APPENDIX C

Air Quality

A

Air Quality

A.1 Air Emissions Inventories

This section documents the data, assumptions, and methodologies used to prepare the existing (2016) emissions inventories for the Charlotte Douglas International Airport (CLT) Environmental Impact Statement (EIS).

An existing emissions inventory (2016) was prepared for the following United States Environmental Protection Agency (EPA) criteria pollutants, surrogate pollutants, and pollutant precursors: carbon monoxide (CO), nitrogen oxides (NO_x) for nitrogen dioxide (NO_2), sulfur oxides (SO_x) for sulfur dioxide (SO_2), particle matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), particle matter with an aerodynamic diameter of 10 microns or less (PM_{10}), and volatile organic compounds (VOC). Lead (Pb) emissions at airports are mostly associated with general aviation (GA) aircraft during taxi operations. Because GA aircraft operations account for a small portion (4.6%) of the total existing (2016) aircraft fleet mix and the Proposed Project would have a minimal influence on GA aircraft, Project related emissions of Pb are not expected to be significant. Therefore, emissions of Pb were not analyzed.[1]

Emissions inventories of Greenhouse Gases (GHGs) and Hazardous Air Pollutants (HAPs) were also prepared. The GHG inventory was prepared for carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The individual HAPs that were inventoried are listed below and are in accordance with the Federal Aviation Administration's (FAA's) Air Quality Handbook[2] and are provided for disclosure purposes only.

The inventoried HAPs are:

- Formaldehyde
- Methyl alcohol
- Benzene
- Acetaldehyde
- Naphthalene
- O-xylene
- Isopropyl-benzene
- Ethylbenzene
- Styrene
- M & P-xylene
- 1,3-butadiene
- Acrolein
- M-xylene
- Toluene
- Phenol (carbolic acid)
- N-hexane
- 2,2,4-trimethylpentane
- Propionaldehyde
- Acetone
- 2-methylnaphthalene
- Benzaldehyde
- N-heptane
- Cyclohexene

1 VHB, *Purpose and Need Working Paper, Charlotte Douglas International Airport EIS*, July 2018.

2 FAA, *Aviation Emissions and Air Quality Handbook*, Version 3, Update 1, https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/, January 2015.

Following the FAA's Air Quality Handbook and FAA Order 1050.1F Desk Reference guidelines, emissions of criteria pollutants and their precursors, as well as HAPs, are reported in tons per year (tpy), while Greenhouse Gas (GHG) emissions are reported in units of metric tons (MT) of CO_2 equivalents (CO_2e) per year.[3] The GHG emissions presented in this EIS were converted to CO_2e values using the Global Warming Potentials (GWPs) presented in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report.[4]

A.1.1 Operational Emissions

The existing or "baseline" year 2016 emissions inventory was prepared for the following airport-related sources—aircraft, auxiliary power units (APUs), ground support equipment (GSE), and motor vehicles.

The operational emissions inventory for the CLT EIS was prepared using the FAA-required Aviation Environmental Design Tool (AEDT, version 2d)[5] and the Motor Vehicle Emission Simulator (MOVES, version 2014b).[6]

A.1.1.1 Aircraft

A 2016 average annual day (AAD) flight schedule was used to develop the stage lengths, fleet mix, and annual operations.[7] Aircraft engine selections are based on the most common engines used by the airlines operating at CLT.[8] Aircraft emissions of CO, $PM_{2.5}$, PM_{10}, SO_x, VOC, NO_x, and HAPs were calculated using AEDT default emission factors and the AEDT default mixing height of 3,000 feet. Fuel usage obtained from AEDT and data from EPA's GHG Emissions Factor Hub were used to calculate aircraft GHG emissions.[9]

Table A-1 provides the aircraft operations by category, airframe, engine, stage length, and operation type (arrival/departure) for the existing condition (2016).

3 FAA, *Environmental Desk Reference for Airport Actions*, https://www.faa.gov/airports/environmental/environmental_desk_ref/, October 2007.

4 IPCC Fifth Assessment Report presents GWPs as 1 for CO2, 28 for CH4, and 265 for N2O.

5 FAA, *AEDT (Version 2d)*, https://aedt.faa.gov/, September 28, 2017.

6 EPA, *MOtor Vehicle Emission Simulator (MOVES)*, https://www.epa.gov/moves, August 2018.

7 Data provided by InterVISTAS Consulting Inc., 2018.

8 Eastman Chemical Company, *Eastman Aviation Solutions Turbine-engined fleets of the world's airlines*, 2016.

9 EPA, *Center for Corporate Climate Leadership GHG Emission Factors Hub*, https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub.

Table A-1 Existing (2016) Aircraft Fleet Mix

Category	Airframe	Engine	Stage Length	Operation Type	Annual Operation
ARRIVALS					
Air Taxi	Raytheon Super King Air 300	PT6A-60	NA	A	283
	Cessna 525A Citation Jet	BIZLIGHTJET_F	NA	A	283
	Cessna 560 Citation V	JT15D-5, -5A, -5B	NA	A	283
	Cessna 560 Citation XLS	BIZMEDIUMJET_F	NA	A	565
	CX 680 SOVEREIGN	BIZLIGHTJET_F	NA	A	564
	Cessna 750 Citation X	AE3007C	NA	A	282
	Bombardier Challenger 300	AS907-1-1A	NA	A	1,413
	Embraer 505	BIZLIGHTJET_F	NA	A	283
	Dassault Falcon 2000	PW308C	NA	A	283
	Gulfstream G500	BR700-710A1-10	NA	A	283
	Raytheon Hawker 800	BIZMEDIUMJET_F	NA	A	565
	Bombardier Learjet 45	TFE731-2-2B	NA	A	848
	Pilatus PC-12	PT6A-67B	NA	A	1
Subtotal: Air-Taxi (Arrivals):					**5,936**
Cargo	Boeing 767-200 Series Freighter	CF6-80A2	NA	A	225
	Airbus A300F4-600 Series	PW4158	NA	A	674
	Boeing DC-10-10 Series	CF6-6D	NA	A	449
Subtotal: Cargo (Arrivals):					**1,348**
General Aviation	Raytheon Super King Air 200	PT6A-61	NA	A	1,943
	Raytheon Super King Air 300	PT6A-60AG	NA	A	1
	Raytheon Beech Bonanza 36	TIO-540-J2B2	NA	A	1
	Raytheon Beech Jet 400	JT15D-1 series	NA	A	1,166
	Raytheon King Air 90	PT6A-60	NA	A	777
	Cessna 172 Skyhawk	IO-360-B	NA	A	777
	Cessna 560 Citation XLS	BIZMEDIUMJET_F	NA	A	389
	Cessna 750 Citation X	AE3007C	NA	A	389
	Bombardier Challenger 300	AS907-1-1A	NA	A	1
	Bombardier Challenger 600	CF34-3B	NA	A	1
	Dassault Falcon 900-EX	TFE731-2/2A	NA	A	389
	Gulfstream G150	TFE731-3	NA	A	389
	Gulfstream G200	PW306A	NA	A	1
	Gulfstream IV-SP	TAY 611-8C	NA	A	1
	GULFSTREAM AEROSPACE Gulfstream G650	BR-700-725A1-12	NA	A	389
	Raytheon Hawker 800	BIZMEDIUMJET_F	NA	A	389
	Bombardier Learjet 31	TFE731-2-2B	NA	A	776
	Bombardier Learjet 60	PW306A	NA	A	1,165
	Piaggio P.180 Avanti	PT6A-60	NA	A	388
	Piper PA46-TP Meridian	PT6A-42	NA	A	389
	Partenavia P.68 Victor	IO-360-B	NA	A	389

Table A-1 Existing (2016) Aircraft Fleet Mix (Continued)

Category	Airframe	Engine	Stage Length	Operation Type	Annual Operation
	Piper PA-32 Cherokee Six	TIO-540-J2B2	NA	A	388
	Pilatus PC-12	PT6A-67B	NA	A	776
	Cirrus SR22	TIO-540-J2B2	NA	A	777
	EADS Socata TBM-700	PT6A-60	NA	A	389
Subtotal: General Aviation (Arrivals):					12,440
Military	Lockheed C-130 Hercules	T56-A-7	NA	A	1,338
Subtotal: Military (Arrivals):					1,338
Air Carrier	Airbus A319-100 Series	CFM56-5B6/P	NA	A	44,487
	Airbus A320-200 Series	V2527-A5	NA	A	17,361
	Airbus A321-100 Series	V2533-A5	NA	A	36,531
	Airbus A330-200 Series	Trent 772	NA	A	723
	Airbus A330-300 Series	PW4168A	NA	A	1,447
	Boeing 717-200 Series	BR700-715C1-30	NA	A	1,808
	Boeing 737-800 Series	CFM56-7B26/2	NA	A	361
	Boeing 737-900 Series	CFM56-7B27/2	NA	A	362
	Boeing 757-200 Series	RB211-535E4B	NA	A	1,809
	Boeing 737-300 Series	CFM56-3-B1	NA	A	723
	Boeing 737-800 Series	CFM56-7B27/3	NA	A	5,787
	Boeing 737-700 with winglets	CFM56-7B27/3	NA	A	1,808
	Bombardier CRJ-200	CF34-3B	NA	A	31,105
	Bombardier CRJ-700-LR	CF34-8C1	NA	A	15,553
	Bombardier CRJ-900-ER	CF34-8C5	NA	A	57,148
	DeHavilland DHC-8-300	PW123	NA	A	11,212
	DeHavilland DHC-8-100	PW120	NA	A	2,532
	Embraer ERJ170	CF34-8E2	NA	A	1,447
	Embraer ERJ175	CF34-8E5	NA	A	13,382
	Embraer ERJ190	CF34-10E6	NA	A	1,085
	Embraer EMB120 Brasilia	PW118	NA	A	1,085
	Embraer ERJ145	AE3007A1/1	NA	A	723
	Dornier 328 Jet	PW306B	NA	A	362
	Boeing MD-88	JT8D-219	NA	A	3,617
Subtotal: Air Carrier (Arrivals):					**252,458**
DEPARTURES					
Air Taxi	Raytheon Super King Air 300	PT6A-60	1	D	282
	Cessna 525A Citation Jet	BIZLIGHTJET_F	2	D	282
	Cessna 560 Citation V	JT15D-5, -5A, -5B	1	D	282
	Cessna 560 Citation XLS	BIZMEDIUMJET_F	1	D	848
	CX 680 SOVEREIGN	BIZLIGHTJET_F	1	D	1

Table A-1 Existing (2016) Aircraft Fleet Mix (Continued)

Category	Airframe	Engine	Stage Length	Operation Type	Annual Operation
	Cessna 750 Citation X	AE3007C	1	D	1
	Bombardier Challenger 300	AS907-1-1A	1	D	565
	Bombardier Challenger 300	AS907-1-1A	2	D	565
	Embraer 505	BIZLIGHTJET_F	1	D	282
	Dassault Falcon 2000	PW308C	1	D	282
	Gulfstream G500	BR700-710A1-10	1	D	282
	Gulfstream G500	BR700-710A1-10	4	D	283
	Raytheon Hawker 800	BIZMEDIUMJET_F	1	D	565
	Bombardier Learjet 45	TFE731-2-2B	1	D	565
	Pilatus PC-12	PT6A-67B	1	D	282
Subtotal: Air Taxi (Departures):					**5,367**
Cargo	Boeing 767-200 Series Freighter	CF6-80A2	4	D	225
	Airbus A300F4-600 Series	PW4158	1	D	674
	Boeing DC-10-10 Series	CF6-6D	1	D	449
Subtotal: Cargo (Departures):					**1,348**
General Aviation	Raytheon Super King Air 200	PT6A-61	1	D	1,554
	Raytheon Super King Air 300	PT6A-60AG	1	D	388
	Raytheon Beech Bonanza 36	TIO-540-J2B2	1	D	388
	Raytheon Beech Jet 400	JT15D-1 series	1	D	777
	Raytheon King Air 90	PT6A-60	1	D	777
	Cessna 172 Skyhawk	IO-360-B	1	D	777
	Cessna 560 Citation XLS	BIZMEDIUMJET_F	1	D	388
	Cessna 750 Citation X	AE3007C	1	D	388
	Bombardier Challenger 300	AS907-1-1A	1	D	388
	Bombardier Challenger 600	CF34-3B	2	D	388
	Dassault Falcon 900-EX	TFE731-2/2A	1	D	388
	Gulfstream G150	TFE731-3	1	D	388
	Gulfstream G200	PW306A	1	D	388
	Gulfstream IV-SP	TAY 611-8C	1	D	388
	GULFSTREAM AEROSPACE Gulfstream G650	BR-700-725A1-12	1	D	388
	Raytheon Hawker 800	BIZMEDIUMJET_F	1	D	388
	Bombardier Learjet 31	TFE731-2-2B	1	D	1
	Bombardier Learjet 60	PW306A	1	D	1,165
	Piaggio P.180 Avanti	PT6A-60	1	D	1
	Piper PA46-TP Meridian	PT6A-42	1	D	777
	Partenavia P.68 Victor	IO-360-B	1	D	388
	Piper PA-32 Cherokee Six	TIO-540-J2B2	1	D	1
	Pilatus PC-12	PT6A-67B	1	D	1

Table A-1 Existing (2016) Aircraft Fleet Mix (Continued)

Category	Airframe	Engine	Stage Length	Operation Type	Annual Operation
	Cirrus SR22	TIO-540-J2B2	1	D	1,166
	EADS Socata TBM-700	PT6A-60	1	D	388
Subtotal: General Aviation (Departures):					**12,429**
Military	Lockheed C-130 Hercules	T56-A-7	1	D	1,338
Subtotal: Military (Departures):					**1,338**
Air Carrier	Airbus A319-100 Series	CFM56-5B6/P	1	D	31,467
	Airbus A319-100 Series	CFM56-5B6/P	2	D	11,937
	Airbus A319-100 Series	CFM56-5B6/P	3	D	723
	Airbus A319-100 Series	CFM56-5B6/P	4	D	362
	Airbus A320-200 Series	V2527-A5	1	D	9,765
	Airbus A320-200 Series	V2527-A5	2	D	7,596
	Airbus A321-100 Series	V2533-A5	1	D	7,594
	Airbus A321-100 Series	V2533-A5	2	D	14,830
	Airbus A321-100 Series	V2533-A5	3	D	2,532
	Airbus A321-100 Series	V2533-A5	4	D	11,575
	Airbus A330-200 Series	Trent 772	6	D	724
	Airbus A330-300 Series	PW4168A	5	D	723
	Airbus A330-300 Series	PW4168A	6	D	723
	Boeing 717-200 Series	BR700-715C1-30	1	D	1,809
	Boeing 737-800 Series	CFM56-7B26/2	2	D	1
	Boeing 737-900 Series	CFM56-7B27/2	2	D	723
	Boeing 757-200 Series	RB211-535E4B	1	D	1,447
	Boeing 737-300 Series	CFM56-3-B1	1	D	724
	Boeing 737-800 Series	CFM56-7B27/3	1	D	3,617
	Boeing 737-800 Series	CFM56-7B27/3	2	D	2,170
	Boeing 737-700 with winglets	CFM56-7B27/3	1	D	362
	Boeing 737-700 with winglets	CFM56-7B27/3	2	D	1,447
	Boeing 757-200 Series	RB211-535E4B	2	D	361
	Bombardier CRJ-200	CF34-3B	1	D	28,574
	Bombardier CRJ-700-LR	CF34-8C1	1	D	13,743
	Bombardier CRJ-700-LR	CF34-8C1	2	D	1,809
	Bombardier CRJ-900-ER	CF34-8C5	1	D	46,657
	Bombardier CRJ-900-ER	CF34-8C5	2	D	10,490
	Bombardier CRJ-200	CF34-3B	2	D	1,809
	DeHavilland DHC-8-300	PW123	1	D	11,212
	DeHavilland DHC-8-100	PW120	1	D	2,532
	Embraer ERJ170	CF34-8E2	1	D	1,084
	Embraer ERJ170	CF34-8E2	2	D	362

Table A-1 Existing (2016) Aircraft Fleet Mix (Continued)

Category	Airframe	Engine	Stage Length	Operation Type	Annual Operation
	Embraer ERJ175	CF34-8E5	1	D	9,042
	Embraer ERJ175	CF34-8E5	3	D	362
	Embraer ERJ175	CF34-8E5	2	D	3,980
	Embraer ERJ190	CF34-10E6	1	D	362
	Embraer ERJ190	CF34-10E6	2	D	723
	Embraer EMB120 Brasilia	PW118	1	D	1,085
	Embraer ERJ145	AE3007A1/1	2	D	724
	Dornier 328 Jet	PW306B	1	D	361
	Boeing MD-88	JT8D-219	1	D	3,255
	Boeing MD-88	JT8D-219	2	D	362
Subtotal: Air Carrier (Departures):					**251,740**
TOTAL AIRCRAFT OPERATIONS:					**545,742**

Source: InterVISTAS Consulting Inc., and KB Environmental Sciences, 2018.
Notes: NA = Not Applicable

Emissions from aircraft vary based on engine power setting and duration of operation. An aircraft arrival is comprised of an approach, ground roll, and taxi-in mode. An aircraft departure is comprised of engine start, taxi-out, takeoff, and climb-out. With the exception of aircraft taxi/delay, the AEDT default times-in-mode were assumed in the analysis. Aircraft taxi/delay times were obtained from the Capacity/Delay Analysis and Airfield Modeling Technical Memorandum and are presented in **Table A-2**.[10]

Table A-2 Aircraft Taxi/Delay Times (minutes)

Year	Scenario	Taxi-in	Taxi-out
2016	Existing	10.6	15.0

Source: Capacity/Delay Analysis and Airfield Modeling Technical Memorandum, CLT EIS, July 16, 2018.

A.1.1.2 Ground Support Equipment (GSE) and Auxiliary Power Units (APUs)

GSE represent an array of specially designed vehicles and equipment that support and service aircraft in an airport's gate and terminal area (e.g., baggage tugs, belt loader, etc.). Some aircraft also have APUs that provide power to an aircraft when the engines are not on (e.g., when gate-power/pre-conditioned air (PCA) are not available at an airport's gate). For this analysis, emissions from GSE, including any applicable APUs, were calculated using AEDT defaults. APU and GSE fuel usage rates (derived from AEDT) along with EPA GHG emissions factors were used to calculate GHG emissions.

10 VHB and TransSolutions, *Capacity/Delay Analysis and Airfield Modeling Technical Memorandum, Charlotte Douglas International Airport Environmental Impact Statement*, July 16, 2018.

A.1.1.3 Mobile Sources

The evaluated mobile sources were motor vehicles traveling on roadways and parking facilities within the Study Area. Air emissions associated with motor vehicles are a function of site-specific data such as traffic volumes, speeds, travel distances, vehicle fleet mix, fuel type, and meteorological factors.

Emission factors for criteria pollutants, precursor pollutants, HAPs, and GHGs were developed using EPA's MOVES model. Vehicle mixes within MOVES were assumed to include passenger cars, passenger trucks, light commercial trucks and single-unit short-haul trucks. Posted speeds of 35 miles per hour (mph) and 45 mph were assumed based on the type of roadway segment; and 15 mph were used for vehicles traveling within the existing Daily North Parking Lot.

The input data for MOVES that is specific to Mecklenburg County, such as vehicle age distribution, ambient temperature, humidity, etc., were obtained from the North Carolina Department of Environmental Quality (NCDEQ).

Tables A-3 through **A-5** p_bookmark18resent the existing (2016) emission factors for motor vehicles traveling on roadways at 35 and 45 mph for criteria/precursor pollutants, HAPs, and GHGs, respectively.

Table A-3 Roadway Emission Factors – Criteria and Precursor Pollutants (grams/mile)

Vehicle Type	CO	NO_x	SO_x	$PM_{2.5}$	PM_{10}	VOC
35 mph						
Passenger Cars	4.19	0.33	0.01	0.01	0.05	0.22
Passenger Trucks	10.58	1.21	0.01	0.02	0.06	0.63
Light Commercial Trucks	6.03	2.29	0.01	0.13	0.18	0.50
Single Unit Short-Haul Trucks	1.66	4.30	0.01	0.25	0.40	0.51
45 mph						
Passenger Cars	3.54	0.32	0.01	0.01	0.03	0.20
Passenger Trucks	9.49	1.23	0.01	0.02	0.05	0.57
Light Commercial Trucks	5.25	1.95	0.01	0.11	0.15	0.44
Single Unit Short-Haul Trucks	1.47	3.65	0.01	0.21	0.30	0.43

Source: EPA, MOVES 2014b.
Notes: Values subject to rounding.

Table A-4 Roadway Emission Factors – HAPs (grams/mile)

HAPs	Passenger Cars	Passenger Trucks	Light Commercial Trucks	Single Unit Short-Haul Trucks
35 mph				
Benzene	0.003	0.014	0.014	0.024
1,3 Butadiene	<0.001	0.002	0.002	0.002
Formaldehyde	0.001	0.005	0.005	0.008
Acetaldehyde	0.001	0.004	0.004	0.005
Acrolein	<0.001	<0.001	<0.001	<0.001
2,2,4-Trimethylpentane	0.005	0.014	0.014	0.015
Ethyl Benzene	0.002	0.009	0.008	0.012
Hexane	0.009	0.020	0.019	0.024
Propionaldehyde	<0.001	<0.001	<0.001	<0.001
Styrene	<0.001	<0.001	<0.001	0.001
Toluene	0.023	0.062	0.060	0.073
Xylene	0.009	0.033	0.032	0.043
45 mph				
Benzene	0.003	0.013	0.012	0.016
1,3 Butadiene	<0.001	0.002	0.002	0.001
Formaldehyde	0.001	0.004	0.004	0.005
Acetaldehyde	0.001	0.004	0.003	0.004
Acrolein	<0.001	<0.001	<0.001	<0.001
2,2,4-Trimethylpentane	0.005	0.013	0.012	0.012
Ethyl Benzene	0.002	0.008	0.007	0.008
Hexane	0.009	0.019	0.018	0.020
Propionaldehyde	<0.001	<0.001	<0.001	<0.001
Styrene	<0.001	<0.001	<0.001	<0.001
Toluene	0.022	0.059	0.054	0.056
Xylene	0.008	0.030	0.027	0.031

Source: EPA, MOVES 2014b.
Notes: Values subject to rounding.

Table A-5 Roadway Emission Factors – Greenhouse Gas (grams/mile)

Vehicle Type	CO_2	CH_4	N_2O	CO_2e
35 mph				
Passenger Cars	359	0.005	<0.001	359
Passenger Trucks	483	0.012	<0.001	484
Light Commercial Trucks	667	0.016	<0.001	668
Single Unit Short-Haul Trucks	1,186	0.043	<0.001	1,187
45 mph				
Passenger Cars	332	0.005	<0.001	332
Passenger Trucks	453	0.01	<0.001	454
Light Commercial Trucks	619	0.015	<0.001	619
Single Unit Short-Haul Trucks	1,010	0.035	<0.001	1,011

Source: EPA MOVES 2014b.
Notes: Values subject to rounding.

Table A-6 below p_bookmark18resents the existing (2016) roadway traffic data. The table includes roadway segments analyzed within the Study Area, segment lengths, annual average daily traffic (AADT) counts, annual traffic counts, vehicle mix distributions, and speeds. Annual traffic counts were estimated by multiplying the AADT volumes by 366 days. Roadway segments were derived from the traffic analysis developed in support of the Proposed Project.

Table A-6 Roadway Traffic Data – Existing (2016)

Road Segment	Segment Length (miles)	Annual Average Daily Traffic (AADT) Counts	Vehicle Mix (%)				Speed (mph)
			PC	PT	LCT	SHT	
101A – 101B	0.27	27,200	47.0	47.0	4	2	45
101B – 102	0.90	27,600	47.5	47.5	4	1	45
102 – 103	0.22	30,200	47.5	47.5	4	1	45
103 – 104	0.28	31,900	47.5	47.5	4	1	45
104 – 105	0.13	29,400	47.5	47.5	4	1	45
105 – 106	0.51	32,200	47.5	47.5	4	1	45
106 – 107	0.49	28,700	47.5	47.5	4	1	45
106 – 108	0.23	8,700	48.5	48.5	2	1	45
107 – 109	0.49	5,100	47.0	47.0	4	2	45
109 – 201	0.09	10,700	47.5	47.5	4	1	45
201 – 202	0.50	44,000	47.5	47.5	4	1	45
202 – 203	0.45	54,500	47.5	47.5	4	1	45
203 – 204	0.68	51,000	47.5	47.5	4	1	45
204 – 205	0.88	42,200	47.5	47.5	4	1	45
204 – 206	0.34	17,300	45.5	45.5	6	3	45
205 – 205A	0.13	18,500	48.0	48.0	3	1	45
205 – 301	0.41	28,700	48.0	48.0	3	1	45
206 – 207	0.39	20,900	45.5	45.5	6	3	45
207 - 307	0.33	20,900	45.5	45.5	6	3	45
301 – 311	0.27	23,000	48.0	48.0	3	1	35
301 – 302	0.10	14,400	46.0	46.0	6	2	35
302 – 303	0.16	12,000	46.0	46.0	6	2	35
303 – 304	0.19	13,200	46.0	46.0	6	2	35
304 – 305	0.10	13,800	46.0	46.0	6	2	35
305 – 306	0.27	14,000	46.0	46.0	6	2	35
306 – 307	0.26	8,500	45.5	45.5	6	3	35
307 – 308	1.47	17,300	46.5	46.5	4	3	45
308 – 309	0.36	13,800	43.0	43.0	4	10	45
309 – 310A	0.18	14,900	42.0	42.0	4	12	45
310A – 310B	0.24	400	46.0	46.0	5	3	45
311 – 312	0.20	22,900	48.5	48.5	2	1	45

Source: KB Environmental Sciences and VHB, Ground Transportation Analysis for Charlotte-Douglas International Airport Improvement Program, September 2018.

Notes: LCT = Light Commercial Truck, PC= Passenger Car, PT= Passenger Truck, and SHT = Single Unit Short-Haul Truck.

Tables A-7 through **A-9** p_bookmark18resent the existing (2016) emission factors for the motor vehicles traveling within the parking lot at 15 mph for criteria/precursor pollutants, HAPs, and GHGs, respectively.

Table A-7 Parking Lot Emission Factors – Criteria Pollutants (grams/mile)

Vehicle Type	CO	NO_x	SO_x	$PM_{2.5}$	PM_{10}	VOC
15 mph						
Passenger Cars	6.62	0.41	0.01	0.03	0.10	0.29
Passenger Trucks	16.43	1.43	0.01	0.04	0.13	0.92

Source: EPA, MOVES 2014b.
Notes: Values subject to rounding.

Table A-8 Parking Lot Emission Factors – HAPs (grams/mile)

HAPs	Passenger Cars	Passenger Trucks
15 mph		
Benzene	0.005	0.023
1,3 Butadiene	0.001	0.003
Formaldehyde	0.002	0.008
Acetaldehyde	0.001	0.007
Acrolein	<0.001	<0.001
2,2,4-Trimethylpentane	0.007	0.020
Ethyl Benzene	0.004	0.014
Hexane	0.010	0.025
Propionaldehyde	<0.001	0.001
Styrene	<0.001	0.001
Toluene	0.030	0.089
Xylene	0.014	0.053

Source: EPA, MOVES 2014b.
Notes: Values subject to rounding.

Table A-9 Parking Lot Emission Factors – Greenhouse Gas (grams/mile)

Vehicle Type	CO_2	CH_4	N_2O	CO_2e
15 mph				
Passenger Cars	570	0.01	<0.001	570
Passenger Trucks	752	0.02	<0.001	753

Source: EPA, MOVES 2014b.
Notes: Values subject to rounding.

The existing Daily North Parking Lot is planned to be replaced by the proposed Daily North Parking Garage. Thus, existing emissions from motor vehicles accessing this facility were inventoried. **Table A-10** below p_bookmark18resents the existing (2016) parking lot traffic data including estimated travel distance, traffic volumes, and vehicle mix. Annual vehicle-miles traveled (VMT) were obtained by multiplying the travel distance per vehicle by annual traffic counts. Traffic volumes and vehicle mix were derived from the traffic analysis.

Table A-10 Daily North Parking Lot Traffic Data – Existing (2016)

		Vehicle Mix (%)		Annual VMT	
Distance (miles)	**Annual Traffic Counts**	**PC**	**PT**	**PC**	**PT**
0.66	110,580	50	50	36,491	36,491

Source: CLT, 2018.
Notes: PC= Passenger Car, PT= Passenger Truck, and VMT = vehicle-miles traveled.

Tables A-11 p_bookmark18resent the mobile source emissions inventories for the roadways and parking lot for existing conditions (2016).

Table A-11 Criteria Pollutants and HAPs Emissions (metric tons/year)

Vehicle Type	CO	NO_x	SO_x	$PM_{2.5}$	PM_{10}	VOC	Total HAPs
Roadways	775	105	1	3	6	47	12
Parking Lot	1	<1	<1	<1	<1	<1	<1
Total Emissions	**776**	**105**	**1**	**3**	**6**	**47**	**12**

Source: KB Environmental Sciences, 2018.
Notes: Values subject to rounding.

Proposed Capacity Enhancements at Charlotte Douglas International Airport

National Environmental Policy Act Environmental Assessment

Air Quality Technical Report

August 2021

PREPARED FOR
Charlotte Douglas International Airport

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List of Acronyms

AEDT	Aviation Environmental Design Tool
APU	Auxiliary Power Unit
Avgas	Aviation gasoline
CAA	Clean Air Act
CDOT	City of Charlotte Department of Transportation
CEQ	Council on Environmental Quality
C.F.R.	Code of Federal Regulations
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2E	Carbon dioxide equivalent
EA	Environmental Assessment
FAA	Federal Aviation Administration
GHG	Greenhouse Gas
GSE	Ground Support Equipment
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
LTO	Landing and takeoff cycle
MOVES	MOtor Vehicle Emission Simulator
MPO	Metropolitan Planning Organization
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NCDOT	North Carolina Department of Transportation
NEPA	National Environmental Policy Act
NH_3	Ammonia
NO_x	Nitrogen oxides
NO_2	Nitrogen dioxide
O_3	Ozone
Pb	Lead
$PM_{2.5}$	Fine Particulate matter
PM_{10}	Coarse Particulate matter
ppb	Parts per billion
ppm	Parts per million
SIP	State Implementation Plan
SO_x	Sulfur oxides
SO_2	Sulfur dioxide
$\mu g/m^3$	Micrograms per cubic meter
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compounds

1 Introduction

The purpose of this Air Quality Technical Report is to provide supporting documentation for the Environmental Assessment (EA) being prepared for the Proposed Capacity Enhancements at the Charlotte Douglas International Airport (CLT or Airport). The following document discloses the affected environment and environmental consequences of air quality for the following alternatives in the projected future conditions in 2028 and 2033: No Action Alternative, Alternative 1, Alternative 2, and Alternative 3. The Federal Aviation Administration (FAA) uses 2028 as a basis for analysis because 2028 is the projected implementation year of the proposed air cargo facility development. In addition, specific Airport activity levels and their associated air quality impacts are evaluated for a condition five years beyond the opening year in 2033.

2 Regulatory Setting

The NEPA provides for an environmental review process to disclose the potential impacts, including air quality, from a proposed federal action on the human environment. Per the United States Environmental Protection Agency (USEPA), NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment. On a federal level, air quality is governed by the Clean Air Act (CAA) administered by the USEPA in coordination with state and local governments. Additionally, air quality in North Carolina is governed by regulations under the North Carolina Department of Environmental Quality (NCDEQ) and by the regulations established by the Mecklenburg County's Land Use and Environmental Services Agency.

This air quality assessment of the Proposed Action and its alternatives was conducted in accordance with the guidelines provided in the most recent version of the FAA's *Aviation Emissions and Air Quality Handbook Version 3 Update 1*[1]; FAA Order 5050.4B, *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions*; and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures.*

2.1 National Ambient Air Quality Standards

The USEPA is the primary Federal agency responsible for regulating air quality. The USEPA implements the provisions of the Federal Clean Air Act (CAA). The CAA, including the 1990 Amendments, provides the establishment of standards and programs to evaluate, achieve, and maintain acceptable air quality in the United States. Under the CAA, the USEPA established a set of standards, or criteria, for six pollutants determined to be potentially harmful to human health and welfare.[2]

The USEPA considers the presence of the following six criteria pollutants to be indicators of air quality:

- Carbon monoxide (CO);
- Ozone (O_3);
- Nitrogen dioxide (NO_2);
- Sulfur dioxide (SO_2).

[1] Federal Aviation Administration, Aviation Emissions and Air Quality Handbook, Version 3 Update 1, January 2015.
[2] USEPA, C.F.R. Title 40, Part 50 (40 C.F.R. Part 50) National Primary and Secondary Ambient Air Quality Standards (NAAQS), July 2011.

- Particulate matter (PM_{10} and $PM_{2.5}$); and,
- Lead (Pb).

For each of the criteria pollutants, the USEPA established primary standards intended to protect public health, and secondary standards for the protection of public welfare, which captures factors such as preventing materials damage, preventing crop and vegetation damage, and assuring good visibility. The National Ambient Air Quality Standards for the criteria pollutants, known as the NAAQS, are summarized in **Table 2-1**. Areas of the country where air pollution levels consistently exceed these standards may be designated nonattainment by the USEPA.

A nonattainment area is a homogeneous geographical area (usually referred to as an air quality control region or airshed) that is in violation of one or more NAAQS and has been designated as nonattainment by the USEPA as provided for under the CAA. Each nonattainment area is required to have a State Implementation Plan (SIP), developed by the state that quantifies current conditions, projects future conditions through the date of prescribed attainment, and identifies mitigation measures that are to be used to bring the area back into attainment.

A maintenance area describes the air quality designation of an area previously designated nonattainment by the USEPA and subsequently re-designated attainment after emissions are reduced. Such an area remains designated as maintenance for a period up to 20 years at which time the state can apply for redesignation to attainment, provided that the NAAQS were sufficiently maintained throughout the maintenance period.

The CAA conformity regulations (40 C.F.R. Part 93) apply only to areas designated as nonattainment or maintenance. Under these rules, a Federal agency shall not support, permit, or approve any action, which does not conform to an approved SIP.

2.2 Conformity

2.2.1 General Conformity

The General Conformity Rule under the CAA is conducted in three phases, depending on the extent of the proposed Federal action: (1) applicability, (2) evaluation, and (3) determination. The General Conformity Rule establishes minimum values, referred to as the *de minimis* thresholds, for the criteria and precursor pollutants[3] for the purpose of:

- Identifying Federal actions with project-related emissions that are clearly negligible (*de minimis*);
- Avoiding unreasonable administrative burdens on the sponsoring agency; and,
- Focusing efforts on key actions that would have potential for significant air quality impacts.

The Federal *de minimis* thresholds established under the CAA are given in **Table 2-2**.

[3] Precursor pollutants are pollutants that are involved in the chemical reactions that form the resultant pollutant. Ozone precursor pollutants are NOx and VOC, whereas $PM_{2.5}$ precursor pollutants include NO_x, VOC, SO_2, and ammonia (NH_3)

TABLE 2-1, NATIONAL AMBIENT AIR QUALITY STANDARDS

POLLUTANT		PRIMARY/ SECONDARY	AVERAGING TIME	LEVEL	FORM
Carbon Monoxide		Primary	8 hour	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead		Primary and Secondary	Rolling 3-month average	0.15 μg/m3 (1)	Not to be exceeded
Nitrogen Dioxide		Primary	1 hour	100 ppb	98^{th} percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and Secondary	1 year	53 ppb (2)	Annual Mean
Ozone		Primary and Secondary	8 hour	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particulate Matter	$PM_{2.5}$	Primary	1 year	12.0 $\mu g/m^3$	Annual mean, averaged over 3 years
		Secondary	1 year	15.0 $\mu g/m^3$	Annual mean, averaged over 3 years
		Primary and Secondary	24 hour	35 $\mu g/m^3$	98^{th} percentile, averaged over 3 years
	PM_{10}	Primary and Secondary	24 hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		Primary	1 hour	75 ppb (4)	99^{th} percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3 hour	0.5 ppm	Not to be exceeded more than once per year

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 μg/m3 as a calendar quarter average) also remain in effect.

(2) The level of the annual NO2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)). A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

Notes: ppm is parts per million; ppb is parts per billion, and μg/m3 is micrograms per cubic meter.

Source: USEPA, https://www.epa.gov/criteria-air-pollutants/naaqs-table Accessed February 2021

TABLE 2-2, FEDERAL *DE MINIMIS* THRESHOLDS

CRITERIA AND PRECURSOR POLLUTANTS	TYPE AND SEVERITY OF NONATTAINMENT AREA	TONS PER YEAR THRESHOLD
Ozone (VOC or NO_x)[1]	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NO_x)[1]	Marginal and moderate nonattainment inside an ozone transport regions[2]	100
	Maintenance	100
Ozone (VOC)[1]	Marginal and moderate nonattainment inside an ozone transport region[2]	50
	Maintenance within an ozone transport region[2]	50
	Maintenance outside an ozone transport region[2]	100
Carbon monoxide (CO)	All nonattainment & maintenance	100
Sulfur dioxide (SO_2)	All nonattainment & maintenance	100
Nitrogen dioxide (NO_2)	All nonattainment & maintenance	100
Coarse particulate matter (PM_{10})	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
Fine particulate matter ($PM_{2.5}$) (VOC, NO_x, NH_3, and SO_x)[3]	All nonattainment and maintenance	100
Lead (Pb)	All nonattainment and maintenance	25

1 The rate of increase of ozone emissions is not evaluated for a project-level environmental review because the formation of ozone occurs on a regional level and is the result of the photochemical reaction of NOx and VOC in the presence of abundant sunlight and heat. Therefore, USEPA considers the increasing rates of NOx and VOC emissions to reflect the likelihood of ozone formation on a project level.

2 An OTR is a single transport region for ozone, comprised of the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and the Consolidated Metropolitan Statistical Area that includes the District of Columbia.

3 For the purposes of General Conformity applicability, VOCs and NH3 emissions are only considered PM2.5 precursors in nonattainment areas where either a state or USEPA has made a finding that the pollutants significantly contribute to the PM2.5 problem in the area. In addition, NOx emissions are always considered a PM2.5 precursor unless the state and USEPA make a finding that NOx emissions from sources in the state do not significantly contribute to PM2.5 in the area. Refer to 74 FR 17003, April 5, 2006.

Notes: C.F.R. Title 40, Protection of the Environment Part 93.153
USEPA defines de minimis as emissions that are so low as to be considered insignificant and negligible. Volatile organic compounds (VOC); Nitrogen oxides (NOx); Ammonia (NH3); Sulfur oxides (SOx).

Sources: USEPA, 40 C.F.R. Part 93.153(b)(1) & (2).

The *de minimis* rates vary depending on the severity of the nonattainment area and further depend on whether the general Federal action is located inside an ozone transport region[4]. An evaluation relative to the General Conformity Rule (the Rule), published under 40 C.F.R. Part 93,[5] is applicable to general Federal actions that would cause emissions of the criteria or precursor pollutants, and are:

- Federally-funded or Federally-approved;
- Not a highway or transit project[6];
- Not identified as an exempt project[7] under the CAA;
- Not a project identified on the approving Federal agency's Presumed to Conform list[8]; and,
- Located within a nonattainment or maintenance area.

The Proposed Action at CLT is included in a maintenance area for ozone. Therefore, the Proposed Action meets the remaining criteria for requiring an evaluation under the General Conformity Rule. When the action requires evaluation under the General Conformity regulations, the net total direct and indirect emissions due to the Federal action may not equal or exceed the relevant *de minimis* thresholds unless:

- An analytical demonstration is provided that shows the emissions would not exceed the NAAQS; or
- Net emissions are accounted for in the State Implementation Plan (SIP) planning emissions budget; or
- Net emissions are otherwise accounted for by applying a solution prescribed under 40 CFR Part 93.158.

Conformity to the *de minimis* thresholds is relevant only with regard to those pollutants and the precursor pollutants for which the area is nonattainment or maintenance. Notably, there are no *de minimis* thresholds to which a Federal agency would compare ozone emissions. This is because ozone is not directly emitted from a source. Rather, ozone is formed through photochemical reactions involving emissions of the precursor pollutants, nitrogen oxides (NO_x) and volatile organic compounds (VOC), in the presence of abundant sunlight and heat. Therefore, emissions of ozone on a project level are evaluated based on the rate of emissions of the ozone precursor pollutants, NO_x and VOC. Because conformity to the de minimis threshold is relevant only with regard to the ozone precursor pollutants, only NOx and VOC emissions are presented and evaluated in this report.

If the General Conformity evaluation for this air quality assessment were to show that any of the applicable thresholds were equaled or exceeded due to the Proposed Action, further, more detailed

4 The ozone transport region is a single transport region for ozone (within the meaning of Section 176A(a) of the CAA), comprised of the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and the Consolidated Metropolitan Statistical Area that includes the District of Columbia, as given at Section 184 of the CAA.

5 EPA, 40 C.F.R. Part 93, Subpart B, Determining Conformity of General Federal Actions to state or Federal Implementation Plans, July 1, 2006.

6 Highway and transit projects are defined under Title 23 United States Code and the Federal Transit Act.

7 The Proposed Project is not listed as an action exempt from a conformity determination pursuant to 40 C.F.R. § 93.153(c). An exempt project is one that the USEPA has determined would clearly have no impact on air quality at the facility, and any net increase in emissions would be so small as to be considered negligible.

8 The provisions of the CAA allow a Federal agency to submit a list of actions demonstrated to have low emissions that would have no potential to cause an exceedance of the NAAQS and are presumed to conform to the CAA conformity regulations. This list would be referred to as the "Presumed to Conform" list. The FAA Presumed to Conform list was published in the Federal Register on February 12, 2007 (72 FR 6641-6656) and includes airport projects that would not require evaluation under the General Conformity regulations.

analysis to demonstrate conformity would be required, which is referred to as a General Conformity Determination. Conversely, if the General Conformity evaluation were to show that none of the relevant thresholds were equaled or exceeded, the Proposed Action would be presumed to conform to the applicable North Carolina SIPs and no further analysis would be required under the CAA.

2.2.2 Transportation Conformity

Although airport improvement projects are usually considered under the General Conformity regulations, there can be elements of a Federal action or its alternatives that may require an analysis to demonstrate Transportation Conformity, such as actions relating to transportation plans, programs, projects developed, funded, or approved under Title 23 United States Code (U.S.C.) or the Federal Transit Act (FTA),[9] or involve Federal highways. In such cases, the sponsoring Federal agency would be required to coordinate with the Federal Highway Administration (FHWA), the state Department of Transportation (DOT), and the local metropolitan planning organization (MPO) to assist in completing a Transportation Conformity evaluation. Furthermore, as with General Conformity, Transportation Conformity regulations apply only to Federal actions located within a nonattainment or maintenance area. The Proposed Action under consideration at CLT would not be developed, funded, or approved by the FHWA or FTA. Therefore, the Transportation Conformity regulations would not apply.

2.2.3 Indirect Source Review

Some states require an air quality review when a Federal action has the potential to cause an increase in net emissions from indirect sources. Indirect sources cause emissions that occur later in time or are farther removed from the Federal action. Depending on the state, indirect sources may be identified as motor vehicles on highways, parking at sports and entertainment facilities, or an increase in aircraft operations. The state requirement may be referred to as the indirect source review (ISR) and each state requiring an ISR sets thresholds for increased operation of the indirect sources. When a Federal action has the potential to exceed these thresholds, an air quality review is required to assess the character and impact of the additional emissions and determine whether a permit is required, which is separate from the analyses required under NEPA or the CAA.

The state of North Carolina did have indirect source review thresholds known as the Transportation Facility Permitting (TFP) regulations; however, these regulations were repealed by the North Carolina Division of Air Quality effective January 1, 2015.[10]

2.3 Federal Attainment Status

As previously stated, the Proposed Action at CLT is included in a maintenance area for ozone and is in attainment for all other criteria pollutants. The area was previously designated nonattainment for the 1971 standard for CO and was designated in attainment effective September 18, 1995.[11] The maintenance period for carbon monoxide expired in 2015. Additionally, the USEPA has classified Mecklenburg County as attainment for CO, ending conformity requirements for the CO.[12]

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9 USEPA, 40 CFR Part 93.153, Applicability, July 1, 2006.

10 North Carolina Air Quality Rules Subchapter 2Q Air Quality Permit Procedures Section 0600 Transportation Facility Procedures.

11 Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants, USEPA Green Book, January 31, 2021. Available on-line: https://www3.epa.gov/airquality/greenbook/anayo_nc.html

12 Letter from the USEPA Air, Pesticides, and Toxics Management Division to the Charlotte Regional Transportation Planning Organization.

Therefore, it can be asserted that no conformity requirements are required for carbon monoxide and no *de minimis* threshold will be applied in the air quality analysis.

The area was previously designated nonattainment for ozone under the 1-hour 1979 ozone standard and the 8-hour 1997 ozone standard; however, the standards were revoked by USEPA effective June 15, 2005 and April 6, 2015.[13] Additionally, the area was previously designated nonattainment for the 8-hour 2008 ozone standard but was found in attainment for the standard by the USEPA effective August 27, 2015 under the condition that the area operate under a maintenance plan for the standard. The maintenance plan remains in effect and contains future year emissions budgets under which the maintenance area can demonstrate that timely attainment of NAAQS will be achieved. Furthermore, the area is in attainment for the 8-hour 2015 ozone standard. Regardless, the area continues to operate under the maintenance plan for the 8-hour 2008 ozone standard. For the purpose of this study, the federal *de minimis* threshold for ozone will be applied in the air quality analysis.

2.3.1 Summary

As of January 31, 2021, Mecklenburg County operates under a maintenance plan for ozone and is in attainment for all other criteria pollutants. [14] The ozone precursor pollutants are VOC and NOx; as such, the pollutants of concern are NO_x and VOC. **Table 2-3** identifies the applicable federal *de minimis* thresholds for Mecklenburg County.

TABLE 2-3, APPLICABLE FEDERAL *DE MINIMIS* THRESHOLDS FOR MECKLENBURG COUNTY

CRITERIA AND PRECURSOR POLLUTANTS	SHORT TONS PER YEAR THRESHOLD
Ozone (VOC and NO_x)	100

Sources: USEPA, 40 C.F.R. Part 93.153(b)(1) & (2).

2.4 Hazardous Air Pollutants

Since 1975, lead emissions have been in decline due in part to the introduction of catalyst-equipped vehicles and decline in production of leaded gasoline. The chief source of lead emissions at airports would be the combustion of leaded aviation gasoline (Avgas) in small piston engine general aviation aircraft; lead is not an ingredient in Jet A fuels that power large commercial service aircraft. In general, an analysis of lead is limited to projects that emit significant quantities of the pollutant (i.e. lead smelters). Some active general aviation airports prepare lead emissions inventories due to the large quantity of Avgas used. However, a lead inventory analysis will not be conducted as part of this air quality analysis as this project only deals with large commercial jet aircraft.

Per FAA guidance, a HAPs emissions inventory should be considered if the Proposed Action is considered “major” (e.g., new airport, new runway, major runway extension, etc.); if the Proposed Action is located in a nonattainment or maintenance area; and/or if a criteria pollutant emissions inventory is also prepared. Because the Proposed Action includes the construction of a new runway, a HAPS emissions inventory will be conducted for this Proposed Action. However, the results would only be provided for disclosure purposes as there are currently no Federal standards specifically pertaining to HAPs emissions from aircraft engines or airports. The HAPs emissions inventory is provided in **Attachment 2** for each alternative and would not be directly comparable to any regulatory or enforceable ambient air quality standards or emission thresholds.

13 Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants, USEPA Green Book, January 31, 2021. Available on-line: https://www3.epa.gov/airquality/greenbook/anayo_nc.html

14 Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants, USEPA Green Book, January 31, 2021. Available on-line: https://www3.epa.gov/airquality/greenbook/anayo_nc.html

2.5 Air Quality Permits

In order to be in compliance with Federal or state requirements, a proposed project may be required to obtain certain air quality permits before construction or implementation can occur. The Proposed Action and its alternatives would include the construction of a new parallel runway and the expansion of the terminal and associated ramp, and any enabling and connected actions. As such, an air quality permit for the following activities would be obtained prior to construction of any of the alternatives.

- Construction activities which may require material (sand, gravel, etc.) handling
- Coating and/or painting of buildings and pavement
- Removal or replacement of boilers and generators
- Demolition or renovations of structures containing lead and/or asbestos

Furthermore, the Mecklenburg County Air Quality (MCAQ), a division of the Mecklenburg County Land Use and Environmental Services Agency (LUESA) is the local permitting authority for stationary emission source permits in Mecklenburg County. CLT will notify MCAQ, apply for, and receive all necessary permits prior to construction of any regulated emission source as detailed in the permitting requirements in the Mecklenburg County Air Pollution Control Ordinance Regulation 1.5211 – “Applicability”.

2.6 Air Quality Monitoring In Region

MCAQ maintains five air quality monitoring sites that measure concentrations of criteria air pollutants.[15]

- Garinger (ID 37-119-0041)
- Remount (ID 37-119-0045)
- University Meadows (ID 37-119-0046)
- Ramblewood Park (ID 37-119-0047)
- Friendship Park (ID 37-119-0048)

The Remount site is located approximately three miles due east of the Airport and is the closest to the Airport. The air quality monitor at this site measures multiple pollutants including $PM_{2.5}$, CO, and NO_2 to assess compliance with the NAAQS.

Furthermore, Mecklenburg County monitoring data continues to demonstrate compliance with all federal, health-based air quality standards and overall improvement in air quality.[16]

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15 Mecklenburg County Air Quality, 2020-2021 Annual Monitoring Network Plan – Mecklenburg County Air Quality, July 1, 2020. Available on-line: https://www.mecknc.gov/LUESA/AirQuality/AirQualityData/Documents/MCAQAnnualMonitoringNetworkPlan.pdf

16 Mecklenburg County Air Quality, Mecklenburg County Air Quality Is Improving, March 2020. Available on-line: https://www.mecknc.gov/LUESA/AirQuality/AirQualityData/Documents/AQI%20Days.pdf

3 Methodology

The impacts to air quality due to the alternatives evaluated in the EA were determined in accordance with the guidelines provided in the Federal Aviation Administration (FAA), *Aviation Emissions and Air Quality Handbook Version 3 Update 1*,[17] and FAA Order 5050.4B[18], *NEPA Implementing Instructions for Airport Actions*, which together with the guidelines of FAA Order 1050.1F,[19] *Environmental Impacts: Policies and Procedures*, constitute compliance with all the relevant provisions of NEPA and the CAA.

The construction and operation of the alternatives would result in short-term and long-term emissions.

3.1 Construction Emissions

Short-term temporary air quality impacts would be caused by construction of Alternative 1, Alternative 2, and Alternative 3, which are anticipated to begin late 2021 with a duration of seven years.
The construction emissions inventory for Alternative 1, Alternative 2, and Alternative 3 were developed using the Airport Construction Emissions Inventory Tool (ACEIT) and the USEPA's Motor Vehicle Emissions Simulator version 2014b (MOVES).[20]

The Airport Construction Emissions Inventory Tool (ACEIT) was developed by the Transportation Research Board (TRB) to assist airports and other stakeholders in developing airport construction emissions inventories. The ACEIT was used to estimate construction equipment utilization. MOVES was developed by the USEPA and is an emission modeling system that estimates emission factor for construction equipment specific to Mecklenburg County. The two tools were used in conjunction to estimate construction emissions.

3.2 Operational Emissions

Long-term air quality emissions from aircraft taxing, aircraft landing and takeoffs (LTOs), auxiliary power units (APUs), and ground support equipment (GSE) were estimated using the FAA's Airport Environmental Design Tool (AEDT) version 3b. Also, motor vehicle emissions were estimated with the MOVES 2014b.

A simulation analysis was conducted in an assessment of the capacity and demand of each alternative evaluated as part of this air quality analysis. Based on the simulation analysis, average taxi times were developed for each alternative and account for aircraft taxiing from the gate to assigned runway (and vice versa), runway queue delays, and other taxi delays resulting from congestion.

4 Construction

As previously mentioned, temporary impacts would result from construction activities associated with Alternative 1, Alternative 2, and Alternative 3. Air pollutants would be emitted by construction equipment and fugitive dust generated during demolition and construction of the proposed development

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17 FAA, *Aviation Emissions and Air Quality Handbook Version 3 Update 1*, January 2015.
18 FAA Order 5050.4B, NEPA Implementing Instructions for Airport Actions, April 28, 2006.
19 FAA Order 1050.1F, Environmental Impacts: Policies and Procedures, July 16, 2015.
20 The USEPA's latest version of MOVES (MOVES3) was released in November 2020. However, this air quality analysis was initiated in August 2019 when MOVES 2014b was the latest version available. As stated in 86 FR 1106 and the USEPA's *Policy Guidance on the Use of MOVES3 for State Implementation Plan Development, Transportation Conformity, General Conformity, and Other Purposes*, a two-year grace period was initiated on January 7, 2021 during which the model previously specified by USEPA as the most current version may continue to be used for general conformity applicability analyses. Therefore, the use of MOVES 2014b for the purpose of this air quality analysis is acceptable.

as well as during clearing and grading activities. Each alternative presents a different proposed fourth parallel runway configuration:

- Alternative 1 includes a new 10,000-foot runway displaced 1,200’ from Runway 18C/36C as shown in **Exhibit 4-1**;
- Alternative 2 includes a new 10,000-foot runway displaced 1,100’ from Runway 18C/36C as shown in **Exhibit 4-2**; and
- Alternative 3 includes a new 8,900-foot runway displaced 900’ from Runway 18C/36C as shown in **Exhibit 4-3**.

As such, the construction emissions estimated for Alternative 1, Alternative 2, and Alternative 3 only vary due to proposed fourth parallel runway configuration and the associated impermeable surfaces. The limits of disturbance anticipated for grading were assumed to be the same between all alternatives due to the location of the proposed fourth parallel runway.

4.1 Construction Phasing

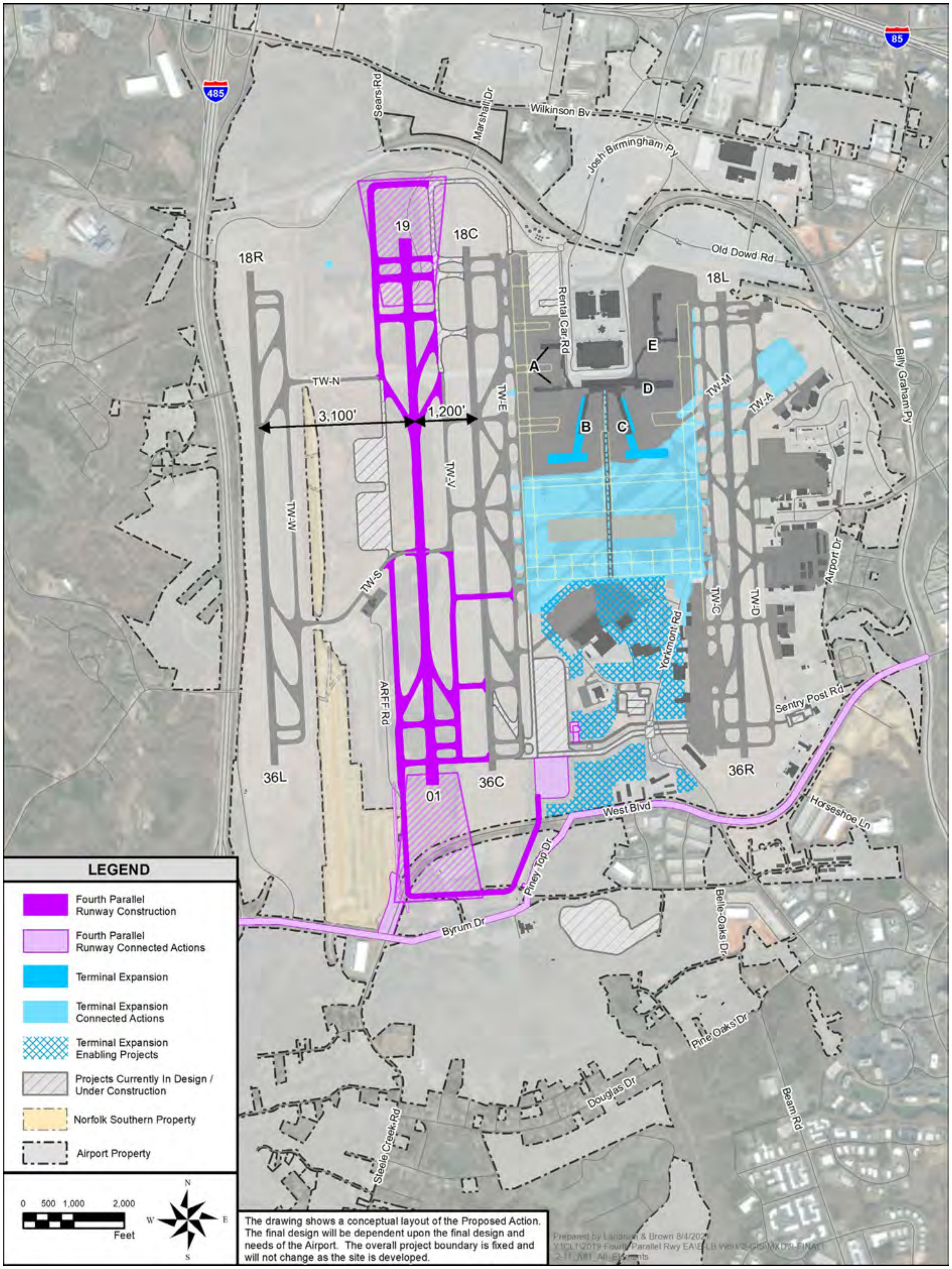
Construction estimates (including phase durations and estimated quantities) were based on the preliminary engineering data available at the time the modeling was completed for this EA. **Table 4-1** provides the estimated construction phasing of the major EA proposed project elements according to the Sponsor’s Capital Improvement Program (CIP).

TABLE 4-1, SPONSOR’S PROPOSED ACTION PROJECT ELEMENTS CONSTRUCTION PHASING

Proposed Action Project Elements	2021	2022	2023	2024	2025	2026	2027	2028
Terminal and Ramp Elements								
East Ramp Dual Taxilanes	■	■	■					
Decommission of Runway 5/23	■	■						
Terminal Construction			■	■	■	■	■	■
South Ramp Construction			■	■	■	■		
Runway Elements								
Runway 01/19 Construction				■	■	■	■	

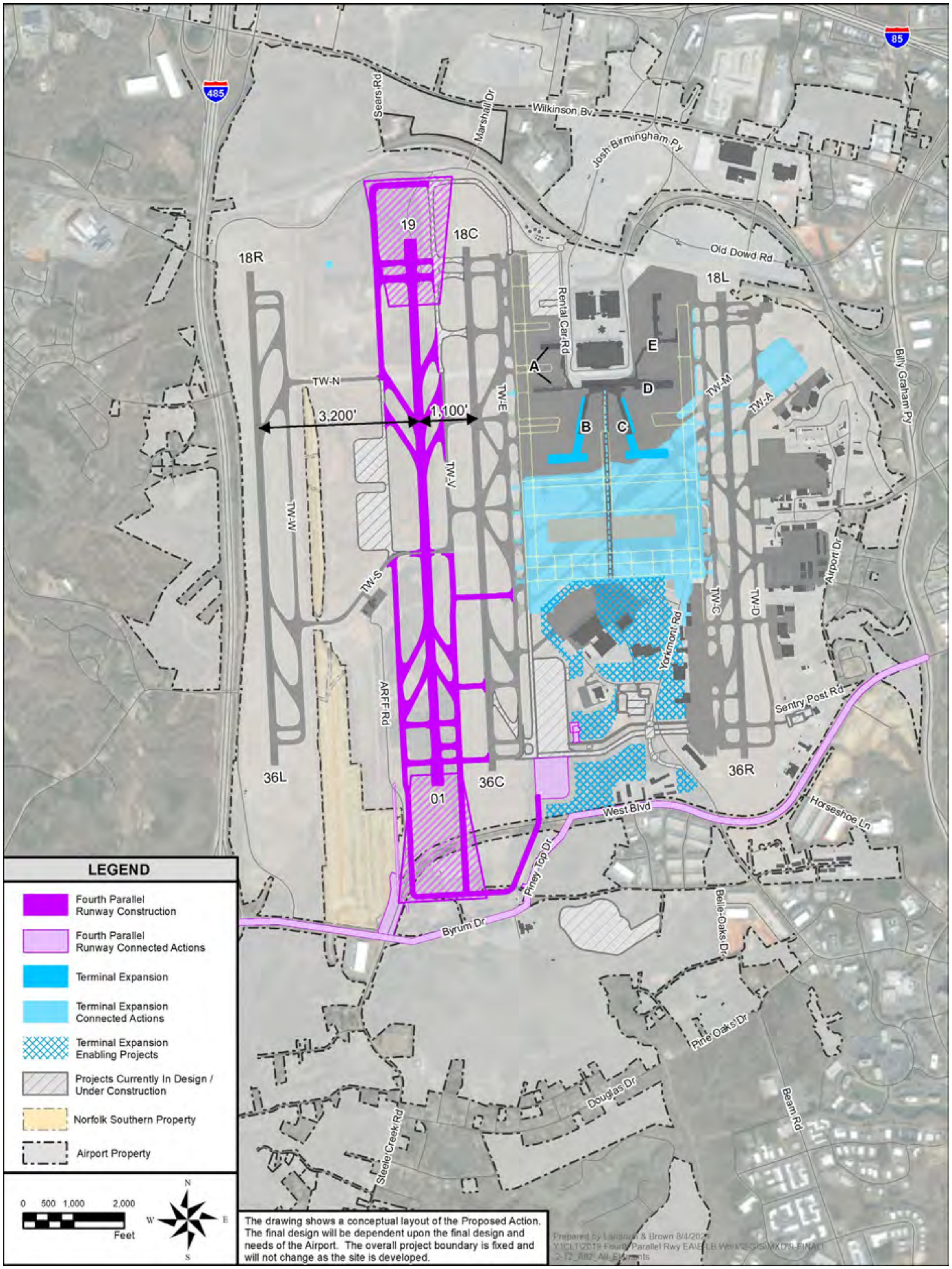
Note: Only the main actions included in the Sponsor’s Proposed Action are listed in this table.
Source: Charlotte Douglas International Airport, January 2020

EXHIBIT 4-1, ALTERNATIVE 1



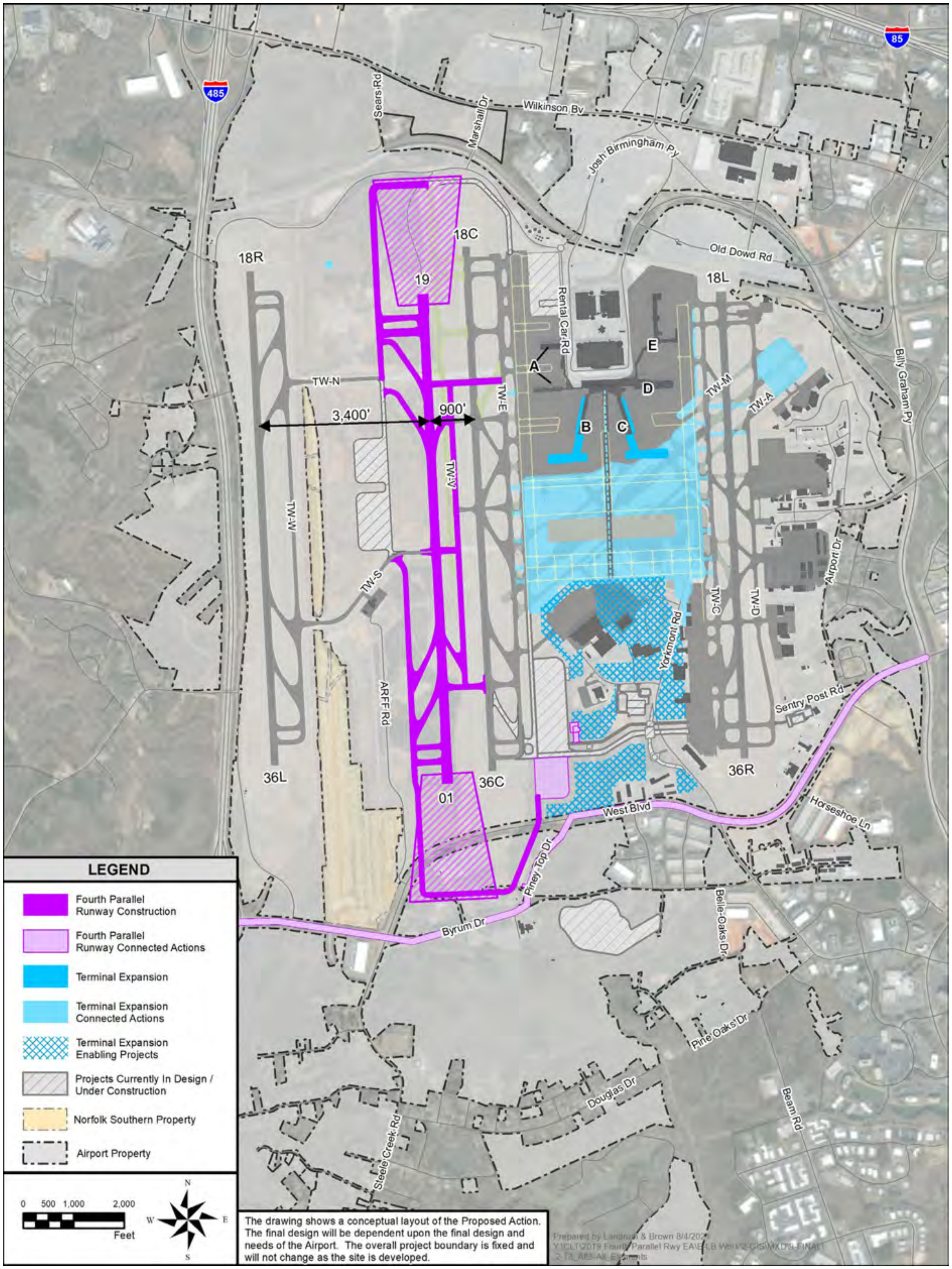
Source: Landrum & Brown, 2020

EXHIBIT 4-2, ALTERNATIVE 2



Source: Landrum & Brown, 2020

EXHIBIT 4-3, ALTERNATIVE 3



Source: Landrum & Brown, 2020

4.2 Construction Emissions

Alternative 1 and Alternative 2 propose a 10,000-foot parallel runway while Alternative 3 proposes an 8,900-foot parallel runway. As such, Alternative 1 and Alternative 2 would be expected to involve more intense construction quantities and materials than those used for Alternative 3. Therefore, construction emissions for Alternative 3 would be lower than those estimated for Alternative 1 and Alternative 2. The detailed construction equipment usage and emission factors applied to develop the emissions inventories are provided for each alternative in **Attachment 3**.

4.2.1 Alternative 1

A construction emissions inventory was prepared to reflect the use of construction equipment and vehicles attributed to Alternative 1. The construction emissions inventory assumes the proposed runway configuration would require approximately 6.5 million square feet of new pavement and the removal of approximately 100,000 square feet of existing pavement in the airfield. The annual construction emissions inventory for Alternative 1 is provided in **Table 4-2**.

TABLE 4-2, CONSTRUCTION EMISSIONS INVENTORY – ALTERNATIVE 1

YEAR	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
2021	31.7	1.2	7.2	0.0	1.2	0.4
2022	53.7	1.8	10.0	0.1	0.4	0.3
2023	124.8	6.0	50.6	0.3	15.5	4.1
2024	101.3	4.6	31.1	0.2	18.7	3.8
2025	114.3	5.1	34.6	0.2	18.9	4.0
2026	99.9	4.5	30.8	0.2	18.7	3.8
2027	46.4	2.2	15.7	0.1	9.6	2.0
2028	20.6	0.7	3.6	0.0	0.2	0.2

Source: Landrum & Brown analysis, 2021.

4.2.2 Alternative 2

The construction emissions inventory assumes the Alternative 2 proposed runway configuration would require approximately 6.9 million square feet of new pavement and the removal of approximately 100,000 square feet of existing pavement in the airfield. The annual construction emissions inventory for Alternative 2 is provided in **Table 4-3**.

TABLE 4-3, CONSTRUCTION EMISSIONS INVENTORY – ALTERNATIVE 2

YEAR	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
2021	31.7	1.2	7.2	0.0	1.2	0.4
2022	53.7	1.8	10.0	0.1	0.4	0.3
2023	124.8	6.0	50.6	0.3	15.5	4.1
2024	102.8	4.6	31.6	0.2	19.3	3.9
2025	115.8	5.2	35.2	0.2	19.5	4.1
2026	101.4	4.6	31.4	0.2	19.2	3.9
2027	47.9	2.3	16.3	0.1	10.1	2.1
2028	20.6	0.7	3.6	0.0	0.2	0.2

Source: Landrum & Brown analysis, 2021.

4.2.3 Alternative 3

The construction emissions inventory for Alternative 3 assumes the proposed runway configuration would require approximately 4.8 million square feet of new pavement and the removal of approximately one million square feet of existing pavement and pavement currently under design or construction in the airfield. The annual construction emissions inventory for Alternative 3 is provided in **Table 4-4**.

TABLE 4-4, CONSTRUCTION EMISSIONS INVENTORY – ALTERNATIVE 3

YEAR	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
2021	31.7	1.2	7.2	0.0	1.2	0.4
2022	53.7	1.8	10.0	0.1	0.4	0.3
2023	124.8	6.0	50.6	0.3	15.5	4.1
2024	107.0	4.6	30.6	0.2	16.4	3.5
2025	107.9	4.8	31.9	0.2	16.5	3.6
2026	93.5	4.2	28.0	0.2	16.3	3.4
2027	40.0	1.9	12.9	0.1	7.2	1.5
2028	20.6	0.7	3.6	0.0	0.2	0.2

Source: Landrum & Brown analysis, 2021.

5 Operational Activities

This section presents the operational air quality emissions analysis from the implementation of the No Action Alternative, Alternative 1, Alternative 2, and Alternative 3 in 2028 and 2033.

5.1 2028 No Action Alternative

5.1.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

Airport physical conditions, including airfield configuration, include the Airport's airfield and facilities from the Existing (2016) Conditions with the inclusion of projects currently under design or construction, as shown in **Exhibit 5-1**. With or without the development of a runway alternative, air traffic is projected to increase each year to 631,783 annual operations in 2028. See Appendix I, *Noise*, for the detailed fleet mix with engine assignments for 2028.

A simulation analysis was conducted in an assessment of the capacity and demand of the 2028 No Action Alternative airfield. Based on the results of the simulation analysis, the 2028 No Action Alternative would result in an average taxi-in time of 13 minutes and 18 seconds and an average taxi-out time of 20 minutes and 27 seconds.

5.1.2 Auxiliary Power Units (APUs) and Ground Support Equipment (GSE)

AEDT defaults for auxiliary power units (APUs) and ground support equipment (GSE) were assumed for the purpose of this analysis. APUs can be used to 'start up' or restart the aircraft engines before departing and operate the heating, air conditioning, and electric system. Typical GSE includes air conditioning, air start, baggage tractors, belt loaders, and emergency vehicles that support airport operations.

EXHIBIT 5-1, NO ACTION ALTERNATIVE

Source: Landrum & Brown, 2021

5.1.3 Motor Vehicles

Mobile sources of air pollution include motor vehicles and other engines and equipment that can be moved from one location to another. The 2028 No Action Alternative would not require the relocation of West Boulevard; as such, it is assumed the vehicles navigating on West Boulevard would continue without modification. Annual emissions for motor vehicles were modeled for three roadways: West Boulevard, Piney Top, and Byrum Road highlighted in blue in **Exhibit 5-2**. The length of each roadway, posted speed limit, annual average daily traffic (AADT), vehicle classification composition, and estimated vehicle miles travelled (VMTs) used to estimate motor vehicle emissions on these roadways in 2028 is presented in **Table 5-1**. See **Attachment 4** for the emission factors used to estimate motor vehicle emissions in 2028.

TABLE 5-1, ROADWAY VOLUMES – 2028 NO ACTION ALTERNATIVE

Description	Intersection ID	Length (miles)	2028 AADT	Vehicle Mix (%)				Speed limit	Annual VMT
				PC	PT	LCT	SHT		
West Blvd	308 - 313	0.90	20,113	44.5	44.5	3	8	45	6,607,049
Piney Top Drive	313 - 314	0.38	975	38.5	38.5	22	1	45	136,296
Byrum Drive	308 - 314	0.56	8,777	47	47	4	2	45	1,785,833
								Total Annual VMT	**8,529,178**

Notes: AADT denotes annual average daily traffic; PC denotes passenger car; PT denotes passenger truck; LCT denotes long haul truck; SHT denotes short haul truck; VMT denotes vehicle miles traveled
Source: AADT is based on coordination with NCDOT and CDOT; Landrum & Brown analysis, 2021

EXHIBIT 5-2, NO ACTION ALTERNATIVE MOTOR VEHICLE PATHWAYS

Source: Landrum & Brown, 2021

5.1.4 Emissions Inventory

The operational emissions inventory for the 2028 No Action Alternative is shown in **Table 5-2**.

TABLE 5-2, OPERATIONAL EMISSIONS INVENTORY –2028 NO ACTION ALTERNATIVE

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	3,378	456	2,347	256	21	21
Taxiing	*3,013*	*239*	*498*	*136*	*10*	*10*
LTOs	*365*	*217*	*1,849*	*120*	*11*	*11*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Motor Vehicles	23	0	4	0	0	0
TOTAL	**3,926**	**483**	**2,477**	**274**	**39**	**39**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment
Source: Landrum & Brown analysis, 2021

5.2 2028 Alternative 1

5.2.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

Airport physical conditions, including airfield configuration, include the project elements identified in Exhibit 4-1. With or without the development of a runway alternative, air traffic is projected to increase each year to 631,783 annual operations in 2028. A simulation analysis was conducted in an assessment of the capacity and demand of the 2028 Alternative 1 airfield. Based on the results of the simulation analysis, 2028 Alternative 1 would result in an average taxi-in time of 10 minutes and 13 seconds and an average taxi-out time of 18 minutes and 44 seconds.

5.2.2 Auxiliary Power Units (APUs) and Ground Support Equipment (GSE)

AEDT defaults for APUs and GSE were assumed for the purpose of this analysis.

5.2.3 Motor Vehicles

2028 Alternative 1 would require the relocation of an approximately one-mile segment of West Boulevard on existing roadways outside of the footprint of the Runway Protection Zone (RPZ) of proposed Runway 01/19 and the south end-around taxiway (SEAT).[21] The relocation would require motor vehicles to travel an additional approximately 0.04 miles (211 feet) and would result in a net increase of annual VMTs. Annual emissions for motor vehicles were modeled by assigning traffic on West Boulevard to Piney Top Drive and Byrum Drive, as shown in **Exhibit 5-3** and presented in **Table 5-3**.

TABLE 5-3, ROADWAY VOLUMES – 2028 ALTERANTIVE 1

Description	Intersection ID	Length (miles)	2028 AADT	Vehicle Mix (%)				Speed limit	Annual VMT
				PC	PT	LCT	SHT		
West Blvd	308 - 313	0.90	0	44.5	44.5	3	8	45	0
Piney Top Drive	313 - 314	0.38	21,089	38.5	38.5	22	1	45	2,947,404
Byrum Drive	308 - 314	0.56	28,890	47	47	4	2	45	5,878,366
								Total Annual VMT	**9,744,363**

Notes: AADT denotes annual average daily traffic; PC denotes passenger car; PT denotes passenger truck; LCT denotes long haul truck; SHT denotes short haul truck; VMT denotes vehicle miles traveled
Source: AADT is based on coordination with NCDOT and CDOT; Landrum & Brown analysis, 2021

21 A traffic analysis was conducted and coordinated with the North Carolina Department of Transportation (NCDOT) and City of Charlotte Department of Transportation (CDOT) that concluded that the design and implementation of the proposed West Boulevard relocation would not substantially reduce the Level of Service (LOS) at intersections 308, 313, 314 in the analysis years 2028 and 2033. See Appendix I, *Traffic* for the traffic analysis and coordination with NCDOT and CDOT

EXHIBIT 5-3, ALTERNATIVE 1 WEST BOULEVARD ROUTE

Source: Landrum & Brown analysis, 2021

5.2.4 Emissions Inventory

The operational emissions inventory for 2028 Alternative 1 is shown in **Table 5-4**.

TABLE 5-4, OPERATIONAL EMISSIONS INVENTORY –2028 ALTERNATIVE 1

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	2,949	409	2,275	237	19	19
Taxiing	*2,584*	*192*	*428*	*117*	*9*	*9*
LTOs	*365*	*217*	*1,848*	*120*	*10*	*10*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Motor Vehicles	23	0.5	4	0.0	0.1	0.1
TOTAL	**3,498**	**436**	**2,405**	**255**	**37**	**37**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment

Source: Landrum & Brown analysis, 2021

5.3 2028 Alternative 2

5.3.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

Airport physical conditions, including airfield configuration, include the project elements identified in Exhibit 4-2. With or without the development of a runway alternative, air traffic is projected to increase each year to 631,783 annual operations in 2028. Because the airfield configuration for Alternative 2 is similar to that of Alternative 1, 2028 Alternative 2 was assumed to operate with the same taxi times as those of 2028 Alternative 1 (average taxi-in time of 10 minutes and 13 seconds, average taxi-out time of 18 minutes and 44 seconds).

5.3.2 Auxiliary Power Units (APUs) and Ground Support Equipment (GSE)

AEDT defaults for APUs and GSE were assumed for the purpose of this analysis.

5.3.3 Motor Vehicles

The 2028 Alternative 2 would require the relocation of a one-mile West Boulevard on existing roadways outside of the footprint of the RPZ of proposed Runway 01/19 and the SEAT as evaluated in 2028 Alternative 1. Annual emissions for motor vehicles were modeled by assigning traffic on West Boulevard to Piney Top Drive and Byrum Drive, as shown in Exhibit 5-3 and presented in Table 5-3.

5.3.4 Emissions Inventory

The operational emissions inventory for the 2028 Alternative 2 is shown in **Table 5-5**.

TABLE 5-5, OPERATIONAL EMISSIONS INVENTORY –2028 ALTERNATIVE 2

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	2,949	409	2,275	237	19	19
Taxiing	*2,584*	*192*	*428*	*117*	*9*	*9*
LTOs	*365*	*217*	*1,848*	*120*	*10*	*10*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Motor Vehicles	23	0.5	4	0.0	0.1	0.1
TOTAL	**3,498**	**436**	**2,405**	**255**	**37**	**37**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment
Source: Landrum & Brown analysis, 2021

5.4 2028 Alternative 3

5.4.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

Airport physical conditions, including airfield configuration, are assumed to include the project elements identified in Exhibit 4-3. With or without the development of a runway alternative, air traffic is projected to increase each year to 631,783 annual operations in 2028. A simulation analysis was conducted in an assessment of the capacity and demand of the 2028 Alternative 3 airfield. Based on the results of the simulation analysis, the 2028 Alternative 3 would result in an average taxi-in time of 11 minutes and 49 seconds and an average taxi-out time of 17 minutes and 28 seconds.

5.4.2 Auxiliary Power Units (APUs) and Ground Support Equipment (GSE)

AEDT defaults for APUs and GSE were assumed for the purpose of this analysis.

5.4.3 Motor Vehicles:

The 2028 Alternative 3 would require the relocation of a one-mile West Boulevard on existing roadways outside of the footprint of the RPZ of proposed Runway 01/19 and the SEAT as evaluated in 2028 Alternative 1. Annual emissions for motor vehicles were modeled by assigning traffic on West Boulevard to Piney Top Drive and Byrum Drive, as shown in Exhibit 5-3 and presented in Table 5-3.

5.4.4 Emissions Inventory

The operational emissions inventory for the 2028 Alternative 3 is shown in **Table 5-6**.

TABLE 5-6, OPERATIONAL EMISSIONS INVENTORY –2028 ALTERNATIVE 3

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	2,979	412	2,280	238	20	20
Taxiing	2,614	195	432	118	9	9
LTOs	365	217	1,848	120	11	11
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Motor Vehicles	23	0.5	4	0.0	0.1	0.1
TOTAL	**3,528**	**439**	**2,410**	**256**	**38**	**38**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment
Source: Landrum & Brown analysis, 2021

5.5 2033 No Action Alternative

5.5.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

The Airport physical conditions in the 2033 No Action Alternative is expected to remain the same as that of the 2028 No Action Alternative. With or without the development of a runway alternative, air traffic is projected to increase to 675,643 annual operations in 2033. See Appendix I, *Noise*, for the detailed fleet mix with engine assignments for 2033.

A simulation analysis was conducted in an assessment of the capacity and demand of the 2033 No Action Alternative airfield. Based on the results of the simulation analysis, the 2033 No Action Alternative would result in an average taxi-in time of 15 minutes and 7 seconds and an average taxi-out time of 21 minutes and 45 seconds.

5.5.2 Auxiliary Power Units (APUs) and Ground Support Equipment (GSE)

AEDT defaults for APUs and GSE were assumed for the purpose of this analysis.

5.5.3 Motor Vehicles

Similar to the 2028 No Action Alternative, the 2033 No Action Alternative would not require the relocation of West Boulevard on existing roadways, as shown in Exhibit 5-2. The length of each roadway, posted speed limit, AADT, vehicle classification composition, and estimated vehicle miles travelled used to estimate motor vehicle emissions on these roadways in 2033 is presented in **Table 5-7**. See **Attachment 4** for the emission factors used to estimate motor vehicle emissions in 2033.

TABLE 5-7, ROADWAY VOLUMES – 2033 NO ACTION ALTERNATIVE

Description	Intersection ID	Length (miles)	2033 AADT	Vehicle Mix (%)				Speed limit	Annual VMT
				PC	PT	LCT	SHT		
Piney Top Drive	313 - 314	0.38	1,077	38.5	38.5	22	1	45	150,482
West Blvd	308 - 313	0.90	22,207	44.5	44.5	3	8	45	7,294,716
Byrum Drive	308 - 314	0.56	9,690	47	47	4	2	45	1,971,704
								Total Annual VMT	**9,416,902**

Notes: AADT denotes annual average daily traffic; PC denotes passenger car; PT denotes passenger truck; LCT denotes long haul truck; SHT denotes short haul truck; VMT denotes vehicle miles traveled
Source: AADT is based on coordination with NCDOT and CDOT; Landrum & Brown analysis, 2021

5.5.4 Emissions Inventory

The operational emissions inventory for the 2033 No Action Alternative is shown in **Table 5-8**.

TABLE 5-8, OPERATIONAL EMISSIONS INVENTORY –2033 NO ACTION ALTERNATIVE

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	3,834	526	2,599	285	23	23
Taxiing	*3,453*	*295*	*577*	*157*	*12*	*12*
LTOs	*381*	*231*	*2,022*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Motor Vehicles	18	0.2	2	0.0	0.1	0.1
TOTAL	**4,413**	**555**	**2,734**	**304**	**42**	**41**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment
Source: Landrum & Brown analysis, 2021

5.6 2033 Alternative 1

5.6.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

Airport physical conditions, including airfield configuration, for 2033 Alternative 1 are assumed to be the same as those for 2028 Alternative 1. With or without the development of a runway alternative, air traffic is projected to increase each year to 675,643 annual operations in 2033. A simulation analysis was conducted in an assessment of the capacity and demand of 2033 Alternative 1 airfield. Based on the results of the simulation analysis, 2033 Alternative 1 would result in an average taxi-in time of 10 minutes and 26 seconds and an average taxi-out time of 19 minutes and 20 seconds.

5.6.2 Auxiliary Power Units (APUs) and Ground Support Equipment (GSE)

AEDT defaults for APUs and GSE were assumed for the purpose of this analysis.

5.6.3 Motor Vehicles

Similar to 2028 Alternative 1, 2033 Alternative 1 would require the relocation of an approximately one-mile segment of West Boulevard on existing roadways outside of the footprint of the RPZ of proposed Runway 01/19 and the SEAT. As previously discussed, the relocation would require motor vehicles to travel an additional distance of approximately 0.4 miles (211 feet) and would result in a net increase of annual VMTs. Annual emissions for motor vehicles were modeled by assigning traffic on West Boulevard to Piney Top Drive and Byrum Drive, as shown in Exhibit 5-3 and presented in **Table 5-9**.

TABLE 5-9, ROADWAY VOLUMES – 2033 ALTERNATIVE 1

Description	Intersection ID	Length (miles)	2033 AADT	Vehicle Mix (%)				Speed limit	Annual VMT
				PC	PT	LCT	SHT		
West Blvd	308 - 313	0.90	0	44.5	44.5	3	8	45	0
Piney Top Drive	313 - 314	0.38	23,284	38.5	38.5	22	1	45	3,254,172
Byrum Drive	308 - 314	0.56	31,897	47	47	4	2	45	6,490,191
								Total Annual VMT	**9,744,363**

Notes: AADT denotes average annual daily traffic; PC denotes passenger car; PT denotes passenger truck; LCT denotes long haul truck; SHT denotes short haul truck; VMT denotes vehicle miles traveled
Source: AADT is based on coordination with NCDOT and CDOT; Landrum & Brown analysis, 2021

5.6.4 Emissions Inventory

The operational emissions inventory for 2033 Alternative 1 is shown in **Table 5-10**.

TABLE 5-10, OPERATIONAL EMISSIONS INVENTORY –2033 ALTERNATIVE 1

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	3,169	450	2,487	254	20	20
Taxiing	*2,788*	*219*	*466*	*127*	*9*	*9*
LTOs	*381*	*231*	*2,020*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Motor Vehicles	18	0.2	3	0.0	0.1	0.1
TOTAL	**3,748**	**479**	**2,622**	**274**	**39**	**39**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment
Source: Landrum & Brown analysis, 2021

5.7 2033 Alternative 2

5.7.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

Airport physical conditions, including airfield configuration, for the 2033 Alternative 2 are assumed to be the same as those for the 2028 Alternative 2. With or without the development of a runway alternative, air traffic is projected to increase each year to 675,643 annual operations in 2028. Because the airfield configuration for Alternative 2 is similar to that of Alternative 1, the 2033 Alternative 2 was assumed to operate with the same taxi times as those of 2033 Alternative 1 (average taxi-in time of 10 minutes and 26 seconds and average taxi-out time of 19 minutes and 20 seconds).

5.7.2 Auxiliary Power Units (APUs), and Ground Support Equipment (GSE)

AEDT defaults for APUs and GSE were assumed for the purpose of this analysis.

5.7.3 Motor Vehicles:

Similar to the 2028 Alternative 2, the 2033 Alternative 2 would require the relocation of a one-mile West Boulevard on existing roadways outside of the footprint of the RPZ of proposed Runway 01/19 and the south EAT. Annual emissions for motor vehicles were modeled by assigning traffic on West Boulevard to Piney Top Drive and Byrum Drive, as shown in Exhibit 5-3 and presented in Table 5-9.

5.7.4 Emissions Inventory

The operational emissions inventory for the 2033 Alternative 2 is shown in **Table 5-11**.

TABLE 5-11, OPERATIONAL EMISSIONS INVENTORY –2033 ALTERNATIVE 2

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	3,169	450	2,487	254	20	20
Taxiing	*2,788*	*219*	*466*	*127*	*9*	*9*
LTOs	*381*	*231*	*2,020*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Motor Vehicles	18	0.2	3	0.0	0.1	0.1
TOTAL	**3,748**	**479**	**2,622**	**274**	**39**	**39**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment
Source: Landrum & Brown analysis, 2021

5.8 2033 Alternative 3

5.8.1 Airfield Configuration, Aircraft Activity Levels, and Taxi Time

Airport physical conditions, including airfield configuration, for the 2033 Alternative 3 are assumed to be the same as those for the 2028 Alternative 3. With or without the development of a runway alternative, air traffic is projected to increase each year to 675,643 annual operations in 2033. A simulation analysis was conducted in an assessment of the capacity and demand of the 2033 Alternative 3 airfield. Based on the results of the simulation analysis, the 2033 Alternative 3 would result in an average taxi-in time of 12 minutes and 8 seconds and an average taxi-out time of 18 minutes and 13 seconds.

5.8.2 Auxiliary Power Units (APUs) and Ground Support Equipment (GSE):

AEDT defaults for APUs and GSE were assumed for the purpose of this analysis.

5.8.3 Motor Vehicles:

Similar to the 2028 Alternative 3, the 2033 Alternative 3 would require the relocation of a one-mile West Boulevard on existing roadways outside of the footprint of the RPZ of proposed Runway 01/19 and the SEAT. Annual emissions for motor vehicles were modeled by assigning traffic on West Boulevard to Piney Top Drive and Byrum Drive, as shown in Exhibit 5-3 and presented in Table 5-9.

5.8.4 Emissions Inventory

The operational emissions inventory for the 2033 Alternative 3 is shown in **Table 5-12**.

TABLE 5-12, OPERATIONAL EMISSIONS INVENTORY –2033 ALTERNATIVE 3

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	3,224	456	2,496	257	21	21
Taxiing	*2,843*	*225*	*475*	*130*	*10*	*10*
LTOs	*381*	*231*	*2,020*	*127*	*12*	*12*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Motor Vehicles	18	0.2	3	0.0	0.1	0.1
TOTAL	**3,803**	**485**	**2,631**	**276**	**40**	**40**

Note: LTOs denotes landing and takeoff operations. Numbers may not appear to sum as reported due to rounding. APUs represents Auxiliary Power Units; GSE represents Ground Support Equipment
Source: Landrum & Brown analysis, 2021

6 Total Emissions

In this section, the emissions inventories prepared for Alternative 1 and its alternatives are compared to the emissions inventories prepared for the No Action Alternative of the same future year to disclose the potential increase in emissions caused by each alternative. The comparison of the emission inventories, which included an inventory of construction and operational emissions, were used for the evaluation of General Conformity as required under the CAA (including the 1990 Amendments).

6.1 Alternative 1 Emissions Inventory

Table 6-1 shows that neither of the relevant Federal thresholds were equaled or exceeded for Alternative 1. From 2021 through 2027, there is an increase in net emissions due to construction activities associated with Alternative 1. Construction activities are also included in the first operational year (2028). Additionally, the West Boulevard relocation would result in an increase in motor vehicle emissions in both 2028 and 2033 due to the longer distance required to be traveled due to the West Boulevard relocation. The total annual operations remain the same between the No Action Alternative and Alternative 1 and emissions resulting from aircraft landings and takeoffs would remain the same between the two alternatives. However, there is an overall decrease in emissions due to aircraft taxiing emissions. Compared to the No Action Alternative, Alternative 1 has substantially reduced taxi times in 2028 and 2033 due to the reduction in taxi delays from congestion in the terminal apron and the shortened departure queues. Therefore, the Alternative 1 airfield configuration provides airfield efficiencies that would reduce overall operational air quality emissions.

As such, the air quality assessment demonstrates that Alternative 1 would not cause an increase in air emissions above the applicable *de minimis* thresholds. Therefore, Alternative 1 conforms to the SIP and the CAA and would not create any new violation of the NAAQS, delay the attainment of any NAAQS, nor increase the frequency or severity of any existing violations of the NAAQS. As such, no adverse impact on local or regional air quality is expected by construction of Alternative 1. o further analysis or reporting is required under the CAA or NEPA.

TABLE 6-1, TOTAL EMISSIONS INVENTORY – ALTERNATIVE 1

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Federal de minimis Threshold	***N/A***	***100***	***100***	***N/A***	***N/A***	***N/A***
2021						
Construction	32	1	7	0	1	0
Alternative 1 Subtotal	*32*	*1*	*7*	*0*	*1*	*0*
2022						
Construction	54	2	10	0	0	0
Alternative 1 Subtotal	*54*	*2*	*10*	*0*	*0*	*0*
2023						
Construction	125	6	51	0	15	4
Alternative 1 Subtotal	*125*	*6*	*51*	*0*	*15*	*4*
2024						
Construction	101	5	31	0	19	4
Alternative 1 Subtotal	*101*	*5*	*31*	*0*	*19*	*4*
2025						
Construction	114	5	35	0	19	4
Alternative 1 Subtotal	*114*	*5*	*35*	*0*	*19*	*4*
2026						
Construction	100	5	31	0	19	4
Alternative 1 Subtotal	*100*	*5*	*31*	*0*	*19*	*4*
2027						
Construction	46	2	16	0	10	2
Alternative 1 Subtotal	*46*	*2*	*16*	*0*	*10*	*2*

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Federal de minimis Threshold	***N/A***	***100***	***100***	***N/A***	***N/A***	***N/A***
2028						
No Action Alternative						
Aircraft	3,378	456	2,347	256	21	21
Taxiing	3,013	239	498	136	10	10
LTOs	365	217	1,849	120	11	11
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Vehicles	23	0.5	4	0.0	0.1	0.1
No Action Alternative Subtotal	3,926	483	2,477	274	39	39
Alternative 1						
Construction	21	0.7	4	0.0	0.2	0.2
Aircraft	2,949	409	2,275	237	19	19
Taxiing	*2,584*	*192*	*428*	*117*	*9*	*9*
LTOs	*365*	*217*	*1,848*	*120*	*10*	*10*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Vehicles	23	0.5	4	0.0	0.1	0.1
Alternative 1 Subtotal	3,519	437	2,408	255	37	37
2028 Net Emissions	***-408***	***-47***	***-69***	***-19***	***-2***	***-2***
2033						
No Action Alternative						
Aircraft	3,834	526	2,599	285	23	23
Taxiing	*3,453*	*295*	*577*	*157*	*12*	*12*
LTOs	*381*	*231*	*2,022*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Vehicles	18	0.2	2	0.0	0.1	0.1
No Action Alternative Subtotal	*4,413*	*555*	*2,734*	*304*	*42*	*41*
Alternative 1						
Aircraft	3,169	450	2,487	254	20	20
Taxiing	*2,788*	*219*	*466*	*127*	*9*	*9*
LTOs	*381*	*231*	*2,020*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Vehicles	18	0.2	3	0.0	0.1	0.1
Alternative 1 Subtotal	*3,748*	*479*	*2,622*	*274*	*39*	*39*
2033 Net Emissions	***-665***	***-76***	***-112***	***-30***	***-3***	***-3***
Federal Threshold Exceeded?	***N/A***	***NO***	***NO***	***N/A***	***N/A***	***N/A***

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment. Numbers may not sum to totals due to rounding

Source: Landrum & Brown analysis, 2021

6.2 Alternative 2 Emissions Inventory

Table 6-2 shows that neither of the relevant Federal thresholds were equaled or exceeded for Alternative 2. From 2021 through 2027, there is an increase in net emissions due to construction activities associated with Alternative 2. Construction activities are also included in the first operational year (2028). Additionally, the West Boulevard relocation would result in an increase in motor vehicle emissions in both 2028 and 2033 due to the longer distance required to be traveled due to the West Boulevard relocation. The total annual operations remain the same between the No Action Alternative and Alternative 2 and emissions resulting from aircraft landings and takeoffs would remain the same between the two alternatives. However, there is an overall decrease in emissions due to aircraft taxiing emissions. Compared to the No Action Alternative, Alternative 2 has substantially reduced taxi times in 2028 and 2033 due to the reduction in taxi delays from congestion in the terminal apron and the shortened departure queues. Therefore, the Alternative 2 airfield configuration provides airfield efficiencies that would reduce overall operational air quality emissions.

As such, the air quality assessment demonstrates that Alternative 2 would not cause an increase in air emissions above the applicable *de minimis* thresholds. Therefore, Alternative 2 conforms to the SIP and the CAA and would not create any new violation of the NAAQS, delay the attainment of any NAAQS, nor increase the frequency or severity of any existing violations of the NAAQS. As such, no adverse impact on local or regional air quality is expected by construction of Alternative 2. No further analysis or reporting is required under the CAA or NEPA.

TABLE 6-2, TOTAL EMISSIONS INVENTORY – ALTERNATIVE 2

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Federal de minimis Threshold	***N/A***	***100***	***100***	***N/A***	***N/A***	***N/A***
2021						
Construction	32	1	7	0	1	0
Alternative 2 Subtotal	*32*	*1*	*7*	*0*	*1*	*0*
2022						
Construction	54	2	10	0	0	0
Alternative 2 Subtotal	*54*	*2*	*10*	*0*	*0*	*0*
2023						
Construction	125	6	51	0	15	4
Alternative 2 Subtotal	*125*	*6*	*51*	*0*	*15*	*4*
2024						
Construction	103	5	32	0	19	4
Alternative 2 Subtotal	*103*	*5*	*32*	*0*	*19*	*4*
2025						
Construction	116	5	35	0	19	4
Alternative 2 Subtotal	*116*	*5*	*35*	*0*	*19*	*4*
2026						
Construction	101	5	31	0	19	4
Alternative 2 Subtotal	*101*	*5*	*31*	*0*	*19*	*4*
2027						
Construction	48	2	16	0	10	2
Alternative 2 Subtotal	*48*	*2*	*16*	*0*	*10*	*2*
2028						
No Action Alternative						
Aircraft	3,378	456	2,347	256	21	21
Taxiing	*3,013*	*239*	*498*	*136*	*10*	*10*
LTOs	*365*	*217*	*1,849*	*120*	*11*	*11*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Vehicles	23	0.5	4	0.0	0.1	0.1
No Action Alternative Subtotal	*3,926*	*483*	*2,477*	*274*	*39*	*39*

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Federal de minimis Threshold	***N/A***	***100***	***100***	***N/A***	***N/A***	***N/A***
Alternative 2						
Construction	21	1	4	0	0	0
Aircraft	2,949	409	2,275	237	19	19
Taxiing	*2,584*	*192*	*428*	*117*	*9*	*9*
LTOs	*365*	*217*	*1,848*	*120*	*10*	*10*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Vehicles	23	0.5	4	0.0	0.1	0.1
Alternative 2 Subtotal	*3,519*	*437*	*2,408*	*255*	*37*	*37*
2028 Net Emissions	***-408***	***-47***	***-69***	***-19***	***-2***	***-2***
2033						
No Action Alternative						
Aircraft	3,834	526	2,599	285	23	23
Taxiing	*3,453*	*295*	*577*	*157*	*12*	*12*
LTOs	*381*	*231*	*2,022*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Vehicles	18	0.2	2	0.0	0.1	0.1
No Action Alternative Subtotal	*4,413*	*555*	*2,734*	*304*	*42*	*41*
Alternative 2						
Aircraft	3,169	450	2,487	254	20	20
Taxiing	*2,788*	*219*	*466*	*127*	*9*	*9*
LTOs	*381*	*231*	*2,020*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Vehicles	18	0.2	3	0.0	0.1	0.1
Alternative 2 Subtotal	*3,748*	*479*	*2,622*	*274*	*39*	*39*
2033 Net Emissions	***-665***	***-76***	***-112***	***-30***	***-3***	***-3***
Federal Threshold Exceeded?	***N/A***	***NO***	***NO***	***N/A***	***N/A***	***N/A***

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment. Numbers may not sum to totals due to rounding

Source: Landrum & Brown analysis, 2021

6.3 Alternative 3 Emissions Inventory

Table 6-3 shows that neither of the relevant Federal thresholds were equaled or exceeded for Alternative 3. From 2021 through 2027, there is an increase in net emissions due to construction activities associated with Alternative 3. Construction activities are also included in the first operational year (2028). Additionally, the West Boulevard relocation would result in an increase in motor vehicle emissions in both 2028 and 2033 due to the longer distance required to be traveled due to the West Boulevard relocation. The total annual operations remain the same between the No Action Alternative and Alternative 3 and emissions resulting from aircraft landings and takeoffs would remain the same between the two alternatives. However, there is an overall decrease in emissions due to aircraft taxiing emissions. Compared to the No Action Alternative, Alternative 3 has substantially reduced taxi times in 2028 and 2033 due to the reduction in taxi delays from congestion in the terminal apron and the shortened departure queues. Therefore, the Alternative 2 airfield configuration provides airfield efficiencies that would reduce overall operational air quality emissions.

As such, the air quality assessment demonstrates that Alternative 3 would not cause an increase in air emissions above the applicable *de minimis* thresholds. Therefore, Alternative 3 conforms to the SIP and the CAA and would not create any new violation of the NAAQS, delay the attainment of any NAAQS, nor increase the frequency or severity of any existing violations of the NAAQS. As such, no adverse impact on local or regional air quality is expected by construction of Alternative 3. No further analysis or reporting is required under the CAA or NEPA.

TABLE 6-3, TOTAL EMISSIONS INVENTORY – ALTERNATIVE 3

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Federal de minimis Threshold	***N/A***	***100***	***100***	***N/A***	***N/A***	***N/A***
2021						
Construction	32	1	7	0	1	0
Alternative 3 Subtotal	*32*	*1*	*7*	*0*	*1*	*0*
2022						
Construction	54	2	10	0	0	0
Alternative 3 Subtotal	*54*	*2*	*10*	*0*	*0*	*0*
2023						
Construction	125	6	51	0	15	4
Alternative 3 Subtotal	*125*	*6*	*51*	*0*	*15*	*4*
2024						
Construction	107	5	31	0	16	3
Alternative 3 Subtotal	*107*	*5*	*31*	*0*	*16*	*3*
2025						
Construction	108	5	32	0	17	4
Alternative 3 Subtotal	108	5	32	0	17	4
2026						
Construction	93	4	28	0	16	3
Alternative 3 Subtotal	93	4	28	0	16	3
2027						
Construction	40	2	13	0	7	2
Alternative 3 Subtotal	40	2	13	0	7	2
2028						
No Action Alternative						
Aircraft	3,378	456	2,347	256	21	21
Taxiing	*3,013*	*239*	*498*	*136*	*10*	*10*
LTOs	*365*	*217*	*1,849*	*120*	*11*	*11*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Vehicles	23	0.5	4	0.0	0.1	0.1
No Action Alternative Subtotal	*3,926*	*483*	*2,477*	*274*	*39*	*39*
Alternative 3						
Construction	21	0.7	4	0.0	0.2	0.2
Aircraft	2,979	412	2,280	238	20	20
Taxiing	*2,614*	*195*	*432*	*118*	*9*	*9*
LTOs	*365*	*217*	*1,848*	*120*	*11*	*11*
APU	164	13	94	14	15	15
GSE	363	13	31	4	2	2
Vehicles	23	0.5	4	0.0	0.1	0.1
Alternative 3 Subtotal	*3,549*	*440*	*2,413*	*256*	*38*	*38*
2028 Net Emissions	***-378***	***-43***	***-64***	***-18***	***-0.8***	***-0.8***

SOURCE	ANNUAL EMISSIONS (SHORT TONS PER YEAR)					
	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Federal de minimis Threshold	***N/A***	***100***	***100***	***N/A***	***N/A***	***N/A***
2033						
No Action Alternative						
Aircraft	3,834	526	2,599	285	23	23
Taxiing	*3,453*	*295*	*577*	*157*	*12*	*12*
LTOs	*381*	*231*	*2,022*	*127*	*11*	*11*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Vehicles	18	0.2	2	0.0	0.1	0.1
No Action Alternative Subtotal	*4,413*	*555*	*2,734*	*304*	*42*	*41*
Alternative 3						
Aircraft	3,224	456	2,496	257	21	21
Taxiing	*2,843*	*225*	*475*	*130*	*10*	*10*
LTOs	*381*	*231*	*2,020*	*127*	*12*	*12*
APU	173	14	100	15	16	16
GSE	388	15	32	4	2	2
Vehicles	18	0.2	3	0.0	0.1	0.1
Alternative 3 Subtotal	*3,803*	*485*	*2,631*	*276*	*40*	*40*
2033 Net Emissions	***-610***	***-70***	***-103***	***-28***	***-2***	***-2***
Federal Threshold Exceeded?	***N/A***	***NO***	***NO***	***N/A***	***N/A***	***N/A***

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment. Numbers may not sum to totals due to rounding
Source: Landrum & Brown analysis, 2021

6.4 Significance Determination

As previously stated, the air quality assessment demonstrates that neither Alternative 1 nor Alternative 2 nor Alternative 3 would cause an increase in air emissions above the applicable *de minimis* thresholds. Therefore, Alternative 1, Alternative 2, and Alternative 3 conform to the SIP and the CAA and would not create any new violation of the NAAQS, delay the attainment of any NAAQS, nor increase the frequency or severity of any existing violations of the NAAQS. As such, no adverse impact on local or regional air quality is expected by construction of Alternative 1, Alternative 2, or Alternative 3. No further analysis or reporting is required under the CAA or NEPA.

Construction of Alternative 1, Alternative 2, or Alternative 3 would result in short term air quality impacts from exhaust emissions from construction equipment and from fugitive dust emissions from vehicle movement and soil excavation. As presented in Tables 6-1 through 6-3, emissions due to construction equipment would not exceed applicable thresholds.

While the construction of Alternative 1, Alternative 2, or Alternative 3 would be expected to contribute to fugitive dust in and around the construction site, the City of Charlotte would ensure that all possible measures would be taken to reduce fugitive dust emissions by adhering to guidelines included in FAA Advisor Circular 150/5370-10H, *Standard Specifications for Construction of Airports*, including Item C-102, *Temporary Air and Water Pollution, Soil Erosion and Siltation Control*. [22]

Methods of controlling dust and other airborne particles will be implemented to the maximum possible extent and may include, but not limited to, the following:

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[22] FAA Advisory Circular 150/5370-10H, *Standard Specifications for Construction of Airports,* including Item C-102, *Temporary Air and Water Pollution, Soil Erosion and Siltation Control*, December 21, 2018.

- Exposing the minimum area of erodible earth.
- Applying temporary mulch with or without seeding.
- Using water sprinkler trucks.
- Using covered haul trucks.
- Using dust palliatives or penetration asphalt on haul roads.
- Using plastic sheet coverings.

7 Climate

GHGs are gases that trap heat in the earth's atmosphere. The primary GHGs which will be the focus of this assessment include the following:

- **Carbon dioxide (CO_2)**, which enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), agriculture, irrigation, and deforestation, as well as the manufacturing of cement.
- **•Methane (CH_4)**, which is emitted through the production and transportation of coal, natural gas, and oil, as well as from livestock. Other agricultural activities influence methane emissions as well as the decay of waste in landfills.
- **Nitrous oxide (N_2O)**, which is released most often during the burning of fuel at high temperatures. This greenhouse gas is caused mostly by motor vehicles, which also include non-road vehicles, such as those used for agriculture.

Two key ways in which these GHGs differ from each other are their ability to absorb energy and how long they stay in the atmosphere. The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases by converting each gas amount to a carbon dioxide equivalent (CO_2E).[23] GWPs provide a common unit of measure, which allows for one emission estimate of the different GHGs. GWPs based on a 100-year period provided in the FAA's *Aviation Emissions and Air Quality Handbook Version 3 Update 1* and based on the Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5) are used in this evaluation. CO_2 has a GWP of one (1) because it is the gas used as the reference point. Methane does not last as long in the atmosphere as CO_2 however it absorbs much more energy. Therefore, one ton of methane has 28 times more heat capturing potential than one ton of carbon dioxide.[24] The amount of methane emissions would be multiplied by 28 to determine its CO_2E value. Nitrous oxides lasts in the atmosphere far longer than CO_2. The amount of nitrous oxides emissions would be multiplied by 265 to determine its CO_2E value.[25]

7.1 Climate Environmental Consequences

Although there are no federal standards for aviation-related GHG emissions, it is well established that GHG emissions can affect climate.[26] The Council on Environmental Quality (CEQ) has indicated that climate should be considered in NEPA analyses. The following provides an estimate of GHG emissions for each alternative. This report used the carbon dioxide equivalent (CO_2E) method to show relative impacts on climate change of different chemical species. The resulting CO_2E is provided for information

23 EPA, 2017, Understanding Global Warming Potentials. https://www.epa.gov/ghgemissions/understanding-global-warming-potentials, Accessed August 2017.
24 Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), November 2014. IPCC presents GWPs as 1 for CO_2, 28 for CH_4, and 265 for N_2O.
25 Ibid.
26 See Massachusetts v. E.P.A., 549 U.S. 497, 508-10, 521-23 (2007).

only as no federal NEPA standard for the significance of GHG emissions from individual projects on the environment has been established. **Table 7-1** provides the Alternative 1 net CO_2E emissions inventory for the construction and operational activities previously discussed in Sections 4.0 and 5.0 of this document.

TABLE 7-1, TOTAL GHG EMISSIONS INVENTORY – ALTERNATIVE 1 (PROPOSED ACTION)

SOURCE	ANNUAL GHG EMISSIONS (CO_2E METRIC TONS PER YEAR)
2021	
Construction	5,497
Alternative 1 Subtotal	*5,497*
2022	
Construction	6,735
Alternative 1 Subtotal	*6,735*
2023	
Construction	33,829
Alternative 1 Subtotal	*33,829*
2024	
Construction	22,575
Alternative 1 Subtotal	*22,575*
2025	
Construction	24,681
Alternative 1 Subtotal	*24,681*
2026	
Construction	22,377
Alternative 1 Subtotal	*22,377*
2027	
Construction	11,356
Alternative 1 Subtotal	*11,356*
2028	
No Action Alternative	
Aircraft	627,800
Taxiing	*333,245*
LTOs	*294,555*
Motor Vehicles	3,609
No Action Alternative Subtotal	*631,409*
Alternative 1	
Construction	2,307
Aircraft	578,531
Taxiing	*285,733*
LTOs	*292,798*
Motor Vehicles	3,871
Alternative 1 Subtotal	*584,709*
2028 Net Emissions	***- 46,700***
2033	
No Action Alternative	
Aircraft	694,230
Taxiing	*384,710*
LTOs	*309,520*
Motor Vehicles	3,697
No Action Alternative Subtotal	*697,927*

SOURCE	ANNUAL GHG EMISSIONS (CO_2E METRIC TONS PER YEAR)
Alternative 1	
Aircraft	621,315
Taxiing	*310,529*
LTOs	*310,785*
Motor Vehicles	3,985
Alternative 1 Subtotal	*625,300*
2033 Net Emissions	***- 72,627***

Note: GHG emissions for APUs and GSE are not reported because AEDT does not have the capability of calculating GHG emissions for these emission sources. Numbers may not sum due to rounding.
Source: Landrum & Brown analysis, 2021

Table 7-2 provides the Alternative 2 net CO_2E emissions inventory for the construction and operational activities previously discussed in Sections 4.0 and 5.0 of this document.

TABLE 7-2, TOTAL GHG EMISSIONS INVENTORY – ALTERNATIVE 2

SOURCE	ANNUAL GHG EMISSIONS (CO_2E METRIC TONS PER YEAR)
2021	
Construction	5,497
Alternative 2 Subtotal	*5,497*
2022	
Construction	6,735
Alternative 2 Subtotal	*6,735*
2023	
Construction	33,829
Alternative 2 Subtotal	*33,829*
2024	
Construction	23,004
Alternative 2 Subtotal	*23,004*
2025	
Construction	25,110
Alternative 2 Subtotal	*25,110*
2026	
Construction	22,806
Alternative 2 Subtotal	*22,806*
2027	
Construction	11,784
Alternative 2 Subtotal	*11,784*
2028	
No Action Alternative	
Aircraft	627,800
Taxiing	*333,245*
LTOs	*294,555*
Motor Vehicles	3,609
No Action Alternative Subtotal	*631,409*

SOURCE	ANNUAL GHG EMISSIONS (CO_2E METRIC TONS PER YEAR)
Alternative 2	
Construction	2,307
Aircraft	578,531
Taxiing	*285,733*
LTOs	*292,798*
Motor Vehicles	3,871
Alternative 2 Subtotal	*584,709*
2028 Net Emissions	***-46,700***
2033	
No Action Alternative	
Aircraft	694,230
Taxiing	*384,710*
LTOs	*309,520*
Motor Vehicles	3,697
No Action Alternative Subtotal	*697,927*
Alternative 2	
Aircraft	621,315
Taxiing	*310,529*
LTOs	*310,785*
Motor Vehicles	3,985
Alternative 2 Subtotal	625,300
2033 Net Emissions	***-72,627***

Note: GHG emissions for APUs and GSE are not reported because AEDT does not have the capability of calculating GHG emissions for these emission sources. Numbers may not sum due to rounding.
Source: Landrum & Brown analysis, 2021

Table 7-3 provides the Alternative 3 net CO_2E emissions inventory for the construction and operational activities previously discussed in Sections 4.0 and 5.0 of this document.

TABLE 7-3, TOTAL GHG EMISSIONS INVENTORY – ALTERNATIVE 3

SOURCE	ANNUAL GHG EMISSIONS (CO_2E METRIC TONS PER YEAR)
2021	
Construction	5,497
Alternative 3 Subtotal	*5,497*
2022	
Construction	6,735
Alternative 3 Subtotal	*6,735*
2023	
Construction	33,829
Alternative 3 Subtotal	*33,829*
2024	
Construction	22,268
Alternative 3 Subtotal	*22,268*
2025	
Construction	22,668
Alternative 3 Subtotal	*22,668*
2026	
Construction	20,364
Alternative 3 Subtotal	*20,364*

SOURCE	ANNUAL GHG EMISSIONS (CO_2E METRIC TONS PER YEAR)
2027	
Construction	9,343
Alternative 3 Subtotal	*9,343*
2028	
No Action Alternative	
Aircraft	627,800
Taxiing	*333,245*
LTOs	*294,555*
Motor Vehicles	3,609
No Action Alternative Subtotal	*631,409*
Alternative 3	
Construction	2,307
Aircraft	581,810
Taxiing	*289,080*
LTOs	*292,730*
Motor Vehicles	3,871
Alternative 3 Subtotal	*587,988*
2028 Net Emissions	**- 43,421**
2033	
No Action Alternative	
Aircraft	694,230
Taxiing	*384,710*
LTOs	*309,520*
Motor Vehicles	3,697
No Action Alternative Subtotal	*697,927*
Alternative 3	
Aircraft	626,705
Taxiing	*316,820*
LTOs	*309,885*
Motor Vehicles	3,985
Alternative 3 Subtotal	*630,690*
2033 Net Emissions	**- 67,237**

Note: GHG emissions for APUs and GSE are not reported because AEDT does not have the capability of calculating GHG emissions for these emission sources. Numbers may not sum due to rounding.
Source: Landrum & Brown analysis, 2021

7.2 Climate Cumulative Impacts

The cumulative impact of Alternative 1, Alternative 2, or Alternative 3 on the global climate when added to other past, present, and reasonably foreseeable future actions is not currently scientifically predictable. Aviation has been calculated to contribute approximately 3 percent of global CO_2 emissions; this contribution may grow to 5 percent by 2050. Actions are underway within the U.S. and by other nations to reduce aviation's contribution through such measures as new aircraft technologies to reduce emissions and improve fuel efficiency, renewable alternative fuels with lower carbon footprints, more efficient air traffic management, market-based measures and environmental regulations including an aircraft CO_2 standard. The U.S. has ambitious goals to achieve carbon-neutral growth for aviation by 2020 compared to a 2005 baseline, and to gain absolute reductions in GHG emissions by 2050. At present there are no calculations of the extent to which measures individually or cumulatively may affect aviation's CO_2 emissions. Moreover, there are large uncertainties regarding aviation's impact on climate. The FAA, with support from the U.S. Global Change Research Program and its participating federal agencies (e. g., NASA, NOAA, EPA, and DOE), has developed the Aviation Climate Change Research Initiative (ACCRI) in an effort to advance scientific understanding of regional and global climate impacts of aircraft emissions, with quantified uncertainties for current and projected aviation scenarios under changing atmospheric conditions.[27]

[27] Nathan Brown, et. al. The U.S. Strategy for Tackling Aviation Climate Impacts, (2010). 27th International Congress of the Aeronautical Sciences.

ATTACHMENT 1, DESCRIPTION OF POLLUTANTS

Ozone (O_3) - Ozone is a pollutant which is not directly emitted, rather, ozone is formed in the atmosphere through photochemical reaction with nitrogen oxides (NO_X), volatile organic compounds (VOC), sunlight, and heat. It is the primary constituent of smog and problems can occur many miles away from the pollutant sources.

People with lung disease, children, older adults, and people who are active can be affected when ozone levels are unhealthy. Numerous scientific studies have linked ground-level ozone exposure to a variety of problems, including:

- lung irritation that can cause inflammation much like a sunburn;
- wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities;
- permanent lung damage to those with repeated exposure to ozone pollution; and
- aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

Carbon Monoxide (CO) - Carbon monoxide is a colorless, odorless gas primarily associated with the incomplete combustion of fossil fuels in motor vehicles. Carbon monoxide combines with hemoglobin in the bloodstream and reduces the amount of oxygen that can be circulated through the body. High carbon monoxide concentrations can lead to headaches, aggravation of cardiovascular disease, and impairment of central nervous system functions. Carbon monoxide concentrations can vary greatly over comparatively short distances. Relatively high concentrations are typically found near crowded intersections, along heavily used roadways carrying slow moving traffic, and at or near ground level. Even under the most severe meteorological and traffic conditions, high concentrations of carbon monoxide are limited to locations within a relatively short distance of heavily traveled roadways. Overall carbon monoxide emissions are decreasing as a result of the Federal Motor Vehicle Control Program, which has mandated increasingly lower emission levels for vehicles manufactured since 1973.

Volatile Organic Compound (VOC) – Volatile Organic Compounds are gases that are emitted from solids or liquids, such as stored fuel, paint, and cleaning fluids. VOCs include a variety of chemicals, some which can have short and long-term adverse health effects. As previously stated, VOCs are precursor pollutants that react with heat, sunlight and nitrogen oxides (NO_X) to form ozone (O_3). VOC can also mix with other gases to form particulate matter $PM_{2.5}$ as referenced below.

Nitrogen Dioxide (NO_2) - Nitrogen gas, normally relatively inert (unreactive), comprises about 80% of the air. At high temperatures (i.e., in the combustion process) and under certain other conditions it can combine with oxygen, forming several different gaseous compounds collectively called nitrogen oxides (NO_x). Nitric oxide (NO) and nitrogen dioxide (NO_2) are the two most important compounds. Nitric oxide is converted to nitrogen dioxide in the atmosphere. Nitrogen dioxide (NO_2) is a red-brown pungent gas. Motor vehicle emissions are the main source of NO_x in urban areas.

Nitrogen dioxide is toxic to various animals as well as to humans. Its toxicity relates to its ability to form nitric acid with water in the eye, lung, mucus membrane and skin. In animals, long-term exposure to nitrogen oxides increases susceptibility to respiratory infections lowering their resistance to such diseases as pneumonia and influenza. Laboratory studies show susceptible humans, such as asthmatics, exposed to high concentrations of NO_2 can suffer lung irritation and potentially, lung damage. Epidemiological studies have also shown associations between NO_2 concentrations and daily mortality from respiratory and cardiovascular causes and with hospital admissions for respiratory conditions.

While the NAAQS only addresses NO_2, NO and the total group of nitrogen oxides is of concern. NO and NO_2 are both precursors in the formation of ozone and secondary particulate matter. Because of this and that NO emissions largely convert to NO_2, NO_x emissions are typically examined when assessing potential air quality impacts.

Sulfur Dioxide (SO_2) - Sulfur oxides (SO_x) constitute a class of compounds of which sulfur dioxide (SO_2) and sulfur trioxide (SO_3) are of greatest importance. SO_2 is commonly expressed as SO_X since it is a larger subset of sulfur dioxides (SO_2). SO_2 is a colorless gas that is typically identified as having a strong odor and is formed when fuel containing sulfur, like coal, oil and jet fuel, is burned. SO_2 combines easily with water vapor, forming aerosols of sulfurous acid (H_2SO_3), a colorless, mildly corrosive liquid. This liquid may then combine with oxygen in the air, forming the even more irritating and corrosive sulfuric acid (H_2SO_4). Peak levels of SO_2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposures to high levels of SO_2 gas and particles cause respiratory illness and aggravate existing heart disease.

Particulate Matter (PM_{10} and $PM_{2.5}$) - Particulate matter includes both aerosols and solid particles of a wide range of size and composition. PM_{10} is considered coarse particles with a diameter of 10 micrometers or less, and $PM_{2.5}$, fine particles with a diameter of 2.5 micrometers or less. Emissions of $PM_{2.5}$ are a subset of emissions of PM_{10}. Particulate matter can be any particle of these sizes, including dust, dirt, and soot. Smaller particulates are of greater concern because they can penetrate deeper into the lungs than large particles.

$PM_{2.5}$ is directly emitted in combustion exhaust and formed from atmospheric reactions between various gaseous pollutants including nitrogen oxides (NO_x) sulfur oxides (SO_x) and volatile organic compounds (VOC). PM_{10} is generally emitted directly as a result of mechanical processes that crush or grind larger particles or the resuspension of dusts, most typically through construction activities and vehicular movements. $PM_{2.5}$ can remain suspended in the atmosphere for days and weeks and can be transported over long distances. PM_{10} generally settles out of the atmosphere rapidly and is not readily transported over large distances.

The principal health effect of airborne particulate matter is on the respiratory system. Short-term exposures to high $PM_{2.5}$ levels are associated with premature mortality, increased hospital admissions, and emergency room visits. Long-term exposures to high $PM_{2.5}$ levels are associated with premature mortality and development of chronic respiratory disease.

Carbon Dioxide (CO_2) - Carbon dioxide is a colorless, odorless gas produced through the incomplete combustion of fossil fuels. Carbon dioxide is considered to be the most significant GHG that traps heat in the earth's atmosphere.

Carbon Dioxide Equivalent (CO_2E) - The CO_2E method is a way to show relative impacts on climate change of different chemical species, including both naturally occurring and man-made greenhouse gases such as CO_2, water vapor (H_2O), methane (CH_4), and nitrous oxide (N_2O). These different chemical species that are emitted have a different effect on climate known as Global Warming Potential (GWP). Specifically, it is a measure of how much energy the emission of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of CO_2. The CO_2E method accounts for each GHG's GWP in order to represent the relative impacts on climate change by different chemical species.

Lead (Pb) - Lead is a stable compound, which persists and accumulates both in the environment and in animals. In humans, it affects the blood forming or hematopoletic, the nervous, and the renal systems. In addition, lead has been shown to affect the normal functions of the reproductive, endocrine, hepatic, cardiovascular, immunological, and gastrointestinal systems, although there is significant individual variability in response to lead exposure. Since 1975, lead emissions have been in decline due in part to the introduction of catalyst-equipped vehicles, and decline in production of leaded gasoline. In general, an analysis of lead is limited to projects that emit significant quantities of the pollutant (i.e. lead smelters) and are generally not applied to transportation projects.

ATTACHMENT 2, HAZARDOUS AIR POLLUTANTS

Based on FAA Order 1050.1F, hazardous air pollutant emissions inventories were developed for the purpose of this analysis as Alternative 1, Alternative 2, or Alternative 3 include the construction of a new runway. The resulting HAPS are provided strictly for disclosure purposes as there are currently no Federal standards specifically pertaining to HAPs emissions from aircraft engines or airports. The HAPs emissions inventories provided in the following sections were developed for the construction and operational activities previously discussed in Section 4.0 and 5.0 of this document. The reported HAPs emissions inventories are not directly comparable to any regulatory or enforceable ambient air quality standards or emission thresholds.

2028 No Action Alternative

TABLE A-1, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2028 NO ACTION ALTERNATIVE

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	6.144	0.000	0.224	0.000
2,2,4 Trimethylpentane	0.000	0.161	0.000	0.000
2-Methylnaphthalene	0.750	0.000	0.027	0.000
Acetaldehyde	15.560	0.136	0.567	0.025
Acetone	1.344	0.000	0.049	0.000
Acrolein (2-propenal)	8.920	0.000	0.325	0.000
Benzaldehyde	1.712	0.026	0.062	0.000
Benzene	6.123	0.188	0.223	0.082
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.169	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.634	0.072	0.023	0.000
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	44.836	0.402	1.634	0.026
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.011	0.000	0.000	0.000
m & p-Xylene	1.027	0.000	0.037	0.000
Methyl alcohol	6.574	0.000	0.240	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.199	0.000	0.000
Naphthalene	1.970	0.000	0.072	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.233	0.078	0.008	0.000
n-Hexane	0.000	0.164	0.000	0.000
o-Xylene	0.605	0.098	0.022	0.000
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	2.644	0.000	0.096	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	2.648	0.083	0.097	0.000
Styrene	1.125	0.000	0.041	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.338	0.319	0.085	0.395
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

2028 Alternative 1

TABLE A-2, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2028 ALTERNATIVE 1

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	5.341	0.000	0.224	0.000
2,2,4 Trimethylpentane	0.000	0.161	0.000	0.000
2-Methylnaphthalene	0.652	0.000	0.027	0.000
Acetaldehyde	13.525	0.136	0.567	0.026
Acetone	1.168	0.000	0.049	0.000
Acrolein (2-propenal)	7.754	0.000	0.325	0.000
Benzaldehyde	1.488	0.026	0.062	0.000
Benzene	5.322	0.188	0.223	0.086
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.169	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.551	0.072	0.023	0.000
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	38.973	0.402	1.634	0.028
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.009	0.000	0.000	0.000
m & p-Xylene	0.893	0.000	0.037	0.000
Methyl alcohol	5.715	0.000	0.240	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.199	0.000	0.000
Naphthalene	1.713	0.000	0.072	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.203	0.078	0.008	0.000
n-Hexane	0.000	0.164	0.000	0.000
o-Xylene	0.526	0.098	0.022	0.000
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	2.299	0.000	0.096	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	2.302	0.083	0.097	0.000
Styrene	0.978	0.000	0.041	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.033	0.319	0.085	0.420
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

2028 Alternative 2

TABLE A-3, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2028 ALTERNATIVE 2

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	5.341	0.000	0.224	0.000
2,2,4 Trimethylpentane	0.000	0.161	0.000	0.000
2-Methylnaphthalene	0.652	0.000	0.027	0.000
Acetaldehyde	13.525	0.136	0.567	0.026
Acetone	1.168	0.000	0.049	0.000
Acrolein (2-propenal)	7.754	0.000	0.325	0.000
Benzaldehyde	1.488	0.026	0.062	0.000
Benzene	5.322	0.188	0.223	0.086
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.169	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.551	0.072	0.023	0.000
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	38.973	0.402	1.634	0.028
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.009	0.000	0.000	0.000
m & p-Xylene	0.893	0.000	0.037	0.000
Methyl alcohol	5.715	0.000	0.240	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.199	0.000	0.000
Naphthalene	1.713	0.000	0.072	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.203	0.078	0.008	0.000
n-Hexane	0.000	0.164	0.000	0.000
o-Xylene	0.526	0.098	0.022	0.000
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	2.299	0.000	0.096	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	2.302	0.083	0.097	0.000
Styrene	0.978	0.000	0.041	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.033	0.319	0.085	0.420
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

2028 Alternative 3

TABLE A-4, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2028 ALTERNATIVE 3

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	5.397	0.000	0.224	0.000
2,2,4 Trimethylpentane	0.000	0.161	0.000	0.000
2-Methylnaphthalene	0.659	0.000	0.027	0.000
Acetaldehyde	13.666	0.136	0.567	0.026
Acetone	1.180	0.000	0.049	0.000
Acrolein (2-propenal)	7.835	0.000	0.325	0.000
Benzaldehyde	1.504	0.026	0.062	0.000
Benzene	5.378	0.188	0.223	0.086
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.169	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.557	0.072	0.023	0.000
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	39.381	0.402	1.634	0.028
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.010	0.000	0.000	0.000
m & p-Xylene	0.902	0.000	0.037	0.000
Methyl alcohol	5.774	0.000	0.240	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.199	0.000	0.000
Naphthalene	1.731	0.000	0.072	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.205	0.078	0.008	0.000
n-Hexane	0.000	0.164	0.000	0.000
o-Xylene	0.531	0.098	0.022	0.000
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	2.323	0.000	0.096	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	2.326	0.083	0.097	0.000
Styrene	0.989	0.000	0.041	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.054	0.319	0.085	0.420
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

2033 No Action Alternative

TABLE A-5, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2033 NO ACTION ALTERNATIVE

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	7.226	0.000	0.244	0.000
2,2,4 Trimethylpentane	0.000	0.167	0.000	0.002
2-Methylnaphthalene	0.882	0.000	0.030	0.000
Acetaldehyde	18.298	0.142	0.618	0.004
Acetone	1.580	0.000	0.053	0.000
Acrolein (2-propenal)	10.489	0.000	0.354	0.001
Benzaldehyde	2.013	0.027	0.068	0.000
Benzene	7.200	0.194	0.243	0.007
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.175	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.745	0.074	0.025	0.003
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	52.726	0.422	1.782	0.012
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.013	0.000	0.000	0.000
m & p-Xylene	1.208	0.000	0.041	0.000
Methyl alcohol	7.731	0.000	0.261	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.206	0.000	0.000
Naphthalene	2.317	0.000	0.078	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.274	0.081	0.009	0.000
n-Hexane	0.000	0.170	0.000	0.004
o-Xylene	0.711	0.101	0.024	0.010
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	3.110	0.000	0.105	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	3.114	0.087	0.105	0.000
Styrene	1.323	0.000	0.045	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.750	0.331	0.093	0.012
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

2033 Alternative 1

TABLE A-6, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2033 ALTERNATIVE 1

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	5.937	0.000	0.244	0.000
2,2,4 Trimethylpentane	0.000	0.167	0.000	0.002
2-Methylnaphthalene	0.725	0.000	0.030	0.000
Acetaldehyde	15.033	0.142	0.618	0.005
Acetone	1.299	0.000	0.053	0.000
Acrolein (2-propenal)	8.618	0.000	0.354	0.001
Benzaldehyde	1.654	0.027	0.068	0.000
Benzene	5.916	0.194	0.243	0.007
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.175	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.612	0.074	0.025	0.003
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	43.320	0.422	1.782	0.014
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.011	0.000	0.000	0.000
m & p-Xylene	0.992	0.000	0.041	0.000
Methyl alcohol	6.352	0.000	0.261	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.206	0.000	0.000
Naphthalene	1.904	0.000	0.078	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.225	0.081	0.009	0.000
n-Hexane	0.000	0.170	0.000	0.004
o-Xylene	0.584	0.101	0.024	0.011
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	2.555	0.000	0.105	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	2.558	0.087	0.105	0.000
Styrene	1.087	0.000	0.045	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.259	0.331	0.093	0.012
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

2033 Alternative 2

TABLE A-7, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2033 ALTERNATIVE 2

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	5.937	0.000	0.244	0.000
2,2,4 Trimethylpentane	0.000	0.167	0.000	0.002
2-Methylnaphthalene	0.725	0.000	0.030	0.000
Acetaldehyde	15.033	0.142	0.618	0.005
Acetone	1.299	0.000	0.053	0.000
Acrolein (2-propenal)	8.618	0.000	0.354	0.001
Benzaldehyde	1.654	0.027	0.068	0.000
Benzene	5.916	0.194	0.243	0.007
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.175	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.612	0.074	0.025	0.003
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	43.320	0.422	1.782	0.014
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.011	0.000	0.000	0.000
m & p-Xylene	0.992	0.000	0.041	0.000
Methyl alcohol	6.352	0.000	0.261	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.206	0.000	0.000
Naphthalene	1.904	0.000	0.078	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.225	0.081	0.009	0.000
n-Hexane	0.000	0.170	0.000	0.004
o-Xylene	0.584	0.101	0.024	0.011
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	2.555	0.000	0.105	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	2.558	0.087	0.105	0.000
Styrene	1.087	0.000	0.045	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.259	0.331	0.093	0.012
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

2033 Alternative 3

TABLE A-8, HAZARDOUS AIR POLLUTANT EMISSIONS INVENTORY – 2033 ALTERNATIVE 3

HAZARDOUS AIR POLLUTANT	ANNUAL EMISSIONS (SHORT TONS PER YEAR)			
	AIRCRAFT	GSE	APU	VEHICLES
1,1,1-Trichloroethane	0.000	0.000	0.000	0.000
1,3-Butadiene	6.043	0.000	0.244	0.000
2,2,4 Trimethylpentane	0.000	0.167	0.000	0.002
2-Methylnaphthalene	0.738	0.000	0.030	0.000
Acetaldehyde	15.302	0.142	0.618	0.005
Acetone	1.322	0.000	0.053	0.000
Acrolein (2-propenal)	8.772	0.000	0.354	0.001
Benzaldehyde	1.683	0.027	0.068	0.000
Benzene	6.021	0.194	0.243	0.007
Butyl cellosolve	0.000	0.000	0.000	0.000
Chlorobenzene	0.000	0.000	0.000	0.000
Cyclohexane	0.000	0.175	0.000	0.000
Dichloromethane	0.000	0.000	0.000	0.000
Ethyl ether	0.000	0.000	0.000	0.000
Ethylbenzene	0.623	0.074	0.025	0.003
Ethylene bromide	0.000	0.000	0.000	0.000
Ethylene glycol	0.000	0.000	0.000	0.000
Formaldehyde	44.092	0.422	1.782	0.014
Isomers of xylene	0.000	0.000	0.000	0.000
Isopropylbenzene	0.011	0.000	0.000	0.000
m & p-Xylene	1.010	0.000	0.041	0.000
Methyl alcohol	6.465	0.000	0.261	0.000
Methyl chloride	0.000	0.000	0.000	0.000
Methyl ethyl ketone	0.000	0.000	0.000	0.000
Methyl tert butyl ether	0.000	0.000	0.000	0.000
m-xylene	0.000	0.206	0.000	0.000
Naphthalene	1.938	0.000	0.078	0.000
n-Butyl alcohol	0.000	0.000	0.000	0.000
n-Heptane	0.229	0.081	0.009	0.000
n-Hexane	0.000	0.170	0.000	0.004
o-Xylene	0.595	0.101	0.024	0.011
Perchloroethylene	0.000	0.000	0.000	0.000
Phenol (carbolic acid)	2.600	0.000	0.105	0.000
Phthalic anhydride	0.000	0.000	0.000	0.000
Propionaldehyde	2.604	0.087	0.105	0.000
Styrene	1.107	0.000	0.045	0.000
Thyl acetate	0.000	0.000	0.000	0.000
Toluene	2.300	0.331	0.093	0.012
Trichloroethylene	0.000	0.000	0.000	0.000
Trichlorotrifluoroethan	0.000	0.000	0.000	0.000
Vinyl acetate	0.000	0.000	0.000	0.000

Note: LTO denotes landing and takeoff; APU denotes auxiliary power units; GSE denotes ground support equipment.
Source: Landrum & Brown analysis, 2021

ATTACHMENT 3, CONSTRUCTION

Construction Equipment and Activity

TABLE A-9, ANNUAL ON-ROAD CONSTRUCTION ACTIVITY BY ALTERNATIVE

YEAR	ON-ROAD VEHICLE ACTIVITY	ALTERNATIVE 1 VMT	ALTERNATIVE 2 VMT	ALTERNATIVE 3 VMT
2021	Employee Commute	7,556,175	7,556,175	7,556,175
2021	Material Delivery	213,744	213,744	213,744
2022	Employee Commute	13,068,990	13,068,990	13,068,990
2022	Material Delivery	378,448	378,448	378,448
2023	Employee Commute	27,521,505	27,521,505	27,521,505
2023	Material Delivery	3,665,958	3,665,958	3,665,958
2024	Employee Commute	22,847,320	23,166,594	24,433,052
2024	Material Delivery	1,164,144	1,195,170	1,068,191
2025	Employee Commute	25,805,936	26,125,210	24,454,338
2025	Material Delivery	1,179,372	1,210,398	1,028,674
2026	Employee Commute	25,805,936	26,125,210	24,454,338
2026	Material Delivery	1,179,372	1,210,398	1,028,674
2027	Employee Commute	10,267,885	10,587,159	8,916,287
2027	Material Delivery	586,995	618,021	436,297
2028	Employee Commute	4,967,919	4,967,919	4,967,919
2028	Material Delivery	10,797	10,797	10,797

Note: VMT denotes vehicle miles travelled.
Source: Landrum & Brown analysis, 2021

TABLE A-10, ANNUAL NON-ROAD CONSTRUCTION ACTIVITY BY ALTERNATIVE

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
				HOURS OF ACTIVITY	HOURS OF ACTIVITY	HOURS OF ACTIVITY
2021	Asphalt Paver	175	0.59	21	21	21
2021	Chain Saw	11	0.7	46	46	46
2021	Chipper/Stump Grinder	100	0.43	46	46	46
2021	Distributing Tanker	600	0.59	46	46	46
2021	Dozer	175	0.59	317	317	317
2021	Dump Truck	600	0.59	175	175	175
2021	Dump Truck (12 cy)	600	0.59	541	541	541
2021	Excavator	175	0.59	85	85	85
2021	Flatbed Truck	600	0.59	3,861	3,861	3,861
2021	Grader	300	0.59	18	18	18
2021	Hydroseeder	600	0.59	17	17	17
2021	Loader	175	0.59	57	57	57
2021	Off-Road Truck	600	0.59	17	17	17
2021	Other General Equipment	175	0.43	4,022	4,022	4,022
2021	Pickup Truck	600	0.59	4,306	4,306	4,306
2021	Pumps	11	0.43	15	15	15
2021	Roller	100	0.59	204	204	204
2021	Scraper	600	0.59	72	72	72
2021	Skid Steer Loader	75	0.21	35	35	35
2021	Surfacing Equipment (Grooving)	25	0.59	27	27	27
2021	Tractors/Loader/Backhoe	100	0.21	45	45	45
2021	Water Truck	600	0.59	2,880	2,880	2,880
2022	Flatbed Truck	600	0.59	7,014	7,014	7,014
2022	Other General Equipment	175	0.43	7,014	7,014	7,014
2022	Pickup Truck	600	0.59	7,014	7,014	7,014
2023	90 Ton Crane	300	0.43	320	320	320
2023	Air Compressor	100	0.43	898	898	898
2023	Backhoe	100	0.21	320	320	320
2023	Bob Cat	75	0.21	13,968	13,968	13,968
2023	Chain Saw	11	0.7	688	688	688
2023	Chipper/Stump Grinder	100	0.43	688	688	688
2023	Concrete Pump	11	0.43	12	12	12
2023	Concrete Ready Mix Trucks	600	0.59	60	60	60
2023	Concrete Saws	40	0.59	898	898	898
2023	Concrete Truck	600	0.59	3,783	3,783	3,783

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
				HOURS OF ACTIVITY	HOURS OF ACTIVITY	HOURS OF ACTIVITY
2023	Distributing Tanker	600	0.59	719	719	719
2023	Dozer	175	0.59	4,663	4,663	4,663
2023	Dump Truck	600	0.59	14,988	14,988	14,988
2023	Dump Truck (12 cy)	600	0.59	8,483	8,483	8,483
2023	Excavator	175	0.59	1,059	1,059	1,059
2023	Excavator with Bucket	175	0.59	7,384	7,384	7,384
2023	Excavator with Hoe Ram	175	0.59	400	400	400
2023	Flatbed Truck	600	0.59	9,055	9,055	9,055
2023	Fork Truck	100	0.59	3,400	3,400	3,400
2023	Generator	40	0.43	300	300	300
2023	Generator Sets	40	0.43	6,984	6,984	6,984
2023	Grader	300	0.59	277	277	277
2023	High Lift	100	0.59	920	920	920
2023	Hydroseeder	600	0.59	249	249	249
2023	Loader	175	0.59	338	338	338
2023	Man Lift	75	0.21	3,000	3,000	3,000
2023	Man Lift (Fascia Construction)	75	0.21	24	24	24
2023	Material Deliveries	600	0.59	60	60	60
2023	Off-Road Truck	600	0.59	249	249	249
2023	Other General Equipment	175	0.43	12,205	12,205	12,205
2023	Pickup Truck	600	0.59	26,774	26,774	26,774
2023	Pumps	11	0.43	229	229	229
2023	Roller	100	0.59	2,580	2,580	2,580
2023	Rubber Tired Loader	175	0.59	898	898	898
2023	Scraper	600	0.59	1,123	1,123	1,123
2023	Skid Steer Loader	75	0.21	155	155	155
2023	Slip Form Paver	175	0.59	898	898	898
2023	Surfacing Equipment (Grooving)	25	0.59	898	898	898
2023	Survey Crew Trucks	600	0.59	10	10	10
2023	Tool Truck	600	0.59	742	742	742
2023	Tractor Trailer- Material Delivery	600	0.59	826	826	826
2023	Tractor Trailer- Steel Deliveries	600	0.59	40	40	40
2023	Tractor Trailers Temp Fac.	600	0.59	4	4	4
2023	Tractors/Loader/Backhoe	100	0.21	473	473	473
2023	Trowel Machine	600	0.59	12	12	12

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1 HOURS OF ACTIVITY	ALTERNATIVE 2 HOURS OF ACTIVITY	ALTERNATIVE 3 HOURS OF ACTIVITY
2023	Water Truck	600	0.59	5,760	5,760	5,760
2024	90 Ton Crane	300	0.43	320	320	320
2024	Air Compressor	100	0.43	1,178	1,210	1,020
2024	Backhoe	100	0.21	320	320	320
2024	Chain Saw	11	0.7	925	949	808
2024	Chipper/Stump Grinder	100	0.43	925	949	808
2024	Concrete Pump	11	0.43	12	12	12
2024	Concrete Ready Mix Trucks	600	0.59	60	60	60
2024	Concrete Saws	40	0.59	1,178	1,210	1,020
2024	Concrete Truck	600	0.59	5,069	5,204	4,414
2024	Distributing Tanker	600	0.59	461	461	461
2024	Dozer	175	0.59	6,443	6,605	5,659
2024	Dump Truck	600	0.59	2,403	2,424	2,297
2024	Dump Truck (12 cy)	600	0.59	11,121	11,427	9,636
2024	Excavator	175	0.59	1,690	1,723	1,533
2024	Excavator with Bucket	175	0.59	538	538	1,720
2024	Excavator with Hoe Ram	175	0.59	538	538	1,720
2024	Flatbed Truck	600	0.59	7,274	7,474	6,303
2024	Fork Truck	100	0.59	3,400	3,400	3,400
2024	Generator	40	0.43	300	300	300
2024	Grader	300	0.59	372	382	325
2024	High Lift	100	0.59	920	920	920
2024	Hydroseeder	600	0.59	335	344	292
2024	Loader	175	0.59	1,021	1,021	1,020
2024	Man Lift	75	0.21	3,000	3,000	3,000
2024	Man Lift (Fascia Construction)	75	0.21	24	24	24
2024	Material Deliveries	600	0.59	60	60	60
2024	Off-Road Truck	600	0.59	335	344	292
2024	Other General Equipment	175	0.43	11,975	12,248	10,649
2024	Pickup Truck	600	0.59	20,480	20,953	20,542
2024	Pumps	11	0.43	308	316	269
2024	Roller	100	0.59	3,693	3,780	3,271
2024	Rubber Tired Loader	175	0.59	1,178	1,210	1,020
2024	Scraper	600	0.59	1,472	1,512	1,275
2024	Skid Steer Loader	75	0.21	778	778	777
2024	Slip Form Paver	175	0.59	1,178	1,210	1,020

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
				HOURS OF ACTIVITY	HOURS OF ACTIVITY	HOURS OF ACTIVITY
2024	Surfacing Equipment (Grooving)	25	0.59	1,178	1,210	1,020
2024	Survey Crew Trucks	600	0.59	10	10	10
2024	Tool Truck	600	0.59	742	742	742
2024	Tractor Trailer- Material Delivery	600	0.59	826	826	826
2024	Tractor Trailer- Steel Deliveries	600	0.59	40	40	40
2024	Tractor Trailers Temp Fac.	600	0.59	4	4	4
2024	Tractors/Loader/Backhoe	100	0.21	1,372	1,380	1,332
2024	Trowel Machine	600	0.59	12	12	12
2024	Water Truck	600	0.59	5,760	5,760	5,760
2025	90 Ton Crane	300	0.43	960	960	960
2025	Air Compressor	100	0.43	1,178	1,210	1,020
2025	Backhoe	100	0.21	960	960	960
2025	Chain Saw	11	0.7	925	949	808
2025	Chipper/Stump Grinder	100	0.43	925	949	808
2025	Concrete Pump	11	0.43	36	36	36
2025	Concrete Ready Mix Trucks	600	0.59	180	180	180
2025	Concrete Saws	40	0.59	1,178	1,210	1,020
2025	Concrete Truck	600	0.59	5,117	5,252	4,462
2025	Distributing Tanker	600	0.59	461	461	461
2025	Dozer	175	0.59	6,443	6,605	5,659
2025	Dump Truck	600	0.59	2,403	2,424	2,297
2025	Dump Truck (12 cy)	600	0.59	11,121	11,427	9,636
2025	Excavator	175	0.59	1,690	1,723	1,533
2025	Excavator with Bucket	175	0.59	400	400	400
2025	Excavator with Hoe Ram	175	0.59	400	400	400
2025	Flatbed Truck	600	0.59	7,274	7,474	6,303
2025	Fork Truck	100	0.59	10,201	10,201	10,201
2025	Generator	40	0.43	900	900	900
2025	Grader	300	0.59	372	382	325
2025	High Lift	100	0.59	2,760	2,760	2,760
2025	Hydroseeder	600	0.59	335	344	292
2025	Loader	175	0.59	1,021	1,021	1,020
2025	Man Lift	75	0.21	9,000	9,000	9,000
2025	Man Lift (Fascia Construction)	75	0.21	72	72	72
2025	Material Deliveries	600	0.59	180	180	180

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
				HOURS OF ACTIVITY	HOURS OF ACTIVITY	HOURS OF ACTIVITY
2025	Off-Road Truck	600	0.59	335	344	292
2025	Other General Equipment	175	0.43	11,975	12,248	10,649
2025	Pickup Truck	600	0.59	20,205	20,678	17,902
2025	Pumps	11	0.43	308	316	269
2025	Roller	100	0.59	3,693	3,780	3,271
2025	Rubber Tired Loader	175	0.59	1,178	1,210	1,020
2025	Scraper	600	0.59	1,472	1,512	1,275
2025	Skid Steer Loader	75	0.21	778	778	777
2025	Slip Form Paver	175	0.59	1,178	1,210	1,020
2025	Surfacing Equipment (Grooving)	25	0.59	1,178	1,210	1,020
2025	Survey Crew Trucks	600	0.59	30	30	30
2025	Tool Truck	600	0.59	2,227	2,227	2,227
2025	Tractor Trailer- Material Delivery	600	0.59	2,478	2,478	2,478
2025	Tractor Trailer- Steel Deliveries	600	0.59	120	120	120
2025	Tractor Trailers Temp Fac.	600	0.59	12	12	12
2025	Tractors/Loader/Backhoe	100	0.21	1,372	1,380	1,332
2025	Trowel Machine	600	0.59	36	36	36
2025	Water Truck	600	0.59	5,760	5,760	5,760
2026	90 Ton Crane	300	0.43	960	960	960
2026	Air Compressor	100	0.43	1,178	1,210	1,020
2026	Backhoe	100	0.21	960	960	960
2026	Chain Saw	11	0.7	925	949	808
2026	Chipper/Stump Grinder	100	0.43	925	949	808
2026	Concrete Pump	11	0.43	36	36	36
2026	Concrete Ready Mix Trucks	600	0.59	180	180	180
2026	Concrete Saws	40	0.59	1,178	1,210	1,020
2026	Concrete Truck	600	0.59	5,117	5,252	4,462
2026	Distributing Tanker	600	0.59	461	461	461
2026	Dozer	175	0.59	6,443	6,605	5,659
2026	Dump Truck	600	0.59	2,403	2,424	2,297
2026	Dump Truck (12 cy)	600	0.59	11,121	11,427	9,636
2026	Excavator	175	0.59	1,690	1,723	1,533
2026	Excavator with Bucket	175	0.59	400	400	400
2026	Excavator with Hoe Ram	175	0.59	400	400	400
2026	Flatbed Truck	600	0.59	7,274	7,474	6,303
2026	Fork Truck	100	0.59	10,201	10,201	10,201

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
				HOURS OF ACTIVITY	HOURS OF ACTIVITY	HOURS OF ACTIVITY
2026	Generator	40	0.43	900	900	900
2026	Grader	300	0.59	372	382	325
2026	High Lift	100	0.59	2,760	2,760	2,760
2026	Hydroseeder	600	0.59	335	344	292
2026	Loader	175	0.59	1,021	1,021	1,020
2026	Man Lift	75	0.21	9,000	9,000	9,000
2026	Man Lift (Fascia Construction)	75	0.21	72	72	72
2026	Material Deliveries	600	0.59	180	180	180
2026	Off-Road Truck	600	0.59	335	344	292
2026	Other General Equipment	175	0.43	11,975	12,248	10,649
2026	Pickup Truck	600	0.59	20,205	20,678	17,902
2026	Pumps	11	0.43	308	316	269
2026	Roller	100	0.59	3,693	3,780	3,271
2026	Rubber Tired Loader	175	0.59	1,178	1,210	1,020
2026	Scraper	600	0.59	1,472	1,512	1,275
2026	Skid Steer Loader	75	0.21	778	778	777
2026	Slip Form Paver	175	0.59	1,178	1,210	1,020
2026	Surfacing Equipment (Grooving)	25	0.59	1,178	1,210	1,020
2026	Survey Crew Trucks	600	0.59	30	30	30
2026	Tool Truck	600	0.59	2,227	2,227	2,227
2026	Tractor Trailer- Material Delivery	600	0.59	2,478	2,478	2,478
2026	Tractor Trailer- Steel Deliveries	600	0.59	120	120	120
2026	Tractor Trailers Temp Fac.	600	0.59	12	12	12
2026	Tractors/Loader/Backhoe	100	0.21	1,372	1,380	1,332
2026	Trowel Machine	600	0.59	36	36	36
2026	Water Truck	600	0.59	5,760	5,760	5,760
2027	90 Ton Crane	300	0.43	320	320	320
2027	Air Compressor	100	0.43	601	634	444
2027	Backhoe	100	0.21	320	320	320
2027	Chain Saw	11	0.7	485	509	367
2027	Chipper/Stump Grinder	100	0.43	485	509	367
2027	Concrete Pump	11	0.43	12	12	12
2027	Concrete Ready Mix Trucks	600	0.59	60	60	60
2027	Concrete Saws	40	0.59	601	634	444
2027	Concrete Truck	600	0.59	2,668	2,803	2,013

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
				HOURS OF ACTIVITY	HOURS OF ACTIVITY	HOURS OF ACTIVITY
2027	Dozer	175	0.59	3,444	3,605	2,660
2027	Dump Truck	600	0.59	1,781	1,803	1,675
2027	Dump Truck (12 cy)	600	0.59	5,678	5,984	4,193
2027	Excavator	175	0.59	1,002	1,034	845
2027	Flatbed Truck	600	0.59	3,714	3,914	2,743
2027	Fork Truck	100	0.59	3,400	3,400	3,400
2027	Generator	40	0.43	300	300	300
2027	Grader	300	0.59	195	204	147
2027	High Lift	100	0.59	920	920	920
2027	Hydroseeder	600	0.59	175	184	133
2027	Loader	175	0.59	793	794	792
2027	Man Lift	75	0.21	3,000	3,000	3,000
2027	Man Lift (Fascia Construction)	75	0.21	24	24	24
2027	Material Deliveries	600	0.59	60	60	60
2027	Off-Road Truck	600	0.59	175	184	133
2027	Other General Equipment	175	0.43	6,427	6,700	5,101
2027	Pickup Truck	600	0.59	10,252	10,726	7,949
2027	Pumps	11	0.43	162	170	122
2027	Roller	100	0.59	2,029	2,116	1,607
2027	Rubber Tired Loader	175	0.59	601	634	444
2027	Scraper	600	0.59	752	792	555
2027	Skid Steer Loader	75	0.21	726	726	725
2027	Slip Form Paver	175	0.59	601	634	444
2027	Surfacing Equipment (Grooving)	25	0.59	601	634	444
2027	Survey Crew Trucks	600	0.59	10	10	10
2027	Tool Truck	600	0.59	742	742	742
2027	Tractor Trailer- Material Delivery	600	0.59	826	826	826
2027	Tractor Trailer- Steel Deliveries	600	0.59	40	40	40
2027	Tractor Trailers Temp Fac.	600	0.59	4	4	4
2027	Tractors/Loader/Backhoe	100	0.21	1,110	1,118	1,070
2027	Trowel Machine	600	0.59	12	12	12
2027	Water Truck	600	0.59	2,880	2,880	2,880
2028	90 Ton Crane	300	0.43	320	320	320
2028	Backhoe	100	0.21	320	320	320
2028	Concrete Pump	11	0.43	12	12	12

YEAR	NON-ROAD EQUIPMENT	HORSE-POWER	LOAD FACTOR	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
				HOURS OF ACTIVITY	HOURS OF ACTIVITY	HOURS OF ACTIVITY
2028	Concrete Ready Mix Trucks	600	0.59	60	60	60
2028	Concrete Truck	600	0.59	24	24	24
2028	Fork Truck	100	0.59	3,400	3,400	3,400
2028	Generator	40	0.43	300	300	300
2028	High Lift	100	0.59	920	920	920
2028	Man Lift	75	0.21	3,000	3,000	3,000
2028	Man Lift (Fascia Construction)	75	0.21	24	24	24
2028	Material Deliveries	600	0.59	60	60	60
2028	Survey Crew Trucks	600	0.59	10	10	10
2028	Tool Truck	600	0.59	742	742	742
2028	Tractor Trailer- Material Delivery	600	0.59	826	826	826
2028	Tractor Trailer- Steel Deliveries	600	0.59	40	40	40
2028	Tractor Trailers Temp Fac.	600	0.59	4	4	4
2028	Trowel Machine	600	0.59	12	12	12

Source: Landrum & Brown analysis, 2021

Construction Equipment Emission Factors

TABLE A-11, ANNUAL ON-ROAD EQUIPMENT EMISSION FACTORS

ACTIVITY	GRAMS PER VEHICLE MILE							
	CO	VOC	NOx	Sox	PM_{10}	$PM_{2.5}$	CO_2	CH_4
Employee Commute	3.66	0.11	0.46	0.00	0.01	0.01	347.78	0.01
Material Delivery	1.23	0.24	4.47	0.02	0.15	0.14	1,884.12	0.06

Note: 2021 emission factors unique to Mecklenburg County were applied for all construction years
Source: MOVES 2014b

TABLE A-12, ANNUAL NON-ROAD EQUIPMENT EMISSION FACTORS

ACTIVITY	HORSE-POWER	GRAMS PER HORSEPOWER-HOUR							
		CO	VOC	NOx	Sox	PM_{10}	$PM_{2.5}$	CO_2	CH_4
Aerial Lifts	75	2.8724	0.6058	4.1499	0.0056	0.4037	0.3916	694.2060	0.0228
Aerial Lifts	100	3.3073	0.5872	3.4110	0.0054	0.4763	0.4620	694.2668	0.0192
Air Compressors	100	0.8012	0.1059	1.9330	0.0043	0.1319	0.1279	590.0628	0.0074
Cement & Mortar Mixers	600	0.9002	0.1894	3.0053	0.0041	0.1329	0.1289	530.4748	0.0027
Chain Saws > 6 HP	11	266.0291	61.5419	1.5283	0.0041	9.7482	8.9684	685.9978	0.0000
Chippers/Stump Grinders (com)	100	1.7871	0.3594	3.7336	0.0048	0.3304	0.3205	589.3091	0.0126
Concrete/Industrial Saws	40	0.4626	0.1202	2.6967	0.0041	0.0607	0.0589	595.8010	0.0146
Cranes	300	0.1851	0.0490	0.6999	0.0038	0.0359	0.0349	530.8984	0.0042
Crawler Tractor/Dozers	175	0.2471	0.0383	0.7889	0.0037	0.0625	0.0606	536.7197	0.0034
Excavators	175	0.1888	0.0278	0.6123	0.0037	0.0485	0.0470	536.7500	0.0025
Forklifts	100	0.1574	0.0134	0.9485	0.0040	0.0293	0.0284	596.1185	0.0011
Generator Sets	40	1.1107	0.2910	3.6160	0.0046	0.2176	0.2110	589.5124	0.0196
Graders	300	0.1721	0.0329	0.4902	0.0037	0.0353	0.0342	536.7346	0.0029
Irrigation Sets	600	0.7929	0.1843	2.5784	0.0043	0.1432	0.1389	530.4986	0.0092
Off-highway Trucks	600	0.1416	0.0239	0.3731	0.0036	0.0271	0.0263	536.7594	0.0020
Other Construction Equipment	175	0.4933	0.0806	1.3311	0.0039	0.1248	0.1211	536.5978	0.0064
Other Construction Equipment	600	0.7675	0.1099	1.6260	0.0039	0.1096	0.1063	536.5030	0.0040
Pavers	175	0.2910	0.0477	0.8233	0.0038	0.0724	0.0703	536.6922	0.0041
Pumps	11	2.7912	0.8125	4.3841	0.0054	0.3169	0.3074	588.0296	0.0658
Rollers	100	0.7936	0.0632	1.5215	0.0042	0.1185	0.1149	595.9735	0.0053
Scrapers	600	0.4607	0.0622	1.0546	0.0039	0.0782	0.0758	536.6481	0.0056
Skid Steer Loaders	75	4.0734	0.9360	4.6041	0.0054	0.7037	0.6826	693.1918	0.0162
Surfacing Equipment	25	1.5314	0.3586	3.7744	0.0055	0.1745	0.1692	595.1286	0.0316
Tractors/Loaders/Backhoes	75	2.1466	0.4542	3.5468	0.0052	0.3365	0.3264	694.6430	0.0167
Tractors/Loaders/Backhoes	100	2.5158	0.4145	2.5379	0.0051	0.4193	0.4067	694.7647	0.0103
Tractors/Loaders/Backhoes	175	1.2834	0.2898	2.0947	0.0046	0.2414	0.2341	625.6854	0.0090

Note: 2021 emission factors unique to Mecklenburg County were applied for all construction years
Source: MOVES 2014b

ATTACHMENT 4, MOTOR VEHICLES

Operational Motor Vehicle Emission Factors

TABLE A-13, OPERATIONAL VEHICLE EMISSION FACTORS 2028 CRITERIA POLLUTANTS

Vehicle Type	Speed (mph)	GRAMS PER VEHICLE MILE TRAVELLED								
		CO	NO_X	SO_X	VOC	$PM_{2.5}$	PM_{10}	CO_2	CH_4	N_2O
Passenger Car (gasoline)	45	1.9187	0.1414	0.0016	0.0252	0.0047	0.0053	245.3687	0.0021	0.0010
Passenger Truck (gasoline)	45	3.2929	0.2987	0.0022	0.0603	0.0057	0.0065	334.9925	0.0035	0.0019
Short-Haul Truck (diesel)	45	0.5305	1.9115	0.0129	0.0832	0.0457	0.0496	1545.7190	0.0419	0.0018
Long-Haul Truck (diesel)	45	0.6549	2.5103	0.0136	0.1045	0.0722	0.0785	1620.6766	0.0411	0.0018

Note: Emission factors are unique to Mecklenburg County; mph denotes miles per hour
Source: MOVES 2014b

TABLE A-14, OPERATIONAL VEHICLE EMISSION FACTORS 2033 CRITERIA POLLUTANTS

Vehicle Type	Speed (mph)	GRAMS PER VEHICLE MILE TRAVELLED								
		CO	NO_X	SO_X	VOC	$PM_{2.5}$	PM_{10}	CO_2	CH_4	N_2O
Passenger Car (gasoline)	45	1.4498	0.0503	0.0015	0.0095	0.0037	0.0042	219.8055	0.0015	0.0009
Passenger Truck (gasoline)	45	2.2531	0.1122	0.0020	0.0196	0.0043	0.0049	298.2676	0.0022	0.0012
Short-Haul Truck (diesel)	45	0.3741	1.3911	0.0128	0.0507	0.0236	0.0256	1530.0548	0.0431	0.0018
Long-Haul Truck (diesel)	45	0.3950	1.5885	0.0133	0.0558	0.0320	0.0348	1592.5451	0.0431	0.0018

Note: Emission factors are unique to Mecklenburg County; mph denotes miles per hour
Source: MOVES 2014b

TABLE A-15, OPERATIONAL VEHICLE EMISSION FACTORS 2028 HAZARDOUS AIR POLLUTANTS

Vehicle Type	Speed (mph)	GRAMS PER VEHICLE MILE TRAVELLED											
		Ben-zene	1,3-Butad-iene	Formal-dehyde	Aceta-ldehyde	Acro-lein	2,2,4-Trimethyl -pentane	Ethyl Benzene	Hexane	Propion-aldehyde	Styrene	Toluen e	Xylene
Passenger Car (gasoline)	45	0.0009	0.0001	0.0004	0.0003	0.0000	0.0004	0.0005	0.0005	0.0000	0.0000	0.0020	0.0017
Passenger Truck (gasoline)	45	0.0023	0.0002	0.0009	0.0007	0.0000	0.0011	0.0011	0.0011	0.0000	0.0001	0.0049	0.0041
Short-Haul Truck (diesel)	45	0.0008	0.0002	0.0119	0.0043	0.0007	0.0004	0.0004	0.0003	0.0003	0.0001	0.0014	0.0016
Long-Haul Truck (diesel)	45	0.0010	0.0002	0.0135	0.0050	0.0008	0.0004	0.0004	0.0003	0.0004	0.0001	0.0014	0.0017

Note: Emission factors are unique to Mecklenburg County; mph denotes miles per hour
Source: MOVES 2014b

TABLE A-16, OPERATIONAL VEHICLE EMISSION FACTORS 2033 HAZARDOUS AIR POLLUTANTS

Vehicle Type	Speed (mph)	GRAMS PER VEHICLE MILE TRAVELLED											
		Ben-zene	1,3-Butad-iene	Formal-dehyde	Aceta-ldehyde	Acro-lein	2,2,4-Trimethyl -pentane	Ethyl Benzene	Hexane	Propion-aldehyde	Styrene	Toluen e	Xylene
Passenger Car (gasoline)	45	0.0004	0.0000	0.0001	0.0001	0.0000	0.0001	0.0002	0.0002	0.0000	0.0000	0.0007	0.0006
Passenger Truck (gasoline)	45	0.0009	0.0000	0.0003	0.0001	0.0000	0.0003	0.0003	0.0005	0.0000	0.0000	0.0015	0.0012
Short-Haul Truck (diesel)	45	0.0006	0.0001	0.0095	0.0032	0.0005	0.0003	0.0003	0.0002	0.0002	0.0000	0.0012	0.0016
Long-Haul Truck (diesel)	45	0.0006	0.0001	0.0099	0.0033	0.0005	0.0003	0.0003	0.0002	0.0002	0.0000	0.0013	0.0016

Note: Emission factors are unique to Mecklenburg County; mph denotes miles per hour
Source: MOVES 2014b