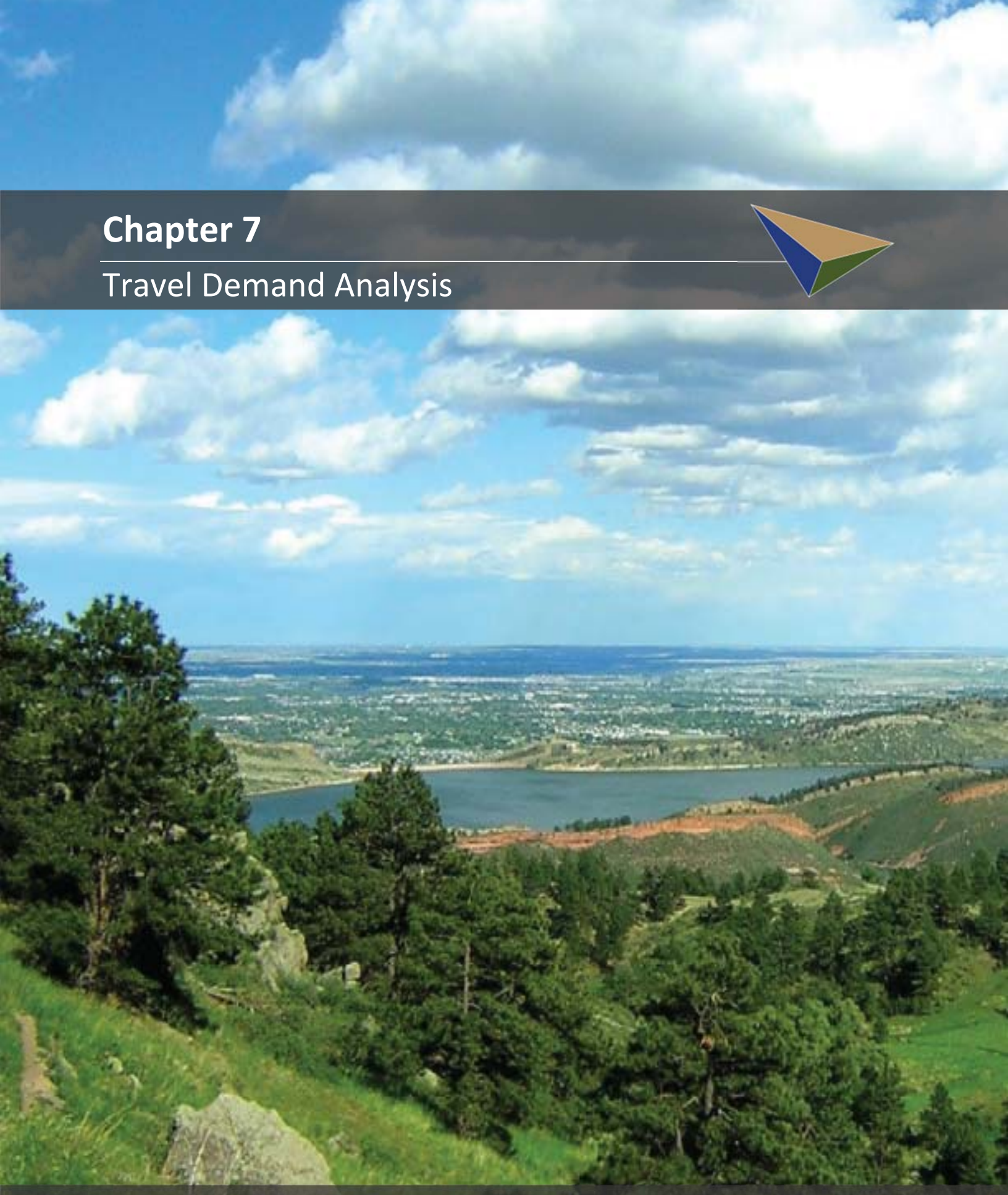
Chapter 7

Travel Demand Analysis



Lory State Park in Larimer County. Image Credit: Paul Carlson, http://www.paulwcarlson.com/LoryFourSeasons/

Chapter 7: Travel Demand Analysis

A. Overview

The North Front Range Metropolitan Planning Organization (NFRMPO) prepared the NFRMPO 2040 Regional Travel Demand Model (RTDM) with input based on the socio-economic data provided in ***Chapter 3*** to evaluate the effects of growth on the transportation system in the North Front Range region and to meet the Clean Air Act (CAA) requirements. The RTDM estimates and forecasts for the following scenarios:

- **2012 Base Year** – Model calibrated to 2012 using the *NFRMPO Household Survey of 2010* and validated using traffic counts and transit boardings.
- **2015 Interim Year** – Interim for Conformity testing (CAA), includes 2015 transportation network and 2015 socio-economic forecasts.
- **2025 Interim Year** – Interim for Conformity testing (CAA), includes 2025 transportation network and 2025 socio-economic forecasts.
- **2035 Interim Year** – Interim for Conformity testing (CAA), includes 2035 transportation network and 2035 socio-economic forecasts.
- **2040 No Build** – 2012 transportation network and 2040 socio-economic forecasts.
- **2040 Build** – 2040 transportation network based on the fiscally constrained plan (described in ***Chapter 10*** and 2040 socio-economic forecasts for Conformity testing (CAA).

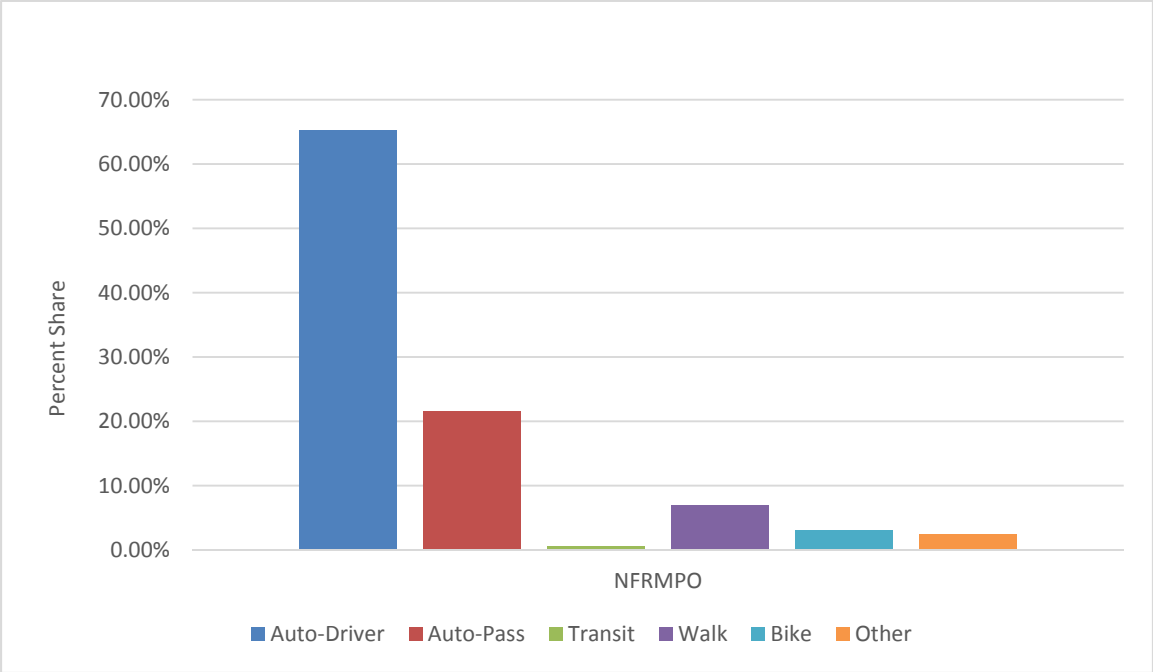
It is important to recognize transportation improvements other than increasing highway capacity may result in the reduction of roadway travel demand. The RTDM is a mode choice model, meaning transit is modeled on the roadway network to allow for scenario testing both modes. This section provides a summary of travel demand forecasting results from the RTDM.

B. Existing Travel Characteristics

The 2040 RTDM uses a base year of 2012 to provide estimates and travel forecasts within the North Front Range modeling boundary to the 2040 horizon year. The base year was calibrated using the *NFRMPO Household Survey of 2010*, which only contains data inside the NFRMPO boundary. The survey indicated the main reason for nearly 34 percent of traveling in the NFRMPO was returning home from non-work activities (e.g., shopping), **Table 7-1.** The difference in travel modes in the NFRMPO are summarized in **Figure 7-1**.

Table 7-1: Primary Reasons for Traveling			
Main Reason for Traveling	Number of Trips	Percent	Avg. Trip Duration
Working at home	127	0.90%	14.16
Shop at home	0	0.00%	--
On-line school at home	7	0.00%	8.8
Return home from non-work activities	4,920	34.00%	17.17
Work/job	1,637	11.30%	19.34
All other activities at work	70	0.50%	17.82
Attending class	790	5.50%	15.53
All other activities at school	92	0.60%	11.75
Change of mode/transportation	354	2.40%	15.43
Dropped off passenger from car	566	3.90%	12.95
Picked up passenger from car	557	3.80%	14.6
Drive through	88	0.60%	9.93
Other – travel related	37	0.30%	10.97
Work/business related	618	4.30%	20.36
Service private vehicle	160	1.10%	13.21
Routine shopping (groceries, clothing, etc.)	1,236	8.50%	12.5
Shopping for major purchases or specialty	91	0.60%	18.35
Household errands (bank, dry cleaning, etc.)	475	3.30%	11.18
Personal business (attorney, accountant, etc.)	241	1.70%	16.86
Eat meal outside of home	577	4.00%	12.09
Health care (doctor, dentist)	224	1.50%	18.59
Civic/religious activities	196	1.40%	14.89
Outdoor recreation/entertainment	254	1.80%	23.18
Indoor recreation/entertainment	516	3.60%	16.42
Visit friends/relatives	435	3.00%	33.89
Loop trip	18	0.10%	38.74
Other	180	1.20%	14.33
Total	**14,467**	**100.00%**	**16.76**
Source: *NFRMPO Household Survey of 2010*			

Figure 7-1: Travel Modes by Area



Source: *NFRMPO Household Survey of 2010*

Travel by Automobile

The majority of trips within the NFRMPO are trips in single occupancy vehicles (SOV), which are vehicles with only the driver as an occupant (identified as Auto-Driver in **Figure 7-1**). Auto-Pass in **Figure 7-1** refers to vehicles carrying passengers, which is the second most used travel mode in the NFRMPO at 21.6 percent.

Non-Motorized Travel

The survey showed 10.1 percent of work and non-work related trips in the NFRMPO are by non-motorized modes, either bicycle or pedestrian travel. These are stand-alone trips or augment transit trips (to and from transit stops). Generally, people in the region make non-motorized trips more frequently to attend class (e.g., at Colorado State University (CSU) or University of Northern Colorado (UNC)) or non-work related activities.

Survey data shows approximately 70 percent of households in the region have at least one bicycle, and 50 percent have two or more bicycles**.** More than 24 percent of survey respondents indicated a household member walked or rode a bicycle to school or work at least once per week.

Transit Use

In the region, transit use accounts for less than one percent of work-related and other trips based on the survey. A large portion of the region consists of rural areas not served by transit, which is a contributing factor to the overall low rate of transit use. Most transit users connect to transit by walking or bicycling. Nearly seven percent of survey respondents indicated they use transit at least once per week.

Of the adult survey respondents, four percent reported having a transit pass**.** Less than two percent of survey respondents reported their employers provide a transit pass.

The lack of available transit options and sustainable revenue sources are likely reasons behind the low transit pass use. Another factor to explain the low rates of transit use is the high percentage (nearly 95 percent throughout the region) of employers providing free parking. Employees have fewer incentives to use other modes of transportation when there is abundant free parking.

C. Travel Demand Growth

Roadways

Daily vehicle miles traveled (VMT) is the total distance traveled by all motor vehicles each day. VMT was used to measure forecasted growth of travel in the region on roads included in the model. **Table 7-2** shows the estimated VMT for 2012 and the forecasted 2040 VMT for the NFRMPO area.

It should be noted, using a no-build scenario does not always result in realistic outputs for smaller areas of the region. This is due to significant levels of congestion in the forecast year without any improvements to the roadway system. A build scenario is also shown for comparison.

Forecasts from the 2040 RTDM show VMT for the region is projected to grow by 83 percent between 2012 and 2040 (No-Build). This growth assumes no roadway, transit, or non-motorized improvements in the future and only accounts for growth in households and employment. This also assumes current patterns and travel trends are held constant. This VMT growth compares with household growth forecasts of 56 percent and employment growth forecasts of 60 percent for the same period.

Table 7-2: Growth in Vehicle Miles of Travel

Area	Daily VMT				
	2012	2040 (No-Build)	Percent Growth (%)	2040 (Build)	Percent Growth (%)
NFRMPO	**10,314,179**	**18,915,133**	**83%**	**19,555,049**	**90%**

Source: *NFRMPO 2040 Regional Travel Demand Model*

Roadway Travel Time Index

Travel Time Index (TTI) is a quantitative measure, which takes the peak period travel time and divides it by free flow travel time. This is used as a system-wide measure to analyze the impacts of congestion on transportation. TTI has been calculated on all arterials, expressways, and freeways. Congestion, defined in the 2015 Congestion Management Process (see ***Chapter 11***), is a TTI of 2.5 times or more than free flow.

The percent of congested roadway during the average peak period in 2012 was 0.02 percent. It is anticipated to grow to 3.5 percent by 2040 (No Build), with no transportation improvements and 3.3 percent with improvements, 2040 (Build). **Figures 7-2 through 7-4** depict the 2012 TTI and forecasted 2040 TTI. This TTI analysis is based on results from the 2040 RTDM and does not account for intersection operations or delay.

$$\textbf{Travel Time Index} = \frac{\text{Peak Period Travel Time}}{\text{Free Flow Travel Time}}$$

Figure 7-2: 2012 Travel Time Index

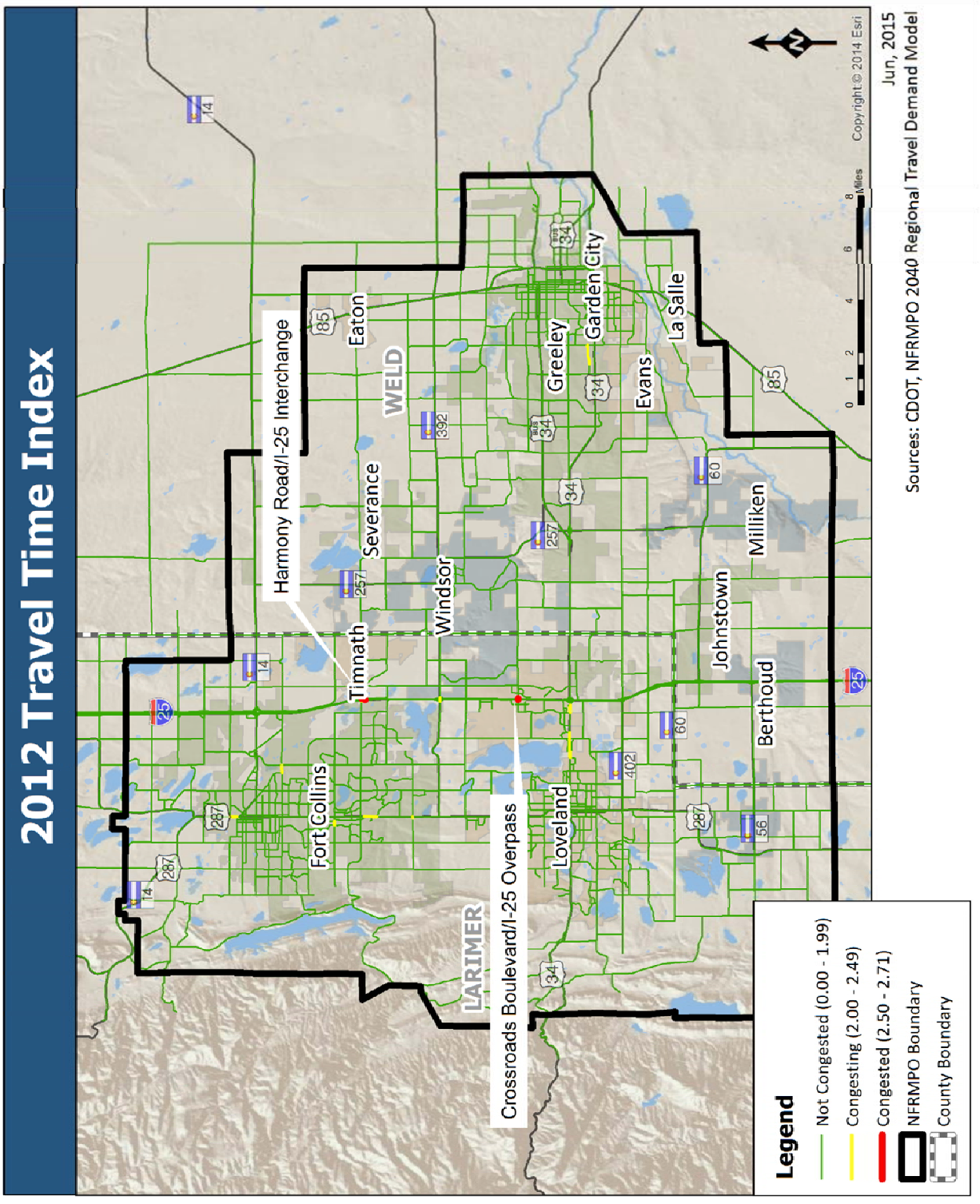


Figure 7-3: 2040 (No-Build) Travel Time Index

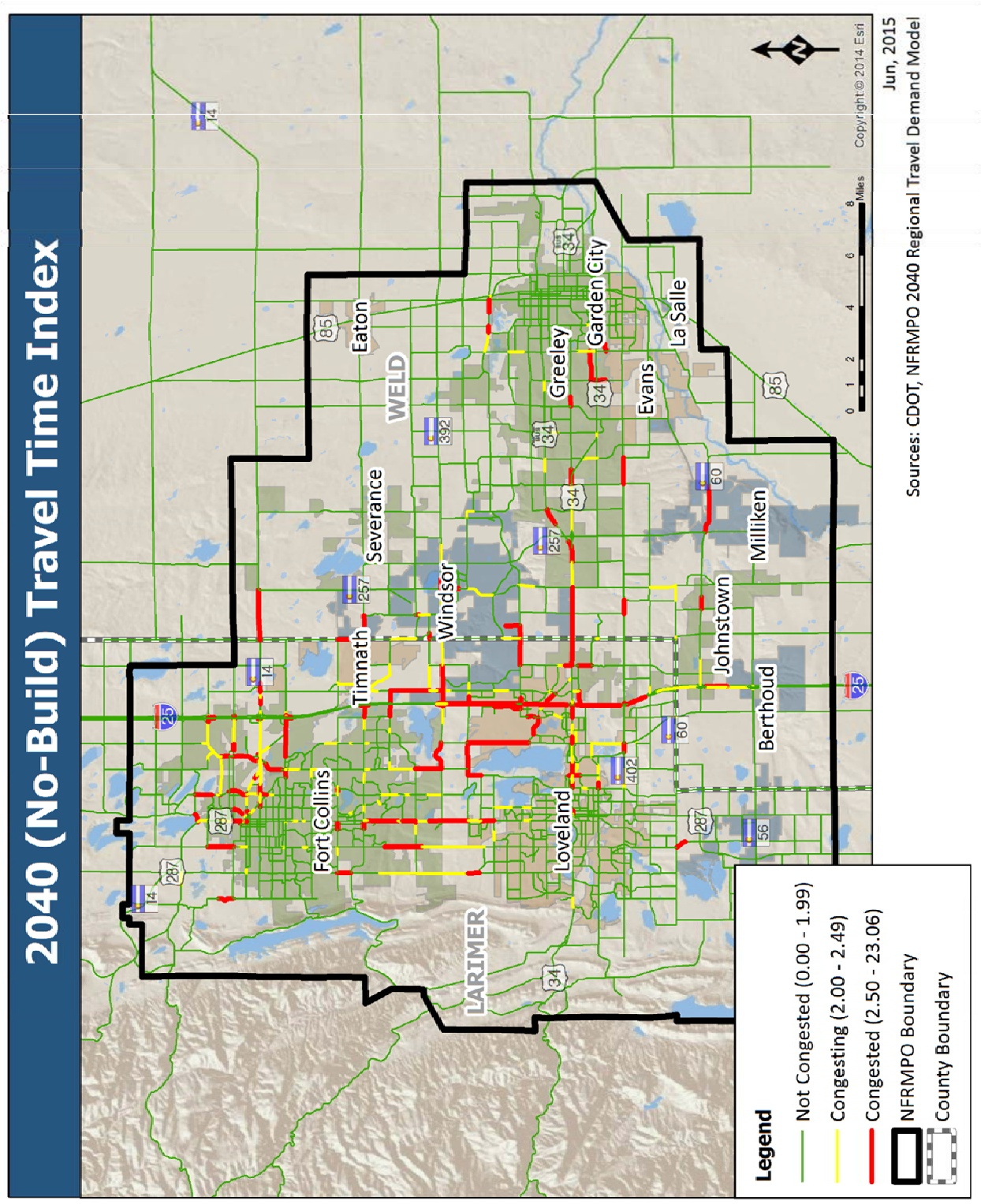
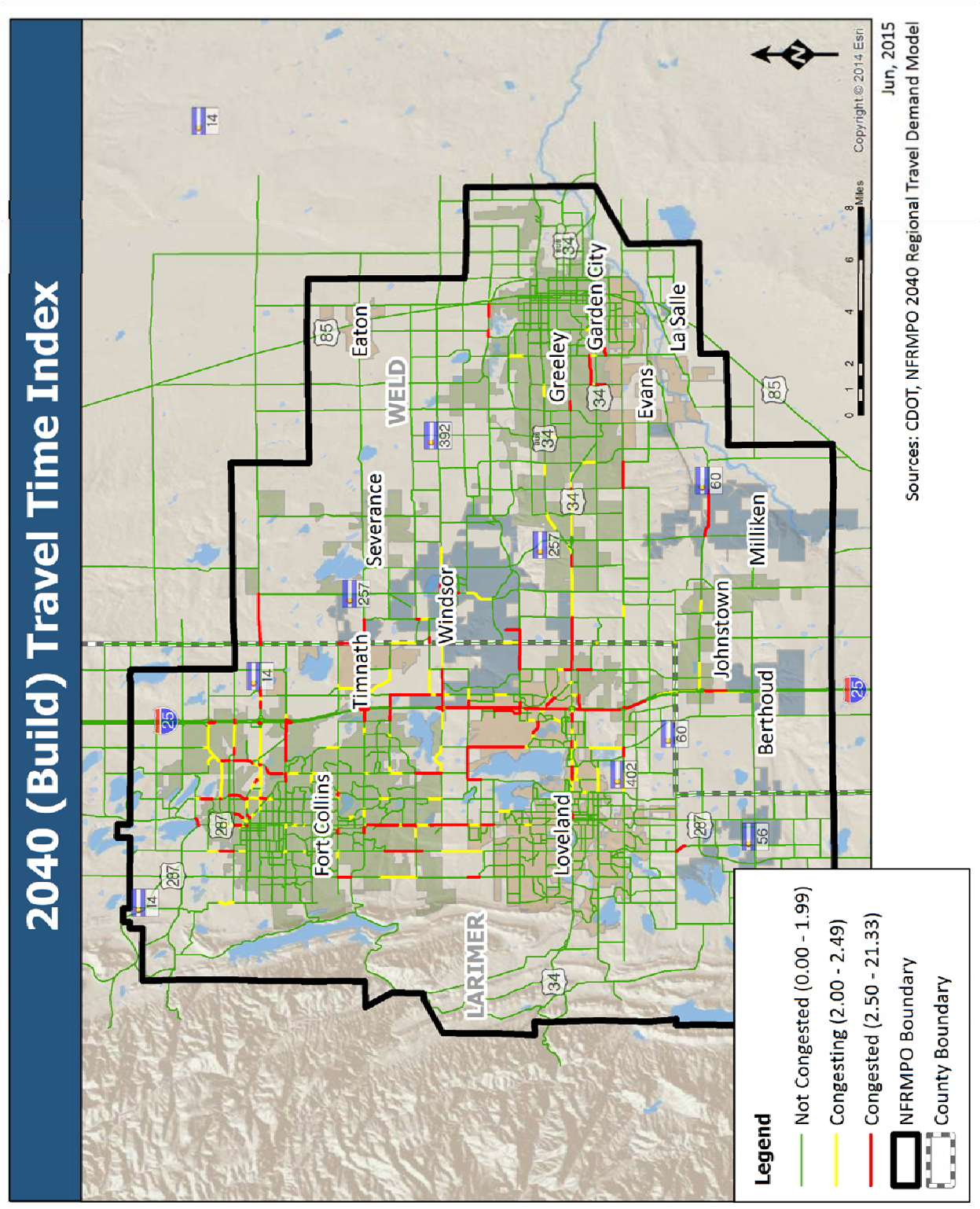


Figure 7-4: 2040 (Build) Travel Time Index



Mode Choice

The NFRMPO uses a mode choice model as it allows for the estimation of transit ridership on the local, regional, and interregional systems on the existing roadway network. The NFRMPO first built the RTDM with mode choice capability for the 2030 model. Transit alternatives can be tested both locally and regionally. Transit ridership is verified and validated for the base-year scenario through on-board surveys which count the number of riders on any given route. This is similar to the validation of the highway portion of the model verified using traffic count data.

Regional Routes

The *2040 Regional Transit Element (RTE)*, a companion document to the *2040 Regional Transportation Plan (RTP)*, describes the demand analysis used to model potential regional transit corridors. The 2040 RTE used the RTDM to show how anticipated growth over the next 25 years could impact transit ridership in the proposed regional corridors.

Service Standards and Policies

Service standards are set by each of the three local transit agencies. Currently, Transfort's service standards act as a model for City of Loveland Transit (COLT) and Greeley-Evans Transit (GET). Transfort service standards are divided into three groups: productivity standards, load standards, and on-time performance. For productivity and load standards, Transfort groups its routes into five categories which provide different types of service:

- Rapid Transit (routes in a dedicated guideway);
- Commercial (provide basic route coverage and access);
- University (routes near and connecting to CSU);
- Residential (routes serving residential areas); and
- Regional (routes operating outside of Fort Collins).

By dividing the route system based on type of service, the agency can tailor the service standards to the purposes of each route. Transit routes can operate for different reasons and should be measured appropriately.

Productivity standards alert transit staff to routes and services which may require marketing, revision, or elimination. The two measures include passengers per revenue hour and passengers per revenue mile. The measurement of passengers per revenue hour considers the number of riders on a given service divided by the total number of revenue hours. The measurement of passengers per revenue mile considers the total number of riders over the route's extent. These numbers are collected and compared on an annual basis. Each measurement is monitored and categorized into four levels of performance:

- E (Exceeds);
- S (Satisfactory);
- M (Marginal); or
- U (Unsatisfactory).

Using these grades, the transit service can consider schedule changes, marketing, redesign, or elimination. For example, the Fort Collins City Council has set a system-wide benchmark of 20 passengers per hour for routes as

a measurement of consideration. Routes above this benchmark perform well, while routes below this benchmark should be evaluated for possible changes to improve or eliminate the route.

Minimum and maximum load standards measure when to provide additional service, reductions in service, or service eliminations. In this case, loads are the number of passengers on a given service compared to the capacity of the bus providing service. Peak hours (7:00 a.m. to 9:00 a.m. and 2:30 p.m. to 6:00 p.m.) and off-peak hours typically have different load standards. For example, local Transfort buses have a maximum load standard of 125 percent of the seated capacity during peak hours, and a maximum load standard of the seated capacity during off-peak hours.

On-time performance is a service standard used for dependability and can be measured either by percent of trips operated or schedule adherence. Each transit agency defines schedule adherence differently. Transfort considers "on-time" to mean arriving at a bus stop between zero minutes early and five minutes late, while GET defines "on-time" as zero minutes early to eight minutes late. As a service standard, each transit agency sets a minimum for on-time percentage. Transfort has set a standard of 90 percent of peak-hour buses and 95 percent of off-peak buses to arrive on time, while COLT requires 95 percent on-time performance for all buses. Buses which are consistently early or late should have their schedules evaluated to improve schedule adherence.

Further explanation of service standards can be found in the City of Fort Collins' *Service Standards and Policies* document.[54] GET is in the process of creating similar system wide benchmarks, expected to be completed by the end of 2015. COLT measures the same service standards and is in the process of creating benchmarks.

Greenhouse Gas Emissions

The State of Colorado, under the 2009 Funding Advancements for Surface Transportation and Economic Recovery (FASTER) legislation, is required to address the reduction in Green House Gas (GHG) emissions. To assist the State, a technical analysis from of the RTDM is included in this plan.

GHG in the atmosphere absorbs and emits radiation. GHGs are tied to the natural process, or greenhouse effect, whereby they capture radiant heat from the sun in the Earth's lower atmosphere. The gases that contribute most to the greenhouse effect are water vapor, carbon dioxide (CO_2), methane, and nitrous oxides (N_2O). Most greenhouse gases have both natural and human activity sources. Transportation is the second largest source of GHG emissions, accounting for roughly 27 percent of all emissions.[55]

As it relates to the transportation system, energy is directly consumed by vehicles (automobiles, trucks, and buses) using the regional system and indirectly consumed by equipment during the construction of transportation capital improvement projects (non-mobile source). The GHG emissions quantified for this 2040 RTP are based only on the direct energy (i.e., energy consumed by vehicles using the facilities). Transportation emissions from fuel combustion in vehicles are normally presented as the total CO_2 equivalent released, and take into account the potential greenhouse effect of each gas. For example, motor vehicles emit small amounts

[54] *Service Standards and Policies*, 2009:
http://www.ridetransfort.com/abouttransfort/plans-and-projects/transfort-strategic-plan
[55] EPA, *Sources of Greenhouse Gas Emissions*, 2013
http://www.epa.gov/climatechange/ghgemissions/sources.html

of N_2O, which has a greenhouse gas effect potential 310 times that of CO_2. Therefore, each ton of N_2O is equivalent to 310 tons of CO_2. The greenhouse gas emissions presented in this section are all presented as a CO_2 equivalent.

Table 7-3 compares the total mobile source on- and off-network GHG emissions from the 2015 land use and transportation system, as well as the 2040 forecasts, with the fiscally constrained transportation system (2040 Fiscally Constrained). The energy calculations are based on VMT forecasts generated by the RTDM and calculated by Colorado Department of Public Health and US Environment (CDPHE) using the Environmental Protection Agency's (EPA) Motor Vehicle Emissions Simulator (MOVES2014).[56] MOVES2014 is an upgraded version of the EPA's modeling tools for estimating emissions from motor vehicles and adheres to new federal emission standard rules not included in previous modeling tools. A base year of 2015 was used for this calculation because it is the first input network year available in the MOVES2014 emissions model for the North Front Range region. The North Front Range region records GHG emissions for the winter and summer months due to the difference in non-mobile source emissions between the Estes Park area and the NFRMPO area. The Estes Park area has higher emissions during the summer due to tourist activity from Rocky Mountain National Park and other destinations within the area. The NFRMPO has much higher emissions in the winter because of the traffic generated by CSU and UNC. The direct energy consumption and GHG emissions associated with the use of the regional transportation system is projected to increase by approximately 19 percent in the winter and 20 percent in the summer, less than the projected VMT increase of 75 percent for the entire region from 2015 to 2040.

Table 7-3: Mobile Source Greenhouse Gas Emissions

Time Period	Tons of CO_2 Equivalent		
	2015	2040 (Fiscally Constrained)	Percent Growth (%)
Winter	6,677	7,948	19.0
Summer	6,716	8,062	20.0

Source: *NFRMPO 2040 Regional Travel Demand Model, CDPHE, MOVES 2014*

[56] 79 FR 60343, https://federalregister.gov/a/2014-23258, 2014