FINAL DRAFT

San Diego International Airport Air Quality Management Plan

Criteria Pollutant & Greenhouse Gases Baseline Emissions Inventory Protocol

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April 9, 2009

Executive Summary

This document outlines and describes the technical approach, methodology, and data sources to be used in preparing the Baseline emissions inventory for San Diego International Airport (SAN). The results will be used in support of the SAN *Air Quality Management Plan* (AQMP) being prepared by the San Diego County Regional Airport Authority (SDCRAA or Airport Authority).

The overall approach to preparing the emissions inventory is based on the following four fundamentals: a.) representative of emission sources and conditions that are characteristic of SAN; b.) uses the most up-to-date information and data currently available; c.) is consistent with the most appropriate guidelines for quantifying airport-related emissions; and d.) aids the Airport Authority with its development plans in a transparent fashion.

The emissions inventory will include both the US Environmental Protection (EPA) criteria pollutants (and their precursors) as well as greenhouse gases (GHG) associated with the development and operation of the airport. For the purposes of this assessment, the year 2010 represents the Baseline conditions.

Much of the information and data used to prepare the emissions inventory will be obtained from Airport Authority records, Federal Aviation Administration (FAA) databases and/or derived from the SAN Master Plan *Environmental Impact Report* (EIR). This information includes aircraft operational and fleet mix data, ground support equipment (GSE) data, motor vehicle traffic, and stationary source information. In some cases, these operational data will need to be adjusted through extrapolation to 2010 conditions. Details of this approach and the data needs are contained in the Appendix

For the criteria pollutants, the analysis will be accomplished following guidelines for preparing airport-related emissions inventories issued by the FAA such as the *Airport Air Quality Assessment Guidelines*. In the case of GHG's, the emissions inventory will also follow recommendations recently issued by the Transportation Research Board (TRB) Airport Cooperative Research Program (ACRP); specifically, the *Guidebook on Preparing Airport Greenhouse Gas Emission Inventories (ACRP Report 11)*. The modeling of the majority of sources will be accomplished using the latest version of the FAA's Emissions and Dispersion Modeling System (EDMS5.1) and other federal and state-approved models.

The approach to reporting the results of the Baseline emissions inventory for SAN are also discussed in this document and example tables and figures are given. The information provided in this document is a synopsis of the technical approach to the SAN Baseline emissions inventory which will be expanded upon, and potentially subject to modification, as the work advances.

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I. BACKGROUND INFORMATION AND PURPOSE OF THE PROTOCOL

The San Diego County Regional Airport Authority (SDCRAA or Airport Authority) is preparing an Air Quality Management Plan (AQMP) for San Diego International Airport (SAN, also known as Lindbergh Field) located in San Diego, California.[1] The AQMP is a multi-faceted program to aid the Airport Authority in the reduction and management of air emissions associated with SAN. In particular, the AQMP is specifically designed to accomplish the following:

- Identity the sources and quantify the amounts of air emissions (e.g., criteria pollutants[2] and greenhouse gases - GHG[3]) associated with the development and operation of the airport;
- Address the energy and GHG emission reduction measures called for in the Attorney General Memorandum of Understanding (MOU)[4]; and
- Support the Airport Authority's on-going Environmental Sustainability Program.[5]

This document, referred to as the *Baseline Emissions Inventory Protocol*, outlines and describes the overall technical approach, methodology, and data sources to be used in preparing the Baseline emissions inventories for SAN. This effort will help to ensure that work is completed in an acceptable and efficient manner, meets the objectives of the AQMP and assists the Airport Authority with its current and future development plans for SAN.[6]

Purpose of the *Protocol*

The purpose of this document is to outline and describe the overall approach, methodology, and data sources for preparing the Baseline emissions inventories for the Air Quality Management Plan (AQMP) for SAN.

For the purposes of this assessment, the year 2010 represents the Baseline conditions associated with SAN, as called for in the MOU.

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[1] The Airport Authority is a public entity created by state law to operate SAN and plan for the region's future air transportation needs. For more information on SAN, SDCRAA or the *Airport Master Plan* go to: http://www.san.org/

[2] For this assessment the criteria pollutants comprise the U.S. EPA criteria pollutants and/or their precursors and include: carbon monoxide (CO), lead, nitrogen oxides (NO_x), particulate matter (PM), sulfur oxides (SO_x), and volatile organic compounds (VOCs).

[3] For this assessment greenhouse gases comprise the following: carbon dioxide (CO_2), methane (CH_4) and nitrous oxides (N_2O) expressed as "CO2 equivalents" (CO_{2e}).

[4] *Memorandum of Understanding Between the Attorney General of the State of California and the San Diego County Regional Airport Authority Regarding the San Diego International Airport Master Plan*, May 5, 2008. www.san.org/documents/airport_authority/MOU_SDCRAA_AG_Master_Plan_2008.pdf

[5] For more information on the SDCRAA's Environmental Sustainability Program go to: http://www.san.org/airport_authority/environmental_affairs/index.asp

[6] A *Protocol for the Analysis of Conventional to Alternative Fuel Conversion* has also been prepared in support of the AQMP and is published separately (Draft April 2, 2009).

II. OVERALL APPROACH

The overall approach to the preparation of the SAN Baseline criteria pollutant and GHG emissions inventory is based principally on the following four fundamentals: a.) representative of emission sources and conditions that are characteristic of SAN; b.) uses the most up-to-date information and data currently available; c.) is consistent with the most appropriate guidelines for quantifying airport-related emissions; and d.) aids the Airport Authority with its current and future development plans in a transparent fashion.

For the criteria pollutant emissions inventory, these guidelines include the following publication issued by the Federal Aviation Administration (FAA):

- *Air Quality Procedures for Civilian Airports and Air Force Bases (and Addendum)* – Referred to as the *Airport Air Quality Handbook*, provides specific methodologies for computing emissions from airport-related sources including aircraft, auxiliary power units (APUs), ground support equipment (GSE), fuel facilities, stationary sources, and motor vehicle.[7]

In the case of GHG's, the SAN Baseline emissions inventory will also follow recommendations recently issued by the Transportation Research Board (TRB) Airport Cooperative Research Program (ACRP):

- *Guidebook for Preparing Airport-Related Greenhouse Gas (GHG) Emissions Inventories* – Referred to as ACRP Report 11, provides recommended instructions to airport operators on how to prepare an airport-specific GHG emissions inventory. [8]

In addition, the majority of the technical analysis for many of the sources will be accomplished using the latest version of the FAA's Emissions and Dispersion Modeling System (EDMS) (Version 5.1) and other federal and state-approved models (see Section V).

Importantly, the process of assessing and reporting airport criteria pollutants is fairly well established. By comparison, the assessment and reporting of airport GHGs is relatively new and still evolving. In this case, the overall approach to preparing both the criteria pollutant and GHG emissions inventories is to help meet the immediate and long-term needs of the Airport Authority as they advance the AQMP, implement the MOU requirements[9], and address other federal, state and local air quality or initiatives.

[7] *Air Quality Procedures for Civilian Airports and Air Force Bases – and Addendum, Federal Aviation Administration, 1997 and 2004.*
[8] *Guidebook for Preparing Airport-Related Greenhouse Gas Emissions Inventories, prepared for the Airport Cooperative Research Program, Transportation Research Board, April 2009.*
[9] In particular, this analysis will provide a means of assessing aircraft ground-based movement emissions and evaluating emission reduction measures called for in the MOU.

III. TERMS AND CONCEPTS

There are a number of terms and concepts that are considered standard, but unique, to the preparation of airport-related emissions inventories. Some of the more important ones used in this assessment include the following:

- Baseline Conditions – These are the conditions for which the criteria pollutant and GHG emissions inventories will be computed and compared. The year 2010 will represent these baseline conditions, as called for in the MOU.
- Criteria Pollutants - The U.S. EPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants including: carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x), sulfur dioxide (SO_2), ozone (O_3) and particulate matter of 10 and 2.5 microns ($PM_{10/2.5}$). Because O_3 cannot be calculated directly, the "precursors" of NO_x and volatile organic compounds (VOCs) are used.
- Atmospheric Mixing Height – The altitude above which aircraft emissions are not expected to have significant ground level impacts. Forms the upper boundary of the criteria pollutant emissions inventory for the landing/take-off (LTO) cycle.
- Greenhouse Gases - The six main GHGs whose emissions are human-caused are: CO_2, CH_4, nitrous oxides (N_2O), hydroflorocarbons (HFCs), perfluorcarbons (PFCs) and sulfur hexafluoride (SF_6). Notably, CO_2, CH_4, and N_2O are the predominant GHGs associated with airports. The other GHGs occur - but to a far lesser extent.
- CO_2 equivalents - This is the universal unit of measurement used to indicate the global warming potential for different GHG. Represented by the symbol CO_2e, these values range from "1" for CO_2 to "25" for CH_4 to "298 " for N_2O.[10,11]
- Greenhouse Gas Boundaries – The boundaries of a GHG emissions inventory are based largely upon emission source ownership and control. From this, three general categories have identified and characterized as follows:
  - Category 1 – GHG emissions from sources that are owned and controlled by the reporting entity (e.g., Airport Authority). These sources typically include airport-owned and controlled stationary sources (e.g., boilers, generators, etc.), some GSE, fleet vehicles, and purchased electricity. On-airport ground transportation emissions are also included if they are controlled by the airport.
  - Category 2 – This category typically comprises GHG emissions associated with sources owned and controlled by airlines and airport tenants. These sources can include aircraft (on-ground, within the LTO, in the cruise/residual modes), APU, most GSE, electrical consumption, and other stationing sources.
  - Category 3 – This category generally comprises GHG emissions associated with other sources associated with the airport. These include public automobiles, taxis, limousines, buses, shuttle vans, etc. operating on the off-airport roadway network.

[10] Based on these CO_2 equivalents factors (CO_2e), 1 ton of CH_4 is 25 times more "potent" than 1 ton of CO_2.
[11] *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, 2001.

IV. SOURCES OF EMISSIONS

In general, the primary sources of emissions associated with SAN are typical of most commercial airports of its size and function. As shown in **Table 1**, the primary emission sources include aircraft; GSE and APUs; a small assortment of stationary sources; and motor vehicles operating on the internal roadways, parking facilities, and off-airport roadways. For GHG's, emissions associated with the consumption of electricity at the airport (but generated elsewhere by burning coal, oil, and natural gas) are also included.

Table 1: Sources of Airport Criteria Pollutant and GHG Emissions

Sources	Characteristics of Emissions
Aircraft	Exhaust products of fuel combustion that vary depending on aircraft engine type (i.e., turbo-jet, turbo-prop, etc.), fuel type (Jet-A, avgas), number of engines, power setting and time-in-mode (i.e., taxi/idle, take-off, cruise), and amount of fuel burned.
Ground service equipment / Auxiliary Power Units (GSE/APUs)	Exhaust products of fuel combustion from aircraft service trucks, tow tugs, belt loaders, and other portable equipment. Emissions are also emitted by auxiliary power units used to furnish power to some aircraft when the main engines are off.
Ground Access Vehicles (GAV)	Exhaust products of fuel combustion from airport authority, passengers, employee and cargo motor vehicles approaching, departing, and moving about the airport site. These include automobiles, vans, trucks, and buses. Emissions vary depending on vehicle and fuel type (i.e., gasoline, diesel, etc.) and the amount of fuel consumed.
Stationary sources and fuel facilities	Exhaust products of fossil fuel combustion in boilers for space heating and emergency generator units. Evaporative emissions from fuel storage and transfer facilities and fugitive emissions of refrigerant and cooling system gases are also included.
Electrical Consumption	Emissions associated with the production of electricity at off-site utilities that use coal, oil or natural gas.

Source: KB Environmental Sciences, Inc. 2009.

For the most part, the emissions from these sources arise from the combustion of fossil fuels (i.e., jet fuel, avgas, diesel, gasoline, natural gas, etc.) and are by-products contained in the engine exhausts. It is expected that these emission sources will constitute the majority of those included in the Baseline emissions inventory for SAN.

Construction activities also represent sources of air emissions at SAN but they are short-term and intermittent. Nevertheless, they will also be addressed in the AQMP as an element of the MOU GHG emissions reduction initiatives.

GHG emissions from refrigerants, cooling systems and the recycling of solid wastes are not considered to be significant at SAN.

V. INFORMATION, DATA AND ASSUMPTIONS

Most of the information and data used to prepare the Baseline emissions inventory for SAN will be obtained from Airport Authority records, FAA databases and/or derived from the SAN Master Plan Environmental Impact Report (EIR).[12] This includes aircraft operational and fleet mix data, GSE data, motor vehicle traffic, and stationary source information. In some cases, these data will need to be adjusted through extrapolation to 2010 conditions.

Aircraft emission factors and other emission source performance characteristics are inherent to the EDMS database. For GSE and motor vehicle emissions, California-specific data from the California Air Resources Board (CARB) EMFAC2007 and OFFROAD2007 emission models will be used.

These sources of information, data and other assumptions used to prepare the emissions inventory are listed and generally described in **Table 2**, by emission source category (i.e., aircraft, GSE, etc.) and parameter (i.e., emission factors, operational data, etc.), and then further discussed in the **Appendix**.

Table 2: Input Data and Information Summary

Emission Source	Parameter - Source of Data and Information
Aircraft	Criteria pollutant emission factors – EDMS5.1 Operations and fleet mix – FAA Terminal Area Forecasts (TAF), Aircraft Situational Display (ASDi), SAN Airport Noise and Operations Monitoring System (ANOMS). Aircraft/engine combinations – Jane's Information Group Airline Fleet and JP Airline Fleets International Times-in-mode – EDMS5.1 default, FAA Aviation System Performance Metrics (ASPM) and T-1 Data for SAN Mixing Height – Local mixing height data from NCDC or 3,000 ft. GHG emission factors – 2006 IPCC guidelines and ARCP Airport GHG Guidebook Fuel throughput – Airport Authority and tenant records
GSE/APU	Emission factors – EDMS5.1 and CARB OFFROAD GSE fleet mix and operating times – EDMS5.1 default data and observed during GSE field survey conducted by the Airport Authority. APU types and operating times – EDMS5.1 default data and standard assumptions based on preconditioned air and gate power availability and

[12] *San Diego International Airport Master Plan Environmental Impact Report*; Lead Agency – San Diego County Regional Airport Authority, 2007.

Emission Source	Parameter - Source of Data and Information
	SAN-specific turnaround times
Ground Access Vehicles	Emission factors – CARB EMFAC2007 Traffic volumes and fleet mix – SAN Master Plan EIR and SAN survey/records Roadway operating speeds – SAN Master Plan EIR
Stationary sources and fuel facilities	Emission factors – EDMS5.1 and San Diego Air Quality Compliance Guide, 2004. Source and fuel/material types – SAN Master Plan EIR and facility records Fuel/material throughput volumes – SAN records, SAN Master Plan EIR data 2010 forecasts
Electrical Consumption	Electrical Consumption – Airport Authority and tenant records Emission Factors – Energy Information Administration

Source: KB Environmental Sciences, Inc. 2009.

GHG emissions from the use of refrigeration and fire extinguishers can be associated with airport activities, but are not considered to be significant at SAN. When computed, the method is based on material balancing taking into account the charging, operating, and disposal of refrigerants. The EPA and IPCC provide guidance on emission factors and related parameters used to quantify these sources of GHG, if necessary.

GHG emissions associated with the recycling of solid wastes are also not considered to be significant at SAN and will also not be included.

Again, further details on the information and data that will be used to develop the Baseline emissions inventories for SAN are contained and discussed in the **Appendix.**

VI. PRESENTATION OF RESULTS

Because the criteria pollutant and GHG components of the baseline emissions inventory for SAN vary somewhat in the way they are computed and the categories of emissions differ, the results will also be reported separately.

A. Criteria Pollutant Emissions

Following standard convention for reporting airport-related emissions inventories, the criteria pollutant results will be expressed in units of short tons per year (tpy) for each pollutant and emission source. In this way, the results can be used in support of the SAN AQMP and compared directly to the applicable State Implementation Plan (SIP) and the Master Plan EIR/EA. **Table 3** provides a sample format for presenting the emissions inventory results.

Table 3: Baseline Criteria Pollutant Emissions Inventory for SAN [Example]

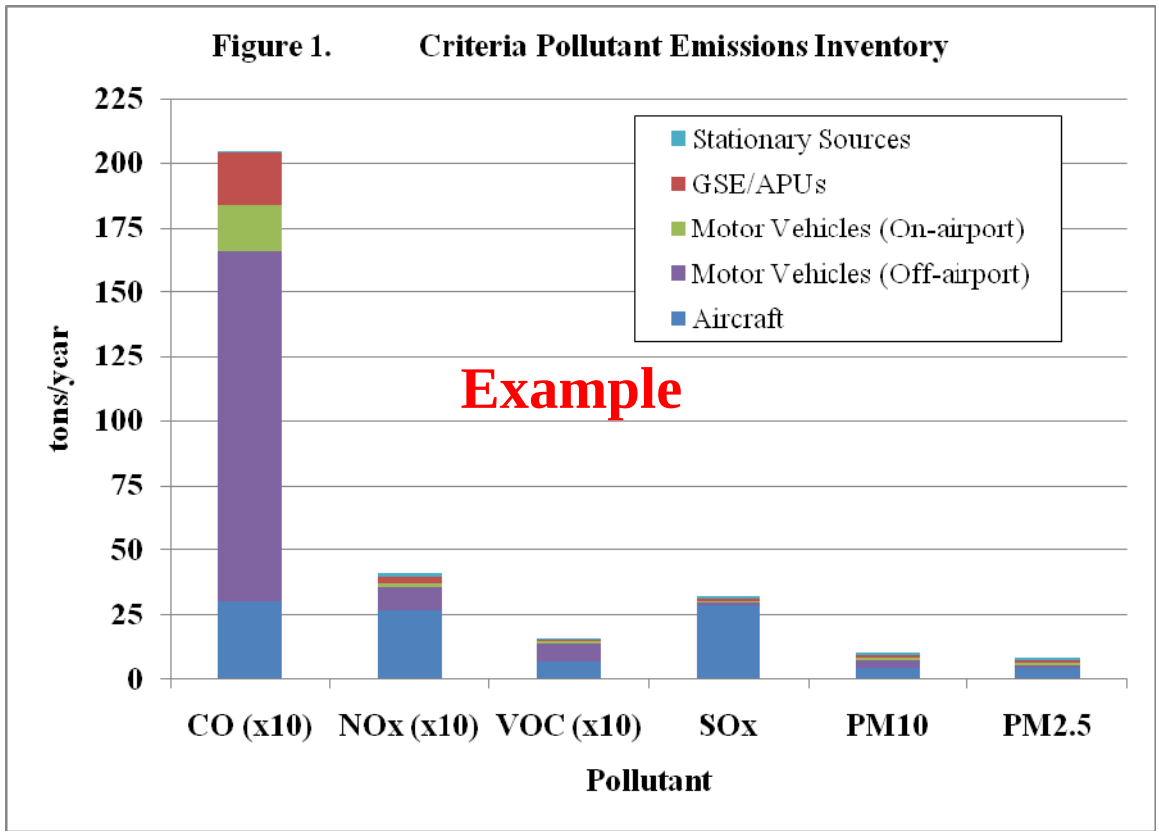
Emission Source	Pollutant[a] (tons/year)					
	CO	NO_x	VOCs	SO_x	PM_{10}	$PM_{2.5}$
Aircraft[b]						
- Ground-based	-	-	-	-	-	-
- Airborne	-	-	-	-	-	-
GSE/APUs[c]	-	-	-	-	-	-
Motor Vehicles						
- On-airport[d]	-	-	-	-	-	-
- Public						
- Taxis/Limos	-	-	-	-	-	-
- Vans/Buses	-	-	-	-	-	-
- Off-airport[e]	-	-	-	-	-	-
Stationary Sources[f]	-	-	-	-	-	-
Totals	-	-	-	-	-	-

Example

Source: KB Environmental Sciences, Inc. 2009.
Tons = short ton = 2,000 lbs.

[a] CO – carbon monoxide, NO_x – nitrogen oxides, VOC – volatile organic compounds, SO_x – sulfur oxides, $PM_{10/2.5}$ – particulate matter equal to, or less than, 10 and 2.5 microns in diameter, respectively.
[b] Within the Landing/Take-off (LTO) cycle.
[c] GSE/APUs – Ground Support Equipment/Auxiliary Power Units.
[d] Broken out by airport-related (e.g., passengers, employees, cargo) motor vehicles on the internal roadway network and parking facilities.
[e] Airport-related motor vehicles on the off-airport roadway network.
[f] Stationary Sources include steam boilers and emergency generators.

For illustration purposes and for ease of comparison, the criteria pollutant emissions inventory results will also be presented graphically as shown in **Figure 1**.



Source: KB Environmental Sciences, Inc. 2009.

Additional details will be provided in the *Emissions Inventory Appendix* that will show further breakdown of the criteria pollutant emissions by source owner (e.g., airline, GSE provider, etc.), facility (e.g., airside, landside, roadway, parking), and location (e.g., on-airport versus off-airport).

B. Greenhouse Gas Emissions

The results of the GHG emissions inventory will be expressed in units of metric tons per year for each emission source (e.g., aircraft, GSE, etc.) and Category (1, II, III). These results will also be converted to CO_2 equivalent values using the Global Warming Potential values of 1 for CO_2, 25 for CH_4, and 298 for N_2O (based on a 100 year period) as presented in the IPCC's Assessment Report.[13]

Table 4 provides a sample format for presenting the GHG emissions inventory results.

[13] Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, New York City, NY. 2007.

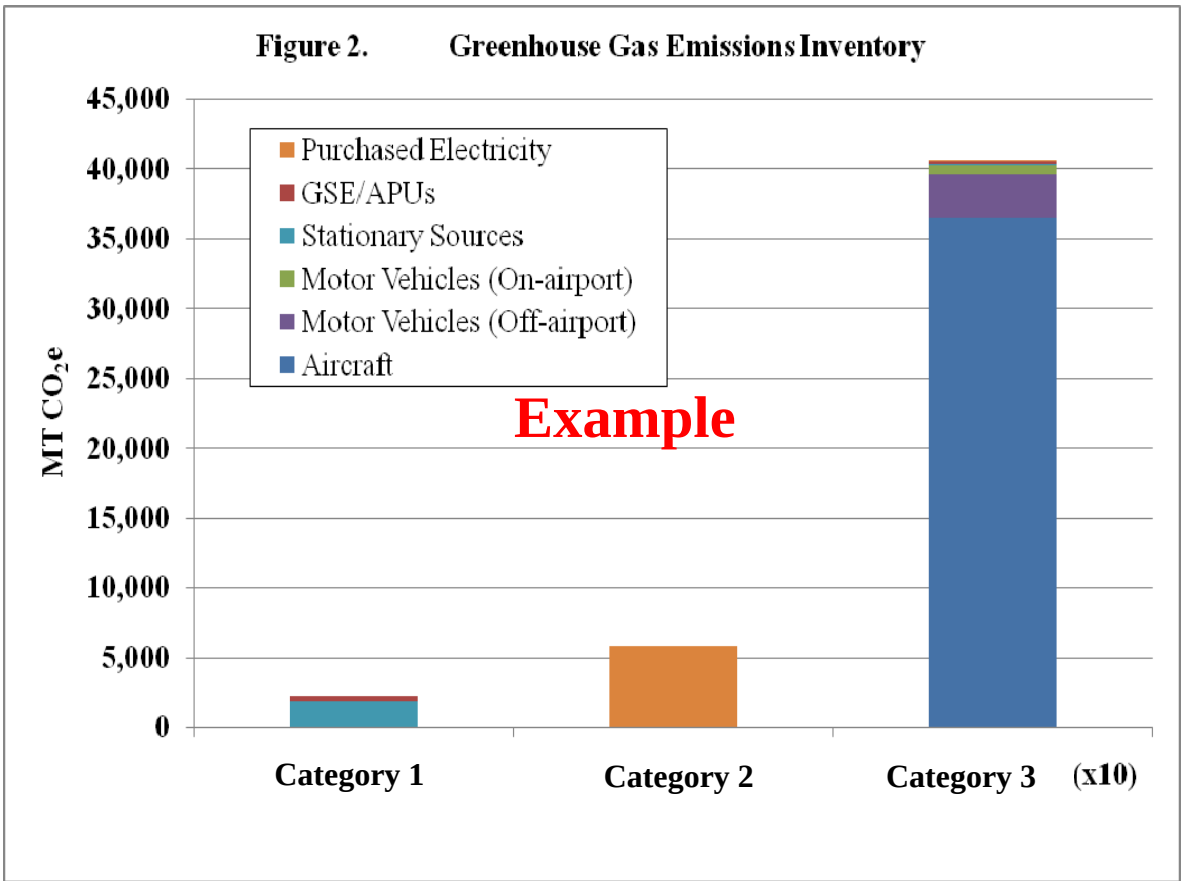
Table 4: Baseline Greenhouse Gas Emissions Inventory for SAN [Example]

Emission Source	Greenhouse Gases (MT CO_{2e})	% of Total
Category 1: Airport Owned/Controlled		
Purchased Electricity	-	-
Stationary Sources - Boilers	-	-
Stationary Sources - Generators	-	-
Ground Support Equipment Fleet	-	-
Ground Access Vehicles – On-airport		
- Public Auto/Trucks	-	-
- Taxis	-	-
- Limos	-	-
- Vans/Shuttles	-	-
- Buses	-	-
Subtotal	-	-
Category 2: Airline, Aircraft Operator, or Tenant Owned/ Controlled		
Aircraft		
- Ground	-	-
- Ground to 3,000 feet	-	-
- Above 3,000 feet	-	-
Aircraft Total	-	-
Auxiliary Power Units	-	-
Ground Support Equipment Fleet	-	-
Ground Access Vehicles	-	-
Purchased Electricity	-	-
Stationary Sources - Boilers	-	-
Stationary Sources - Generators	-	-
Subtotal	-	-
Category 3: Other & Public Ground Travel		
Ground Access Vehicles – Off-airport		
- Public Auto/Trucks	-	-
- Taxis	-	-
- Limos	-	-
- Vans/Shuttles	-	-
- Buses	-	-
Subtotal	-	-
Total Emissions	-	100

Example

[a.] MT - metric tons of CO_2 equivalents (1 MT = 1.1 Short Tons = 2,200 lbs.).

Again, for illustration purposes and for ease of comparison, the GHG emissions inventory results will also be presented graphically as shown in **Figure 2**.



Given the availability of sufficient and detailed input data, additional results will be provided in the *Emissions Inventory Appendix* that will show further breakdown of the GHG emissions by source owner (e.g., airline, GSE provider, etc.), equipment type (e.g., aircraft tug, belt loader, APU, etc), facility (e.g., airside, landside, roadway, parking), and location (e.g., on-airport versus off-airport).

Appendix

The following contains further, and more detailed, explanations of the anticipated methods, models, data, and assumptions to be used in the preparation of the SAN Baseline emissions inventory for the Air Quality Management Plan (AQMP).

For purposes of this Appendix, the emissions sources and other elements of the analysis are broken out by:

- Aircraft Operations
- Aircraft Emission Factors
- Aircraft Time in Mode
- Ground Support Equipment (GSE)
- Auxiliary Power Units (APUs)
- Motor Vehicles:
  - Vehicles owned and controlled by the Airport Authority (fleet vehicles)
  - Vehicles owned and controlled by airport tenants (primarily GSE)
  - Vehicles accessing the airport on public roadways (often called Ground Access Vehicles - GAV)
- Stationary Sources (separated by those owned by the Airport Authority and those owned by tenants).

Although subject to modification, the technical approach represents the framework from which data requests will be made and the analysis will be conducted.

A. Aircraft Operations

Aircraft activity levels (aircraft arrival and departure operations) and aircraft/engine assignments will be developed based on aircraft activity data for SAN in 2008. FAA Aircraft Situational Display to Industry (ASDi), Airport Authority Airport Noise and Operations Monitoring System (ANOMS) information, and other similar data will be collected to identify aircraft operations by individual airlines and aircraft types.

In addition to the use of the FAA Terminal Area Forecasts (TAF) to forecast annual aircraft operation for 2010, other forecasts performed for SAN including (but not limited to) the Regional Aviation Strategic Plan, Part 150 Noise analysis, etc. will be evaluated. From these information and the 2008 aircraft activity, the 2010 aircraft operations forecast will be developed.

Based on knowledge of the airline operating each flight, the specific aircraft type and engine combinations will be identified, using industry publications, such as *Jane's Information Group* - Airline Fleet and *JP Airline Fleets International*. Where unavailable, aircraft engine assignments will be based on EDMS5.1 default values, which are based on the most popular aircraft/engine assignments for the US aircraft fleet. Each

aircraft/engine combination will be assigned an aircraft category to match the FAA TAF categories: air carrier (including cargo), air taxi/commuter, general aviation, and military. **Table A-1** contains an example of an aircraft fleet mix. The aircraft fleet mix determined from the 2008 aircraft activity will be deemed consistent with the forecasted fleet mix for 2010.

Table A-1: Aircraft Fleet Mix and Operation for 2008

Aircraft Category	Aircraft	Engine	Operations
Air Carrier	Boeing 737-500 Series	CFM56-3C-1	972
	Boeing 737-700 Series	CFM56-7B22	17,134
Cargo	Airbus A300F4-600	PW4158 Reduced	8
	Boeing DC-10-10 Series	CF6-6D	12
Air Taxi/ Commuter	Bombardier CRJ-100	CF34-3A1 LEC II	8,752
	Bombardier CRJ-200	CF34-3B	3,856
General Aviation	Cessna 560 Citation V	JT15D-5, -5A, -5B	12
	Bombardier Learjet 40	TFE731-2-2B	74
	Gulfstream G400	TAY Mk611-8	720
	Gulfstream G500	BR700-710A1-10	208
	Raytheon Beech Baron	TIO-540-J2B2	94
Military	Boeing DC-9-20 Series	JT8D-11	176

The 2010 Baseline operations will be derived as a function of the 2008 operations and the TAF estimates for 2010 and applied by aircraft category. **Table A-2** contains the actual 2008 annual aircraft operations and the 2010 forecast values. As shown, air carrier operations are estimated to decrease by 6.1 percent from 2008 to 2010. Thus, the annual operations for 2010 for any aircraft/engine combination within the air carrier category will be determined to be 6.1 percent less than the values associated with 2008.

Table A-2: Annual Enplanements and Aircraft Operations for 2008 and 2010

		Aircraft Operations				
Year	Enplanements	Air Carrier	Air Taxi & Commuter	General Aviation	Military	Total
2008	9,061,155	164,382	46,235	14,501	1,059	226,157
2010	8,263,533	154,432	36,055	14,741	1,043	206,271
Percent	-8.8%	-6.1%	-22.0%	1.7%	-1.5%	-8.8%

Source: FAA ASPM OPSNET and FAA 2008 Terminal Area Forecast

B. Aircraft Emission Factors

EDMS5.1 contains a database of aircraft/engine-specific criteria pollutant emission factors based on engine manufacturer, model, and operational mode. The level of aircraft-related emissions is reflective of the time that an aircraft operates in each of the operational modes with the entire cycle referred to as a landing/take-off (LTO) cycle. A LTO cycle consists of the following operational modes:

- "Taxi/idle" includes the time an aircraft taxis between the runway and a terminal, and all ground-based delay incurred through the aircraft route. The taxi/idle-delay mode includes the landing roll, which is the movement of an aircraft from touchdown through deceleration to taxi speed or full stop (see **Section C** for estimated taxi times).
- "Approach" begins when an aircraft descends below the atmospheric mixing height and ends when an aircraft touches down on a runway.
- "Takeoff" begins when full power is applied to an aircraft and ends when an aircraft reaches approximately 500 to 1,000 feet. At this altitude, pilots typically power back for a gradual ascent.
- "Climb out" begins when an aircraft powers back from the takeoff mode and ascends above the atmospheric mixing height.
- Aircraft emissions (of VOC) also account for the period of engine startup which occurs within the gate terminal area prior to departure.

Mixing heights (also referred to as mixing depths) are used by meteorologists to quantify the vertical height of pollutant mixing that occurs in the atmosphere. Based on available data for San Diego, the annual average atmospheric mixing height is 734 meters (2,409 feet) above ground level, which will be used for the criteria pollutant assessment and is consistent with the Master Plan EIR. Consistent with the ACRP Guidebook, the GHG emissions inventory will assess emissions with a mixing height of 3,000 feet.

For GHG emissions, the EDMS5.1 calculates the fuel usage within each operating mode of the LTO cycle. Based on information within EDMS5.1 and the aircraft fleet mix, the Jet A and avgas fuel usage will be determined for the LTO cycle. **Table A-3** presents the GHG emissions for aircraft fuel usage. From the LTO fuel usage and the cited GHG emission factors, the GHG emissions within the LTO cycle will be determined.

Table A-3: Aircraft GHG Emission Factors

Fuel	CO_2	N_2O	CH_4	Units
Jet A	21.095	0.000188	0.00052	lb/gallon
AvGas	18.355	0.000188	0.00052	lb/gallon

Source: Energy Information Administration, http://www.eia.doe.gov/oiaf/1605/coefficients.html and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

Fuel usage within the aircraft engine startup mode will be estimated based on published guidance for the engine startup fuel flow rate.[14] Based on the number of non-piston aircraft operations and this fuel flow rate, the engine startup fuel usage will be determined and with the use of the aircraft GHG emission factors; to develop the GHG emissions. EDMS5.1 will be used to determine the VOC emissions from engine startup.

Lastly, the total aircraft fuel throughput for 2008 will be determined based on SAN fuel records. The 2008 fuel throughput will be adjusted to 2010 forecast based on the ratio of aircraft operations for 2010 and 2008 from the FAA TAF (see **Table A-2**). This total fuel usage minus the LTO fuel usage minus the engine startup fuel usage minus APU fuel usage is termed the cruise (or residual) fuel usage and represents the fuel usage in cruise mode between SAN and the aircraft destination.

The Airport Authority will also seek information from FAA on the System for Assessing Global Emissions (SAGE) specifically associated with SAN for 2008 (or most recent available data). FAA has indicated that they may make this available to airport operators. This data would then be compared with the fuel throughput data for purposes of better understanding aircraft fuel consumption.

C. Aircraft Time in Mode

EDMS default times-in-mode data will be used for approach, takeoff, and climb-out, as these times are not known to vary substantially from airport to airport.

SAN-specific times-in-mode for taxi-in, taxi-out, and delay periods are available from the FAA *Aviation System Performance Metrics* (ASPM) database.[15] For 2008, a taxi-in of 3.78 minutes and taxi-out of 13.62 minutes for all airport operations was determined from ASPM. These times may be adjusted to better reflect estimated taxi/delay for 2010 as a function of annual operations within the FAA TAF. That is, lesser operations in 2010 would result in less aircraft delay; although taxi time would generally not be affected by the number of operations.

Furthermore, the analysis of emissions from aircraft will use data to identify the specific time that aircraft operate at SAN (both within the taxi/queue mode and within the gate position). This effort may incorporate FAA's T-1 data concerning on-time arrival data for non-stop domestic flights by major air carriers. By using actual airport data, the analysis is able to incorporate any delay and inefficiencies that aircraft actually experience at a location; and thus, better analysis requirements of the MOU. These data can be analyzed by airline and aircraft type.

This analysis will provide a means of assessing aircraft ground movement and evaluating emission reduction measures per the MOU.

[14] ICAO/CAEP Working Group 3, May 5, 2006, Engine Starting Emissions.
[15] FAA, Aviation System Performance Metrics (ASPM), http://www.apo.data.faa.gov/

Aircraft are categorized as Category 2 emissions under airline/tenant owned/controlled. For this assessment, the GHG emissions will be developed using Method 2 for aircraft of the *ACRP Guidebook*.

D. Ground Support Equipment

Ground support equipment is a term used to describe the equipment that service aircraft after arrival and before departure at an airport. The type of GSE includes aircraft tugs, baggage tugs, belt loaders, fuel or hydrant trucks, water trucks, lavatory trucks, and cargo loaders, among others.

Air emissions resulting from the operation of GSE vary depending on the type of equipment, fuel type (gasoline, diesel, propane, electric, etc.) and the duration of equipment operation (engine run time). The type of GSE used depends on the aircraft type and the designated category of an aircraft operation (i.e., passenger, cargo, etc.).

A GSE survey was conducted, in April of 2006, as part of the Master Plan EIR to establish the GSE fleet mix, and typical operating times during an LTO cycle for several aircraft categories. **Table A-4** presents the GSE fleet data and operating times which were used for the Master Plan EIR and will be used for this emissions inventory. The GSE survey provided additional operating times for aircraft under Southwest, United, and US Airway/America West. These data are presented in **Table A-5**. General aviation and cargo aircraft will use EDMS5.1 default GSE fleet mix and operating times.

Within the GSE survey, GSE populations were determined from a total of 16 responding airlines. This data will be used to develop the ratio of fuel type for the GSE within SAN and these ratios will be used in conjunction with the operating time data to determine the GSE emissions. For example, approximate 74 percent of the baggage tugs were listed as gasoline-powered; 17 percent were listed as diesel-powered, and 9 percent were listed as electric units. If the total operating time for baggage tugs is 28.7 minutes (see **Table A-4**), than based on the inventory; the gasoline-powered units will be estimated to operating for 21.2 minutes, diesel-powered for 4.8 minutes, and electric for 2.7 minutes.

The April 2006 survey of operating times and population inventory will be revised or enhanced with additional data if available. Also site-specific data related to GSE supporting general aviation and cargo aircraft will be used, if available.

The use of either fuel trucks or hydrant trucks is dependant on the existence of a fuel hydrant system and if one exists, the percentage of the gates which are serviced by it.

This analysis will provide a means of assessing GSE emissions and evaluating alternative and fuel conversion options called for in the MOU.

Table A-4: Observed GSE Operating Times (minutes)

Equipment	Air Carrier - Narrow Body	Air Carrier – Wide Body	Commuter
Belt Loader	43.7	82.0	16.3
Baggage Tug	28.7	30.0	26.3
Fuel Truck	18.5	24.0	8.0
Catering Truck	10.0	33.0	
Aircraft Tug	6.3	7.0	
Lavatory Truck	4.0	4.0	0.7
Service Truck	1.8	31.0	

Table A-5: Airline-specific GSE Operating Times (minutes)

Equipment	Southwest	United	US Airway/America West
Baggage Tug	28.7	23.8	17.8
Aircraft Tug	4.0	6.3	6.3

Although EDMS5.1 also contains a database of emission factors (and horsepower) for GSE, these emission factors are based on EPA NONROAD emissions program. The California Air Resources Board OFFROAD emissions model provides emissions factors for GSE and was used in the Master Plan EIR as these emission factors better reflect regulatory conditions within California. The CARB OFFROAD model contains emission factors for criteria and GHG pollutants. **Table A-6a and A-6b** present the emissions factors which will be used for the emissions inventory.

Additional GSE survey data concerning the power rating (in horsepower) will be collected. If this data is unavailable, default values (from OFFROAD model) will be used.

Table A-6a: Gasoline-powered GSE Emission Factors for 2010 (g/hp-hr)

Equipment	Hp	VOC	CO	NOx	SO2	PM10	CO2	N2O	CH4
Cargo Tractor	95	18.82	35.80	3.43	0.003	0.03	418.23	0.09	0.08
A/C Tug Narrow Body	130	21.57	22.24	6.34	0.006	0.05	602.60	0.11	0.05
A/C Tug Wide Body	500	1.81	20.39	2.62	0.006	0.05	585.60	0.04	0.02
Air Conditioner	130	0.63	16.94	5.04	0.006	0.04	564.93	0.10	0.04
Air Start Unit	130	0.84	20.68	6.11	0.007	0.05	677.92	0.11	0.04

Equipment	Hp	VOC	CO	NOx	SO2	PM10	CO2	N2O	CH4
Baggage Tug	100	0.68	18.16	1.66	0.004	0.03	425.97	0.06	0.02
Belt Loader	60	0.95	17.49	1.70	0.004	0.03	387.25	0.08	0.03
Bobtail	100	2.03	18.16	1.66	0.004	0.03	425.97	0.06	0.02
Cargo Loader	70	0.61	18.39	1.96	0.004	0.03	387.25	0.08	0.03
Cart	12	2.65	126.37	1.86	0.006	0.11	214.72	0.19	0.15
Deicer	93	1.53	26.81	6.06	0.007	0.06	735.77	0.13	0.07
Forklift	50	0.48	31.51	0.87	0.003	0.02	234.99	0.06	0.03
Fuel Truck	130	0.79	5.62	1.76	0.002	0.01	188.31	0.06	0.01
Ground Power Unit	150	0.45	19.44	1.99	0.006	0.04	564.93	0.06	0.02
Lavatory Cart	12	2.63	126.37	1.86	0.006	0.11	214.72	0.19	0.15
Lavatory Truck	130	31.10	7.40	1.26	0.002	0.01	188.31	0.05	0.01
Lift	100	7.50	20.35	3.44	0.004	0.03	387.25	0.09	0.06
Maintenance. Truck	130	1.24	12.91	3.24	0.004	0.03	376.62	0.08	0.03
Other GSE	50	1.46	42.71	2.43	0.005	0.03	391.65	0.11	0.08
Passenger Stand	125	0.58	14.00	4.25	0.004	0.04	444.42	0.09	0.03
Sweeper	53	1.09	20.49	3.49	0.003	0.03	394.99	0.12	0.06
Generator	107	2.53	46.27	5.84	0.005	0.05	604.11	0.12	0.14
Service Truck	180	2.16	5.74	1.61	0.001	0.01	146.40	0.05	0.01
Catering Truck	204	2.37	15.64	4.29	0.003	0.03	380.64	0.07	0.04
Water Truck	150	0.41	4.93	1.47	0.001	0.01	150.65	0.05	0.01
Hydrant truck	122	4.22	23.94	6.24	0.004	0.04	527.27	0.11	0.06

Source: CARB OFFROAD2007.

Table A-6b: Diesel-powered GSE Emission Factors for 2010 (g/hp-hr)

Equipment	Hp	VOC	CO	NOx	SO2	PM10	CO2	N2O	CH4
Cargo Tractor	88	0.66	2.24	3.88	0.003	0.36	306.88	-	0.06
A/C Tug Narrow Body	178	0.65	1.89	6.04	0.005	0.26	454.64	-	0.06
A/C Tug Wide Body	332	0.59	3.03	5.58	0.004	0.23	454.64	-	0.05
Air Conditioner	155	0.34	2.26	3.24	0.005	0.17	426.22	-	0.03
Air Conditioner	221	0.22	0.78	3.09	0.005	0.09	426.23	-	0.02
Air Conditioner	441	0.20	0.76	2.65	0.005	0.09	426.22	-	0.02
Air Start Unit	134	0.54	2.65	4.93	0.005	0.24	511.45	-	0.05
Air Start Unit	192	0.36	1.17	4.65	0.005	0.14	511.47	-	0.03
Air Start Unit	384	0.32	1.25	4.22	0.005	0.13	511.47	-	0.03
Air Start Unit	576	0.33	1.25	4.34	0.005	0.13	511.47	-	0.03
Baggage Tug	71	0.81	2.44	4.63	0.004	0.42	312.56	-	0.07
Belt Loader	54	0.68	2.12	3.95	0.003	0.36	284.15	-	0.06
Bobtail	113	0.70	2.26	4.24	0.004	0.37	312.56	-	0.06
Cargo Loader	101	0.61	2.04	3.62	0.003	0.33	284.15	-	0.05
Forklift	156	0.21	0.95	1.78	0.002	0.10	170.49	-	0.02
Fuel Truck	189	0.12	0.35	1.37	0.002	0.04	142.07	-	0.01
Ground Power Unit	163	0.55	2.43	4.38	0.005	0.25	426.22	-	0.05
Lavatory Truck	168	0.20	0.84	1.54	0.002	0.09	142.07	-	0.02
Lift	115	0.54	1.96	3.36	0.003	0.30	284.15	-	0.05
Other GSE	140	0.45	1.72	3.54	0.004	0.20	284.15	-	0.04
Passenger Stand	100	0.46	2.00	3.44	0.004	0.23	335.30	-	0.04
Service Truck	174	0.13	0.61	1.14	0.001	0.06	113.66	-	0.01
Catering Truck	240	0.16	0.56	2.35	0.003	0.07	295.51	-	0.01
Hydrant Truck	175	0.50	2.21	4.22	0.004	0.22	397.81	-	0.05

Source: CARB OFFROAD2007.

Thus, with the use of GSE operating times, the percentage of equipment using specific fuel types, the equipment size (in horsepower) and the emission factors (from OFFROAD), the GSE emissions within each LTO can be determined for each aircraft.

However, if available, annual fuel usage and/or operating hours for GSE will be collected (by airline, if available) for 2008. This additional data will allow for computation of the GSE emissions in a population-based method instead of the LTO method. If GSE fuel usage is available, the GHG emissions factors in **Table A-7** will be used instead of the OFFROAD emission factors.

GSE are categorized as either Category 1 or 2 emissions (depending on the owner) but are mostly airline owned/controlled with the exception of some GSE which are airport owned/controlled. For this assessment, the GHG emissions will be developed using Method 2 for GSE of the ACRP Guidebook.

Table A-7: GSE GHG Emission Factors

Fuel/Year	CO_2	N_2O	CH_4	Units
Diesel	22.384	0.0001928	0.000534	lb/gallon
Biodiesel	20.74	0.0001786	0.0004948	lb/gallon
Gasoline	19.564	0.0002	0.00055	lb/gallon
Propane	12.669	0.00000023	0.000003	lb/gallon

E. Auxiliary Power Units

Auxiliary power units are on-board engines that provide power to an aircraft while taxiing or at the terminal gate. Larger aircraft use an APU to run heat and air conditioning, and to provide electrical power for the aircraft. The APU can also be used to restart the engines before departing from the gate area.

EDMS5.1 assigns default APU based on aircraft assignments and also includes criteria pollutant emission factors corresponding to the horsepower for each unit.

In order to determine emissions from APU, the availability of preconditioned air and gate power will need to be determined. In addition, the airlines assigned to each gate position will be required. Gates which have access to preconditioned air and gate power will be assigned an APU operating time of 7 minutes (during arrival and departure); those gates not having access to gate power will be assigned an APU operating time of 26 minutes.

Additional APU usage will be a function of the turnaround time for each airline/aircraft combination based on FAA ASPM data. The turnaround time will be capped at 60 minutes for aircraft overnighting at the airport. Secondly, typically APU are used at ambient temperatures greater than 55F and less than 35F. Five years of historical meteorological data will be analyzed to determine the frequency of this temperature condition during typical airport operating hours of 6 am through 11 pm.

EDMS5.1 calculates the criteria pollutant emissions from APU but does not calculate the GHG emissions, nor does EDMS5.1 determine the fuel usage from APU. For the GHG emissions for APU calculation, the fuel usage will be estimated based on manufacture fuel flow rates for respective APU (typically from 270 to 870 pounds per hour) or other acceptable methods. The fuel usage combined with the Jet A GHG emissions factors in **Table A-3** will be used to determine the GHG emissions for APU.

The SDCRAA will document its gate electrification conversion plans, reflecting currently contracted replacements as well as anticipated plans that were expected regardless of the

Attorney General MOU and the AQMP. This will allow for the comparison to the "business as usual" condition.

Aircraft GHG emissions are categorized as Category 2 under the ACRP *Guidebook for Preparing Airport GHG Emissions Inventories* and are under the ownership and control of the airline tenants. The GHG emissions will be developed using APU-specific fuel consumption along with Jet A GHG emission factors.

F. Motor Vehicles

The level of emissions that would result from the daily operation of airport-related motor vehicles depends on several factors including the volume of vehicles, the vehicle fleet mix, the motor vehicle emission rates, travel distance, speed, the level of congestion/delay, the year of analysis, and meteorological factors.

The SAN Master Plan EIR developed a motor vehicle emissions inventory based on an extensive roadway network which included on-airport roadways and off-airport roadways. Roadway traffic volumes were separated into vehicles associated with SAN and those vehicles which are part of the cumulative traffic. The motor vehicle emissions inventory also included parking facilities and terminal curbside activities. The Master Plan EIR traffic data for 2010 will be used as the initial point of reference for the criteria and GHG emissions inventory. However, the traffic volumes used in the EIR may be updated to better reflect forecasted conditions. Additionally, further information will be collected to better estimate the emissions inventory; this will include a closer accounting of the types of vehicles used by the airport and servicing the airport; both owned and controlled by the airport and by others.

The Airport Authority will provide a comprehensive listing of airport fleet vehicles based on a survey that the Authority completed in the last two years. This inventory would provide: vehicle make/manufacture, vehicle age, fuel type, and annual miles traveled or annual fuel consumed. In addition, SDCRAA will identify vehicle acquisition plans (vehicle type, fuel, use, timeframes, etc.) and fleet vehicle shuttle conversion plans, reflecting currently contracted fleet replacements as well as anticipated plans that were expected regardless of the MOU and AQMP.

On-airport ground access vehicles reflect vehicles not owned by the airport, but which travel on roadways owned by the Airport Authority. The Authority's surveys conducted in the last two years will be used. For on-airport travel, the data will identify: travel mode (single occupancy vehicle, shuttle, taxi, public transportation, etc), vehicle manufacture/type, fuel type, vehicle purpose (cargo, passenger, service, etc), distance traveled, and estimated fuel economy. As part of the EIR, on-airport GAV volumes were estimated for 2010 and will be used to supplement any additional collected data. The Master Plan EIR estimated a total of 6,673,555 vehicle miles traveled within the on-airport roadway network for 2010. This value may be adjusted to reflect more recent trends.

For off-airport vehicle information, major surface transportation providers will be contacted (i.e., taxi cabs, shuttles, rental cars, etc) to identify the requisite vehicle information. General passenger information will be reviewed where possible, such as Airport Authority in-flight passenger surveys concerning passenger mode splits, employee security badge summary information concerning parking and distance traveled, employee work commute information concerning employee travel mode splits. As part of the EIR, off-airport GAV volumes were estimated for 2010 and will be used to supplement any additional collected data. This additional data may include surface movement collected by the California Department of Transportation (CALTRANS), San Diego Council of Governments (SANDAG), Metropolitan Transit System (MTS), Port of San Diego, and the City of San Diego, in addition to the survey data described previously. The Master Plan EIR estimated a total of 56,167,166 vehicle miles traveled within the off-airport roadway network for 2010. This value may be adjusted to reflect more recent trends.

Additionally, airport survey data for enplaned passenger will be request to determine the average travel distance for a passenger going to and from SAN.

Table A-8 contains the traffic volumes within the parking facilities and terminal curbsides developed for 2010 as part of the Master Plan EIR. Data within the Master Plan EIR may be adjusted to account for current trends since the development of the EIR.

Table A-8: Annual Vehicle Volumes – Parking Facilities and Curbsides for 2010

Source	Travel Distance (m)	Queue (min)	Volume
Parking Facility			
Commuter	287	1.50	540,134
Employee Lot 6	351	1.50	611,063
Employee Lot 8	337	1.50	426,752
Long Term Harbor Drive	333	1.50	76,629
Long Term NTC	686	1.50	283,988
Rental Car	306	1.50	777,519
T1E & T2W Long Term Pacific	683	1.50	1,235,470
T2W Garage	1029	1.50	1,213,625
T2W Lot	271	1.50	60,681
T1	340	1.50	326,787
Curbsides			
Commuter Terminal Commercial Curb	209	1.58	317,034
Commuter Terminal Public Curb	209	2.33	176,130
T1 Commercial Curb A	349	1.30	1,144,844
T1 Commercial Curb B	233	1.30	1,144,844
T1 Public Curb A	226	1.90	1,778,912
T1 Public Curb B	145	1.90	1,778,912
T2 West Commercial Curb	445	1.65	915,875
T2 West Public Curb	302	2.17	546,003
T2 East Public Curb	131	2.17	546,003

Source: Master Plan EIR.

The CARB EMFAC2007 emissions model will be used to determine emission factors for 2010. **Table A-9** contains motor vehicle emission factors to be used in the criteria and GHG emissions inventory. The GHG emissions will be developed using Method 3 for motor vehicles of the ACRP Guidebook.

Table A-9: Motor Vehicle Emission Factors for 2010 (g/hp-hr)

Speed	VOC	CO	NOx	SO2	PM10	PM2.5	CO2	N2O	CH4
Idle	1.451	14.846	1.424	0.030	0.316	0.263	656.368	0.005	0.051
10	0.214	4.131	0.407	0.006	0.060	0.043	656.368	0.005	0.051
25	0.176	3.627	0.771	0.005	0.059	0.042	452.077	0.005	0.035
35	0.126	3.066	0.716	0.004	0.049	0.032	407.069	0.005	0.029
40	0.115	2.899	0.710	0.004	0.047	0.030	386.400	0.005	0.027
45	0.111	2.801	0.717	0.004	0.046	0.029	379.089	0.005	0.025

Source: CARB EMFAC2007.

G. Stationary Sources

For the Master Plan EIR, stationary sources such as boilers and generators were included into the analysis (see **Table A-10**). The stationary sources were based on the San Diego International Airport Air Quality Compliance Guide (dated 2004). These sources are generally owned and controlled by the airport. Additional information will be collected to 1) updated the list of stationary sources owned and controlled by the airport, and 2) provide a listing of stationary sources owned and controlled by airport tenants. This information will include (where available), the equipment capacity rating, fuel type, and fuel usage for 2008.

Criteria pollutant emissions will be based on emission factors within EDMS5.1 or set by specific operating permits. The GHG emissions will be based on emissions factors within **Table A-11**.

Electrical consumption for 2008 will be collected and where available be listed by location/mission such that the distinction between airport and tenant usage can be determined.

Stationary sources are categorized as Category 1 and 2 and under the ownership/control of the airport or tenants. The GHG emissions will be developed using Method 1 for stationary sources of the ACRP Guidebook.

GHG emissions from the use of refrigeration and fire extinguishers associated with airport activities are not expected to be significant at SAN. When computed, the method is based on material balancing of the charging, operating, and disposal of refrigerants. The EPA and IPCC provide guidance on emission factors and related parameters used to quantify these sources of GHG if necessary.

GHG emissions associated with the recycling of solid waste at SAN is also not expected to be significant and will not be included.

Table A-10: Stationary Source Usage for 2005

Source	Size	Fuel/Material	Quantity	Units
Kewanne Boiler	7.5 MMBtu/hr	Natural Gas	4,873,424	1,000 cubic meters
Kewanne Boiler	7.5 MMBtu/hr	Natural Gas	9,464,331	1,000 cubic meters
Kewanne Boiler	7.5 MMBtu/hr	Natural Gas	9,958,736	1,000 cubic meters
Generator 972648	650 hp	Diesel	966	gallons
Generator 940098	380 hp	Diesel	133	gallons
Generator 951081	211 hp	Diesel	312	gallons
Generator 973586	277 hp	Diesel	417	gallons
Generator 961289	519 hp	Diesel	755	gallons
Generator 978266	110 hp	Diesel	2,700	gallons
Generator 961809	755 hp	Diesel	495	gallons
Generator 961834	900 hp	Diesel	1,305	gallons
Generator 972682	760 hp	Diesel	966	gallons
Generator 978267	64 hp	Diesel	1,650	gallons
Generator 978268	64 hp	Diesel	1,650	gallons
Generator 978269	64 hp	Diesel	1,650	gallons
Generator	78 hp	Diesel	680	gallons
Electrical Consumption			37,200,00	kWh

Source: San Diego International Airport Air Quality Compliance Guide, 2004 and Master Plan EIR.

Table A-11: Stationary Source GHG Emission Factors

Sources	Fuel/Year	CO_2	N_2O	CH_4	Units
Boilers	Natural Gas	120.593	0.64	2.30	lb/MMcf
Generators	Diesel	22.384	0.0001928	0.000534	lb/gallon
Electrical Consumption	kilowatts	0.61	0.0000037	0.0000067	lb/kWh

Energy Information Administration, http://www.eia.doe.gov/oiaf/1605/coefficients.html and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

US EPA's eGRID Database (http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html) and the Department of Energy's Energy Information Administration (www.eia.doe.gov/oiaf/1605/e-factor.html).

Fuel throughput for 2008 will be collected for storage tanks and dispensing of gasoline, diesel, Jet A, Avgas, etc). **Table A-12** presents the 2005 fuel throughout for SAN based on the Master Plan EIR. If data is not available for 2008, data within the Master Plan EIR may be adjusted to account for current trends since the development of the EIR and estimated for 2010 as a function of aircraft operations.

Table A-12: Fuel Usage for 2005 (gallons)

Source	Usage
Jet A Tanks 1	156,983,154
Jet A Tank 2	979,021
Gasoline	187,034
Avgas	29,587

Source: San Diego Master Plan EIR.

H. Global Warming Potentials

The GHG emission results will be converted to CO_2 equivalent values using the Global Warming Potential values of 1 for CO_2, 25 for CH_4, and 298 for N_2O (based on a 100 year period) as presented in the IPCC's Assessment Report.[16] Use of the Second or Third Assessment Report may be warranted depending on the reporting goals (e.g., CCR).

[End of Appendix]

[16] Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, New York City, NY. 2007.