DENVER SOUTHERN SUBAREA 8-HOUR OZONE CONFORMITY DETERMINATION

for the
DRCOG Fiscally Constrained
2040 Regional Transportation Plan

and the
DRCOG 2012-2017 Transportation Improvement Program
and 2016-2021 Transportation Improvement Program

and the
Southern Subarea Portion of the Upper Front Range 2040 Regional Transportation Plan and the Colorado Statewide Transportation Improvement Program (STIP) for the Upper Front Range Transportation Planning Region

Adopted April 15, 2015

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ABSTRACT

TITLE: **Denver Southern Subarea 8-Hour Ozone Conformity Determination for the DRCOG Fiscally Constrained 2040 Regional Transportation Plan and the Amended 2012-2017 Transportation Improvement Program and 2016-2021 Transportation Improvement Program and the Southern Subarea Portion of the Upper Front Range 2040 Regional Transportation Plan and the Colorado Statewide Transportation Improvement Program for the Upper Front Range Transportation Planning Region**

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SUBJECT: Air quality conformity of the Denver region's and the Southern Subarea Portion of the Upper Front Range region's respective long-range transportation plans and short-range improvement programs

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TABLE OF CONTENTS

ABSTRACT **3**

CHAPTER 1. INTRODUCTION **7**

Background—8-Hour Ozone Nonattainment Area 7

Federal Requirements 9

CONFORMITY REGULATIONS FOR THE 8-HOUR OZONE **9**

Planning Organizations and the Memorandum of Agreement (MOA) 10

Current Situation for the Denver Southern Subarea 13

Transportation Planning *13*

Process 14

Agency Roles 14

Public Participation 15

CHAPTER 2. IMPLEMENTATION OF CONTROL MEASURES **16**

CHAPTER 3. EMISSIONS TESTS **19**

General Description 19

Budgets Analysis Years 19

Technical Process 19

DRCOG Demographic Assumptions 20

DRCOG Transportation Assumptions 22

UFR TPR Transportation Assumptions 24

Air Quality Modeling Assumptions 24

Mobile Source Measures 24

Emission Test Results 25

Summary of 8-hour Ozone Conformity Findings - Denver Southern Subarea 25

APPENDIX A DRCOG TRANSPORTATION NETWORK ASSUMPTIONS **27**

APPENDIX B DRCOG TRANSPORTATION MODEL CALIBRATION DESCRIPTION **37**

Introduction 39

Demographic Forecasts 41

Small Area Development Estimates 41

Focus Model Process Overview 45

Highway and Transit System 45

Model Components 46

Highway and Transit Skims (Path Selection) 46

Denver International Airport/Commercial Vehicle/Internal-External/ External-External Trips 47

Regular Workplace and School Location 47

Auto Availability Choice 47

Tour Models 47

TRIP MODELS **49**

Network Assignment 50

Model Calibration 51

Air Quality Modeling 52

APPENDIX C MODELING SUMMARY TABLES 53

APPENDIX D MEMORANDUM OF AGREEMENT—TRANSPORTATION CONFORMITY EVALUATIONS CONDUCTED UNDER THE 8-HOUR OZONE STANDARD 57

APPENDIX E U.S. DEPARTMENT OF TRANSPORTATION CONFORMITY FINDING (TO BE PROVIDED) 59

APPENDIX F LIST OF ACRONYMS 61

Chapter 1. Introduction

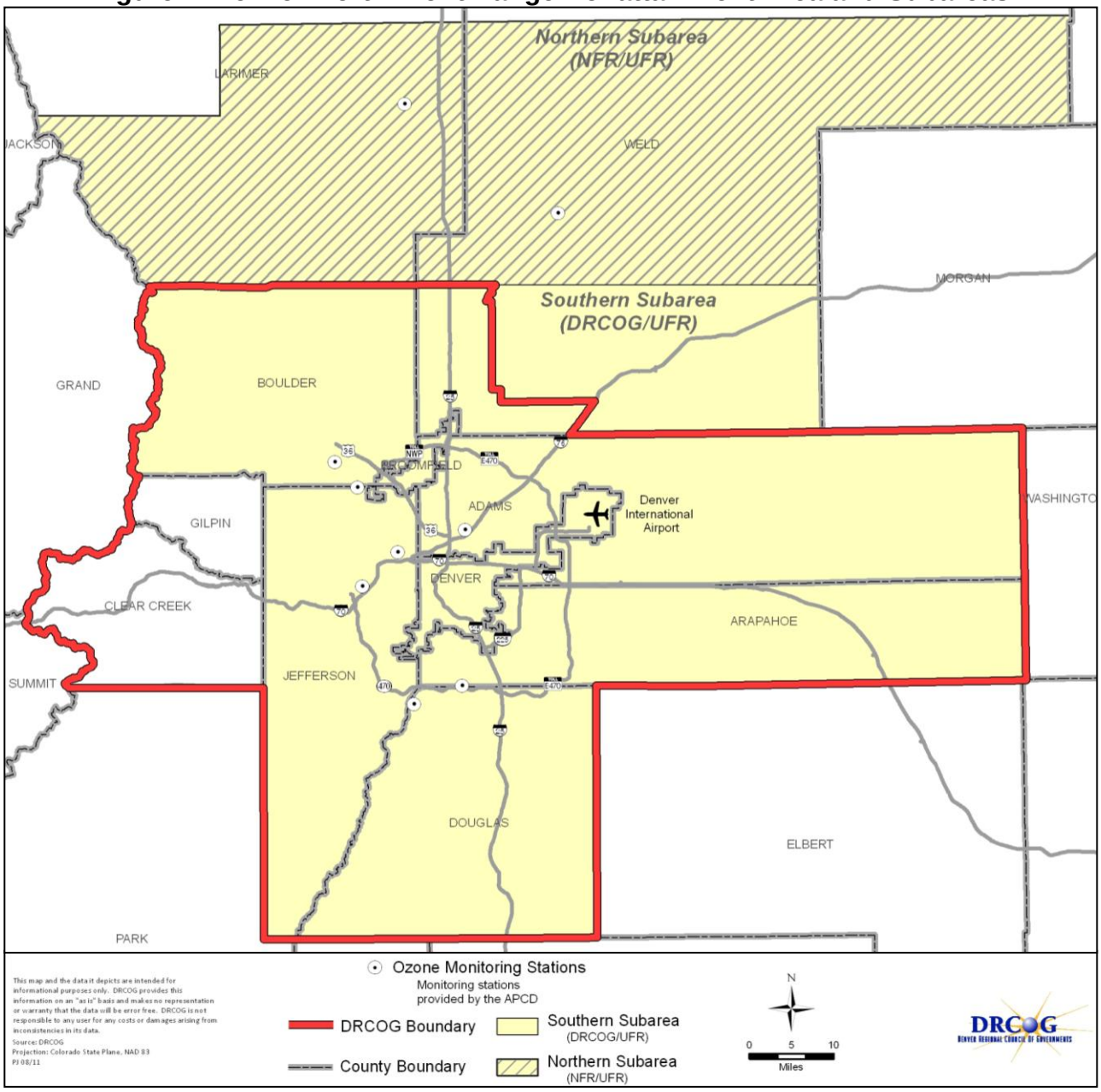
Background—8-Hour Ozone Nonattainment Area

In 2008, the U.S. Environmental Protection Agency (EPA) lowered the National Ambient Air Quality Standards (NAAQS) for ground-level ozone to 0.075 parts per million (ppm) from the 1997 standard of 0.080 ppm. On April 30, 2012, the EPA designated Denver-North Front Range Area as marginal nonattainment under the 2008 ozone standard (0.075 ppm). The marginal nonattainment designation does not impose any new planning requirements on the State of Colorado at this time; however, the Denver-North Front Range Area must meet the standard before 2015 or new requirements may be imposed.

EPA's final rule designating areas for the 2008 ozone NAAQS became effective July 20, 2012. According to the EPA's *Transportation Conformity Guidance for 2008 Ozone Nonattainment Areas,* a conformity determination must be made with regard to the 2008 ozone NAAQS for metropolitan transportation plans and transportation improvement programs (TIP) within one year after the effective date of the nonattainment designation. The initial conformity determination of the fiscally constrained regional transportation plans (RTP) and TIPs with regard to the 2008 ozone NAAQS has been demonstrated by the two Metropolitan Planning Organizations (MPOs), the Denver Regional Council of Governments (DRCOG) and the North Front Range Metropolitan Planning Organization (NFRMPO), and one Transportation Planning Region (TPR), the Upper Front Range (UFR) TPR, that comprise the 8-hour nonattainment area, by April 2013. FHWA made a conformity determination finding for both DRCOG and the NFRMPO by separate letters dated May 30, 2013.

The Denver-North Front Range 8-hour Ozone Nonattainment Area for the 2008 ozone NAAQS keeps the same boundary as the nonattainment area under the 1997 ozone NAAQS, which covers the counties of: Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, and parts of Larimer and Weld Counties that have the highest concentration of emissions. Figure 1 shows the entire 8-hour ozone nonattainment area, which is comprised of two subareas (Northern and Southern). The boundary between the two subareas is the Boulder/Larimer County line extended through southern Weld County to the Morgan County line.

Figure 1 Denver-North Front Range Nonattainment Area and Subareas



EPA found that the motor vehicle emissions budgets (MVEB) for nitrogen oxides (NO_X) and volatile organic compounds (VOC) contained in the Denver-North Front Range 8-Hour Ozone Attainment Plan under the 1997 ozone NAAQS are adequate for transportation conformity purposes (75 FR 9893, March 4, 2010) effective on March 19, 2010. EPA subsequently approved the NOx and VOC MVEBs for transportation conformity purposes in its final rule on August 5, 2011 (76 FR 47443, effective September 6, 2011). As a result, DRCOG and NFRMPO are required to use these budgets for subsequent transportation conformity determinations.

According to the EPA's *Transportation Conformity Guidance for 2008 Ozone Nonattainment Areas*, if 1997 ozone budgets are available for each analysis year in a conformity determination for the 2008 ozone NAAQS, an area would use 1997 ozone budgets that are established for that year.

Federal Requirements

An MPO is required to show conformity of its fiscally constrained RTP and TIP with the State Implementation Plan (SIP) for air quality before transportation plans and programs are adopted. The TIP and STIP are "living" programming documents amended several times a year. New conformity determinations must be made when there are additions or deletions of funded regionally significant projects not depicted as such in a current conformity determination. This action is required under Section 176(c) of the Clean Air Act, as amended in 1990. Conformity to an air quality implementation plan is defined in the Clean Air Act as conformity to the implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQSs and achieving expeditious attainment of such standards. In addition, activities may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with the timely attainment of required emissions reductions towards attainment. For pollutants for which a region currently meets standards but was formerly in nonattainment, the applicable SIP may also be referred to as a maintenance plan, which demonstrates continued attainment of the standards.

The EPA final transportation conformity rule is located at 40 CFR Part 93, Subpart A. To address revised standards and changes in conformity requirements, EPA has promulgated several amendments to the final rule in recent years.

Conformity Regulations for the 8-Hour Ozone

On January 9, 2008, the EPA administrator signed an amendment to the conformity rule, (the "Final Rule"), to implement the provisions of SAFETEA-LU. The Final Rule was promulgated February 25, 2008. The most recent EPA revision to the conformity rule occurred on March 14, 2012 (77 FR 14979, effective April 13, 2012).

According to 40 CFR §93.109 of the Transportation Conformity Rule, criteria and procedures for determining conformity of transportation plans, programs, and projects, transportation plans and programs must satisfy different criteria depending on whether the state has submitted a SIP revision, and whether the EPA has approved such submittal. In this case, EPA found the submitted NOx and VOC motor vehicle emissions budgets (MVEB) adequate (ref. 75 FR 9893, March 4, 2010) and approved these emission budgets on August 5, 2011 (76 FR 47443). Therefore, conformity must be demonstrated for those MVEBs as per 40 CFR §93.118 as described below:

2. §93.109(e) (1) In such 8-hour ozone nonattainment and maintenance areas the budget test must be satisfied as required by §93.118 for conformity determinations made on or after:

(i) the effective date of EPA's finding that a motor vehicle emissions budget in a submitted control strategy implementation plan revision or maintenance plan for the 8-hour ozone NAAQS is adequate for transportation conformity purposes.

EPA found the 8-hour ozone NOx and VOC MVEBs adequate on March 4, 2010 and these MVEBs became effective on March 19, 2010 (ref. 75 FR 9893, March 4, 2010). EPA approved these emission budgets for use on August 5, 2011 (76 FR 47443). Therefore, these MVEBs are used for the 8-hour ozone conformity determination.

Planning Organizations and the Memorandum of Agreement (MOA)

DRCOG is the MPO for the Denver Transportation Management Area (TMA). The DRCOG TMA includes four urbanized areas and consists of the portions of Adams and Arapahoe counties west of Kiowa Creek; all of Boulder County except Rocky Mountain National Park; all of Broomfield, Denver, Douglas, and Jefferson counties; and parts of southwestern Weld County. The TMA boundary expansion into southwestern Weld County was approved by the Governor on February 21, 2008. DRCOG is also the Transportation Planning Region (TPR) for the TMA, portions of Adams and Arapahoe counties east of Kiowa Creek, and the Rocky Mountain National Park area of Boulder County. DRCOG's 2040 RTP includes the entire DRCOG TPR region. The DRCOG TIP covers the TMA, while CDOT and the State Transportation Improvement Program (STIP) covers the remaining portions of the region.

The NFRMPO is the MPO for the North Front Range TMA. The NFRMPO includes 15 local governments in the urbanized area of Larimer and Weld counties.

The UFR TPR is the transportation planning region covering the remainder of the 8-hour ozone nonattainment area. Located in north-central Colorado, it is comprised of Larimer, Morgan, and Weld Counties, and excludes the urbanized areas in Larimer and Weld Counties (which comprise the NFRMPO region and the portion of Southwest Weld County included in the DRCOG TMA). Figure 2 depicts the boundary of all three MPOs/TPRs involved in this 8-hour ozone conformity determination.

Federal Transportation Regulations at 23 CFR 450.314(b) states "*where a metropolitan planning area (MPA) does not include an entire nonattainment area, there shall be written agreement among*

the State Department of Transportation, state air quality agency, affected local agencies, and the MPO describing the process for cooperative planning and analysis of all projects outside the MPA within the nonattainment area." An MOA was signed in March 2008 by the Colorado Department of Public Health and Environment (CDPHE), Colorado Department of Transportation (CDOT), Regional Air Quality Council (RAQC), UFR TPR, NFRMPO, and DRCOG. A copy of the MOA is in Appendix D.

The MOA calls for the establishment of an overall area motor vehicle emissions budget based on the entire 8-hour ozone nonattainment area, and allows for the option for establishing subarea emissions budgets based on subareas, which are delineated in Figure 1.

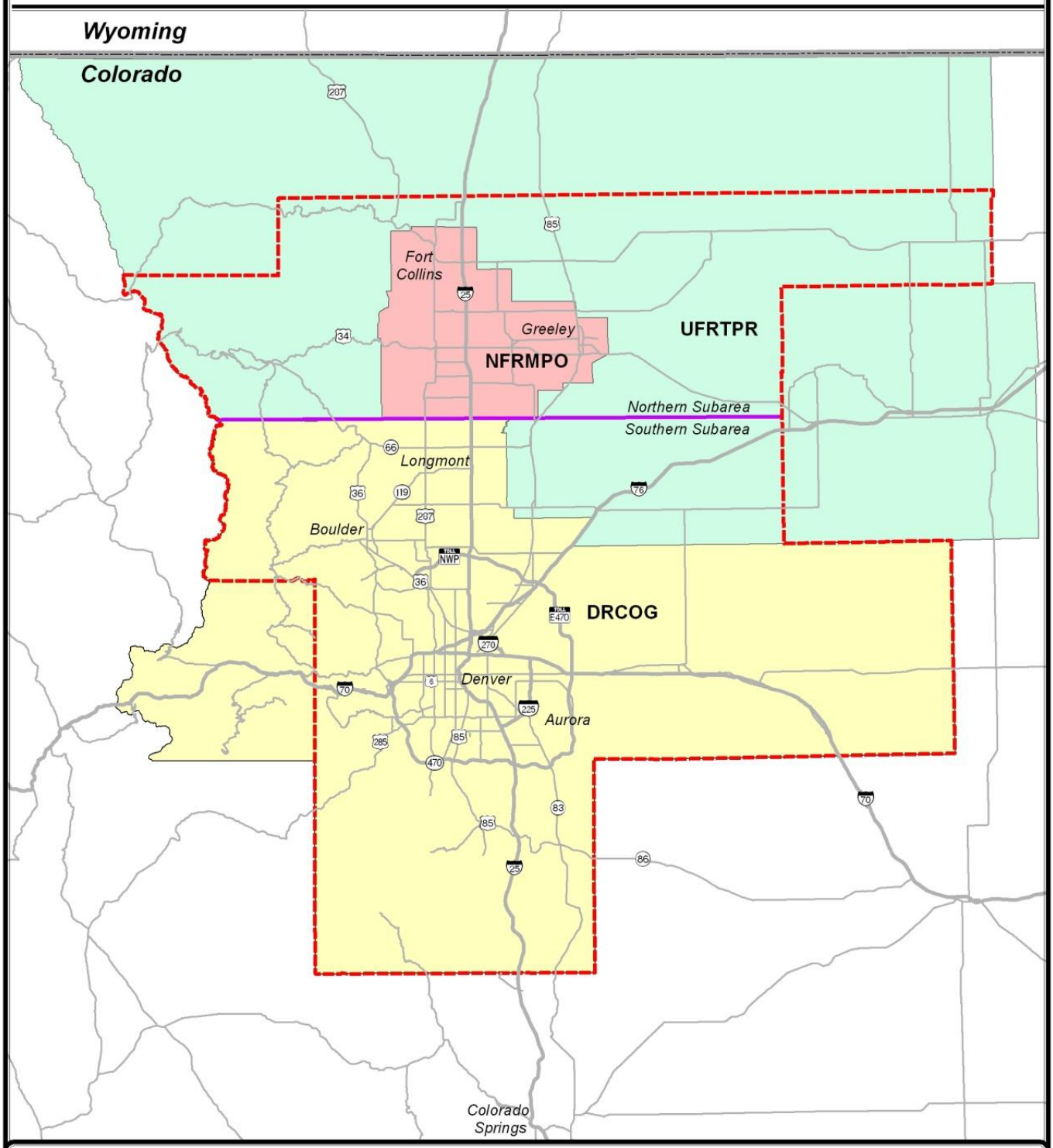
The MOA stipulates that DRCOG will make conformity determinations for the Southern Subarea of the 8-hour ozone nonattainment area, while the NFRMPO will make the conformity determination for the Northern Subarea of the 8-hour ozone nonattainment area. The travel demand model outputs from each of the MPOs are sent to the Air Pollution Control Division (APCD) of CDPHE for generation of emissions estimates. In the Northern Subarea, the 8-hour ozone nonattainment area outside of the NFRMPO model area, also known as the northern "donut" area, will have the transportation forecasting performed by the APCD.

Finally, the MOA states the courses of action to be pursued if one (or both) of the subareas exceeds a conformity test or its (their) emissions budgets.

The NFRMPO and DRCOG worked cooperatively with an interagency consultation group (Federal Highway Administration (FHWA), EPA, CDOT and APCD) to review the conformity documentation and planning assumptions. Furthermore, the NFR Technical Advisory Committee (TAC), or their representative, served as the review team for the NFR socioeconomic data and transportation network as per Regulation No. 10 *Criteria for Analysis of Conformity*.

The MOA noted that after the initial MVEB-based conformity determination, DRCOG and the NFRMPO may switch from using the total nonattainment area MVEBs to using the subarea MVEBs for determining conformity. To switch to use of the subarea MVEBs (or to subsequently switch back to use of the total nonattainment area MVEBs), DRCOG and the NFRMPO must use the process as described in the Denver/NFR Ozone Attainment Plan, that was approved by EPA on August 5, 2011 (76 FR 47443), on pages VI–4 through VI–6.

Figure 2 TPRs Involved in Denver-North Front Range 8-Hour Ozone Nonattainment



This map and the data it depicts are intended for informational purposes only. DRCOG provides this information on an "as is" basis and makes no representation or warranty that the data will be error free. DRCOG is not responsible to any user for any costs or damages arising from inconsistencies in its data.
Source: DRCOG
Projection: Colorado State Plane, NAD 83
PJ 6/2010

Upper Front Range Transportation Planning Region (UFRTPR)
Denver Regional Council of Governments (DRCOG)
North Front Range Metropolitan Planning Org. (NFRMPO)
Ozone Nonattainment

N

0 5 10
Miles

DRCOG
Denver Regional Council of Governments

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Current Situation for the Denver Southern Subarea

Transportation Planning

DRCOG Region

The Metro Vision Plan is the long-range growth and development strategy for the Denver region. It integrates plans for growth and development, transportation, and environmental quality into a single comprehensive foundation for regional planning. Metro Vision calls for a balanced multimodal surface transportation system including rapid transit, a regional bus network, a regional beltway, bicycle and pedestrian facilities, and improvements to the existing roadway system.

The Metro Vision Regional Transportation Plan (MVRTP) is the transportation plan that implements the transportation element of Metro Vision. The MVRTP contains an unconstrained vision plan, outlining the region's total transportation needs, as well as the Fiscally Constrained RTP, which includes those projects that can be implemented given the anticipated level of funding. The 2035 MVRTP was first adopted on December 19, 2007 and last amended in April 2014. The Fiscally Constrained 2040 RTP will be adopted in February 2015.

DRCOG is in the process of preparing a new 2040 MVRTP – with anticipated adoption in mid-2015.

The 2012-2017 Transportation Improvement Program (TIP), first adopted in March 2011, identifies transit, multimodal, and roadway projects to be funded with FY 2012 through FY 2015 federal funds. The Draft 2016-2021 TIP (and associated projects) is scheduled for adoption in March 2015. The current and future TIPs together will implement the Fiscally Constrained 2040 RTP.

UFR TPR

The Draft Upper Front Range 2040 Regional Transportation Plan is scheduled for adoption by the Upper Front Range Regional Planning Commission in March 2015. The UFR TPR 2040 RTP contains both a Fiscally Constrained Plan and unconstrained ("Vision") projects. Short-range transportation projects in the UFR TPR are contained in the STIP. There are no regionally significant amendments to either of these documents since the last determination in February 2013.

Air Quality Planning

Other Pollutants

Currently, the DRCOG region is designated as a maintenance area for carbon monoxide (CO) and particulate matter equal to and less than 10 microns in aerodynamic diameter (PM10). The CO and PM10 conformity determination is being updated concurrently with this document.

8-Hour Ozone

The current State Implementation Plan (SIP) for the Denver-North Front Range 8-hour Ozone Nonattainment Area was approved by the Air Quality Control Commission (AQCC) in December 2008; and approved by the EPA on August 5, 2011. This SIP demonstrates how the region would attain the 1997 8-hour ozone standard (0.085 ppm) by 2010, and also establishes mobile source emissions budgets. Two air quality planning agencies were charged with preparing the SIP. The RAQC is the air quality planning agency for the Denver metropolitan area (Southern Subarea) and the North Front Range Transportation and Air Quality Planning Council (NFRT & AQPC) is the air quality planning agency for the NFRMPO and the Northern Subarea.

The nine-county Denver Metro Area/Northern Front Range has been designated as marginal nonattainment for the 2008 8-hour ozone standard (0.075 ppm). A new SIP or modeled attainment demonstration is not required as long as the area attains the standard in 2015.

Process

Agency Roles

The Conformity SIP, also known as the AQCC Regulation Number 10 or conformity implementation plan, was developed by the AQCC and adopted in 1998. It formally defines the

process for finding conformity. The EPA approved the Regulation Number 10 on September 21, 2001 (66FR48561), making it federally enforceable. The Regulation Number 10 was updated and approved by the AQCC on Dec 15, 2011. It has been submitted to the EPA for final approval.

In November 1998, a MOA was signed by the CDPHE and DRCOG for the purpose of defining the specific roles and responsibilities in conformity evaluations and findings. A similar MOA was also signed by the CDPHE and NFRMPO in November 1998. EPA approved the updated Regulation Number 10 in early 2014, thus the 1998 MOA between CDPHE and DRCOG will also be updated to reflect the changes made in the Regulation Number 10.

Public Participation

Public participation was encouraged throughout the development of DRCOG's Fiscally Constrained 2040 RTP,and associated Metro Vision 2040 and 2040 MVRTP), and the 2012-2017 TIP. DRCOG has held numerous workshops, stakeholder meetings, interactive online forums, and other public participation events, as well as gathering public input through the Sustainable Communities Initiative, Listening Tour, CDOT Town Halls, and other related efforts.

Extensive public engagement also occurred with the UFRTPR's 2040 RTP. Consistent with the MOA, no specific public hearing was held in the UFR TPR. However, public notice of the two MPOs' public hearings was circulated within the UFR TPR. Summaries of testimony received during the review periods and at the public hearings are available at the DRCOG office. The public was also encouraged to provide input to their local elected officials and government staff who work closely with DRCOG.

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Chapter 2. Implementation of Control Measures

For this conformity determination, there are no new transportation control measures (TCMs) identified for timely completion or implementation as part of the applicable implementation plan. The 8-hour Ozone Attainment Plan (SIP) that was adopted by the AQCC in December, 2008, and approved by EPA on August 5, 2011, did not include any TCMs.

Chapter 3. Emissions Tests

General Description

The transportation system, and associated projects contained within fiscally constrained RTPs and short range TIPs, must be reflected in an analysis and evaluation that is shown to pass a series of 8-hour ozone emissions tests to demonstrate conformity. These emissions tests relate to the two ozone precursors, Nitrogen oxides (NO_x) and Volatile Organic Compounds (VOC). The plan and program must respect the motor vehicle emissions budget in the applicable SIP or SIP submittal. Satisfying these tests involves demonstrating that relevant emissions in future years are less than or equal to the emissions budget established in the SIP.

Budgets Analysis Years

In accordance with EPA regulations 40 CFR 93.118, the Interagency Consultation Group agreed upon the following staging years for this 8-hour ozone conformity determination.

- **2015** – RTP base year
- **2025** – an intermediate modeling year
- **2035** – an intermediate modeling year
- **2040** – the last year (horizon) of regional transportation plan

Under the terms of the MOA (as described above), DRCOG is responsible for the 8-hour ozone nonattainment area's Southern Subarea (everything within the 8-hour ozone nonattainment area south of the north line of Township 3), while the NFRMPO is responsible for the conformity analyses determination for the 8-hour ozone nonattainment area's Northern Subarea (everything within the 8-hour ozone nonattainment area north of the north line of Township 3). The entire Denver-North Front Range nonattainment area, with both the Northern and Southern Subareas, is shown in Figure 1.

Technical Process

The technical process used to estimate future pollutant emission levels is based on the latest planning assumptions in effect at the time of this conformity determination. Assumptions behind the analysis were derived from estimates of current and future population, employment, travel,

and congestion most recently developed by DRCOG. The MOA stipulates that the emissions estimates are to be performed by the APCD. Information concerning vehicle miles traveled and operating speeds was updated as part of this conformity finding process. These planning assumptions were used with the EPA emission model (MOVES) to estimate emissions. The DRCOG travel demand model covers the whole Southern Subarea. Appendix B describes the modeling structure and recent enhancements for the DRCOG travel demand model in more detail.

DRCOG Demographic Assumptions

The population forecast for the Southern Subarea of the Denver-North Front Range 8-Hour Ozone Nonattainment Area in 2040 is 4,298,524. This is an increase of 39 percent over the year 2015 estimated population of 3,098,658. Employment is forecasted to be 2,353,061 in 2040, compared to the year 2015 estimate of 1,813,959, an increase of approximately 30 percent. Growth in population and employment will be the principal factors for the increased demand for travel on the region's transportation facilities and services. Table 1 shows the latest forecasts of population and employment for 2015, 2025, 2035 and 2040 for the Southern Subarea of the Denver-North Front Range Nonattainment Area, as depicted in Figure 1. Table 2 lists 2015 and 2040 population and employment estimates by each of the counties in the DRCOG ozone modeling Southern Subarea.

Table 1

Population and Employment Forecasts – DRCOG Ozone Modeling Southern Subarea

	2015	2025	2035	2040
Population	3,098,658	3,680,714	4,130,142	4,298,524
Employment	1,813,959	2,054,442	2,252,532	2,353,061

Source: DRCOG. UrbanSim Modeling Run. August 9, 2014
Counties included in Totals: Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, and SW Weld.

Table 2

2010 and 2040 Population and Employment Estimates by County – DRCOG Ozone Modeling Southern Subarea

County	Population		Employment	
	2015	2040	2015	2040
Adams County	493,979	772,596	228,351	345,808
Arapahoe County	618,503	852,514	350,914	509,696
Boulder County	318,791	409,329	194,597	233,112
Broomfield County	68,201	116,272	50,538	112,840
Denver County	619,989	854,660	525,473	558,196
Douglas County	314,042	446,163	148,527	228,857
Jefferson County	577,866	672,601	285,717	336,034
Weld County*	87,287	174,389	29,842	28,518
Total DRCOG Ozone Modeling Southern Subarea	3,098,658	4,298,524	1,813,959	2,353,061

* Includes entire extent of Weld County within the UFR TPR that lies within the DRCOG 8-hour ozone modeling domain (i.e. Southern Subarea of 8-hour Ozone Nonattainment Area).

Source: DRCOG. UrbanSim Modeling Run. August 9, 2014

DRCOG Transportation Assumptions

In order to complete the emissions tests, the 2015, 2025, 2035, and 2040 transportation networks must first be defined. DRCOG's Fiscally Constrained 2040 RTP specifies financially constrained highway and transit system improvements and resulting networks to be completed by the year 2040. The 2012-2017 TIP and 2016-2021 TIP identify funding to complete a number of regionally significant projects on the designated regional roadway and rapid transit system that are also contained in the Fiscally Constrained 2040 RTP, listed below:

- US-85 from Cook Ranch Road to Meadows Parkway: widen roadway to four lanes.
- I-25 from US-36 to 120th Avenue: add two HOT lanes.
- I-25 from RidgeGate Pkwy to County Line South Ramps: widen roadway to 8 lanes.
- Gold Line, Denver Union Station to Ward Road: new light rail, stations, park-n-Rides.
- I-225 Corridor, Parker Road to Smith Road: new light rail, stations, parking.
- Northwest Rail, Denver Union Station to Westminster (71st Ave Station): new rail, stations, parking.
- East Corridor, Denver Union Station to Denver International Airport: new rail, stations, and park-n-Rides.
- 120th Avenue Connection over US-36: build new six lane road.
- I-25 from Santa Fe to Alameda: interchange reconstruction.
- US-36 from the Table Mesa Park-n-Ride to the I-25 Express Lanes: add two HOT lanes, enhancements for bus rapid transit (BRT).
- I-225 from Parker Road to Mississippi Avenue: widen roadway to six lanes.

The TIPs also include many other projects that will help to reduce emissions associated with ozone:

- Transit operating funds and bus purchases
- Bicycle and pedestrian facilities
- Travel Demand Management (TDM) programs
- Intelligent Transportation Systems (ITS) infrastructure
- Traffic signal systems and coordination
- Master plans for areas around transit stations and urban centers

Other representative regionally significant projects in the Fiscally Constrained 2040 RTP (not yet funded in the TIP) using federal and state resources include:

- Pena Boulevard from I-70 to E-470: widen roadway to eight lanes.
- Wadsworth Boulevard (SH-121) from 36th Avenue to 46th Avenue: widen roadway to six lanes.
- Wadsworth Parkway (SH-121) from 92nd Avenue to SH-128/120th Avenue: widen roadway to six lanes.
- 104th Avenue from Grandview Ponds to McKay Road: widen roadway to four lanes.
- I-70 from Brighton Boulevard to I-270: reconstruct roadway and add managed lanes.
- I-270 from I-25 to I-70: widen roadway to six lanes and reconstruct Vasquez Boulevard interchange.
- US-6 at Wadsworth Boulevard: interchange reconstruction.
- I-25 from 120th Avenue to SH-7 and from SH-66 to WCR 38: add two toll/managed lanes.
- C-470 from Wadsworth Boulevard to I-25: add toll/managed lanes.
- Colfax Avenue from 7th Street to Potomac Street: new Bus Rapid Transit.
- SH-119 from Boulder to Longmont: new Bus Rapid Transit.
- North Metro Rail Line, Denver Union Station to 124th Avenue Station: new rail, stations, parking.
- Southeast Rail Extension, Lincoln Avenue to RidgeGate Parkway: new rail, stations, parking.

Regional highway projects in the Fiscally Constrained RTP using locally-derived funds include:

- C-470 from South Kipling Parkway to I-25: add toll/managed lanes.
- E-470 from I-25/C-470 to I-25/Northwest Parkway: widen to eight/six lanes, build five new interchanges.
- New interchange at I-70/Harvest Mile Road.
- Jefferson Parkway from SH-93 to SH-128: new four-lane tollroad, plus 3 partial interchanges.

The 2015 rapid transit network includes the existing Central, Southwest, Southeast, West, and Central Platte Valley rail lines. It also includes the I-25 HOV/Tolled Express Lanes; HOV lanes

on Santa Fe Drive and US 36; and bus lanes on Broadway and Lincoln. The remaining rapid transit system to be completed by 2040 is shown in Figure 3.

All roadway and rapid transit network and staging assumptions through 2040 are shown in Figures 3 and 4, respectively, in Appendix A.

UFR TPR Transportation Assumptions

There were no regionally significant transportation improvement projects in the UFR TPR portion of the Southern Subarea, and no amendments are proposed for this cycle. The 2012-2017 STIP does include construction of a park-and-ride lot in Fort Lupton on US-85.

Air Quality Modeling Assumptions

The APCD of the CDPHE estimates air pollution emissions using MOVES. The conformity analysis for this 8-hour ozone conformity determination began in October 2014 when DRCOG transmitted initial travel model output files to APCD.

Mobile Source Measures

The regional emissions analysis does not specifically reflect the air quality benefits of such travel demand management programs as DRCOG's Regional TDM Program, Teleworking, Eco Pass, and other transportation demand management actions. In addition, other programs whose benefits are more difficult to ascertain are not fully incorporated into the model. Examples of such programs include compressed workweeks and programs initiated after 1998.

The DRCOG model also does reflect emissions reduction benefits created by DRCOG's Traffic Signal System Improvement Program (TSSIP), which is funded through the TIP. The goal of this program is to ensure that the region's traffic signals operate in a coordinated manner that makes the most efficient use of arterial street capacity. The efficiency objectives include:

- Minimizing vehicle stops.
- Minimizing travel delay.
- Minimizing disruption caused by malfunctioning equipment.

Emission Test Results

According to the EPA's *Transportation Conformity Guidance for 2008 Ozone Nonattainment Areas*, if an area does not have budgets for the 2008 ozone NAAQS, but has budgets for a previous ozone NAAQS (i.e., the 1997 ozone NAAQS), these budgets must be used in the budget test. Since budgets for the 2008 ozone NAAQS are not available, the SIP budgets established for the 1997 ozone NAAQS are used in this conformity.

The results of the Denver Southern Subarea emissions tests by year are reported in Table 3. The emissions estimates were generated by APCD using the transportation inputs from DRCOG's travel demand models and the MOVES emissions model. The 8-hour ozone conformity analysis was performed for the years 2025, 2035, and 2040, which meet the requirements for the staging years specified in 40 CFR 93.118. The test results do not indicate any failures in the horizon years of the program or plan that would lead to a finding of non-conformity. Therefore, conformity is demonstrated for the Denver Southern Subarea.

Table 3

8-Hour Ozone Conformity for Denver Southern Subarea
(Emission Tons per Day)

SIP budgets	2015 Emissions	2025 Emissions	2035 Emissions	2040 Emissions	Pass/Fail
Volatile Organic Compounds (VOC)					
89.7	56.08	34.71	21.56	22.03	Pass all tests
Oxides of Nitrogen (NOx)					
102.4	79.35	34.82	17.48	16.33	Pass all tests

<u>Summary of 8-hour Ozone Conformity Findings for the Denver Southern Subarea</u>

Based on the quantitative conformity analysis, the DRCOG staff have determined conformity is demonstrated for the regionally significant projects funded in the DRCOG Fiscally Constrained 2040 RTP, UFR 2040 RTP, DRCOG's 2012-2017 TIP and the 2016-2021 TIP, and the Colorado STIP within the Denver Southern Subarea associated with the 2008 8-hour ozone standard for the Denver Southern Subarea. Appendix C of this conformity determination

includes more information on the transportation and demographic assumptions used in this emissions analysis.

APPENDIX A
DRCOG TRANSPORTATION NETWORK ASSUMPTIONS

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Appendix A - 2040 Fiscally Constrained Regional Transportation Plan
Fiscally Constrained Roadway & Rapid Transit Capital Improvements
Remaining Project Cost Allocations (FY 2015 - 2040)

Roadway	CDOT Road	Project Location (Limits)	Improvement Type	Length (Miles)	Air Quality Network Staging	Remaining Project Cost (FY '15 $millions)	County
A. Regional Roadway System Projects							
1. Regionally Funded with DRCOG-Controlled Funds							
6th Pkwy.		SH-30/Liverpool St. to E-470	New 2 Lane Road	1.3	2015-2024	$19.9	Arapahoe
56th Ave.		Havana St. to Pena Blvd.	Widen from 2 to 6 Lanes	4.3	2015-2024	$45.0	Denver
88th Ave.		I-76 NB Ramps to SH-2	Widen from 2 to 4 Lanes	1.7	2015-2024	$21.5	Adams
104th Ave.	SH-44	Grandview Ponds to McKay Rd.	Widen from 2 to 4 Lanes	0.7	2015-2024	$8.1	Adams
120th Ave.		Allison St. to Emerald St.	New 6 Lanes	0.4	2015-2024	$0.0 (1)	Broomfield
Arapahoe Rd.	SH-88	Havana St. (or Jordan Rd.)	New Grade Separation		2025-2034	$16.0	Arapahoe
County Line Rd.		Phillips St. to University Blvd.	Widen from 2 to 4 Lanes	1.2	2015-2024	$9.5	Douglas
Hampden Ave./ S. Havana St.	SH-30	Florence St. to s/o Yale Ave.	Widen from 5 to 6 Lanes	1.4	2025-2034	$14.0	Denver
I-25	I-25	Lincoln Ave.	Interchange Capacity		2015-2024	$49.4	Douglas
I-25	I-25	Broadway	Interchange Capacity		2015-2024	$50.0	Denver
I-25	I-25	Ridgegate Pkwy. to County Line Rd. S. Ramps	Widen from 6 to 8 Lanes	2.7	2015-2024	$0.0 (1)	Douglas
I-70	I-70	Brighton Blvd. to I-270	Add 4 New Managed Lanes	3.8	2015-2024	$1,175.7 (2)	Denver
Kipling St.	SH-391	Colfax Ave. to I-70	Widen from 4 to 6 Lanes	3.0	2025-2034	$18.0	Jefferson
Martin Luther King Jr. Blvd.		Havana St./Iola St. to Peoria St.	Widen 2 to 4 Lanes; New 4 Lane Road	1.0	2015-2024	$15.0	Denver
Parker Rd.	SH-83	Quincy Ave. to Hampden Ave.	Widen from 6 to 8 Lanes	1.0	2025-2034	$18.5	Arapahoe
Pena Blvd.		I-70 to E-470	Widen from 4 to 8 Lanes	6.4	2015-2024	$55.0	Denver
Quebec St.	SH-35	35th Ave. to Sand Creek Dr. S.	Widen from 4 to 6 Lanes	1.2	2015-2024	$11.0	Denver
Ridgegate Pkwy.		Havana St. to Lone Tree E. City Limit	Widen from 2 to 4 Lanes	1.8	2015-2024	$8.0	Arapahoe
SH-7	SH-7	164th Ave. to Dahlia St.	Widen from 2 to 4 Lanes	2.2	2025-2034	$32.7	Adams
Sheridan Blvd.	SH-95	I-76 to US-36	Widen from 4 to 6 Lanes	4.5	2015-2024	$23.0	Adams/Jefferson
US-6	US-6	Federal Blvd. to Bryant St.	Interchange Capacity		2015-2024	$0.0 (1)	Denver
US-36	US-36	I-25 Express Lanes to Table Mesa Dr.	Add HOT Lanes	17.2	2015-2024	$0.0 (1)	Regional
US-36	US-36	Sheridan Blvd.	Interchange Capacity		2015-2024	$0.0 (1)	Jefferson
US-85	US-85	Blakeland Dr. to County Line Rd.	Widen from 4 to 6 Lanes	0.5	2025-2034	$26.0	Douglas
US-85	US-85	Highlands Ranch Pkwy. to Blakeland Dr.	Widen from 4 to 6 Lanes	1.6	2015-2024	$24.1	Douglas
Wadsworth Blvd.	SH-121	36th Ave. to 46th Ave.	Widen from 4 to 6 Lanes	0.9	2025-2034	$23.5	Jefferson
Wadsworth Pkwy.	SH-121	92nd Ave. to SH-128	Widen from 4 to 6 Lanes	3.7	2025-2034	$51.4	Jefferson
					Subtotal:	**$1,715.3**	

Notes

(1) Project funds have been fully obligated prior to FY '15; project is under construction.

(2) Includes DRCOG contribution of $50 million. CDOT funds make up $1,125.7 billion.

2. Regionally Funded with CDOT-Controlled Funds							
C-470	C-470	Wadsworth Blvd. to I-25	Add Toll Managed Lanes			$220.0	Douglas/Jefferson
		EB: Platte Canyon Rd. to I-25	*Add 1 New Toll Managed Lane*	*10.8*	*2015-2024*		*Douglas/Jefferson*
		WB: I-25 to Colorado Blvd.	*Add 2 New Toll Managed Lanes*	*4.1*	*2015-2024*		*Douglas*
		WB: Colorado Blvd. to Wadsworth Blvd.	*Add 1 New Toll Managed Lane*	*8.2*	*2015-2024*		*Douglas/Jefferson*
Federal Blvd.	SH-88	6th Ave. to Howard Pl.	Widen from 5 to 6 Lanes	0.8	2015-2024	$23.4	Denver
I-25	I-25	Arapahoe Rd.	Interchange Capacity		2015-2024	$50.4	Arapahoe
I-25	I-25	Santa Fe Dr. (US-85) to Alameda Ave.	Interchange Capacity		2015-2024	$27.0	Denver
I-25	I-25	Alameda Ave. to Walnut St. (Bronco Arch)	Add 1 New Lane in each direction	2.6	2025-2034	$30.0	Denver
I-25	I-25	US-36 to Thornton Pkwy.	Add 1 New SB Lane	2.8	2015-2024	$30.0	Adams
I-25	I-25	US-36 to 120th Ave.	Add 1 Toll/Managed Lane each direction	5.9	2015-2024	$68.5	Adams
I-25	I-25	120th Ave. to SH-7	Add 1 Toll/Managed Lane each direction	6.0	2015-2024	$55.0	Adams/Broomfield
I-25	I-25	SH-66 to WCR 38 (DRCOG Boundary)	Add 1 Toll/Managed Lane each direction	4.1	2035-2040	$92.0	Weld
I-225	I-225	I-25 to Yosemite St.	Interchange Capacity		2025-2034	$43.0	Arapahoe/Denver
I-70	I-70	Empire Junction (US-40) to Twin Tunnels	Add/Convert 1 new EB Peak Period Managed Lane	9.6	2015-2024	$24.0	Clear Creek
I-70	I-70	Twin Tunnels to Empire Junction (US-40)	Add 1 WB Peak Period Managed Lane	9.6	2025-2034	$50.0	Clear Creek
I-70	I-70	Vicinity of US-6 and Floyd Hill	TBD		2015-2024	$100.0	Clear Creek

Appendix A - 2040 Fiscally Constrained Regional Transportation Plan
Fiscally Constrained Roadway & Rapid Transit Capital Improvements
Remaining Project Cost Allocations (FY 2015 - 2040)

Roadway	CDOT Road	Project Location (Limits)	Improvement Type	Length (Miles)	Air Quality Network Staging	Remaining Project Cost (FY '15 $millions)	County
2. Regionally Funded with CDOT-Controlled Funds (cont'd.)							
I-270	I-270	I-25 to I-70	Widen from 4 to 6 Lanes	6.3	2035-2040	$160.0	Adams
I-270	I-270	Vasquez Blvd. (US 6/85)	Interchange Capacity		2015-2024	$60.0	Adams
SH-2	SH-2	72nd Ave. to I-76	Widen from 2 to 4 Lanes	7.5	2015-2024	$13.6	Adams
SH-66	SH-66	Hover St. to Main St. (US-287)	Widen from 2 to 4 Lanes	1.5	2035-2040	$19.0	Boulder
SH-119	SH-119	SH-52	New Interchange		2025-2034	$30.0	Boulder
US-6	US-6	19th St.	New Interchange		2015-2024	$20.0	Jefferson
US-6	US-6	Wadsworth Blvd.	Interchange Capacity		2025-2034	$60.0	Jefferson
US-85	US-85	Meadows Pkwy. to Louviers Ave.	Widen from 2 to 4 Lanes	5.7		$59.0	Douglas
		Meadows Pkwy. to Castlegate			*2015-2024*		
		Castlegate to Daniels Park Rd.			*2025-2034*		
		Daniels Park Rd. to SH-67 (Sedalia)			*2015-2024*		
		MP 191.75 to Louviers Ave.			*2025-2034*		
US-285	US-285	Pine Junction to Richmond Hill					
		Pine Valley Rd. (CR 126)/Mt Evans Blvd.	*New Interchange*		*2015-2024*	$14.0	Jefferson
		Kings Valley Dr.	*New Interchange*		*2015-2024*	$11.0	Jefferson
		Kings Valley Dr. to Richmond Hill Rd.	*Widen 3 to 4 Lanes (Add 1 SB Lane)*	0.9	*2015-2024*	$10.0	Jefferson
		Shaffers Crossing to Kings Valley Dr.	*Widen 3 to 4 Lanes (Add 1 SB Lane)*	1.4	*2015-2024*	$12.0	Jefferson
		Parker Ave.	*New Interchange*		*2015-2024*	$9.0	Jefferson
					Subtotal:	**$1,290.9**	
3. 100% Locally Derived Funding							
6th Ave.		Airport Blvd. to Tower Rd.	Widen from 2 to 6 Lanes	1.0	2015-2024	$10.2	Arapahoe
6th Ave.	SH-30	Tower Rd. to 6th Pkwy.	Widen from 2 to 6 Lanes	1.6	2015-2024	$14.1	Arapahoe
6th Pkwy.		SH-30 to E-470	Widen from 2 to 6 Lanes	1.3	2025-2034	$34.9	Arapahoe
6th Pkwy.		E-470 to Gun Club Rd.	Widen from 2 to 6 Lanes	0.3	2015-2024	$4.9	Arapahoe
6th Ave.		6th Pkwy. to Harvest Mile Rd.	Widen from 2 to 6 Lanes	0.4	2015-2024	$13.2	Arapahoe
17th Ave.		Alpine St. to Ute Creek Dr.	Widen from 2 to 4 Lanes	1.0	2015-2024	$2.3	Boulder
35th Ave.		Brighton Blvd. to Walnut St.	Widen from 2 to 4 Lanes	0.3	2025-2034	$2.5	Denver
48th Ave.		Imboden Rd. to Quail Run Rd.	Widen from 2 to 6 Lanes	1.0	2025-2034	$9.7	Adams
48th Ave.		Picadilly Rd. to Powhaton Rd.	New 6 Lanes	3.0	2015-2024	$40.7	Adams
48th Ave.		Powhaton Rd. to Monaghan Rd.	New 6 Lanes	1.0	2025-2034	$13.6	Adams
56th Ave.		E-470 to Imboden Rd.	Widen from 2 to 6 Lanes	7.0	2015-2024	$67.9	Adams
56th Ave.		Picadilly Rd. to E-470	Widen from 2 to 6 Lanes	1.0	2015-2024	$9.7	Adams
56th Ave.		Dunkirk St. to Himalaya St.	Widen from 4 to 6 Lanes	0.5	2015-2024	$11.5	Denver
56th Ave.		Himalaya St. to Picadilly Rd.	Widen from 2 to 6 Lanes	1.0	2015-2024	$5.8	Denver
56th Ave.		Pena Blvd. to Tower Rd.	Widen from 4 to 6 Lanes	0.7	2015-2024	$17.3	Denver
58th Ave.		Washington St. to York St.	Widen from 2 to 4 Lanes	1.0	2015-2024	$10.4	Adams
64th Ave.		Denver/Aurora City Limit to Himalaya St.	Widen from 2 to 6 Lanes	0.5	2015-2024	$6.5	Adams
64th Ave.		Harvest Mile Rd. to Powhaton Rd.	New 2 Lanes	1.0	2015-2024	$6.5	Adams
64th Ave.		Harvest Mile Rd. to Powhaton Rd.	Widen from 2 to 4 Lanes	1.0	2025-2034	$10.9	Adams
64th Ave.		Himalaya Rd. to Harvest Mile Rd.	Widen from 2 to 4 Lanes	3.0	2015-2024	$12.3	Adams
64th Ave.		Powhaton Rd. to Monaghan Rd.	New 4 Lanes	1.0	2015-2024	$6.7	Adams
64th Ave.		Tower Rd. to Denver/Aurora City Limits	Widen from 2 to 4 Lanes	0.5	2015-2024	$0.7	Denver
64th Ave.		Terry St. to Kendrick Dr.	Widen from 2 to 4 Lanes	1.2	2015-2024	$6.4	Jefferson
96th Ave.		SH-2 to Tower Road	Widen from 2 to 4 Lanes	5.0	2025-2034	$46.7	Adams
96th Ave.		Tower Rd. to Picadilly Rd.	Widen from 2 to 6 Lanes	2.0	2025-2034	$14.7	Adams
96th St.		96th St. at Northwest Pkwy. to SH-128	Add Toll Lanes	2.3	2015-2024	$39.4	Broomfield
104th Ave.		Marion St to Colorado Blvd	Widen from 4 to 6 Lanes	1.6	2025-2034	$6.3	Adams
104th Ave.		US-85 to SH-2	Widen from 2 to 4 Lanes	1.8	2015-2024	$41.2	Adams
104th Ave.	SH-44	McKay Road to US-85	Widen from 2 to 4 Lanes	1.9	2025-2034	$40.6	Adams
120th Ave.		Sable Blvd. to E-470	Widen from 2 to 6 Lanes	2.0	2025-2034	$29.7	Adams
120th Ave.		E-470 to Picadilly Rd.	Widen from 2 to 6 Lanes	2.6	2025-2034	$15.5	Adams
144th Ave.		Washington St. to York St.	Widen from 2 to 4 Lanes	1.0	2015-2024	$12.8	Adams
144th Ave.		York St. to Colorado Blvd.	Widen from 2 to 4 Lanes	1.0	2015-2024	$10.4	Adams
144th Ave.		US-287 to Zuni St.	Widen from 2 to 4 Lanes	3.5	2015-2024	$21.2	Broomfield
152nd Ave.		Washington St. to York St.	Widen from 2 to 4 Lanes	1.2	2025-2034	$11.1	Adams

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Roadway	CDOT Road	Project Location (Limits)	Improvement Type	Length (Miles)	Air Quality Network Staging	Remaining Project Cost (FY '15 $millions)	County
3. 100% Locally Derived Funding (cont'd.)							
160th Ave.		Lowell Blvd. to Sheridan Pkwy.	New 2 Lanes	1.0	2015-2024	$3.8	Broomfield
Alameda Ave.		McIntyre St. to Rooney Rd.	Widen from 2 to 6 Lanes	0.3	2015-2024	$2.6	Jefferson
Alameda Ave.		Bear Creek Blvd. to McIntyre St.	Widen from 2 to 4 Lanes	1.3	2015-2024	$7.6	Jefferson
Arapahoe Rd.		Himalaya Way to Liverpool St.	Widen from 4 to 6 Lanes	0.5	2025-2034	$6.2	Arapahoe
Arapahoe Rd.		Waco St. to Himalaya St.	Widen from 2 to 6 Lanes	1.3	2015-2024	$20.4	Arapahoe
Bayou Gulch Rd. /Chambers Rd.		Parker Road to Parker S. Town Limit	Widen from 0/2 to 4 Lanes	2.4	2025-2034	$18.4	Douglas
Broadway		Arizona Ave. to Mississippi Ave.	Widen from 4 to 6 Lanes	0.1	2015-2024	$2.5	Denver
Broadway		Kentucky Ave. to Exposition Ave.	Widen from 4 to 6 Lanes	0.3	2015-2024	$4.8	Denver
Broadway		Mississippi Ave. to Kentucky Ave.	Widen from 6 to 8 Lanes	0.3	2015-2024	$5.0	Denver
Broncos Pkwy.		Jordan Rd. to Parker Rd.	Widen from 4 to 6 Lanes	0.8	2015-2024	$6.9	Arapahoe
Broncos Pkwy.		Havana St. to Peoria St.	Widen from 4 to 6 Lanes	1.0	2015-2024	$8.1	Arapahoe
Buckley Rd.		118th Ave. to Cameron Dr.	Widen from 2 to 6 Lanes	1.3	2015-2024	$13.9	Adams
Buckley Rd.		136th Ave. to Bromley Ln.	Widen from 2 to 4 Lanes	2.0	2015-2024	$7.8	Adams
C-470	C-470	S. Kipling Pkwy. to I-25	Add New Toll/Managed Lanes				
		WB: Wadsworth Blvd. to S. Kipling Pkwy.	*Add 1 Toll/Managed Lane*	*1.4*	*2025-2034*	*$45.0*	*Jefferson*
		EB: S. Kipling Pkwy. to Platte Canyon Rd.	*Add 1 Toll/Managed Lane*	*3.0*	*2025-2034*		*Jefferson*
		WB: Colorado Blvd. to Lucent Blvd.	*Add 1 Toll/Managed Lane*	*3.7*	*2025-2034*	*$120.0*	*Douglas*
		EB: Broadway to I-25	*Add 1 Toll/Managed Lane*	*6.6*	*2025-2034*		*Douglas*
Canyons Pkwy.		Crowfoot Valley Rd. to Hess Rd.	New 4 Lanes	4.1	2015-2024	$19.1	Douglas
Central Park Blvd.		47th Ave. (Northfield Blvd.) to 56th Ave.	New 4 Lanes	0.9	2015-2024	$4.3	Denver
Chambers Rd.		Crowfoot Valley Road to Parker S. Town Limit	New 2 Lanes	0.7	2025-2034	$3.1	Douglas
Chambers Rd.		Crowfoot Valley Road to Parker S. Town Limit	Widen from 2 to 4 Lanes	0.7	2015-2024	$3.1	Douglas
Chambers Rd.		Crowfoot Valley Rd. to Hess Rd.	New 4 Lanes	2.3	2015-2024	$15.4	Douglas
Chambers Rd.		Hess Rd. to Mainstreet	Widen from 2 to 4 Lanes	1.9	2015-2024	$12.6	Douglas
Chambers Rd.		Mainstreet to Lincoln Ave.	Widen from 2 to 4 Lanes	1.4	2015-2024	$4.4	Douglas
Colorado Blvd.		144th Ave. to 168th Ave.	Widen from 0/2 to 4 Lanes	3.7	2025-2034	$23.5	Adams
Crowfoot Valley Rd.		Stroh Rd. to Chambers Rd.	Widen from 2 to 4 Lanes	1.4	2015-2024	$6.4	Douglas
Crowfoot Valley Rd.		Macanta Rd. to Chambers Rd.	Widen from 2 to 4 Lanes	3.6	2025-2034	$22.9	Douglas
Crowfoot Valley Rd.		Founders Pkwy. to Macanta Rd.	Widen from 2 to 4 Lanes	1.1	2025-2034	$5.1	Douglas
E. Bromley Ln.		Hwy 85 to Sable Blvd.	Widen from 4 to 6 Lanes	0.5	2015-2024	$1.3	Adams
E. Bromley Ln.		Tower Rd. to I-76	Widen from 4 to 6 Lanes	1.1	2015-2024	$1.9	Adams
E-470		48th Ave.	Add New Interchange		2015-2024	$26.9	Adams
E-470		88th Ave.	Add New Interchange		2025-2034	$17.6	Adams
E-470		I-25 North to I-76	Widen from 4 to 6 Lanes	11.0	2025-2034	$76.5	Adams
E-470		Potomac	Add New Interchange		2015-2024	$8.0	Adams
E-470		Quebec	Add New Interchange		2015-2024	$24.8	Adams
E-470		112th Ave.	Add New Interchange		2025-2034	$17.6	Adams
E-470		I-70 to Pena Blvd.	Widen from 4 to 6 Lanes	7.4	2025-2034	$29.3	Adams/Denver
E-470		Pena Blvd. to I-76	Widen from 4 to 6 Lanes	7.6	2025-2034	$51.5	Adams/Denver
E-470		I-25 to Parker Rd.	Widen from 6 to 8 Lanes	5.5	2025-2034	$32.0	Arapahoe
E-470		Parker Rd. to I-70	Widen from 4 to 6 Lanes	15.2	2025-2034	$67.3	Arapahoe/Douglas
East County Line Rd.		9th Ave. to SH-66	Widen from 2 to 4 Lanes	2.0	2025-2034	$9.8	Boulder
Erie Pkwy.		US-287 to 119th St.	Widen from 2 to 4 Lanes	1.5	2015-2024	$14.6	Boulder
Green Valley Ranch Blvd.		Chambers Rd. to Telluride St.	Widen from 4 to 6 Lanes	1.5	2015-2024	$9.9	Denver
Green Valley Ranch Blvd.		Chambers Rd. to Pena Blvd.	Widen from 2 to 4 Lanes	1.0	2015-2024	$2.4	Denver
Green Valley Ranch Blvd.		Telluride St. to Tower Rd.	Widen from 4 to 6 Lanes	0.5	2015-2024	$1.7	Denver
Gun Club Rd.		1.5 Miles s/of Quincy Ave. to Quincy Ave.	Widen from 2 to 6 Lanes	1.6	2015-2024	$26.7	Arapahoe
Gun Club Rd.	SH-30	Yale Ave. to Mississippi Ave.	Widen from 2/4 to 6 Lanes	2.1	2025-2034	$10.9	Arapahoe
Hampden Ave.		Picadilly Rd. to Gun Club Rd.	Widen from 2 to 4 Lanes	1.1	2015-2024	$12.4	Arapahoe
Harvest Mile Rd.		56th Ave. to 64th Ave.	New 3 Lanes	1.0	2015-2024	$6.5	Adams
Harvest Mile Rd.		56th Ave. to 64th Ave.	Widen from 3 to 6 Lanes	1.0	2025-2034	$7.8	Adams
Harvest Mile Rd.		I-70 to 56th Ave.	New 6 Lanes	4.1	2015-2024	$54.3	Adams
Harvest Mile Rd.		Jewell Ave. to Mississippi Ave.	Widen from 2 to 6 Lanes	1.0	2025-2034	$13.3	Arapahoe
Harvest Rd.		6th Ave. to I-70	New 6 Lanes	1.1	2015-2024	$13.3	Adams
Harvest Rd.		Alameda Ave. to 6th Ave.	Widen from 3 to 6 Lanes	1.0	2015-2024	$6.7	Arapahoe

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Remaining Project Cost Allocations (FY 2015 - 2040)

Roadway	CDOT Road	Project Location (Limits)	Improvement Type	Length (Miles)	Air Quality Network Staging	Remaining Project Cost (FY '15 $millions)	County
3. 100% Locally Derived Funding (cont'd.)							
Harvest Rd.		Mississippi Ave. to Alameda Ave.	New 6 Lanes	1.0	2015-2024	$13.3	Arapahoe
Hess Rd.		I-25 to Chambers Rd.	Widen from 2 to 4 Lanes	5.1	2025-2034	$44.5	Douglas
Hess Rd.		Motsenbocker Rd. to Nate Dr.	Widen from 2 to 4 Lanes	0.5	2015-2024	$3.5	Douglas
Hilltop Rd.		Canterberry Pkwy. to Singing Hills Rd.	Widen from 2 to 4 Lanes	2.7	2025-2034	$17.8	Douglas
Huron St.		150th Ave. to 160th Ave.	Widen from 2 to 4 Lanes	1.3	2015-2024	$8.6	Broomfield
Huron St.		160th Ave. to SH-7	Widen from 2 to 4 Lanes	1.2	2015-2024	$5.1	Broomfield
I-25	I-25	Castlegate Dr.	Add New Interchange		2015-2024	$15.3	Douglas
I-25	I-25	Crystal Valley Pkwy.	Add New Interchange		2025-2034	$44.5	Douglas
I-70	I-70	E-470	Interchange Capacity		2025-2034	$100.0	Adams/Arapahoe
I-70	I-70	Harvest Mile Rd.	Add New Interchange		2015-2024	$39.6	Adams/Arapahoe
I-70	I-70	32nd Ave.	Interchange Capacity		2015-2024	$22.4	Jefferson
I-70	I-70	Picadilly Rd.	Add New Interchange		2015-2024	$27.5	Adams
I-76	I-76	Bridge St.	Add New Interchange		2015-2024	$25.4	Adams
Imboden Rd.		48th Ave. to 56th Ave.	Widen from 2 to 6 Lanes	1.0	2025-2034	$10.3	Adams
Jefferson Pkwy.		Initial Phase: SH-93 to SH-128	New 4 Lane Toll Road; 3 Partial Interchanges	10.2	2015-2024	$259.1	Jefferson
		Candelas Pkwy.	*New Partial Interchange*		*2015-2024*		
		Indiana St. s/o SH-128	*New Partial Interchange*		*2015-2024*		
		SH-72	*New Partial Interchange*		*2015-2024*		
Jewell Ave.		E-470 to Gun Club Rd.	Widen from 2 to 6 Lanes	0.5	2015-2024	$4.9	Arapahoe
Jewell Ave.		Gun Club Rd. to Harvest Rd.	Widen from 2 to 6 Lanes	1.0	2015-2024	$10.0	Arapahoe
Jewell Ave.		Himalaya Rd. to E-470	Widen from 3 to 6 Lanes	1.4	2015-2024	$13.2	Arapahoe
Jordan Rd.		Bradbury Pkwy. to Hess Rd.	Widen from 2 to 4 Lanes	0.6	2015-2024	$3.0	Douglas
Lincoln Ave.		1st St. to Keystone Blvd.	Widen from 4 to 6 Lanes	1.8	2025-2034	$8.3	Douglas
Lincoln Ave.		Keystone Blvd. to Parker Rd.	Widen from 4 to 6 Lanes	1.6	2015-2024	$8.0	Douglas
Lincoln Ave.		Peoria St. to 1st Ave.	Widen from 4 to 6 Lanes	0.7	2015-2024	$3.2	Douglas
Mainstreet		Canterberry Pkwy. to Tomahawk Rd.	Widen from 2 to 4 Lanes	1.4	2025-2034	$7.6	Douglas
Mainstreet		Lone Tree E. City Limit to Chambers Rd.	Widen from 2 to 4 Lanes	0.9	2025-2034	$7.6	Douglas
Monaghan Rd.		Quincy Ave. to Yale Ave.	New 6 Lanes	2.0	2025-2034	$22.9	Arapahoe
Nelson Rd.		75th St. to Affolter Dr.	Widen from 2 to 4 Lanes	2.3	2015-2024	$5.2	Boulder
Pace St.		5th Ave. to Ute Rd.	Widen from 2 to 4 Lanes	2.5	2015-2024	$3.8	Boulder
Pecos St.		52nd Ave. to I-76	Widen from 2 to 4 Lanes	1.3	2015-2024	$8.7	Adams
Pena Blvd.		Jackson Gap St. West Ramps to DIA Terminal	Widen from 6 to 8 Lanes	1.7	2015-2024	$10.2	Denver
Peoria St.		E-470 to .75 miles s/o Lincoln Ave.	Widen from 2 to 4 Lanes	1.9	2015-2024	$4.4	Douglas
Peoria St.		.75 miles s/o Lincoln Ave. to Mainstreet	Widen from 2 to 4 Lanes	0.5	2025-2034	$4.4	Douglas
Picadilly Rd.		48th Ave. to 56th Ave.	Widen from 2 to 6 Lanes	1.2	2015-2024	$13.6	Adams
Picadilly Rd.		56th Ave. to 70th Ave./Aurora City Limits	New 6 Lanes	1.7	2015-2024	$20.4	Adams
Picadilly Rd.		82nd Ave. to 96th Ave.	New 6 Lanes	1.8	2025-2034	$21.6	Adams
Picadilly Rd.		Colfax Ave. to I-70	New 6 Lanes	0.3	2015-2024	$12.9	Adams
Picadilly Rd.		I-70 to Smith Rd.	Widen from 2 to 6 Lanes	0.5	2015-2024	$5.3	Adams
Picadilly Rd.		Smith Rd. to 48th Ave.	Widen from 2 to 6 Lanes	2.2	2015-2024	$22.5	Adams
Picadilly Rd.		96th Ave. to 120th Ave.	New 6 Lanes	3.0	2025-2034	$49.0	Adams
Picadilly Rd.		6th Ave. to Colfax Ave.	Widen from 2 to 6 Lanes	1.6	2015-2024	$10.0	Arapahoe
Picadilly Rd.		Jewell Ave. to 6th Pkwy.	New 4 Lanes	2.7	2015-2024	$18.1	Arapahoe
Picadilly Rd.		70th Ave. to 82nd Ave.	New 6 Lanes	1.5	2015-2024	$11.4	Denver
Plum Creek Pkwy.		Gilbert St. to Ridge Rd.	Widen from 2 to 4 Lanes	1.5	2015-2024	$5.1	Douglas
Powhaton Rd.		Smoky Hill Rd. to County Line Rd.	Widen from 2 to 6 Lanes	1.0	2025-2034	$3.5	Arapahoe
Quail Run Rd.		I-70 to 48th Ave.	New 6 Lanes	3.0	2025-2034	$36.4	Adams
Quebec St.		120th Ave. to 128th Ave.	Widen from 2 to 4 Lanes	1.0	2015-2024	$8.4	Adams
Quebec St.		132nd Ave. to 160th Ave.	Widen from 2 to 4 Lanes	3.5	2015-2024	$21.0	Adams
Quincy Ave.		Plains Pkwy. to Gun Club Rd.	Widen from 2 to 6 Lanes	0.6	2015-2024	$13.3	Arapahoe
Quincy Ave.		Hayesmount Rd. to Watkins Rd.	Widen from 2 to 6 Lanes	2.0	2025-2034	$16.0	Arapahoe
Quincy Ave.		Monaghan Rd. to Hayesmount Rd.	Widen from 2 to 6 Lanes	1.1	2025-2034	$18.9	Arapahoe
Quincy Ave.		C-470 to Simms St.	Widen from 2 to 4 Lanes	1.9	2025-2034	$16.0	Jefferson
Quincy Ave.		Kipling St. to Carr St.	Widen from 2 to 4 Lanes	1.0	2015-2024	$10.2	Jefferson
Quincy Ave.		Simms St. to Kipling Pkwy.	Widen from 2 to 4 Lanes	1.0	2015-2024	$12.0	Jefferson

Appendix A - 2040 Fiscally Constrained Regional Transportation Plan
Fiscally Constrained Roadway & Rapid Transit Capital Improvements
Remaining Project Cost Allocations (FY 2015 - 2040)

Roadway	CDOT Road	Project Location (Limits)	Improvement Type	Length (Miles)	Air Quality Network Staging	Remaining Project Cost (FY '15 $millions)	County
3. 100% Locally Derived Funding (cont'd.)							
Quincy Ave.		Irving St. to Federal Blvd.	New 2 Lanes	0.3	2015-2024	$3.8	Jefferson
Rampart Range Rd.		Waterton Rd. to Titan Rd.	Widen from 2 to 4 Lanes	1.5	2025-2034	$10.2	Douglas
Ridge Rd.		Plum Creek Pkwy. to SH-86	Widen from 2 to 4 Lanes	1.1	2015-2024	$3.8	Douglas
S. Boulder Rd./160th Ave.		120th St. to Boulder/Broomfield County Line	New 2 Lanes	1.2	2025-2034	$10.2	Boulder
SH-7	SH-7	Riverdale Rd. to US-85	Widen from 2 to 4 Lanes	1.1	2025-2034	$16.3	Adams
SH-7	SH-7	Boulder County Line to Sheridan Pkwy.	Widen from 2 to 4 Lanes	2.5	2015-2024	$6.6	Broomfield
SH-7	SH-7	Sheridan Pkwy. to I-25	Widen from 2 to 6 Lanes	1.5	2015-2024	$10.2	Broomfield
SH-58	SH-58	Cabela St.	Add New Interchange		2015-2024	$19.6	Jefferson
Sheridan Blvd.		Lowell Blvd. to NW Pkwy.	Widen from 2 to 4 Lanes	1.1	2015-2024	$7.6	Broomfield
Sheridan Pkwy.		NW Pkwy. to SH-7	Widen from 2 to 4 Lanes	1.3	2015-2024	$5.7	Broomfield
Smoky Hill Rd.		Pheasant Run Pkwy. to Versailles Pkwy.	Widen from 4 to 6 Lanes	4.4	2025-2034	$33.9	Arapahoe
Southwest Ring Rd.		Wolfensberger Rd. to I-25	Widen from 2 to 4 Lanes	1.4	2015-2024	$5.1	Douglas
Stroh Rd.		Crowfoot Valley Rd. to J. Morgan Blvd.	Widen from 2 to 4 Lanes	0.5	2015-2024	$6.4	Douglas
Stroh Rd.		Chambers Rd. to Crowfoot Valley Rd.	New 4 Lanes	1.4	2015-2024	$10.6	Douglas
Thornton Pkwy.		Colorado Blvd. to Riverdale Rd.	Widen from 2 to 4 Lanes	0.5	2025-2034	$14.0	Adams
Titan Rd.		Rampart Range Rd. to Santa Fe Dr.	Widen from 2 to 4 Lanes	3.0	2025-2034	$38.1	Douglas
Tower Rd.		Colfax Ave. to Smith Rd.	Widen from 2 to 6 Lanes	1.0	2015-2024	$8.7	Adams
Tower Rd.		Pena Blvd. to 105th Ave.	Widen from 2 to 6 Lanes	3.8	2015-2024	$23.2	Adams
Tower Rd.		6th Ave. to Colfax Ave.	New 2 Lanes	1.0	2015-2024	$9.5	Arapahoe
Tower Rd.		6th Ave. to Colfax Ave.	Widen from 2 to 6 Lanes	1.0	2025-2034	$16.3	Arapahoe
Tower Rd.		38th/40th Ave. to Green Valley Ranch Blvd.	Widen from 2/4 to 6 Lanes	1.0	2015-2024	$26.7	Denver
Tower Rd.		56th Ave. to Pena Blvd.	Widen from 4 to 6 Lanes	2.4	2015-2024	$16.0	Denver
Tower Rd.		48th Ave. to 56th Ave.	Widen from 4 to 6 Lanes	1.0	2015-2024	$5.3	Denver
Tower/Buckley Rd.		105th Ave. to 118th Ave.	New 4 Lanes	2.0	2015-2024	$8.8	Adams
US-85	US-85	Titan Rd. to Highland Ranch Pkwy.	Widen from 4 to 6 Lanes	2.2	2025-2034	$5.9	Douglas
US-85	US-85	Castlegate Dr.	Add New Interchange		2015-2024	$31.8	Douglas
Washington St.		144th Ave. to 152nd Ave.	Widen from 2 to 4 Lanes	0.7	2015-2024	$12.0	Adams
Washington St.		52nd Ave. to 58th Ave.	Widen from 2 to 4 Lanes	0.8	2015-2024	$4.4	Adams
Washington St.		152nd Ave. to 160th Ave.	Widen from 2 to 4 Lanes	1.4	2015-2024	$24.8	Adams
Washington St.		Elk Pl. to 52nd Ave.	Widen from 2 to 4 Lanes	0.6	2015-2024	$13.3	Denver
Waterton Rd.		Dante Dr. to Campfire St.	Widen from 2 to 4 Lanes	1.0	2025-2034	$3.8	Douglas
Watkins Rd.		Quincy Ave. to I-70	Widen from 2 to 6 Lanes	7.1	2025-2034	$54.7	Arapahoe
Wolfensberger Rd.		Coachline Rd. to Prairie Hawk Dr.	Widen from 2 to 4 Lanes	1.0	2025-2034	$7.5	Douglas
Yale Ave.		Monaghan Rd. to Hayesmount Rd.	Widen from 2 to 6 Lanes	1.1	2025-2034	$17.3	Arapahoe
York St.		152nd Ave. to E-470	Widen from 2 to 4 Lanes	0.2	2025-2034	$2.0	Adams
York St.		160th Ave. (SH-7) to 168th Ave.	Widen from 2 to 4 Lanes	1.0	2015-2024	$7.5	Adams
York St.		E-470 to SH-7	Widen from 2 to 4 Lanes	0.7	2015-2024	$10.7	Adams
					Subtotal:	**$3,165.2**	
			Grand Total for Regional Roadway System Projects:			**$6,171.4**	

B. Regional Transit Projects

FasTracks Components							
Eagle Project						$1,033.2	
East Rail Line		DUS to DIA	Commuter Rail	22.8	2015-2024		Adams/Denver
Gold Line		DUS to Ward Rd.	Commuter Rail	11.2	2015-2024		Multiple
Northwest Rail Phase 1		DUS to 71st/Lowell Blvd.	Commuter Rail	6.2	2015-2024		Adams/Denver
I-225 Rail Line		Parker Rd. to East Rail Line	Light Rail	10.5	2015-2024	$476.9	Adams/Arapahoe
North Metro Commuter Rail		DUS to 124th Ave.	Commuter Rail	13.0	2015-2024	$606.8	Adams/Denver
Southeast Rail Extension		Lincoln Ave. to Ridgegate Pkwy.	Light Rail	2.3	2015-2024	$205.9	Douglas
US-36 Bus Rapid Transit		DUS to Table Mesa	Bus Rapid Transit	18.0	2015-2024	$78.9	Multiple
Other FasTracks Projects						$99.4	
Other Regional Transit							
Colfax Ave.	US-40	7th St. to Potomac St.	Bus Rapid Transit	10.5	2015-2024	$115.0	Adams/Denver
SH-119	SH-119	Foothills Pkwy to US-287	Bus Rapid Transit	11.0	2015-2024	$57.0	Boulder
					Total of Regional Transit Projects	**$2,673.1**	

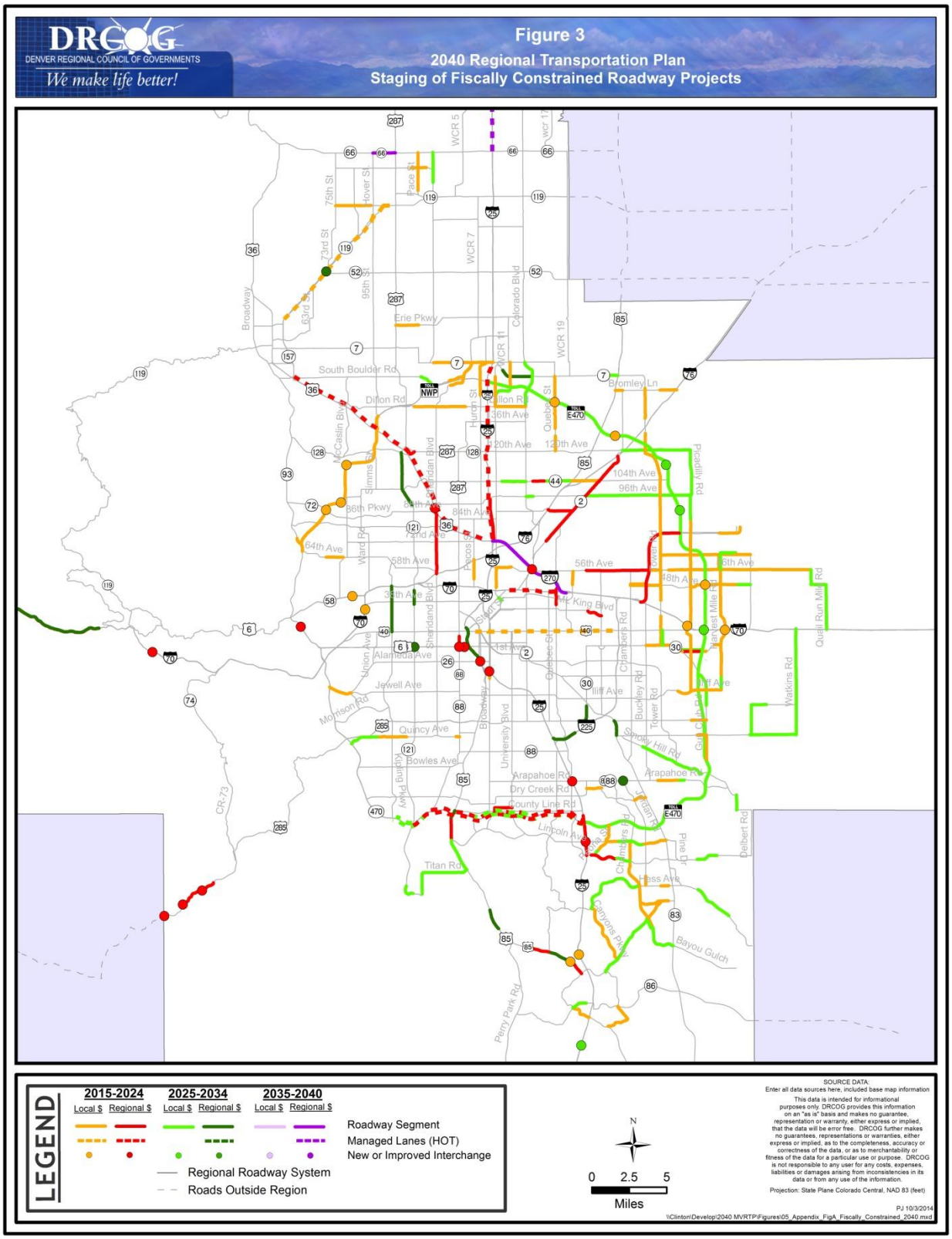
DRCOG
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Figure 3
2040 Regional Transportation Plan
Staging of Fiscally Constrained Roadway Projects
LEGEND
2015-2024
Local $ Regional $
2025-2034
Local $ Regional $
2035-2040
Local $ Regional $
Roadway Segment
Managed Lanes (HOT)
New or Improved Interchange
Regional Roadway System
Roads Outside Region
N
0 2.5 5
Miles
SOURCE DATA:
Enter all data sources here, included base map information
This data is intended for informational purposes only. DRCOG provides this information on an "as is" basis and makes no guarantee, representation or warranty, either express or implied, that the data will be error free. DRCOG further makes no guarantees, representations or warranties, either express or implied, as to the completeness, accuracy or correctness of the data, or as to merchantability or fitness of the data for a particular use or purpose. DRCOG is not responsible to any user for any costs, expenses, liabilities or damages arising from inconsistencies in its data or from any use of the information.
Projection: State Plane Colorado Central, NAD 83 (feet)
PJ 10/3/2014
\\Clinton\Develop\2040 MVRTP\Figures\05_Appendix_FigA_Fiscally_Constrained_2040.mxd

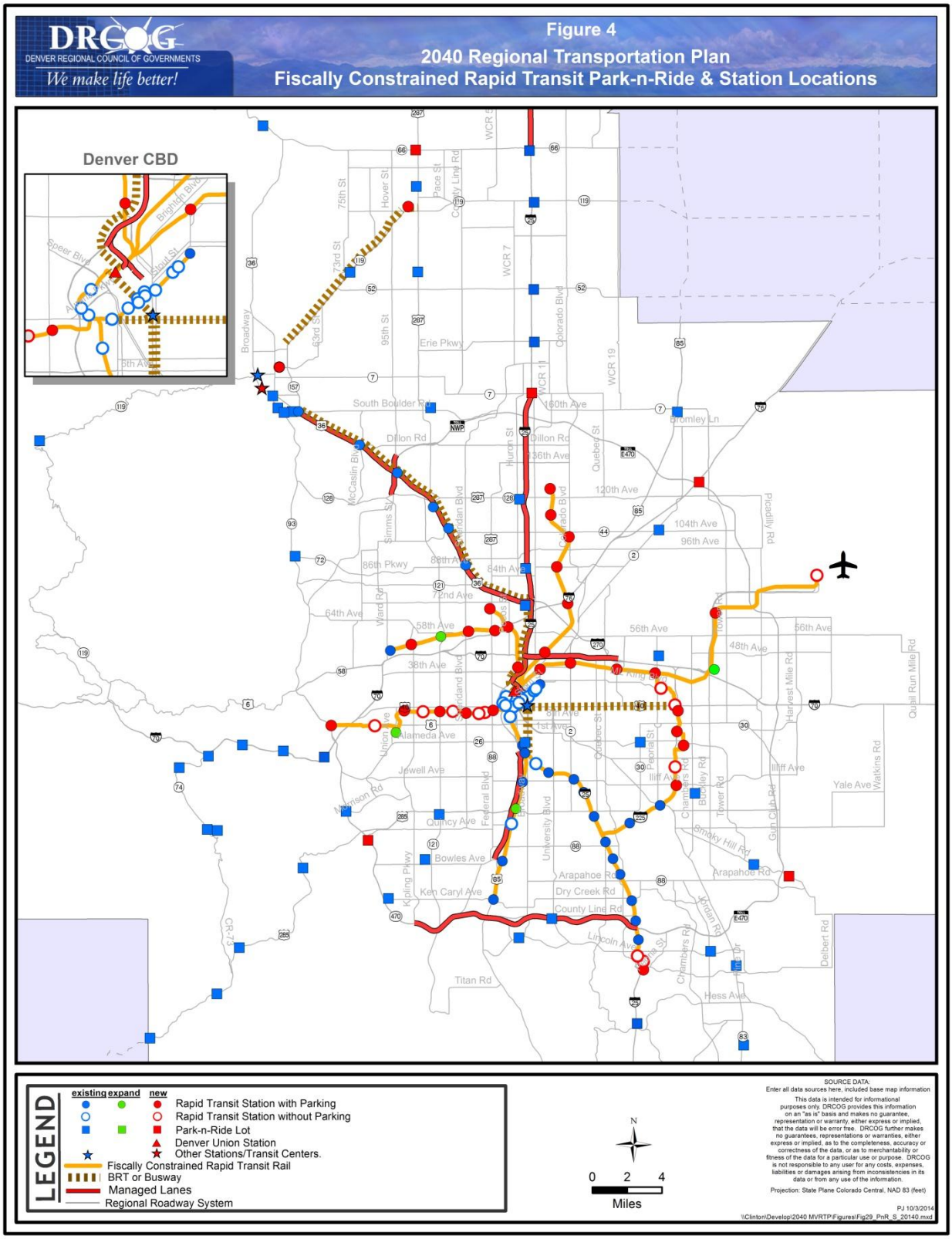
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Figure 4
2040 Regional Transportation Plan
Fiscally Constrained Rapid Transit Park-n-Ride & Station Locations
Denver CBD
LEGEND
existing expand new
Rapid Transit Station with Parking
Rapid Transit Station without Parking
Park-n-Ride Lot
Denver Union Station
Other Stations/Transit Centers.
Fiscally Constrained Rapid Transit Rail
BRT or Busway
Managed Lanes
Regional Roadway System
N
0 2 4
Miles
SOURCE DATA:
Enter all data sources here, included base map information
This data is intended for informational purposes only. DRCOG provides this information on an "as is" basis and makes no guarantee, representation or warranty, either express or implied, that the data will be error free. DRCOG further makes no guarantees, representations or warranties, either express or implied, as to the completeness, accuracy or correctness of the data, or as to merchantability or fitness of the data for a particular use or purpose. DRCOG is not responsible to any user for any costs, expenses, liabilities or damages arising from inconsistencies in its data or from any use of the information.
Projection: State Plane Colorado Central, NAD 83 (feet)
PJ 10/3/2014
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APPENDIX B

DRCOG Transportation Model Calibration Description

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Introduction

In support of the conformity determination for the 2040 Regional Transportation Plan (RTP), the Denver Regional Council of Governments' (DRCOG) Regional Planning and Operations Division used the Regional UrbanSim Socio-economic Model together with *Focus*, the updated regional travel modeling system. Travel modeling uses mathematical formulations in computer software programs to show how regional development impacts road and transit usage.

The *Focus* model simulates the travel of millions of individual people in the region throughout a typical weekday. The *Focus* model sums all travel to forecast how many vehicles will be driven on major roads; how much congestion there will be; and how many people will walk, bike or use transit. To realistically simulate each person's daily travel, *Focus* and UrbanSim model the many choices each person makes, including:

(1) where to work
(2) where to go to school
(3) how many automobiles are owned by the person's household
(4) how many trips each person makes in a day, and for what reasons
(5) which trips are chained together into home-to-home tours
(6) the address where each trip starts from and goes to
(7) the travel mode for each trip, with choices including walk and biking
(8) which major streets or bus routes were chosen to reach each destination

The models take into account many characteristics of people, such as their age, gender, employment status, and income; and how the region will change demographically over time. It also takes into account characteristics of the built environment such as congestion, density, and walkability.

The *Focus* travel model was initially estimated based on detailed data from a survey called the Travel Behavior Inventory (TBI). The TBI project involved multiple surveys of travel in the Denver metropolitan area, including:

- The Household Survey – a travel diary survey that gathered complete travel information for an assigned day for approximately 5,000 households;
- The Front Range Travel Survey - a survey of vehicles entering and leaving the metropolitan area;

- The Commercial Vehicle Survey – a survey that gathered complete travel information from more than 800 commercial vehicles on an assigned day; and
- The Non-Respondent Populations Project - an effort to evaluate whether those who did not respond to the survey exhibited different travel behavior than people who did respond to the survey.

The bulk of this survey work was conducted in 1997-1998, with data “cleaning” and summary conducted through 2001.

Focus was calibrated using 2005 data sources including roadway counts, transit boardings, American Community Survey data, and Census data.

Since this original work, additional surveys of travel behavior have been conducted, including:

- RTD's 2008 Regional On-Board Transit Survey – a questionnaire handed out to light rail and bus travelers to understand how transit travel patterns have changed since the opening of the Southeast Corridor Light Rail in November 2006. The survey contains information on almost 24,000 transit trips.
- The 2010 Front Range Travel Counts Household Survey – A survey of over 12,000 households along the Colorado Front Range, including 7,000 in the DRCOG region, using a format similar to the 1997 TBI Household Survey described above.

In developing the 2040 RTP this year, the mathematical relationships within the *Focus* model were adjusted to better reflect the travel behavior recorded in these two surveys, including:

- Where people live and work within the region
- Where students attend school
- How many trips of each type different kinds of people make on a typical day
- How far people travel for various kinds of trips
- Preferences about traveling by auto, carpool, transit, biking and walking
- How different types of transit riders trade off different elements of their trip, such as the fare, in-vehicle time, access and egress times, and waiting time

The final outputs of *Focus* were also checked against traffic counts and RTD ridership data to make sure the overall regional travel patterns being forecasted were reasonable.

Demographic Forecasts

DRCOG works with a panel of economists and planners from both the private and public sectors to review current growth trends and evaluate the output of a regional forecasting model. This model relates the regional economy to national economic forecasts. The forecasts are reviewed annually with major revisions expected every five years.

Small Area Development Estimates

To provide development data at a level of detail necessary for the travel model, the regional urban activity forecasts are dis-aggregated into 2,800 transportation analysis zones (TAZs), as shown in Figure 1. The allocation to TAZs is carried out within the UrbanSim model based on the dynamics of urban land markets and the simulated decisions of land developers, and residential and commercial land customers. The UrbanSim model considers questions such as:

- What parcels of land are profitable for development, and for what uses?
- Where should a firm locate to conduct its business in accordance with zoning regulations, and with suitable access to workers, supplies, and finished product markets?
- Does a family's current house continue to meet its needs and be convenient to jobs, schools, and other activities, or should the family move to a better house?
- What size and types of house does a family need based on the number and ages of its members and its household income?
- What neighborhoods are convenient to work and offer the amenities the family values?

The UrbanSim model includes a population synthesizer that creates a descriptive database record for each household in the region (about one million records in 2010) and each person (about 2.8 million records in 2010). The effects of several regional planning policies also are taken into account in the model: open space plans affect the amount of developable land in the relevant parcels; the regional Urban Growth Boundary/Area affects expected densities, and the development totals in parcels outside that boundary. Figure 2 shows a flowchart for the process of socioeconomic forecasting in the Denver region.

Figure 1
DRCOG Travel Analysis Zones

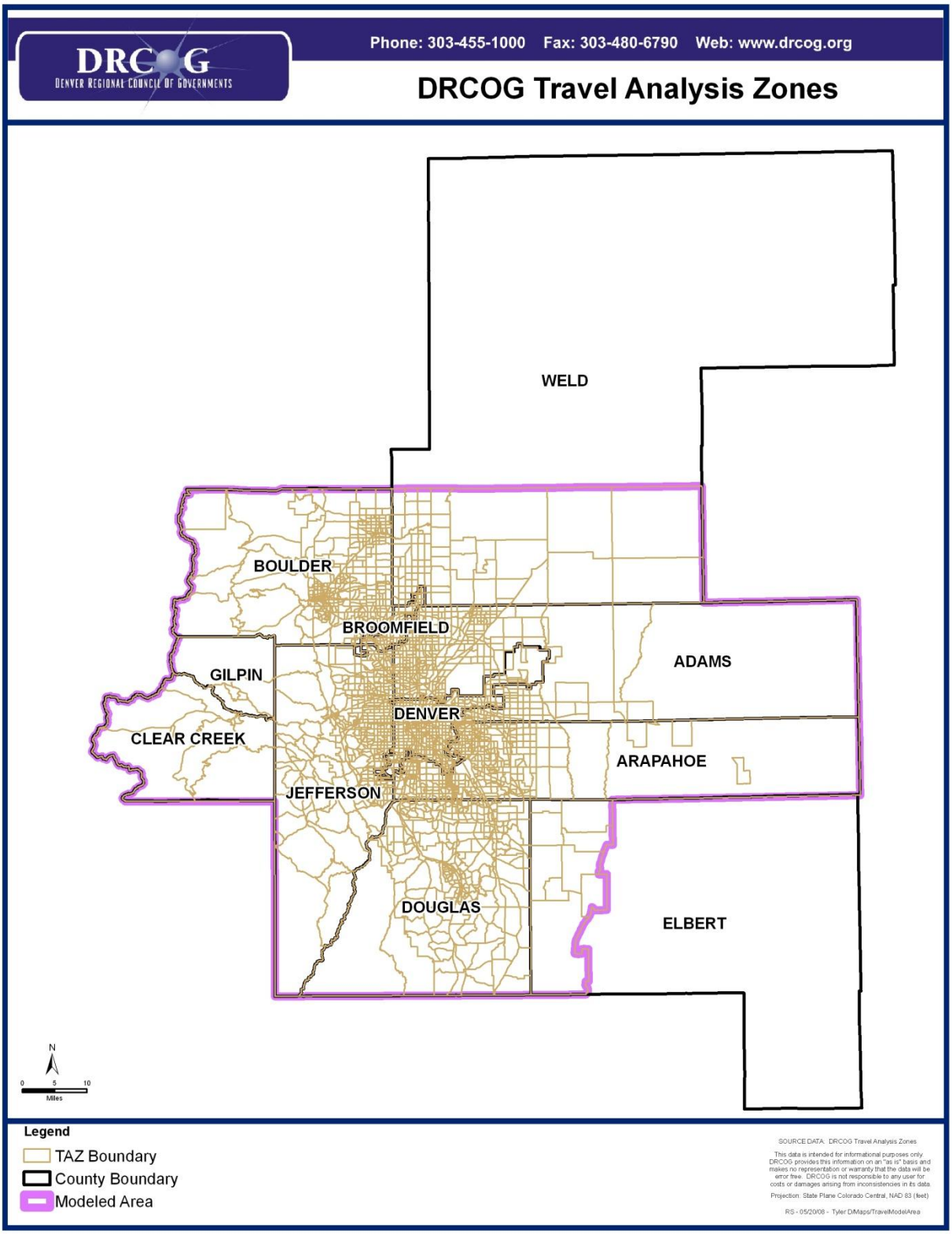


Figure 2
Socioeconomic Model Elements and Flow

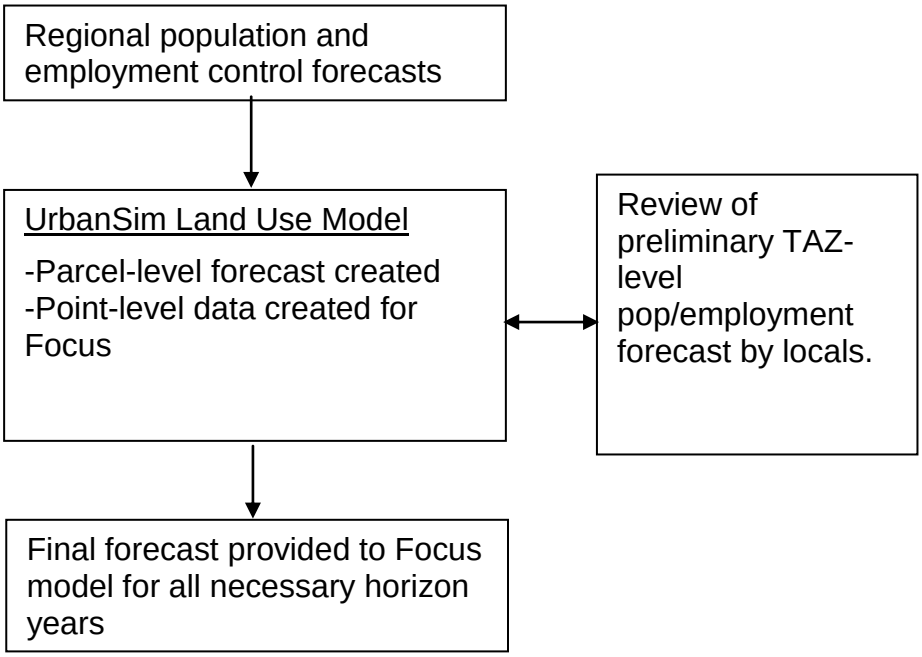
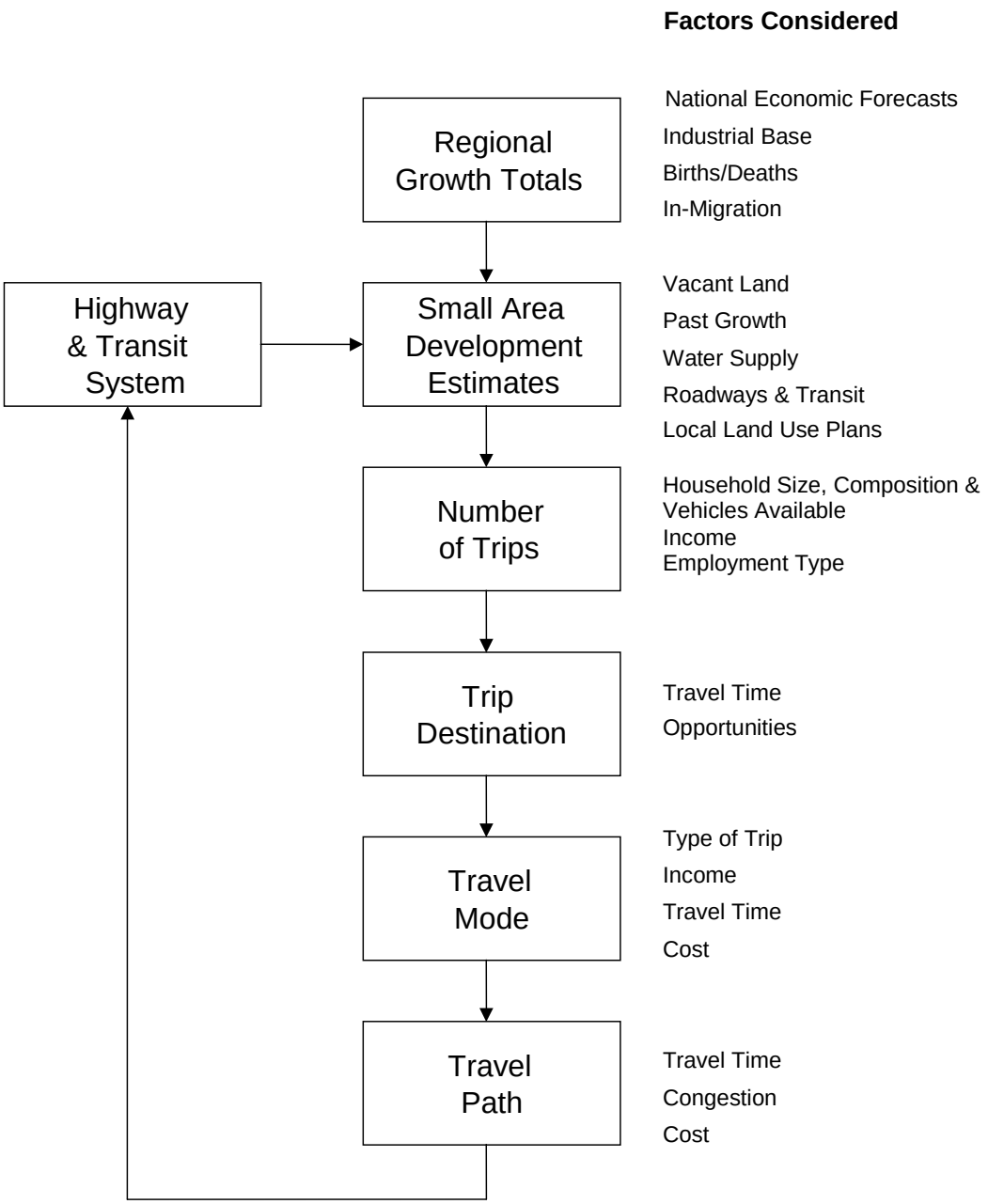


Figure 3
Travel Model Elements and Flow



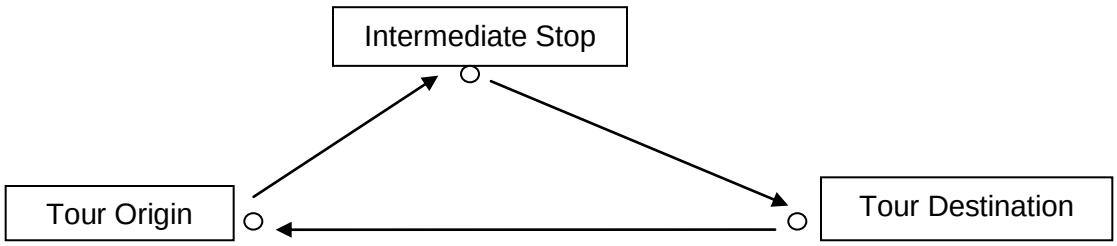
Focus Model Process Overview

Figure 3 shows a simplified diagram of how the *Focus* model components flow after the socioeconomic forecast has been completed.

First, travel time and cost information between zones are calculated by mode and time of day. Tours are the first travel elements to be created, considering the travel times and costs. Figure 4 shows a diagram to explain how tours are related to trips. This example diagram has one tour composed of three trips (shown as individual arrows), and one intermediate stop.

The model then runs through a set of steps for each tour, including activity generation, location choice, mode choice, and time of day choice model components. Then the model runs through a parallel set of model components for each trip within a tour.

Figure 4
Tour Diagram



Highway and Transit System

One of the most significant inputs to all travel model components is the transportation network representation. The highway network is represented by over 25,000 directional road segments, described by location, length, number of lanes, functional classification, and area type. High-occupancy vehicle (HOV) lanes also are represented as special links. Tollway links are assessed an additional impedance to reflect toll charges. The model also includes a fully detailed representation of transit facilities, including all bus and rapid transit lines, Park-n-Ride lots, bus stops, and walk access/egress routes. Bus routes follow the same highway network as auto trips, and bus speeds are based on auto speeds. Rail speeds are developed based on transit schedule information. Capture areas for Park-n-Ride lots are quite broad, permitting trip-makers in the model to select the lot that produces the most convenient overall transit path to their destination. As part of the process of estimating highway and transit use, minimum impedance paths are calculated

using time, distance and toll cost over the highway and HOV system, and time and cost over the transit system.

Model Components

The most important model components are briefly described in the sections below, and Table 1 lists all model components. Most model components are multinomial logit or nested logit models, which are statistical models that have two or more discrete choice outcomes.

Table 1. Focus Model Components

1. TransCAD Initialization	14. Tour Time of Day Simulation
2. Size Sum Variable Calculator	15. Tour Primary Destination Choice
3. TransCAD Trip Generation	16. Tour Priority Assignment
4. TransCAD Skimming (Path Selection)	17. Tour Main Mode Choice
5. TransCAD Airport, Commercial Vehicle, and External Travel Distribution and Mode Choice	18. Tour Time of Day Choice
6. Regular Workplace Location	19. Intermediate Stop Generation Choice
7. Regular School Location	20. Trip Time of Day Simulation
8. Auto Availability	21. Intermediate Stop Location Choice
9. Aggregate Destination Choice Logsum Generation	22. Trip Mode Choice
10. Daily Activity Pattern	23. Trip Time of Day
11. Exact Number of Tours	24. Write Trips To TransCAD
12. Work Tour Destination Type	25. TransCAD Highway and Transit Assignment
13. Work-Based Subtour Generation	

Highway and Transit Skims (Path Selection)

The highway and transit paths are chosen for all origin-destination zone pairs and times-of-day by finding the most convenient paths that balance the travel time, travel cost, and other considerations. The time and cost matrices are used extensively in later model components such as location choice, mode choice, and time of day choice.

Denver International Airport/Commercial Vehicle/Internal-External/ External-External Trips

After optimal paths are identified, the Compass 4.0 model components must be run for airport trips, internal-external trips, commercial vehicle trips, and external-external trips. The entire Compass model must be run to generate and assign these trips.

Regular Workplace and School Location

The work location choice model takes all regional workers and assigns them a regular work location zone and point. Characteristics of the worker and their home zone are used in combination with zonal characteristics to determine the desirability of any zone.

Similarly to the regular work location choice model, the regular school location choice model assigns each student a regular school location zone and school. The model uses information about the student, such as income and age, and information on school enrollment and distance from home to school to determine which schools will be attractive for which students. There are four school location choice models by student grade level: pre-school, kindergarden-8th grade, 9th-12th grade, and university. Four separate models are used to reflect that the decision-making of school location for different grade ranges has significantly different characteristics. The models are all multinomial logit with the choice being the location of the school zone.

Auto Availability Choice

The auto availability choice model is a multinomial logit model that selects number of automobiles available for each household in the region. The choices range from no cars to 4+ cars. The model uses information about households and their accessibility to work and school to determine how many autos are available to households.

Tour Models

After *Focus* has projected the long-term decisions about work and school location and auto ownership, it forecasts daily activities on a tour-level.

The ***day activity pattern*** model determines which combinations of up to seven purposes (work, school, escort a family member, personal business, shopping, dining, and social or recreational) a person will make tours or stops along a tour.

The ***exact number of tours*** model determines exactly how many tours of each type each person will make in his or her day. The tour types predicted for each person include: work, school, escort, personal business, shop, meal, and social recreation. The model outputs this number of tours by purpose into the tours table in the database.

The ***work tour destination type*** model determines whether a person making a work tour will travel to his or her usual work location, or somewhere else, perhaps to meet with clients or customers, or for off-site training. If the regular workplace is selected, this information is entered into the tours table in the database.

Work-based subtour generation determines whether someone will leave their regular workplace and return during the middle of the day. Such a person may be eating out or running errands during his or her lunch break. She or he might also be attending meetings with colleagues in related firms, or with government regulators, for example. After this point, the *Focus* model treats work-based subtours similarly to home-based ones.

In reality, a person might consider the interactions of destination, mode, and departure time choices together in creating an itinerary for the day's travel and activities. Despite its complexity, the *Focus* model needs to have some simplifying assumptions to make its mathematical relationships and software workable. ***Tour time of day simulation*** is one such simplification, allowing destination and mode choices to be modeled as if the time of travel is known (so the right time and cost matrices can be used) as an initial guess. The simulated times of days are based on observed survey distributions. The later ***tour time of day choice*** confirms whether the initially simulated time of day was reasonable, or whether a shift earlier or later might be justified.

The ***tour primary destination choice*** model selects the destination of tour based the development (e.g. jobs and households) located within the zone. It then assigns a point within each zone as the final destination.

After the tour destination is known, the ***tour main mode choice*** model predicts the main travel mode used on the tour. The mode chosen is based on the impedances associated with each mode from the tour origin to the tour destination, zonal characteristics, and demographic person characteristics. The tour main mode is used for most of the distance of the tour, but not

necessarily for all trips. For example, if a parent is driving a child to school, the return trip would necessarily be driving alone. In other cases, stops along a tour might be close enough that walking or biking would be more attractive than a motorized tour mode. The tour and trip modes are related by rules of precedence used to simplify the *Focus* model.

Given the known tour origin, destination and mode from previous models, the ***tour arrival and departure time model*** predicts the time arriving at the primary destination of the tour and the time leaving the primary destination, both to within one hour periods.

Trip Models

After the tour-level models are run, a series of trip-level models are run. The first trip level model is the ***intermediate stop generation*** model, which determines the number of intermediate stops on each tour (if any).

As with the tour models, there is a ***trip time of day simulation*** component to simplify the location and mode choices that are modeled next.

The ***intermediate stop location choice*** model selects the zone for each intermediate stop. The locations of all intermediate stops on tours are modeled one at a time, first for stops from home to the primary activity and then for stops from the primary activity to home.

The ***trip mode choice*** model determines the trip mode on all trips. The tour mode has already been found by the tour mode choice model, and this knowledge is used in combination with skim data, zonal data, and person data to find the trip modes on these tours.

Given the origin, destination and mode of each trip, the ***trip time of day choice*** model predicts the time each intermediate stop will occur. The trip time of day choice model has 24 alternatives corresponding to each hour period.

After the trip models have been run, the following information is known for every trip internal to the region:

- Origin and Destination Zone and Point Location

- Trip Purpose (work, school, escort, personal business, shop, social recreation)
- Trip Mode (drive alone, shared ride 2, shared ride 3+, walk to transit, drive to transit, walk, bike, school bus)
- Trip Time of Day (one of 24 hours)
- Which tour the trip is part of
- What person made the trip
- What household the person who made the trip belongs

The ***write trips to TransCAD*** component assembles the individual records for auto and transit trips into origin-destination trip tables (matrices) that TransCAD can use for assignment. These trip tables are then combined with those developed for DIA, commercial vehicle, internal-external, external-internal, and external-external trips developed earlier.

Network Assignment

Automobile trips are assigned to the highway network via a “user equilibrium” algorithm, after commercial trips have been loaded first using an “all-or-nothing process.” The all-or-nothing process simply assigns trips to the shortest path between origin and destination, ignoring possible congestion effects that might cause trips to take different paths. The user equilibrium process assigns the trips between each origin and each destination TAZ in such a way that, at the end of the process, no trip can reduce its travel time by changing its path. In other words, taking into account the congestion produced by all other trips in the region, each trip is following its minimum path. High-occupancy vehicles (HOV) are loaded simultaneously with single-occupant vehicles (SOV). During this process, TransCAD keeps track of which vehicles are eligible to use HOV facilities, and which might need to pay a toll to use High-Occupancy/Toll (HOT) lanes, such as the reversible I-25 Express Lanes north of downtown Denver. The model also takes into account the effect of toll costs in roadway route choice by converting toll costs into equivalent time cost using an estimated value of time for automobile trip-makers.

Transit assignment is performed separately, using an all-or-nothing algorithm that does not take into account the possibility that high demand on some transit routes may motivate some riders to shift routes, or that other riders may not be able to board when a train or bus is full. RTD has special modeling tools that allow them to use *Focus* model forecasts for more detailed operational planning.

Finally, the model is run several times, feeding back the output speeds from highway assignment to the input stages that require them as input (among them, the trip distribution stage) until the output speeds and the input speeds match closely enough.

Model Calibration

In developing the 2040 RTP, each *Focus* model component was calibrated using 2010 inputs and comparing the resulting "forecast" to 2010 external data sources such as roadway counts and RTD transit boardings, both individually and from a region-wide perspective.

When the *Focus* model was initially developed, external data from 2005 was used wherever possible to ensure that the model was correctly capturing observed 2005 Denver travel behavior when 2005 inputs were used in the model. The following 2005 datasets were used to calibrate against:

- 2005 American Community Survey (ACS)
- 2005 Colorado state demographer data
- 2005 Colorado Department of Transportation (CDOT) highway counts
- 2005 HPMS estimated regional VMT
- 2005 Regional Transportation District (RTD) transit boardings and 2005 Compass trip-based model results

In the spring of 2012, and again in fall of 2014, the model was again calibrated, these times using observations of highway volume and transit boardings from 2010.

Once comparisons were made of model results against the observed datasets, each model component was calibrated. The calibration involved changing the coefficients describing the mathematical models and travel, and adding variables. Then the model was re-run, results compared again, and modifications made again. This process was repeated until satisfactory results were achieved.

The major regional level model results of the calibration are shown in Table 2 and Table 3. These tables demonstrate that the aggregate model results match the observed counts and transit boardings sufficiently well. When summed over the region, the links with counts were observed to carry about 28.0 million vehicles per weekday, while Focus is showing 0.2 million additional vehicles, or less than a one percent difference.

Table 2
Sum of Observed Counts & Modeled Volumes on (Non-Tollway) Links with Counts

Sum of Observed Counts	Sum of Modeled Counts
27,966,475	28,200,000

Table 3. Observed and Modeled Transit Boardings

Observed Transit Boardings	Modeled Transit Boardings
317,645	355,000

Air Quality Modeling

Formal air pollutant emissions modeling is conducted by the APCD. However, DRCOG, the APCD, and other agencies work closely together in this effort, both in developing the modeling techniques, assumptions, and parameters, and in executing the model runs. Travel model results are, of course, one of the principal inputs to the air pollutant emissions model. The model produces estimates of the amount of emissions of carbon monoxide (CO), volatile organic compounds (VOCs), oxides of nitrogen (NOx), and particulate matter (PM10) generated by motor vehicles. The results are then combined with numerous assumptions concerning meteorology and atmospheric chemical reactions to produce air pollutant concentration estimates.

APPENDIX C
MODELING SUMMARY TABLES

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Table 1 – Denver Regional Council of Governments

Assumptions for the Entire Modeling Area and Data for Base and Future Years

(Data to be revised following completion of model runs in October)

	Interim Year (2015)	Future Year (2040)
Total Population	3,135,399	4,132,611
Employment	1,876,573	2,346,897
Annual Growth Rate (Pop.)	1.4%	1.6%
Dwelling Units (Households)	1,266,000	1,697,924
Persons/Dwelling Unit (Household)	2.42	2.40
VMT by Roadway Type		
-Freeway	28,427,764	36,334,245
-Expressway	6,124,852	7,981,432
-Principal	26,186,277	35,096,198
-Minor	7,450,020	10,254,925
-Other (Collectors, Centroid Connectors, Ramps)	12,637,883	17,592,755
Total	80,826,796	107,259,554
Speed by Roadway Type (miles per hour)		
-Freeway	60.9	56.2
-Expressway	47.9	43.8
-Principal	34.9	32.3
-Minor	31.7	29.0
-Other (Collectors, Centroid Connectors, Ramps)	22.9	21.7
Total (Average Speed)	37.9	34.9
Lane Miles by Roadway Type		
-Freeway	2,136	2,331
-Expressway	627	662
-Principal	4,045	4,787
-Minor	2,953	3,076
-Other (Collectors, Centroid Connectors, Ramps)	6,370	6,447
Total	16,131	17,304

Table 2 – 8-Hour Ozone Emission Rates (Gram/Mile)
For the DRCOG Modeling Area

	Base Year (2015)	Intermediate Year (2025)	Intermediate Year (2035)	Future Year (2040)
VOC	.65	.35	.20	.19
NOx	.93	.35	.16	.14

APPENDIX D

MEMORANDUM OF AGREEMENT—TRANSPORTATION CONFORMITY EVALUATIONS CONDUCTED UNDER THE 8-HOUR OZONE STANDARD

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APPENDIX E
U.S. DEPARTMENT OF TRANSPORTATION CONFORMITY FINDING
(TO BE PROVIDED)

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APPENDIX F

List of Acronyms

AADT	Average Annual Daily Traffic
ACT	Agency Coordination Team
APCD	Air Pollution Control Division
AQCC	Air Quality Control Commission
BNSFRR	Burlington Northern Santa Fe Railroad
CAMP	Continuous Air Monitoring Project
CDOT	Colorado Department Of Transportation
CDPHE	Colorado Department of Public Health and Environment
CMAQ	Congestion Mitigation Air Quality
CO	Carbon Monoxide
DRCOG	Denver Regional Council of Governments
DTD	CDOT Division of Transportation Development
EAC	Early Action Compact
EPA	United States Environmental Protection Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HOT	High-Occupancy Toll
HOV	High-Occupancy Vehicle
HPMS	Highway Performance Monitoring System
MOA	Memorandum of Agreement
MPO	Metropolitan Planning Organization
MVEB	Motor Vehicle Emissions Budget
MVRTP	Metro Vision Regional Transportation Plan
NAAQS	National Ambient Air Quality Standards
NFRT & AQPC	North Front Range Transportation and Air Quality Planning Council
NFRMPO	North Front Range Metropolitan Planning Organization
NFRRTM	North Front Range Regional Travel Model
NO	Nitrogen Oxide
PM	Particulate Matter
Ppm	Parts per Million
RAQC	Regional Air Quality Council
RTD	Regional Transportation District
RTP	Regional Transportation Plan
SIP	State Implementation Plan
STIP	State Transportation Improvement Program
TCM	Transportation Control Measures
TDM	Transportation Demand Management
TIP	Transportation Improvement Program
TMA	Transportation Management Area
TMO	Transportation Management Organization
TPR	Transportation Planning Region
TSSIP	Traffic Signal System Improvement Program
UFR	Upper Front Range Transportation Planning Region
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds