus SR20	IO-360-B	P	1	921	345	115
Cirrus SR22	TIO-540-J2B2	P	1	921	345	115
Total				61,380	23,014	7,672
piston twin engine						
Beechcraft Baron	TIO-540-J2B2	P	2	643	322	0
Piper PA 34 Seneca	IO-360-B	P	2	2,574	1,287	0
Piper PA 44 Seminole	TSIO-360-C	P	2	1,287	643	0
Piper PA 31 Chieftain	TIO-540-J2B2	P	2	2,574	1,287	0
Cessna 401	TIO-540-J2B2	P	2	1,287	643	0
Cessna 421	TIO-540-J2B2	P	2	1,287	643	0
Partenevia P68-C	IO-360-B	P	2	2,574	1,287	0
Beechcraft D95A	TSIO-360-C	P	2	643	322	0
Total				12,869	6,434	0
Helicopter						
Bell 206 B-III Jet ranger	250B17B	TS	1	2,607	1,304	0
Robinson R-22 (piston engine)	O-320	P	1	869	435	0
Total				3,476	1,739	0

TABLE 2 2008 AIRCRAFT OPERATIONS AT OXNARD AIRPORT (concluded)

aircraft type aircraft model	engine model	engine type	# of engines	2008 Operations per year	2008 LTOs per year	2008 TGOs per year
turboprop civil						
Beech King Air 200	PT6A-41	TP	2	121	61	0
Cessna 441 Conquest	TPE331-10	TP	2	40	20	0
EADS Socata TBM 850	PT6A-64	TP	1	20	10	0
EADS Socata TBM 700	PT6A-64	TP	1	20	10	0
Total				201	101	0
turboprop commercial (air taxi)						
Embraer EMB-120 Brasilia	PW118	TP	2	6,025	3,013	0
jet civil						
Canadair 601 Challenger	CF34-3A	TJ	2	10	5	0
Dassault Falcon 50	TFE731-3	TJ	3	10	5	0
Gulfstream IV	TAY Mk611-8	TJ	2	10	5	0
Raytheon Hawker 700/800A	TFE731-3	TJ	2	10	5	0
Total				40	20	0
jet commercial (air taxi)						
None				0	0	0
TOTAL ALL				**83,991**	**34,321**	**7,672**

Operations Data: FAA ATADS (2008).
Engine Types: P = piston, TS = turboshaft, TP = turboprop, TJ = turbojet.

TABLE 3
2008 AIRCRAFT OPERATIONS AT CAMARILLO AIRPORT

aircraft type aircraft model	engine model	engine type	# of engines	2008 Operations per year	2008 LTOs per year	2008 TGOs per year
Camarillo (KCMA)						
piston single engine					75%	25%
Cessna 172	O-320	P	1	31,672	11,877	3,959
Cessna 152	O-320	P	1	6,334	2,375	792
Cessna 172SP	IO-360-B	P	1	31,672	11,877	3,959
Piper PA 28 Cherokee	O-320	P	1	1,900	713	238
Piper PA 38 Tomahawk	O-320	P	1	1,900	713	238
Cessna P210	TIO-540-J2B2	P	1	1,900	713	238
Piper Warrior	O-320	P	1	1,900	713	238
Diamond DA 20	O-200	P	1	1,900	713	238
Diamond Star DA 40	TSIO-360-C	P	1	6,334	2,375	792
Cessna 182	IO-360-B	P	1	31,672	11,877	3,959
Cessna 400	TIO-540-J2B2	P	1	1,900	713	238
Piper PA-46 Malibu Mirage	TIO-540-J2B2	P	1	1,900	713	238
EADS Socata TB-21 Trinidad	TIO-540-J2B2	P	1	1,900	713	238
Cirrus SR20	IO-360-B	P	1	1,900	713	238
Cirrus SR22	TIO-540-J2B2	P	1	1,900	713	238
Total				126,684	47,511	15,841
piston twin engine						
Beechcraft Baron	TIO-540-J2B2	P	2	832	416	0
Piper PA 34 Seneca	IO-360-B	P	2	3,327	1,664	0
Piper PA 44 Seminole	TSIO-360-C	P	2	1,664	832	0
Piper PA 31 Chieftain	TIO-540-J2B2	P	2	3,327	1,664	0
Cessna 401	TIO-540-J2B2	P	2	1,664	832	0
Cessna 421	TIO-540-J2B2	P	2	1,664	832	0
Partenevia P68-C	IO-360-B	P	2	3,327	1,664	0
Beechcraft D95A	TSIO-360-C	P	2	832	416	0
Total				16,637	8,320	0
Helicopter						
Bell 206 B-III Jet ranger	250B17B	TS	1	4,415	2,208	0
Robinson R-22 (piston engine)	O-320	P	1	1,472	736	0
Total				5,887	2,944	0

TABLE 3 2008 AIRCRAFT OPERATIONS AT CAMARILLO AIRPORT (continued)

aircraft type aircraft model	engine model	engine type	# of engines	2008 Operations per year	2008 LTOs per year	2008 TGOs per year
turboprop civil						
Beech King Air 200	PT6A-41	TP	2	2,558	1,279	0
Cessna 441 Conquest	TPE331-10	TP	2	853	426	0
EADS Socata TBM 850	PT6A-64	TP	1	426	213	0
EADS Socata TBM 700	PT6A-64	TP	1	426	213	0
Total				4,263	2,131	0
turboprop commercial (air taxi)						
Beech King Air 200	PT6A-41	TP	2	1,957	979	0
Cessna 441 Conquest	TPE331-10	TP	2	652	326	0
EADS Socata TBM 850	PT6A-64	TP	1	326	163	0
EADS Socata TBM 700	PT6A-64	TP	1	326	163	0
Total				3,261	1,631	0
jet civil						
Beechjet 400	JT15D-5, -5A, -5B	TJ	2	9	4	0
Canadair 601 Challenger	CF34-3A	TJ	2	184	92	0
Canadair 604 Challenger	CF34-3B	TJ	2	9	4	0
Cessna Citation 500	JT15D-1 series	TJ	2	9	4	0
Cessna Citation Bravo	JT15D-4 series	TJ	2	9	4	0
Cessna Citation CJ 1	JT15D-1 series	TJ	2	9	4	0
Cessna Citation CJ 2	JT15D-1 series	TJ	2	9	4	0
Cessna Citation II	JT15D-4 series	TJ	2	9	4	0
Cessna Citation V	JT15D-5, -5A, -5B	TJ	2	9	4	0
Dassault Falcon 50	TFE731-3	TJ	3	184	92	0
Global 5000	BR700-710A2-20	TJ	2	9	4	0
Gulfstream III	SPEY MK511-8	TJ	2	9	4	0
Gulfstream IV	TAY Mk611-8	TJ	2	184	92	0
Learjet 24	CJ610-6	TJ	2	9	4	0
Learjet 35	TFE731-2-2B	TJ	2	9	4	0
Learjet 60	PW306A	TJ	2	9	4	0
Ratheon Hawker 1000	PW308A	TJ	2	9	4	0
Raytheon Hawker 700/800A	TFE731-3	TJ	2	184	92	0
Total				862	424	0

TABLE 3 2008 AIRCRAFT OPERATIONS AT CAMARILLO AIRPORT (concluded)

aircraft type aircraft model	engine model	engine type	# of engines	2008 Operations per year	2008 LTOs per year	2008 TGOs per year
jet commercial (air taxi)						
Beechjet 400	JT15D-5, -5A, -5B	TJ	2	7	3	0
Canadair 601 Challenger	CF34-3A	TJ	2	141	70	0
Canadair 604 Challenger	CF34-3B	TJ	2	7	3	0
Cessna Citation 500	JT15D-1 series	TJ	2	7	3	0
Cessna Citation Bravo	JT15D-4 series	TJ	2	7	3	0
Cessna Citation CJ 1	JT15D-1 series	TJ	2	7	3	0
Cessna Citation CJ 2	JT15D-1 series	TJ	2	7	3	0
Cessna Citation II	JT15D-4 series	TJ	2	7	3	0
Cessna Citation V	JT15D-5, -5A, -5B	TJ	2	7	3	0
Dassault Falcon 50	TFE731-3	TJ	3	141	70	0
Global 5000	BR700-710A2-20	TJ	2	7	3	0
Gulfstream III	SPEY MK511-8	TJ	2	7	3	0
Gulfstream IV	TAY Mk611-8	TJ	2	141	70	0
Learjet 24	CJ610-6	TJ	2	7	3	0
Learjet 35	TFE731-2-2B	TJ	2	7	3	0
Learjet 60	PW306A	TJ	2	7	3	0
Ratheon Hawker 1000	PW308A	TJ	2	7	3	0
Raytheon Hawker 700/800A	TFE731-3	TJ	2	141	70	0
Total				662	322	0
TOTAL ALL				**158,256**	**63,283**	**15,841**

Operations Data: FAA ATADS (2008).
Engine Types: P = piston, TS = turboshaft, TP = turboprop.

TABLE 4
2008 AIRCRAFT OPERATIONS AT VENTURA COUNTY 'OTHER FACILITIES'

aircraft type aircraft model	engine model	engine type	# of engines	2008 Operations per year	2008 LTOs per year	2008 TGOs per year
piston single engine					100%	0%
Cessna 172SP	IO-360-B	P	1	4,168	2,084	0
helicopter						
Bell 206 B-III Jet ranger	250B17B	TS	1	2,961	1,481	0
Robinson R-22 (piston engine)	O-320	P	1	987	494	0
Total				3948	1975	
TOTAL ALL				**8,116**	**4,059**	**0**

Operations data represents 1 civilian private airport and 14 heliports listed in Table 5.
Operations Data: EPA assumptions for airports and heliports without reported operations data (March 2009).
Engine Types: P = piston, TS = turboshaft.

TABLE 5
VENTURA COUNTY 'OTHER FACILITIES'

FACILITY NAME	CITY	TYPE	FAA 5010 LOCID
CONOVER AIR LODGE	FRAZIER PARK	AIRPORT	02CL
EAST VALLEY SHERIFF'S STATION	THOUSAND OAKS	HELIPORT	6CA4
WILLIAM SHELLS CO	FILLMORE	HELIPORT	6CL3
SCE MOORPARK SUBSTATION	MOORPARK	HELIPORT	82CA
TWI II	NEWBURY PARK	HELIPORT	96CL
MAJLAR	OJAI	HELIPORT	6CL5
ROTOR-AIDS MAINTENANCE HANGAR	OXNARD	HELIPORT	CL73
ST JOHN'S RGNL MEDICAL CENTER	OXNARD	HELIPORT	2CL6
SCE NORTHERN DIVISION	SAN BUENAVENTURA	HELIPORT	3CL9
BOEING SANTA SUSANA	SIMI VALLEY	HELIPORT	1CA0
FIRST INTERSTATE BANK	SIMI VALLEY	HELIPORT	CL34
HUMMINGBIRD NEST	SIMI VALLEY	HELIPORT	53CA
LOS ROBLES RGNL MEDICAL CENTER	THOUSAND OAKS	HELIPORT	CL82
R I SCIENCE CENTER HELISTOP	THOUSAND OAKS	HELIPORT	1CA8
COMMUNITY MEMORIAL HOSPITAL	VENTURA	HELIPORT	CA72

Source: EPA State Review of Aviation/airport activity data, March 2009

TABLE 6
POINT MUGU INVERSION STUDY STATISTICS

Sounding PST	depth in meters												Avg Meters	Avg Feet
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
400	833	911	881	890	705	595	397	470	553	503	499	845	674	2210
800	788	954	1124	804	807	559	384	451	564	670	692	605	700	2297
1200	1018	942	1271	761	631	395	309	376	480	389	617	981	681	2234
1600	921	833	844	627	560	468	347	392	510	554	535	537	594	1949
													662	2172

Reference: Inversion Characterization Study for San Diego and Point Mugu, California, George H. Taylor and Wayne P. Gibson SBS Corvallis, Oregon, November 1992.

TABLE 7
AIRCRAFT TIME-IN-MODE BY AIRPORT

Time in mode - defaults [1]				
Aircraft Type	MODE DURATION (minutes)			
	Taxi/idle	Takeoff	Climbout	Approach
Business Jet	13.0	0.4	0.5	1.6
Comm. Turboprop	26.0	0.5	2.5	4.5
Civil Helicopter	7.0	N/A	6.5	6.5
Gen. Aviation Piston	16.0	0.3	5.0	6.0

Time in mode - adjusted [2]				
Aircraft Type	MODE DURATION (minutes)			
	Taxi/idle	Takeoff	Climbout	Approach
Business Jet	13.0	0.4	0.3	1.2
Comm. Turboprop	26.0	0.5	1.7	3.3
Civil Helicopter	7.0	N/A	4.3	4.7
Gen. Aviation Piston	16.0	0.3	3.3	4.3

Time in mode - adjusted Santa Paula [2, 3]				
Aircraft Type	MODE DURATION (minutes)			
	Taxi/idle	Takeoff	Climbout	Approach
Business Jet	13.0	0.4	0.3	1.2
Comm. Turboprop	26.0	0.5	1.7	3.3
Civil Helicopter	7.0	N/A	4.3	4.7
Gen. Aviation Piston	8.0	0.3	3.3	4.3

Time in mode - adjusted Oxnard [2, 4]				
Aircraft Type	MODE DURATION (minutes)			
	Taxi/idle	Takeoff	Climbout	Approach
Business Jet	11.0	0.4	0.3	1.2
Comm. Turboprop	11.0	0.5	1.7	3.3
Civil Helicopter	6.0	N/A	4.3	4.7
Gen. Aviation Piston	14.0	0.3	3.3	4.3

Time in mode - adjusted Camarillo [2,4]				
Aircraft Type	MODE DURATION (minutes)			
	Taxi/idle	Takeoff	Climbout	Approach
Business Jet	13.0	0.4	0.3	1.2
Comm. Turboprop	26.0	0.5	1.7	3.3
Civil Helicopter	7.0	N/A	4.3	4.7
Gen. Aviation Piston	16.0	0.3	3.3	4.3

Definitions
taxi/idle: engine startup at gate to runway + runway touchdown to gate
takeoff: full throttle acceleration from ground to engine power cutback (assumed to be 500 feet)
climbout: engine power cutback to mixing height elevation (assumed to be 3000 feet)
approach: descent from mixing height elevation to runway touchdown

Notes

[1] EPA Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, Section 5.0 "Emissions from Aircraft", Table 5-1, December 1992.

[2] Adjusted climbout and approach times for local mixing height
TIM Approach adjusted = TIM approach default*(H/3000)
TIM Climbout adjusted = TIM climbout default *[H-500)/2500]
H =Local mixing height in feet (2172 feet).

[3] Adjusted General Aviation taxi/idle time per Santa Paula Airport Association (Rowena Mason, August 2007).
[4] Adjusted taxi/idle time per Ventura County Department of Airports (Chris Hastert, October 2007).

TABLE 8
2008 AIRCRAFT EMISSIONS AT SANTA PAULA AIRPORT

Aircraft Model	CO2 tons/yr	CO tons/yr	TOG tons/yr	NOx tons/yr	SOx tons/yr	PM10 tons/yr	Fuel gallons/yr	Pb tons/yr
PISTON AIRCRAFT - CIVIL								
Aviat Pitts S2B	50.145	21.895	0.329	0.010	0.021	0.000	5,280.3	0.012
Cessna 150	49.002	15.532	0.408	0.045	0.020	0.000	5,160.0	0.011
Cessna 152	19.168	6.836	0.121	0.013	0.008	0.000	2,018.4	0.004
Cessna 172	76.706	27.356	0.486	0.051	0.031	0.000	8,077.3	0.018
Cessna 172 SP	17.856	5.282	0.078	0.033	0.007	0.000	1,880.3	0.004
Citrabria 7ECA	19.168	6.836	0.121	0.013	0.008	0.000	2,018.4	0.004
Decathalon	16.629	5.051	0.074	0.022	0.007	0.000	1,751.0	0.004
Diamond Star DA40	26.475	8.129	0.201	0.030	0.011	0.000	2,787.8	0.006
Piper Arrow	17.856	5.282	0.078	0.033	0.007	0.000	1,880.3	0.004
Super Decathalon	17.856	5.282	0.078	0.033	0.007	0.000	1,880.3	0.004
Beechcraft Baron	22.541	9.820	0.161	0.004	0.009	0.000	2,373.7	0.005
Robinson R22 (piston eng)	1.383	0.486	0.008	0.001	0.001	0.000	145.6	0.000
JET AIRCRAFT - COMMERCIAL								
none	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JET AIRCRAFT - CIVIL								
Beech King Air 200	22.764	0.196	0.044	0.034	0.009	0.000	2,147.4	0.000
Bell 206 B III Jet Ranger	13.292	0.154	0.028	0.019	0.005	0.000	1,253.8	0.000
TOTALS BY CATEGORY								
PISTON AIRCRAFT - CIVIL	334.784	117.786	2.145	0.288	0.137	0.000	35,253.3	0.078
JET AIRCRAFT - COMMERCIAL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JET AIRCRAFT - CIVIL	36.056	0.350	0.072	0.052	0.015	0.000	3,401.2	0.000
TOTAL ALL AIRCRAFT	370.840	118.137	2.217	0.341	0.152	0.000	38,654.5	0.078

TABLE 9
2008 AIRCRAFT EMISSIONS AT OXNARD AIRPORT

Aircraft Model	CO2 tons/yr	CO tons/yr	TOG tons/yr	NOx tons/yr	SOx tons/yr	PM10 tons/yr	Fuel gallons/yr	Pb tons/yr
PISTON AIRCRAFT - CIVIL								
Cessna 152	21.631	7.692	0.147	0.013	0.009	0.000	2,277.8	0.005
Cessna 172	108.118	38.445	0.734	0.067	0.044	0.000	11,385.0	0.025
Cessna 172 SP	100.025	29.510	0.525	0.172	0.041	0.000	10,532.8	0.023
Cessna 182	100.025	29.510	0.525	0.172	0.041	0.000	10,532.8	0.023
Cessna 400	16.977	7.377	0.133	0.003	0.007	0.000	1,787.7	0.004
Cessna P210	16.977	7.377	0.133	0.003	0.007	0.000	1,787.7	0.004
Cirrus SR20	5.997	1.769	0.031	0.010	0.002	0.000	631.5	0.001
Cirrus SR22	16.977	7.377	0.133	0.003	0.007	0.000	1,787.7	0.004
Diamond DA20	4.273	1.300	0.036	0.004	0.002	0.000	450.0	0.001
Diamond Star DA40	29.573	8.811	0.306	0.032	0.012	0.000	3,114.0	0.007
EADS Socata TB-21 Trinidad	16.977	7.377	0.133	0.003	0.007	0.000	1,787.7	0.004
Piper PA 28 Cherokee	6.483	2.305	0.044	0.004	0.003	0.000	682.6	0.002
Piper PA 46 Malibu	16.977	7.377	0.133	0.003	0.007	0.000	1,787.7	0.004
Piper PA Tomahawk	6.483	2.305	0.044	0.004	0.003	0.000	682.6	0.002
Piper Warrior	6.483	2.305	0.044	0.004	0.003	0.000	682.6	0.002
Beechcraft Baron	25.385	10.996	0.221	0.005	0.010	0.000	2,673.1	0.006
Beechcraft D95A	13.152	3.837	0.161	0.014	0.005	0.000	1,384.9	0.003
Cessna 401	50.691	21.957	0.441	0.010	0.021	0.000	5,337.9	0.012
Cessna 421	50.691	21.957	0.441	0.010	0.021	0.000	5,337.9	0.012
Partenavia P68-C	35.653	10.500	0.208	0.059	0.015	0.000	3,754.3	0.008
Piper PA 31 Chieftain	101.461	43.948	0.883	0.019	0.042	0.000	10,684.0	0.024
Piper PA 34 Seneca	35.653	10.500	0.208	0.059	0.015	0.000	3,754.3	0.008
Piper PA 44 Seminole	26.264	7.663	0.321	0.028	0.011	0.000	2,765.6	0.006
Robinson R22 (piston eng)	7.399	2.603	0.044	0.005	0.003	0.000	779.2	0.002
JET AIRCRAFT - COMMERCIAL								
Embraer EMB 120 Brasilia	927.837	5.596	0.015	2.093	0.380	0.000	87,525.1	0.000
JET AIRCRAFT - CIVIL								
Beech King Air 200	9.662	0.099	0.023	0.013	0.004	0.000	911.5	0.000
Cessna 441 Conquest	3.476	0.013	0.001	0.008	0.001	0.000	327.9	0.000
EADS Socata TBM 850	0.850	0.031	0.014	0.001	0.000	0.000	80.2	0.000
EADS Socata TBM-700	0.850	0.031	0.014	0.001	0.000	0.000	80.2	0.000
Canadair 601 Challenger	2.081	0.017	0.003	0.004	0.001	0.000	196.3	0.000
Dessault Falcon 50	1.696	0.017	0.005	0.004	0.001	0.000	160.0	0.000
Gulfstream IV	6.982	0.024	0.006	0.021	0.003	0.001	658.6	0.000
Raytheon Hawker 700/800	1.131	0.011	0.003	0.003	0.000	0.000	106.6	0.000
Bell 206 B-III Jet Ranger	69.571	0.761	0.137	0.098	0.028	0.000	6,562.8	0.000
TOTALS BY CATEGORY								
PISTON AIRCRAFT - CIVIL	820.323	294.798	6.029	0.707	0.336	0.000	86,381.1	0.192
JET AIRCRAFT - COMMERCIAL	927.837	5.596	0.015	2.093	0.380	0.000	87,525.1	0.000
JET AIRCRAFT - CIVIL	96.298	1.004	0.206	0.153	0.039	0.001	9,084.0	0.000
TOTAL ALL AIRCRAFT	1,844.457	301.399	6.250	2.954	0.755	0.001	182,990.3	0.192

TABLE 10
2008 AIRCRAFT EMISSIONS AT CAMARILLO AIRPORT

Aircraft Model	CO2 tons/yr	CO tons/yr	TOG tons/yr	NOx tons/yr	SOx tons/yr	PM10 tons/yr	Fuel gallons/yr	Pb tons/yr
PISTON AIRCRAFT - CIVIL								
Cessna 152	45.918	16.313	0.318	0.028	0.019	0.000	4,835.2	0.011
Cessna 172	229.611	81.573	1.589	0.141	0.094	0.000	24,178.3	0.054
Cessna 172 SP	211.985	62.493	1.168	0.360	0.087	0.000	22,322.3	0.050
Cessna 182	211.985	62.493	1.168	0.360	0.087	0.000	22,322.3	0.050
Cessna 400	36.118	15.673	0.297	0.007	0.015	0.000	3,803.3	0.008
Cessna P210	36.118	15.673	0.297	0.007	0.015	0.000	3,803.3	0.008
Cirrus SR20	12.729	3.753	0.070	0.022	0.005	0.000	1,340.4	0.003
Cirrus SR22	36.118	15.673	0.297	0.007	0.015	0.000	3,803.3	0.008
Diamond DA 20	9.171	2.756	0.077	0.008	0.004	0.000	965.8	0.002
Diamond Star DA 40	62.585	18.475	0.699	0.068	0.026	0.000	6,590.3	0.015
EADS Socata TB-21 Trinidad	36.118	15.673	0.297	0.007	0.015	0.000	3,803.3	0.008
Piper PA 38 Tomahawk	13.788	4.898	0.095	0.008	0.006	0.000	1,451.9	0.003
Piper PA 46 Malibu	36.118	15.673	0.297	0.007	0.015	0.000	3,803.3	0.008
Piper PA-28 Cherokee	13.788	4.898	0.095	0.008	0.006	0.000	1,451.9	0.003
Piper Warrior	13.788	4.898	0.095	0.008	0.006	0.000	1,451.9	0.003
Beechcraft Baron	33.990	14.699	0.311	0.006	0.014	0.000	3,579.2	0.008
Beechcraft D95A	17.541	5.061	0.231	0.018	0.007	0.000	1,847.1	0.004
Cessna 401	67.980	29.397	0.621	0.013	0.028	0.000	7,158.4	0.016
Cessna 421	67.980	29.397	0.621	0.013	0.028	0.000	7,158.4	0.016
Partenavia P68-C	47.643	14.018	0.293	0.077	0.020	0.000	5,016.9	0.011
Piper PA-31 Chieftain	135.959	58.794	1.243	0.026	0.056	0.000	14,316.7	0.032
Piper PA-34 Seneca	47.643	14.018	0.293	0.077	0.020	0.000	5,016.9	0.011
Piper PA 44 Seminole	35.083	10.123	0.462	0.037	0.014	0.000	3,694.3	0.008
Robinson R22 (piston eng)	12.719	4.472	0.077	0.008	0.005	0.000	1,339.3	0.003
JET AIRCRAFT - COMMERCIAL								
Beech King Air 200 Commercial	166.171	1.861	0.434	0.223	0.068	0.000	15,675.4	0.000
Cessna 441 Conquest – Commercial	61.531	0.252	0.026	0.146	0.025	0.000	5,804.3	0.000
EADS Socata TBM 850 Commercial	14.927	0.581	0.260	0.015	0.006	0.000	1,408.1	0.000
EADS Socata TBM-700 Commercial	14.927	0.581	0.260	0.015	0.006	0.000	1,408.1	0.000
Beechjet 400 Commercial	0.790	0.022	0.024	0.001	0.000	0.001	74.5	0.000
Canadair Challenger 604 Commercial	1.361	0.013	0.002	0.002	0.001	0.000	128.4	0.000
Canadair 601 Challenger Commercial	32.292	0.282	0.048	0.059	0.013	0.002	3,046.2	0.000
Cessna 500 Citation Commercial	0.604	0.018	0.008	0.001	0.000	0.000	56.9	0.000
Cessna Citation Bravo Commercial	1.062	0.018	0.008	0.002	0.000	0.000	100.2	0.000
Cessna Citation CJ1 Commercial	0.927	0.021	0.009	0.001	0.000	0.000	87.5	0.000
Cessna Citation CJ2 Commercial	0.927	0.021	0.009	0.001	0.000	0.000	87.5	0.000
Cessna Citation II Commercial	0.688	0.016	0.008	0.001	0.000	0.000	64.9	0.000
Cessna Citation V Commercial	0.790	0.022	0.024	0.001	0.000	0.001	74.5	0.000
Dessault Falcon 50 Commercial	26.229	0.273	0.080	0.062	0.011	0.000	2,474.2	0.000
Global 5000 Commercial	3.960	0.016	0.002	0.012	0.002	0.000	373.6	0.000
Gulfstream III Commercial	5.239	0.024	0.003	0.017	0.002	0.000	494.2	0.000
Gulfstream IV Commercial	104.759	0.385	0.092	0.295	0.043	0.018	9,882.2	0.000
Learjet 24 Commercial	1.609	0.065	0.008	0.001	0.001	0.000	151.8	0.000
Learjet 35 Commercial	0.692	0.009	0.004	0.001	0.000	0.000	65.2	0.000
Learjet 60 Commercial	1.150	0.009	0.002	0.003	0.000	0.000	108.5	0.000
Raytheon Hawker 1000 Commercial	1.264	0.010	0.003	0.003	0.001	0.000	119.2	0.000
Raytheon Hawker 700/800 Commercial	17.486	0.182	0.053	0.041	0.007	0.000	1,649.5	0.000

TABLE 10 2008 AIRCRAFT EMISSIONS AT CAMARILLO AIRPORT (concluded)

Aircraft Model	CO2 tons/yr	CO tons/yr	TOG tons/yr	NOx tons/yr	SOx tons/yr	PM10 tons/yr	Fuel gallons/yr	Pb tons/yr
JET AIRCRAFT - CIVIL								
Beech King Air 200 Civil	217.092	2.431	0.567	0.291	0.089	0.000	20,478.8	0.000
Cessna 441 Conquest – Civil	80.405	0.330	0.034	0.190	0.033	0.000	7,584.8	0.000
EADS Socata TBM 850 Civil	19.506	0.759	0.339	0.020	0.008	0.000	1,840.0	0.000
EADS Socata TBM-700 Civil	19.506	0.759	0.339	0.020	0.008	0.000	1,840.0	0.000
Beechjet 400 Civil	1.053	0.029	0.032	0.001	0.000	0.001	99.3	0.000
Canadair Challenger 604 Civil	1.815	0.018	0.003	0.003	0.001	0.000	171.2	0.000
Canadair 601 Challenger Civil	42.441	0.371	0.063	0.077	0.017	0.003	4,003.5	0.000
Cessna 500 Citation Civil	0.805	0.025	0.011	0.001	0.000	0.000	75.9	0.000
Cessna Citation Bravo Civil	1.416	0.023	0.011	0.002	0.001	0.000	133.5	0.000
Cessna Citation CJ1 Civil	1.236	0.027	0.011	0.002	0.001	0.000	116.6	0.000
Cessna Citation CJ2 Civil	1.236	0.027	0.011	0.002	0.001	0.000	116.6	0.000
Cessna Citation II Civil	0.918	0.021	0.010	0.001	0.000	0.000	86.6	0.000
Cessna Citation V Civil	1.053	0.029	0.032	0.001	0.000	0.001	99.3	0.000
Dessault Falcon 50 Civil	34.472	0.359	0.105	0.081	0.014	0.000	3,251.9	0.000
Global 5000 Civil	5.281	0.021	0.002	0.016	0.002	0.000	498.1	0.000
Gulfstream III Civil	6.985	0.032	0.004	0.022	0.003	0.000	658.9	0.000
Gulfstream IV Civil	137.683	0.506	0.120	0.388	0.056	0.023	12,988.0	0.000
Learjet 24 Civil	2.145	0.087	0.010	0.001	0.001	0.000	202.4	0.000
Learjet 35 Civil	0.922	0.012	0.005	0.002	0.000	0.000	87.0	0.000
Learjet 60 Civil	1.533	0.012	0.003	0.004	0.001	0.000	144.6	0.000
Raytheon Hawker 1000 Civil	1.685	0.013	0.004	0.004	0.001	0.000	158.9	0.000
Raytheon Hawker 700/800 Civil	22.981	0.240	0.070	0.054	0.009	0.000	2,167.9	0.000
Bell 206 B-III Jet Ranger	121.776	1.412	0.261	0.170	0.050	0.000	11,487.4	0.000
TOTALS BY CATEGORY								
PISTON AIRCRAFT - CIVIL	1,472.478	520.894	11.014	1.321	0.603	0.000	155,054.0	0.344
JET AIRCRAFT - COMMERCIAL	459.384	4.680	1.365	0.902	0.188	0.023	43,334.8	0.000
JET AIRCRAFT - CIVIL	723.945	7.542	2.049	1.354	0.296	0.030	68,291.5	0.000
TOTAL ALL AIRCRAFT	2,655.806	533.116	14.427	3.577	1.088	0.052	266,680.3	0.344

TABLE 11
2008 AIRCRAFT EMISSIONS AT VENTURA COUNTY 'OTHER FACILITIES'

Aircraft Model	CO2 tons/yr	CO tons/yr	TOG tons/yr	NOx tons/yr	SOx tons/yr	PM10 tons/yr	Fuel gallons/yr	Pb tons/yr
PISTON AIRCRAFT - CIVIL								
Cessna 172 SP	26.151	7.677	0.124	0.048	0.011	0.000	2,753.8	0.006
Robinson R22 (piston eng)	8.600	3.005	0.051	0.006	0.004	0.000	905.6	0.002
JET AIRCRAFT - COMMERCIAL								
none	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JET AIRCRAFT - CIVIL								
Bell 206 B III Jet Ranger	82.284	0.948	0.175	0.118	0.034	0.000	7,762.0	0.000
TOTALS BY CATEGORY								
PISTON AIRCRAFT - CIVIL	34.752	10.682	0.176	0.054	0.014	0.000	3,659.4	0.008
JET AIRCRAFT - COMMERCIAL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JET AIRCRAFT - CIVIL	82.284	0.948	0.175	0.118	0.034	0.000	7,762.0	0.000
TOTAL ALL AIRCRAFT	117.035	11.630	0.350	0.172	0.048	0.000	11,421.4	0.008

TABLE 12
2008 COMMERCIAL AND CIVIL AIRCRAFT EMISSIONS SUMMARY

Aircraft Emissions			Emissions in Tons/Year										
EIC#	CES#	CATEGORY NAME	LTOs	TOG	ROC	NOX	CO	SOX	PM	PM10	PM2.5	Pb	CO2
Santa Paula													
810-804-1140-0000	57331	PISTON AIRCRAFT - CIVIL	24,231	2.145	1.897	0.288	117.786	0.137	0.000	0.000	0.000	0.078	334.784
810-810-1400-0000	47555	JET AIRCRAFT - COMMERCIAL	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
810-812-1400-0000	47589	JET AIRCRAFT - CIVIL	402	0.072	0.065	0.052	0.350	0.015	0.000	0.000	0.000	0.000	36.056
		TOTAL	24,633	2.217	1.962	0.341	118.137	0.152	0.000	0.000	0.000	0.078	370.840
Oxnard													
810-804-1140-0000	57331	PISTON AIRCRAFT - CIVIL	37,555	6.029	5.332	0.707	294.798	0.336	0.000	0.000	0.000	0.192	820.323
810-810-1400-0000	47555	JET AIRCRAFT - COMMERCIAL	3,013	0.015	0.014	2.093	5.596	0.380	0.000	0.000	0.000	0.000	927.837
810-812-1400-0000	47589	JET AIRCRAFT - CIVIL	1,425	0.206	0.183	0.153	1.004	0.039	0.001	0.001	0.001	0.000	96.298
		TOTAL	41,993	6.250	5.530	2.954	301.399	0.755	0.001	0.001	0.001	0.192	1,844.457
Camarillo													
810-804-1140-0000	57331	PISTON AIRCRAFT - CIVIL	72,408	11.014	9.742	1.321	520.894	0.603	0.000	0.000	0.000	0.344	1,472.478
810-810-1400-0000	47555	JET AIRCRAFT - COMMERCIAL	1,953	1.365	1.217	0.902	4.680	0.188	0.023	0.023	0.022	0.000	459.384
810-812-1400-0000	47589	JET AIRCRAFT - CIVIL	4,763	2.049	1.828	1.354	7.542	0.296	0.031	0.030	0.030	0.000	723.945
		TOTAL	79,124	14.427	12.787	3.577	533.116	1.088	0.054	0.052	0.052	0.344	2,655.806
Ventura County Other Facilities													
810-804-1140-0000	57331	PISTON AIRCRAFT - CIVIL	2,578	0.176	0.155	0.054	10.682	0.014	0.000	0.000	0.000	0.008	34.752
810-810-1400-0000	47555	JET AIRCRAFT - COMMERCIAL	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
810-812-1400-0000	47589	JET AIRCRAFT - CIVIL	1,481	0.175	0.156	0.118	0.948	0.034	0.000	0.000	0.000	0.000	82.284
		TOTAL	4,059	0.350	0.311	0.172	11.630	0.048	0.000	0.000	0.000	0.008	117.035
TOTAL													
810-804-1140-0000	57331	PISTON AIRCRAFT - CIVIL	136,772	19.363	17.127	2.370	944.160	1.090	0.000	0.000	0.000	0.622	2,662.336
810-810-1400-0000	47555	JET AIRCRAFT - COMMERCIAL	4,966	1.380	1.231	2.995	10.276	0.568	0.023	0.023	0.022	0.000	1,387.220
810-812-1400-0000	47589	JET AIRCRAFT - CIVIL	8,071	2.502	2.232	1.678	9.845	0.384	0.032	0.031	0.031	0.000	938.582
Countywide Total			**149,809**	**23.245**	**20.590**	**7.043**	**964.281**	**2.043**	**0.055**	**0.054**	**0.053**	**0.622**	**4,988.138**

Emission Factors			Emission Factors in lbs/LTO									
EIC#	CES#	CATEGORY NAME	TOG	ROC	NOX	CO	SOX	PM	PM10	PM2.5	Pb	CO2
810-804-1140-0000	57331	PISTON AIRCRAFT - CIVIL	0.283	0.250	0.035	13.806	0.016	0.000	0.000	0.000	0.009	38.931
810-810-1400-0000	47555	JET AIRCRAFT - COMMERCIAL	0.556	0.496	1.206	4.139	0.229	0.009	0.009	0.009	0.000	558.687
810-812-1400-0000	47589	JET AIRCRAFT - CIVIL	0.620	0.553	0.416	2.439	0.095	0.008	0.008	0.008	0.000	232.581

TABLE 13
2008 TEMPORAL PROFILES by EMISSION CATEGORY

Temporal Profiles by Emission Category - based on monthly operations

Month	EIC 810-804-1140-0000 / CES 57331 PISTON AIRCRAFT - CIVIL						EIC 810-810-1400-0000 / CES 47555 JET AIRCRAFT - COMMERCIAL						EIC 810-812-1400-0000 / CES 47589 JET AIRCRAFT - CIVIL					
	OXR	CMA	SPZ	VTA	Total	% Month	OXR	CMA	SPZ	VTA	Total	% Month	OXR	CMA	SPZ	VTA	Total	% Month
Jan	6,868	9,944	4,039	430	21,281	7.78%	457	294	0	0	751	7.55%	261	655	67	247	1,230	7.62%
Feb	7,100	9,090	4,039	430	20,659	7.55%	532	366	0	0	898	9.03%	269	598	67	247	1,181	7.31%
Mar	8,686	11,775	4,039	430	24,930	9.11%	471	361	0	0	832	8.37%	329	775	67	247	1,418	8.78%
Apr	8,173	11,652	4,039	430	24,294	8.88%	561	281	0	0	842	8.47%	310	767	67	247	1,391	8.61%
May	8,171	11,331	4,039	430	23,971	8.76%	443	308	0	0	751	7.55%	310	746	67	247	1,370	8.48%
Jun	7,811	12,393	4,039	430	24,673	9.02%	461	298	0	0	759	7.64%	296	816	67	247	1,426	8.83%
Jul	4,908	14,330	4,039	430	23,707	8.67%	493	362	0	0	855	8.60%	186	944	67	247	1,444	8.94%
Aug	5,134	14,127	4,039	430	23,730	8.68%	488	374	0	0	862	8.67%	195	930	67	247	1,439	8.91%
Sep	4,387	14,107	4,039	430	22,963	8.39%	631	369	0	0	1,000	10.06%	166	929	67	247	1,409	8.73%
Oct	5,542	14,208	4,039	430	24,219	8.85%	560	369	0	0	929	9.35%	210	935	67	247	1,459	9.03%
Nov	4,176	12,071	4,039	430	20,716	7.57%	435	274	0	0	709	7.13%	158	795	67	247	1,267	7.85%
Dec	4,159	9,768	4,039	430	18,396	6.73%	493	260	0	0	753	7.57%	158	643	67	247	1,115	6.90%
Totals	75,115	144,796	48,473	5,155	273,539	100.00%	6,025	3,916	0	0	9,941	100.00%	2,848	9,533	803	2,961	16,145	100.00%

Data Sources: FAA ATADS for Oxnard (OXR) and Camarillo (CMA), Santa Paula Airport Association for Santa Paula (SPZ), EPA assumptions for calculating aviation gasoline lead emissions, March 2009 for Ventura County Other Facilities (VTA).

AGRICULTURAL AIRCRAFT

EIC 810-806-1140-0000 - CES 47563

METHODOLOGY:

Fuel consumption data and operating hours for 1995 were obtained from a survey of companies that used civil aircraft to perform crop dusting within Ventura County (Reference 1) to estimate combustion emissions from agricultural aircraft operations. Emissions from materials sprayed by the aircraft are inventoried under 'Pesticide Application' emission categories (Activity 29), estimated by the California Air Resource Board (Reference 2).

There are two types of agricultural aircraft used in Ventura County: helicopter - piston and helicopter - turbine. Emission factors corresponding to the "approach" mode were used to estimate emissions because most of the activity in crop dusting occurs close to the ground and involves many quick and small changes in elevation, as described in the California Air Resources Board (CARB) area source methodology document for agricultural aircraft (Reference 3). Fuel consumption from landings and takeoffs are inventoried under 'commercial and civil aircraft' (Activity 48). Approach mode emission factors for piston helicopters were developed by CARB (Reference 3). Turbine helicopter emission factors were obtained from the engine manufacturer (Reference 4). Emission factors in units of lb/hr are divided by the weighted average of the fuel consumption rate (lb/hr) and multiplied by the density of aircraft fuel (lb/gallon) to convert emission factor units to lb/1,000 gallon. Emissions were calculated using fuel consumption data for each surveyed source. Total fuel consumed and emissions are used to determine composite emission factors.

Emissions were projected to subsequent years on the basis of the number of agricultural aircraft growth parameter developed by CARB (Reference 5).

TEMPORAL DISTRIBUTION:

Daily: Activity during daylight hours.

Weekly: Uniform activity on weekdays, reduced activity on weekends.

Annual:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
53	53	86	86	108	108	108	108	108	75	53	53

SPATIAL DISAGGREGATION: Agricultural Acreage.

GROWTH PARAMETER: Number of Agricultural Aircraft.

ORGANIC REACTIVE FRACTION: 0.8845 (Profile Number 413).

PM10 FRACTION: 0.9000 (Profile Number 399).

PM2.5 FRACTION: 0.6800 (Profile Number 399).

2008 PROCESS RATE: (1,000 gallons burned)

Annual
40.4

EMISSION FACTORS: (pounds per 1,000 gallons burned)

TOC	ROC	NOx	CO	SO_2	PM
16.949	14.992	29.661	326.273	8.474	4.237

2008 AGRICULTURAL AIRCRAFT EMISSIONS:

	TOC	ROC	NOx	CO	SO_2	PM	PM10	PM2.5	CO2
Planning (tons/day):	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	N/A
Annual (tons/year):	0.34	0.30	0.60	6.58	0.17	0.09	0.08	0.06	N/A

ASSUMPTIONS:

1. Emissions related to pesticide spraying are accounted for in 'pesticide' emission categories.

2. There are two types of agricultural aircraft used in Ventura County: helicopter - piston and helicopter - turbine.

3. "Approach mode" emission factors are used to estimate emissions because most of the activity in crop dusting occurs close to the ground and involves many quick and small changes in elevation.

4. Emissions related to other landing and takeoff operational modes are inventoried in 'commercial and civil aircraft' emission categories.

5. The approach mode emission factors in units of lb/hr can be divided by the weighted average of the fuel consumption rate (lb/hr) and multiplied by the density of aircraft fuel (lb/gallon) to convert to units of lb/1,000 gallons fuel.

6. Emissions can be projected to subsequent years on the basis of the number of agricultural aircraft growth parameter.

REFERENCES:

1. Agricultural aircraft fuel reports and emission factors for companies operating in Ventura County. These companies have requested operating information to be confidential.

2. California Environmental Protection Agency; Air Resources Board; Emission Inventory Procedural Manual; Volume III; "Methods for Assessing Area Source Emissions;" Section 6.4 “Agricultural/Structural Pesticides”; Revised May 2005.

3. California Environmental Protection Agency; Air Resources Board; Emission Inventory Procedural Manual; Volume III; "Methods for Assessing Area Source Emissions;" Section 8.1; Updated August 22, 1990.

4. General Motors Corporation, Allison Gas Turbine Division, Allison 250-C20 engine exhaust emission factor data sheet, September 29, 1992.

5. California Air Resources Board/California Agricultural Aircraft Association (CAAA), EI Subcommittee Update 05-24-05; Num Ag aircraft 1997-2004.