I-70 Floyd Hill to Veterans Memorial Tunnels

State Air Quality Technical Report

July 2021

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I-70 Floyd Hill State Air Quality Technical Report Addendum

Introduction

In July 2021, the Colorado Department of Transportation (CDOT) and Federal Highway Administration (FHWA) released an Environmental Assessment (EA) for the Interstate 70 (I-70) Floyd Hill to Veterans Memorial Tunnels Project (Project). Since the release of the EA, CDOT has been following a Construction Manager/General Contractor (CMGC) process for Project delivery. The purpose of the CMGC process is to optimize efficiency in design, schedule, and cost, minimize environmental impacts, manage risk, and ensure constructability.

Design innovations that have been identified through the CMGC process have resulted in refinements to the EA Preferred Alternative, which are described and illustrated in the *I-70 Floyd Hill to Veterans Memorial Tunnels Project Finding of No Significant Impact* (FONSI). The design changes do not affect the air quality analysis included with the EA or the conclusion that the Project would not affect regional or localized emissions of pollutants regulated by National Ambient Air Quality Standards or mobile source air toxics and would not contribute to increased greenhouse gas (GHG) emissions.

However, since publication of the EA, the Project has been designated as a Regionally Significant Transportation Capacity Project in CDOT's 10 Year Plan under the requirements of Senate Bill 21-260 (SB260), which was signed by Governor Polis June 17, 2021. SB260 included new environmental requirements in Section 30, which have been codified in the Colorado Revised Statutes (CRS) 43-1-128. The CRS law requires Regionally Significant Transportation Capacity projects to account for the impacts on statewide GHG pollution as part of the planning process and for the air quality impacts as part of the environmental study process. Information on CDOT's interpretation of a Regionally Significant Transportation Capacity Project is provided on the Greenhouse Gas (GHG) Program website.

Although requirements associated with CRS 43-1-128 were not in effect during the preparation of the EA, CDOT did include a quantitative analysis of GHG air emissions from on road vehicle tailpipe emission sources (e.g., passenger vehicles, heavy duty trucks) for existing conditions and future conditions for the Project. This analysis is documented in the *State Air Quality Technical Report*, July 2021, which is an appendix to the EA. This addendum updates the *State Air Quality Technical Report* to reflect CRS-43-1-128 requirements and interim guidance, as described below, and the associated monitoring requirements that will be required during the Project construction.

Compliance with the GHG Planning Standard

To comply with the GHG requirements in the CRS, the Pollution Reduction Planning Standard, commonly referred to as the "GHG Planning Standard," was adopted by the Transportation Commission in December 2021. On May 19, 2022, the Transportation Commission also voted to adopt GHG Mitigation Measures Policy Directive 1610, which established an ongoing administrative process and guidelines for selecting, measuring, confirming, verifying, and reporting on GHG Mitigation Measures. The rule requires CDOT and the state's five metropolitan planning organizations (MPOs) to create transportation plans that support travel choices which reduce GHG emissions. The agencies (CDOT and the MPOs) used travel demand models, in combination with the United States Environmental Protection Agency (EPA) Motor Vehicle Emission Simulator (MOVES) Model, to make this determination for different years in the future, and the emission goals differ for each agency. The Transportation Commission accepted CDOT's 10 Year Plan, which included the I-70 Floyd Hill Project, and the GHG Transportation Report in September of 2022, which demonstrates compliance with the GHG Transportation Planning Standard. This Regionally Significant Transportation Capacity Project was included in the statewide modeling that demonstrated compliance with the GHG Planning Standard, and therefore Part 3 of the SB21-260 and the associated CRS.

GHG Reduction Measures

The Project incorporates components that are intended to reduce GHG emissions. These include:

- Improvements to the multimodal Clear Creek Greenway trail, which provides expanded local and regional connections to walking and bicycle trails.
- A new parking area and CDOT Pegasus transit shuttle service stop at the I-70 El Rancho Exit in Evergreen. In addition to supporting Pegasus use of the Express Lanes, the new lot includes other GHG reduction components with parking for carpooling and electric vehicle charging.
- Addition of a westbound Express Lane, which helps manage transportation demand by providing choices for travellers and improving travel time reliability.

Additionally, the CMGC identified the following GHG reduction measures that will be implemented during construction, which are included in the FONSI mitigation commitments:

- Keep construction equipment and vehicles well maintained in accordance with equipment manufacturing requirements to ensure exhaust systems are kept in good working order.
- Post signage indicating engines should not idle more than 5 minutes.
- Perform early offline construction work that reduces emissions from idling vehicles in potential traffic slowdowns.
- Encourage workers to carpool to the Project site and consider implementing a carpooling program.
- Use an existing gravel pit at the Project site to process excess rock cut material, reducing haul distance by 75 percent.

Air Quality Modeling Requirements during Construction

Part 4 of the CRS requires air quality monitoring before and during construction. Although the guidance has not been finalized, an interim draft guidance is available, which indicates pre-construction monitoring will need to be conducted for a minimum of two weeks for a variety of pollutants that will likely include carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5

microns in diameter ($PM_{2.5}$), and ozone in addition to meteorological data. During construction, PM_{10} and $PM_{2.5}$ in addition to the meteorological data will be required for the duration of construction.

In support of statewide air quality goals ahead of the CRS requirements, CDOT committed in the EA to install two permanent air quality monitors in the Floyd Hill and Idaho Springs areas to gather data and monitor local air quality to supplement other regional air quality data. CDOT also committed to conduct real-time monitoring of dust emissions and take appropriate action if air quality is diminished by construction activities. The mitigation commitments for air quality monitoring have been modified to indicate the air quality requirements in Part 4 of the CRS apply and will be followed. Because the pollutants, duration, and number of monitors required may change, the CDOT Project Director and CDOT Construction Manager will coordinate closely with CDOT's Air Quality team to ensure the monitoring meets the most current guidance.

Table of Contents

1. Executive Summary 1

2. Introduction and Purpose of this Report 2

3. Proposed Action and Alternatives 4
   3.1. Description of Proposed Action and Alternatives 4
   3.2. No Action Alternative 7
   3.3. Action Alternatives: East Section 7
   3.4. Action Alternatives: Central Section 7
      3.4.1. I-70 Mainline 8
      3.4.2. Frontage Road 8
   3.5. Action Alternatives: West Section 9
   3.6. Construction of Action Alternatives 10

4. Monitoring Data 11
   4.1. National Ambient Air Quality Standards Overview 11
   4.2. Air Quality Monitoring by APCD 12
      4.2.1. Carbon Monoxide 12
      4.2.2. Ozone 13
      4.2.3. Nitrogen Dioxide 13
      4.2.4. Particulate Matter 13
   4.3. Air Quality Monitoring by CDOT and Clear Creek County 14

5. Emissions Modeling Methodology 16
   5.1. Traffic Data 16
      5.1.1. Microsimulation Model Results 16
      5.1.2. Travel Demand Model Results 17
   5.2. Model Selection 17
   5.3. Model Years and Time Periods 17
   5.4. Geographic Bounds 18
   5.5. Emissions Sources 18
   5.6. Road and Structure Types 19
   5.7. Pollutants 19
   5.8. Meteorology Data 20
   5.9. Average Speed 20
   5.10. Grade 20
   5.11. Vehicle Age Distribution 22
   5.12. Fuel 23
   5.13. Inspection and Maintenance Parameters 23
   5.14. Post Processing 23
   5.15. Construction (Nonroad) Emissions 24

6. Emissions Model Results 25
   6.1. Nitrogen Oxides 26
   6.2. Carbon Monoxide 27
   6.3. Volatile Organic Compounds 28
   6.4. Particulate Matter 29
   6.5. Mobile Source Air Toxics 31
   6.6. Onroad Greenhouse Gas Emissions 39

6.7. Construction (Nonroad) Discussion 40
7. References 41

Appendices

Appendix A. Meteorological Data

List of Exhibits

Exhibit 1. Project Location 5
Exhibit 2. East, Central, and West Project Sections 6
Exhibit 3. Averaging Time and Primary Standard for NAAQS 12
Exhibit 4. Average of Recorded Pollutant Levels at Floyd Hill and Idaho Springs Monitoring Stations . 15
Exhibit 5. Speed Bins 20
Exhibit 6. Yao et al., 2014 Sensitive Analysis Results – MOVES Emission Rates with Changes in Speed, Acceleration, and Grade 21
Exhibit 7. Vehicle Age Distribution 22
Exhibit 8. NOx Emissions Results (tons per day) 26
Exhibit 9. CO Emissions Results (tons per day) 27
Exhibit 10. VOC Emissions Results (tons per day) 28
Exhibit 11. PM_{10} Emissions Results (tons per day) 29
Exhibit 12. $PM_{2.5}$ Emissions Results (tons per day) 30
Exhibit 13. Diesel-PM Emissions Results (pounds per day) 31
Exhibit 14. 1,3-Butadiene Emissions Results (pounds per day) 32
Exhibit 15. Benzene Emissions Results (pounds per day) 33
Exhibit 16. Formaldehyde Emissions Results (pounds per day) 34
Exhibit 17. Acetaldehyde Emissions Results (pounds per day) 35
Exhibit 18. Acrolein Emissions Results (pounds per day) 36
Exhibit 19. Naphthalene Emissions Results (pounds per day) 37
Exhibit 20. Ethylbenzene Emissions Results (pounds per day) 38
Exhibit 21. POM Emissions Results (pounds per day) 39
Exhibit 22. Onroad CO_2e Emissions Results (metric tons per year) 40

List of Acronyms

$\mu g/m^3$	micrograms per cubic meter
ADA	Americans with Disabilities Act
APCD	Air Pollution Control Division
AR4	Assessment Report 4
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CEO	Colorado Energy Office
CFR	Code of Federal Regulations
CH_4	methane
CMGC	Construction Manager/General Contractor
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CR	County Road
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
g/mi	grams per mile
GHG	greenhouse gas
GUI	graphical user interface
GWP	global warming potential
HCOM	heavy-duty commercial vehicles
I-25	Interstate 25
I-70	Interstate 70
I/M	inspection and maintenance
IPCC	Intergovernmental Panel on Climate Change
lb/mi	pound per mile
LCOM	light-duty commercial vehicles
LEV	low emission vehicle
MEXL	Mountain Express Lane
MOVES	Motor Vehicle Emission Simulator
MP	Mile Post
mph	miles per hour
MSAT	mobile source air toxic
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act

NOAA	National Oceanic and Atmospheric Administration
NO_2	nitrogen dioxide
NOx	nitrogen oxides
NREL	National Renewable Energy Laboratory
O_3	ozone
PC	passenger cars
PEIS	Programmatic Environmental Impact Statement
PM	particulate matter
$PM_{2.5}$	particulate matter 2.5 microns or less in diameter
PM_{10}	particulate matter 10 microns or less in diameter
ppb	parts per billion
ppm	parts per million
Project	I-70 Floyd Hill to Veterans Memorial Tunnels Project
QAQC	quality assurance/quality control
ROD	Record of Decision
SB	Senate Bill
SIP	State Implementation Plan
SO_2	sulfur dioxide
SQL	structured query language
US 6	U.S. Highway 6
US 40	U.S. Highway 40
VOC	volatile organic compounds
WRCC	Western Regional Climate Center
ZEV	zero emission vehicle

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1. Executive Summary

This *I-70 Floyd Hill to Veterans Memorial Tunnels State Air Quality Technical Report* details analyses conducted to evaluate air quality emissions for the Interstate 70 (I-70) Floyd Hill to Veterans Memorial Tunnels Project (Project). This analysis goes beyond what is required under State and Federal law and guidance in an effort to better understand air quality emissions in the Project area. The required analysis is contained in the *I-70 Floyd Hill to Veterans Memorial Tunnels Air Quality Technical Report* (Appendix A4 to the EA).

Due to the increased concern over GHG emissions and climate change, CDOT conducted quantitative analyses on the air emissions from onroad vehicle tailpipe emission sources (e.g., passenger vehicles, heavy duty trucks) for existing conditions and future conditions, as a result of the Project in addition to analyses that were required by State and Federal law and guidance. CDOT also evaluated criteria pollutant and mobile source air toxic emissions to highlight the additional measures CDOT will take to better understand air quality in the I-70 Mountain Corridor. Additionally, CDOT conducted a qualitative assessment of construction (nonroad mobile) emissions.

The analysis shows reductions in criteria pollutant, mobile source air toxic, and greenhouse gas emissions in the Project area for conditions between 2018 and 2045. The reduction is attributed to older vehicles being taken off the road, more fuel-efficient vehicles entering the fleet, and higher travel speeds due to less congestion in some portions of the Project area, particularly areas that are currently heavily congested.

2. Introduction and Purpose of this Report

The Colorado Department of Transportation (CDOT) and the Federal Highway Administration (FHWA), in cooperation with local communities and other agencies, are conducting the *I-70 Floyd Hill to Veterans Memorial Tunnels Environmental Assessment* (EA) to advance a portion of the program of improvements for the I-70 Mountain Corridor identified in the 2011 Tier 1 *Final I-70 Mountain Corridor Programmatic Environmental Impact Statement* (PEIS) (CDOT, 2011a) and approved in the 2011 *I-70 Mountain Corridor Record of Decision* (ROD) (CDOT, 2011b). The EA is a Tier 2 National Environmental Policy Act (NEPA) process and is supported by resource-specific technical reports, including the *I-70 Floyd Hill to Veterans Memorial Tunnel Air Quality Report*, which provides an assessment of existing air quality conditions, Project impacts and mitigation based on applicable federal and state laws, regulations, and guidance. This report provides additional analysis to address air quality concerns raised in the Project's NEPA process and other transportation projects in the I-70 Mountain Corridor.

Human activity is changing the Earth's climate by causing the buildup of heat-trapping greenhouse gas (GHG) emissions through the burning of fossil fuels and other human influences. Carbon dioxide is the largest component of human produced emissions; other prominent emissions include methane, nitrous oxide, and hydrofluorocarbons (HFCs). These emissions are different from criteria air pollutants since their effects in the atmosphere are global rather than localized, as well as their capacity to remain in the atmosphere for decades to centuries, depending on GHG pollutant. Greenhouse gas emissions are often reported together as carbon dioxide equivalent emissions, weighting the global warming potential of the gases. Additional discussion on global warming potentials is included in Section 5.7.

GHG emissions have accumulated rapidly as the world has industrialized, with concentration of atmospheric carbon dioxide increasing from roughly 310 parts per million in 1960 to over 410 parts per million in February 2021 (National Oceanic and Atmospheric Administration [NOAA], 2021). Over this timeframe, global average temperatures have increased by roughly 1.5 degrees Fahrenheit (0.9 degrees Celsius), and the most rapid increases have occurred over the past 50 years (Lindsey and Dahlman, 2021). Scientists have warned that significant and potentially dangerous shifts in climate and weather are possible without reductions in GHG emissions (IPCC, 2007).

Colorado set a state-wide goal to reduce GHG emissions 26 percent by 2025, 50 percent by 2030, and 90 percent by 2050 from a 2005 baseline through Colorado House Bill 19-1261. In 2020, the industries with the highest emissions in Colorado in order were transportation, electricity generation, oil and gas, and buildings. For the last several months, CDOT, the Colorado Department of Public Health and Environment (CDPHE), and the Colorado Energy Office (CEO) have been working in partnership to advance the nine transportation policy measures in the GHG Roadmap. This shared approach relies on the separate authorities and expertise of each Commission and agency and distributes this critical work among agency staff. In January 2021, CDOT and CDPHE began a stakeholder process to consider how to set GHG requirements for transportation planning at the state and regional level. At the same time, the recently passed Colorado Senate Bill (SB) 260 provided new language clarifying and giving direction regarding GHG reduction objectives to CDOT and the Transportation Commission. Based on these developments, CDOT and the Transportation Commission will be moving forward as follows:

- The Transportation Commission will revise its current statewide planning rules to incorporate new requirements establishing a GHG pollution reduction framework.
- This rule will be promulgated in accordance with Colorado's Administrative Procedure Act, which includes formal notice of rulemaking filed with the Secretary of State, official

publication of the notice in the Colorado Register, and a rulemaking hearing for testimony and written comments. The Transportation Commission is anticipated to officially initiate the rulemaking process at its July 2021 meeting and file the notice of rulemaking with the Secretary of State before the end of July 2021.

The transportation planning sector initiatives are currently being drafted and estimated to be ready for final approval in late 2021.

Due to the increased concern over GHG emissions and climate change, CDOT conducted quantitative analyses on the air emissions from onroad mobile sources (e.g., passenger vehicles, heavy duty trucks) for existing conditions and future conditions, as a result of the Project in addition to analyses that were required by State and Federal law and guidance. Additionally, CDOT has evaluated criteria pollutant and mobile source air toxic emissions to highlight the additional measures CDOT will take to better understand air quality in the I-70 Mountain Corridor. Construction (nonroad mobile) emissions are qualitatively evaluated as part of this analysis due to lack of exact construction equipment and schedules, at this time. The quantitative analyses involve air quality emissions modeling (as outlined in the methodology document submitted on November 25, 2020 and detailed in Section 5 of this report). These quantitative analyses are not required under NEPA or air quality regulations but are intended to provide supplemental information to characterize air quality in the I-70 Mountain Corridor better and to respond to stakeholder concerns.

3. Proposed Action and Alternatives

3.1. Description of Proposed Action and Alternatives

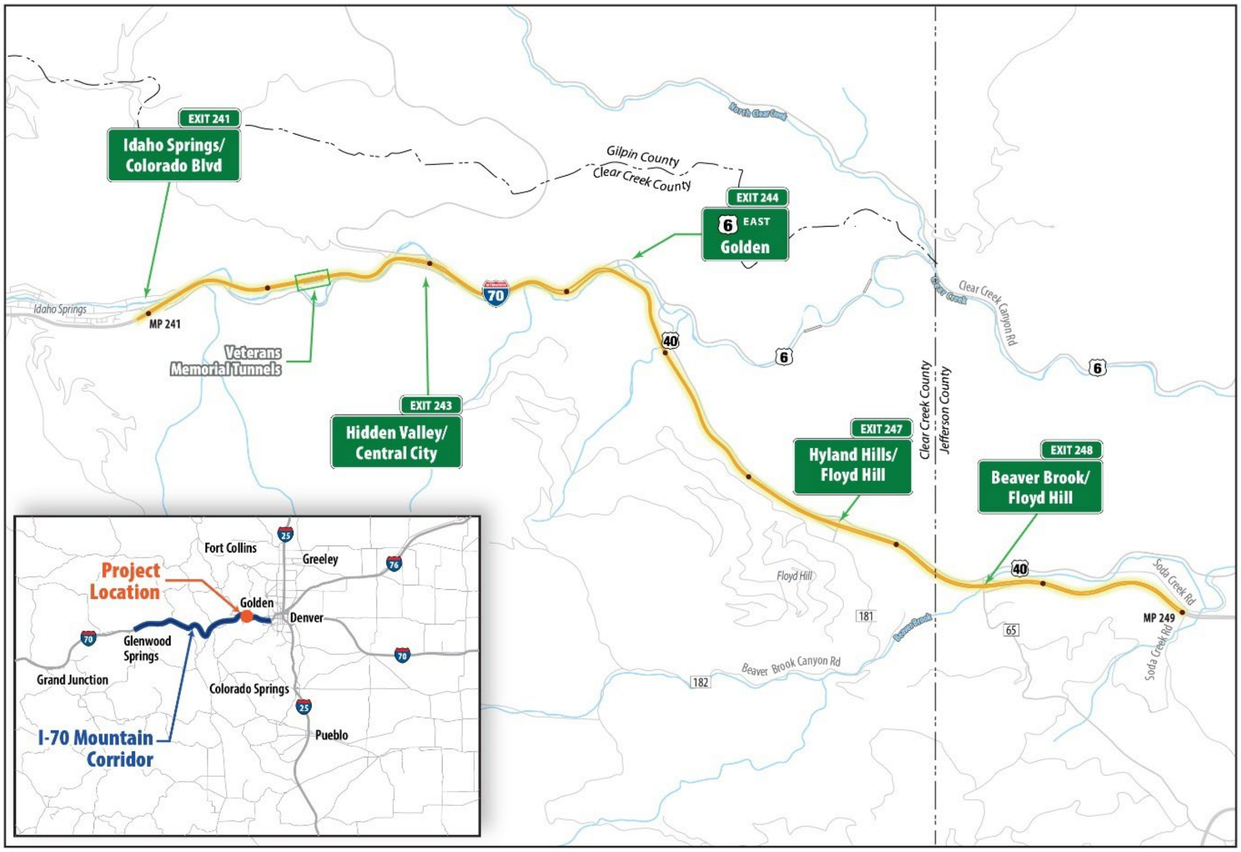
CDOT and FHWA propose improvements along approximately 8 miles of the I-70 Mountain Corridor from the top of Floyd Hill through the Veterans Memorial Tunnels to the eastern edge of Idaho Springs. The purpose of the Project is to improve travel time reliability, safety, and mobility, and address the deficient infrastructure through this area.

The major Project elements include:

- Adding a third westbound travel lane to the two-lane section of I-70 from the current three-lane to two-lane drop (approximately milepost (MP) 246) through the Veterans Memorial Tunnels
- Constructing a new frontage road between the U.S. Highway 6 (US 6) interchange and the Hidden Valley/Central City interchange
- Improving interchanges and intersections throughout the Project area
- Improving design speeds and stopping sight distance on horizontal curves
- Improving the multimodal trail (Clear Creek Greenway) between US 6 and the Veterans Memorial Tunnels
- Reducing animal-vehicle conflicts and improving wildlife connectivity
- Providing two permanent air quality monitors at Floyd Hill and Idaho Springs to collect data on local air quality conditions and trends
- Coordinating rural broadband access with local communities, including providing access to existing/planned conduits and fiber in the interstate right of way

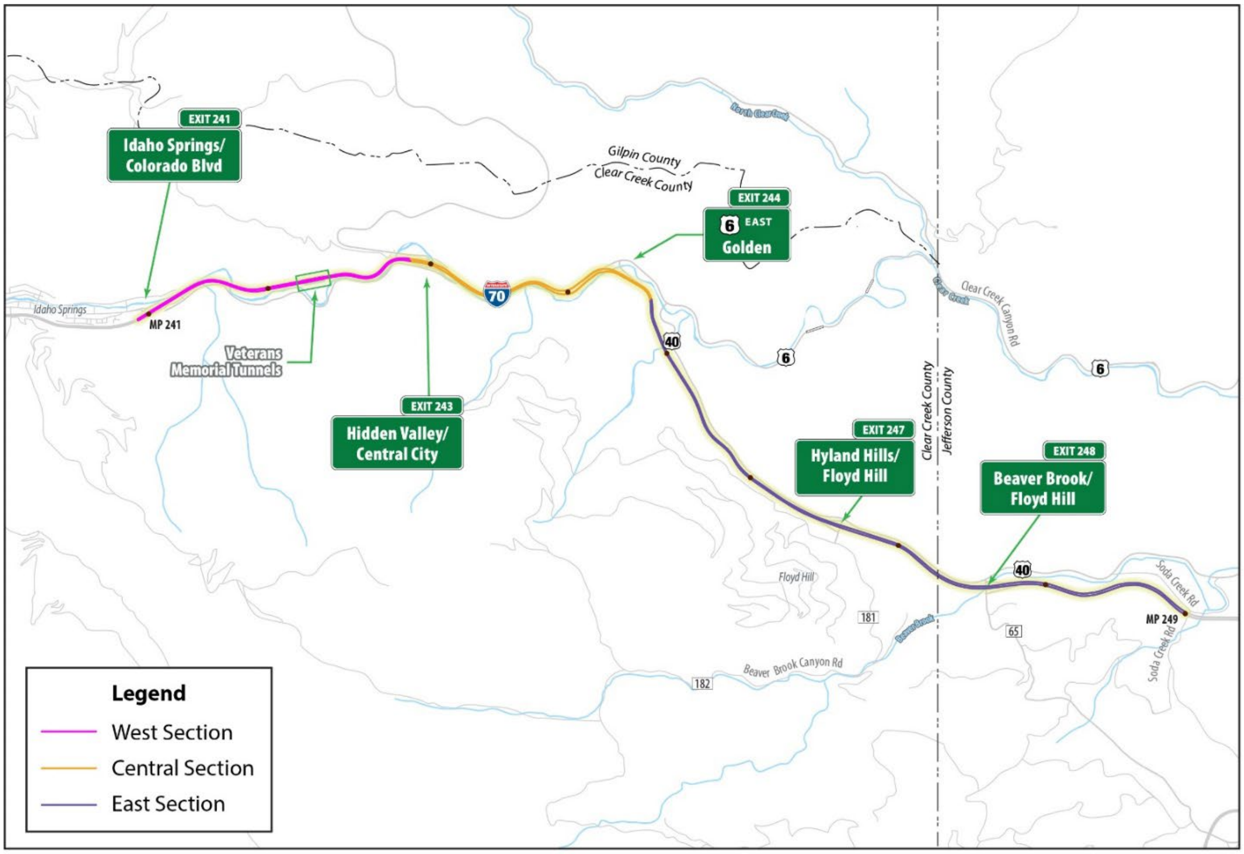
The Project is located on I-70 between MP 249 (east of the Beaver Brook/Floyd Hill interchange) and MP 241 (Idaho Springs/Colorado Boulevard), west of the Veterans Memorial Tunnels. It is located mostly in Clear Creek County, with the eastern end in Jefferson County (see Exhibit 1). The primary roadway construction activities would occur between County Road (CR) 65 (the Beaver Brook/Floyd Hill interchange) and the western portals of the Veterans Memorial Tunnels (MP 247.6 and MP 242.3, respectively), with the Project area extended east and west to account for signing, striping, and fencing.

Exhibit 1. Project Location



Three alternatives are being evaluated in the EA: (1) No Action Alternative, (2) Tunnel Alternative, and (3) Canyon Viaduct Alternative. The Project improvements are grouped into three geographic sections: (1) East Section (top of Floyd Hill to US 6 interchange), (2) Central Section (US 6 interchange to Hidden Valley/Central City interchange), and (3) West Section (Hidden Valley/Central City interchange through Veterans Memorial Tunnels) (see Exhibit 2).

Exhibit 2. East, Central, and West Project Sections



The action alternatives—the Tunnel Alternative and Canyon Viaduct Alternative—include the same improvements in the East Section and West Section to flatten curves, add a third westbound travel lane (the new lane would be an Express Lane), provide wildlife and water quality features, and improve interchange/intersection operations.

Through the Central Section between the US 6 interchange and the Hidden Valley/Central City interchange, the action alternatives vary in how they provide for the third westbound I-70 travel lane and frontage road connections, as follows:

- The **Tunnel Alternative** would realign westbound I-70 to the north (along the curve between MP 244.3 and MP 243.7) through a new 2,200-foot-long tunnel west of US 6. Eastbound I-70 would be realigned within the existing I-70 roadway template to flatten curves to improve design speed and sight distance. This alternative also would include two design options for the alignment of the new frontage road—north or south of Clear Creek. The Clear Creek Greenway trail would be reconstructed in its current location on the south side of Clear Creek.
- The **Canyon Viaduct Alternative** would realign approximately one-half mile of both the westbound and eastbound I-70 lanes (along the curve between MP 244 and MP 243.5) on viaduct structures approximately 400 feet south of the existing I-70 alignment on the south side of Clear Creek Canyon. Through the realigned area, the frontage road would be constructed under the viaduct on the existing I-70 roadway footprint north of Clear Creek. The Clear Creek Greenway would be reconstructed in its current location on the south side of Clear Creek. The viaduct would cross above Clear Creek and the Clear Creek Greenway twice.

Additional information regarding the alternatives evaluated in the EA can be found in the *I-70 Floyd Hill to Veterans Memorial Tunnels Alternatives Analysis Technical Report* (Appendix A3 to the EA).

3.2. No Action Alternative

The No Action Alternative includes ongoing highway maintenance. In addition, due to its poor condition, the westbound I-70 bridge at the bottom of Floyd Hill is programmed to be replaced regardless of whether CDOT moves forward with one of the action alternatives. Therefore, replacing the bridge in kind (as a two-lane bridge) is part of the No Action Alternative. Under the No Action Alternative, the bridge would be replaced in its current location but would need to be designed to current standards, with a 55 mile-per-hour (mph) design speed and improved sight distance with wider shoulders.

3.3. Action Alternatives: East Section

In the East Section between the top of Floyd Hill and the US 6 interchange, the action alternatives are the same. Through this section, westbound I-70 would be widened to the south to accommodate a third travel lane, which is planned as an Express Lane. The typical section would include an additional 12-foot travel lane and inside and outside shoulders of varying widths, depending on sight distance needs around curves. The proposed footprint would include a 4-foot buffer between the new Express Lane and the existing (general purpose) lanes.

In the eastbound direction, the three travel lanes would be retained but the roadway would be realigned where needed to accommodate westbound widening or curve modifications to improve sight distance and safety. An approximately one-mile-long eastbound auxiliary (climbing) lane would be added in the uphill direction from the bottom of Floyd Hill to the Hyland Hills/Floyd Hill interchange (Exit 247). Water quality features would be added along the south side of the eastbound lanes.

At the Beaver Brook/Floyd Hill and Hyland Hills/Floyd Hill interchange systems, the split diamond interchange configuration (with on- and off-ramps connected by U.S. Highway 40 [US 40]) would remain, and no new accesses would be provided.

Wildlife fencing would be added along the north and south sides of I-70 between the Hyland Hills/Floyd Hill interchange on the west and Soda Creek Road on the east to reduce wildlife-vehicle collisions.

3.4. Action Alternatives: Central Section

The Central Section of the Project involves the most substantial improvements—including realigning curves, adding a third westbound travel lane, improving the Clear Creek Greenway, and providing the frontage road connection. These improvements occur within the most-constrained section of the Project area, where the existing I-70 footprint and planned roadway improvements are located between canyon rock faces north and south of existing I-70 and Clear Creek. Because of these constraints, the action alternatives within this section include the same improvements but differ with respect to the I-70 mainline and frontage road alignments and the relationship of the roadway improvements to the rock faces and the creek. The Clear Creek Greenway would be reconstructed generally along its existing alignment under both action alternatives, but the Clear Creek Greenway's location to the creek and roadway infrastructure would differ as described below.

3.4.1. I-70 Mainline

The I-70 mainline through this section continues the same roadway typical section from the East Section. Both alternatives would provide an additional westbound 12-foot travel lane; inside and outside shoulders of varying widths, depending on sight distance needs around curves; and a 4-foot buffer between the new Express Lane and the existing (general purpose) lanes.

Under the Tunnel Alternative, approximately one mile of westbound I-70 would be realigned to the north near the US 6 interchange. A portion of the realignment would extend through a 2,200-foot-long tunnel that would tie in to the existing westbound I-70 alignment and elevation just east of the Hidden Valley/Central City interchange. The three eastbound I-70 lanes through this area would remain within the existing roadway prism but would be realigned, moving approximately 100 feet north into the rock face adjacent to the existing westbound lanes to flatten horizontal curves and improve the design speed and sight distance.

Under the Canyon Viaduct Alternative, the westbound I-70 alignment would shift to the south on a new 5,300-foot-long viaduct beginning at approximately MP 245 east of the exit ramp to US 6 and it would rejoin the existing alignment about one-half mile east of the Hidden Valley/Central City interchange at approximately MP 243.5. Through this area, eastbound I-70 also would be realigned on a separate viaduct structure next to westbound I-70 from MP 243.4 east to just beyond MP 244.3. Both viaduct structures would cross Clear Creek and the Clear Creek Greenway twice near MP 243.9 and MP 243.5 (approximately 60 feet above ground level).

3.4.2. Frontage Road

Both alternatives include a new approximately 1.5-mile-long frontage road connection between the Hidden Valley/Central City interchange and the US 6 interchange. The frontage road would run from the intersection of CR 314 and Central City Parkway (south of the I-70 eastbound off-ramp at the Hidden Valley/Central City interchange where CR 314, which acts as a frontage road from east Idaho Springs, terminates) to the US 6/I-70 ramp terminal. The roadway section for the frontage road would consist of two 11-foot lanes (one in the eastbound direction and one in the westbound direction) with consistent 2-foot shoulders. The design speed would be 30 mph and the roadway would be constructed to comply with Clear Creek County local access standards.

The Tunnel Alternative includes two design options for this frontage road:

- **North Frontage Road Option** would provide the new frontage road connection between the two interchanges mostly on the north side of Clear Creek. The I-70 mainline would be realigned north into the mountainside, requiring substantial rock cuts (150 feet high) to make room for the frontage road between the creek and existing I-70. The Clear Creek Greenway would be reconstructed along its current alignment north of Clear Creek. In the Sawmill Gulch area where the existing trail's grade does not meet Americans with Disabilities Act (ADA) standards, the Greenway trail would be lowered to meet grades.
- **South Frontage Road Option** would provide the new frontage road connection between the two interchanges mostly on the south side of Clear Creek. Moving the frontage road to the south side of the creek would require new rock cuts on the south side of Clear Creek Canyon and less substantial rock cuts on the north side of I-70. The Clear Creek Greenway would be reconstructed generally along its current alignment south of Clear Creek; in the Sawmill Gulch area, an approximately 1,500-foot new section of the Greenway trail would be constructed

across the creek to the north (with two pedestrian bridge crossings of the creek) to be ADA compliant, and the existing trail would remain in place but not be resurfaced. The Clear Creek Greenway would be located closer to the frontage road than under the North Frontage Road Option; although the design seeks to maximize horizontal and vertical separation between the facilities and includes a new section of trail to meet ADA compliance, the alignment of the frontage road nearer to the Greenway and between the Greenway and creek is not supported by Clear Creek County, Idaho Springs, community members, or the Project Technical Team because it diminishes the recreational experience.

Under the Canyon Viaduct Alternative, the existing I-70 pavement under the elevated structures would be repurposed for the frontage road; excess right of way would be available for other uses—presumably, creek and recreation access—through this approximately one-mile area of the canyon.

3.5. Action Alternatives: West Section

The West Section between the Hidden Valley/Central City interchange and the Veterans Memorial Tunnels continues the widening of the interstate to add the third westbound travel lane and to flatten the S-curve in this location. Improvements in this section are the same under both action alternatives. The curve modifications require realigning both the I-70 mainline and frontage road through this section. The I-70 mainline alignment would shift south approximately 100 feet around the first curve from the Hidden Valley/Central City interchange, then north around the second curve approximately 50 feet, continuing a slight (25 foot) shift north before tying into the existing alignment at the Veterans Memorial Tunnels. Much of CR 314 would be realigned south between the Doghouse Rail Bridge over Clear Creek near the Veterans Memorial Tunnels east portal and the Hidden Valley/Central City interchange. A small section of CR 314 (between MP 242.6 and MP 242.7) would remain and connect to the reconstructed portions west and east.

These alignment shifts result in substantial rock cuts on both the north and south sides of the canyon. On the north side, rock cuts up to 160 feet high would be required next to the I-70 westbound lanes (along the curve in the area where CR 314 is not reconstructed). To realign CR 314 south, rock cuts from 70 feet to 100 feet high are required on the south side of the canyon. Additionally, a 1,200-foot section of Clear Creek, which is located between I-70 and CR 314, would need to be relocated south near MP 242.5.

The Hidden Valley/Central City interchange would not be reconstructed, and the I-70 bridges would remain because they are wide enough to accommodate the widened I-70 footprint without being replaced. All the on- and off-ramps for the interchange would be reconstructed, but the bridges over Clear Creek for the I-70 westbound off-ramp and I-70 eastbound on-ramp also can be retained. New bridges over Clear Creek to the west would be needed for the I-70 westbound on-ramp and I-70 eastbound off-ramp to accommodate the curve flattening and shift of I-70 to the south in this location. The CDOT maintenance facility would need to be relocated.

No changes are required west of the Veterans Memorial Tunnels. Within the westbound tunnel, the roadway would be restriped for the third lane (the expansion of the tunnel to accommodate the third lane was completed in 2014). After the tunnel, restriping and signing would continue west to the next interchange at Idaho Springs/Colorado Boulevard (Exit 241), where the third lane would terminate. The Express Lane would operate in conjunction with the westbound Mountain Express Lane (MEXL) during peak periods (mostly winter and summer weekends and holidays).

3.6. Construction of Action Alternatives

CDOT is planning to use a Construction Manager/General Contractor (CMGC) delivery method for construction of the Project. This contracting method involves a contractor advising in the design phases to better define Project technical requirements and costs, improve design quality and constructability, and reduce risks through the construction phase. This method promotes innovation and aligns well with the multidisciplinary Context Sensitive Solutions process. It was used successfully on the Twin Tunnels projects to reduce environmental impacts and accommodate community values in the design and construction project development phases.

Construction of the action alternatives is anticipated to be complex and take four to five years but could occur generally within the proposed right of way. CDOT would work with the CMGC to refine the construction details and develop a plan that promotes safety and minimizes disruption to the traveling public and nearby residents and businesses.

The Tunnel Alternative would take approximately one year longer to build than the Canyon Viaduct Alternative; most of the additional time would be needed for the tunnel rock blasting and construction that could take place without disrupting traffic. However, in addition to the tunnel rock blasting, the Tunnel Alternative has considerable rock cuts at the tunnel portals and along the north side of I-70 to realign curves, widen the highway, and add the frontage road connection. Rock cuts, staging for the excavation of the tunnel portals, and haul of waste rock are major construction activities that are likely to interrupt traffic on I-70 due to increased construction equipment traffic on the highway and the proximity of construction to live traffic, the need for temporary lane closures and detours, and closures for blasting. The North Frontage Road Option has significantly larger (taller and longer) rock cuts than the South Frontage Road Option.

The Canyon Viaduct Alternative has substantially less rock cuts and blasting compared to the Tunnel Alternative but would require more work in the existing highway right of way. Bridge construction over and pier placement within the highway template will need to be carefully coordinated. However, construction of some elements, such as the bench portion of the viaduct, are separated from the existing I-70 alignment and could be constructed offline similarly to the tunnel excavation.

Specific construction methods and phasing will be determined with contractor input and could affect the duration and/or physical requirements for construction activities. The focus of environmental impact analysis during the NEPA process is to identify resources and locations sensitive to construction impacts and incorporate reasonable mitigation measures, including the potential to avoid impacts by avoiding sensitive areas, to inform the contractor's plans. Final design and construction plans will consider changes in resource impacts, and reevaluations will be completed as needed during final design.

4. Monitoring Data

As reported in the *I-70 Floyd Hill to Veterans Memorial Tunnels Air Quality Technical Report* (Appendix A4 to the EA), there are no regulatory air quality monitors located near the Project area or in Clear Creek County that are a part of the state program of monitoring air quality by the Colorado Air Pollution Control Division (APCD). Outside of the APCD air quality monitoring program, CDOT and Clear Creek County are collecting air quality data at monitors installed in Clear Creek County along I-70 in response to stakeholder concerns about pollutant emissions from the interstate. The data from these monitors are not part of the APCD monitoring program used to determine whether an area is in attainment for the criteria pollutants and do not inform the regulatory process mandated by the Clean Air Act of 1990. As part of the Project, CDOT plans to install two permanent air quality monitors in Idaho Springs and Floyd Hill to collect regulatory-grade data on local air quality conditions and trends.

4.1. National Ambient Air Quality Standards Overview

The Clean Air Act of 1970 and its amendments led to the U.S Environmental Protection Agency (EPA) establishing National Ambient Air Quality Standards (NAAQS) for criteria air pollutants: carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ground level ozone (O_3), particulate matter less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$), and sulfur dioxide (SO_2). Multiple revisions to the NAAQS have occurred over time and the current NAAQS are provided in Exhibit 3 (EPA, 2016). Lead and SO_2 are not pollutants associated with motor vehicle emissions and, therefore, are not discussed in this report. Ozone is a regional pollutant that is not modeled on a project-level scale. Ozone and NAAQS status are discussed in detail in the *I-70 Floyd Hill to Veterans Memorial Tunnels Air Quality Technical Report* (Appendix A4 to the EA). Recent monitoring data for the Project area are discussed in Section 4.2.

Exhibit 3. Averaging Time and Primary Standard for NAAQS

Pollutant	Averaging Time	Primary Standard	Form of Standard
CO	1 hour	35 ppm	Not to be exceeded more than once per year
	8 hours	9 ppm	
NO_2	1 hour	100 ppb	98th percentile of 1-hour daily maximum, averaged over 3 years
	Annual	53 ppb(1)	Annual mean
O_3(2)	8 hours	0.070 ppm	Annual 4th highest 8-hour daily maximum, averaged over 3 years
$PM_{2.5}$	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	Annual	12 µg/m^3	Annual mean, averaged over 3 years
PM_{10}	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years

(1) The level of the annual NAAQS for NO_2 is 0.053 ppm. It is shown here in terms of ppb for clearer comparison to the 1-hour NAAQS.
(2) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards (EPA, 2016).

Counties, or areas within counties, are classified based on criteria pollutant monitoring data within the specific county or area. Classifications are defined below:

- Attainment: no exceedances of NAAQS
- Maintenance: previously in nonattainment for a NAAQS; however, is now consistently meeting the NAAQS
- Nonattainment: currently exceeding NAAQS

Maintenance areas may be redesignated as attainment after 20 years of demonstrating no NAAQS exceedances.

4.2. Air Quality Monitoring by APCD

APCD has numerous monitors throughout Colorado recording ambient measurements of pollutants that have NAAQS. APCD releases an Ambient Air Monitoring Network Plan annually with the various monitor measurements for the NAAQS pollutants and any current or proposed changes to the monitoring network that inform compliance with NAAQS status throughout Colorado.

4.2.1. Carbon Monoxide

In the state of Colorado, the CDPHE monitors CO only in central Denver and near State Highway 24 in Colorado Springs; APCD discontinued monitoring CO west of Jefferson County in 2006 and in Grand Junction in 2019 (CDPHE, 2020). The closest regulatory CO monitor to the Project is the Interstate 25 (I-25) roadway monitor near 8th Avenue, a distance that is well outside of the Project area.

The I-25 monitor recorded the highest maximum 1-hour CO concentration was 2.8 parts per million (ppm) and the second highest maximum 1-hour CO concentration was 2.6 ppm in 2019 (CDPHE, 2020).

The highest maximum 8-hour CO concentration was 2.1 ppm and the second highest maximum 8-hour concentration was 2.0 ppm in 2019 (CDPHE, 2020). The form of the standard for the 1-hour and 8-hour CO NAAQS is not to be exceeded more than once per year. Therefore, both 1-hour and 8-hour highest maximum concentrations are well below the 1-hour NAAQS of 35 ppm, and the 8-hour NAAQS of 9 ppm.

4.2.2. Ozone

Because of ozone (O_3) exceedances of NAAQS in the Denver Metro area, there are a number of air quality monitors measuring ambient O_3 concentrations. The NAAQS standard for O_3 is the fourth 8-hour maximum averaged over a three-year period. The air quality monitor nearest to the Project that collects data on O_3 is located at the city government offices in Black Hawk, Colorado, approximately three miles to the north of the Project Area. The air quality monitor was set up in July 2019 and has approximately six months of certified data. Because of its recent installation, the Black Hawk monitor does not have enough data to evaluate the NAAQS status of its surrounding area. The next closest O_3 air quality monitor is at the National Renewable Energy Laboratory (NREL) in Golden, Colorado, located approximately 11 miles east of the Project area, which has been operating since June 1994.

At NREL, the three-year average of the fourth maximum 8-hour value for monitored O_3 is 77 parts per billion (ppb) in 2019 (CDPHE, 2020). This value is above both the 2008 and 2015 NAAQS for 8-hour O_3 (CDPHE, 2020). The 8-hour O_3 2008 NAAQS is 75 ppb and the 8-hour O_3 2015 NAAQS is 70 ppb.

4.2.3. Nitrogen Dioxide

The only NO_2 monitor in Jefferson County, and the one closest to the Project area, was installed in February 2019 and is located in Rocky Flats, denoted as Rocky Flats—N. NO_2 has NAAQS for 1-hour and annual time periods. However, the Rocky Flats-N. monitor does not have three years of data so cannot be used to evaluate NAAQS. Therefore, the next closest monitor is located more than 25 miles away at I-25 Denver near 8th Avenue. The form of standard for 1-hour NO_2 is the 98th percentile averaged over three years. The form of standard for annual NO_2 is the annual mean.

At the I-25 Denver monitor near 8th Avenue, the 1-hour NO_2 98th percentile averaged over three years was 65 ppb and the annual NO_2 mean for 2019 was 24.1 ppb (CDPHE, 2020). The 1-hour NO_2 NAAQS is 100 ppb and the annual NO_2 NAAQS is 53 ppb. Therefore, the measured concentrations at the I-25 monitor are below the NAAQS for NO_2. It is important to note that, while only a year of data has been collected from the Rocky Flats—N. monitor, the recorded measurements in 2019 show approximately 60 percent less 1-hour NO_2 results and approximately 85 percent less annual results (CDPHE, 2020).

4.2.4. Particulate Matter

The Boulder Chamber of Commerce site, 20 miles northeast of the Project, is the closest site with similar terrain for monitoring PM_{10} and $PM_{2.5}$ (CDPHE, 2020). The PM_{10} NAAQS has an averaging period of 24 hours and the form of the standard is not to be exceeded more than once per year on average over three years. $PM_{2.5}$ has an annual and 24-hour NAAQS that are the annual mean averaged over three years and the 98th percentile averaged over three years, respectively.

There were no violations of the 24-hour PM_{10} NAAQS in the Denver Metro area in 2019 (CDPHE, 2020). The highest 24-hour maximum recorded at the Boulder site was 53 micrograms per cubic meter ($\mu g/m^3$) compared to the NAAQS of 150 $\mu g/m^3$. The three-year average of the 98th percentile of the 24-hour $PM_{2.5}$ monitoring result at the Boulder site was 19 $\mu g/m^3$ compared to the NAAQS of 35 $\mu g/m^3$

(CDPHE, 2020). The annual mean of $PM_{2.5}$ in 2019 at the Boulder site was 5.8 μg/m^3 compared to the NAAQS of 12 μg/m^3 (CDPHE, 2020). Therefore, the measured concentrations at the Boulder Chamber of Commerce monitor are below the NAAQS for PM_{10} and $PM_{2.5}$.

4.3. Air Quality Monitoring by CDOT and Clear Creek County

CDOT and Clear Creek County installed three monitors in Clear Creek County (in Dumont, Idaho Springs, and Floyd Hill) to collect air quality data in March 2019. These monitors are not regulatory monitors and were installed for informational purposes. The data from these monitors were not used as part of the air quality modeling performed for the analysis documented in this report and are not used to determine compliance with the NAAQS. Mountainous topography has unique dispersion characteristics making some current air quality monitoring non-representative of the Project area. Furthermore, for purposes of modeling, estimating dispersion in mountainous topography comes with its own challenges with varying wind patterns and potential landscape changes.

The monitors record pollutant levels hourly every day (when in operation) for CO, NOx, ozone, and PM_{10} and $PM_{2.5}$. There are days and weeks when one or more of the pollutants are not sampled, and the data are sparsely recorded from month to month. APCD does not include data collected from these monitors in its annual reporting.

Generally, the pollutant levels recorded between July 2019 and November 2020 at the Floyd Hill and Idaho Springs monitors are below the NAAQS, except for ozone. Data collection has not been consistently recorded every hour since the data collection started in 2019. The NAAQS for ozone is determined by the average of the fourth highest average recorded over each of the past 3 years. This means that there has not been enough data collected to determine whether the ozone NAAQS was exceeded since the monitor has been recording data. However, the Idaho Springs monitor recorded hourly levels above the NAAQS of 70 ppb over an 8-hour period 27 times between July 2019 and November 2020, with approximately three-fourths of those recordings occurring during wildfire events. The fourth highest 8-hour average of the hourly records collected is 82.3 ppb at Idaho Springs. The Floyd Hill monitor recorded hourly levels above the NAAQS of 70 ppb over an 8-hour period 496 times between July 2019 and November 2020, with approximately three-fourth of those recordings occurring during wildfire events. The fourth highest 8-hour average of the hourly records collected is 74.9 ppb at Floyd Hill.

The data for other pollutants, especially PM and NOx, show high pollutant concentrations only during extraordinary events, such as smoke from wildfires in the region (see Appendix A4 to the EA). Outside of the extraordinary events, the hourly recordings for CO, NOx, and PM_{10} and $PM_{2.5}$ are well below the NAAQS. See Exhibit 4 for hourly recordings that exclude extraordinary events.

In addition to these monitors, CDOT plans to monitor PM during construction activities of the Project due to knowledge of and stakeholder concerns about increased PM_{10} and $PM_{2.5}$ emission impacts of these construction activities. Additionally, CDOT has plans to install two long-term regulatory-grade air quality monitors in Idaho Springs and on Floyd Hill to collect regulatory-quality data on local air quality conditions and trends. These monitors will be installed to better inform air quality impacts within the and overcome the challenge with estimating potential impacts within the I-70 Mountain Corridor with monitoring data that is representative of the local topography, climate, and dispersion characteristics. The monitors will be operated and maintained per EPA and CDPHE guidelines, however, will not be used for NAAQS compliance determinations. These monitors will be the property of CDOT; specific details of the monitoring plan are still in progress.

Exhibit 4. Average of Recorded Pollutant Levels at Floyd Hill and Idaho Springs Monitoring Stations

Readings	CO (ppb)	NO (ppb)	NO_2 (ppb)	NOx (ppb)	O_3 (ppb)	$PM_{1.0}$ (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
Floyd Hill Average Hourly Reading	96.0	2.2	13.1	15.4	36.3	3.1	5.6	5.6
Idaho Springs Average Hourly Reading	136.6	1.3	25.4	27.0	13.2	2.0	3.8	3.5
NAAQS	9,000	n/a	53	n/a	70	n/a	150	35

Data collected from July 2019 to November 2020

5. Emissions Modeling Methodology

This section outlines steps followed to complete the emissions modeling using Motor Vehicle Emission Simulator (MOVES) version 2014b as part of the quantitative assessment in this report. The quantitative assessment in this section is an evaluation of emissions. Modeling data are included in the project record and are available by request. The conformity evaluation for this Project was discussed in the *I-70 Floyd Hill to Veterans Memorial Tunnels Air Quality Technical Report* (Appendix A4 to the EA).

5.1. Traffic Data

Traffic data are a key input to air quality modeling. Required data include vehicle type distribution, vehicle volumes, and average vehicle speed. This information is required for each link and time period being modeled. The I-70 Mountain Corridor has unique travel patterns, with peak traffic occurring on weekends driven by recreational travel and showing significant seasonal changes. Weekday traffic tends to follow more normal commuter traffic behavior. Traffic data for air quality modeling purposes were gathered from two sources: the microsimulation traffic models developed for the EA and the CDOT statewide activity-based travel demand model.

5.1.1. Microsimulation Model Results

On the I-70 Mountain Corridor, peak traffic conditions exist on weekends, with westbound peak traffic occurring on winter Saturday mornings and eastbound peak traffic occurring on summer Sunday afternoons. Seasonal trends also influence peaking behavior, with much higher volumes in summer and winter. To capture this in the air quality analysis, peak weekend traffic information was obtained from the microsimulation traffic models developed for the EA. These models captured daytime hours (4:00 a.m. to 10:00 p.m.) for Saturdays and Sundays for both existing conditions (2018) and future conditions (2045) for all no action and action alternatives. Further detail on the development of modeled weekend peak volumes is provided in the *I-70 Floyd Hill to Veterans Memorial Tunnels Traffic Analysis Methodology Memorandum* Appendix A1 to the EA).

To use these results in the air quality analysis, several assumptions and post-processing activities occurred. These are discussed below.

5.1.1.1. *Accounting for Overnight Hours*

The microsimulation model developed for use in the EA only captured the hours between 4:00 a.m. and 10:00 p.m. To capture the additional overnight hours, 24-hour traffic count data collected for development of the 2018 existing conditions model were reviewed. It was assumed that the ratio of vehicles traveling overnight compared to those traveling during the daytime hours (captured in the microsimulation model) would remain constant for future years and all action alternative scenarios. Using this assumption, the overnight vehicle volumes were estimated using the daytime volumes captured in the microsimulation model. Furthermore, it was assumed that there is no congestion during the overnight hours and, therefore, all traffic travels at or near free-flow speeds.

5.1.1.2. *Aggregating Results to Match the Air Quality Analysis Time Periods*

The results obtained from the microsimulation models were reported originally in 30-minute intervals. These results then needed to be aggregated together to match the pre-defined time periods used in the air quality analysis (see Section 5.3). For volumes, this was done by adding together individual 30-

minute periods as needed. For speeds, this was completed by calculating the volume-weighted average of speed for each segment for each given period.

5.1.2. Travel Demand Model Results

The traffic analysis completed for the EA was done only for the peak weekend travel times. However, for the air quality analysis, traffic data for weekday periods also were needed. To obtain these data, the statewide travel demand model developed by CDOT was used. This activity-based travel demand model was used to obtain volume and speed data for the no action and action alternatives conditions for both the existing conditions (2018) and future planning horizon (2045). Action alternatives conditions were modeled using the same geometry as the microsimulation model in the Project area. The same trip table was used for all future models to ensure a common basis for comparison.

5.2. Model Selection

The model choice for the quantitative analysis is the EPA model, MOVES. The official release of MOVES3 was announced in the Federal Register on January 7, 2021. The Federal Register noted a two-year transportation conformity grace period for MOVES3 that ends on January 9, 2023. Therefore, this analysis used the approved MOVES 2014b version.

MOVES has an onroad and a nonroad mobile source model selection. The onroad mobile source selection was used for emissions estimates for vehicles and traffic changes for the existing and Project alternative conditions. For the onroad model, the inventory calculation type with the national domain/scale database was used to determine the emissions rate within a region over a specified time period.

5.3. Model Years and Time Periods

The Project evaluated existing conditions in Year 2018 and three Project alternatives in Year 2045.

Due to the nature of I-70 traffic patterns where weekday traffic is vastly different than weekend traffic, the model results were evaluated separately for weekdays (Monday through Friday) and each weekend day (Saturday and Sunday). Traffic data were provided for average weekday travel, peak Saturday travel, and peak Sunday travel, as described in Section 5.2. Upon review of the data, highest daily travel occurs during the summer season, however peaks in the winter season are comparable. Existing conditions 2018, No Action Alternative 2045, Tunnel Alternative 2045, and Canyon Viaduct Alternative 2045 were evaluated separately for emissions estimates on weekdays, Saturdays, and Sundays in post-processing.

The MOVES 2014b model evaluates time aggregation as broad as an annual level to as granular as an hourly level. This Project evaluated time aggregation on an hour level based on varied traffic levels throughout a day. Each hour provided an emissions rate, and an average emissions rate for each hour grouping was calculated for the model result. Based on traffic data, the hour groupings that are best suited for the Project are:

- OP1: overnight: 11:00 p.m. to 6:29 a.m.
- AM1: AM early shoulder: 6:30 a.m. to 6:59 a.m.
- AM2: AM peak hour: 7:00 a.m. to 7:59 a.m.
- AM3: AM late shoulder: 8:00 a.m. to 8:59 a.m.
- OP2: early midday: 9:00 a.m. to 11:29 a.m.
- OP3: late midday: 11:30 a.m. to 2:59 p.m.

- PM1: PM early shoulder: 3:00 p.m. to 4:59 p.m.
- PM2: PM peak hour: 5:00 p.m. to 5:59 p.m.
- PM3: PM late shoulder: 6:00 p.m. to 6:59 p.m.
- OP4: evening: 7:00 p.m. to 10:59 p.m.

5.4. Geographic Bounds

As shown in Exhibit 1, the Project area spans Clear Creek and Jefferson counties. Both counties were chosen in the onroad model and provided in the output separately for emissions evaluation of roadways and traffic volumes in each county.

5.5. Emissions Sources

From the traffic model, the vehicles were divided into the following categories:

- Heavy-duty commercial vehicles (HCOM)
- Light-duty commercial vehicles (LCOM)
- Passenger cars (PC)

The MOVES 2014b model includes different vehicle and fuel combination types for evaluation. There are 13 vehicle types within the MOVES 2014b model. The traffic data does not have granular enough data to speciate vehicle types to determine the percentage of each vehicle type for emissions modeling. For the model input, the traffic model vehicle types were categorized further based on the type and purpose of the vehicles traveling on the roadways in the Project area and conservative emissions results:

- HCOM – diesel combination long-haul truck
- LCOM – diesel light commercial truck
- PC – gasoline passenger truck

All 13 vehicle types in MOVES 2014b were modeled to determine the highest emissions factor per mile driven. For HCOM, the potential vehicle types are intercity buses, school buses, motor homes, short haul trucks (single unit and combination), long haul trucks (single unit and combination), transit buses, and refuse trucks. Based on known prevalent vehicle types and the vehicle counts for HCOM on the I-70 Mountain Corridor, intercity buses, transit buses, motor homes, and school buses were uncommon in the I-70 Mountain Corridor and the small vehicle numbers would not affect model outcomes. Upon review of the emissions factors for the remaining HCOM, combination long haul trucks were determined to have a higher emissions factor (emissions per mile) than single unit long haul trucks, single unit short haul trucks, and combination short haul trucks. Additionally, diesel-fueled combination long haul trucks were determined to have the higher emissions factor, comparatively. Therefore, emissions factors for diesel combination long haul trucks were used for HCOM, to be conservative. For LCOM, there is only one vehicle type: light commercial truck. Diesel light commercial truck emissions factors were determined to be higher than gasoline light commercial truck emissions factors. Therefore, emissions factors for diesel light commercial trucks were used for LCOM, to be conservative. For PC, the available MOVES 2014b vehicle types were motorcycles, passenger cars, and passenger trucks. Gasoline passenger trucks were determined to have higher emissions factors compared to motorcycles and passenger cars. Therefore, emissions factors for gasoline passenger trucks were used for PC, to be conservative. With the recent zero-emissions vehicle (ZEV) and low-emissions vehicle (LEV) legislation, it is likely that the Project alternatives will include a percentage of electric vehicles. Since there is no concrete data on future LEV or ZEV, these vehicles were not included in the emissions factors. This approach is conservative in estimating Project area emissions in 2045.

5.6. Road and Structure Types

The Project area covers rural roads, some with unrestricted access and some with restricted access. For the model to run for all necessary pollutants, all road types had to be evaluated. However, post-processing selected only unrestricted rural and restricted rural roads for each segment as provided by the traffic engineers.

5.7. Pollutants

The existing conditions, No Action Alternative 2045, Canyon Viaduct Alternative 2045, and Tunnel Alternative 2045 evaluated criteria pollutants, mobile source air toxics (MSATs), and GHGs for both onroad (e.g., vehicle traffic).

Criteria pollutants modeled include:

- NOx
- CO
- Volatile organic compounds (VOC) as a precursor to O_3
- PM_{10}
- $PM_{2.5}$

PM_{10} and $PM_{2.5}$ occur on paved public roadways from fugitive dust in addition to combustion of fuel to travel. To estimate emissions from fugitive dust on paved public roadways, EPA AP-42 emissions methodology procedures were used, specifically Equation 1 of Section 13.2.1. The appropriate particle size multiplier was used for PM_{10} and $PM_{2.5}$, respectively and the silt loading parameter was retrieved from Table 13.2.1-2 based on daily traffic volumes. Average weight tons were calculated based on percentages of PC times 3 tons per PC, percentages of LCOM times 6 tons per LCOM, and percentages of HCOM times 40 tons per HCOM.

MSATs modeled include:

- Diesel PM
- 1,3-Butadiene
- Benzene
- Formaldehyde
- Acetaldehyde
- Acrolein
- Naphthalene
- Ethylbenzene
- Polycyclic Organic Matter (POM)

GHGs modeled include:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)

Individual GHGs were modeled, as well as a carbon dioxide equivalents (CO_2e), using the 100-year global warming potentials (GWPs) of individual GHGs. A GWP accounts for a specific GHG's longevity and ability to hold heat in the atmosphere as compared to CO_2. The GWPs published in the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 4 (AR4) 100-year timeframe were used to calculate CO_2e: CO_2 GWP is 1, CH_4 GWP is 25, and N_2O GWP is 298 (IPCC, 2007).

5.8. Meteorology Data

Local meteorological data were imported for pre-processing. Temperature data were provided by CDPHE based on available data and Project location. The Henderson Mine meteorological dataset from 1997 was suggested to be used by CDPHE. The Henderson mine is located approximately 20 miles west of Idaho Springs. Monthly relative humidity data were retrieved for Idaho Springs also for inclusion in the MOVES 2014b model. The input parameters for meteorological data are included in Appendix A.

5.9. Average Speed

Average speed data provided by traffic engineers showed that different segments along the Project area spanned speeds ranging from 0 mph to 80 mph (speed bins). The model has 16 speed bins, tabulated in Exhibit 5. Model output emissions rates were applied to each road segment and time period combination based on its expected average speed modeled by traffic engineers.

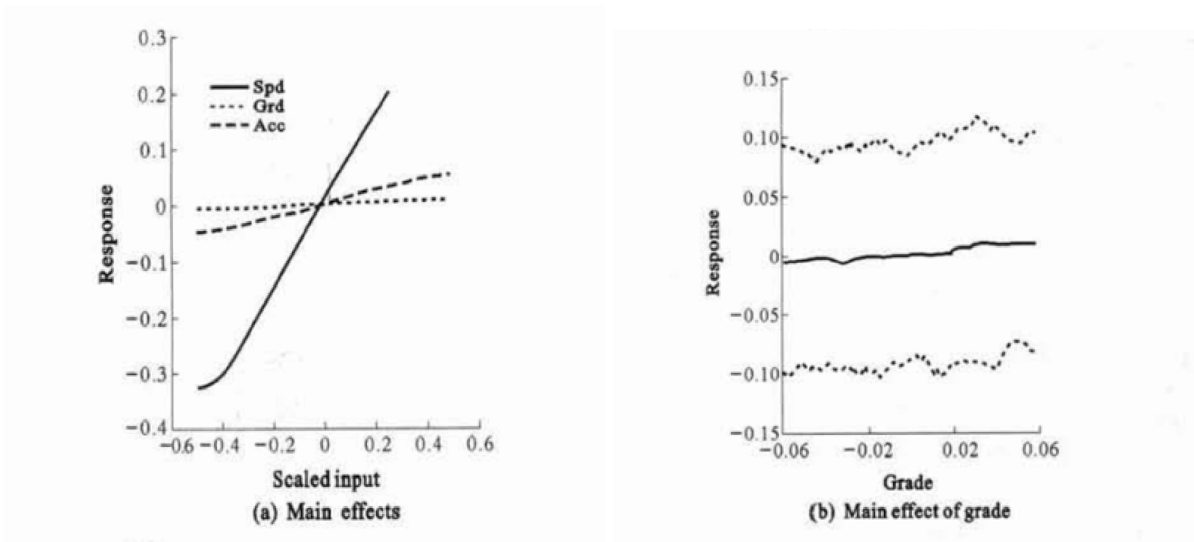
Exhibit 5. Speed Bins

Speed Bin	Speed Bin Description
1	Speed < 2.5 mph
2	2.5 mph ≤ Speed < 7.5 mph
3	7.5 mph ≤ Speed < 12.5 mph
4	12.5 mph ≤ Speed < 17.5 mph
5	17.5 mph ≤ Speed < 22.5 mph
6	22.5 mph ≤ Speed < 27.5 mph
7	27.5 mph ≤ Speed < 32.5 mph
8	32.5 mph ≤ Speed < 37.5 mph
9	37.5 mph ≤ Speed < 42.5 mph
10	42.5 mph ≤ Speed < 47.5 mph
11	47.5 mph ≤ Speed < 52.5 mph
12	52.5 mph ≤ Speed < 57.5 mph
13	57.5 mph ≤ Speed < 62.5 mph
14	62.5 mph ≤ Speed < 67.5 mph
15	67.5 mph ≤ Speed < 72.5 mph
16	Speed ≥ 72.5 mph

5.10. Grade

Due to the location in the I-70 Mountain Corridor, the Project area has elevation changes ranging from about 7,200 to 7,900 feet above sea level. The maximum grade changes are approximately 6 percent along the two-mile section of Floyd Hill (approximately MP 246 to MP 244), causing the gradient to range from -6 percent (downhill) to +6 percent (uphill). The incline or decline of a road may have an impact on emissions as the amount of energy, and thus fuel consumption, would be different. To travel uphill requires more energy, and therefore *more* fuel, than to travel at a level elevation and would likely result in higher emissions. To travel downhill requires less energy, and therefore *less* fuel, than to travel at a level elevation and would likely result in lower emissions. Results of a sensitivity analysis on grade, speed, and acceleration using the MOVES model were published in the Journal of Traffic and Transportation Engineering's article *Sensitivity analysis of project level MOVES running emission rates for light and heavy duty vehicles* (Yao et al, 2014). The study analyzed the algorithm used by MOVES to determine the amount of energy consumption, which directly correlates to fuel consumption and emissions and is dependent on the traveling vehicle weight, acceleration, speed, and grade. The sensitivity analysis concluded based on quantitative data that changes in road grade do not result in significant of changes in required energy or fuel consumption, and therefore, emissions. The study found that grade has little effect on outputs in MOVES, particularly in comparison to speed and acceleration. Exhibits 6 shows the graphic representation of the study's findings regarding changes in MOVES results based on changes in speed, acceleration, and grade.

Exhibit 6. Yao et al., 2014 Sensitive Analysis Results – MOVES Emission Rates with Changes in Speed, Acceleration, and Grade



For a change in grade from approximately -6 percent to +6 percent, the net change in required energy for a vehicle to travel (i.e., the amount of fuel consumed) is on the order of a 1 percent change compared to a level or flat elevation (i.e., 0 percent grade) (See Exhibit 6, which is a reproduction of Figure 3 Yao et al, 2014). Since the change in required energy for a vehicle to travel the grade in the Project area is minimal, the change in emissions output can also be determined to be minimal. Due to the low sensitivity of grade changes within the MOVES model within the -6 percent to +6 percent range (similar to the Project area), the default level (0 percent) grade in the MOVES model has a minimal impact on the emission calculations. Additionally, since the Project includes both and westbound (downhill) and eastbound (uphill) travel on the same roadways, the potential increase in emissions for uphill travel would be offset by the potential decrease in emissions for downhill travel. Therefore, the approach to model using the default 0 percent grade is expected to provide a reasonably predictive estimate of emissions.

5.11. Vehicle Age Distribution

To properly account for the vehicle emissions standards of varying ages of vehicles (and lower emissions for newer model years), an age distribution import file was included in all the models. The age distribution in Exhibit 7 was retrieved from the *I-70 East Final Environmental Impact Statement Attachment J Air Quality Technical Report* (CDOT, 2016). Variations in vehicle age distribution may exist with more recent data; however, changes are likely insignificant and would not impact overall emissions results. It was conservatively assumed that the same vehicle age distribution was used for existing conditions and Project conditions for all alternatives. While future vehicle purchase trends are unknown in terms of rate of new car purchases to used car purchases. it is nearly certain that the average age of vehicles will be newer in 2045 than 2018. As described in Section 5.5, proposed conditions for the Project alternatives do not include electric vehicles. The vehicle age distribution file imported into the model for all model runs is included in Exhibit 7.

Exhibit 7. Vehicle Age Distribution

Vehicle Age (relative to 2018)	Passenger Truck (percent)	Light Commercial Truck (percent)	Combination Short-Haul Truck (percent)
1	2.04 percent	1.90 percent	1.46 percent
2	4.36	3.87	2.04
3	2.97	3.06	2.51
4	6.04	6.06	3.55
5	6.28	6.27	7.87
6	6.08	6.39	5.30
7	6.69	6.66	6.47
8	7.00	7.15	4.02
9	6.26	6.45	5.48
10	6.70	6.66	3.90
11	6.38	6.50	5.77
12	6.18	6.09	8.97
13	5.53	5.59	7.40
14	4.41	4.13	4.08
15	3.89	3.99	4.37
16	2.95	2.94	3.96
17	2.77	2.84	4.20
18	2.32	2.29	3.32
19	1.76	1.73	3.32
20	1.27	1.31	1.92
21	1.13	1.11	1.28
22	0.94	0.96	1.34
23	0.83	0.89	1.40
24	0.68	0.68	1.40

Vehicle Age (relative to 2018)	Passenger Truck (percent)	Light Commercial Truck (percent)	Combination Short-Haul Truck (percent)
25	0.49	0.49	0.82
26	0.45	0.48	0.93
27	0.36	0.39	1.10
28	0.30	0.35	0.41
29	0.18	0.19	0.17
30+	0.14	0.18	0.52

5.12. Fuel

Specific parameters of fuel composition, either gasoline or diesel, were not available. Therefore, the default parameters for both diesel and gasoline in MOVES 2014b were used as provided by EPA State Implementation Plan (SIP) and transportation conformity guidance. Recent legislation topics on retrofitting large diesel commercial vehicles to other less-pollutant intensive fuels has been proposed by the CDPHE, but nothing has been enacted yet. For that reason, the air quality analysis does not assume diesel-fueled vehicles will be retrofitted under any of the Project alternatives for a conservative analysis.

5.13. Inspection and Maintenance Parameters

A vehicle inspection and maintenance (I/M) program is currently not in place for Clear Creek County. Conservatively, I/M parameters were not added to the MOVES 2014b model. This is a conservative approach as many vehicles traveling in the mountain corridor within the Project area are from Denver metro area where certain inspection and maintenance requirements are in place.

5.14. Post Processing

MOVES requires minimal post processing to determine emissions rates. The onroad mobile source model has a post-processing template for Emissions Rates where pollutant emissions are output in pounds per mile (lb/mi). The output is classified to the appropriate road segment, time period, speed bin, road type, and pollutant combination for the breakout of vehicle types and hours groupings of the traffic model. Spreadsheets organizing the outputs bulleted below were created to organize the emissions results for each road segment as provided by the traffic model output. Separate tabs were created for each time period modeled in the traffic analysis (see Section 5.3), as each time period had different traffic volumes, roadway segment traveling speeds, and vehicle type percentages (e.g., percent of HCOM, percent LCOM, percent of PC) requiring separate analysis. For ease of review, the emissions were converted from pounds to tons using the conversion of 1 ton equaling 2,000 pounds for criteria and GHG pollutants. MSATs were kept in the unit of pounds due to their emissions quantity.

- Existing Weekday
- Existing Saturday
- Existing Sunday
- No Action Weekday
- No Action Saturday
- No Action Sunday

- Canyon Viaduct Weekday
- Canyon Viaduct Saturday
- Canyon Viaduct Sunday
- Tunnel Weekday
- Tunnel Saturday
- Tunnel Sunday

GHG emissions are more suited for comparison on an annual basis rather than hourly or daily due to their chemistry and persistence in the atmosphere. Therefore, GHG, namely CO_2e emissions were compared for existing conditions and Project Alternative conditions based on estimated yearly totals. Since traffic data are provided for average weekday, peak Saturday (summer, and only slightly lower in winter), and peak Sunday (summer, and only slightly lower in winter), assumptions were made to estimate CO_2e totals. Peak weekends were assumed to occur during January, February, March, July, August, and December, which equates 26 weekends or 52 days out of the year. Conservatively, non-peak weekends were assumed to have the same average daily traffic as an average weekday. Therefore, CO_2e emissions were estimated assuming average weekday traffic for 313 days out of the year, peak Saturday traffic for 26 days out of the year, and peak Sunday traffic for 26 days out of the year for existing conditions and each of the Project Alternatives. Daily emissions totals generated for GHGs, similar to criteria and MSATs, were totaled and summed based on this methodology to estimate annual GHG emissions.

5.15. Construction (Nonroad) Emissions

At this time, no specific construction, nonroad equipment, or schedule of construction activities has been developed, so a quantitative assessment of emissions estimates for the Project alternatives from nonroad sources is not able to be evaluated. However, a qualitative assessment of construction emissions is included in Section 6, as well as specific commitments CDOT will make as it relates to construction emissions for this Project.

6. Emissions Model Results

The methodology in Section 5 was followed using the MOVES 2014b model to estimate emissions from each road segment of the Project area provided by the traffic modeling. The output from the MOVES 2014b model was emissions factors in units of lb/mi for each vehicle type, fuel type, time of day, and traveling speed. These emissions factors were post-processed for each road segment based on traffic data, noting average vehicles traveled during a specific time of day (Section 5.3) and the vehicles' traveling speed during a weekday, Saturday, and Sunday for existing conditions and for the three alternatives. The road segments' emissions totals for each time period and then a daily total was added together and are presented in Exhibit 8 through Exhibit 22. For comparison, the emissions totals are divided by Output Scenario—namely, the weekday, Saturday, or Sunday totals for existing conditions and the alternatives. It is important to note that these are the modeled emissions for a part of the day or one full day across the entire Project area except for GHGs where estimates are made on an annual basis.

The MOVES model results show that, generally, the highest emissions periods for the modeled pollutants in a day (Exhibit 8 through Exhibit 22) occur during peak traffic periods. Peak traffic periods are morning peak travel between 7:00 a.m. and 7:59 a.m. (AM2) and evening peak travel between 5:00 p.m. and 5:59 p.m. (PM2), though generally during AM2. Additionally, Saturday yields the highest emissions results when compared to a typical weekday and Sunday. For this reason, further analysis on potential impacts from the Project was conducted, for informational purposes for the Saturday AM2 time period. The methodology and results from the impacts analysis is discussed in Sections 6 and 7 of this report. The three alternatives modeled daily emissions are less than existing conditions for a weekday, Saturday, and Sunday. The most prominent reason is that older vehicles are replaced by newer, more fuel-efficient vehicles along with higher traveling speeds as a result of less congestion.

It is important to note that the emissions analysis in Section 6 does not quantify emissions from construction of the Project itself, under any of the Project alternatives. Emissions from construction materials, construction equipment, and construction vehicles were not evaluated in this report. Given the Project's size, these construction activities could represent a large, temporary source of criteria, MSAT, and GHG emissions.

6.1. Nitrogen Oxides

Exhibit 8 depicts the modeled emissions for NOx. For ease of comparison, the results shown are broken out by alternative (output scenario) and time of day.

Exhibit 8. NOx Emissions Results (tons per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.03	0.01	0.03	0.02	0.04	0.06	0.05	0.03	0.02	0.04	0.33
Existing Saturday	0.07	0.04	0.09	0.09	0.14	0.19	0.09	0.04	0.03	0.08	0.86
Existing Sunday	0.04	0.01	0.03	0.03	0.12	0.19	0.09	0.04	0.04	0.08	0.67
No Action Weekday	0.01	2e-3	7e-3	6e-3	0.01	0.01	0.01	6e-3	4e-3	0.01	**0.08**
No Action Saturday	0.02	0.01	0.01	0.01	0.04	0.05	0.02	0.01	0.01	0.01	**0.19**
No Action Sunday	0.01	2e-3	5e-3	0.01	0.02	0.04	0.02	0.01	0.01	0.02	**0.15**
Canyon Viaduct Weekday	0.01	2e-3	7e-3	5e-3	0.01	0.02	0.01	6e-3	4e-3	0.01	0.08
Canyon Viaduct Saturday	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.02	0.16
Canyon Viaduct Sunday	0.01	2e-3	4e-3	5e-3	0.02	0.03	0.02	0.01	0.01	0.02	0.13
Tunnel Weekday	0.01	2e-3	6e-3	6e-3	0.01	0.02	0.01	6e-3	4e-3	0.01	0.08
Tunnel Saturday	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.02	0.15
Tunnel Sunday	0.01	2e-3	4e-3	5e-3	0.02	0.03	0.02	0.01	0.01	0.02	0.13

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily modeled NOx emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, NOx emissions in the future are estimated to be approximately 75 percent to 83 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion). The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak travel times (AM2 and PM2) show highest AM and PM peak period emissions for the No Action Alternative for all three day types.

6.2. Carbon Monoxide

Exhibit 9 depicts the modeled emissions for CO. For ease of comparison, the results shown are broken out by alternative (output scenario) and time of day.

Exhibit 9. CO Emissions Results (tons per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.16	0.04	0.14	0.12	0.19	0.31	0.26	0.14	0.10	0.20	1.66
Existing Saturday	0.26	0.16	0.33	0.30	0.56	0.77	0.37	0.14	0.12	0.25	3.26
Existing Sunday	0.14	0.04	0.10	0.13	0.48	0.76	0.34	0.14	0.13	0.27	2.53
No Action Weekday	0.07	0.02	0.05	0.04	0.07	0.07	0.10	0.05	0.03	0.04	0.54
No Action Saturday	0.10	0.04	0.07	0.04	0.17	0.24	0.12	0.05	0.04	0.08	0.95
No Action Sunday	0.04	0.01	0.03	0.04	0.15	0.16	0.11	0.05	0.03	0.09	0.71
Canyon Viaduct Weekday	0.07	0.02	0.05	0.04	0.07	0.12	0.09	0.05	0.03	0.07	**0.61**
Canyon Viaduct Saturday	0.10	0.05	0.08	0.07	0.15	0.23	0.12	0.05	0.04	0.08	**0.97**
Canyon Viaduct Sunday	0.04	0.01	0.03	0.04	0.15	0.24	0.11	0.04	0.04	0.08	**0.78**
Tunnel Weekday	0.07	0.02	0.03	0.04	0.07	0.12	0.09	0.05	0.03	0.07	0.59
Tunnel Saturday	0.06	0.04	0.08	0.07	0.16	0.24	0.12	0.05	0.04	0.08	0.94
Tunnel Sunday	0.04	0.01	0.03	0.04	0.15	0.24	0.11	0.04	0.04	0.05	0.75

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily CO emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, CO emissions in the future are estimated to be approximately 63 percent to 72 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion). The Canyon Viaduct Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak travel times (AM2 and PM2) show highest AM peak period emissions for the Canyon Viaduct Alternative for all three day types. The highest PM peak period emissions are estimated for the No Action Alternative for all three day types.

6.3. Volatile Organic Compounds

Exhibit 10 depicts the modeled emissions for VOC. For ease of comparison, the results shown are broken out by alternative (output scenario) and time of day.

Exhibit 10. VOC Emissions Results (tons per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.01	0.001	0.005	0.004	0.01	0.01	0.01	0.005	0.003	0.01	0.07
Existing Saturday	0.01	0.01	0.02	0.02	0.03	0.03	0.02	0.01	0.01	0.01	0.17
Existing Sunday	0.01	0.002	0.005	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0.13
No Action Weekday	0.002	4e-4	0.001	0.001	2e-3	0.003	0.002	0.001	0.001	0.002	**0.02**
No Action Saturday	0.003	0.002	0.005	0.002	0.01	0.02	0.005	0.001	0.001	0.002	**0.05**
No Action Sunday	0.001	4e-4	0.001	0.001	4e-3	0.01	0.003	0.001	0.002	0.003	**0.03**
Canyon Viaduct Weekday	0.002	4e-4	0.001	0.001	2e-3	3e-3	0.002	0.001	0.001	0.002	0.02
Canyon Viaduct Saturday	0.003	0.002	0.004	0.003	0.01	0.01	0.003	0.001	0.001	0.002	0.04
Canyon Viaduct Sunday	0.001	4e-4	0.001	0.001	4e-3	0.01	0.003	0.001	0.001	0.003	0.03
Tunnel Weekday	0.002	4e-4	0.001	0.001	2e-3	0.003	0.002	0.001	0.001	0.002	0.02
Tunnel Saturday	0.003	0.002	0.004	0.003	5e-3	0.007	0.003	0.001	0.001	0.002	0.03
Tunnel Sunday	0.001	3e-4	0.001	0.001	4e-3	0.007	0.003	0.001	0.001	0.002	0.02

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily VOC emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, VOC emissions in the future are estimated to be approximately 70 percent to 80 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion). The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak travel times (AM2 and PM2) show the highest AM peak period and highest PM peak period emissions for the No Action Alternative for all three day types.

6.4. Particulate Matter

Exhibit 11 depicts the modeled emissions for PM_{10} added with fugitive dust calculations for PM_{10} based on AP-42 procedures. For ease of comparison, the results shown are broken out by alternative (output scenario) and time of day.

Exhibit 11. PM_{10} Emissions Results (tons per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.003	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.002	0.003	0.03
Existing Saturday	0.003	0.002	0.005	0.005	0.006	0.008	0.004	0.002	0.002	0.004	0.04
Existing Sunday	0.002	9e-4	0.001	0.002	0.005	0.008	0.004	0.002	0.002	0.004	0.03
No Action Weekday	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.01
No Action Saturday	0.001	8e-4	0.001	8e-4	0.003	0.003	0.001	7e-4	6e-4	9e-4	0.01
No Action Sunday	8e-4	5e-4	6e-4	7e-4	0.001	0.002	0.001	7e-4	8e-4	0.001	0.01
Canyon Viaduct Weekday	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.002	**0.02**
Canyon Viaduct Saturday	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.001	0.001	0.001	**0.01**
Canyon Viaduct Sunday	0.001	8e-4	9e-4	0.001	0.002	0.002	0.001	0.001	0.001	0.001	**0.01**
Tunnel Weekday	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.02
Tunnel Saturday	0.001	9e-4	0.001	0.001	0.002	0.002	0.001	9e-4	9e-4	0.001	0.01
Tunnel Sunday	0.001	8e-4	8e-4	9e-4	0.002	0.002	0.001	0.001	0.001	0.001	0.01

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

Exhibit 12 depicts the emissions results for $PM_{2.5}$ added with fugitive dust calculations for $PM_{2.5}$ based on AP-42 procedures. For ease of comparison, the results shown are broken out by alternative (output scenario) and time of day.

Exhibit 12. $PM_{2.5}$ Emissions Results (tons per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.001	7e-4	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.002	0.01
Existing Saturday	0.003	0.002	0.004	0.004	0.005	0.007	0.004	0.002	0.001	0.003	0.04
Existing Sunday	0.002	5e-4	0.001	0.001	0.005	0.007	0.003	0.002	0.001	0.003	0.03
No Action Weekday	6e-4	4e-4	5e-4	5e-4	6e-4	8e-4	7e-4	5e-4	5e-4	6e-4	0.01
No Action Saturday	8e-4	4e-4	8e-4	5e-4	0.002	0.003	0.001	4e-4	3e-4	6e-4	0.01
No Action Sunday	4e-4	2e-4	3e-4	4e-4	0.001	0.002	8e-4	4e-4	5e-4	7e-4	0.01
Canyon Viaduct Weekday	7e-4	4e-4	5e-4	5e-4	7e-4	8e-4	7e-4	5e-4	5e-4	7e-4	**0.01**
Canyon Viaduct Saturday	0.001	5e-4	8e-4	6e-4	0.001	0.002	0.001	5e-4	4e-4	7e-4	**0.01**
Canyon Viaduct Sunday	5e-4	3e-4	4e-4	4e-4	0.001	0.002	9e-4	5e-4	5e-4	8e-4	**0.01**
Tunnel Weekday	7e-4	5e-4	6e-4	5e-4	7e-4	9e-4	7e-4	6e-4	5e-4	7e-4	0.01
Tunnel Saturday	7e-4	5e-4	8e-4	6e-4	0.001	0.002	9e-4	5e-4	4e-4	7e-4	0.01
Tunnel Sunday	5e-4	3e-4	4e-4	4e-4	0.001	0.002	9e-4	5e-4	5e-4	7e-4	0.01

1 Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily PM (PM_{10} and $PM_{2.5}$) emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, PM emissions in the future are estimated to be approximately 20 percent to 77 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The wide range of variation in reduction is due to the fugitive dust emissions that will still result from vehicles on paved roadways. The Canyon Viaduct Alternative is the highest estimated daily Weekday, Saturday, and Sunday totals. Peak travel times (AM2 and PM2) are comparable across all alternatives. The highest AM and PM peak period emissions for PM are estimated for the No Action Alternative.

6.5. Mobile Source Air Toxics

Exhibit 13 through Exhibit 21 depict the modeled emissions for MSATs. MSATs that were modeled are Diesel PM (Exhibit 13), 1,3-Butadiene (Exhibit 14), Benzene (Exhibit 15), Formaldehyde (Exhibit 16), Acetaldehyde (Exhibit 17), Acrolein (Exhibit 18), Naphthalene (Exhibit 19), Ethylbenzene (Exhibit 20), and POM (Exhibit 21). For ease of comparison, the results shown are broken out by output scenario and time of day.

Exhibit 13. Diesel-PM Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	1.31	0.36	1.14	0.96	1.58	2.54	2.16	1.16	0.81	1.65	13.7
Existing Saturday	4.66	3.4	7.76	7.81	9.39	12.37	6.31	2.71	2.21	5.08	61.7
Existing Sunday	2.82	0.70	1.66	2.08	7.66	12.45	5.75	2.48	2.37	5.27	43.2
No Action Weekday	0.29	0.07	0.22	0.18	0.30	0.65	0.41	0.22	0.15	0.40	**2.89**
No Action Saturday	0.97	0.49	1.27	0.60	3.66	4.52	1.42	0.46	0.37	0.80	**14.6**
No Action Sunday	0.49	0.13	0.31	0.39	1.43	2.41	1.11	0.52	0.67	0.97	**8.4**
Canyon Viaduct Weekday	0.29	0.07	0.22	0.18	0.30	0.50	0.41	0.22	0.14	0.31	2.64
Canyon Viaduct Saturday	1.03	0.53	1.02	0.67	1.50	2.31	1.16	0.50	0.41	0.91	10.0
Canyon Viaduct Sunday	0.51	0.13	0.31	0.38	1.41	2.32	1.08	0.47	0.44	0.96	8.01
Tunnel Weekday	0.29	0.07	0.28	0.18	0.30	0.50	0.41	0.22	0.14	0.31	2.70
Tunnel Saturday	0.92	0.54	1.05	0.78	1.46	2.29	1.16	0.51	0.42	0.91	10.04
Tunnel Sunday	0.48	0.12	0.29	0.36	1.43	2.34	1.09	0.48	0.44	0.87	7.90

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily Diesel PM emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, Diesel PM emissions in the future are estimated to be approximately 76 percent to 84 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak travel times (AM2 and PM2) are fairly comparable across all alternatives. The highest AM and PM peak period emissions for Diesel PM are estimated for the No Action Alternative.

Exhibit 14. 1,3-Butadiene Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.02	0.01	0.02	0.02	0.03	0.04	0.04	0.02	0.01	0.03	0.24
Existing Saturday	0.05	0.05	0.11	0.11	0.13	0.16	0.08	0.03	0.02	0.05	0.79
Existing Sunday	0.03	0.01	0.02	0.03	0.10	0.15	0.07	0.03	0.03	0.06	0.53
No Action Weekday	3e-4	1e-4	3e-4	2e-4	4e-4	1e-3	1e-3	3e-4	2e-4	5e-4	**0.004**
No Action Saturday	2e-3	1e-3	2e-3	1e-3	7e-3	9e-3	3e-3	1e-3	1e-3	1e-3	**0.03**
No Action Sunday	1e-3	2e-4	1e-3	1e-3	3e-3	5e-3	2e-3	1e-3	1e-3	2e-3	**0.02**
Canyon Viaduct Weekday	3e-4	1e-4	3e-4	2e-4	4e-4	1e-3	1e-3	3e-4	2e-4	4e-4	0.004
Canyon Viaduct Saturday	2e-3	1e-3	2e-3	1e-3	3e-3	4e-3	2e-3	1e-3	1e-3	1e-3	0.02
Canyon Viaduct Sunday	1e-3	2e-4	1e-3	1e-3	2e-3	4e-3	2e-3	1e-3	1e-3	2e-3	0.02
Tunnel Weekday	3e-4	1e-4	3e-4	2e-4	4e-4	1e-3	5e-4	3e-4	2e-4	4e-4	0.004
Tunnel Saturday	2e-3	1e-3	2e-3	1e-3	3e-3	4e-3	2e-3	1e-3	1e-3	1e-3	0.02
Tunnel Sunday	1e-3	2e-4	5e-4	1e-3	3e-3	4e-3	2e-3	1e-3	1e-3	1e-3	0.02

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily 1,3-Butadiene emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, 1,3-Butadiene emissions in the future are estimated to be approximately 96 percent to 98 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak travel times (AM2 and PM2) are fairly comparable across all alternatives. The highest AM and PM peak period emissions for 1,3-Butadiene are estimated for the No Action Alternative.

Exhibit 15. Benzene Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.22	0.06	0.19	0.16	0.27	0.43	0.37	0.20	0.13	0.28	2.31
Existing Saturday	0.34	0.26	0.65	0.61	0.83	1.00	0.48	0.19	0.15	0.34	4.85
Existing Sunday	0.19	0.05	0.14	0.17	0.62	0.98	0.45	0.18	0.17	0.35	3.30
No Action Weekday	0.05	0.01	0.04	0.03	0.05	0.06	0.07	0.03	0.02	0.04	**0.43**
No Action Saturday	0.07	0.04	0.08	0.04	0.21	0.27	0.10	0.03	0.03	0.06	**0.93**
No Action Sunday	0.03	0.01	0.02	0.03	0.11	0.16	0.08	0.03	0.04	0.06	**0.57**
Canyon Viaduct Weekday	0.05	0.01	0.04	0.03	0.05	0.08	0.07	0.03	0.02	0.05	0.43
Canyon Viaduct Saturday	0.07	0.04	0.07	0.05	0.11	0.17	0.08	0.03	0.03	0.06	0.71
Canyon Viaduct Sunday	0.03	0.01	0.02	0.03	0.11	0.17	0.08	0.03	0.03	0.06	0.57
Tunnel Weekday	0.05	0.01	0.03	0.03	0.05	0.08	0.07	0.03	0.02	0.05	0.42
Tunnel Saturday	0.06	0.04	0.07	0.06	0.11	0.17	0.08	0.03	0.03	0.06	0.71
Tunnel Sunday	0.03	0.01	0.02	0.03	0.11	0.17	0.08	0.03	0.03	0.05	0.56

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily Benzene emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, Benzene emissions in the future are estimated to be approximately 81 percent to 85 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak travel times (AM2 and PM2) are fairly comparable across all alternatives. The highest AM peak period emissions for Benzene are estimated for the Canyon Viaduct Alternative in the AM and the No Action Alternative in the PM.

Exhibit 16. Formaldehyde Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.27	0.07	0.23	0.20	0.32	0.52	0.44	0.24	0.17	0.34	2.80
Existing Saturday	1.32	1.07	2.58	2.56	3.04	3.80	1.86	0.75	0.60	1.32	18.9
Existing Sunday	0.73	0.21	0.51	0.63	2.34	3.74	1.69	0.71	0.66	1.39	12.6
No Action Weekday	0.11	0.03	0.08	0.07	0.11	0.23	0.15	0.08	0.05	0.14	**1.05**
No Action Saturday	0.46	0.27	0.69	0.34	1.96	2.46	0.80	0.22	0.18	0.37	**7.75**
No Action Sunday	0.21	0.06	0.15	0.19	0.70	1.33	0.54	0.24	0.32	0.43	**4.17**
Canyon Viaduct Weekday	0.11	0.03	0.08	0.07	0.11	0.18	0.15	0.08	0.05	0.11	0.97
Canyon Viaduct Saturday	0.48	0.30	0.55	0.35	0.80	1.19	0.56	0.23	0.18	0.40	5.04
Canyon Viaduct Sunday	0.22	0.06	0.15	0.18	0.70	1.13	0.52	0.22	0.20	0.42	3.80
Tunnel Weekday	0.11	0.03	0.10	0.07	0.11	0.18	0.15	0.08	0.05	0.11	0.99
Tunnel Saturday	0.44	0.30	0.56	0.41	0.75	1.14	0.56	0.23	0.19	0.40	4.98
Tunnel Sunday	0.21	0.06	0.14	0.17	0.70	1.14	0.52	0.22	0.20	0.40	3.76

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily Formaldehyde emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, Formaldehyde emissions in the future are estimated to be approximately 63 percent to 74 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion). The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. The highest AM and PM peak period emissions for Formaldehyde are estimated for the No Action Alternative in the AM and the No Action Alternative in the PM Weekday and Sunday and the Tunnel Alternative in the PM Saturday.

Exhibit 17. Acetaldehyde Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.14	0.04	0.12	0.10	0.16	0.27	0.23	0.12	0.08	0.17	1.43
Existing Saturday	0.58	0.48	1.16	1.14	1.36	1.68	0.82	0.33	0.26	0.58	8.39
Existing Sunday	0.32	0.09	0.23	0.28	1.03	1.65	0.75	0.31	0.29	0.61	5.56
No Action Weekday	0.04	0.01	0.03	0.02	0.04	0.08	0.05	0.03	0.02	0.05	**0.37**
No Action Saturday	0.15	0.09	0.22	0.11	0.63	0.79	0.25	0.07	0.06	0.12	**2.49**
No Action Sunday	0.07	0.02	0.05	0.06	0.23	0.43	0.17	0.08	0.10	0.14	**1.35**
Canyon Viaduct Weekday	0.04	0.01	0.03	0.02	0.04	0.06	0.05	0.03	0.02	0.04	0.34
Canyon Viaduct Saturday	0.16	0.10	0.18	0.11	0.26	0.38	0.18	0.07	0.06	0.13	1.63
Canyon Viaduct Sunday	0.07	0.02	0.05	0.06	0.22	0.36	0.17	0.07	0.06	0.14	1.22
Tunnel Weekday	0.04	0.01	0.03	0.02	0.04	0.06	0.05	0.03	0.02	0.04	0.34
Tunnel Saturday	0.14	0.10	0.18	0.13	0.24	0.37	0.18	0.08	0.06	0.02	1.50
Tunnel Sunday	0.07	0.01	0.05	0.06	0.23	0.37	0.17	0.07	0.07	0.13	1.23

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily Acetaldehyde emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, Acetaldehyde emissions in the future are estimated to be approximately 71 percent to 82 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion). The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. The highest AM and PM peak period emissions for Acetaldehyde are estimated for the No Action Alternative in the AM and the No Action Alternative in the PM Weekday and Sunday and Tunnel Alternative in the PM Saturday.

Exhibit 18. Acrolein Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.02	0.01	0.02	0.01	0.02	0.04	0.03	0.02	0.01	0.02	0.22
Existing Saturday	0.10	0.08	0.19	0.19	0.22	0.28	0.14	0.06	0.04	0.10	1.40
Existing Sunday	0.05	0.02	0.04	0.05	0.17	0.27	0.12	0.05	0.05	0.10	0.92
No Action Weekday	5e-3	1e-3	4e-3	3e-3	0.01	0.01	0.01	4e-3	2e-3	0.01	**0.06**
No Action Saturday	0.02	0.01	0.03	0.02	0.09	0.11	0.04	0.01	0.01	0.02	**0.36**
No Action Sunday	0.01	3e-3	0.01	0.01	0.03	0.06	0.03	0.01	0.02	0.02	**0.20**
Canyon Viaduct Weekday	5e-3	1e-3	4e-3	3e-3	0.01	0.01	0.01	4e-3	2e-3	0.01	0.06
Canyon Viaduct Saturday	0.02	0.01	0.03	0.02	0.04	0.06	0.03	0.01	0.01	0.02	0.25
Canyon Viaduct Sunday	0.01	3e-3	0.01	0.01	0.03	0.05	0.02	0.01	0.01	0.02	0.17
Tunnel Weekday	5e-3	1e-3	5e-3	3e-3	0.01	0.01	0.01	4e-3	2e-3	0.01	0.06
Tunnel Saturday	0.02	0.01	0.03	0.02	0.03	0.05	0.03	0.01	0.01	0.02	0.23
Tunnel Sunday	0.01	3e-3	6e-3	8e-3	0.03	0.05	0.02	0.01	0.01	0.02	0.17

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily Acrolein emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, Acrolein emissions in the future are estimated to be approximately 73 percent to 84 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak traffic period emissions estimates are fairly comparable across all three future alternatives. The highest AM and PM peak period emissions for Acrolein are estimated for the No Action Alternative.

Exhibit 19. Naphthalene Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.03	0.01	0.03	0.02	0.04	0.06	0.05	0.03	0.02	0.04	0.33
Existing Saturday	0.14	0.12	0.28	0.28	0.33	0.41	0.20	0.08	0.02	0.14	2.00
Existing Sunday	0.08	0.02	0.06	0.07	0.25	0.40	0.18	0.08	0.07	0.15	1.36
No Action Weekday	0.01	2e-3	7e-3	5e-3	0.01	0.02	0.01	7e-3	4e-3	0.01	**0.09**
No Action Saturday	0.04	0.02	0.06	0.03	0.15	0.19	0.06	0.02	0.01	0.03	**0.61**
No Action Sunday	0.02	0.01	0.01	0.01	0.05	0.10	0.04	0.02	0.02	0.03	**0.31**
Canyon Viaduct Weekday	0.01	2e-3	6e-3	5e-3	0.01	0.02	0.01	6e-3	4e-3	0.01	0.08
Canyon Viaduct Saturday	0.04	0.02	0.04	0.03	0.06	0.09	0.04	0.02	0.01	0.03	0.38
Canyon Viaduct Sunday	0.01	0.01	0.01	0.01	0.05	0.09	0.04	0.02	0.02	0.03	0.29
Tunnel Weekday	0.01	2e-3	8e-3	5e-3	0.01	0.02	0.01	6e-3	4e-3	0.01	0.09
Tunnel Saturday	0.03	0.02	0.04	0.03	0.06	0.09	0.04	0.02	0.01	0.03	0.37
Tunnel Sunday	0.02	4e-3	0.01	0.01	0.05	0.09	0.04	0.02	0.02	0.03	0.29

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily Naphthalene emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, Naphthalene emissions in the future are estimated to be approximately 70 percent to 82 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak traffic period emissions estimates are fairly comparable across all three future alternatives. The highest AM and PM peak period emissions for Naphthalene are estimated for the No Action Alternative.

Exhibit 20. Ethylbenzene Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.15	0.04	0.13	0.11	0.19	0.30	0.26	0.14	0.09	0.19	1.60
Existing Saturday	0.21	0.17	0.45	0.42	0.54	0.62	0.30	0.12	0.10	0.20	3.13
Existing Sunday	0.11	0.03	0.08	0.10	0.39	0.61	0.28	0.11	0.11	0.22	2.04
No Action Weekday	0.05	0.01	0.04	0.03	0.05	0.09	0.07	0.04	0.02	0.06	**0.46**
No Action Saturday	0.07	0.04	0.11	0.05	0.30	0.37	0.12	0.03	0.02	0.05	**1.16**
No Action Sunday	0.03	0.01	0.02	0.03	0.10	0.17	0.07	0.03	0.04	0.06	**0.56**
Canyon Viaduct Weekday	0.05	0.01	0.04	0.03	0.05	0.08	0.07	0.04	0.02	0.05	0.44
Canyon Viaduct Saturday	0.07	0.04	0.09	0.07	0.12	0.16	0.08	0.03	0.02	0.05	0.73
Canyon Viaduct Sunday	0.03	0.01	0.02	0.03	0.10	0.16	0.07	0.03	0.03	0.06	0.54
Tunnel Weekday	0.05	0.01	0.04	0.03	0.05	0.08	0.07	0.04	0.02	0.05	0.44
Tunnel Saturday	0.06	0.04	0.09	0.06	0.11	0.16	0.08	0.03	0.03	0.05	0.71
Tunnel Sunday	0.03	0.01	0.02	0.02	0.10	0.16	0.07	0.03	0.03	0.05	0.52

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily Ethylbenzene emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, Ethylbenzene emissions in the future are estimated to be approximately 61 percent to 77 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The No Action Alternative has the highest estimated daily Weekday, Saturday, and Sunday totals. Peak traffic period emissions estimates are fairly comparable across all three future alternatives. The highest AM and PM peak period emissions for Ethylbenzene are estimated for the No Action Alternative.

Exhibit 21. POM Emissions Results (pounds per day)

Output Scenario	OP1	AM1	AM2	AM3	OP2	OP3	PM1	PM2	PM3	OP4	Day Total
Existing Weekday	0.02	0.004	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.02	0.15
Existing Saturday	0.05	0.04	0.11	0.11	0.12	0.15	0.07	0.03	0.02	0.05	0.75
Existing Sunday	0.03	0.01	0.02	0.02	0.09	0.14	0.07	0.03	0.03	0.05	0.49
No Action Weekday	3e-3	1e-3	2e-3	2e-3	3e-3	4e-3	4e-3	2e-3	1e-3	2e-3	0.02
No Action Saturday	5e-3	3e-3	6e-3	3e-3	0.02	0.02	8e-3	2e-3	2e-3	4e-3	**0.07**
No Action Sunday	2e-3	8e-3	2e-3	2e-3	8e-3	0.01	6e-3	3e-3	3e-3	5e-3	**0.05**
Canyon Viaduct Weekday	3e-3	1e-3	2e-3	2e-3	3e-3	5e-3	4e-3	2e-3	1e-3	3e-3	**0.03**
Canyon Viaduct Saturday	5e-3	3e-3	5e-3	4e-3	0.01	0.01	6e-3	2e-3	2e-3	4e-3	0.05
Canyon Viaduct Sunday	2e-3	1e-3	2e-3	2e-3	8e-3	0.01	6e-3	2e-3	2e-3	5e-3	0.04
Tunnel Weekday	3e-3	1e-3	2e-3	2e-3	3e-3	5e-3	4e-3	2e-3	1e-3	3e-3	0.03
Tunnel Saturday	4e-3	3e-3	6e-3	4e-3	8e-3	0.01	6e-3	3e-3	2e-3	4e-3	0.05
Tunnel Sunday	2e-3	1e-3	2e-3	2e-3	8e-3	0.01	6e-3	2e-3	2e-3	4e-3	0.04

[1] Time periods are noted in Section 5.3. OP1: 11:00 p.m. to 6:29 a.m.; AM1: 6:30 a.m. to 6:59 a.m.; AM2: 7:00 a.m. to 7:59 a.m.; AM3: 8:00 a.m. to 8:59 a.m.; OP2: 9:00 a.m. to 11:29 a.m.; OP3: 11:30 a.m. to 2:59 p.m.; PM1: 3:00 p.m. to 4:59 p.m.; PM2: 5:00 p.m. to 5:59 p.m.; PM3: 6:00 p.m. to 6:59 p.m.; OP4: 7:00 p.m. to 10:59 p.m.

The highest daily POM emissions for each day type (weekday, Saturday, Sunday) of the future output scenarios are presented in bold font. Compared to existing conditions, POM emissions in the future are estimated to be approximately 83 percent to 93 percent lower since older vehicles are being taken off the road, more fuel-efficient vehicles are traveling, and, in some areas, there are higher traveling speeds (i.e., less congestion).The No Action Alternative has the highest estimated daily Saturday and Sunday totals, and the Canyon Viaduct alternative hast the highest estimated daily Weekday totals. Peak traffic period emissions estimates are fairly comparable across all three future alternatives. The highest AM and PM peak period emissions for POM are estimated for the No Action Alternative.

6.6. Onroad Greenhouse Gas Emissions

An exhibit of CO_2e emissions (Exhibit 22) depicts the modeled emissions for annual GHGs based on the methodology outlined in Section 5.14 and GWPs in Section 5.7. Modeled GHGs are CO_2, CH_4, and N_2O though based on standard GHG reporting guidance for transportation projects, the totals are presented in CO_2e which accounts for each pollutants 100-year GWP. For ease of comparison, the results shown are broken out by alternative (output scenario) based on known traffic data for existing conditions and each of the Project Alternatives.

Exhibit 22. Onroad CO_2e Emissions Results (metric tons per year)

Output Scenario[1]	2018 Existing	2045 No Action Alternative	2045 Canyon Viaduct Alternative	2045 Tunnel Alternative
CO_2e Emissions (metric tons per year)	77,439	77,093	73,427	73,371

[1] To estimate annual emissions based on average weekday and peak weekend traffic, average weekday emission totals were used for all weekdays and all non-peak weekends (313 days). Peak Saturday emissions totals were used for peak Saturdays (26 days) and peak Sunday emissions totals were used for peak Sundays (26 days).

CO_2e emissions were estimated using the appropriate 100-year GWPs for CO_2, CH_4, and N_2O published by the EPA in 40 CFR Part 98, Subpart A, Table A-1 in 2014. Compared to existing conditions, CO_2e emissions in the future are estimated to be approximately 0.5 percent to 5 percent lower since older vehicles are being taken off the road and more fuel-efficient vehicles are traveling. The No Action Alternative has the highest estimated annual totals of the Project Alternatives. The two action alternatives have lower modeled GHG emissions due to reduced congestion and higher traveling speeds (e.g., less idling) than the No Action Alternative.

The report does not include an assessment of the potential climate effects of the estimated GHG emissions. Climate change is driven by global cumulative changes of GHG concentrations in the atmosphere. Changes in GHG emissions from one individual project are a small fraction of global GHG emissions, therefore not warranting the analysis of potential changes in temperature, precipitation, and other cumulative climate effects such as number of cold days and warm days.

6.7. Construction (Nonroad) Discussion

Due to lack of known data regarding construction materials quantities, equipment, and schedules, a quantitative assessment of construction-related emissions could not be conducted. The *I-70 Floyd Hill to Veterans Memorial Tunnels Air Quality Technical Report* (Appendix A4 to the EA) discusses construction impacts as temporary, intermittent emissions sources. Specific types of construction activities may include reduced speeds for detour routes, tunnel blasting, rock excavation, portable power generation, and construction equipment such as dozers, backhoes, and excavators. Based on the *I-70 Floyd Hill to Veterans Memorial Tunnels Air Quality Technical Report* (Appendix A4 to the EA) that includes discussion on monitoring conducted at the Twin Tunnels project, impacts from construction are expected to be minor. In addition, CDOT will be conducting additional PM monitoring during construction activities to track potential impacts and to quickly respond to real time data of impacts. As discussed in Section 4.3, CDOT will install and maintain two long-term monitors beginning in the construction phase of the Project and following construction into normal operation to gain more air quality data in the Mountain Corridor.

7. References

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Appendix A: Meteorological Data

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
1	80190	1	14.83	76
1	80190	2	15.35	76
1	80190	3	14.99	76
1	80190	4	14.59	76
1	80190	5	14.95	76
1	80190	6	15.51	76
1	80190	7	15.88	76
1	80190	8	16.06	76
1	80190	9	17.2	76
1	80190	10	43.57	76
1	80190	11	20.61	76
1	80190	12	22.24	76
1	80190	13	22.83	76
1	80190	14	22.63	76
1	80190	15	22.39	76
1	80190	16	20.97	76
1	80190	17	18.99	76
1	80190	18	17.82	76
1	80190	19	16.95	76
1	80190	20	16.64	76
1	80190	21	16.3	76
1	80190	22	16.22	76
1	80190	23	15.86	76
1	80190	24	15.48	76
2	80190	1	11.89	78
2	80190	2	11.76	78
2	80190	3	11.76	78
2	80190	4	12.38	78
2	80190	5	12.4	78
2	80190	6	12.33	78
2	80190	7	12.24	78
2	80190	8	12.64	78
2	80190	9	15.06	78
2	80190	10	18.74	78

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
2	80190	11	21.24	78
2	80190	12	23.01	78
2	80190	13	23.85	78
2	80190	14	23.51	78
2	80190	15	23	78
2	80190	16	21.94	78
2	80190	17	19.7	78
2	80190	18	17.22	78
2	80190	19	14.97	78
2	80190	20	13.78	78
2	80190	21	13.65	78
2	80190	22	13.01	78
2	80190	23	12.09	78
2	80190	24	11.66	78
3	80190	1	22	70
3	80190	2	22.09	70
3	80190	3	22	70
3	80190	4	21.8	70
3	80190	5	21.39	70
3	80190	6	21.41	70
3	80190	7	21.76	70
3	80190	8	23.86	70
3	80190	9	27.23	70
3	80190	10	29.76	70
3	80190	11	31.6	70
3	80190	12	33.2	70
3	80190	13	34.22	70
3	80190	14	34.42	70
3	80190	15	34.33	70
3	80190	16	33.66	70
3	80190	17	32.32	70
3	80190	18	29.6	70
3	80190	19	26.67	70
3	80190	20	25.44	70

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
3	80190	21	24.74	70
3	80190	22	24.17	70
3	80190	23	23.74	70
3	80190	24	23.09	70
4	80190	1	20.48	69
4	80190	2	20.27	69
4	80190	3	20.07	69
4	80190	4	19.57	69
4	80190	5	19.55	69
4	80190	6	19.54	69
4	80190	7	21.65	69
4	80190	8	24.42	69
4	80190	9	26.16	69
4	80190	10	27.88	69
4	80190	11	29.48	69
4	80190	12	30	69
4	80190	13	30.51	69
4	80190	14	29.96	69
4	80190	15	30.13	69
4	80190	16	29.71	69
4	80190	17	28.52	69
4	80190	18	26.89	69
4	80190	19	24.28	69
4	80190	20	22.81	69
4	80190	21	21.8	69
4	80190	22	21.46	69
4	80190	23	21.49	69
4	80190	24	21.06	69
5	80190	1	32.8	64
5	80190	2	32.8	64
5	80190	3	32.46	64
5	80190	4	32.06	64
5	80190	5	31.91	64
5	80190	6	32.46	64

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
5	80190	7	36.13	64
5	80190	8	39.19	64
5	80190	9	41.33	64
5	80190	10	42.85	64
5	80190	11	44.28	64
5	80190	12	45.32	64
5	80190	13	45.58	64
5	80190	14	45.54	64
5	80190	15	45.66	64
5	80190	16	44.1	64
5	80190	17	43.78	64
5	80190	18	42.7	64
5	80190	19	39.83	64
5	80190	20	36.88	64
5	80190	21	35.42	64
5	80190	22	34.57	64
5	80190	23	34.17	64
5	80190	24	33.63	64
6	80190	1	41.25	50
6	80190	2	40.91	50
6	80190	3	40.2	50
6	80190	4	40	50
6	80190	5	39.3	50
6	80190	6	40.26	50
6	80190	7	46.04	50
6	80190	8	50.87	50
6	80190	9	53.43	50
6	80190	10	55.53	50
6	80190	11	56.88	50
6	80190	12	57.84	50
6	80190	13	58.64	50
6	80190	14	59.23	50
6	80190	15	57.98	50
6	80190	16	57.15	50

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
6	80190	17	56.39	50
6	80190	18	54.71	50
6	80190	19	52.08	50
6	80190	20	48.13	50
6	80190	21	45.52	50
6	80190	22	43.72	50
6	80190	23	42.59	50
6	80190	24	42.14	50
7	80190	1	46.27	56
7	80190	2	45.9	56
7	80190	3	45.51	56
7	80190	4	44.99	56
7	80190	5	44.64	56
7	80190	6	45.22	56
7	80190	7	50.67	56
7	80190	8	56.32	56
7	80190	9	59.43	56
7	80190	10	60.79	56
7	80190	11	61.38	56
7	80190	12	62.18	56
7	80190	13	61.64	56
7	80190	14	61.57	56
7	80190	15	61.35	56
7	80190	16	60.21	56
7	80190	17	59.96	56
7	80190	18	59.02	56
7	80190	19	56.85	56
7	80190	20	53.4	56
7	80190	21	50.72	56
7	80190	22	49.04	56
7	80190	23	47.84	56
7	80190	24	47.03	56
8	80190	1	45.14	53
8	80190	2	44.71	53

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
8	80190	3	44.75	53
8	80190	4	44.41	53
8	80190	5	44.2	53
8	80190	6	44.14	53
8	80190	7	47.8	53
8	80190	8	52.94	53
8	80190	9	56.48	53
8	80190	10	58.16	53
8	80190	11	82.6	53
8	80190	12	82.87	53
8	80190	13	59.41	53
8	80190	14	58.94	53
8	80190	15	81.49	53
8	80190	16	80.76	53
8	80190	17	56.38	53
8	80190	18	54.65	53
8	80190	19	51.93	53
8	80190	20	49.12	53
8	80190	21	47.74	53
8	80190	22	47.02	53
8	80190	23	46.5	53
8	80190	24	45.86	53
9	80190	1	41.94	52
9	80190	2	41.51	52
9	80190	3	40.87	52
9	80190	4	40.61	52
9	80190	5	40.3	52
9	80190	6	39.9	52
9	80190	7	41.87	52
9	80190	8	46.41	52
9	80190	9	50.44	52
9	80190	10	52.81	52
9	80190	11	54.64	52
9	80190	12	55.95	52

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
9	80190	13	56.16	52
9	80190	14	56.18	52
9	80190	15	55.37	52
9	80190	16	54.25	52
9	80190	17	52.81	52
9	80190	18	49.96	52
9	80190	19	46.61	52
9	80190	20	44.9	52
9	80190	21	43.78	52
9	80190	22	43.24	52
9	80190	23	42.63	52
9	80190	24	42.51	52
10	80190	1	30.34	56
10	80190	2	29.48	56
10	80190	3	28.86	56
10	80190	4	28.67	56
10	80190	5	28.42	56
10	80190	6	28.04	56
10	80190	7	28.1	56
10	80190	8	30.6	56
10	80190	9	35.6	56
10	80190	10	38.43	56
10	80190	11	40.22	56
10	80190	12	41.38	56
10	80190	13	42.03	56
10	80190	14	42.57	56
10	80190	15	42.38	56
10	80190	16	41.49	56
10	80190	17	38.23	56
10	80190	18	34.91	56
10	80190	19	33.43	56
10	80190	20	32.29	56
10	80190	21	31.37	56
10	80190	22	31.02	56

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
10	80190	23	30.36	56
10	80190	24	30.24	56
11	80190	1	19.05	62
11	80190	2	18.98	62
11	80190	3	18.35	62
11	80190	4	18.49	62
11	80190	5	18.75	62
11	80190	6	18.49	62
11	80190	7	18.27	62
11	80190	8	18.73	62
11	80190	9	20.76	62
11	80190	10	23.5	62
11	80190	11	25.57	62
11	80190	12	26.77	62
11	80190	13	27.37	62
11	80190	14	27.25	62
11	80190	15	26.71	62
11	80190	16	24.97	62
11	80190	17	22.83	62
11	80190	18	21.35	62
11	80190	19	20.52	62
11	80190	20	19.97	62
11	80190	21	19.55	62
11	80190	22	19.11	62
11	80190	23	19.21	62
11	80190	24	19.12	62
12	80190	1	12.54	72
12	80190	2	12.93	72
12	80190	3	12.8	72
12	80190	4	13.16	72
12	80190	5	13.09	72
12	80190	6	12.53	72
12	80190	7	12.26	72
12	80190	8	12.32	72

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
12	80190	9	13.92	72
12	80190	10	16.13	72
12	80190	11	42.7	72
12	80190	12	21.51	72
12	80190	13	22.96	72
12	80190	14	21.7	72
12	80190	15	21.35	72
12	80190	16	19.73	72
12	80190	17	17.5	72
12	80190	18	15.97	72
12	80190	19	15.24	72
12	80190	20	14.72	72
12	80190	21	14.37	72
12	80190	22	14.16	72
12	80190	23	13.52	72
12	80190	24	13	72
1	80590	1	14.83	76
1	80590	2	15.35	76
1	80590	3	14.99	76
1	80590	4	14.59	76
1	80590	5	14.95	76
1	80590	6	15.51	76
1	80590	7	15.88	76
1	80590	8	16.06	76
1	80590	9	17.2	76
1	80590	10	43.57	76
1	80590	11	20.61	76
1	80590	12	22.24	76
1	80590	13	22.83	76
1	80590	14	22.63	76
1	80590	15	22.39	76
1	80590	16	20.97	76
1	80590	17	18.99	76
1	80590	18	17.82	76

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
1	80590	19	16.95	76
1	80590	20	16.64	76
1	80590	21	16.3	76
1	80590	22	16.22	76
1	80590	23	15.86	76
1	80590	24	15.48	76
2	80590	1	11.89	78
2	80590	2	11.76	78
2	80590	3	11.76	78
2	80590	4	12.38	78
2	80590	5	12.4	78
2	80590	6	12.33	78
2	80590	7	12.24	78
2	80590	8	12.64	78
2	80590	9	15.06	78
2	80590	10	18.74	78
2	80590	11	21.24	78
2	80590	12	23.01	78
2	80590	13	23.85	78
2	80590	14	23.51	78
2	80590	15	23	78
2	80590	16	21.94	78
2	80590	17	19.7	78
2	80590	18	17.22	78
2	80590	19	14.97	78
2	80590	20	13.78	78
2	80590	21	13.65	78
2	80590	22	13.01	78
2	80590	23	12.09	78
2	80590	24	11.66	78
3	80590	1	22	70
3	80590	2	22.09	70
3	80590	3	22	70
3	80590	4	21.8	70

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
3	80590	5	21.39	70
3	80590	6	21.41	70
3	80590	7	21.76	70
3	80590	8	23.86	70
3	80590	9	27.23	70
3	80590	10	29.76	70
3	80590	11	31.6	70
3	80590	12	33.2	70
3	80590	13	34.22	70
3	80590	14	34.42	70
3	80590	15	34.33	70
3	80590	16	33.66	70
3	80590	17	32.32	70
3	80590	18	29.6	70
3	80590	19	26.67	70
3	80590	20	25.44	70
3	80590	21	24.74	70
3	80590	22	24.17	70
3	80590	23	23.74	70
3	80590	24	23.09	70
4	80590	1	20.48	69
4	80590	2	20.27	69
4	80590	3	20.07	69
4	80590	4	19.57	69
4	80590	5	19.55	69
4	80590	6	19.54	69
4	80590	7	21.65	69
4	80590	8	24.42	69
4	80590	9	26.16	69
4	80590	10	27.88	69
4	80590	11	29.48	69
4	80590	12	30	69
4	80590	13	30.51	69
4	80590	14	29.96	69

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
4	80590	15	30.13	69
4	80590	16	29.71	69
4	80590	17	28.52	69
4	80590	18	26.89	69
4	80590	19	24.28	69
4	80590	20	22.81	69
4	80590	21	21.8	69
4	80590	22	21.46	69
4	80590	23	21.49	69
4	80590	24	21.06	69
5	80590	1	32.8	64
5	80590	2	32.8	64
5	80590	3	32.46	64
5	80590	4	32.06	64
5	80590	5	31.91	64
5	80590	6	32.46	64
5	80590	7	36.13	64
5	80590	8	39.19	64
5	80590	9	41.33	64
5	80590	10	42.85	64
5	80590	11	44.28	64
5	80590	12	45.32	64
5	80590	13	45.58	64
5	80590	14	45.54	64
5	80590	15	45.66	64
5	80590	16	44.1	64
5	80590	17	43.78	64
5	80590	18	42.7	64
5	80590	19	39.83	64
5	80590	20	36.88	64
5	80590	21	35.42	64
5	80590	22	34.57	64
5	80590	23	34.17	64
5	80590	24	33.63	64

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
6	80590	1	41.25	50
6	80590	2	40.91	50
6	80590	3	40.2	50
6	80590	4	40	50
6	80590	5	39.3	50
6	80590	6	40.26	50
6	80590	7	46.04	50
6	80590	8	50.87	50
6	80590	9	53.43	50
6	80590	10	55.53	50
6	80590	11	56.88	50
6	80590	12	57.84	50
6	80590	13	58.64	50
6	80590	14	59.23	50
6	80590	15	57.98	50
6	80590	16	57.15	50
6	80590	17	56.39	50
6	80590	18	54.71	50
6	80590	19	52.08	50
6	80590	20	48.13	50
6	80590	21	45.52	50
6	80590	22	43.72	50
6	80590	23	42.59	50
6	80590	24	42.14	50
7	80590	1	46.27	56
7	80590	2	45.9	56
7	80590	3	45.51	56
7	80590	4	44.99	56
7	80590	5	44.64	56
7	80590	6	45.22	56
7	80590	7	50.67	56
7	80590	8	56.32	56
7	80590	9	59.43	56
7	80590	10	60.79	56

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
7	80590	11	61.38	56
7	80590	12	62.18	56
7	80590	13	61.64	56
7	80590	14	61.57	56
7	80590	15	61.35	56
7	80590	16	60.21	56
7	80590	17	59.96	56
7	80590	18	59.02	56
7	80590	19	56.85	56
7	80590	20	53.4	56
7	80590	21	50.72	56
7	80590	22	49.04	56
7	80590	23	47.84	56
7	80590	24	47.03	56
8	80590	1	45.14	53
8	80590	2	44.71	53
8	80590	3	44.75	53
8	80590	4	44.41	53
8	80590	5	44.2	53
8	80590	6	44.14	53
8	80590	7	47.8	53
8	80590	8	52.94	53
8	80590	9	56.48	53
8	80590	10	58.16	53
8	80590	11	82.6	53
8	80590	12	82.87	53
8	80590	13	59.41	53
8	80590	14	58.94	53
8	80590	15	81.49	53
8	80590	16	80.76	53
8	80590	17	56.38	53
8	80590	18	54.65	53
8	80590	19	51.93	53
8	80590	20	49.12	53

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
8	80590	21	47.74	53
8	80590	22	47.02	53
8	80590	23	46.5	53
8	80590	24	45.86	53
9	80590	1	41.94	52
9	80590	2	41.51	52
9	80590	3	40.87	52
9	80590	4	40.61	52
9	80590	5	40.3	52
9	80590	6	39.9	52
9	80590	7	41.87	52
9	80590	8	46.41	52
9	80590	9	50.44	52
9	80590	10	52.81	52
9	80590	11	54.64	52
9	80590	12	55.95	52
9	80590	13	56.16	52
9	80590	14	56.18	52
9	80590	15	55.37	52
9	80590	16	54.25	52
9	80590	17	52.81	52
9	80590	18	49.96	52
9	80590	19	46.61	52
9	80590	20	44.9	52
9	80590	21	43.78	52
9	80590	22	43.24	52
9	80590	23	42.63	52
9	80590	24	42.51	52
10	80590	1	30.34	56
10	80590	2	29.48	56
10	80590	3	28.86	56
10	80590	4	28.67	56
10	80590	5	28.42	56
10	80590	6	28.04	56

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
10	80590	7	28.1	56
10	80590	8	30.6	56
10	80590	9	35.6	56
10	80590	10	38.43	56
10	80590	11	40.22	56
10	80590	12	41.38	56
10	80590	13	42.03	56
10	80590	14	42.57	56
10	80590	15	42.38	56
10	80590	16	41.49	56
10	80590	17	38.23	56
10	80590	18	34.91	56
10	80590	19	33.43	56
10	80590	20	32.29	56
10	80590	21	31.37	56
10	80590	22	31.02	56
10	80590	23	30.36	56
10	80590	24	30.24	56
11	80590	1	19.05	62
11	80590	2	18.98	62
11	80590	3	18.35	62
11	80590	4	18.49	62
11	80590	5	18.75	62
11	80590	6	18.49	62
11	80590	7	18.27	62
11	80590	8	18.73	62
11	80590	9	20.76	62
11	80590	10	23.5	62
11	80590	11	25.57	62
11	80590	12	26.77	62
11	80590	13	27.37	62
11	80590	14	27.25	62
11	80590	15	26.71	62
11	80590	16	24.97	62

Appendix A - Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
11	80590	17	22.83	62
11	80590	18	21.35	62
11	80590	19	20.52	62
11	80590	20	19.97	62
11	80590	21	19.55	62
11	80590	22	19.11	62
11	80590	23	19.21	62
11	80590	24	19.12	62
12	80590	1	12.54	72
12	80590	2	12.93	72
12	80590	3	12.8	72
12	80590	4	13.16	72
12	80590	5	13.09	72
12	80590	6	12.53	72
12	80590	7	12.26	72
12	80590	8	12.32	72
12	80590	9	13.92	72
12	80590	10	16.13	72
12	80590	11	42.7	72
12	80590	12	21.51	72
12	80590	13	22.96	72
12	80590	14	21.7	72
12	80590	15	21.35	72
12	80590	16	19.73	72
12	80590	17	17.5	72
12	80590	18	15.97	72
12	80590	19	15.24	72
12	80590	20	14.72	72
12	80590	21	14.37	72
12	80590	22	14.16	72
12	80590	23	13.52	72
12	80590	24	13	72