APPENDIX F
CLIMATE CHANGE

This appendix contains background information that supplements the results and conclusions in **Section 3.3**. This appendix consists of the following sections:

- F.1 Regulatory Context – Discusses the current status of regulations that relate to climate.
- F.2 Methodologies, Assumptions, and Data Descriptions – Documents the methods and various assumptions used to evaluate the effect of the Proposed Interim Fly Quiet and Revised Interim Fly Quiet 1 and 2 on greenhouse gas (GHG) levels.
- F.3 Climate Change Analysis Results – Presents the results of the GHG emission inventories prepared for the Existing Fly Quiet, Proposed Interim Fly Quiet, and Revised Interim Fly Quiet 1 and 2.

F.1 REGULATORY CONTEXT

Research has shown that an increase in GHG emissions is significantly affecting the Earth's climate. These conclusions are based on a scientific record that includes substantial contributions from the United States Global Change Research Program (USGCRP), mandated by Congress in the Global Change Research Act to "assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change."[1]

In 2009, based primarily on the scientific assessments of the USGCRP, the National Research Council, and the Intergovernmental Panel on Climate Change (IPCC), the United States Environmental Protection Agency (USEPA) issued a finding deeming it reasonable to assume that changes in climate caused by elevated concentrations of GHG in the atmosphere endanger the health and welfare of current and future generations.[2] By summer 2016, the USEPA acknowledged that scientific assessments by that time "highlight the urgency of addressing the rising concentration of carbon dioxide (CO_2) in the atmosphere" and formally announced that GHG emissions from certain classes of aircraft engines contribute to climate change.[3,4]

The most prevalent GHG at airports[5] are CO_2, methane (CH_4), and nitrous oxide (N_2O). GHG emissions are typically reported in units of metric tons (MT) of carbon dioxide equivalents (CO_{2e}).[6]

Worldwide emissions of GHG in 2014 were 45.7 billion tons of CO_{2e} per year.[7] This value includes ongoing emissions from industrial and agricultural sources. In 2016, the United States emitted about 6,511 million

[1] Global Change Research Act of 1990, Pub. L. 101–606, Sec. 103, November 16, 1990, http://www.globalchange.gov.
[2] Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66496 (December 15, 2009).
[3] USEPA, Final Rule for Carbon Pollution Emission Guidelines for Existing Stationary Sources Electric Utility Generating Units, 80 Fed. Reg. 64661, 64677 (October 23, 2015).
[4] USEPA finalized findings that GHG emissions from certain classes of engines used in aircraft contribute to the air pollution that causes climate change endangering public health and welfare under section 231(a) of the Clean Air Act.
[5] Six GHGs are identified in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The latter three primary GHGs do occur at airports, but to a far lesser extent, and therefore are not included in the analysis.
[6] CO_{2e} are calculated as the product of the mass emitted of a given GHG and its specific Global Warming Potential (GWP). While methane (CH_4) and nitric oxides (N_2O) have much higher GWP than CO_2, CO_2 is emitted in such vastly higher quantities that it accounts for the majority of GHG emissions in CO_{2e}. One ton of CO_2 is equivalent to one ton of CO_{2e}.
[7] Climate Analysis Indicator Tool. Accessed July 20, 2018, at http://cait.wri.org/

metric tons of CO_{2e}. Total U.S. emissions have increased by 2.4 percent from 1990 to 2016, and emissions decreased from 2015 to 2016 by 1.9 percent (126.8 million metric tons of CO_{2e}). The decrease in total GHG emissions between 2015 and 2016 was driven in large part by a decrease in CO_{2e} emissions from fossil fuel combustion. The decrease in CO_{2e} emissions from fossil fuel combustion was a result of multiple factors, including substitution from coal to natural gas and other non-fossil energy sources in the electric power sector; and warmer winter conditions in 2016 resulting in a decreased demand for heating fuel in the residential and commercial sectors.[8]

Of the five major sectors nationwide—residential and commercial, industrial, agriculture, transportation, and electricity—electricity accounts for the highest fraction of GHG emissions (approximately 28 percent), closely followed by transportation (approximately 28 percent) and by industry (approximately 22 percent).[9] The most recent USEPA data indicate that in 2016, aircraft accounted for 9.1 percent of U.S. transportation GHG emissions and 2.6 percent of total U.S. GHG emissions.[10]

Although there are no federal standards for aviation-related GHG emissions, it is well established that GHG emissions affect climate.[11] Following procedures detailed in FAA's 1050.1F Desk Reference, FAA's policy is that GHG emissions should be quantified in a NEPA document when there is a reason to quantify emissions for air quality purposes or when changes in the amount of aircraft fuel used are computed/reported. Because air pollutant/pollutant precursor emissions and fuel burn were estimated for the Existing Fly Quiet, Proposed Interim Fly Quiet, and Revised Interim Fly Quiet 1 and 2, GHG inventories were also prepared.

F.2 METHODOLOGIES, ASSUMPTIONS, AND DATA DESCRIPTIONS

The Proposed Interim Fly Quiet and Revised Interim Fly Quiet 1 and 2 would result in the same level of activity as would be expected with the Existing Fly Quiet. The Proposed Interim Fly Quiet and Revised Interim Fly Quiet 1 and 2 could potentially affect total GHG emissions by changing the taxi times of the aircraft arriving and departing during nighttime hours.

To evaluate the effect of the change in aircraft taxi times on GHG emissions, the GHG emissions inventory was prepared using the following guidelines:

- Transportation Research Board (TRB), Airport Cooperative Research Program (ACRP) Report 11, Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories;[12]
- USEPA Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Optional Emissions from Commuting, Business Travel and Product Transport;[13] and
- IPCC Guidelines for National Greenhouse Gas Inventories.[14]

[8] USEPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016*, April 2018, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016

[9] USEPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016*, April 2018, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016

[10] USEPA, Regulations for Greenhouse Gas Emissions from Aircraft, June 2018, https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-aircraft.

[11] FAA, An Environmental Desk Reference for Airport Actions, October 2007. https://www.faa.gov/airports/environmental/environmental_desk_ref/.

[12] ACRP Report 11, Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories, 2009, http://www.trb.org/Publications/Blurbs/160829.aspx.

[13] USEPA, Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Optional Emissions from Commuting, Business Travel and Product Transport, May 2008, https://nepis.epa.gov/Exe/ZyPDF.cgi/P1001177.PDF?Dockey=P1001177.PDF.

[14] IPCC, Guidelines for National Greenhouse Gas Inventories, 2006, https://www.ipcc-nggip.iges.or.jp/public/2006gl/.

The level of GHG emissions from aircraft activity (i.e., taxi, approach, climb-out, and take-off) is directly attributable to the level of fuel consumption by the aircraft. For this analysis, total estimates of aircraft fuel consumption (in gallons) for the Existing Fly Quiet, Proposed Interim Fly Quiet, and Revised Interim Fly Quiet 1 and 2 were obtained from the FAA Aviation Environmental Design Tool (AEDT Version 2d) output prepared for the air quality analysis. Given the aircraft fleet mix at O'Hare, all fuel usage was assumed to be Jet A (i.e., aircraft with jet or turboprop engines) while the Avgas (i.e., piston aircraft) is minimal. AEDT then computes GHG emissions of CO_2 based on the aircraft emission factor of 21.095 pounds of CO_2/gallon of Jet A fuel to compute GHG emissions.

F.3 CLIMATE CHANGE ANALYSIS RESULTS

Using the methodologies, assumptions, and data described previously, estimated GHG emissions levels from the Existing Fly Quiet, Proposed Interim Fly Quiet, and Revised Interim Fly Quiet 1 and 2—represented in terms of MT of CO_{2e}—are presented.

The fuel burn estimates for the Existing Fly Quiet were used to estimate metric tons of CO_{2e}. Using AEDT, the estimated fuel burn for the Existing Fly Quiet is 12,231,681 gallons of Jet A. Using an emission factor of 21.095 pounds of CO_2 per gallon of Jet A, the estimated level of GHG emissions with the Existing Fly Quiet is 117,456 metric tons of CO_{2e}; again, this only includes nighttime aircraft operations within the aircraft operational mode of ground travel taxi/queue.

Using the same methodology used for the Existing Fly Quiet, the estimated fuel burn for the Proposed Interim Fly Quiet is 12,349,224 gallons of Jet A. The estimated level of GHG emissions for the Proposed Interim Fly Quiet is 118,584 metric tons of CO_{2e}.

Based on estimates of GHG emissions for the Existing Fly Quiet and the Proposed Interim Fly Quiet, the Proposed Interim Fly Quiet would result in an increase of 117,543 gallons of Jet A usage and 1,129 metric tons of CO_{2e}. This level of emissions, compared to the 6,511 million metric tons of CO_{2e} within the U.S. during 2016, indicates that the Proposed Interim Fly Quiet GHG emissions would represent 0.00002 percent of total GHG emissions generated in the U.S.

Using the same methodology used for the Existing Fly Quiet, the estimated fuel burn for the Revised Interim Fly Quiet 1 is 12,386,656 gallons of Jet A. The estimated level of GHG emissions for the Revised Interim Fly Quiet 1 is 118,944 metric tons of CO_{2e}. Based on estimates of GHG emissions for the Existing Fly Quiet and the Revised Interim Fly Quiet 1, the Revised Interim Fly Quiet 1 would result in an increase of 154,975 gallons of Jet A usage and 1,488 metric tons of CO_{2e}. This level of emissions, compared to the 6,511 million metric tons of CO_{2e} in the U.S. during 2016, indicates that the Revised Interim Fly Quiet 1 GHG emissions would represent 0.00003 percent of total GHG emissions generated in the U.S.

Using the same methodology used for the Existing Fly Quiet, the estimated fuel burn for the Revised Interim Fly Quiet 2 is 12,362,898 gallons of Jet A. The estimated level of GHG emissions for the Revised Interim Fly Quiet 2 is 118,716 metric tons of CO_{2e}. Based on estimates of GHG emissions for the Existing Fly Quiet and the Revised Interim Fly Quiet 2, the Revised Interim Fly Quiet 2 would result in an increase of 131,217 gallons of Jet A usage and 1,260 metric tons of CO_{2e}. This level of emissions, compared to the 6,511 million metric tons of CO_{2e} in the U.S. during 2016, indicates that the Revised Interim Fly Quiet 2 GHG emissions would represent 0.00002 percent of total GHG emissions generated in the U.S.

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