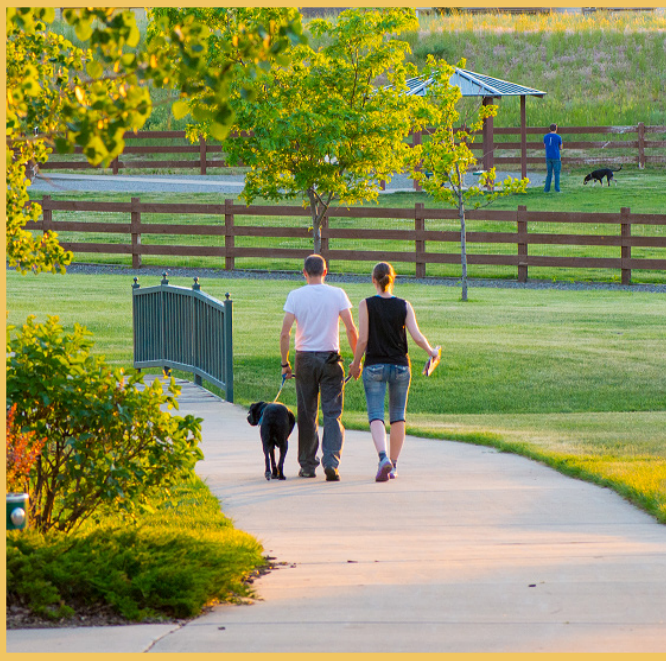


FIRESTONE TRANSPORTATION MASTER PLAN 2022

Bohannan Huston

FIRESTONE TRANSPORTATION MASTER PLAN 2022

Table of Contents

FIGURES

TABLES

LIST OF APPENDICES

CHAPTER 1 | INTRODUCTION

FIRESTONE TRANSPORTATION MASTER PLAN

PLAN PURPOSE & BENEFITS

The Town of Firestone is a rapidly growing community on the north side of the Denver metropolitan area. Accommodating that growth – the population of the greater Firestone area is expected to more than double between 2015 and 2040 – and ensuring that current and future residents can travel safely and efficiently through the Town are critical for maintaining a high quality of life. This Town of Firestone Transportation Master Plan (TMP) allows the Town to proactively address long-term transportation infrastructure needs and provide residents and visitors with a range of travel options.

The TMP specifically identifies transportation policies, strategies, and priority investments that respond to both current and anticipated transportation needs. While the primary focus of the plan is the network of roads, bikeways, and pedestrian facilities within the Town, the TMP also considers the regional nature of commuting and the interaction of Firestone roadways with the regional transportation system.

Overall, the TMP provides the tools needed to guide policy decisions and transportation investments over time. The TMP addresses the needs of all transportation modes – including driving, biking, walking, and taking transit – and identifies a long-range roadway system and critical locations where transportation investments will be necessary to support Town land development patterns.

Key components and products of the plan include:

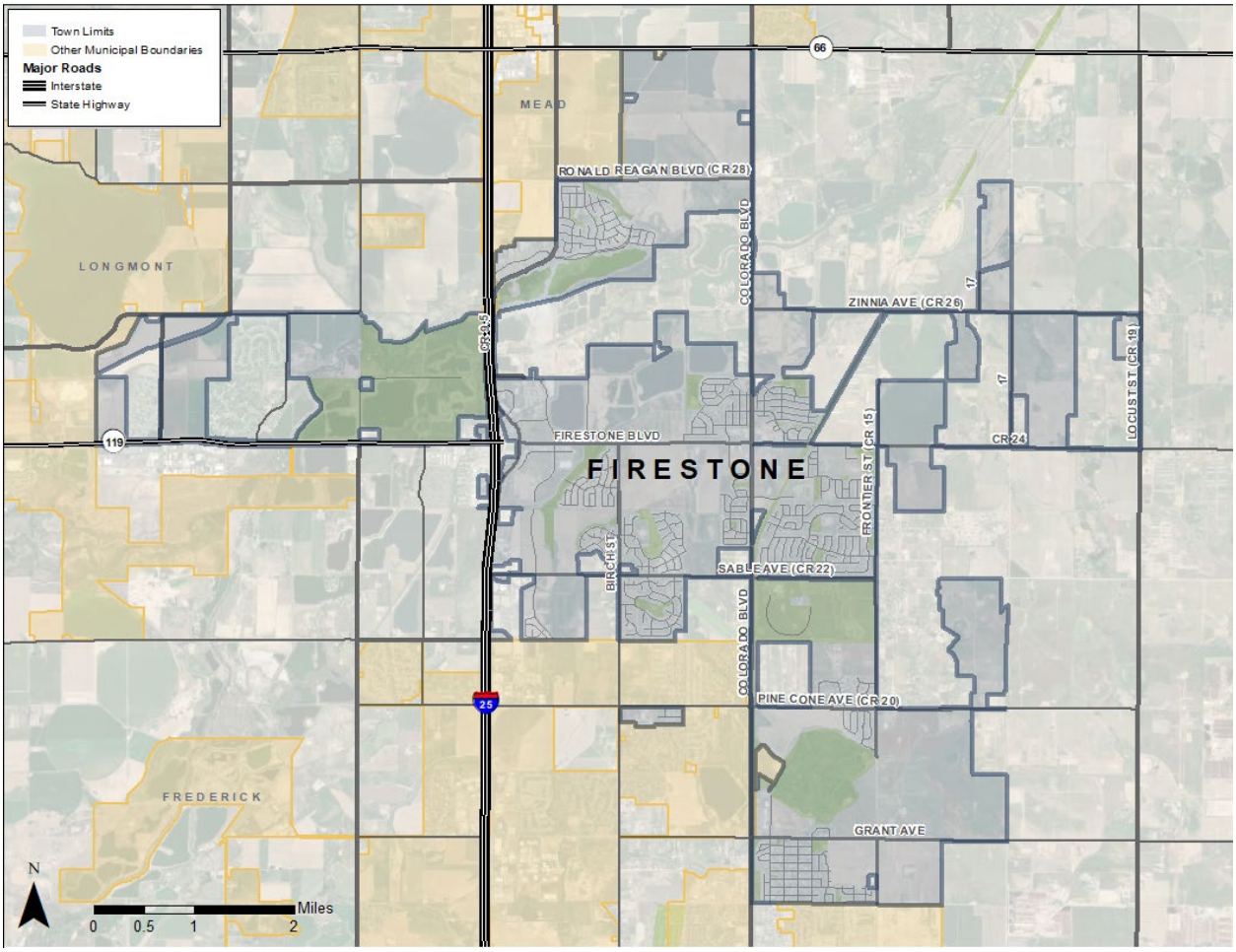
- Existing conditions analysis
- Household and population projections for the greater Firestone area
- Roadway type designations and identification of a long-range roadway network
- Proposed roadway improvements
- Existing and proposed bikeways and trails
- Design guidance
- Policy recommendations

STUDY AREA

The Town of Firestone, established in 1908 to support local coal miners and their families, is situated on the northern edge of the Denver metropolitan area along Interstate 25 (I-25) and midway between Fort Collins and Denver. The Town borders the Town of Mead to the north, the City of Longmont to the west, and the Town of Frederick to the south (refer to Figure 1). As of the 2020 Census, the Town Firestone had 16,381 residents, though the population is growing rapidly. Firestone is noteworthy for its community amenities, including access to regional and local parks, trails, and recreational facilities and is noteworthy for its fast-growing population and economy.

Major roadways are oriented east-west and north-south and follow section line boundaries, which create a large-scale grid system with various parallel routes that help distribute vehicle traffic across the roadway network. Regional access to Firestone is via I-25 and Colorado Blvd and CO 66 and CO 119/Firestone Blvd. The I-25/Firestone Blvd interchange is the most heavily trafficked location within Town limits. All figures are presented full-sized in Appendix D: Maps**.**

Figure 1: Town of Firestone Limits and Major Roads

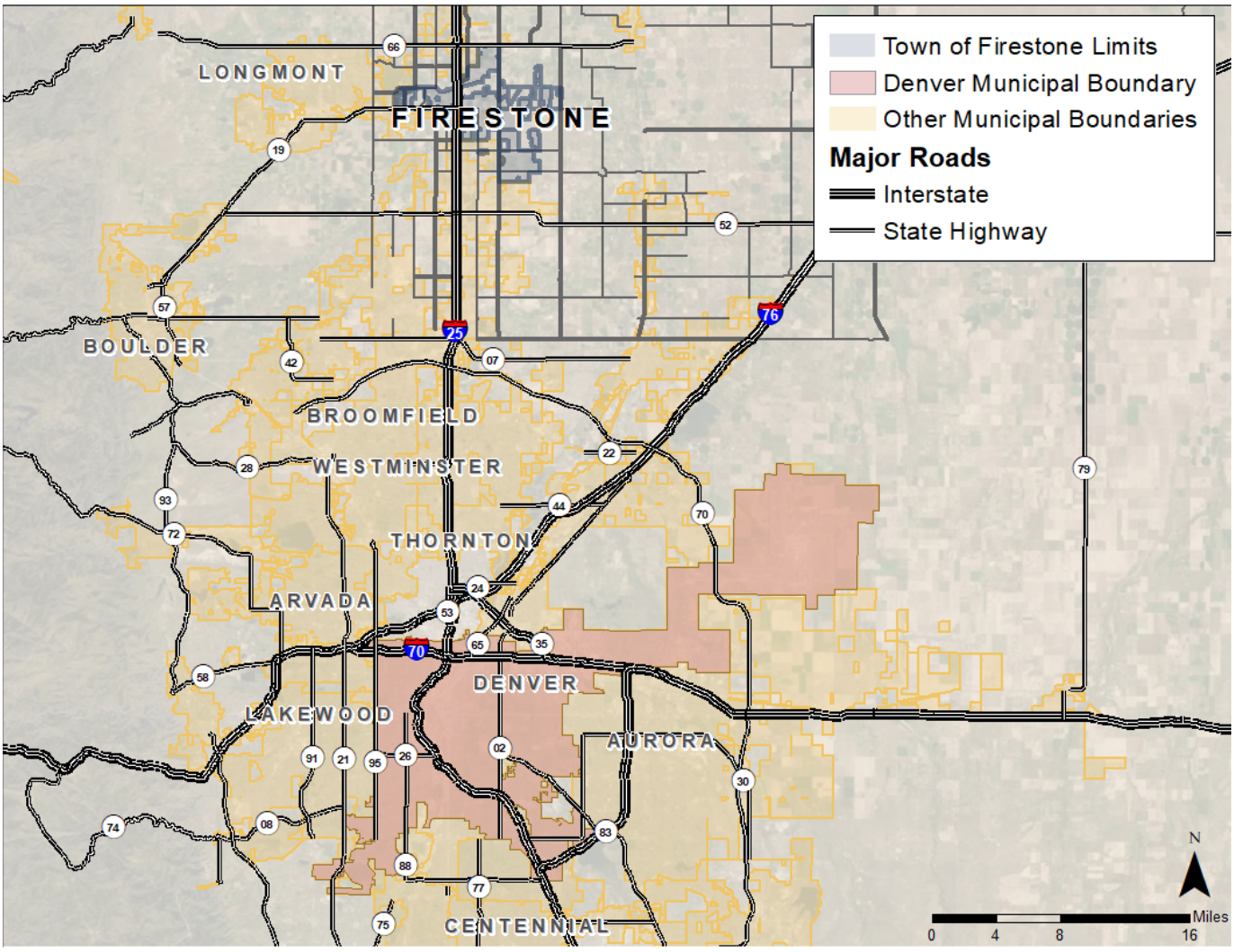


TOWN OF FIRESTONE PLANNING CONTEXT

Regional Planning Efforts and the Role of DRCOG

The Town of Firestone is part of the Denver Regional Council of Governments (DRCOG) planning region. DRCOG is a regional planning organization that provides technical assistance to local agencies and serves as a forum for government agencies to discuss regional needs and identify priorities that transcend jurisdictional boundaries. Per Colorado state statue, DRCOG also functions as a regional planning commission and prepares the coordinated plan for the physical development of the region, known as Metro Vision. Since 1977, DRCOG has also served as the metropolitan planning organization for the region, acting as a forum for a collaborative transportation planning process.

Figure 2: Firestone Context Map



Today, nearly 60 local governments are represented in a continuing, cooperative, and comprehensive transportation planning process for all modes of transportation in the region. In addition to local governments, key stakeholders include the

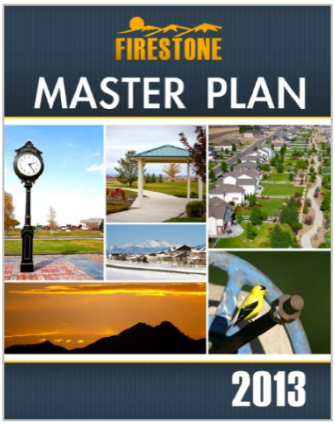
Colorado Department of Transportation (CDOT), the Regional Transportation District (RTD), the Regional Air Quality Council (RAQC), and others. Through the DRCOG planning process, the Town of Firestone has the ability to work with other jurisdictions to address long-term regional challenges, as identified in the Regional Transportation Plan (RTP) the Metro Vision plan, and to access federal funds through the Transportation Improvement Program (TIP).

The Firestone TMP is intended to align with the DRCOG transportation planning process. Through projects and priorities identified in the TMP, Firestone staff are better prepared to apply and advocate for the inclusion of improvement projects in the TIP that directly benefit Town residents, including the allocation of federal funds at the sub-regional level. Additionally, Firestone is eligible to apply for appropriate regional set-asides to further the development of key transportation and land-use planning needs. The most relevant set-aside funding is through the Community Mobility Planning and Implementation; Regional Transportation Operations and Technology; and Human Service Transportation programs. Each set-aside typically consists of a 2-year funding cycle within the board 4-year TIP cycle. Maintaining representation and participation in this ongoing process with DRCOG will be key in accessing funding to for critical transportation projects in the near and long-term.

Local Plans

This TMP incorporates relevant goals and priorities from recent plans developed by the Town of Firestone. The plan also refers to planning documents from adjacent communities to ensure consistency and incorporate transportation investments that may impact Town of Firestone residents.

Firestone Master Plan (2013)

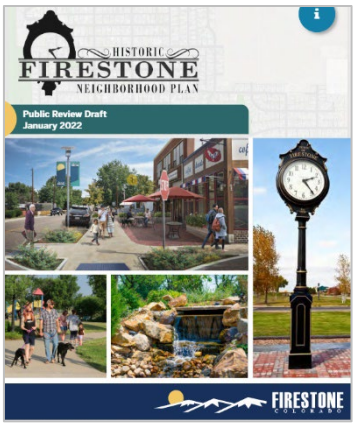


The Town of Firestone Master Plan applies a comprehensive approach to land use and development and identifies policies and programs intended to enhance quality of life. The Plan highlights the Town's dedication to being "A Community in Motion" and goal of becoming "The Greatest Small Town in the USA." Among the general priorities include urban growth boundaries that help concentrate development while preserving surrounding agricultural land. Key transportation recommendations from the Master Plan that are relevant for the TMP include:

- Potential membership in the Regional Transportation District (RTD), pending mass transit improvements, including light rail along I-25
- Feasibility of a local bus system along major transportation corridors that is operated in coordination with surrounding communities.

The Town of Firestone anticipates updating its Master Plan shortly after the completion of the TMP. Priorities and recommendations from the TMP should be incorporated into the updated Town Master Plan.

Historic Firestone Neighborhood Plan (2022)

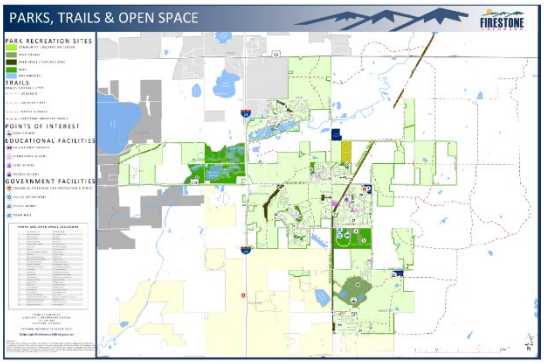


The Historic Firestone Neighborhood Plan evaluates conditions throughout the Old Town area of Firestone and provides goals and policies to guide public improvements and catalyze private investment in the neighborhood. The Historic Firestone Neighborhood Plan was developed concurrently to the TMP and contains streetscape recommendations and design guidance for the area between Colorado Blvd and Frontier St to the north of McClure Ave and south of the Saddleback Golf Course.

General transportation-related improvements include wide sidewalks, new bikeways, and streetscape improvements. Location specific improvements include Main Street design features along 1st St and connectivity improvements in the area around Grant Ave and 1st St. Further design guidance for Main Street corridors is provided in this TMP, while the Old Town area is identified as a major destination.

Town of Firestone Parks, Open Space & Trails Master Plan (2020)

The Parks, Open Space & Trails Master Plan responds to the community desire for greater recreational amenities and identifies various park and trail improvements. In addition to an expanded network of trails/walking paths and bikeways, key recommendations include improved access to parks, trails, and recreational services and improved linkages between residential neighborhoods and commercial areas, services, and schools. Relevant goals from the Plan include:

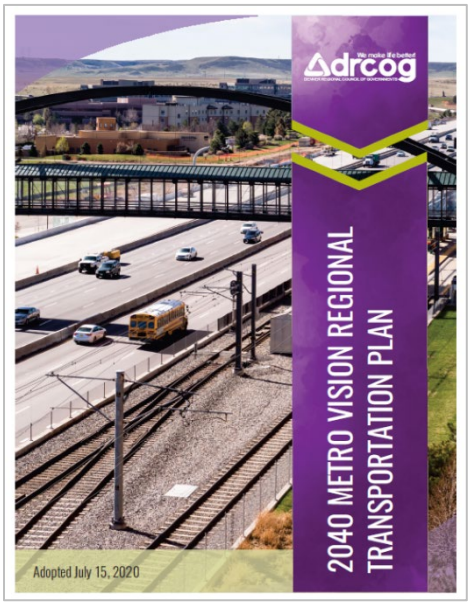


- Acquire property and develop Town parks, open space lands, and trails to meet community needs
- Upgrade existing parks, open space lands, and trails to meet community needs
- Enhance walkability in priority areas with site specific improvements to existing parks and open space lands
- Improve the marketing and visibility of the Town's parks, open space, and trails

Transportation Plans in Adjacent Communities

The Town of Mead (2018) and the Town of Frederick (2021) recently adopted transportation plans to guide investments within their respective communities. These plans are noteworthy for their common emphasis on creating increased transportation options and the need for regional coordination to ensure roadway networks are well-connected. Recent and planned roadway and bikeway projects in these communities are depicted in the figures in the Future Transportation Networks section of this TMP.

REGIONAL PLANS



DRCOG 2040 METRO VISION REGIONAL TRANSPORTATION PLAN (2020)

The DRCOG Metro Vision Regional Transportation Plan (RTP), most recently updated in 2020, encompasses the region's vision for a multimodal transportation system needed to respond to future growth and demographic trends. The plan identifies transportation facilities and services across the DRCOG region as well as current and anticipated levels of congestion. To respond to anticipated transportation challenges, the Metro Valley RTP identifies priority improvement projects for the coming decades. The Metro Vision RTP is consistent with the larger DRCOG Metro Vision Plan, which provides priorities for transportation investments and urban development practices.

The Metro Vision RTP identifies several corridors where congestion is a challenge, such as Firestone Blvd (CO 119) and I-25. While parts of Firestone Blvd are considered to be congested during the peak periods under current conditions, I-25 is projected to be congested by 2040.

Federal funding is allocated by DRCOG throughout the region to projects that are contained in the Metro Region RTP or are consistent with the plan goals and priorities. Overarching goals of the plan include:

- Enhance the relationship between transportation and land use development
- Provide for maintenance of a well-connected multimodal system
- Incorporate transportation management actions to increase the existing system's efficiency
- Include travel demand management efforts to reduce single-occupancy vehicle trips

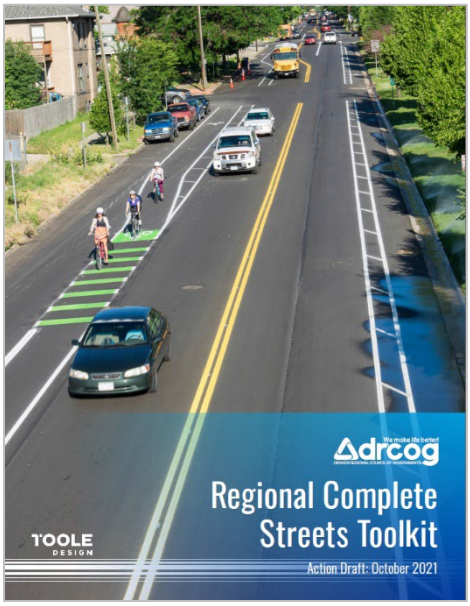
ACTIVE TRANSPORTATION PLANS AND GUIDANCE DOCUMENTS

The **Denver Regional Active Transportation Plan** (ATP) complements the Metro Vision RTP by establishing a common vision for bicycling and walking in the Denver region and provides tools for local agencies to implement projects in their jurisdictions. ATP priorities include increasing bicycling and pedestrian activity by expanding and connecting the regional and local bicycle networks, improving access to mass transit, and reducing the number and severity of crashes involving pedestrians and bicyclists.

WELD COUNTY COMMUNITY PROFILE

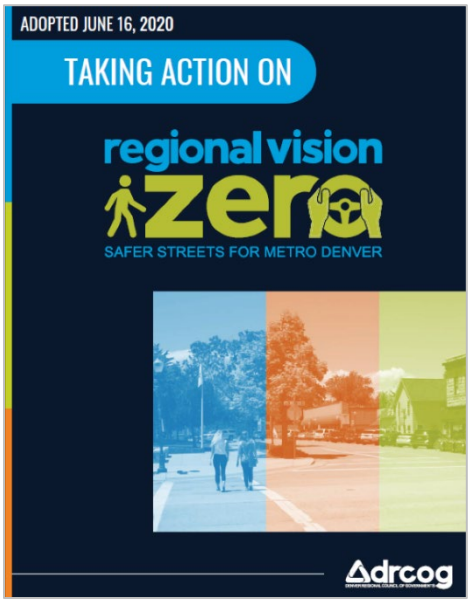
The ATP provides snapshots of bicycle and walking within DRCOG counties, including Weld County. The profiles highlight local conditions and the potential benefits associated with investments in active transportation infrastructure. County has the highest obesity rate (66%) and lowest rate of adults who participate in aerobic physical activity each week (53%) among all Denver region counties. These poor health outcomes coincide with limited facilities for county residents to bike or walk for transportation or leisure purposes.

DRCOG Regional Complete Streets Toolkit supports the actual implementation of the Metro Vision RTP by providing design concepts and resources for the implementation of Complete Streets projects. The Toolkit is also intended to give jurisdictions a common set of tools and design considerations when working on projects that cross jurisdictional boundaries. The design guidance contained in the Firestone TMP is consistent with the guiding principles of the DRCOG Regional Complete Streets Toolkit.



DRCOG's **Taking Action on Regional Vision Zero** report establishes a target of zero fatalities and serious injuries within Denver's regional transportation system. This effort aligns with the global Vision Zero movement that seeks to eliminate all traffic fatalities and serious injuries while simultaneously addressing safety, improving public health, and ensure equitable mobility for all.

The plan identifies regional Vision Zero objectives including improving collaboration between allied agencies, increasing awareness and adoption of vision zero policies and programs, designing and retrofitting roadways to prioritize people's safety, improving data collection reporting, increasing funding and resources, and increasing legislative support. The Regional Vision Zero report is particularly relevant for the Town of Firestone as a reference for strategies to reduce motor vehicle speeds and promote safety along major roads.




For the Citizens of Firestone
Firestone Trail
Weld County and Colorado

GOALS & PRIORITIES

Goals and priorities for the Town of Firestone Transportation Master Plan are informed by feedback from the Town Board of Trustees and the public and are consistent with regional goals adopted by DRCOG in the 2040 Metro Vision Regional Transportation Plan. The goals cover a range of transportation needs and are supported by recommendations and implementation measures identified in the TMP.

Vision Statement

The Firestone TMP establishes a blueprint for a comprehensive transportation system that accommodates high levels of anticipated growth. The Town of Firestone is committed to providing a range of transportation options and meeting the needs of current and future residents and visitors.

Firestone TMP Goal Areas

LAND USE & TRANSPORTATION CONNECTION

- Consider growth scenarios to understand transportation system needs required to meet future growth patterns
- Evaluate the capacity of existing roadways against future travel demand
- Require transportation infrastructure improvements as part of new developments
- Ensure consistency between the Town subdivision ordinance and Design Guide

ROADWAY NETWORK DEVELOPMENT

- Invest in a comprehensive and redundant roadway network that accommodates future growth and ensures Firestone residents have adequate access to regional employment and recreation destinations
- Create and apply design guidance so that roadways feature consistent design characteristics and elements

EFFICIENCY AND OPERATIONS

- Pursue efficiency and operations improvements to reduce travel time and manage congestion
- Consider transportation demand management strategies that reduce the need for future roadway widening

INCREASE TRANSPORTATION OPTIONS

- Ensure Firestone provides a well-connected system of trails and bikeways that allows residents and visitors to destinations within the Town of Firestone and to make connections to surrounding communities
- Develop cross-sections for reference during new road construction and roadway improvement projects that include pedestrian facilities and bikeways
- Ensure ADA compliance for new transportation facilities and pursue ADA improvements as part of roadway improvement projects

MAINTENANCE

- Maintain the existing transportation systems to a high standard
- Consider future maintenance costs associated with roadway network expansion
- Provide adequate funding for maintenance of trails and bikeways

REGIONAL COORDINATION

- Evaluate roadways and bikeways as part of a regional network of transportation services

- Coordinate with DRCOG, CDOT, Weld County, and surrounding communities on transportation improvements that transcend jurisdictional boundaries

Community Engagement

Town Board Meetings & Public Outreach

A wide variety of meetings and outreaching activities took place during the planning process of the TMP. Input received during these efforts were used to inform the overall recommendations included in this Plan.

- **Town Board Workshops and Presentations**: Project team members presented the vision and goals and solicited input members on Plan priorities and local challenges and opportunities.
- **Meet & Greet Tabling Event** (March 25, 2021): Town staff managed a booth that provided interactive opportunities to gather public input on the vision and goals for the future and opportunities and challenges associated with the existing transportation system. Interactive boards and a study area map were used to solicit input from participants through sticky notes and dots. A three-question response card was also provided to gather additional feedback.
- **Online Interactive Map** (available throughout full duration of the project): provided an opportunity for the public to share transportation opportunities at specific locations throughout the Town, as well as issues related to safety and desired connections.

Key Takeaways & Priorities

The following takeaways and priorities emerged during the various meetings and outreach activities conducted throughout the planning process. These priorities are organized below and are reflected in the TMP Goal Areas. Overall, members of the public and Town Board indicated the highest support for *creating a multi-modal system*.

<u>Safety</u>

- Access to King Soopers located at Colorado Blvd and Firestone Blvd
- Need for safe crossings for bicyclists and pedestrians
- General concerns with speeding

<u>System Efficiency</u>

- Providing a better off ramp at I-25 and Firestone Blvd
- Addressing access and congestion along I-25
- Need to expand roadways to accommodate growth and increase land access

Regional Coordination

- Facilitating transportation connections to surrounding communities
- Need for coordination with CDOT

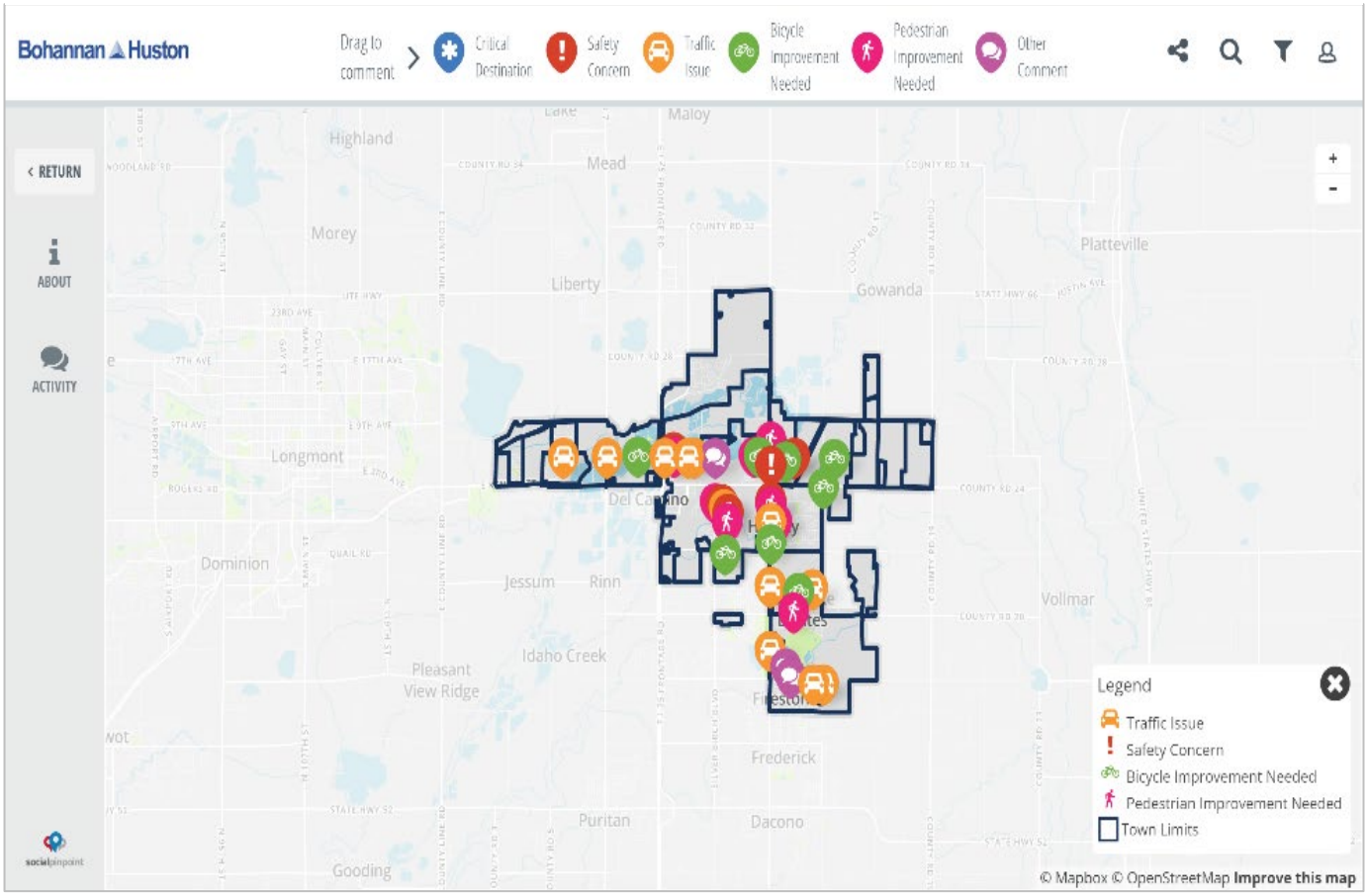
Multi-Modal System Development

- Supporting bicycle connections to regional destinations such as Sandstone Park and St Vrain State Park
- Need for safe crossings for bicyclists and pedestrians
- A desire to continue the Firestone Trail to the north
- Desire for soft surface trails
- Desire for rail connections to the Town of Firestone and surrounding areas
- Providing additional commuting options

Maintenance

- Need for repaving existing roadways
- Maintenance of existing trails
- Snow removal response time

Figure 3: Interactive Map Available on Project Website



CHAPTER 3 | EXISTING CONDITIONS

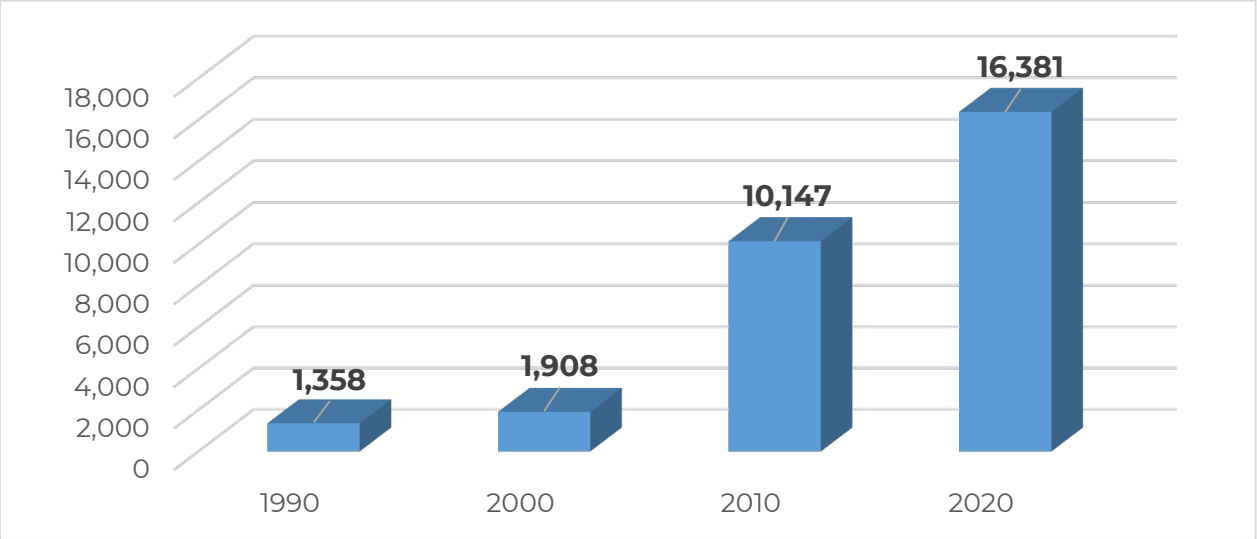
FIRESTONE TRANSPORTATION MASTER PLAN

SOCIOECONOMIC CONDITIONS

2020 Population

Due to its proximity to I-25 and destinations across the Denver metropolitan area and the high quality of life for residents, the Town of Firestone is a popular community for families with young children and individuals who want access to urban amenities but seek a more suburban housing environment. The Town is also growing rapidly. As of the 2020 Census, The Town of Firestone had a total population of 16,391, compared to only 1,908 in 2000. By 2040, the household population for the greater Firestone area is expected to more than double. Anticipated levels of growth will have significant impacts on the Town and regional transportation system.

Figure 4: Town of Firestone Population, 1990-2020



Population & Employment Projections

This TMP contains household population and employment projections through the year 2040 that utilize DRCOG forecasts as a baseline and incorporate input from Town staff based on known development projects, current zoning, and local development policies. This alternative socioeconomic dataset is believed to be more reflective of current trends and local policies than the regional forecast and is incorporated into the travel demand analysis that serves as a cornerstone of this plan. The travel demand model analysis is utilized in this plan to determine the location and likely benefits of potential roadway improvements.

The data in Table 1 represents base year (2015) and future year (2040) household population and employment levels for the greater Firestone area. Consideration of this larger geographic area is necessary because vehicle travel transcends jurisdictional boundaries and the geographic units of analysis in the travel model do not conform to municipal limits. Significant growth is anticipated both within the Town of Firestone and in the surrounding area.

Overall, the household population in the greater Firestone area is projected to increase by 129% while employment is projected to grow by 254% between 2015 and 2040. While high levels of growth are expected across the Town, areas expected to see significant growth in housing units (and household population) include neighborhoods between I-25 and Colorado Blvd, with substantial new housing construction expected north of CR 28. Areas where high levels of employment growth are likely to occur include southeast Firestone along either side of Colorado Blvd.

Table 1: Household Population and Employment Summary Table

Type	Period	Greater Firestone Modeling Area
Household Population	2015	36,482
	2040	83,632
	Change 2015-2040	47,150
Households	2015	12,732
	2040	26,719
	Change 2015-2040	13,987
Employment	2015	12,232
	2040	43,349
	Change 2015-2040	31,117

Figure 5: Percent Change in Household Population and Employment, 2015-2040

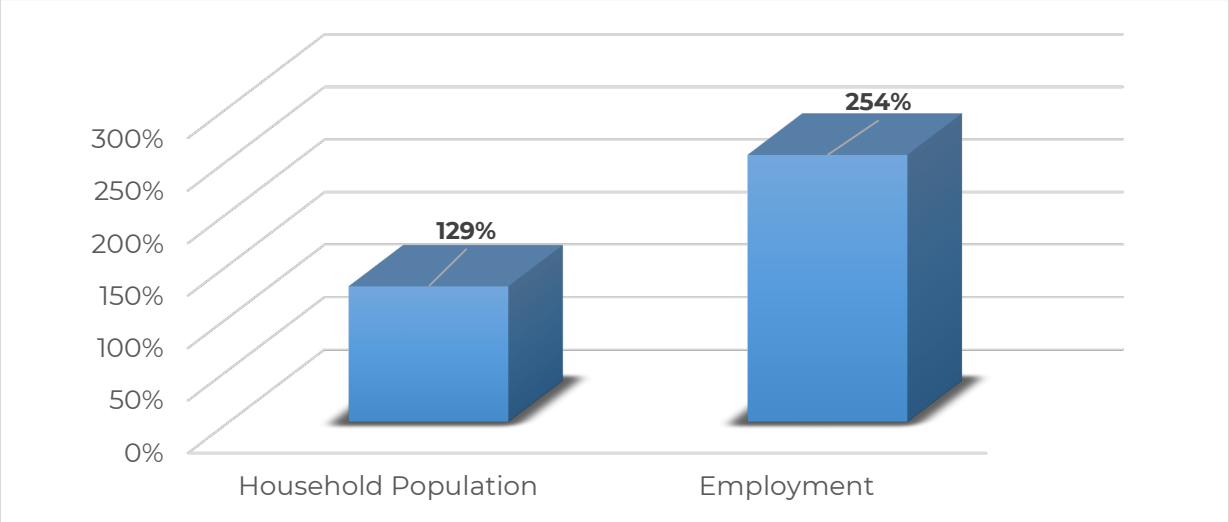


Figure 6: Growth in Household Population by Traffic Analysis Zone, 2015-2040

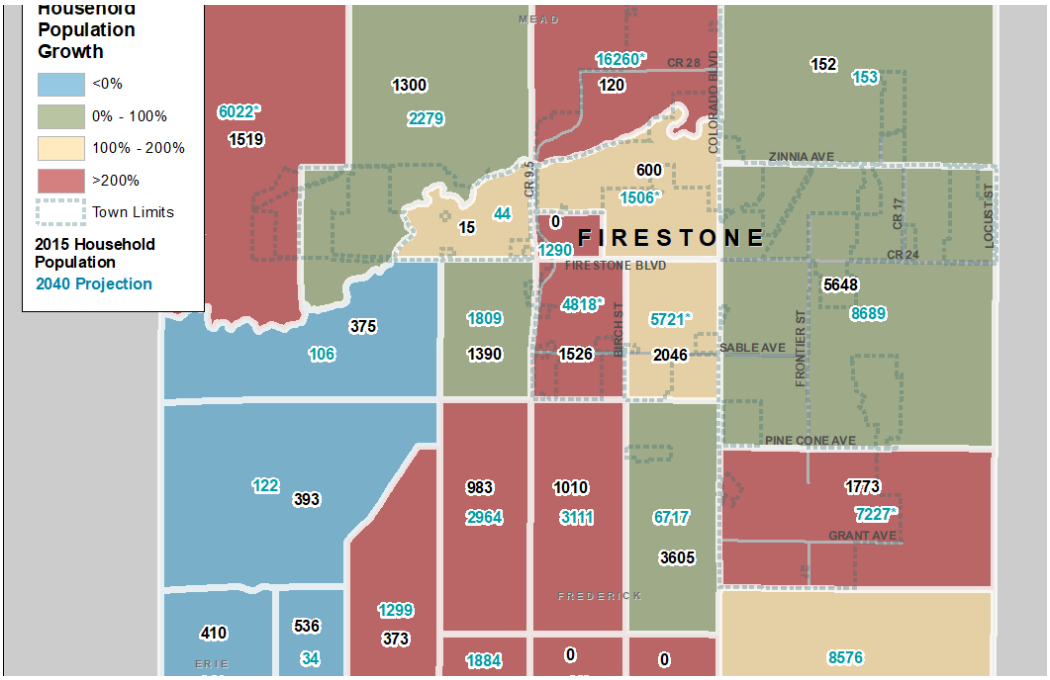
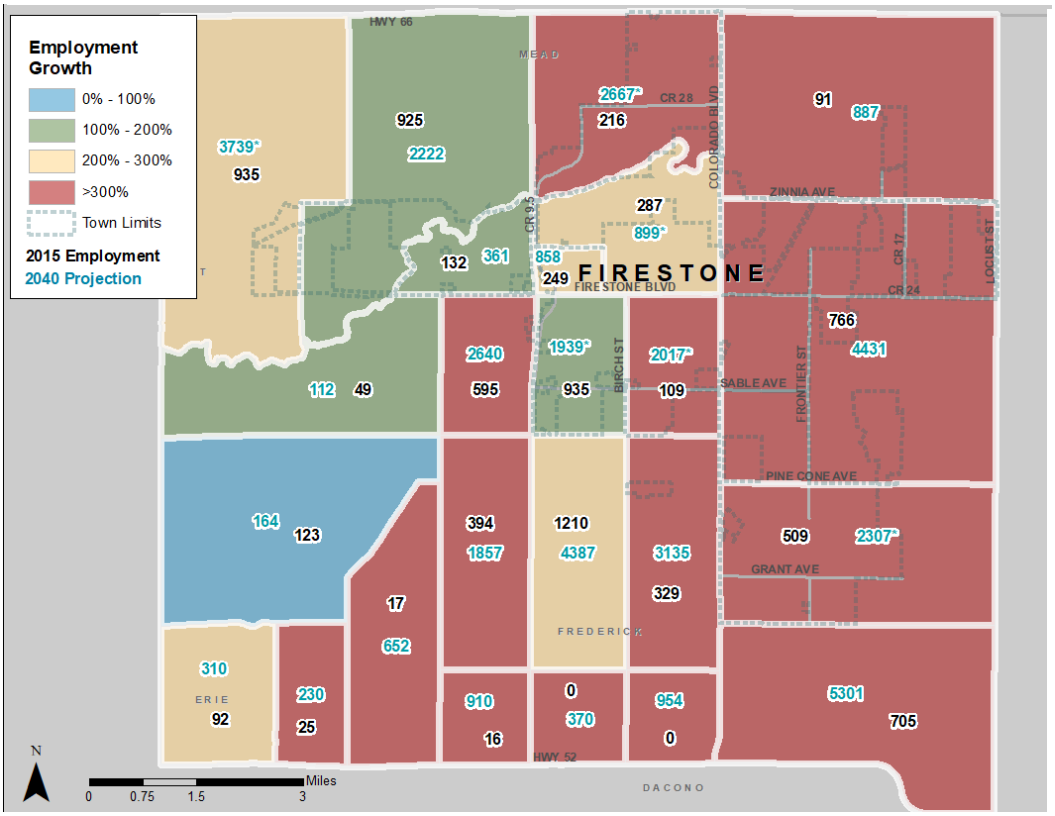


Figure 7: Growth in Employment by Traffic Analysis Zone, 2015-2040



Commuting Patterns

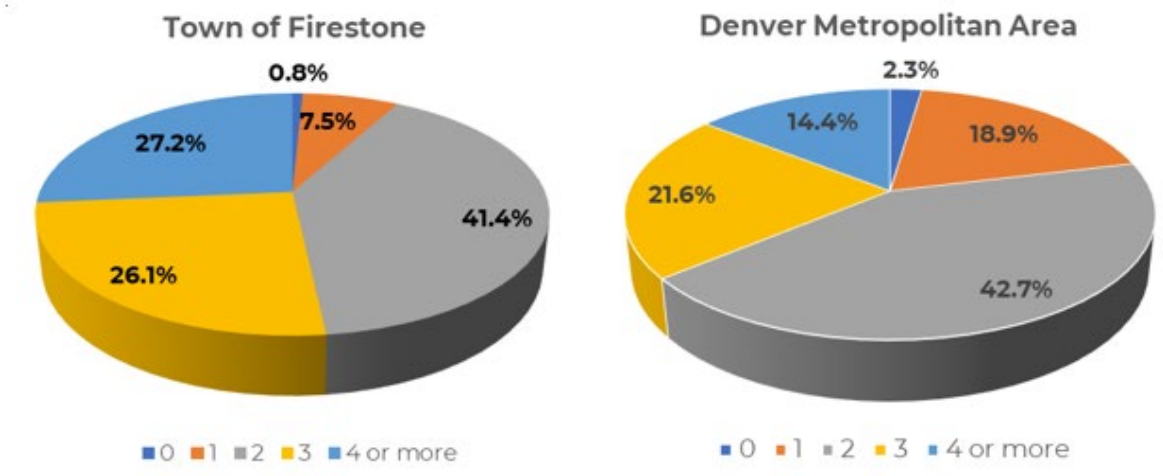
Means of Transportation to Work

As demonstrated by various Census data, Firestone residents tend to rely heavily on single-occupancy vehicles. Compared to the overall Denver metropolitan area, Firestone residents are significantly more likely to commute by private vehicle and less likely to commute by walking biking or transit. The average travel time is 31 minutes, and more than a quarter of Firestone residents travel more than 45 minutes per direction to work. Firestone residents also own vehicles at rates significantly above the regional average; more than half of Firestone households (53.3%) have three or more cars available, compared to 36.0% for the overall metropolitan area.

Table 2: Means of Transportation to Work

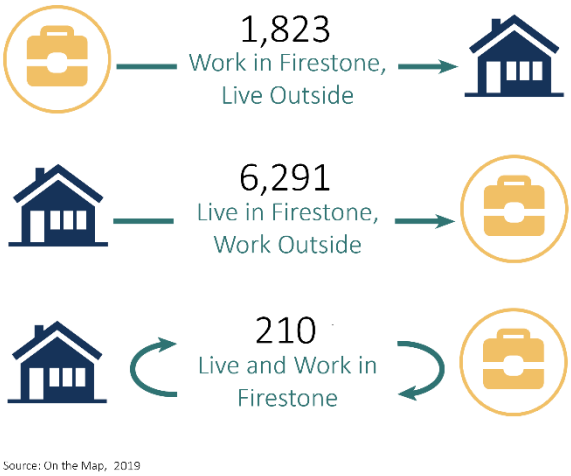
	Town of Firestone	Denver Metropolitan Area
Private Vehicle	90.3%	83.4%
Drive Alone	84.2%	75.3%
Carpool	6.1%	8.1%
Bicycle	0.0%	0.8%
Walk	0.2%	2.2%
Public Transit	0.8%	4.2%
Other	0.6%	1.0%
Work At Home	8.1%	8.4%

Figure 8: Number of Vehicles Available by Household



Worker Flows

The dependence on private vehicles is consistent with commuting patterns of Firestone residents, as nearly 97% of the 6,500 employed residents of Firestone travel outside of the Town for work. Primary work destinations for Firestone residents include Boulder, Longmont, and Downtown Denver. It is also important to note that approximately 90% of the 2,033 jobs located within Town limits are filled by non-residents (source: OnTheMap, 2019).



Source: On the Map, 2019

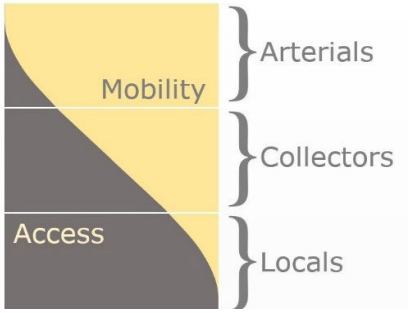
These commuting dynamics demonstrate the need to promote safe and convenient access to I-25 for travel to the greater Denver region and for regional coordination on roadway, transit, and other transportation investments and economic development initiatives that transcend jurisdictional boundaries.

ROADWAY NETWORK

The Town of Firestone's roadway network serves the needs of the traveling public to access jobs, services, recreational sites, and other destinations. This section details the roadway network throughout the Town of Firestone, including traffic volumes and the current and long-term roadway networks by road type (i.e. functional class). This information is a vital input to the travel demand modeling analysis, which is used as an indicator of projected traffic congestion today and by 2040 and helps identify the need for new roadways and widening of existing roadways.

Functional Classification

Definition and Purpose

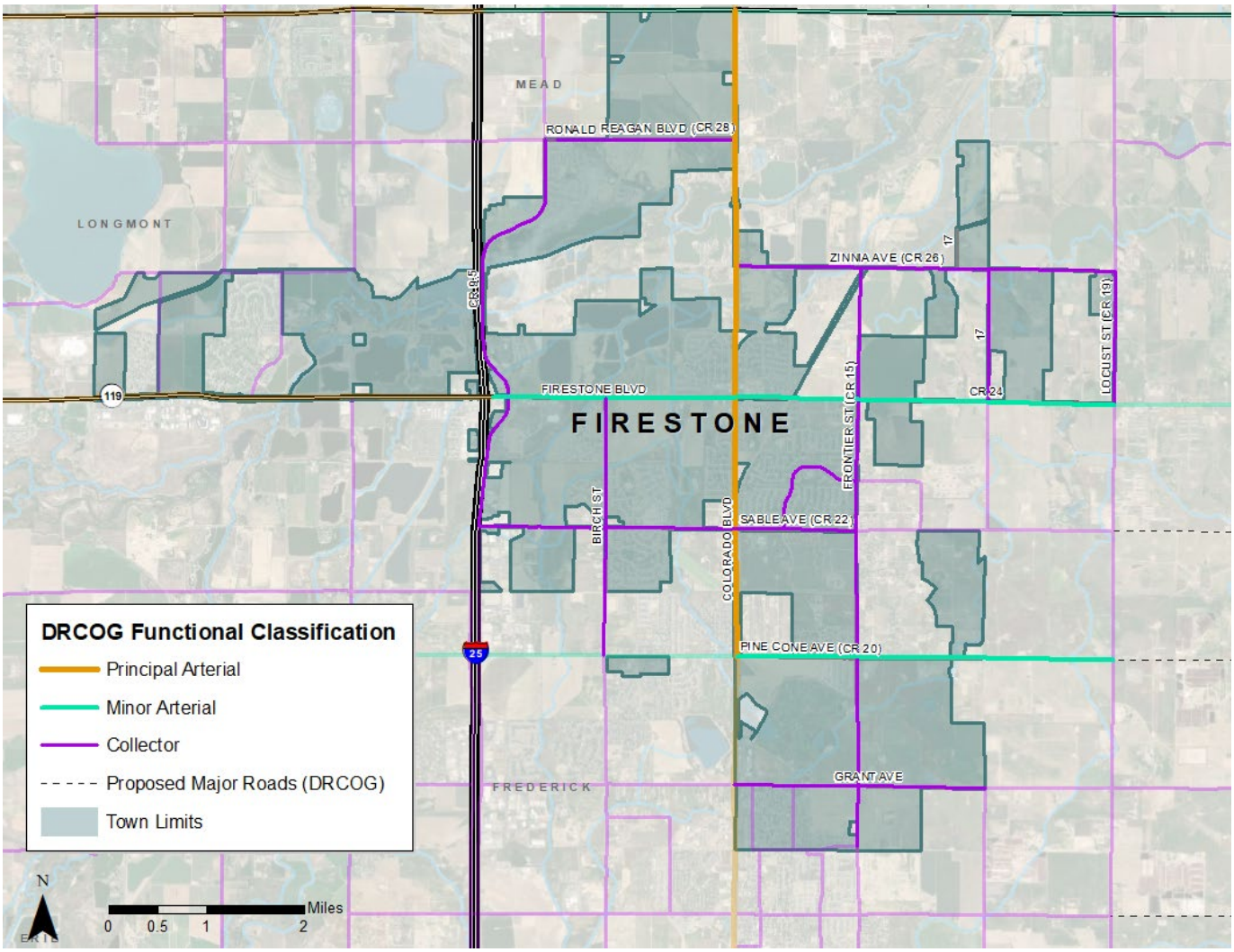


Source: FWHA, COMPASS (Idaho)

Functional classification refers to a road network hierarchy based on the level of mobility and land access provided. Typically, higher category roads such as freeways and arterials provide more mobility and less access while lower category roads such as collectors and local streets provide less mobility and more access. DRCOG maintains the federally-recognized functional classification for roadways within the Denver metro area, which includes the Town of Firestone. Figure 9 references the existing functional classification system as defined by DRCOG. However, the formal system does not reflect the current or anticipated travel demand or desired road design types within the Town. At present, Colorado Blvd is classified as a principal arterial and Firestone Blvd and Pine Cone Ave are classified

as minor arterials. The remainder of Town roads are classified as collectors or local streets.

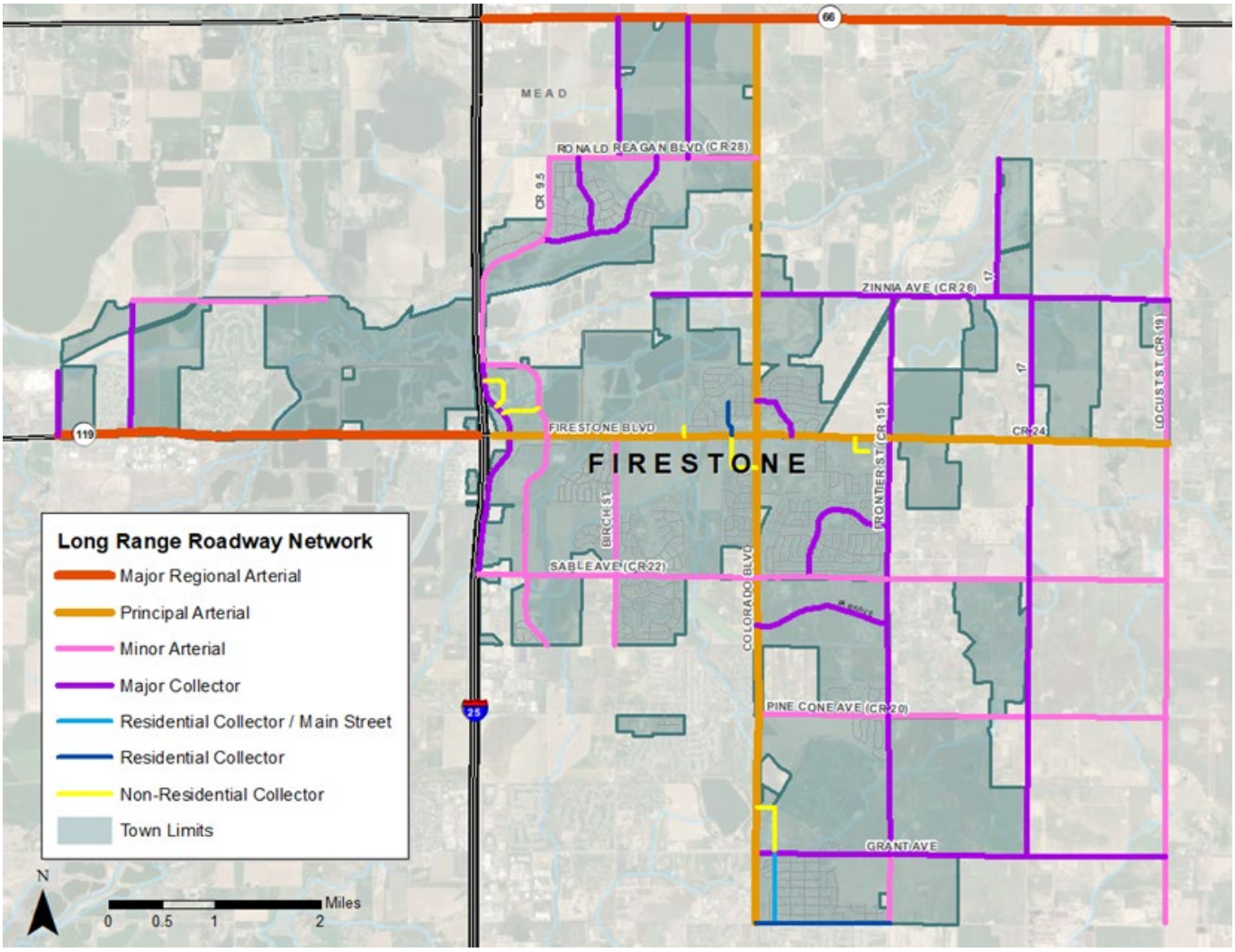
Figure 9: Existing Functional Classification System, DRCOG



Updated Firestone Network

An essential product of this Plan is the development of updated Town road type designations and a proposed long-range roadway network that reflects current and future roadway design. Ultimately, the Town network should coordinate with DRCOG to align the Town road designations with the functional classification established at the regional level. Figure 10 depicts the proposed long-range roadway system.

Figure 10: Long-Range Roadway System for the Town of Firestone



Connection to Roadway Design

The designation of Town roads is directly linked to the Design Guide developed as part of the TMP. See the Implementation section for additional discussion and Appendix A for the complete Design Guide.

Roadway Types

Road type designations are tied to the design guidance developed as part of this TMP. Definitions by functional class are provided below; additional information, typical sections, and design guidance can be found in Appendix A. It is important to note that Firestone distinguishes among collectors depending on location and desired roadway features. In general, non-residential and residential collectors correspond to the minor collector designation.

Principal Arterial: Principal arterials are roadways that serve long-distance regional trips and are intended to carry the largest volumes at generally high speeds (i.e.

design speed of 45-55 MPH). These roadways generally prioritize vehicle throughput over providing access to parcels adjacent to the roadway.

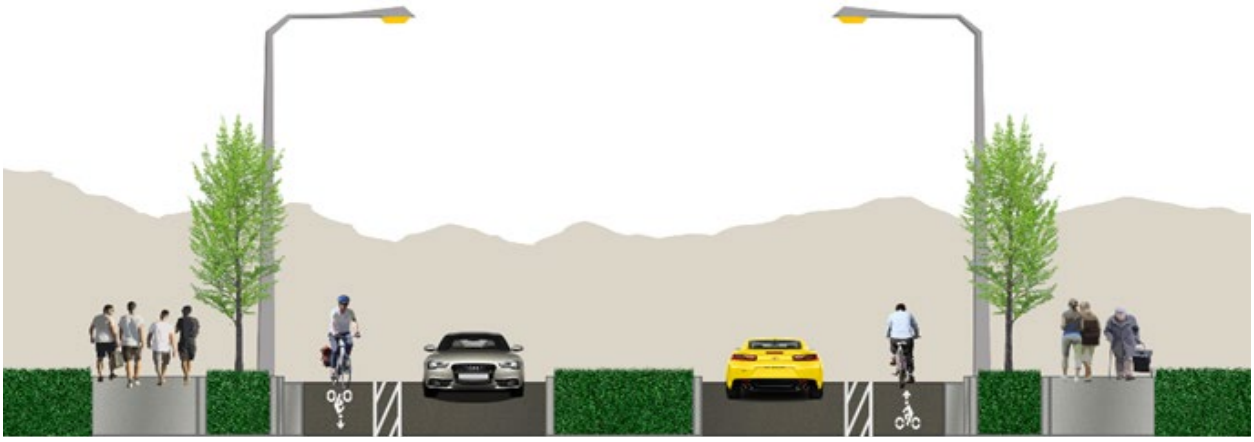
Minor Arterial: Minor arterials are intended to carry large volumes of traffic at a design speed of 40-50 MPH. They generally provide more access to adjacent parcels than principal arterials but still prioritize vehicle throughput over access.

Major Collector: Major collectors are intended to carry more than 10,000 vehicles per day at a design speed of 35-45 MPH. Major collectors generally carry more vehicles per day than other collectors and may be located in commercial or residential areas. Because their role is to connect local roads and arterials, major collectors must balance between vehicle throughput and providing access to parcels.

Non-Residential Collector: Non-residential collectors are intended to carry up to 10,000 vehicles per day at a design speed of 35 MPH. Because their role is to connect commercial areas with arterials, non-residential collectors generally strive to balance between vehicle throughput and providing access to adjacent parcels.

Residential collector: Residential collectors are intended to carry up to 2,000 vehicles per day at a design speed of 30 MPH. Residential collectors connect local roads and arterials and generally prioritize providing access to parcels over vehicle throughput.

Figure 11: Non-Residential Collector Typical Section



** Visuals for all Roadway Types included in Appendix A*

Traffic Volumes

Traffic volumes help quantify travel patterns and identify roadways and intersections where congestion may occur. Traffic volume data was collected by the Town of Firestone in May of 2021 along select roadways corridor-wide and at specific intersections. A total of 15 corridors and 5 intersections were chosen based on existing travel patterns and data gaps. Traffic volumes summarized below are a combination of 24-hour segment level data and peak period intersection counts. An adjustment factor was applied to traffic volume data collected during peak periods only to create 24-hour volume estimates. This adjustment factor is based on the average share of total trips on Firestone roads that occur in the AM peak period.

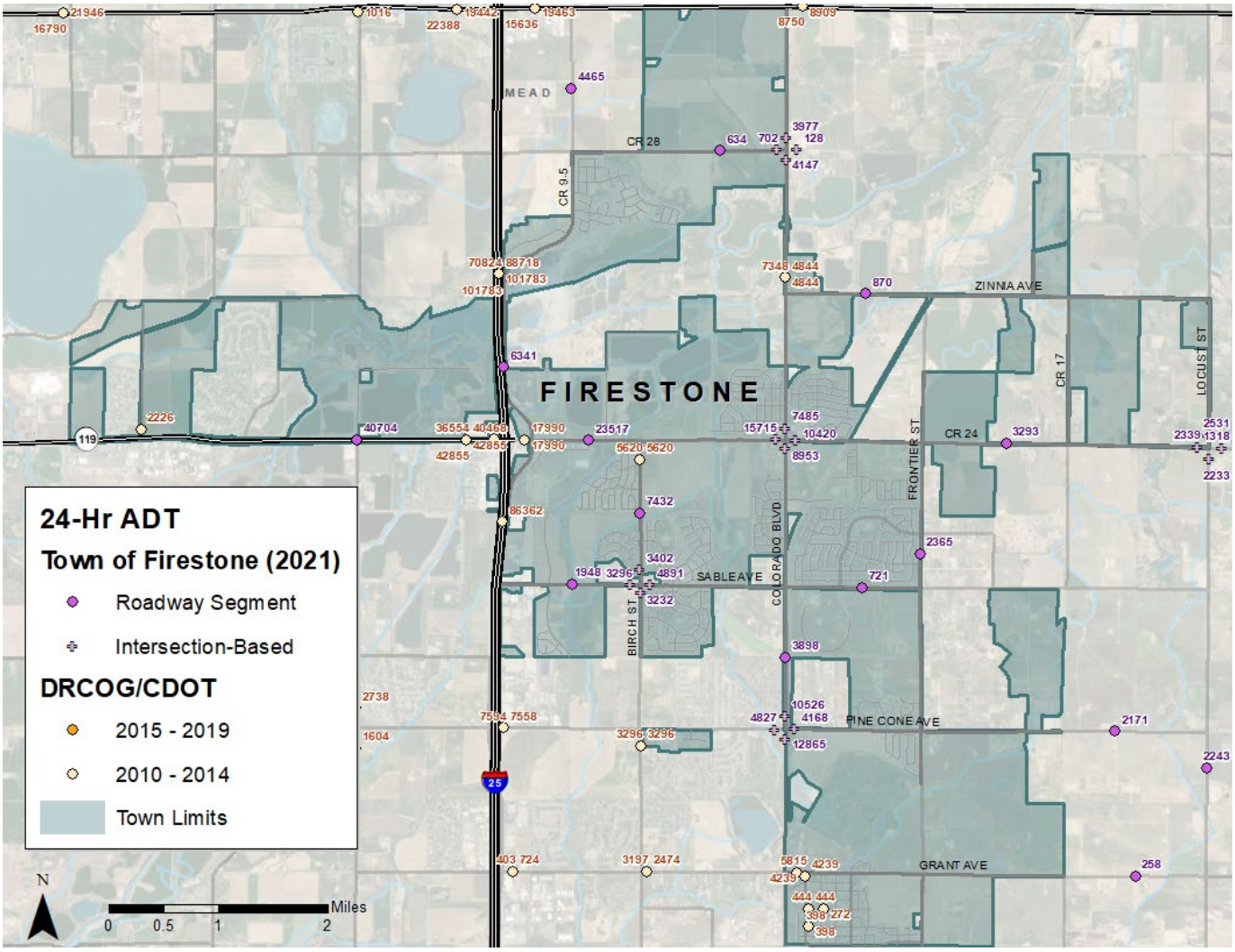
As shown in Table 3 below, CO 119 to the west of I-25 has the highest 24-hour volumes with more than 40,000 vehicles per day, followed by Firestone Blvd to the east of I-25 near Birch St with 23,500 vehicles per day.

In addition to recent traffic counts, Average Annual Daily Traffic (AADT) volumes from DRCOG's Regional Data Catalog were used to calibrate the Firestone Travel Model, which was developed to determine long-term travel demand and where roadway widening may be needed to accommodate future development. Refer to the travel model analysis discussion in Chapter 4 for more information.

Table 3: Traffic Volumes by Location, 2021

Route	Location	Direction	24-Hour Volume	AM Peak Total	PM Peak Total
Birch St (CR 11)	Firestone Blvd	North-South	7,432	562	686
CO 119	CR 7	East-West	40,704	3,021	3,203
Colorado Blvd	Sable Ave	North-South	3,898	339	408
CR 9	CR 24.5	North-South	6,341	572	525
CR 9.5	CR 28	North-South	4,465	338	410
Firestone Blvd (CR 24)	Birch St	East-West	23,517	1,804	1,888
Firestone Blvd (CR 24)	CR 17	East-West	3,293	231	282
Frontier St (CR 15)	Sable Ave	North-South	2,365	197	261
Grant Ave	Locust St	East-West	258	19	30
Locust St (CR 19)	Pine Cone Ave	North-South	2,243	154	216
Pine Cone Ave (CR 20)	Locust St	East-West	2,171	188	201
Sable Ave (CR 22)	Frontier St	East-West	721	60	74
Sable Ave (CR 22)	Birch St	East-West	1,948	197	195
Zinnia Ave (CR 26)	Frontier St	East-West	870	84	82

Figure 12: 24-hour Traffic Volumes by Location



Crashes and Safety Issues

Crash data are an important means of understanding areas of safety concern. The crash analysis contained in this TMP is based on 2019 data compiled by DCROG as part of its Regional Data Catalog. All crashes that occurred within a half-mile buffer of the Town of Firestone limits are shown in Figure 13.

COMMUNITY SAFETY PRIORITIES

Based on feedback collected through public outreach efforts, the following areas were highlighted as priorities for safety:

- Safety concerns with the light at King Soopers located at Colorado Blvd and Firestone Blvd
- Need for safe crossings for bicyclists and pedestrians
- Concerns with speeding

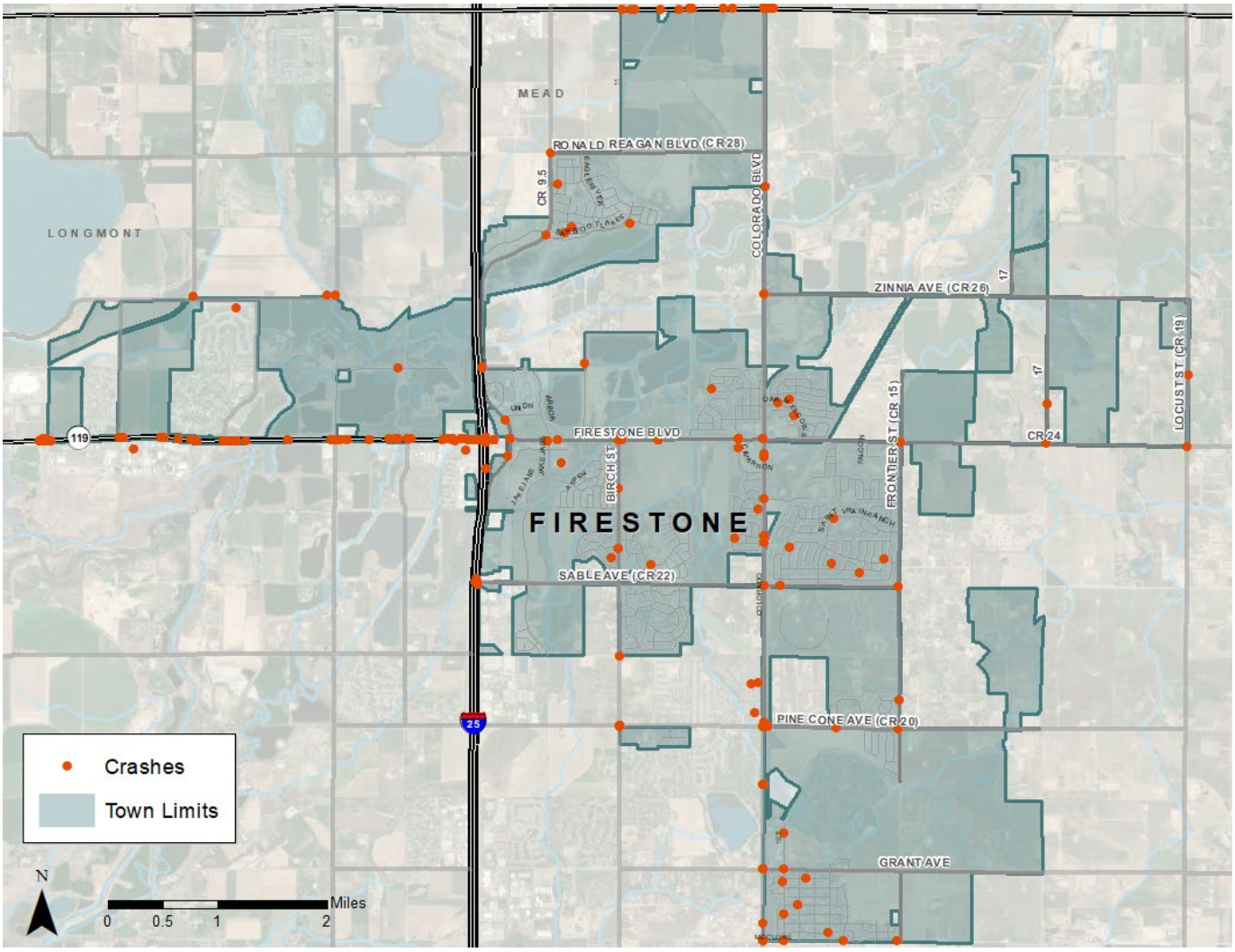
There were 316 reported crashes along roads within the Town in 2019, excluding the I-25 corridor. The majority of crashes occurred along CO 66 and CO 119, which are CDOT roadways and experience high traffic volumes.

Among roads owned by the Town of Firestone, Firestone Blvd (to the east of I-25) and Colorado Blvd experienced the greatest number of crashes overall (see Table 4). The intersections that experienced the highest number of crashes include Colorado Blvd and Pine Cone Ave (n=10), Colorado Blvd and Grant Ave (n=7), Firestone Blvd and Birch St (n=7), and Firestone Blvd and I-25 Frontage Road (n=5).

Table 4: Total Crashes by Intersection, 2019

Intersection	Total Number of Crashes
Colorado Blvd & Pine Cone Ave	10
Colorado Blvd & W Grant Ave	7
Firestone Blvd & Birch St	7
Firestone Blvd & I-25 Frontage Road	5
All Other Locations	287
Total	316

Figure 13: Firestone Area Crashes, DRCOG 2019



Bikeways and Pedestrian Facilities

Benefits of Active Transportation Networks

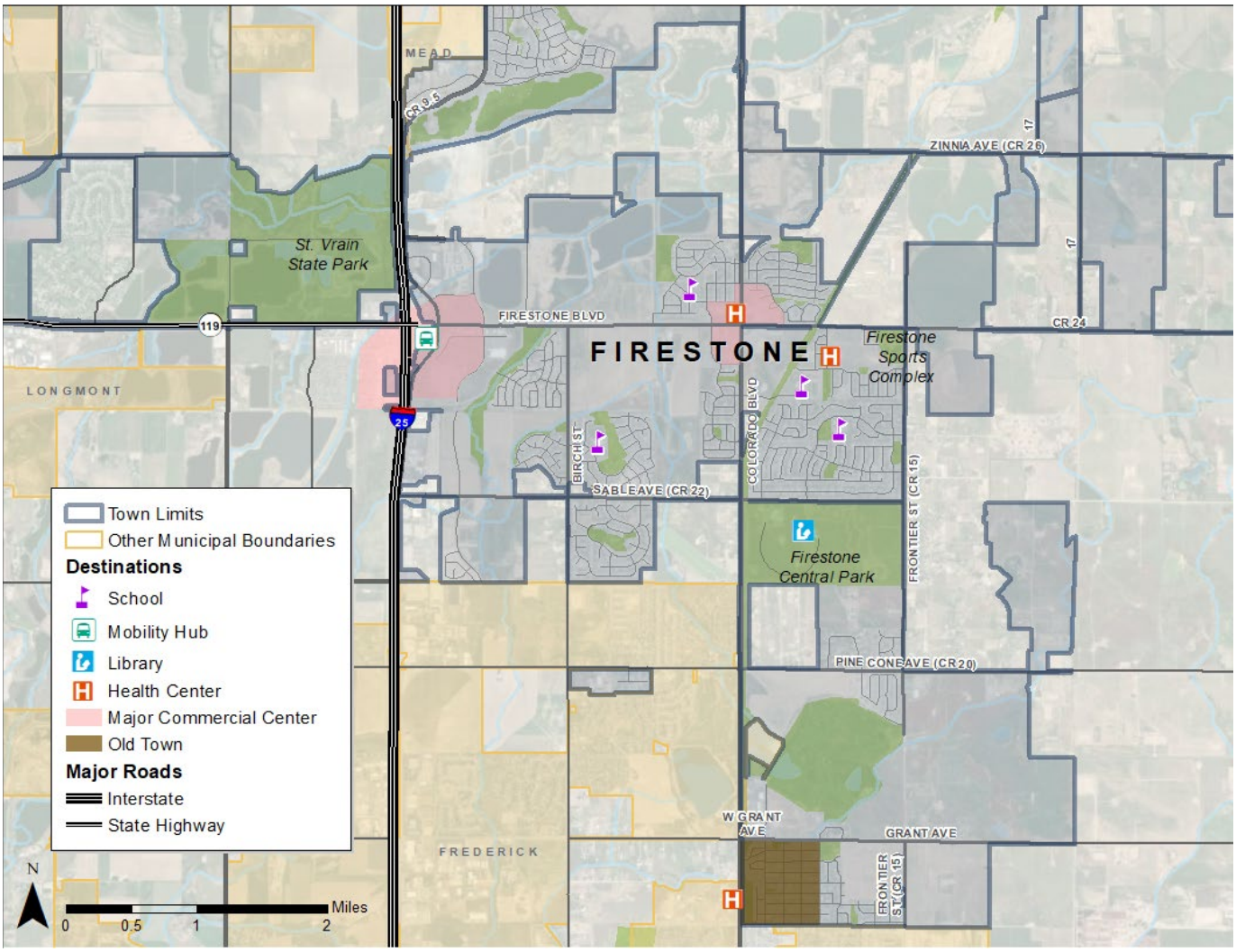
A well-connected and robust active transportation network is vital to promoting healthy lifestyles, supporting economic developing, and improving overall quality of life for those traveling to and through the Town of Firestone. High-quality and continuous active transportation facilities also support recreational activities and help encourage visitors to stay longer. Expanding these networks will become increasingly important as the Town of Firestone grows over time and competes with other communities for new residents and businesses.

Major Destinations

The Town of Firestone features a growing set of trails and bikeways, though there are gaps in the existing networks. A primary emphasis of this Plan is to connect residential areas to major destinations to allow for local trips to be completed without a private vehicle. Major destinations identified for the purposes of this effort are shown in Figure 14 and include the following:

- Parks and open space, including Central Park and St Vrain State Park
- Old Town, including the 1st St corridor between Grant Ave and McClure Ave
- Major commercial centers, including near I-25 and Firestone Blvd and Colorado Blvd and Firestone Blvd
- Major planned developments, including near Firestone Blvd and Colorado Blvd and Sable Ave and Jake Jabs
- Community destinations, including Town Hall, schools, and libraries

Figure 14: Major Destinations within the Town of Firestone



Pedestrian Facilities

Pedestrian facilities, such as sidewalks or multi-use trails at curb level (also referred to as side paths), provide dedicated infrastructure for people to walk within neighborhoods and throughout the greater transportation network. Sidewalks and side paths improve safety as they allow pedestrians to be separated from motor vehicle travel and major roads and minimize potential conflicts between transportation modes.

An analysis of existing pedestrian facilities along major roads in Firestone was completed to better understand locations with existing sidewalks or trails and areas where there are gaps (refer to Figure 15). Over half (58%) of the total length of major roads analyzed *do not* have either a sidewalk or a parallel trail.

On-Street Bikeways

Firestone currently features a small number of roads with formal bike lanes as well as various routes with shoulders that support bicycling. Existing bike lanes including along St Vrain Ranch Blvd between Frontier St and Sable Ave and Falcon St / Tilbury

Ave, which provides access to the Firestone Regional Sports Complex. Existing bike lanes are approximately 4 foot wide and includes striping. Shoulders exist on major roads such as Firestone Blvd, Colorado Blvd, and the I-25 Frontage Rd. Roadways with shoulders suitable for biking are concentrated between I-25 and Colorado Blvd and CR 28 and Sable Ave. See Figure 16 for existing bikeways.

Trails

Sidewalks and on-street bike lanes are complemented by multi-use trails that often serve recreational users and bicyclists who are less comfortable riding along a street and prefer a separated facility. This plan distinguishes between major and minor trails.

Major Trail: Wide trail (i.e. generally 10' or wider) that provides long-distance connections and may be used for both recreation and utilitarian purposes. Major trails located alongside a collector or arterial road that take the place of a sidewalk are also referred to as a side path. The most notable trail is the **Firestone Trail**, a major community asset and integral part of the Colorado Front Range Trail system that connects to the greater region. The Firestone Trail is a paved, 10-foot wide facility that is 6.6 miles long and spans the Town from the north to the south along Colorado Blvd. The trail diverts northeast onto an old railroad bed near Sable Ave. The Town maintains the extent of the facility, though portions of the Firestone Trail are outside of municipal limits.

Minor Trail: Narrower trail (i.e. less than 10' wide) generally located within a park or subdivision that serves primarily recreational purposes. Minor trails may be paved or unpaved. There are 30.5 miles of minor trails within the Town of Firestone. St. Vrain Park

Table 5: Existing Trails in the Town of Firestone

Trail Type	Total Miles
Minor	30.5
Major*	6.6
Total	**37.1**

**Note: The Firestone Trail extends beyond Town boundaries. The table includes the extent of the Firestone Trail, though portions of the trail are outside of municipal limits.*

Pedestrian and Trail Crossings

Though numerous mid-block and trail crossings are under consideration or proposed in the Parks, Open Space, and Trails Master Plan, there are no existing trail crossings within Town limits. There is one existing underpass just to the west of Firestone in Longmont along CO 119, which connects users to existing facilities in the City of Longmont. Refer to the Chapter 4: Future Transportation Networks for recommendations for proposed crossings in Firestone.

Figure 15: Existing Pedestrian Facilities along Major Roads

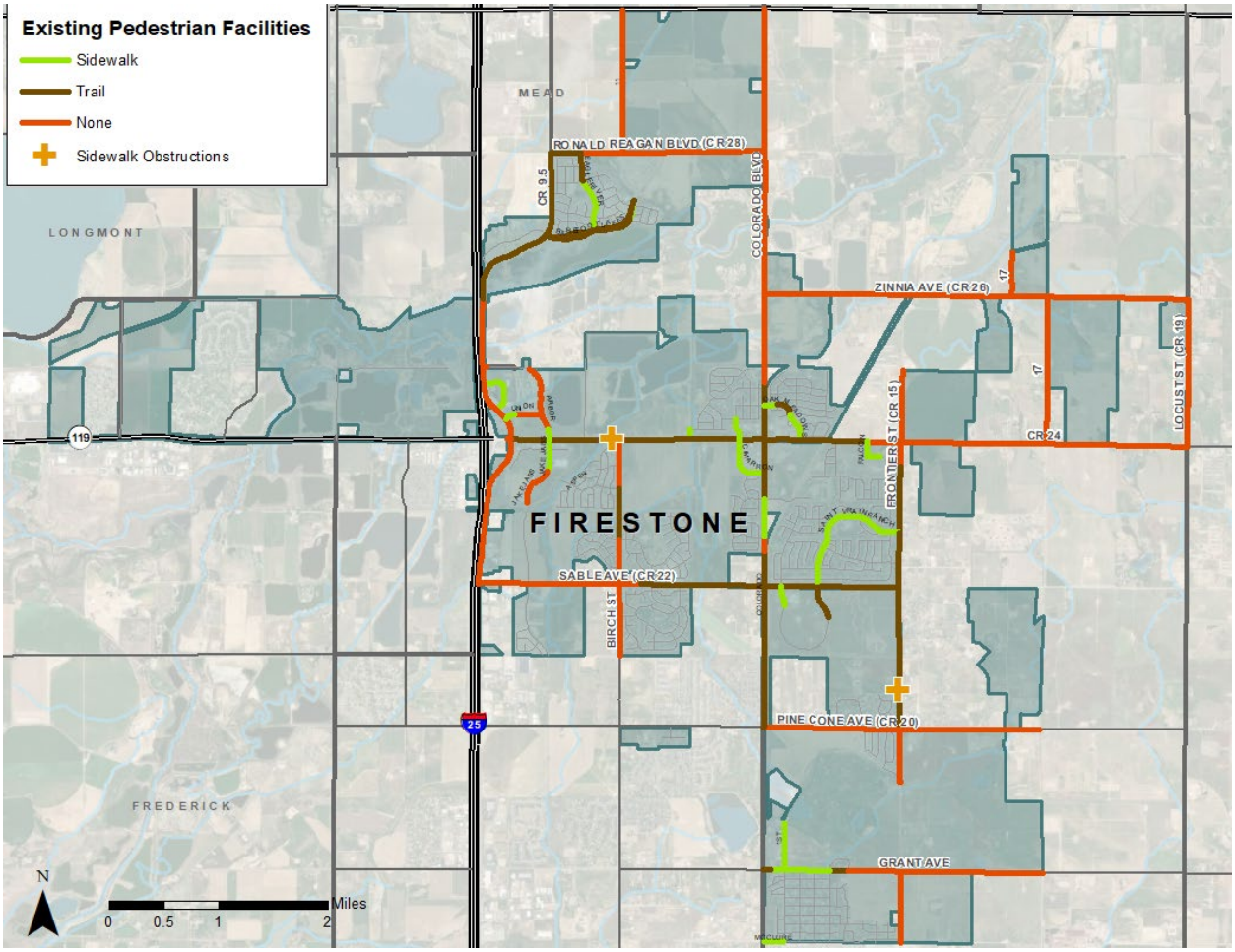
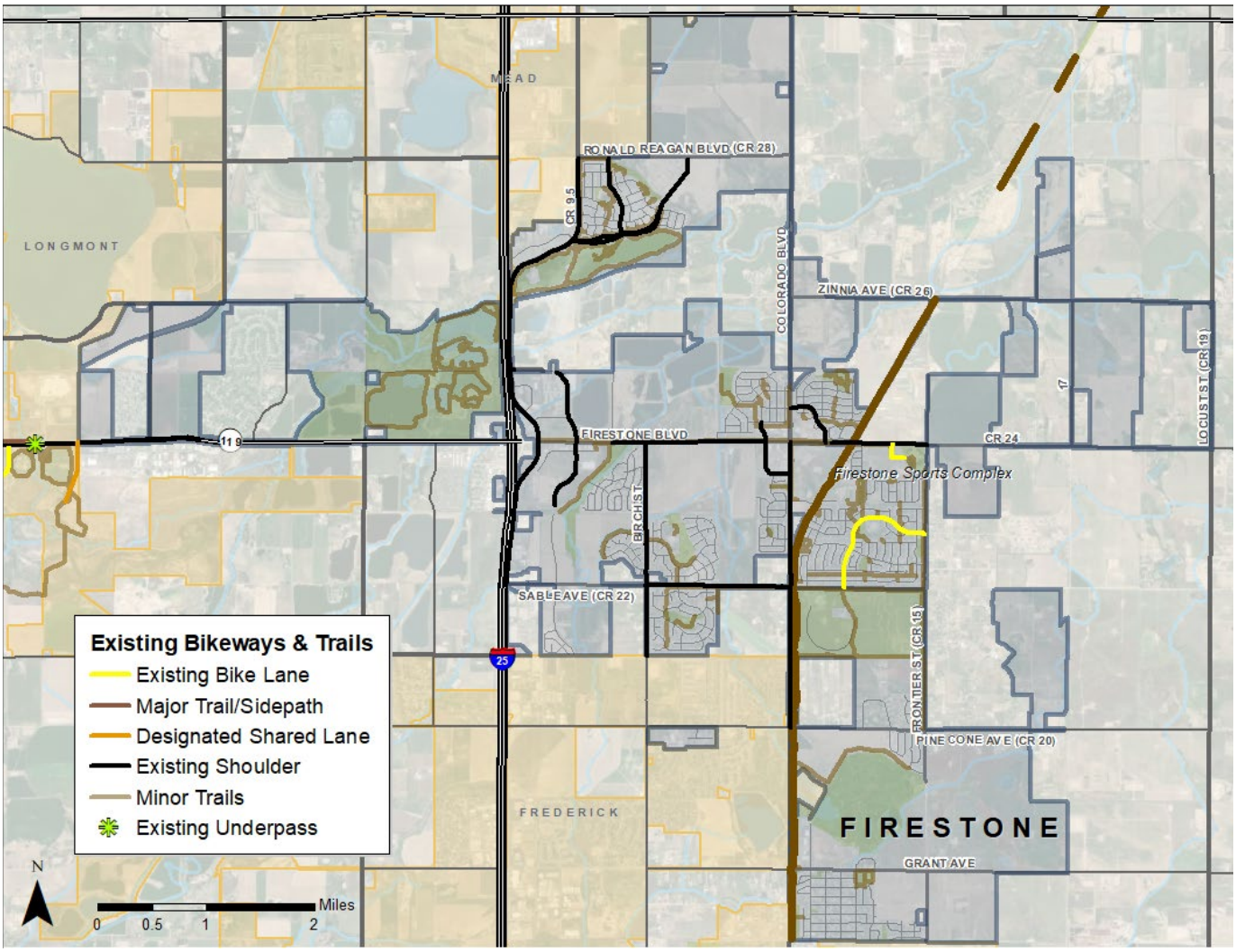


Figure 16: Existing Bikeways and Trails



CHAPTER 4 | FUTURE TRANSPORTATION NETWORKS

FIRESTONE TRANSPORTATION MASTER PLAN

ROADWAYS

General Principles and Priorities

Roadways are critical facilities that are integral to people's daily lives. Because people rarely live, work, shop, and play in the same place, roadways connect people to jobs, important services like healthcare, social networks, and recreational opportunities. In addition to their role establishing connections, roadways can define the character of a place and contribute to a sense of community identity. Roadway design must also address the safety needs of all individuals and ensure that road users of all modes, ages, and abilities can reach their destinations conveniently and safely.

The roadway improvements identified in this section are intended to help accommodate the high levels of growth anticipated across the Town of Firestone and further develop the Town's infrastructure to serve residents and visitors. Among the general roadway priorities are for the Town to pursue complete streets improvements with infrastructure that supports a wide range of users and to create a redundant network that disperses traffic across multiple roadways and allows the network to continue to function if a crash or construction along creates delays along an individual corridor. Finally, improvements along the regional roadway network should be coordinated to ensure a well-integrated transportation system with consistent roadway design that allows for seamless travel across the greater Firestone area.

ROADWAY NETWORK DEVELOPMENT PRINCIPLES AND PRIORITIES

- Accommodate future growth
- Complete Streets improvements
- Create a redundant network
- Connections to surrounding communities

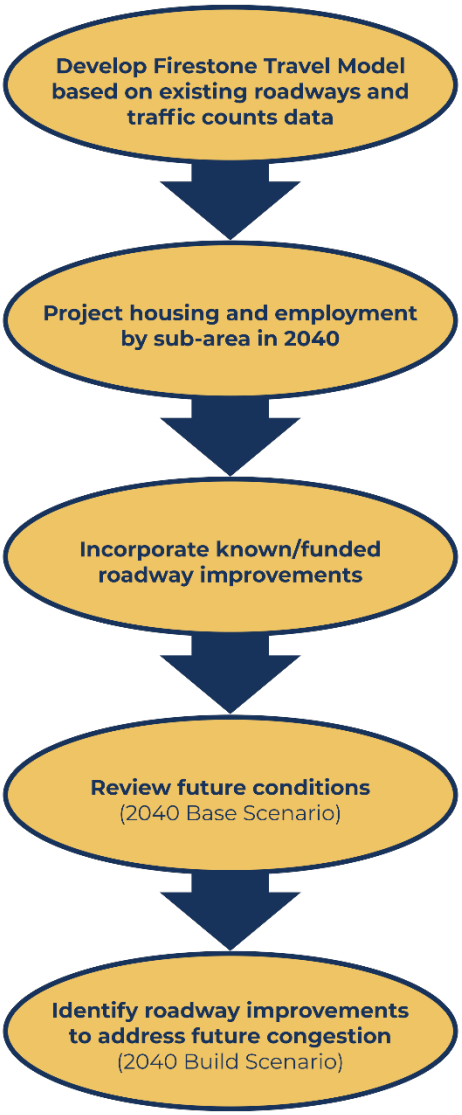
Building out the Town's roadway network will take time, and some of the roadway improvements associated with the proposed long-range network may be implemented beyond the 2040 timeframe of the TMP. Major roadway improvement projects that are likely to be completed in the next two decades are included in the 2040 Build Scenario (see discussion on travel model analysis below). Building out the transportation network also depends on continued land development and the participation of the private sector. Major roadway improvements that are to be constructed by developers as part of adjacent master planned areas or subdivisions are identified below, while local roads within new subdivisions will also be funded and constructed by the private sector.

Roadway improvement projects will feature bicycle and pedestrian facilities, in accordance with the design guidance contained in this TMP. See the Active Transportation Network section for additional discussion.

Travel Model Analysis and Identifying Future Roadway Conditions

Background and Purpose

Travel demand models are tools that allow planners and decision-makers to anticipate travel demand based on projected levels of growth and determine whether the existing roadway system can meet future needs. The Project Team adapted the DRCOG regional travel model to support transportation planning efforts specific to the Town of Firestone. The resulting product, the **2020-2040 Firestone Travel Model**, allows the Town of Firestone to better understand existing conditions, locations of future congestion, and the impacts and benefits of proposed transportation projects, including whether the current roadway network can accommodate the high levels of projected growth in population and employment.



Locations that are expected to see significant increases in traffic volume and congestion by 2040 may indicate that additional capacity (i.e. new or wider roadways) is warranted. See Appendix B for additional information on the model development process.

Key inputs to the Firestone Travel Model include:

- **Traffic counts data** collected in spring 2021 and calibrated to match the regional travel model by DRCOG.
- **Household and employment projections** for 2040 based on known and potential development projects.
- **Updated roadway network** including transportation investments that are expected to be completed as part of new development efforts.

FOCUS OF FIRESTONE TMP AND LIMITATIONS OF TRAVEL MODEL ANALYSIS

The primary focus of this plan is on network improvements, and it is important to note that roadway projects that increase efficiency or improve operations at intersections are not considered in a travel demand model. Capacity expansion projects should be complemented with transportation systems management and access management efforts.

Methodology

Three scenarios were developed and evaluated in the Firestone Travel Model:

- **2020 Existing Conditions**: Based on the existing roadway network and calibrated using observed traffic counts.
- **2040 Future Base Scenario**: Based on anticipated levels of growth and known roadway improvement projects, including privately funded projects that will occur as part of new development in the coming decades.
- **2040 Build Scenario**: Based on long-term roadway improvement projects to be funded through future development *and* by the Town of Firestone. These improvements respond to the levels of congestion anticipated in the 2040 Future Base Scenario.

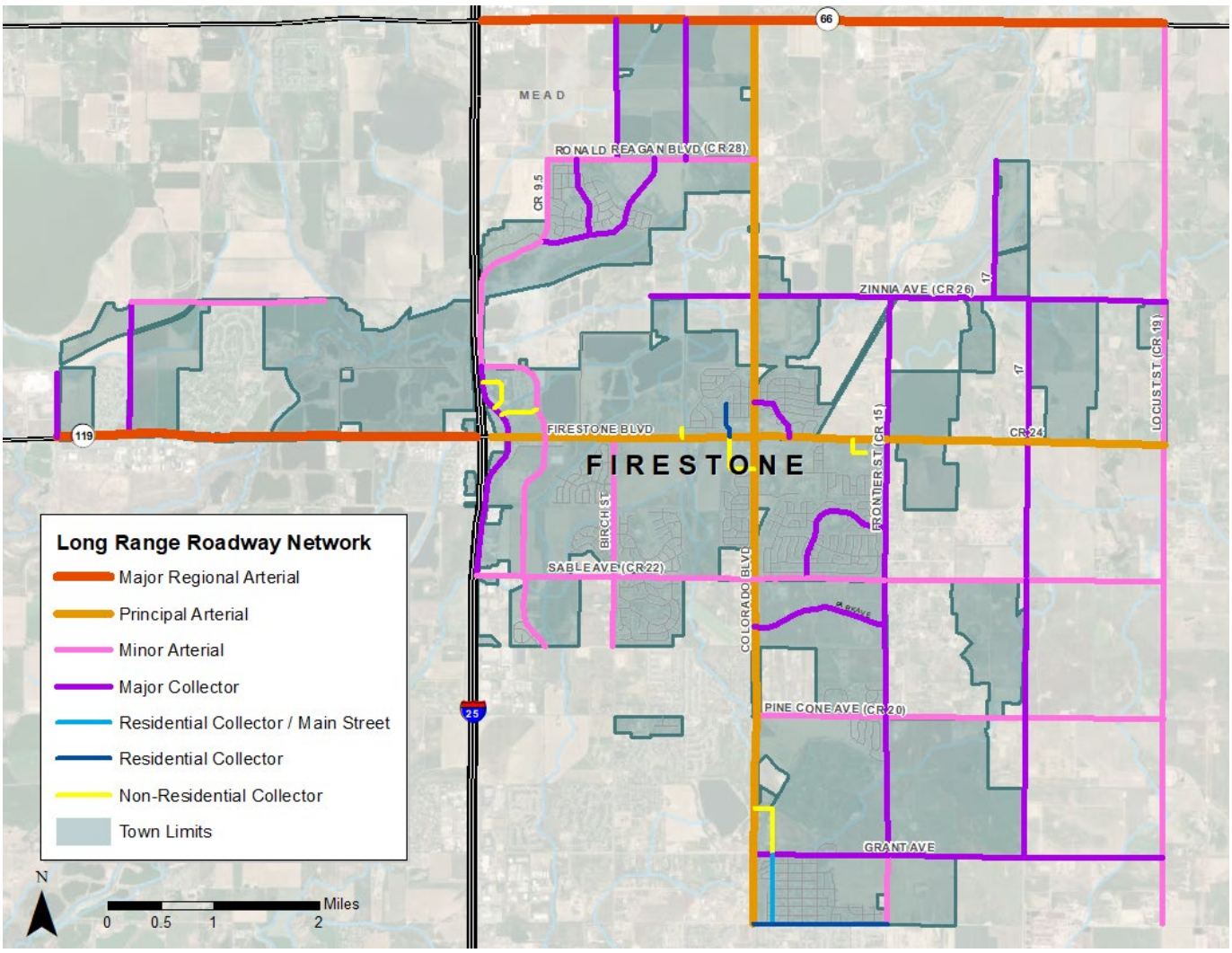
Comparison between the 2020 Base and the 2040 Future Base Scenario allows Town staff to determine where roadway enhancements may be needed and the scale of those new roadways. For example, the anticipated travel demand can shed light on whether a new road should be a collector or an arterial, or whether an existing roadway may be widened to accommodate future travel demand needs. Comparison between the 2040 Future Base Scenario and the 2040 Build Scenario allows Town staff to quantify the impacts of proposed investments.

Roadway Improvement Projects

The TMP identifies both publicly and privately funded roadway improvement projects. These projects are the result of travel model analysis that compared the projected changes between the 2020 and 2040 Base Scenarios and identified where capacity expansion is warranted. The benefits of proposed roadway improvements are validated through the improved conditions observed in the 2040 Build Scenario.

Figure 17 contains the proposed long-range roadway network, which reflect the desired road types after improvements are completed. The planned capacity expansion projects contained in the 2040 Build Scenario are identified in Figure 18 and Table 6 and Table 7. Roadways where multimodal improvements are desired, but capacity expansion is not necessary are not included in the tables but are indicated in Figure 18. In these instances, bikeways and pedestrian facilities should be added as adjacent development occurs or by the Town if the land is fully developed.

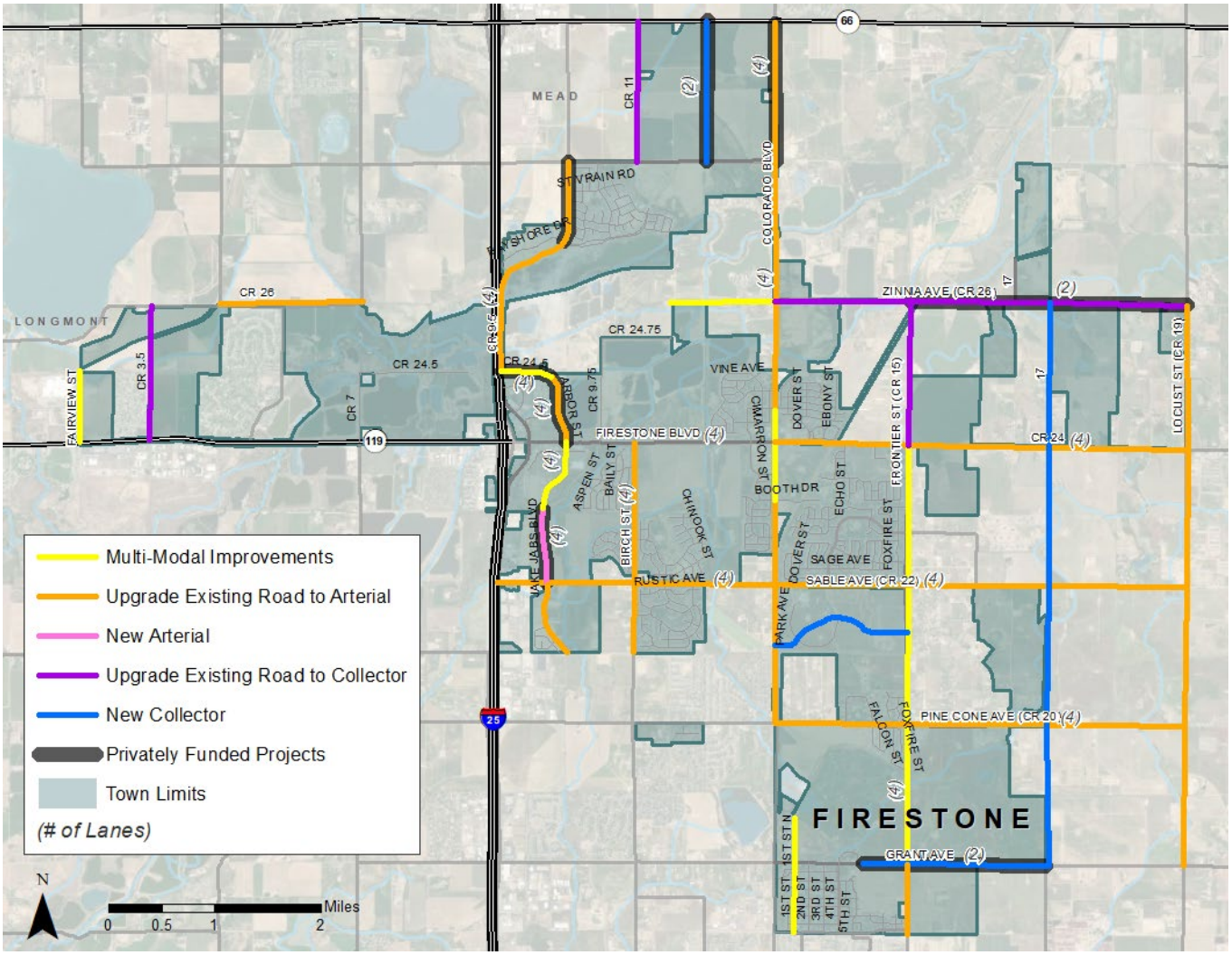
Figure 17: Proposed Long-Range Roadway Network



Most of the identified improvements involve additional capacity through roadway widening and filling in gaps to create a continuous network with redundant travel options. A key example of the creation of network redundancies is the build-out of the frontage road network, where Arbor St and Jake Jabs Blvd are intended to serve as relief routes for I-25 and allow for local access to businesses and housing development in the area of the I-25/Firestone Blvd interchange.

It is important to note that portions of some roads included in this list, such as Sable Ave, are outside of Town boundaries. The full length of the roadway improvement is shown in the figures and tables below. See the Implementation chapter for cost estimates for publicly-funded roadway projects.

Figure 18: Key Firestone Roadway Projects



Priority Projects

Priority projects for the Town of Firestone to fund using public dollars are provided by timeframe in Table 6 and Figure 25. Privately funded projects are also provided for a comprehensive view of the future transportation network (Table 7).

- **Near-term**: 2022-2030
- **Medium-to-long-term**: 2030-2040

Major near-term priorities for the Town of Firestone include roadway widening and multi-modal enhancements along Firestone Blvd from Oak Meadows Blvd to Frontier St and Colorado Blvd from McClure Ave to Ronald Reagan Blvd (CR 28). Further improvements to Firestone Blvd and Colorado Blvd may be undertaken in the medium-to-long-term as additional growth and development occurs on more peripheral parts of the Town. Other near-term priorities include intersection improvements along portions of Locust St (CR 19) within municipal limits to address safety concerns.

Notes on Roadways for Public Investment

- **Colorado Blvd** features four general purposes lanes for approximately 1/3-mile from north of Firestone Blvd to Cimarron Ave. The rest of the corridor features two general purpose lanes, with a center turn lane present for parts of the corridor. Further study is warranted in the near-term to determine preferred roadway features, identify crossing locations, and address engineering challenges.
- **Firestone Blvd** is a four-lane facility with a center turn lane from Colorado Blvd to Oak Meadows Blvd (about ¼-mile). Improvements should include widening other segments of the corridor and adding pedestrian and bicycle facilities.
- **Jake Jabs Blvd** currently features four lanes and a center turn lane from Firestone Blvd to about 0.2 miles south: desired improvements include widening existing sidewalks to create multi-use trails. Roadway improvements south of this point are to be privately funded.
- Improvements to **Birch St** may include some private funds.

Table 6: Major Publicly Funded Roadway Projects in the Town of Firestone

Roadway	Segment	Length (Miles)	Existing Roadway	Future Roadway	Travel Lanes	Bikeways & Trails
Near-Term (2022-2030)						
Firestone Blvd (CR 24)	Colorado Blvd to Firestone Trail	0.44	Minor Arterial	Principal Arterial	**2020**: 2 **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Existing
Colorado Blvd	Pine Cone Ave (CR 20) to Ronald Reagan Blvd (CR 28)	4.00	Principal Arterial (2 lanes)	Principal Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Existing
Sable Ave (CR 22)	I-25 to Frontier St	2.97	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Existing
Medium-to-Long Term (2030-2040)						
Birch St / CR 11	Sable Ave to Firestone Blvd	1.00	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: None
Jake Jabs Blvd	S. of Firestone Blvd to American Furniture	0.53	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Proposed
Frontier St (CR 15)	Pine Cone Ave to Panorama Ave	0.38	Collector	Major Collector	**2020**: 2 **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Proposed
Pine Cone Ave (CR 20)	Colorado Blvd to Coal Ridge Ditch	1.65	Minor Arterial	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Proposed
Sable Ave (CR 22)	Frontier St to CR 15 1/2	0.48	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Existing
Arbor St	CR 24.5 to Bayshore Dr	1.10	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Proposed

Table 7: Privately Funded Roadway Projects in the Town of Firestone

Roadway	Segment	Length (Miles)	Existing Roadway	Future Roadway	Travel Lanes	Bikeways
Colorado Blvd	Ronald Reagan Blvd (CR 28) to CO 66	1.0	Principal Arterial (2 lanes)	Principal Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Existing
Firestone Blvd (CR 24)	Firestone Trail to Locust St (CR 19)	2.52	Minor Arterial	Principal Arterial	**2020**: 2 **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Proposed
Arbor St	Bayshore Dr to CR 28	1.02	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Existing
Arbor St	CR 24.5 to Firestone Blvd	0.50	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: Shoulders **Proposed**: Bike Lanes **Trails**: Proposed
Jake Jabs Blvd^	Sable Ave to American Furniture	0.54	None	Minor Arterial	**2020**: N/A **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Proposed
Frontier St (CR 15)	Grant Ave to McClure Ave	0.50	Collector	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Proposed
Pine Cone Ave (CR 20)	Coal Ridge Ditch to Locust St (CR 19)	1.29	Minor Arterial	Minor Arterial	**2020**: 2 **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Proposed
Sable Ave	CR 15 ½ to Locust St	1.53	Dirt	Minor Arterial	**2020:** N/A **2040:** TBD	**Current:** None **Proposed:** TBD **Trails:** TBD
Frontier St (CR 15)	Panorama Ave to Grant Ave	0.63	Collector	Major Collector	**2020**: 2 **2040**: 4	**Current**: None **Proposed**: Bike Lanes **Trails**: Proposed
CR 17	Zinnia Ave (CR 26) to Grant Ave	4.00	Dirt/None	Major Collector	**2020:** N/A **2040:** TBD	**Current:** None **Proposed:** Bike Lanes **Trails:** TBD
Frontier St (CR 15)	Zinnia Ave (CR 26) to Firestone Blvd (CR 24)	1.00	Dirt	Major Collector	**2020:** N/A **2040:** TBD	**Current:** None **Proposed:** TBD **Trails:** TBD
CR 11	Hwy 66 to Ronald Reagan Blvd (CR 28)	1.00	Dirt	Major Collector	**2020:** N/A **2040:** TBD	**Current:** None **Proposed:** TBD **Trails:** TBD

(Table 7 continued)

Roadway	Segment	Length (Miles)	Existing Roadway	Future Roadway	Travel Lanes	Bikeways
Fairview St	Hwy 119 to railroad	0.50	Collector	Major Collector	**2020:** 2 **2040:** TBD	**Current:** None **Proposed:** TBD **Trails:** TBD
CR 3.5	Hwy 119 to CR 26	0.96	Collector	Major Collector	**2020:** 2 **2040:** TBD	**Current:** None **Proposed:** TBD **Trails:** TBD
Grant Ave^	Sherilynn Cr to CR 17	1.32	Dirt	Collector	**2020**: N/A **2040**: 2	**Current**: None **Proposed**: Bike Lanes **Trails**: None
New Road (To Be Named)^	Ronald Reagan Blvd to CO 66	1.0	None	Collector	**2020**: N/A **2040**: 2	**Current**: None **Proposed**: Bike Lanes **Trails**: None
Zinnia Ave (CR 26)	Frontier St to Locust St (CR 19)	2.0	Dirt	Collector	**2020**: N/A **2040**: 2	**Current**: None **Proposed**: Bike Lanes **Trails**: None

^Indicates project is assumed to be completed by 2030

Projected Impacts and Benefits of Roadway Improvement Projects

Summary Data

Overall, daily vehicle miles traveled (VMT) in the greater Firestone area is projected to increase by 87% from 2020 to 2040. Without enhancements to the network, such levels of increased travel demand will have a significant effect on the efficiency and operations of the roadway network in the greater Firestone area.

Figure 19: Daily VMT in the Greater Firestone Area

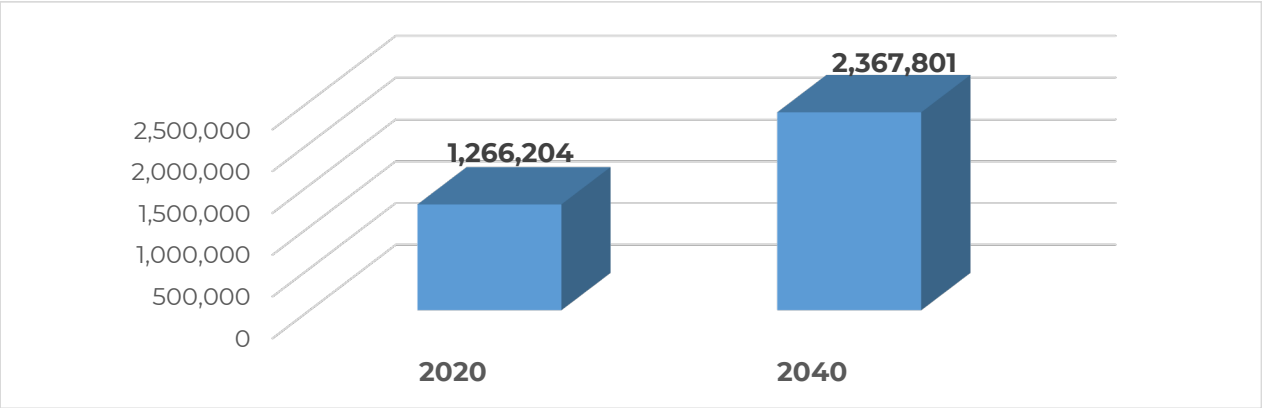


Table 8 and Table 9 summarize PM peak period data for the 2040 Future Base Scenario and the 2040 Build Scenario respectively, and Table 10 quantifies the differences between the two scenarios. Figure 20 through Figure 22 depict the single highest volume-to-capacity (V/C) value – or most congested conditions – for

each segment during the PM peak hour, regardless of the direction. Darker colors represent higher levels of congestion.

In the 2040 Build Scenario, 39% of the road segments in the greater Firestone area and 28% of road segments within the Town are projected to be approaching or experiencing congested conditions in the PM peak hour. An even higher share of the VMT – or total driving – will take place under congested conditions in 2040 (see Table 9).

Table 8: 2040 Future Base Scenario–PM Peak Period

Roadway Type	Centerline Miles	VMT in Congested Conditions	Total VMT	Percent of VMT in Congested Conditions
Freeway (I-25)	11.79	24,546	56,321	43.6%
Regional arterial	3.15	14,471	14,662	98.7%
Principal arterial	6.67	0	5,692	0.0%
Minor arterial	18.01	2,932	17,556	16.7%
Collector	40.77	1,537	13,219	11.6%
Ramp/Managed Lane	14.46	30	2,564	9.2%
Total	**94.85**	**43,516**	**110,015**	**39.6%**

Table 9: 2040 Future Build Scenario–PM Peak Period

Roadway Type	Centerline Miles	VMT in Congested Conditions	Total VMT	Percent of VMT in Congested Conditions
Freeway	11.79	24,531	56,205	43.6%
Regional arterial	5.10	14,576	17,209	84.7%
Principal arterial	11.52	1,009	11,016	9.2%
Minor arterial	25.11	110	18,198	0.6%
Collector	27.17	378	5,213	7.2%
Ramp/managed lane	14.46	31	2,554	9.3%
Total	**95.17**	**40,635**	**110,397**	**36.8%**

Table 10: Difference Between 2040 Base Scenario and 2040 Build Scenario

Roadway Type	Centerline Miles	VMT in Congested Conditions	Total VMT	Percent of VMT in Congested Conditions
Freeway	11.79	-14	-116	0.1%
Regional arterial	5.10	105	2,547	-14.0%
Principal arterial	11.52	1,009	5,324	9.2%
Minor arterial	25.11	-2,822	642	-16.1%
Collector	27.17	-1,159	-8,006	-4.4%
Ramp/managed lane	14.46	1	-10	0.0%
Total	**0.32**	**-2,881**	**382**	**-6.9%**

Note: Congested conditions refers to segments where the V/C ratio exceeds 0.85.

Overall, the travel model results demonstrate that proposed roadway improvements more effectively accommodate the anticipated levels of growth and result in decreases in congestion on regional facilities and minor arterials. Summary results demonstrate a decrease in VMT that takes places under congested conditions under the 2040 Build Scenario for regional arterials, minor arterials, and collectors, and an overall 6.9% reduction in VMT in congested conditions. Figure 22 (2040 Build Scenario) also depicts a greater share of roadways where V/C ratios are below 0.5 or 0.65 as compared to the 2040 Future Base Scenario Figure 21.

Figure 20: 2020 Base Scenario PM Peak Period V/C Ratios

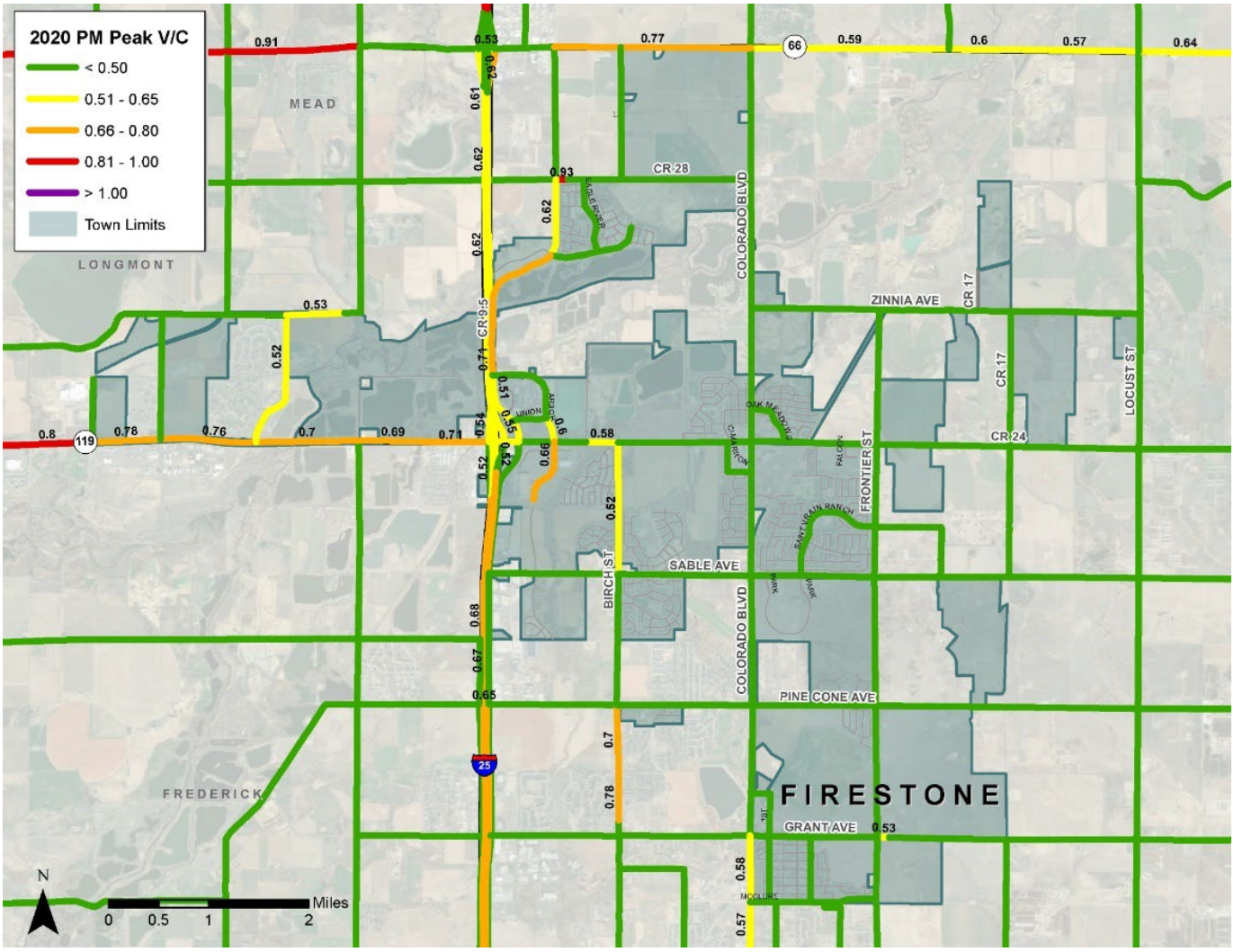


Figure 21: 2040 Base Scenario PM Peak Period V/C Ratios

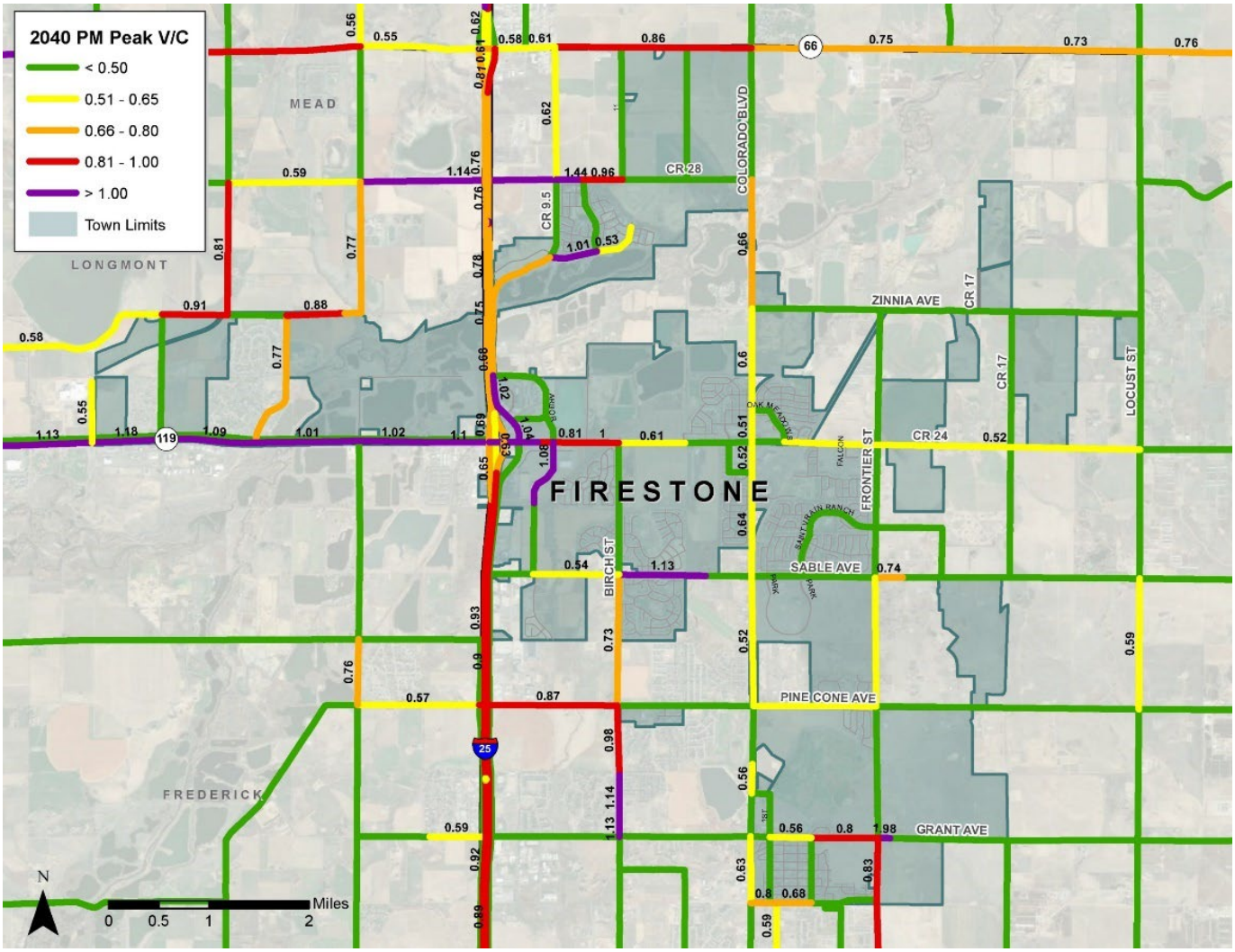
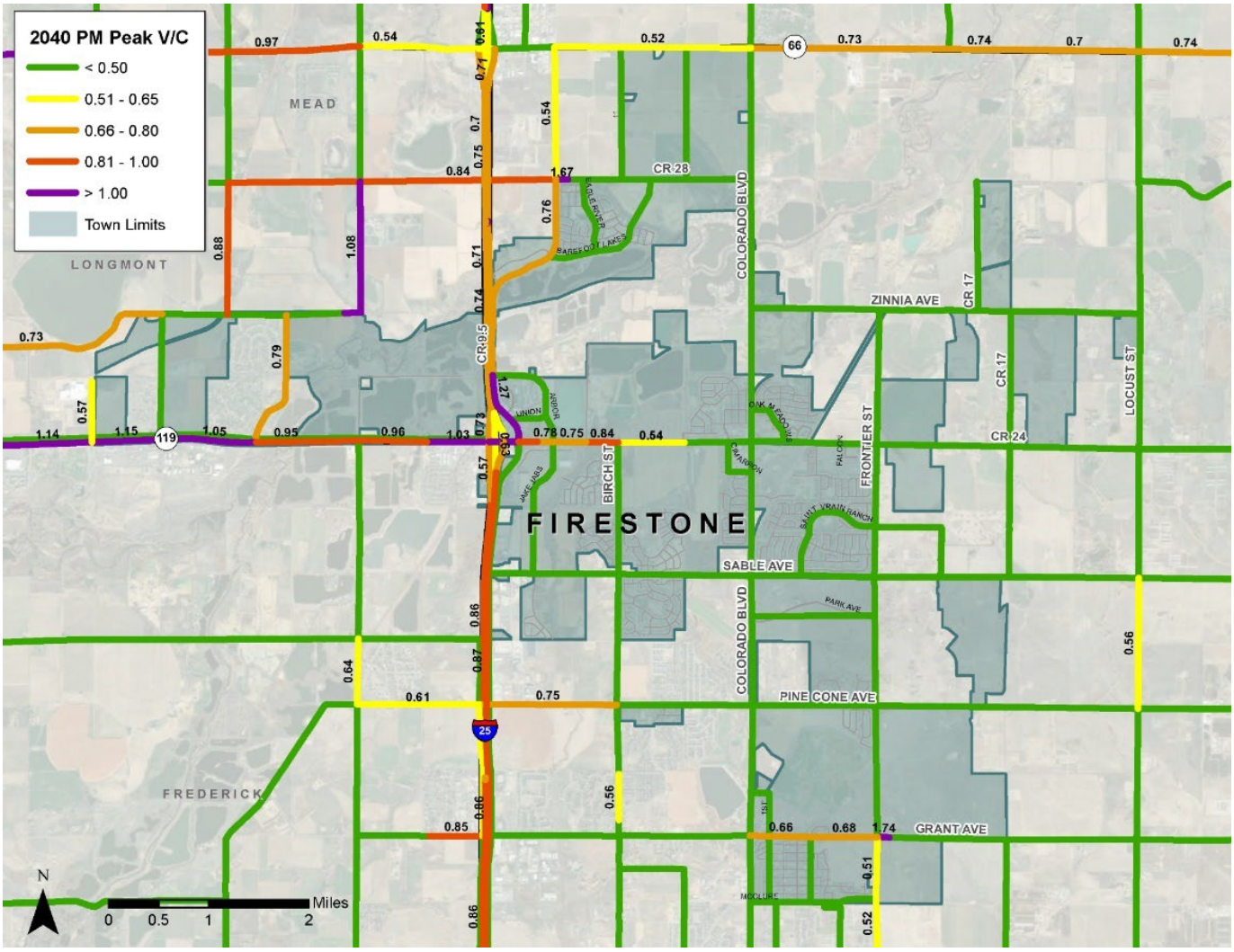


Figure 22: 2040 Build Scenario PM Peak Period V/C Ratios



Findings/Discussion

Town Roadway Network

Roadways that are projected to experience the greatest congestion in 2040 include I-25 and CO 119, which are both owned and maintained by I-25. However, congestion along these facilities will directly impact Firestone residents.

Locations high V/C levels in the 2040 Build Scenario include:

- I-25 throughout greater Firestone area
- Firestone Blvd approaching I-25
- CO 119 west of I-25
- CO 66 east of Colorado Blvd
- Birch St south of Pine Cone Ave

Proposed publicly-funded capacity expansion projects along north-south corridors such as Birch St, Colorado Blvd, and Frontier St provide redundancy in the overall roadway network and result in V/C ratios below congested conditions in the 2040 Build Scenario. Other key capacity expansion projects that result in improved future conditions include Firestone Blvd east of Frontier St and the build-out of the Frontage Rd system to the east of I-25.

I-25/Firestone Blvd Interchange and Frontage Rd System

The I-25 interchange with Firestone Blvd is a major access point to the Town and is likely to become increasingly congested over time. However, the build-out of Arbor Rd and Jake Jabs Blvd are projected to have considerable benefits in the distribution of trips. Nevertheless, the Frontage Rd segment north of Firestone Blvd is projected to become highly congested in the PM peak period by 2040. Mitigation measures to manage the congestion are under discussion, with one option being to limit access along the Frontage Rd to encourage greater utilization of Arbor Rd.

There are also plans to place an improved mobility hub at the southeast corner of I-25 and the Frontage Rd, ultimately this is intended to reduce vehicular travel in the region but access to the mobility hub will need to be managed to minimize localized congestion in this area.

Figure 23: I-25 & Firestone Blvd Area: 2020 Base, 2040 Future Base, 2040 Build Scenarios

West Firestone

Despite the overall reduction in congestion across the greater Firestone area, CO 119 to the west of I-25 is expected to be highly congested in the 2040 Build Scenario. This congestion is due in part to growth in Longmont and other communities west of Firestone and represents a challenge for regional mobility. In addition to general delay for commuters, congestion on CO 119 likely leads to an increase in local trips along alternative routes to the north of CO 119, which causes those collector streets to feature congested conditions in the 2040 scenarios in the travel model. The model can therefore be understood as diagnosing that general traffic demand from Longmont towards I-25 and the Town of Firestone exceeds capacity at present and in the future.

The question of whether to widen streets in west Firestone or make improvements and add capacity to CO 119 is a larger question that requires detailed study and the participation of CDOT and DRCOG. Among the considerations is that CR 26 west of I-25, which warrants capacity expansion, is only partially owned and maintained by the Town of Firestone but should be improved in a coordinated manner.

Impacts of Telecommuting

It is likely that a growing share of jobs held by Firestone residents will be performed remotely, which could moderate some of the projected travel demand associated with regional commuting trips. However, significant employment growth is

anticipated in the retail and service jobs, which will generate high numbers of local trips.

Considerations and Next Steps

Regional Planning

Town staff will need to coordinate with DRCOG to ensure local assumptions and transportation project needs are incorporated into future regional planning efforts. Key components of this TMP, including the socioeconomic forecast and long-range roadway network, should become part of the baseline regional forecast in future versions of the Metro Vision RTP.

Corridor-Specific Enhancements

The primary purpose of this TMP is to identify network improvements and the general roadway designs by roadway type. The specific roadway elements and design features of each roadway may be determined through corridor-specific studies and case-by-case application of the Town design guidelines. Location-specific design will depend on available right-of-way, and tradeoffs among desired roadway features may be required under constrained circumstances. Roadway design will also be informed by operations considerations such as the need for site access and dedicated turn lanes at intersections.

Maintenance and Operations

Expanding the Town roadway network will create the need for additional maintenance funding over time. The Town of Firestone should therefore consider the long-term term costs associated with capacity expansion projects, in addition to the capital costs associated with construction.

While capacity expansion projects will likely be warranted in various locations throughout the greater Firestone area due to the high levels of anticipated growth, the Town should take measures where possible to enhance traffic operations and ensure the system operates as efficiently as possible. Specific opportunities include investing in upgraded signal equipment and other intelligent transportation systems technologies that adapt to real-time traffic conditions.

The Town may also consider developing an asset management plan that outlines desired surface conditions by roadway type and preferred maintenance schedules. Such an asset management plan could be used as the basis for determining budgetary needs and the municipal revenue required to maintain the roadway system in a state of good repair.

ACTIVE TRANSPORTATION

General Principles and Priorities

The active transportation networks in the Town of Firestone will expand over time to provide greater mobility across the Town. A major priority is to connect residential areas to major destinations and increase access to a wide variety of parks and

recreational facilities. The active transportation network will feature a system of multi-use trails, on-street bike lanes, and sidewalks, and will be expanded through multiple approaches:

- **Public investment projects** that enhance facilities either as part of roadway widening or through dedicated bicycle and pedestrian improvements.
- **Privately funded roadway enhancements** and widening projects that take place as new development occurs.

In accordance with the design guidance developed as part of this plan, on-street bicycle facilities should be located along all arterial and most collector roadways. Side paths or sidewalks should be provided along all roads, including local roads. Key priorities are to upgrade existing shoulders, where present, to bike lanes, and to provide new facilities where none exist.

In many cases, on-street bike lanes and multi-use trails are proposed along the same

corridor to provide facility options that appeal to a wide range of users. Trails along major roads are to be complemented with connections to minor trails through subdivisions and recreational areas.

On-Street Bikeway and Multi-use Trail Enhancements

Figure 24 depicts the long-range network of bikeways and trails across the Town of Firestone. This initial network focuses on facilities along major roadways and is intended to provide access to major destinations within the town and linkages to regional facilities, including bikeways and trails in other jurisdictions. Trails identified in the Parks, Open Space, and Trails Plan are also included in the map. Subsequent

planning efforts should include analysis of local roads to identify bike routes and bike boulevards that provide low stress options on local roads.

Major priorities include the extension of the Firestone Trail as well as installation of dedicated bikeway and pedestrian facilities in locations where roadway expansion is not anticipated, and such facilities are not currently provided. Areas where sidewalks or trails are not present but are particularly desirable include Arbor St / Jake Jabs Blvd, Birch St, and Sable Ave. A further opportunity exists to widen and convert sidewalks along minor and principal arterials into two-way side paths.
Such improvements would be particularly beneficial in locations where right-of-way exists outside of the curb lines and roadway widening is not anticipated and adding on-street bike lanes would be costly.

Proposed Trail and Pedestrian Crossings

In general, pedestrian and trail crossings should be considered where pedestrian generators are present or are likely to be present in the near future. Crossings may be installed without a warrant analysis if a crossing is determined to be necessary to support pedestrian travel.

Various street or river crossings across the Town are recommended in the Parks, Open Space, and Trails Master Plan. These crossings support travel for existing trails, including the Firestone Trail, and potential future trail extensions, such as the north-south connection between Firestone Blvd and Sable Ave (see Table 11 for previously proposed crossing locations.

I-25 represents a significant barrier that separates the Town of Firestone into distinct east and west areas. The barrier is particularly significant for non-auto users and limits access to recreational facilities such as St. Vrain State Park. The Town of Firestone should consider dedicated bridges or underpasses for bicyclists and pedestrians that better link together the two sides of Firestone. A desirable location for a bicycle and pedestrian crossing is near CR 24 ½, which would provide direct access to St. Vrain State Park.

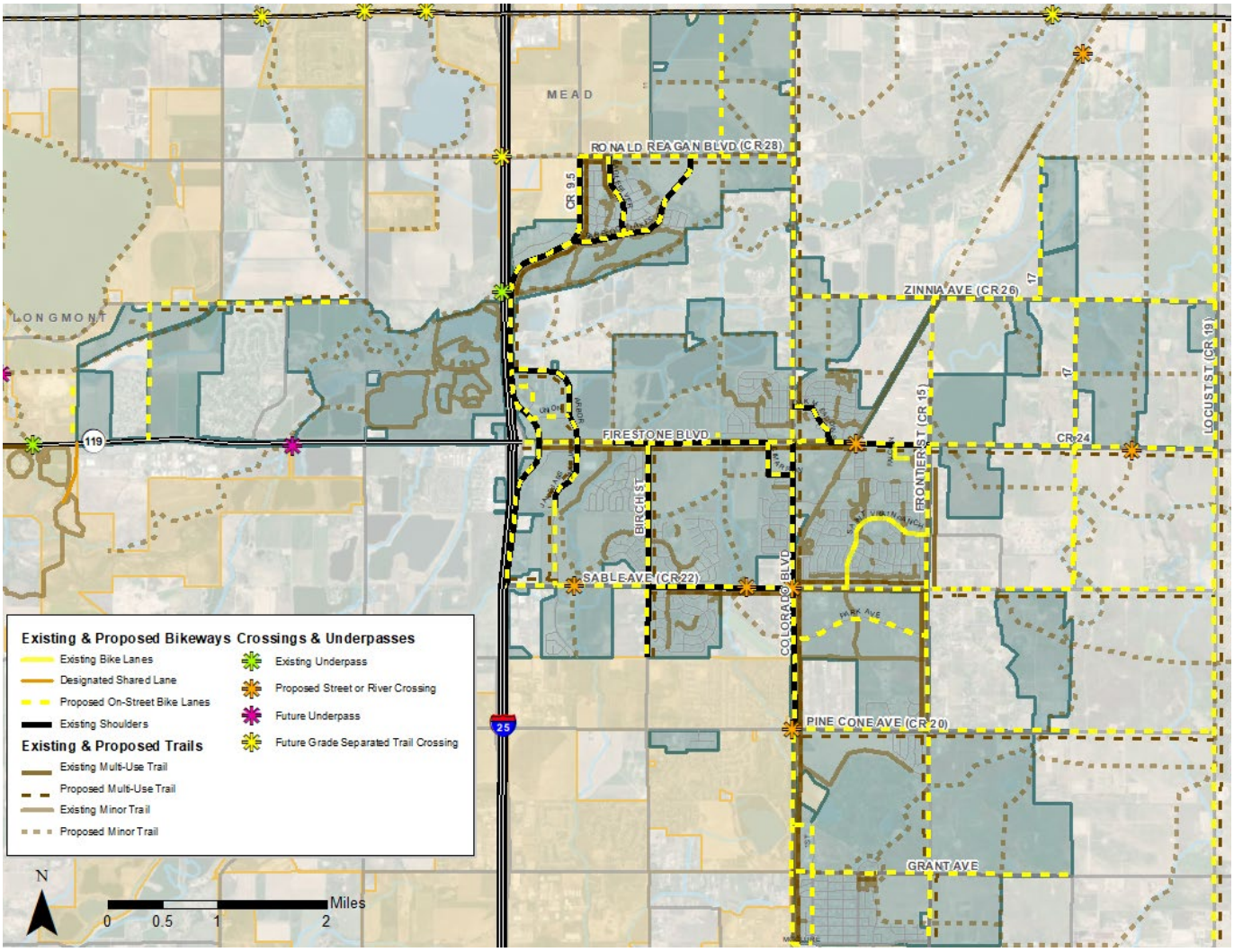
Table 11: Proposed Crossing Locations

At-Grade Crossings

• Proposed Trails – Open Space, Parks & Trails Master Plan
  o Firestone Blvd - CR 17 and Locust St
  o Sable Ave west of Colorado Blvd
  o Sable Ave east of Arbor St
• Firestone Trail:
  o Colorado Blvd and Sable Ave
  o Colorado Blvd and Pine Cone Ave
  o Firestone Blvd east of Oak Meadows

Grade-Separated Crossings
• Proposed Trail (Mead TMP): I-25 between WCR 28 and Firestone Blvd • Proposed Trail (Envision Longmont): CO 119 between WCR 5.5 and WCR 7 • Frontage Rds & I-25 near CR 24 ½

Figure 24: Long-Range Bikeways and Trails Network



Emerging Modes

One of the most significant transportation innovations in recent years is the emergence of shared or micro-mobility, including electric scooters (commonly referred to as e-scooters) and services such as bike share. Micro-mobility modes allow users to make short or medium-length trips traveling up to 15 mph to complete daily activities or for recreational purposes. Part of the appeal of micro-mobility is the increase in transportation options. According to the National Association of City Transportation Officials (NACTO), shared mobility trips increased more than two-fold from 35 million in 2017 to 84 million in 2018. Impacts to micro-mobility programs as a result of the COVID-19 pandemic are mixed.

Source: Denver Post

Private micro-mobility services currently operate in more dense parts of the Denver metropolitan area, and it is possible that private operators may wish to expand their services to communities such as more complete bikeway infrastructure emerges.

Consideration of shared mobility services and emerging modes in general is important as e-scooters are also growing in popularity for private personal use. However, many communities do not have infrastructure to support these modes or appropriate regulations in their traffic codes. Major challenges associated with these modes include injuries from e-scooter accidents, as well as conflicts with pedestrians, clutter, and insufficient awareness/education surrounding city rules and regulations for correct use. The Town of Firestone should monitor the status of micro-mobility services in the Denver metropolitan area and consider whether regulations are warranted to manage these emerging technologies. A key short-term recommendation for Firestone is to consider an update to the traffic code to clarify where e-scooters may operate and the maximum speeds for such devices.

CHAPTER 5 | IMPLEMENTATION

FIRESTONE TRANSPORTATION MASTER PLAN

IMPLEMENTATION OVERVIEW

The Firestone TMP provides a blueprint for a comprehensive transportation network that accommodates the high levels of growth anticipated in the Town in the coming decades, enables residents and visitors to travel efficiently across the Town via multiple modes of transportation, and supports a high quality of life. This section outlines the steps the Town can take to further develop its transportation system, including the application of key products such as the Town of Firestone Road Design Guide, and complementary policies and programs.

The long-term success of the TMP will depend on actions at the local and regional levels and the involvement of the private sector to ensure a shared vision for the Town's transportation system. Implementation steps for the Town of Firestone involve investments in key corridors identified in this plan and continued reference to the Design Guide and long-range roadway network as part of internal planning process, including land development requirements. At the same time, the Town of Firestone must participate in regional planning efforts to create opportunities to access federal funding and ensure that Town priorities are accounted for as part of regional policy decisions.

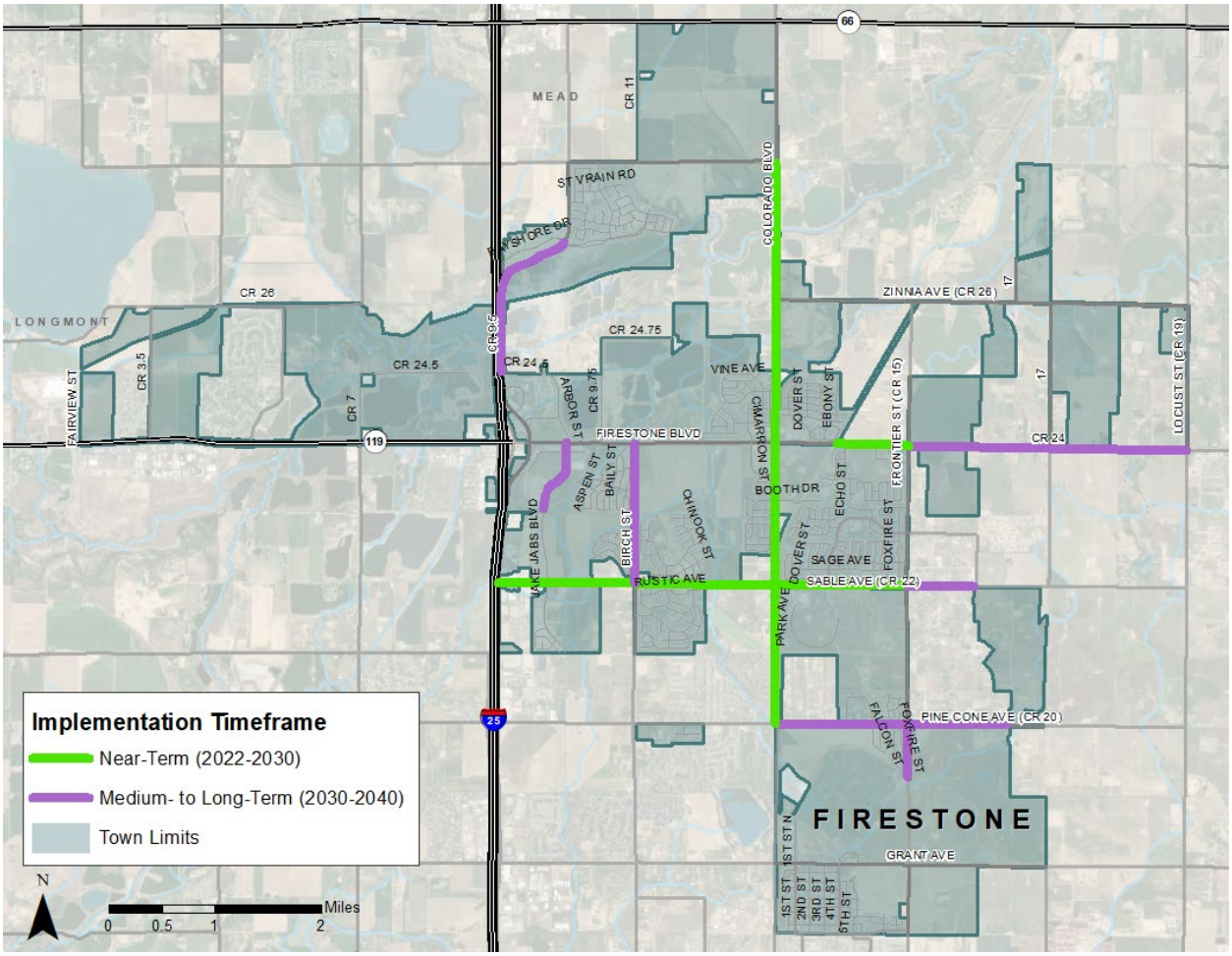
CONTINUED DEVELOPMENT OF TOWN ROAD NETWORK

The Town of Firestone will continue to develop its roadway network over the coming decades through both public investments and private land development efforts that include roadway improvements. In addition to accommodating anticipated vehicle travel demand, further development of the roadway network will increase opportunities for travel by alternative modes as bicycle and pedestrian facilities are to be installed as part of roadway improvement projects.

The Firestone TMP envisions the development of the **long-range roadway network** according to consistent **design guidance** by roadway type.

Aligned with needs and priorities for the transportation network, the proposed roadway improvements were assigned to a timeframe for implementation (Figure 25). See Chapter 4: Future Transportation Networks for the more details on the prioritization of the long-range roadway system.

Figure 25: Major Publicly Funded Roadway Projects with Implementation Timeframe



Cost Estimates and Time Frames

Completing the build-out of the Town roadway network will require substantial capital investments as well as ongoing funding for road maintenance and operations. To assist in budgeting for these anticipated expenditures, preliminary costs were developed for the various roadway types consistent with the design guidance. Costs shown in Table 12 consider capacity and impact of expected traffic volumes when applying a cost to materials for various roadway types. All costs are based on the per linear mile cost of new roadway construction, with the assumption of asphalt with soft median, for comparison and planning purposes.

Capacity expansion projects along major roads, including the addition of bicycle and pedestrian facilities, are likely to require significant reconfiguration of the roadways; therefore, all costs are based on new construction while the actual cost for projects will vary depending on the location, context, and type of landscaping utilized. Preliminary costs noted in Table 12 exclude any right-of-way acquisition, drainage

improvements, or utilities. These elements are best estimated closer to time of construction; therefore, for planning purposes the addition of a minimum contingency of 25 percent is recommended for all projects noted in Table 12.

Initial cost estimates, based on 2021 prices, are intended to be used for budgeting and planning purposes only. A more expansive spreadsheet of cost options with other material types and/or specific roadway elements is included in Appendix C.

Table 12: Cost Estimates for Publicly Funded Roadway Projects

Roadway	Segment	Length (Miles)	Proposed Improvements	Costs*	Existing Roadway	Future Roadway
Near-Term (2022-2030)						
Firestone Blvd (CR 24)	Oak Meadows Blvd to Frontier St	0.72	Widen roadway from 2 to 4 lanes, provide on-street bike lanes and multi-use trails	$4,561,920	Collector	Principal Arterial
Colorado Blvd	Pine Cone Ave (CR 20) to Ronald Reagan Blvd (CR 28)	4.00	Widen roadway from 2 to 4 lanes, provide on-street bike lanes and multi-use trails	$25,344,000	Collector	Principal Arterial
Sable Ave (CR 22)	I-25 to Frontier St	2.97	Widen roadway from 2 to 4 lanes, upgrade shoulder to on-street bike lanes	$14,113,440	Collector	Minor Arterial
Medium to Long-Term (2030-2040)						
Firestone Blvd	Frontier St to Locust Ave (CR 19)	2.00	Widen roadway from 2 to 4 lanes, provide on-street bike lanes and multi-use trails	$12,672,000	Collector	Principal Arterial
Frontier St (CR 15)	Pine Cone Ave to Panorama Ave	0.38	Widen roadway from 2 to 4 lanes, provide on-street bike lanes and multi-use trails	$1,204,000	Collector	Major Collector
Birch St / CR 11**	Sable Ave to Firestone Blvd Ave	1.00	Widen roadway from 2 to 4 lanes, provide on-street bike lanes and multi-use trails	$4,752,000	Collector	Minor Arterial
Jake Jabs Blvd	South of Firestone Blvd to American Furniture	0.53	Widen roadway from 2 to 4 lanes, add multi-use trails	$2,518,560	Collector	Minor Arterial
Pine Cone Ave (CR 20)	Colorado Blvd to Coal Ridge Ditch	1.65	Widen roadway from 2 to 4 lanes, provide on-street bike lanes and multi-use trails	$7,840,800	Collector	Minor Arterial
Sable Ave (CR 22)	Frontier St to CR 15 1/2	0.48	Widen roadway from 2 to 4 lanes, upgrade shoulder to on-street bike lanes	$2,280,960	Collector	Minor Arterial

(Table 12 continued)

Roadway	Segment	Length (Miles)	Proposed Improvements	Costs*	Existing Roadway	Future Roadway
Medium to Long-Term (2030-2040)						
Arbor St	CR 24.5 to Bayshore Dr	1.10	Widen roadway from 2 to 4 lanes, upgrade shoulder to on-street bike lanes	$5,227,200	Collector	Minor Arterial

**Costs based on design guidelines and asphalt materials developed with 2021 costs*
***May include private funding.*

Roadway Design Guidance

This plan contains a Design Guide specific to the Town of Firestone that are aligned with Town roadway type definitions. The purpose of the design guidance is to ensure that consistent design practices are applied to all roadway projects. Application of the design guidance will also ensure that bikeways and pedestrian facilities are incorporated into all improvement projects, resulting in the expansion of the Town's active transportation networks.

The design guidance provides both required and recommended features for roadways in the Town of Firestone based on the Town roadway type definition. The Design Guide is intended to be applied to publicly funded improvements to existing roadways and for reference by private developers when roadways are installed as part of new developments.

Definition and design guidance by roadway type include the following:

- Design and posted speed
- Sidewalk width
- Landscape buffer zone
- Trail width
- Median or center turn lane width
- Bike lane width
- Bike lane buffer
- Travel lane width

It is important to note that not all roadway elements are required on all roadways. For example, trails may take the place of sidewalks on principal and minor arterials. See Appendix A for a complete version of the Town of Firestone Design Guide.

REGIONAL COORDINATION

Planning and Data Integration

The Town of Firestone TMP contains a series of unique products and datasets that should be incorporated into the regional transportation planning process led by DRCOG. Key areas of data integration include:

- **Functional classification update**: Firestone staff should coordinate with DRCOG to incorporate the designations contained in the Town's long-range roadway network into the regional functional classification system. Such an update is critical as the existing classifications do not accurately reflect the current or anticipated role and travel demand of Town roads.
- **Socioeconomic forecast**: Firestone staff should coordinate with DRCOG to incorporate the socioeconomic data developed for this plan and utilized in the Firestone Travel Model into the DRCOG regional forecast.

Regional Roadway Planning

The regional nature of commuting patterns demonstrates the need to coordinate with nearby local agencies, CDOT, and DRCOG on transportation improvements on roadways that are either outside of Town limits or not under direct control of the Town of Firestone but that directly affect Town residents. In particular, the Firestone Travel Model analysis demonstrates the long-term transportation challenges along I-25 associated with new growth and development in the greater Firestone area. Other key regional roadways where congestion is anticipated include CO 119/Firestone Blvd and Colorado Blvd. Addressing regional congestion and providing alternative route and mode options will require investment by multiple agencies. Town staff should participate in ongoing regional planning efforts led by DRCOG and CDOT to develop transportation solutions and identify funding opportunities.

Project Development and Access to Federal Funding

Town of Firestone staff should participate in technical committees and coordinate with DRCOG staff on available funding opportunities and identify the transportation projects that are most likely to be competitive for federal funding. In addition to direct allocation of regionally-significant projects, federal funds through DRCOG are allocated at a sub-regional (usually County) level. Firestone staff should be directly involved in all discussions related to the allocation of federal funding within Weld County.

Regional Transit Planning

The Town of Firestone should coordinate with the Regional Transit District (RTD) on potential extension of transit service to the Firestone area. Transit service expansion is emphasized in the Firestone Master Plan and is an important strategy for

increasing transportation options and reducing depending on single-occupancy vehicles. In addition to consideration of service expansion to the northern portion of the Denver metropolitan area, planning and coordination efforts could focus on potential park and ride locations, opportunities for transit-oriented development (TOD), and improved access to station locations.

Transportation Demand Management

Travel demand management (TDM) refers to a set of strategies that increase transportation options and reduce commuting by single-occupancy vehicles during the peak. Various TDM programs exist across the Denver metropolitan area, while resources and toolkits are available through the DRCOG program Way to Go.

The Firestone area is part of the Smart Commute Metro North transportation management organization (TMO), which was founded by local governments involved in the North Area Transportation Alliance to find multi-modal transportation solutions to growing commuting challenges. Smart Commute Metro North provides resources to commuters on transportation options to improve their commutes and reduce regional congestion. Among the services provided include ride-matching and resources for employers to encourage their employees to use alternatives to single-occupancy vehicle travel.

The Town of Firestone can become more involved by promoting the TMO to Town residents and staff, and by working with local employers to encourage TDM activities, including carpooling for longer-distance commuting trips. Involvement in TDM programs also presents an economic development opportunity as the Town of Firestone could become an increasingly appealing community for remote workers who desire access to the greater Denver metropolitan area but wish to avoid daily commuting.

OTHER RECOMMENDATIONS

Plans and Studies

- Pursue a **transit feasibility study** for local bus service connections to Longmont, which would enable connections to the rest of the Denver metropolitan area.
- Develop an **Asset Management Plan** that defines the estimated costs and treatment schedules for roadway maintenance by type.
- Pursue an **Active Transportation Plan** that fully defines the improvements by corridor, evaluates available right-of-way, integrates the recommendations of the TMP with the Historic Firestone Neighborhood Plan and the Parks, Open Space and Trails Master Plan, and identifies a priority improvements list. Other components of an active transportation plan could include further vetting of proposed crossing locations, crossing design guidance by roadway type, and signage and wayfinding recommendations.

- Advocate for and participate in a **CO 119 corridor study**. CO 119 is a CDOT facility with significant implications for residents of the Firestone, Longmont, and other nearby communities. A regional study could examine long-term travel demand and options to increase capacity along the corridor and/or reduce demand through investments in alternative modes of transportation and pursuit of TDM strategies. This effort could build upon the previous study that considered operations at the interchange of I-25 and Firestone Blvd./CO 119.

Programs and Policies

- Consider a **Safe Routes to Schools Program** that improves connections to Firestone schools and encourages students and teachers to travel by walking or biking.
- Update the **Town traffic code** to better account for e-bikes and e-scooters.
- Review and update the **Firestone Development Code** to ensure consistency with the Road Design Guidance.
- Develop **performance measures** to track progress in the implementation of the TMP over time. Potential performance measures include miles of trail, miles of on-street bike lanes, and the share of collectors and arterials with complete cross sections.

APPENDICES

FIRESTONE TRANSPORTATION MASTER PLAN

APPENDIX A: FIRESTONE ROADWAY DESIGN GUIDE

Firestone Roadway Design Guide

INTRODUCTION

Roadways are critical facilities that are integral to people's daily lives. Because people rarely live, work, shop, and play in the same place, roadways connect people to jobs, important services like healthcare, social networks, and recreational opportunities. Whether someone is walking, bicycling, riding transit, or driving, roads are what take people from their origin to their destination. In addition to their role establishing connections, roadways can define the character of a place and contribute to a sense of community identity. Roadway design must also address the safety needs of all individuals and ensure that road users of all modes, ages, and abilities can reach their destination conveniently and safely.

This document presents both required and recommended features for roadways in the Town of Firestone based on their anticipated traffic volumes and general purpose. The roadway type definitions and design considerations included in the document will ensure that all new or improved roads have consistent dimensions and elements and can safely accommodate travel by road users of all travel modes, ages, and abilities. Because the purpose of a given roadway is influenced by adjacent land uses, this document also defines different land use types and provides guidance about desired or necessary roadway elements based on the land uses adjacent to the roadway. Finally, this document contains guidance on factors that affect roadway operations, including access management and potential traffic calming options based on roadway type and land use context.

Intended Users

The design guidance presented below is intended to be used both by Town staff during the design of new roadways and publicly-funded improvements to existing roadways, and by private developers to guide roadway design during the land development process.

Note on Terminology

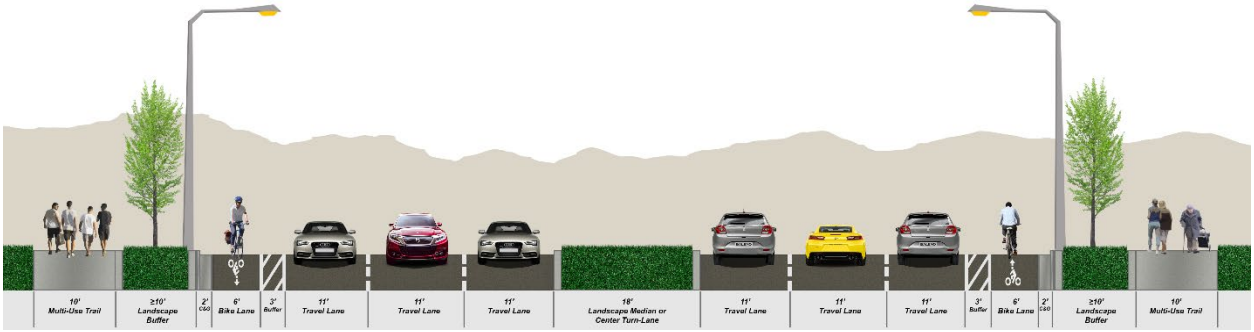
This document contains both standards, which refer to required roadway elements and are generally indicated by the word "shall", and guidance, which refers to desired components generally indicated by the word "should."

Engineering judgment will be required during the roadway design process, particularly where right-of-way is constrained. For this reason, many roadway elements are recommended and strongly encouraged, but are not required in all situations. Where a roadway is to be built using private funds as part of a land development effort, the developer must demonstrate to Town staff why a recommended roadway element should be considered impractical and not included in the final design.

ROADWAY TYPES

Principal Arterial

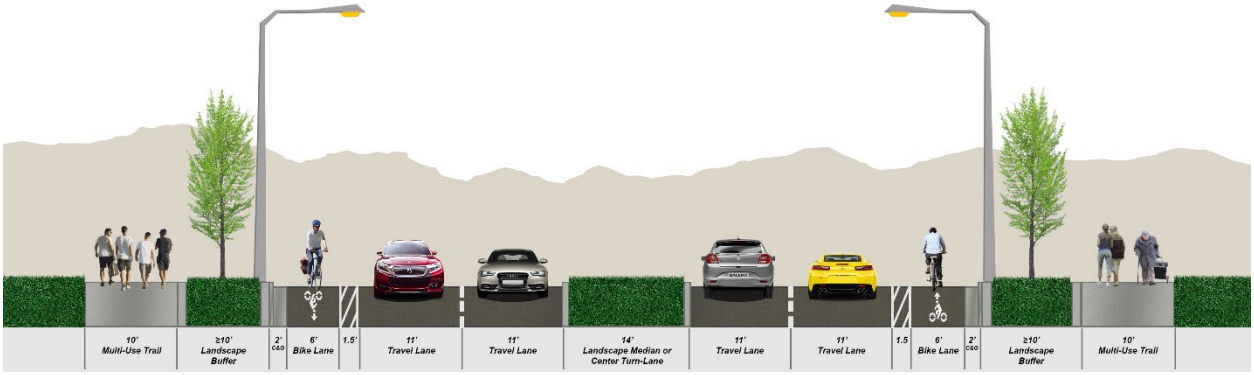
Definition: Principal arterials serve long-distance regional trips and are intended to carry the largest volumes of non-Interstate roadways at generally higher speeds (i.e. design speed of 45-55 MPH). These roadways generally prioritize vehicle throughput over providing access to adjacent parcels.



Design Considerations: Principal arterials shall feature curb and gutter and should include wide landscaped medians. Principal arterials may have as many as six travel lanes (three lanes in each direction) with turning lanes at appropriate intersections. Principal arterials should also have on-street bicycle lanes in each direction of travel that are separated from vehicle traffic by a striped buffer. Principal arterials shall have side paths/multi-use trails on both sides of the street that are separated from vehicle traffic by a landscaped buffer.

Minor Arterial

Definition: Minor arterials are intended to carry large volumes of traffic at a design speed of 40-50 MPH. They generally provide more access to adjacent parcels than principal arterials but still prioritize vehicle throughput over access.

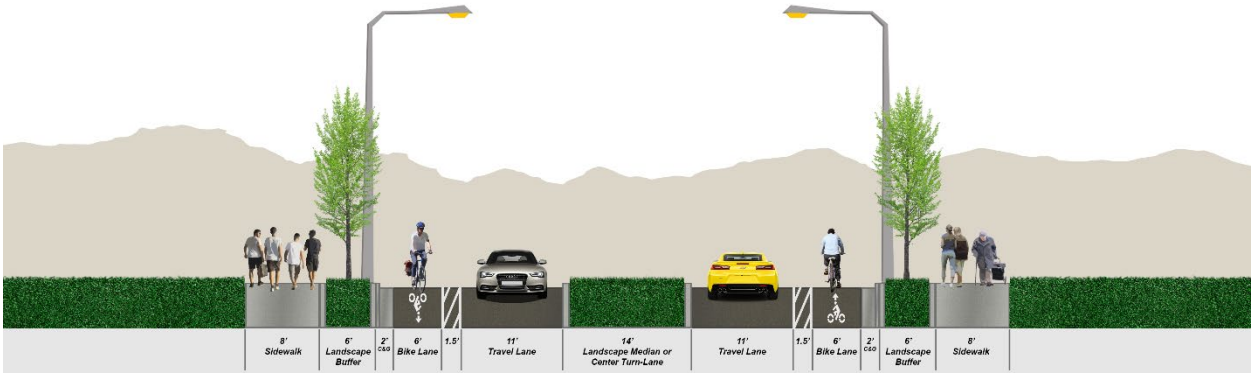


Design Considerations: Minor arterials shall feature curb and gutter and should include wide landscaped medians. They may have as many as four travel lanes (two lanes in each direction) with turning lanes at appropriate intersections. Minor

arterials should also have on-street bicycle lanes in each direction of travel that are separated from vehicle traffic by a striped buffer zone. Minor arterials shall have side paths/multi-use trails on both sides of the street that are separated from vehicle traffic by a landscaped buffer.

Major Collector

Definition: Major collectors are intended to carry more than 10,000 vehicles per day at a design speed of 35-45 MPH. Major collectors generally carry more vehicles per day than other collectors and may be located in commercial or residential areas. Because their role is to connect local roads and arterials, major collectors must balance between vehicle throughput and providing access to parcels.

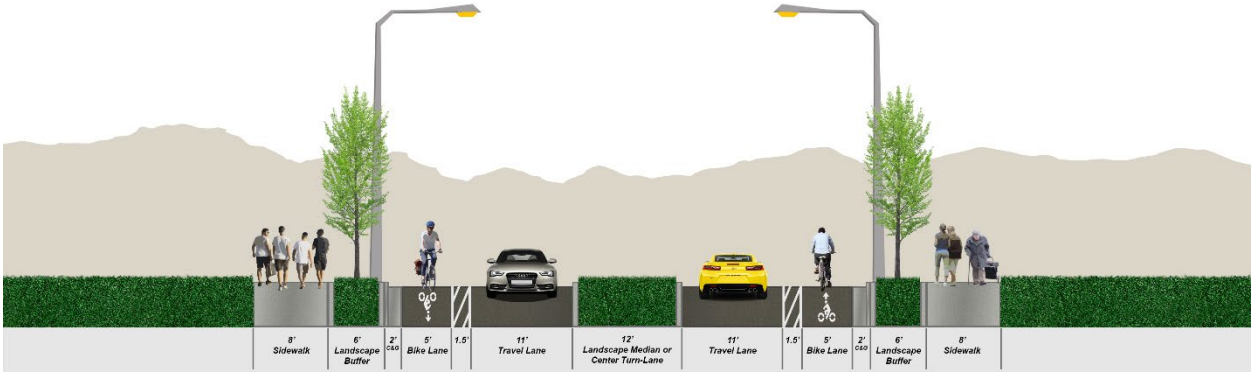


Design Considerations: Major collectors shall include curb and gutter and may feature up to two travel lanes in each direction. As major collectors may carry a larger number of heavy commercial vehicles than other collector roadways, travel lanes may be between 11 and 12 feet wide. Major collectors should have a raised median with landscaping and turning lanes at appropriate locations to safely facilitate left turns. To reduce conflict points and improve safety, major collectors should consolidate access points to the extent possible. Major collectors shall not permit residential driveways to directly access the road. Major collectors shall have sidewalks on both sides of the street that are separated from vehicle traffic by a landscaped buffer.

Non-Residential Collector

Definition: Non-residential collectors are intended to carry up to 10,000 vehicles per day at a design speed of 35 MPH. Because their role is to connect commercial areas with arterials, non-residential collectors generally strive to balance between vehicle

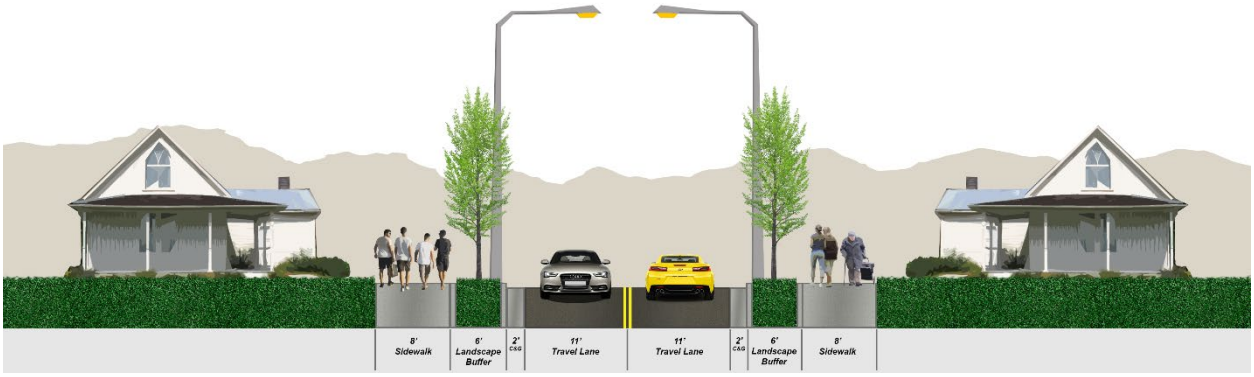
throughput and providing access to adjacent parcels.



Design Considerations: Non-residential collectors shall include curb and gutter and may feature up to two travel lanes in each direction that are 11 feet wide. Non-residential collectors should have a raised median located in the middle of the roadway with landscaping and turning lanes at appropriate locations to facilitate left turns. To reduce conflict points and improve safety, non-residential collectors should consolidate access points and limit the number of driveways that directly access the road. Non-residential collectors shall have sidewalks on both sides of the street that are separated from vehicle traffic by a landscaped buffer.

Residential Collector

Definition: Residential collectors are intended to carry up to 2,000 vehicles per day at a design speed of 30 MPH. Residential collectors connect local roads and arterials and generally prioritize providing access to parcels over vehicle throughput.



Design Considerations: Residential collectors shall include curb and gutter and generally feature one travel lane in each direction that are 11 feet wide. Residential collectors may have turning lanes at appropriate locations to safely facilitate left turns. Residential collectors provide more access to adjacent parcels than other collectors by allowing driveways to directly access the roadway. Residential collectors shall have sidewalks on both sides of the street that are separated from vehicle traffic by a landscaped buffer. On-street parking may be permitted along residential collectors where driveways directly access the roadway. Areas that have

more pedestrian generators (e.g. parks or schools) and foot traffic may benefit from medians that also serve as pedestrian refuge islands.

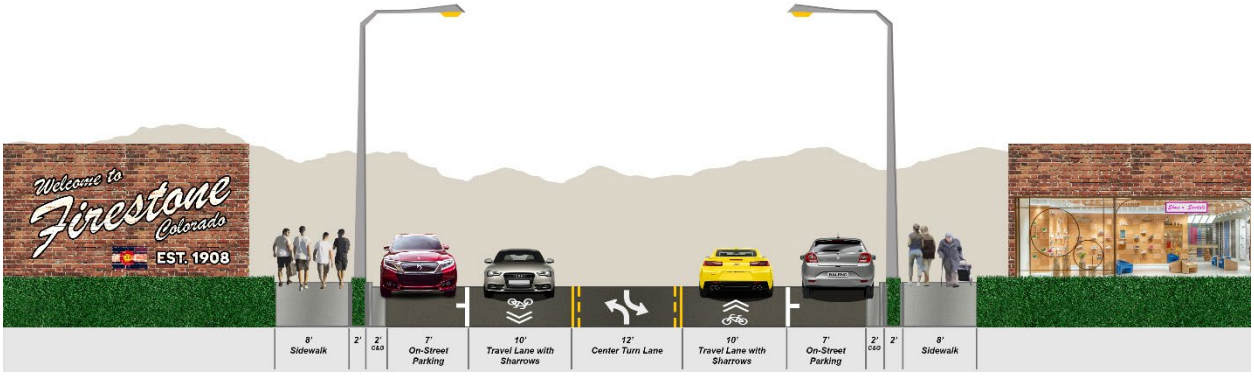
Local Roads

Definition: Local roads are intended to carry low volumes of traffic at low speeds. They prioritize access to adjacent parcels over vehicle throughput.

Design Considerations: Local roads shall feature curb and gutter and a minimum 28-foot-wide paved area that may be used for driving and on-street parking. Local roads shall have sidewalks on both sides of the street. Sidewalks may be directly adjacent to the edge of the curb or separated from the parking lanes by a landscaped area located between the edge of the curb and the sidewalk. Because residents of all ages and abilities frequently travel on local roads using a variety of travel modes (walking, bicycling, skateboarding, scootering, etc.), local roads may benefit from traffic calming devices.

Main Street Overlay

Definition: The Main Street overlay can be applied to collectors and local roads. Instead of being a standalone roadway designation, the Main Street overlay is intended to prescribe a series of features and design elements that could be applied to a variety of different road type designations. Main Streets are intended to carry low volumes of traffic at a design speed of 25-30 MPH. Because they are generally located in high density areas with a mix of land uses, Main Streets prioritize pedestrian travel and access to adjacent parcels over vehicle throughput. Main Streets generally feature zero or minimal setbacks between buildings and the roadway right-of-way.



Design Considerations: Main Streets shall feature curb and gutter, sidewalks, and no more than two total general purpose travel lanes. Depending on the context and the needs of the road, Main Streets may have any of the following elements:

- Continuous turn lanes in the center of the road
- Raised medians that serve as pedestrian refuge islands at intersections or mid-block crossing locations

- Landscape buffer
- On-street parking
- Striped or protected bicycle lanes

Due to the space required to accommodate center turn lanes, medians, on-street parking stalls, and bicycle lanes, Main Streets may have any combination of these elements, but not all of the above elements are required.

Table 13: Design Guidance Summary Table

Roadway Type	Lanes	ROW (ft.)	Design Speed (MPH)	Posted Speed Limit (MPH)	Sidewalk Width (ft.)	Landscape Buffer Zone (ft.)	Trail Width (ft.)	Median or Center Turn Lane Width (ft.)	Bicycle lane Width (ft.)	Bicycle lane Buffer (ft.)	Travel Lane Width (ft.)
Principal Arterial	4-6	≥120	45-55	35-45	N/A	10-20	10	18	5-6	3	11-12
Minor Arterial	2-4	120	40-50	35-45	N/A	10-20	10	14-18	5-6	1.5-3	11-12
Major Collector	2-4	80	35-45	35-45	8	6 min.	N/A	14-18	5-6	1.5-3	11-12
Non-residential Collector	2-4	80	35	25-30	8	6 min.	N/A	12-14	5-6	1.5-3	11
Residential Collector	2	70	30-35	25	8	6 min.	N/A	12-14	N/A	N/A	11
Local Roads	2	60	25-30	25	5	6	N/A	N/A	N/A	N/A	N/A*
Main Street	2	70	25-30	25 -30	8	6	N/A	Varies	5-6	Varies	10-12

*Local roads do not feature center striping. The minimum paved surface area for local roads shall be 28 feet to accommodate two-way travel and on-street parking.

Land Use Types

Residential

Areas classified as residential feature parcels with small lots that have owner or renter-occupied dwelling units and that are adjacent to local roads, Main Streets, or residential collectors. Residential areas will rarely be located adjacent to arterials, and they are generally sited closer to commercial land uses than industrial land uses. Residential land uses may also have off-street shared use trails nearby. Transportation facilities that abut residential parcels should provide low-stress options for bicyclists and pedestrians and should aim to achieve a balance between prioritizing vehicle throughput and providing access to adjacent parcels.

Commercial

Commercial areas generally feature a cluster of destinations that may include retail shops, stores, offices, restaurants, and other businesses on a wide variety of lot sizes, depending on the type of business and when it was constructed. These destinations should be easily accessed by motorists and bicyclists and should be connected with pedestrian infrastructure that allows visitors and patrons to park once and access multiple businesses. Commercial areas may feature smaller-scale business sites with lot sizes that are the same or slightly larger than lots for detached single-family homes, or large lot "big box" retail stores, grocery stores, and similar businesses that generally serve customers who arrive by private vehicle. Commercial areas must balance the needs of delivery trucks and patrons and serve a range of roadway users.

Industrial

Areas with an industrial land use designation feature manufacturing facilities, raw material processing centers, mining operations, power plants, or other activities that are considered a nuisance to residents because of the noise, smell, and look of these activities. Industrial parcels are usually much larger than commercial or residential parcels due to the space needed for the industrial operation and because zoning ordinances generally require industrial land uses to provide large buffers from adjacent parcels. Industrial areas feature roadways that must accommodate frequent heavy vehicle travel and may have higher speed limits because there are fewer potential conflicts from intersecting roads and because the distances between destinations are greater. Pedestrian and bicycle travel to and within industrial areas is less frequent than commercial or residential areas.

GUIDANCE BY ROADWAY ELEMENT

Right-of-Way

Definition: In a transportation facility context, right-of-way (ROW) refers to land that contains roads, curbs, sidewalks, and other transportation structures that are available for public use. In general, transportation ROW is publicly owned and includes the width of the road surface and additional space on either side of the road surface, which may contain shoulders, sidewalks, drainage structures, utilities, or other elements that are associated with transportation facilities.

Design Considerations: ROW width varies according to the roadway type, expected traffic volumes, and desired elements of the roadway, including sidewalks, bikeways, and multi-use trails. Generally, higher classification roadways carry larger volumes of traffic and should have a larger ROW. Because the area outside of the ROW is usually privately owned, ROW can be a limiting factor on roadway expansion and land acquisition costs generally comprise a large share of the costs to construct a new road. For this reason, it is important to set aside sufficient ROW to meet future needs. ROW standards shall also be used to determine the amount of land to be set aside as part of new developments along existing roadways.

For principal arterials, ROW set-aside for new roadways shall be at least 120 feet. Minor arterials, which may feature fewer travel lanes, shall have a ROW of 120 feet. Collectors shall have a ROW between 70-80 feet, depending on the collector type (see Table 13). Given that local roads feature a narrow. paved area and serve low traffic volumes at low speeds, the ROW for these facilities shall be 60 feet.

General Purpose Travel Lanes

Number of Travel Lanes

Definition: General purpose travel lanes are usually designated using roadway striping, with lanes traveling in opposing directions separated by yellow striping and lanes traveling in the same direction separated by white dashed striping.

Design Considerations: Generally, roadways with higher traffic volumes and higher travel speeds will have a larger number of travel lanes. The appropriate number of travel lanes and lane widths by roadway type are included in Table 13.

Lane Widths

The preferred lane width for arterials and collectors is 11 feet; 12-foot lanes may be appropriate on principal arterials and other roadways with high volumes of truck/heavy commercial vehicle traffic. For local roads that carry low volumes of traffic at low speeds, center striping to demarcate travel lanes is generally not required. In addition, center striping is not required on residential collectors that have driveway access onto the roadway. Where striping is desired on local roads, 10-foot lanes are adequate.

Medians/Center Turn Lanes

Medians

A median is an area in the center of a roadway that serves to separate traffic traveling in opposite directions through a raised feature or depressed landscaping strip. Medians are more prevalent on roadways with high traffic volumes and high travel speeds. Turn lanes are frequently incorporated into medians to facilitate safe turns across multiple lanes of traffic. Medians shall be included on all arterial and collector roadways; they may be as wide as 18 feet on arterials and up to 14 feet wide on collectors. Roadways with limited ROW and many pedestrian generators, including parks, schools, shops, with lots of foot traffic may benefit from medians as

narrow as six feet that serve as pedestrian refuge islands for those wishing to cross the street at intersections or mid-block crossings.

Center Turn Lanes

For roadways that provide direct access to a large number of destinations, continuous center turn lanes (also referred to as two-way left turn lanes) may be more desirable than a median. In areas with many different destinations on both sides of the street, incorporating dedicated left turn lanes for each direction of travel into the roadway may be difficult; in such situations, a continuous center turn lane may be more appropriate and provides more flexibility for drivers wishing to make a left turn. Continuous center turn lanes should not be installed on roadways that carry more than 20,000 vehicles per day.

Design Speed

Definition: Design speed refers to the theoretical speed in miles per hour that engineers use when designing a roadway. The chosen design speed dictates the curve radii, superelevation, and other geometric features of the road to ensure that vehicles will be able to navigate the roadway safely at that speed. See the AASHTO Green Book for guidance on the design of roadway geometric elements.

Rather than the posted speed or the maximum speed that a vehicle could safely travel on the road, design speed is based on the "target speed" of the roadway, or the speed at which engineers would like drivers to travel. Decisions regarding what design speed to use therefore place more emphasis on moderating travel speeds instead of designing roads to maximize travel speeds.

Design Considerations: When determining the design speed of a new or existing roadway slated for improvements, designers should evaluate the land use context of the roadway, the number of destinations along the road, the distance between destinations, desired pedestrian and bicycle infrastructure, and the number of intersections along the road. Because the intensity of nearby development varies along collectors and arterials in the Town of Firestone, design speed is expressed as a range as opposed to a single value. Areas with high density development, frequent intersections, and many destinations located close together are good candidates for design speeds at the low end of the range given in Table 13. In contrast, for areas with low density development, few intersections that are spaced far apart, and infrequent destinations, a design speed at the higher end of the range may be desirable. For all roadways in the Town, the posted speed limit may be lower than the design speed. See Table 13 for design speeds by roadway type.

Pedestrian Ways

Dedicated travel ways for pedestrians and people who use mobility devices are an integral part of transportation facilities. Pedestrian ways generally fall into two categories: sidewalks and multi-use trails. Although not considered part of the pedestrian travel way, landscaped buffer zones (also referred to as amenity zones, are an important element of pedestrian infrastructure as they provide additional separation between vehicles and pedestrians. All roadways in the town shall have a

dedicated pedestrian way on both sides of the street, either in the form of a sidewalk or a multi-use trail.

Sidewalks

Sidewalks are typically made of concrete and may be directly adjacent to the edge of the curb or separated from vehicle traffic by a landscaped area. Collector roadways shall have sidewalks on both sides of the street that are at least eight (8) feet wide and are separated from vehicle traffic by a landscaped buffer. Sidewalks adjacent to major collectors or non-residential collectors may have a meandering alignment with a landscaped buffer of varying width. Because of the more limited ROW available, sidewalks adjacent to residential collectors should generally follow an alignment that is parallel to the roadway. Sidewalks on local roads should be at least five (5) feet wide. Rather than sidewalks, arterials shall have multi-use trails.

Source: Bucks Local News

Multi-use Trails

Multi-use trails, which may be referred to as side paths when located adjacent to a roadway, are usually wider than sidewalks and are typically made of asphalt or concrete. While sidewalks are usually intended for use by pedestrians only, multi-use trails allow bicycles and pedestrians to use the same trail. Arterials shall have side paths/multi-use trails on both sides of the street that are separated from vehicle lanes by a landscaped buffer. Multi-use trails on arterials should be at least 10 feet wide and may either meander along the side of the roadway or follow an alignment that is parallel to the road.

Source: Rural Design Guide

Landscape Buffer Zones

Landscaped buffer zones (also referred to as amenity zones) are areas between the edge of the curb and the beginning of the sidewalk that are usually landscaped with grasses, shrubs, or street trees.

Landscaped buffer areas provide separation between vehicles and pedestrians, contribute positive aesthetic value, and can also offer stormwater management benefits.

Landscaped buffer zones shall be installed along all arterial and collector roadways.

Landscaped buffer zones along minor and principal arterials should be a minimum of six (6) to 10 feet wide. Landscaped buffer zones for collectors should be at least six (6) to eight (8) feet wide, depending on the collector type and the location.

Source: City of Seattle

Summary of Pedestrian Infrastructure

Table 14 below shows the required pedestrian infrastructure for each roadway type. Cells with N/A indicate that the pedestrian infrastructure element is not required for that roadway type; cells with numerical values indicate that the pedestrian infrastructure element is required for that roadway type.

Table 14: Pedestrian Infrastructure Summary Table

Roadway Type	Sidewalk Width (ft.)	Landscaped Buffer Zone Width (ft.)	Shared Use Trail Width (ft.)
Principal Arterial	N/A	10-20	10
Minor Arterial	N/A	10-20	10
Major Collector	8	≥8	N/A
Non-residential Collector	8	≥6	N/A
Residential Collector	8	≥6	N/A
Local Road	6	6	N/A

On-street Bikeways

Dedicated bikeways are essential transportation facilities that provide safe places for bicyclists to travel. Bikeways can take a variety of different forms; the most common bikeways are striped lanes adjacent to vehicle traffic. Striped or vertical buffers may be utilized to provide separation between vehicle traffic and bicyclists. Bicycle lanes may be used in a complementary manner to multi-use trails on arterial roads; see the Pedestrian Ways section for additional discussion on multi-use trails.

Bicycle Lanes

All new arterial and collector roads in the town shall have bicycle facilities, with the exception of residential collectors where bicycle lanes are optional. Bicycle lanes support different users than multi-use trails and may be used in a complementary manner to trails. Because bicyclists travel at higher speeds than pedestrians, providing separate bikeways is generally preferable to only providing multi-use trails.

Striped bicycle lanes are bikeways established by roadway striping that are dedicated for use by bicyclists. Striped bicycle lanes are usually located between the outermost travel lane and the sidewalk. Striped bicycle lanes provide tend to be used most often by confident bicyclists who are comfortable riding adjacent to vehicle traffic. Striped bicycle lanes on all roads in the town shall be between five (5) and six (6) feet wide, with wider facilities desired on higher speed and higher volume roadways.

Source: FHWA

Buffered bicycle lanes are similar to striped bicycle lanes, but they provide additional separation between bicyclists and vehicle traffic through the use of a striped buffer zone. Buffered bicycle lanes are strongly encouraged on arterials, and they are recommended for collector roadways and roads with speed limits greater than 25 MPH. Striped buffers for buffered bicycle lanes should be 1.5 to three (3) feet wide.

Source: Bike Portland

Protected bicycle lanes are similar to buffered bicycle lanes but include additional vertical structures in the buffer zone that separate vehicles and bicyclists. Protected bicycle lanes are desirable along roadways in high-density areas with a mix of land uses as they ensure separation between bicyclists and motorists and are appealing to bicyclists of all ages and abilities. The vertical separation that protects bicyclists can be comprised of bollards, curbs, planters, flexible posts, or other structures. Buffer zones for protected bicycle lanes should be at least three (3) feet wide to allow for the installation of protective structures. Protected bicycle lanes may be difficult to implement where there are frequent curb cuts or driveways.

Source: City of Burlington, VT

Shared Lanes are travel lanes that permit both drivers and bicyclists to use the same lane. On streets with low travel speeds and traffic volumes, dedicated bikeways may not be necessary and travel lanes that permit bicyclists and drivers to occupy the same lane may be adequate. These shared lanes should include pavement markings and signage that communicate the shared nature of the lane to drivers; typically, "sharrows" are used for this purpose.

Source: The Kansan

Streets with shared lanes may benefit from the application of traffic calming devices – such as speed humps, chicanes, diverters, or traffic circles – that generally prioritize non-drivers and force drivers to slow down. Shared lanes are appropriate on local roads that serve as designed bike routes and near school zones. but they should not be placed on roadways with traffic volumes greater than 3,000 vehicles per day or speed limits of 30 MPH or greater.

Source: Kansas Cyclist

Bikeway Facilities Summary Table

The table below summarizes the recommended application for different bikeway types based on road designation, speed limit, and traffic volume.

Table 15: Applications for Different Bikeway Facility Types

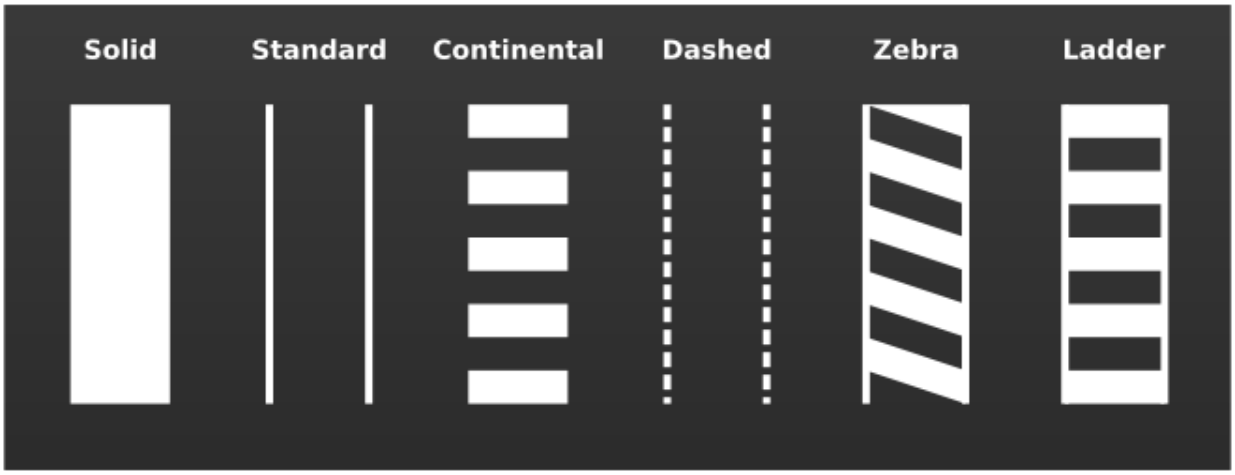
Bikeway Type	Appropriate Roadways and Contexts	Maximum Speed Limit (MPH)	Daily Traffic Volume
Shared Lanes / Sharrows	Local Roads, Residential Collectors; may be appropriate for Main Street corridors	30	<3,000
Striped Lane	Non-residential Collectors, Major Collectors	35	3,000-10,000
Buffered Lane	Non-residential Collectors, Major Collectors, Minor Arterials, Principal Arterials	40	5,000-30,000
Protected Lane	Non-residential Collectors, Major Collectors, Minor Arterials, Principal Arterials; also appropriate for high-density areas with a mix of land uses	40	3,000-20,000

Pedestrian Crossings

Pedestrian Crossing Design

Pedestrian crossings shall be provided at all signalized intersections. For all pedestrian crossings, "continental," "zebra," or "ladder" style crosswalks are preferred. These crosswalk types feature wide, highly visible stripes that tend to encourage higher driver yield rates compared to crosswalks striped with two parallel lines. See Section 3B.18 of the MUTCD for dimensions and additional design guidance.

Figure 26: Types of Pedestrian Crossing Striping



Source: sfbetterstreets.org

The length of the pedestrian WALK phase shall be based on the values contained in the MUTCD. Leading pedestrian intervals that display a "WALK" signal prior to the beginning of the green phase for drivers may be considered in Main Street areas, in school zones, and around other pedestrian generators.

Pedestrian Crossing Frequency

Definition: Providing safe pedestrian crossings at appropriate locations is of paramount importance when designing roadways. Pedestrians tend to take the shortest path between their origin and destination; therefore, pedestrian crossing locations should be plentiful and frequent enough to encourage pedestrians to use dedicated crossings.

Design Considerations: In areas with high pedestrian activity, designated crossings should be provided every 660 feet or less. In areas with moderate pedestrian activity, crossings should be provided every 1,320 feet or less. Areas with little to no pedestrian activity should have crossings provided every 2,640 feet or less.

Signalized crossings include intersections or pedestrian hybrid beacons (also referred to at HAWK signals) that force drivers to stop at a red light which is illuminated when a pedestrian activates the signal. Unsignalized crossings may be designated using signage and pavement marking; rectangular rapid flashing beacons should also be considered. Designated but unsignalized crossings are appropriate in areas that have adequate stopping sight distance, traffic volumes less than 12,000 vehicles per day, and fewer than three general purpose travel lanes. Unsignalized mid-block crossings are not recommended in areas that do not meet these criteria.

Mid-Block Crossings

Because pedestrians will rarely take a detour to reach a dedicated crossing, mid-block crossings at appropriate locations should also be considered. Mid-block crossings are recommended for trail crossings and where multiple pedestrian generators (residential areas, schools, parks, shops, etc.) are located on opposite sides of the street. Mid-block crossings can be signalized or unsignalized. HAWK signals are strongly recommended at mid-block crossings on arterial roadways.

School Zone Crossings

Ensuring that pedestrian crossings in school zones are safe is critical, especially considering that many pedestrians in school zones are children. Because children are less visible to drivers than adults, pedestrian crossings in school zones should incorporate design elements that both enhance the visibility of pedestrians and force drivers to slow down.

For **signalized intersections**, pedestrian countdown signals are recommended to provide pedestrians with additional information about how much time they have to cross the street. Leading pedestrian intervals are recommended for signalized intersections in school zones. The length of the pedestrian WALK phase should be examined to ensure that the pedestrian signal phase is long enough to accommodate the slower average walking speed of children, older adults, and

families with strollers. Prohibiting right turns on red lights should also be evaluated in school zones. Intersections that have adequate lane storage capacity and many pedestrians crossing at that location may be good candidates for prohibiting right turns on red.

For **unsignalized crossings** on collectors and local roads in school zones, overhead signage, flashing beacons, raised crosswalks are recommended. Raised crosswalks may also be considered on local roads and collectors with lower speeds to improve pedestrian visibility by bringing pedestrians (particularly children) into the driver's field of view and by requiring drivers to reduce their speed.

On-Street Parking

On-street parking provides drivers with space to store vehicles without impacting through traffic. On-street parking lanes should be at least eight (8) feet wide and located adjacent to the curb. On-street parking is required to be provided along residential collectors and local roads. On residential collectors in school zones and near parks, on-street parking lanes should have dedicated curb extension bump outs to delineate the parking zone and reduce pedestrian crossing distances at crossing locations. On-street parking is generally appropriate in Main Street areas and may be applied in other locations at the discretion of the Town Engineer.

OTHER ROADWAY CONSIDERATIONS

Network Design/Access Management

General Principles

Access management refers to practices and policies aimed at reducing and restricting direct access to parcels from adjacent roadways. In general, access management tries to consolidate access points for high-speed roads (> 40MPH) so that access to parcels is provided from connecting roadways with lower speed limits and lower traffic volumes. Access management also typically involves limiting the number of driveways with direct access to a roadway and restricting the type of turning movements permitted at driveway access points.

Signal Spacing

The distance between signalized intersections and full median breaks is an important aspect of access management and ensuring efficient traffic flow. Signalized intersections on principal arterials should be located at least 2,640 feet (1/2 mile) from each other. Signalized intersections on minor arterials and collectors (both non-residential and residential) should be located at least 1,320 feet from each other (see Table 16).

Driveway Spacing

Limiting the number and location of driveways along access-managed roadways can decrease the potential for crashes, improve traffic flow, and improve the pedestrian experience. Driveway access points generally fall into two categories: full

access (with breaks in the median, where present) and right-in-right-out points. Full access points and median breaks allow for both left and right turns from the roadway and the driveway, while right-in-right-out access points only permit right turns into and out of the driveway access point. Driveway spacing on roadways within Town limits should adhere to the standards in Figure 16.

Table 16: Access Type and Spacing by Road Type

Road Type	Access Type	Spacing Between Access Points (ft.)
Principal Arterial	Traffic Signal	2,640
	Full Access/Median Break	1,320
	Right-in/Right-out	660
Minor Arterial	Traffic Signal	1,320
	Full Access/Median Break	660
	Right-in/Right-out	330
Collectors (Major and Non-residential)	Traffic Signal	1,320
	Full Access/Median Break	330-660
	Right-in/Right-out	150
Residential Collector	Traffic Signal	1,320
	Driveway Access	150
Local Roads	N/A	75

Drainage/Stormwater Management

Roadways play an important role in drainage and stormwater management. Given their imperviousness, roadways do not allow the underlying soil to absorb stormwater runoff and therefore require drainage and stormwater management structures to capture runoff, transport it away from the roadway, and thereby reduce flooding during storm events.

All roadways in the Town of Firestone shall have adjacent curb and gutter that direct runoff away from the roadway. The dimensions of curb and gutter shall adhere to the standard detail drawings (drawings SW1 through SW13) contained in the Town's Design Guide and Construction Specifications for Public Improvements.

Landscaped areas in medians or adjacent to the roadway may also be used for stormwater management using Low Impact Development installations. Green Stormwater Infrastructure refers to landscaped features that mimic natural ecosystems to capture rainwater where it falls and remove excess nitrogen and phosphorous from runoff as it slowly drains into the underlying soil. Common Green Stormwater Infrastructure installations include bioswales and detention basins.

Traffic Calming

Traffic calming refers to a set of engineering solutions and design strategies that are proven to force drivers to slow down. In general, traffic calming devices introduce obstacles that drivers can only navigate at low speeds. Traffic calming devices recommended for use in the Town of Firestone include raised crosswalks,

chokers/diverters, corner extensions/bulb-outs, median islands, and chicanes. These techniques may be combined with speed feedback signs, roadway signage, and flashing beacons to achieve desired speed reduction and safety benefits.

Raised crosswalks are flat, elevated areas at crossing locations where the crosswalk is above the grade of the road and aligned with the grade of the sidewalk. Raised crosswalks have low-angle ramps to allow vehicles to safely traverse the intersection and generally resemble speed humps with the crosswalk located at the apex of the speed hump. Raised crosswalks frequently feature rectangular rapid flashing beacons and can be combined with textured crosswalks, curb extensions, and curb radius reductions. Raised crosswalks are recommended at school crossing locations and at crossings in areas with high pedestrian activity and are most appropriate on roadways with speed limits of 30 MPH or less.	 Source: LkldNow.com
A **choker/diverter** refers to a median or a horizontal extension of the sidewalk into the street at a mid-block location that results in a narrower roadway section. Chokers encourage lower travel speeds by reducing the space available for drivers. Chokers can be installed on two-way or one-way streets; some chokers on two-way streets allow only one vehicle to pass at a time. A pair of chokers are typically between six (6) and eight (8) feet wide and at least 20 feet long. Median diverters can also be used as refuge islands.	 Source: CMAP
Curb extensions, or intersection bulb-outs, are horizontal extensions of the sidewalk into the street that result in a narrower roadway section. They are similar to chokers but are located at intersections instead of mid-block locations. Curb extensions tend to reduce vehicle speeds by reducing driver margin of error and by reducing curb radii for turning movements. They can be combined with median islands, are compatible with on-street parking, and are appropriate for all types of roadways, regardless of speed limit or traffic volume.	 *Source: Minnesota DOT*

Median refuge islands are raised islands located along the street centerline that narrow the travel lanes and facilitate pedestrian crossings by allows bicyclists and pedestrians to cross a roadway in two stages. In addition, they can be landscaped to provide aesthetic and stormwater management benefits. Median islands are appropriate for all road types but are not recommended at locations that attract heavy truck traffic.	 Source: Getting Around Sacramento
Chicanes are a series of alternating curves or lane shifts that force drivers to steer back and forth instead of traveling a straight path. Chicanes are typically created by the installation of a series at least three curb extensions, which may be landscaped. Chicanes are appropriate for mid-block locations on roadways with speed limits less than or equal to 35 MPH and one lane in each direction. Chicanes are compatible with on-street parking, though the presence of chicanes may reduce the number of eligible parking spaces.	 Source: FHWA

Table 17: Traffic Calming Techniques Summary Table

Traffic Calming Technique	Appropriate Roadway Type	Land Use Context
Raised crosswalk	Local Roads, Collectors	Residential, School Zone
Chokers/Diverters	Local Roads, Residential Collectors	Residential
Curb extensions/bulb-outs	Local Roads, Collectors	Residential, Commercial, School Zone
Median refuge islands	All roadways	Residential, Commercial, School Zone
Chicanes	Local Roads, Residential Collectors	Residential

APPENDIX B: TRAVEL DEMAND MODEL

2020-2040 Firestone CO Traffic Model Methodology

Technical Memorandum

Submitted by:

September 2021

Table of Contents

List of Figures

Acronyms Used in this Document

ADT	Average Daily Traffic
CDOT	Colorado Department of Transportation
DRCOG	Denver Regional Council of Governments
GIS	Geographic Information System
ODME	Origin-Destination Matrix Estimation
PCPHPL	Passenger Cars Per Hour Per Lane
TAZ	Traffic Analysis Zones
V/C Ratio	Volume-to-Capacity Ratio

1 Introduction

WSP adapted the Denver MPO (DRCOG) travel model to serve a needs assessment planning study on roadway projects in Firestone, Colorado. The approach remained consistent as possible to the DRCOG model framework while introducing local data to fit the needs of Firestone. The result is the 2020-2040 Firestone Traffic Model. WSP staff established communication and received permission from DRCOG staff regarding the Firestone application. The following is a synopsis of the application:

- DRCOG Version: DRCOG Focus Model version 2.3 was requested and received from DRCOG in March 2021.
- Study Years: The two key study years are the 2020 base and the 2040 future year.
- Model Type: A subarea study district drawn from the DRCOG model was established to capture Firestone and a buffer area around it.
- Highway Networks: The parent databases were the DRCOG 2020 and 2040 networks. The 2020 and 2040 highway networks in the subarea were reviewed using local data and corrections/additions were made for number of lanes, roads that will be added by 2040 to serve expansion in Firestone, and centroid connectors to better load the network for traffic assignment.
- Validation Data: 2020 was validated with over 40 recent daily traffic counts from Firestone, DRCOG and Colorado Department of Transportation (CDOT). The subarea model traffic matched observed (count) traffic within plus or minus 7%.
- Process: A subarea conversion of the DRCOG model was used. Origin-destination matrix estimation was used to refine the demand tables.
- Socioeconomic Data: Socioeconomic (number of households and total employment) data from DRCOG for both 2020 and 2040 were enhanced with locally derived information on residential and employment growth expected in each Firestone Traffic Analysis Zone (TAZ). Local business inputs on residential and commercial development were key to capturing a realistic 2040 profile.
- Time Periods: The DRCOG model time periods were adapted to deliver one-hour AM and PM peaks to the 2020-2040 Firestone Traffic Model with the goal of capturing real- world congestion on the roadway system.

The 2020-2040 Firestone Traffic Model was then used to evaluate 2040 highway improvement projects in Firestone.

The philosophy of the model approach had two major tenets:

1. To remain faithful to the DRCOG travel model with respect to model run procedures, to time periods, and to link and zone attributes.
2. To build a subarea traffic model capable of running planning level traffic congestion scenarios for Firestone, Colorado.

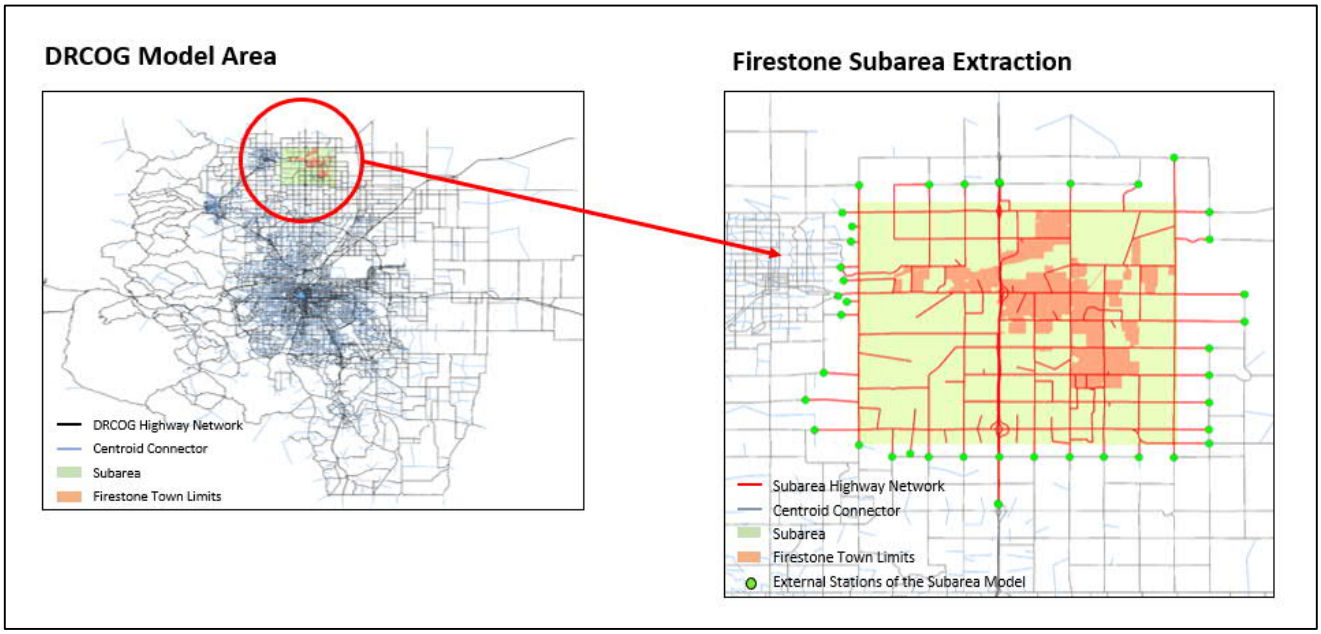
In the following sections, the process of converting the DRCOG model, procedures for highway network and zonal (socioeconomic) updates, the 2020 validation approach and results, and the 2040 demand table development will be discussed.

2 Firestone Traffic Model Development

2.1 Subarea Extraction

Firestone, Colorado lies within the geographic extent of the DRCOG travel model, allowing use of DRCOG model components to build a subarea traffic model. When needed, travel demand software allows a regional model to be used to build a focused subarea model. Some examples are isolating a downtown area, a single county, or a municipality such as Firestone, from a larger model extent. This process is called subarea extraction. The extraction process provides a subarea network and reduced dimensionality demand tables. The reduced demand tables are then used to perform a traffic assignment on a subarea network. The advantages of a subarea focused traffic model is that it allows detailed network checking and update (including the future year) within a bounded area, and it facilitates faster model run times. Subarea extraction was used to convert the DRCOG model into the 2020-2040 Firestone Traffic Model. Figure 1 shows the before and after model extents.

Figure 1: Firestone Subarea Extraction



Note that the Firestone subarea includes dozens of external entry points to the subarea, shown in green. These entry points capture all regional traffic into, out of and through the subarea. To enhance the performance of the subarea traffic results, lower functional classification roads, such as connectors, were added to the network. Centroid connectors were reviewed and added where they better connected each zone with an entry point on the highway network. The subarea was focused on Firestone but also included a "halo" or buffer area around Firestone to establish a systematic capture of entering and exiting traffic and capture path-finding for Firestone traffic. Traffic reporting was summarized within the town of Firestone alone.

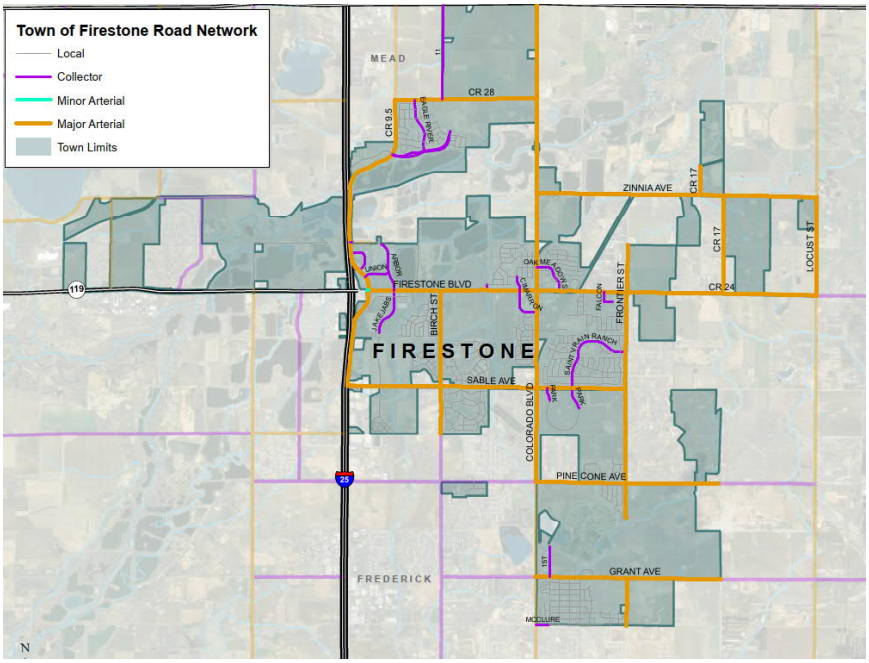
Figure 2 shows the highway link segments used in both the DRCOG and Firestone models. Two-way information is coded on each highway network with attributes length, facility type, and number of lanes required for traffic assignment. Segment capacity is calculated using the facility type and the number of lanes; capacity varies by time period.

Figure 3 shows the Firestone Traffic Model 2020 network prepared for assignment. The functional class within Firestone is composed mainly of major arterials. Collectors and centroid connectors were added to enhance the connectivity of the network.

Figure 2: Firestone & DRCOG Highway Segment Attributes

Field Name	Description
ID	Link ID
Length	Length of the link (mi)
DIST	Length of a link (mi)
TYPE	Highway or transit links
	1: Highway link – standard roadway segment
	2: Transit link – transit-only link (e.g., bus or rail, not on roadway network)
	86: Graphic-only link – used for mapping but not modeling
	98: Transit and walk only link (e.g., 16th street mall)
	99: Walk only (pedestrian overpasses)
FACILITY TYPE	Road type
	1: Freeway
	2: Major regional arterial
	3: Principal arterial
	4: Minor arterial
	5: Collector
	6: Ramp
	7: Special ramp (if needed)
	8: Zone connector
	9: Managed lane
LANE	Number of through lanes in each direction
TOLL	Toll road
	0: Not a toll road
	1: Link on a toll road (may not be a toll collection location)

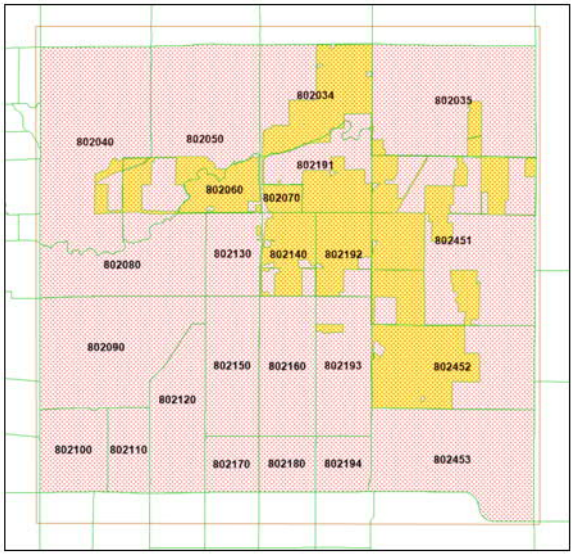
Figure 3: Firestone Traffic Model Highway Network



2.2 Socioeconomic Inputs

2020 base year socioeconomic inputs are used directly from the DRCOG model maintaining consistency with regionally calibrated and validated models. There are 24 TAZs in the Firestone model. Figure 4 shows the TAZ IDs, and the three socioeconomic attributes required: population in households, number of households and employment.

Figure 4: 2020 Socioeconomic Inputs



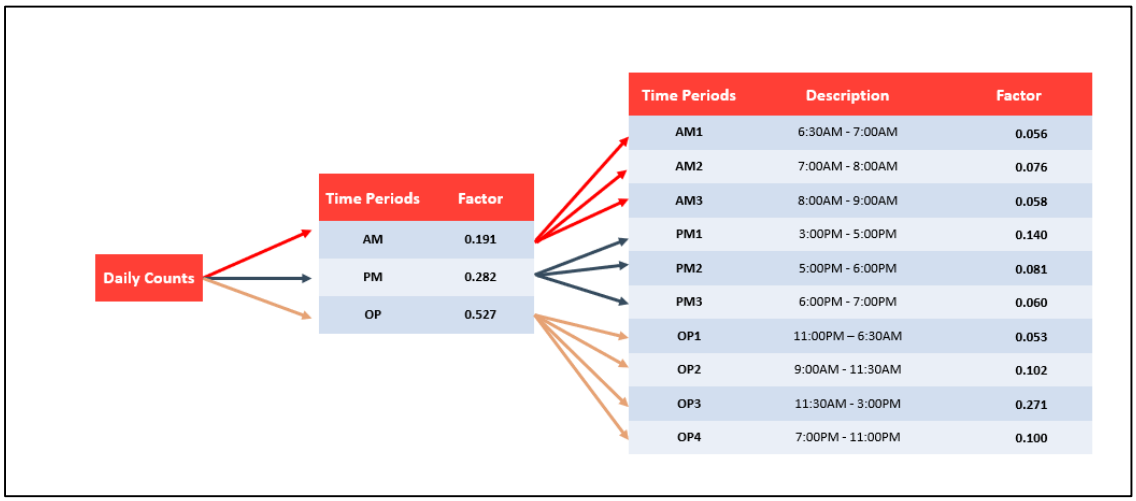
24 TAZs included in the subarea

TAZ_ID	HH Population	Households	Employment
802034	126	45	180
802035	127	50	403
802040	2,691	979	1,268
802050	1,868	624	501
802060	18	10	206
802070	1,096	412	286
802080	89	33	36
802090	94	36	38
802100	200	102	53
802110	20	11	33
802120	885	311	40
802130	1,588	575	1,396
802140	1,794	627	1,689
802150	791	255	462
802160	1,476	479	1,765
802170	472	184	90
802180	-	-	48
802191	1,069	375	278
802192	3,023	1,044	260
802193	5,121	1,753	525
802194	6	2	89
802451	7,594	2,447	682
802452	2,092	769	596
802453	4,242	1,609	1,308
SUM	**36,482**	**12,732**	**12,232**

2.3 Time Periods

The DRCOG model contains 10 time periods with the AM peak representing 2.5 hours and the PM peak 3 hours. To conduct O-D matrix estimation, the ADTs are split into 10 time periods based on the time-of day-factors in the DRCOG model after which the O-D matrix estimation is repeated for each time period using the time of day traffic as a target. The ten results are then collapsed into three Firestone time periods for planning purposes (see Figure 5). The peak periods are needed to capture congestion, identifying "hot spots" in the study area. This analysis is typically done with the Volume/Capacity (V/C) ratio.

Figure 5: Relationship of Firestone and DRCOG Time Periods



2.4 2020 Firestone Traffic Model Validation

2.4.1 Validation Data

To validate the Firestone Traffic Model, observed average daily traffic (ADT) values were collected from three sources: CDOT, DRCOG and Firestone special counts (see Figure 6 and Figure 7). CDOT's OTIS[1] traffic database, Firestone/Weld County existing traffic counts 2016-2020, and the Firestone special traffic counts. Note that traffic counts taken during the Covid-19 months of 2020, which were assumed to be influenced by the pandemic, were not used. Counts taken in 2016 through 2019 were assumed to be a reasonable fit to current conditions. Firestone conducted 14 special counts to get coverage where CDOT and DRCOG did not have counts available. To select locations for these new 2021 traffic counts, the following criteria were used.

- Get good coverage on the main corridors in Firestone:
  - On Firestone Blvd (E-W)
  - On Colorado Blvd (N-S)
- Get coverage on road segments in undercounted parts of the study area, or in areas where recent growth has occurred and/or is forecast to grow in the future.

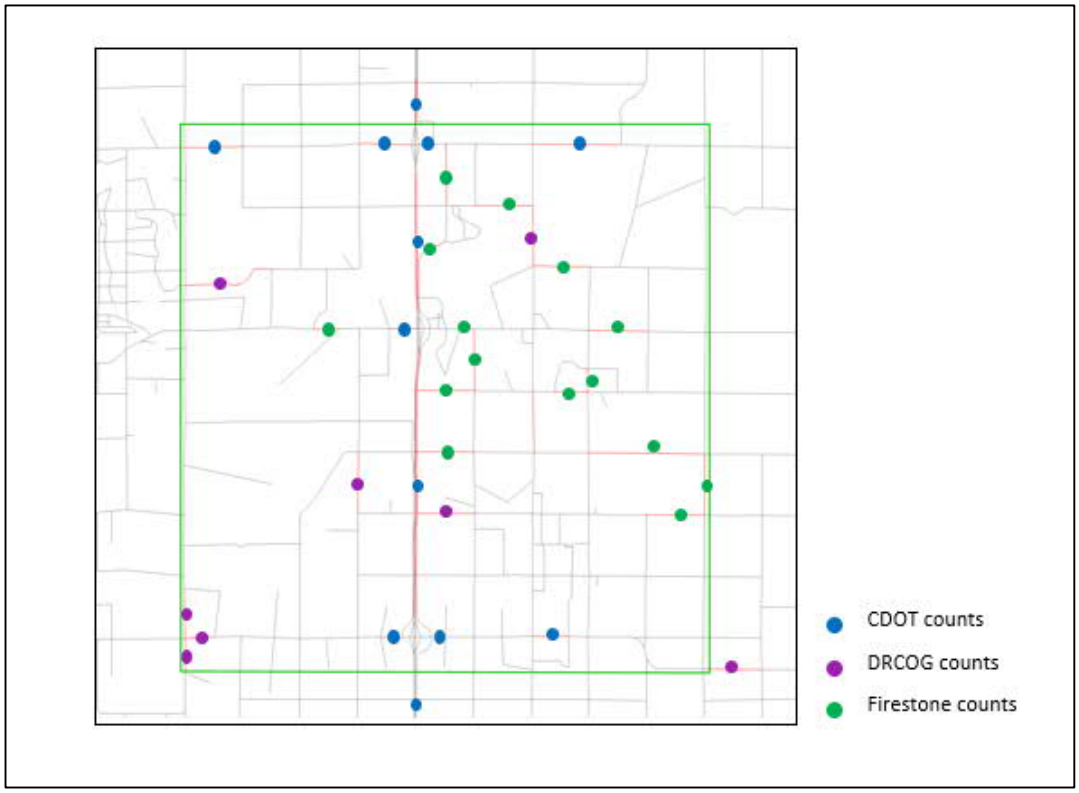
[1] Colorado DOT Traffic Counts: https://dtdapps.coloradodot.info/otis/TrafficData, accessed December 2020.

The collection and assembly of these 39 observed daily traffic counts was key to success. The subarea extraction demand tables, on preliminary traffic assignment, did not deliver a reasonable result (plus or minus 10% ADT to model daily traffic) within Firestone. The observed counts provided a framework for conducting O-D matrix estimation which fit the demand table (model vehicle trips) to the ADT. Due to the importance of the peak time periods, O-D matrix estimation was conducted for each Firestone time period individually. Daily counts were split into 10 time periods based on the time-of day-factors used in the DRCOG model.

Figure 6: Firestone Traffic Model Count Sources

Source	# Counts	Year	URL
CDOT	15	2016-2019	https://dtdapps.coloradodot.info/otis/TrafficData#ui/0/1/0/criteria//14/true/true/
DRCOG	10	2019	https://experience.arcgis.com/experience/dfd764dab6b142d0b2b0f92e6a9bee63/page/home/?views=view_4
Firestone	14	2021	

Figure 7: Firestone Observed Traffic Count Locations



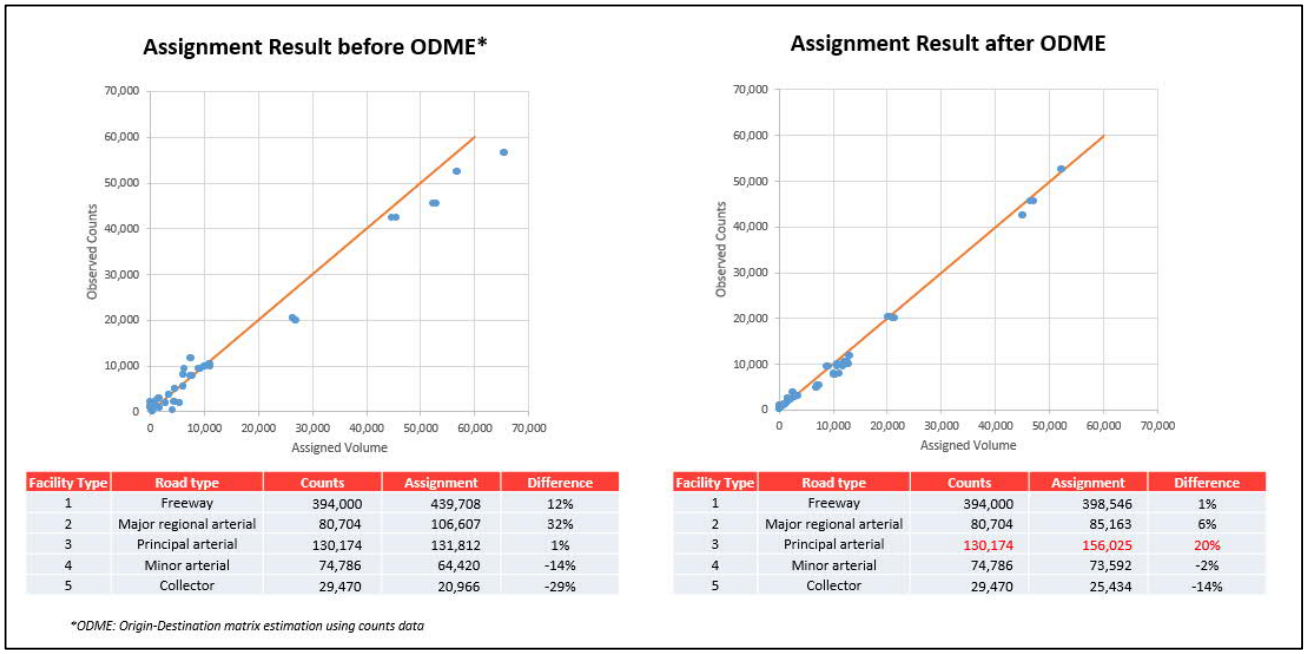
2.4.2 Validation Results

The 2020 Firestone subarea scenario was prepared using O-D matrix estimation. The O/D Matrix Estimation (ODME) procedure is an iterative (or bi-level) process that switches back and forth between a traffic assignment stage and a matrix estimation stage, until convergence is reached. The process updates O/D matrices by comparing assigned and observed link flows along the path(s) used by each O/D pair and by updating the cell value using as the ratios of observed to assigned flows for each O/D pair. The procedure requires an initial estimate of the O/D matrix such as is the case of the Firestone Traffic Model, from a set of subarea extraction matrices.

O-D matrix estimation for the Firestone Traffic Model was conducted for each of the three Firestone time periods: AM, PM, and off-peak. The traffic on all road segments for each time period was then summed and compared to the observed ADT. An additional step used select link analysis on a roadway with an unacceptable error in the final result to test and apply step-wise changes in the O-D matrix output.

Figure 8 shows the daily traffic assignment on the horizontal axis with the ADT on the vertical axis. Note that the model traffic is trending higher than the observed for two functional classifications: freeway and major regional arterial. After the O-D matrix estimation procedure, freeway and major regional arterial have improved although the principal arterial classification model traffic is now trending high. The corridor causing the high model traffic was identified (see Figure 9) and adjusted using a select link tool as a probe and making selected adjustments to the demand tables. The results is that all functional classifications higher than collector line up at plus or minus 7% ADT to model daily traffic. The 2020 model base year conforms to observed traffic in Firestone and provides a base on which to build the 2040 scenario.

Figure 8: O-D Matrix Estimation Results

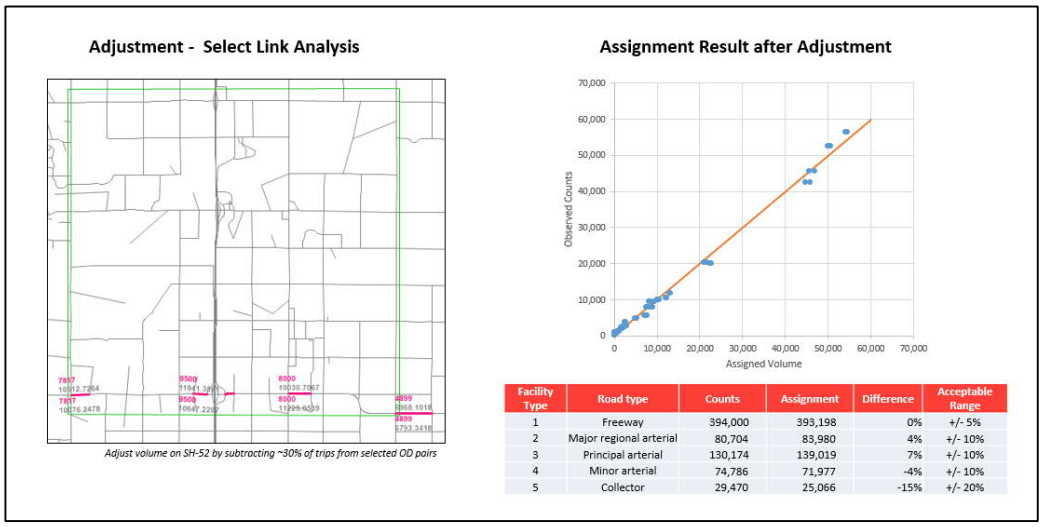


Facility Type	Road type	Counts	Assignment	Difference
1	Freeway	394,000	439,708	12%
2	Major regional arterial	80,704	106,607	32%
3	Principal arterial	130,174	131,812	1%
4	Minor arterial	74,786	64,420	-14%
5	Collector	29,470	20,966	-29%

Facility Type	Road type	Counts	Assignment	Difference
1	Freeway	394,000	398,546	1%
2	Major regional arterial	80,704	85,163	6%
3	Principal arterial	130,174	156,025	20%
4	Minor arterial	74,786	73,592	-2%
5	Collector	29,470	25,434	-14%

**ODME: Origin-Destination matrix estimation using counts data*

Figure 9: O-D Matrix Estimation with Select Link Adjustment Results

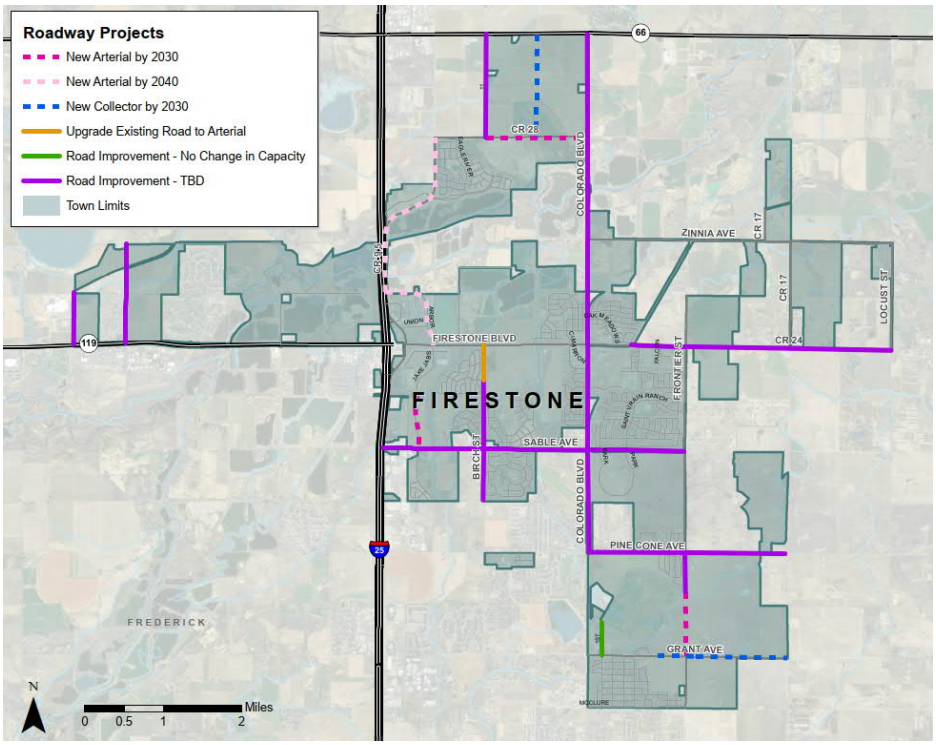


Facility Type	Road type	Counts	Assignment	Difference	Acceptable Range
1	Freeway	394,000	393,198	0%	+/- 5%
2	Major regional arterial	80,704	83,980	4%	+/- 10%
3	Principal arterial	130,174	139,019	7%	+/- 10%
4	Minor arterial	74,786	71,977	-4%	+/- 10%
5	Collector	29,470	25,066	-15%	+/- 20%

2.5 2040 No Build Scenario

Similar to the 2020 base, the 2040 no-build scenario's starting point was the DRCOG model files. The 2040 highway network was reviewed and prepared for traffic assignment. Corrections made to the 2020 network were carried forward to the 2040. Locally proposed roadway projects such as access into new residential or commercial sites were added. Figure 10 shows Firestone with the highway segment status.

Figure 10: Firestone 2040 Traffic Model Highway Network



Preparing the demand matrix of trips required a growth factor approach using the 2020 demand tables plus locally developed Firestone socioeconomic data for 2020 and 2040. The input files were the O-D matrix estimation demand tables from the validated 2020 base. Using a pivot point or incremental approach, a growth factor (2020 to 2040 percent change) was applied to these demand tables, by time period, to prepare 2040 demand table. The goal of this step was to prepare a future scenario reflective of the known growth occurring in Firestone. The following steps outline the procedure:

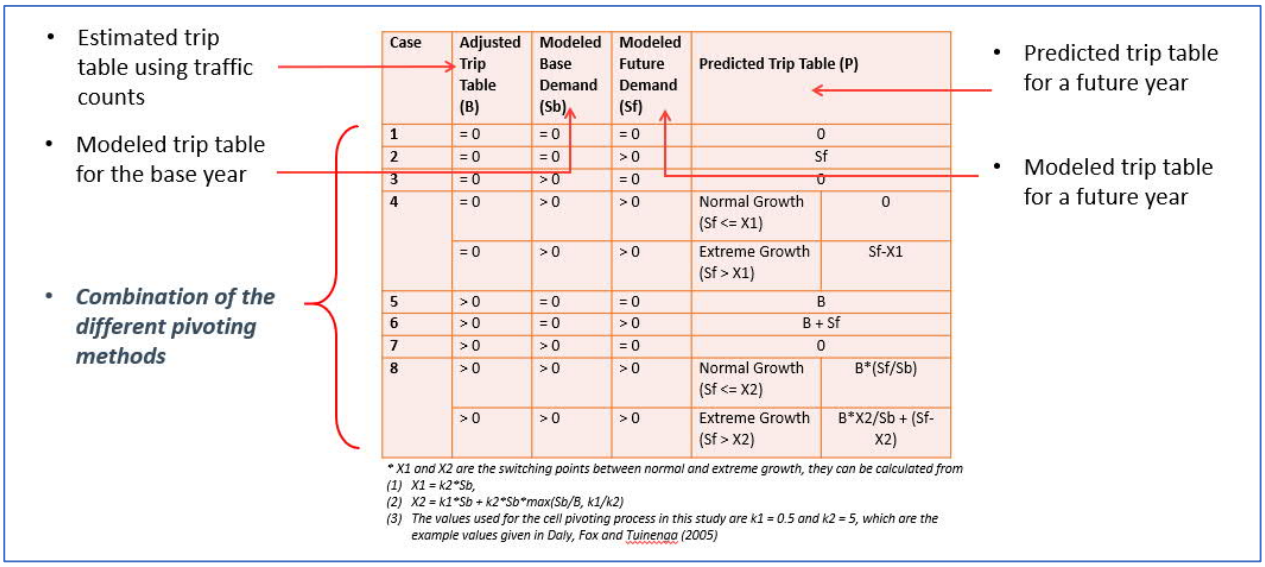
1. Start with the 2020 time of day demand tables.
2. Using the 2020 and 2040 socioeconomic data by TAZ , calculate the growth factor using locally derived population and employment changes in each zone. Note that both the 2020 and 2040 socioeconomic data reflect values verified by local sources (see Figure 11). Growth factors range from 1.04 to 2.81. Where the factor is high, the locally derived population and employment estimate is appropriately affecting a TAZ where new information is available.
3. Apply the growth factor on the 2040 demand tables by time of day at both the row and column level reflecting both the starting and ending point of future trips. Integrate the "Eight-case method" described below.

Figure 11: 2040 Demand Table Growth Factors by TAZ

Zone	TAZ	2040 pop+emp	Final pop+emp	Growth Factor
2790	802034	5,896	16,556	2.81
2791	802035	622	650	1.05
2725	802040	4,750	7,698	1.62
2726	802050	3,079	3,226	1.05
2727	802060	276	289	1.05
2728	802070	1,419	1,657	1.17
2729	802080	127	149	1.18
2730	802090	167	197	1.18
2731	802100	322	443	1.38
2732	802110	149	163	1.10
2733	802120	1,288	1,442	1.12
2734	802130	2,944	3,234	1.10
2735	802140	3,937	6,757	1.72
2736	802150	3,404	3,540	1.04
2737	802160	4,741	5,070	1.07
2738	802170	1,841	2,092	1.14
2739	802180	321	337	1.05
2792	802191	1,635	1,845	1.13
2793	802192	4,391	6,114	1.39
2740	802193	6,607	7,386	1.12
2794	802194	2,212	2,688	1.22
2766	802451	9,361	9,879	1.06
2795	802452	3,319	8,196	2.47
2796	802453	8,616	10,271	1.19

When using the growth factor approach on trip tables, care must be taken to deal logically with each cell in the input demand table. The "eight-case method" is an approach to applying the pivot point or incremental methods, using a case-by-case approach for the cell in the demand table[2]. This approach is useful for situations where starting matrix values in a cell may be zero, for example, which would disallow any growth to take place. Some matrix growth issues are whether the change predicted by the model should be expressed as an absolute difference or a proportional ratio, or whether a mixed approach is necessary; and how to deal with growth in "green-field" situations when applying the procedure. Figure 12 diagrams the eight cases for values in a standard demand table. Using this approach, the future year demand tables for the Firestone Traffic Model were prepared.

Figure 12: Eight Case Method for Demand Table Growth Adjustment



Case	Adjusted Trip Table (B)	Modeled Base Demand (Sb)	Modeled Future Demand (Sf)	Predicted Trip Table (P)	
1	= 0	= 0	= 0	0	
2	= 0	= 0	> 0	Sf	
3	= 0	> 0	= 0	0	
4	= 0	> 0	> 0	Normal Growth (Sf <= X1)	0
	= 0	> 0	> 0	Extreme Growth (Sf > X1)	Sf-X1
5	> 0	= 0	= 0	B	
6	> 0	= 0	> 0	B + Sf	
7	> 0	> 0	= 0	0	
8	> 0	> 0	> 0	Normal Growth (Sf <= X2)	B*(Sf/Sb)
	> 0	> 0	> 0	Extreme Growth (Sf > X2)	B*X2/Sb + (Sf-X2)

** X1 and X2 are the switching points between normal and extreme growth, they can be calculated from*
*(1) X1 = k2*Sb,*
*(2) X2 = k1*Sb + k2*Sb*max(Sb/B, k1/k2)*
(3) The values used for the cell pivoting process in this study are k1 = 0.5 and k2 = 5, which are the example values given in Daly, Fox and Tuinenga (2005)

With the network and demand tables in place for 2040, a traffic assignment for the 2040 No-Build was conducted. The next section offers a brief look at the differences between the 2020 and 2040 traffic assignment results. The intent is to verify that the traffic growth, congestion results and overall model integrity are consistent with the change in socioeconomic values and the highway network in the Firestone study area.

[2] "Pivot-Point Procedures in Practical Travel Demand Forecasting", Daly, Andrew, James Fox, and Jan Gerrit Tuinenga; Rand Europe, September 2005.

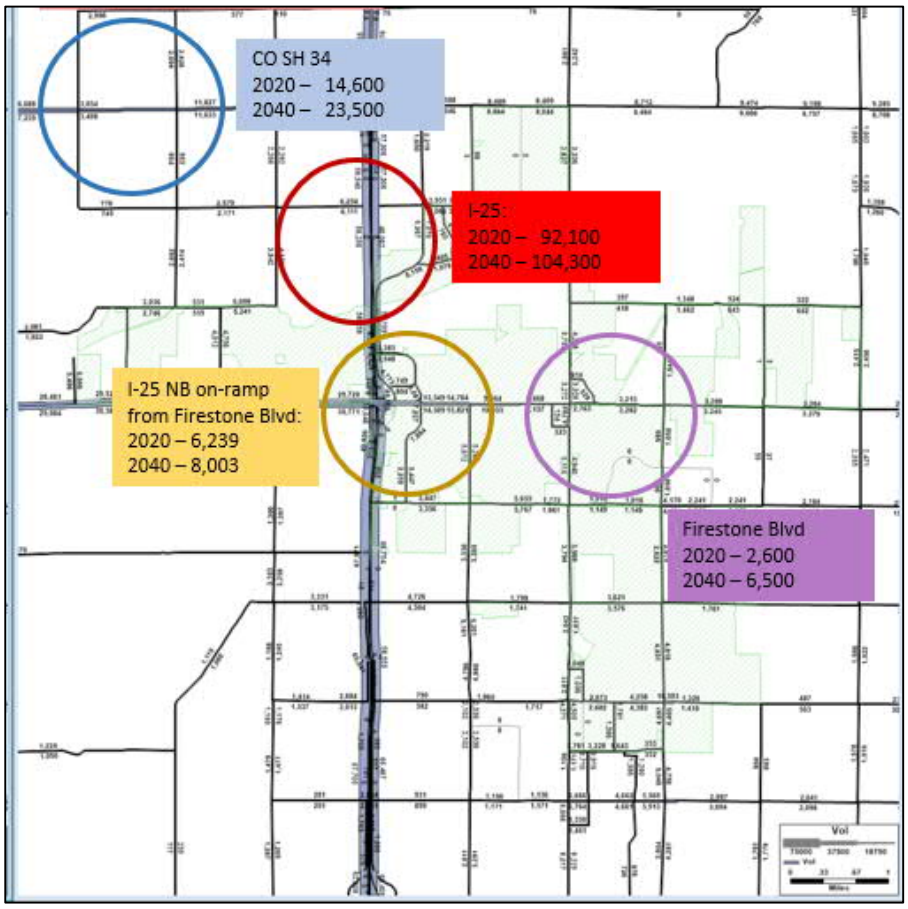
3 Comparison of 2020 to 2040 Firestone Traffic

In this section a brief look at the traffic changes between 2020 and 2040 will be provided. The intent is not to analyze future traffic but to briefly investigate the behavior of the Firestone Traffic Model. There are two metrics selected for analysis of Firestone traffic:

1. Traffic – all Vehicles for 24 hour period
    a. Daily
    b. AM Peak (one hour)
    c. PM Peak (one hour)
2. Volume to Capacity Ratio (volume divided by the segment capacity)
    a. Daily – allows a sketch view of emerging "trouble spots"
    b. AM Peak (one hour)
    c. PM Peak (one hour)

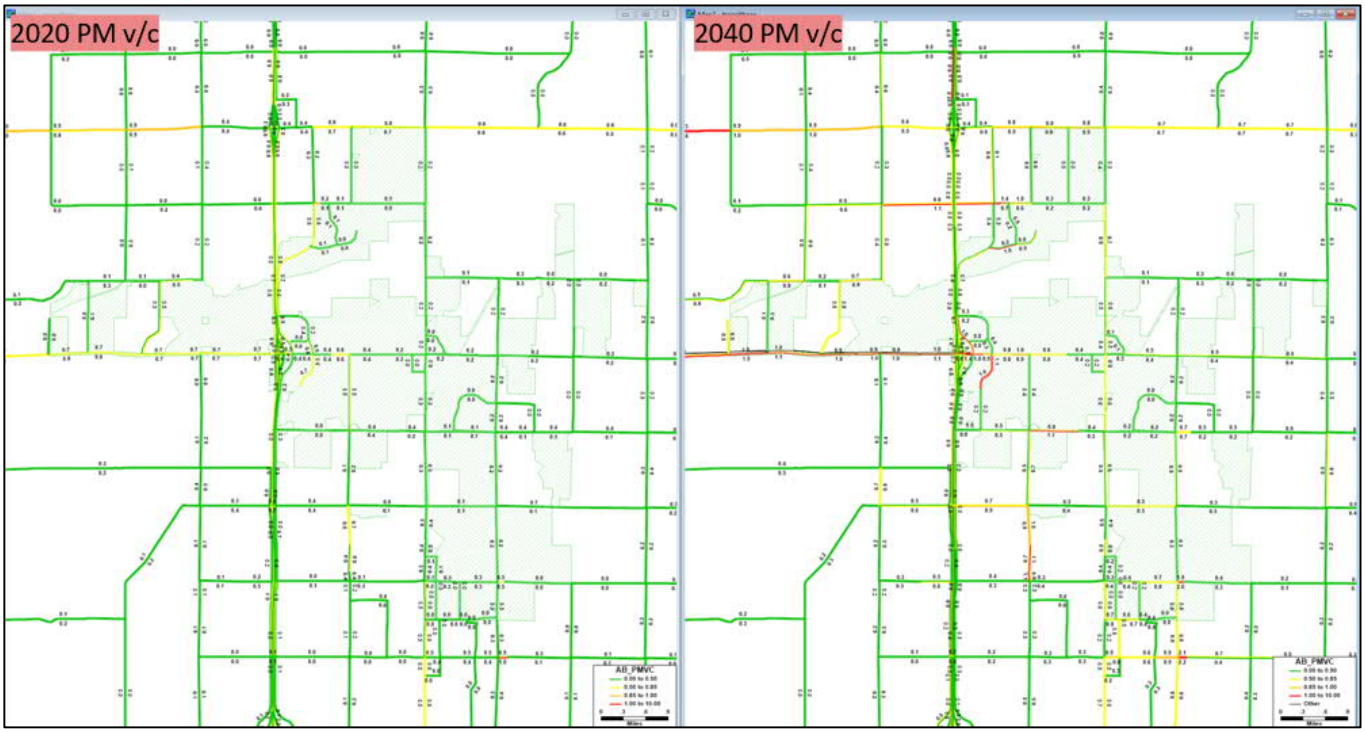
Traffic - Reviewing daily traffic allows planners and engineers to estimate the need for capacity improvements in the area. A key issue in the Firestone study area is that roadways outside the city clearly influence traffic within the city. One example is I-25 which is served by several access points (on and off ramps) situated in the study area. Figure 13 shows four cut-points on key roads in the study area with expected growth (in the 20-30% range) within normal limits for the inputs.

Figure 13: Sample 2020 and 2040 Daily Traffic at Selected Cut-Points



Volume to Capacity Ratio - Reviewing the volume-to-capacity ratio allows planners and engineers to identify congestion "hot spots" in the future year. This analysis requires that a one-hour peak traffic model result be used; the PM peak was selected. Figure 14 shows side-by-side plots of 2020 and 2040 PM V/C ratios. While the cutoff values for congestion are typically altered to serve local profiles of road congestion and project needs, these plots show first-cut emerging congestion on Colorado SH 34 in both directions west of I-25; on Colorado SH 28 in both directions 2-3 miles east and west of I-25; on Firestone Boulevard (Colorado SH 24) – in both directions west of I-25; and on the I-25 northbound on-ramp from Firestone Boulevard. The V/C ratio test demonstrates usefulness to the project by giving first-cut congestion locations.

Figure 14: Sample 2020 and 2040 Volume-to-Capacity Ratio Plots



Model Integrity - For Firestone Traffic Model verification purposes, model outputs were reviewed for overall integrity to standard traffic metrics.

- AM and PM peak model traffic is about 9-11% of daily traffic, consistent with typical observed values.
- Between 2020 and 2040, passenger cars per lane per hour (PCPHPL) on I-25 in the model shift from 1,200 to 1,500– showing that this facility can handle the increase in traffic expected in this interval and demonstrating the growth in to, from and through traffic forecast for Firestone.
- 2020-2040 modeled traffic ADT growth on the selected segments is in the 20-30% range, consistent with the socioeconomic growth in the study area.

In summary, the Firestone Traffic Model, developed using the DRCOG framework, enhanced with local TAZ-level data and network detail, provides a tool for congestion studies in the Firestone study area.

APPENDIX C: COST SUMMARY

Bohannan Huston
Engineering
Spatial Data
Advanced Technologies

Firestone Cost Estimate

Preliminary Design Cost

March 2022

Principal Arterial	Per Linear Foot	Per Linear Mile	
Asphalt with Soft Median	$ 1,200.00	$ 6,336,000.00	*Asphalt Pavement assumes 9 inches of asphalt with 12 inches of Aggregate Base Course, Concrete Pavement assumes 10 inches of concrete and 12 inches of Aggregate base course . Soft median cover material to be decorative, hard medians cover material to be patterned concrete.*
Asphalt with Hard Median	$ 1,600.00	$ 8,448,000.00	
Concrete with Soft Median	$ 2,300.00	$ 12,144,000.00	
Concrete with Hard Median	$ 2,700.00	$ 14,256,000.00	

Minor Arterial	Per Linear Foot	Per Linear Mile	
Asphalt with Soft Median	$ 900.00	$ 4,752,000.00	*Asphalt Pavement assumes 8 inches of asphalt with 9 inches of Aggregate Base Course, Concrete Pavement assumes 8 inches of concrete and 12 inches of Aggregate base course . Soft median cover material to be decorative, hard medians cover material to be patterned concrete.*
Asphalt with Hard Median	$ 1,300.00	$ 6,864,000.00	
Concrete with Soft Median	$ 1,300.00	$ 6,864,000.00	
Concrete with Hard Median	$ 1,700.00	$ 8,976,000.00	

Major Collector	Per Linear Foot	Per Linear Mile	
Asphalt with Soft Median	$ 600.00	$ 3,168,000.00	*Asphalt Pavement assumes 8 inches of asphalt with 8 inches of Aggregate Base Course, Concrete Pavement assumes 8 inches of concrete and 8 inches of Aggregate base course . Soft median cover material to be decorative, hard medians cover material to be patterned concrete.*
Asphalt with Hard Median	$ 1,000.00	$ 5,280,000.00	
Concrete with Soft Median	$ 1,200.00	$ 6,336,000.00	
Concrete with Hard Median	$ 1,500.00	$ 7,920,000.00	

Non-Residential Collector	Per Linear Foot	Per Linear Mile	
Asphalt	$ 400.00	$ 2,112,000.00	*Asphalt Pavement assumes 6 inches of asphalt with 6 inches of Aggregate Base Course, Concrete Pavement assumes 6 inches of concrete and 6 inches of Aggregate base course . Center turn lane, no median cover material used.*
Concrete	$ 900.00	$ 4,752,000.00	

Residential Collector	Per Linear Foot	Per Linear Mile	
Asphalt	$ 300.00	$ 1,584,000.00	*Asphalt Pavement assumes 4 inches of asphalt with 6 inches of Aggregate Base Course, Concrete Pavement assumes 6 inches of concrete and 6 inches of Aggregate base course . Center turn lane, no median cover material used.*
Concrete	$ 600.00	$ 3,168,000.00	

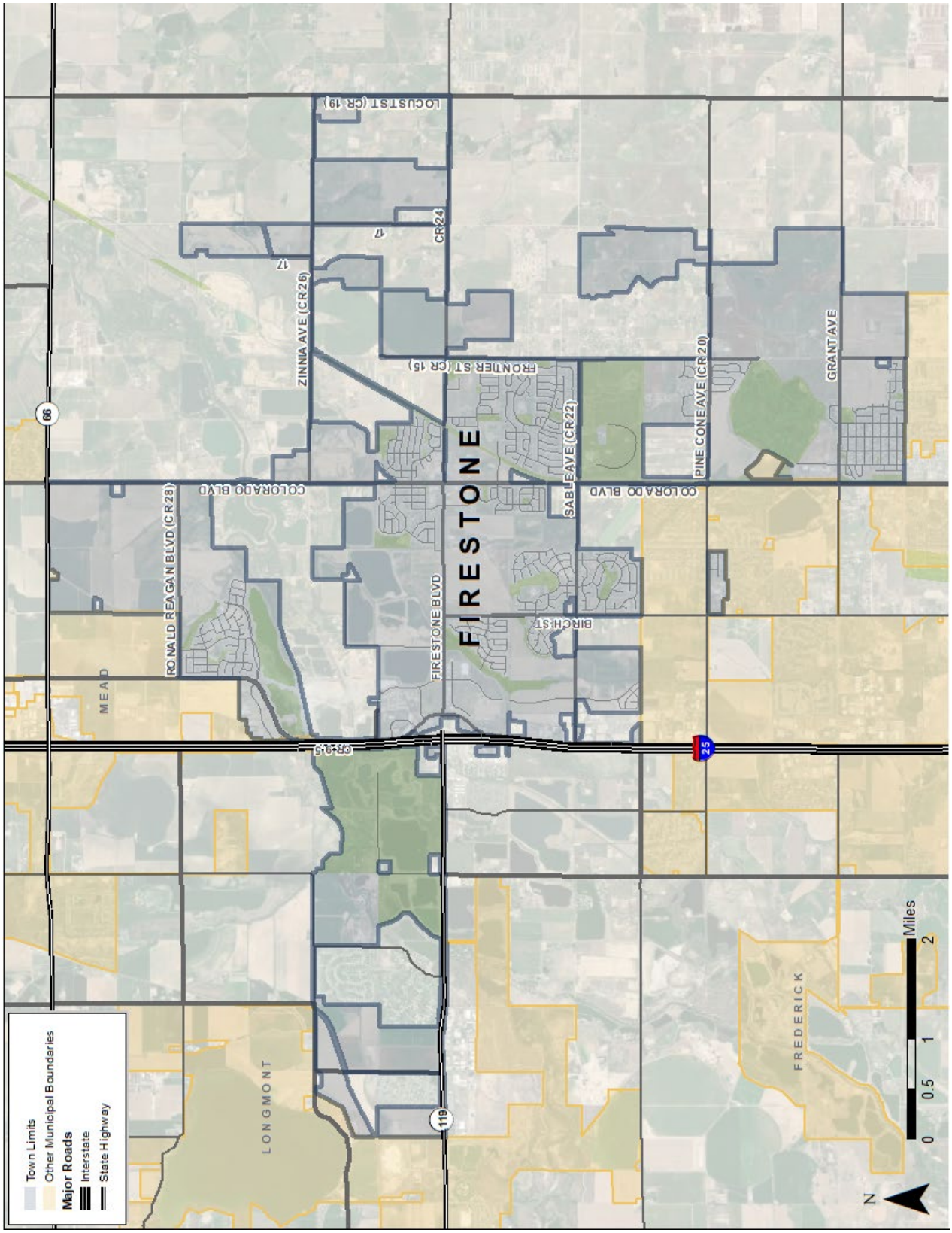
Miscellaneous items	Per Linear Foot	Per Linear Mile	
5' Concrete Sidewalk	$ 33.00	$ 174,240.00	*Concrete sidewalk assumes a single walk with a depth of 4 inches, and 6 inches of Aggregate base Course. Concrete Trail assumes a single trail with a depth of 6 inches, and 6 inches of Aggregate base Course. Striped Bike Lane costs include epoxy pavement markings for single 6" white stripe and bike symbols, bike lane signage is not included.*
10' Concrete Trail	$ 94.00	$ 496,320.00	
Striped Bike Lane	$ 1.25	$ 6,600.00	

Assumptions:
Includes new roadway section, items included include pavement, base course, sidewalk, trail, landscaped buffer zone, bike lanes, medians and Curb and Gutter. Costs associated with removal or modification of existing infrastructure is not included.

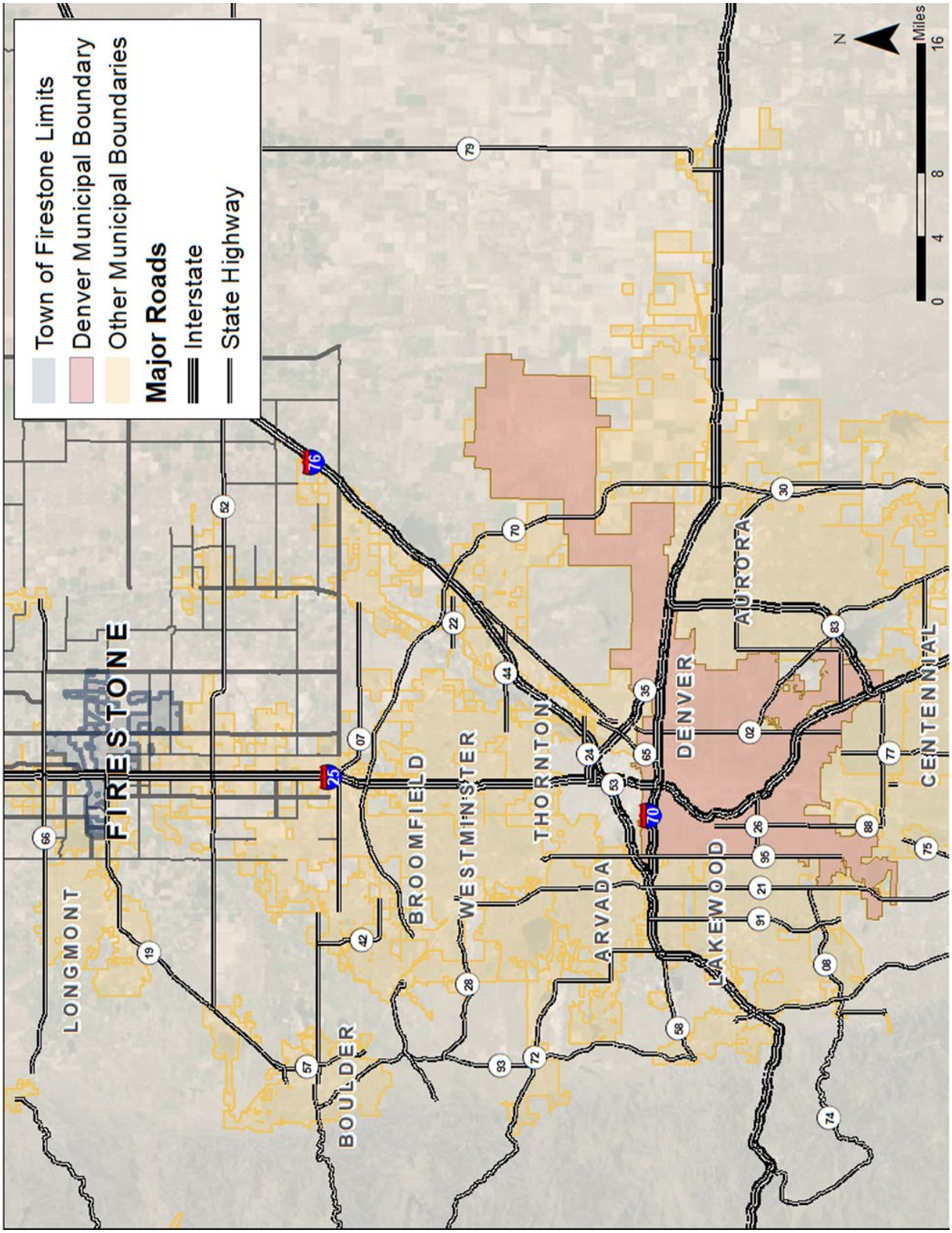
Exclusions:
Does not include; Contingency, Mobilization, Earthwork, Utilities, Drainage, Traffic Control, Erosion Control, Survey, Geotechnical, Environmental, Signal or ADA ramp improvements, or Clearing and Grubbing.

APPENDIX D: MAPS

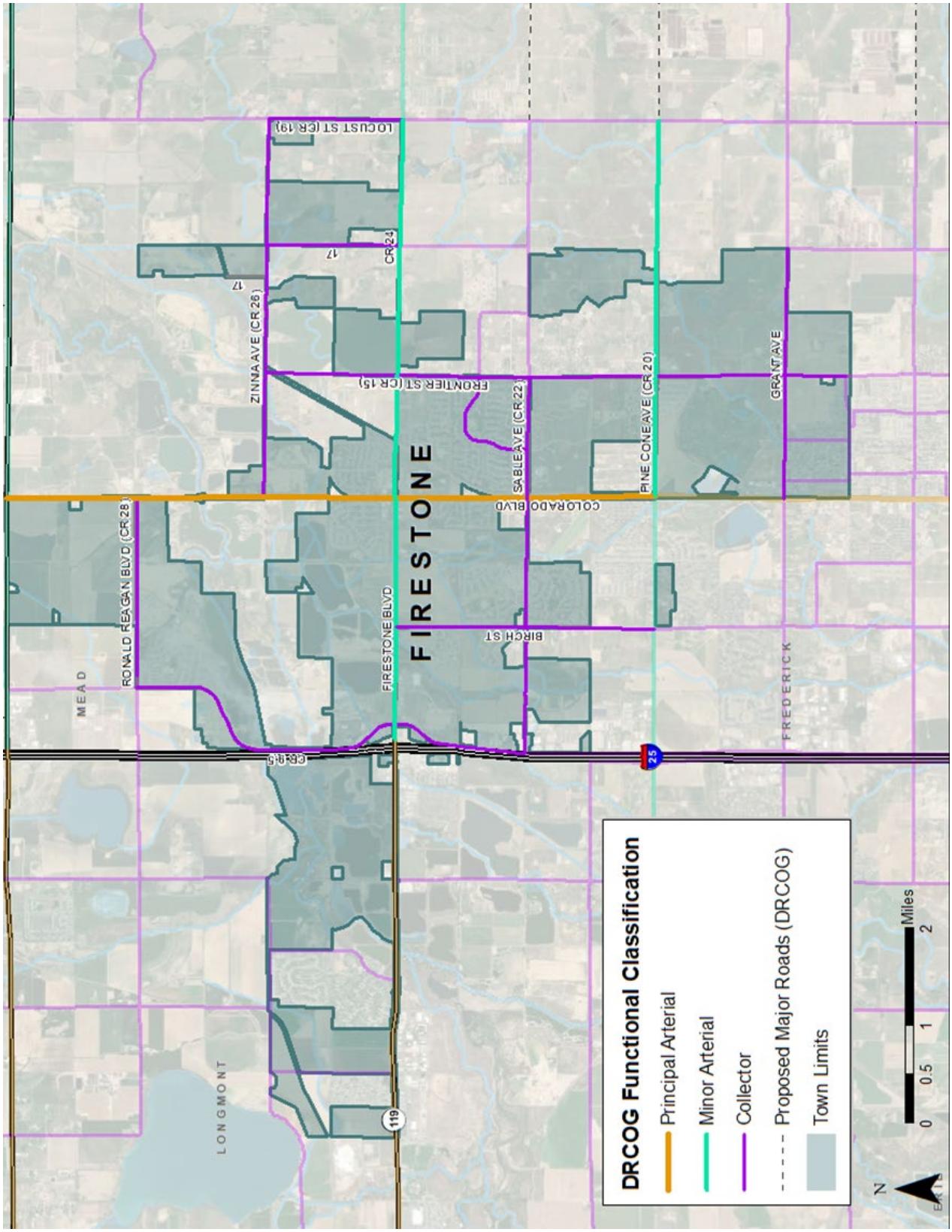
Study Area (Figure 1)



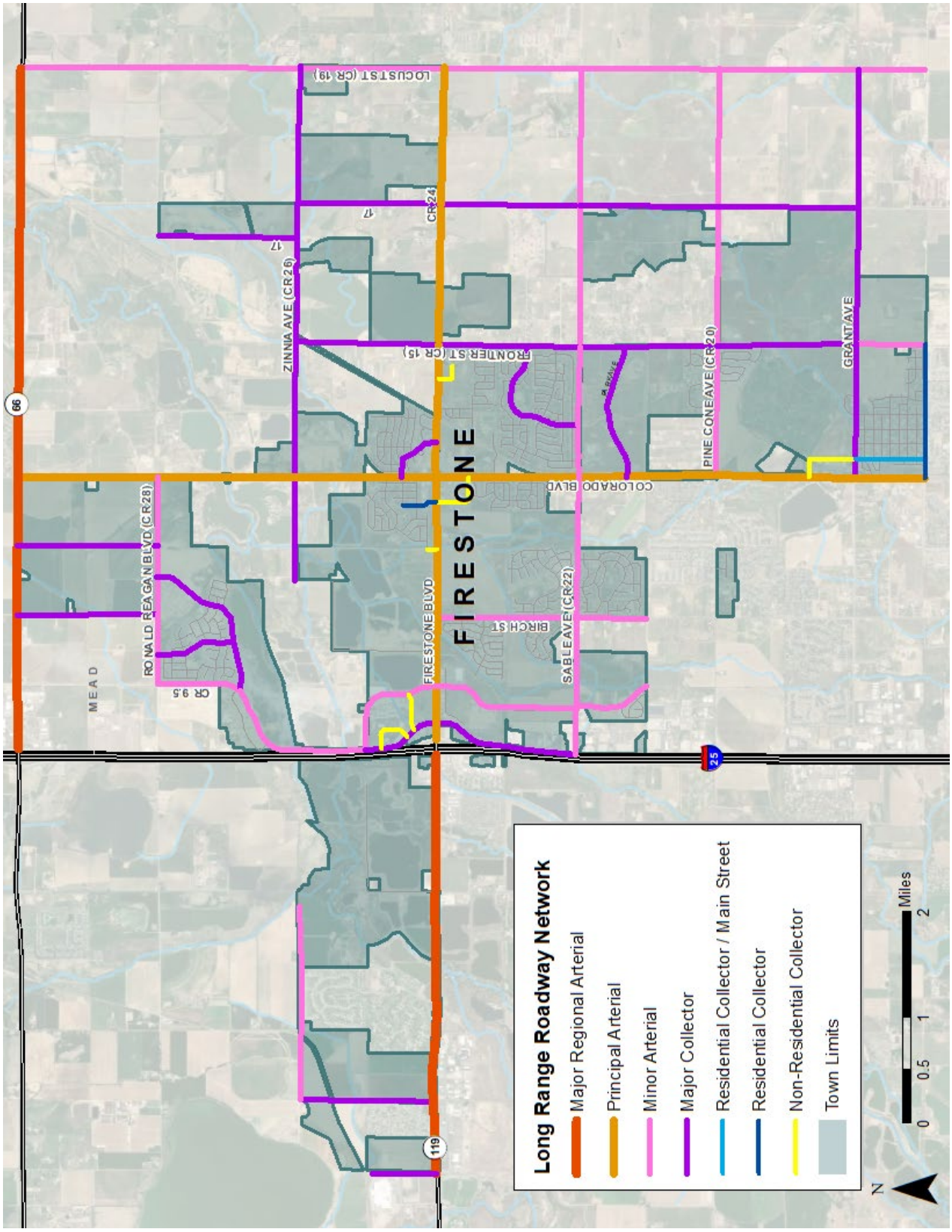
Firestone Context Map (Figure 2)



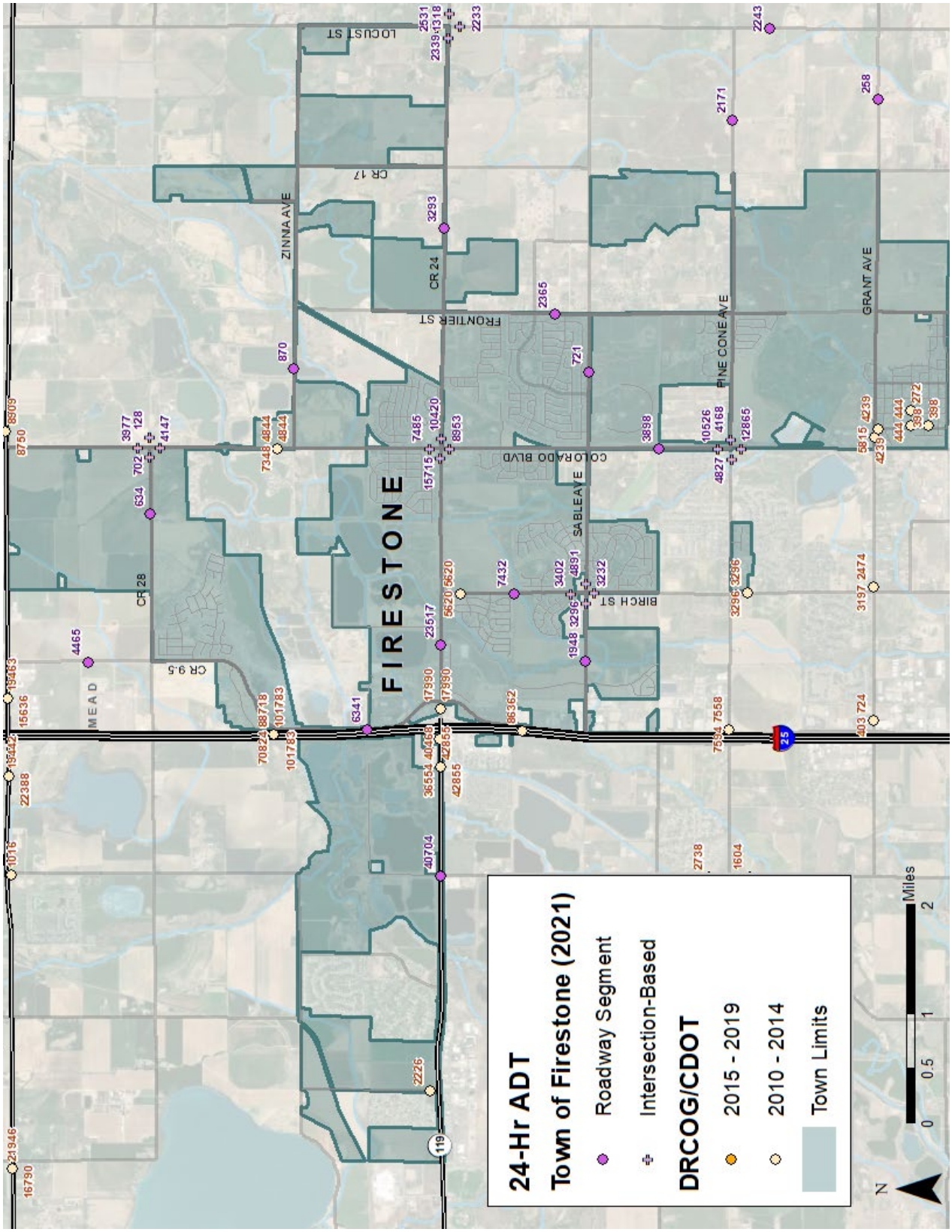
Existing Functional Classification (DRCOG) (Figure 9)



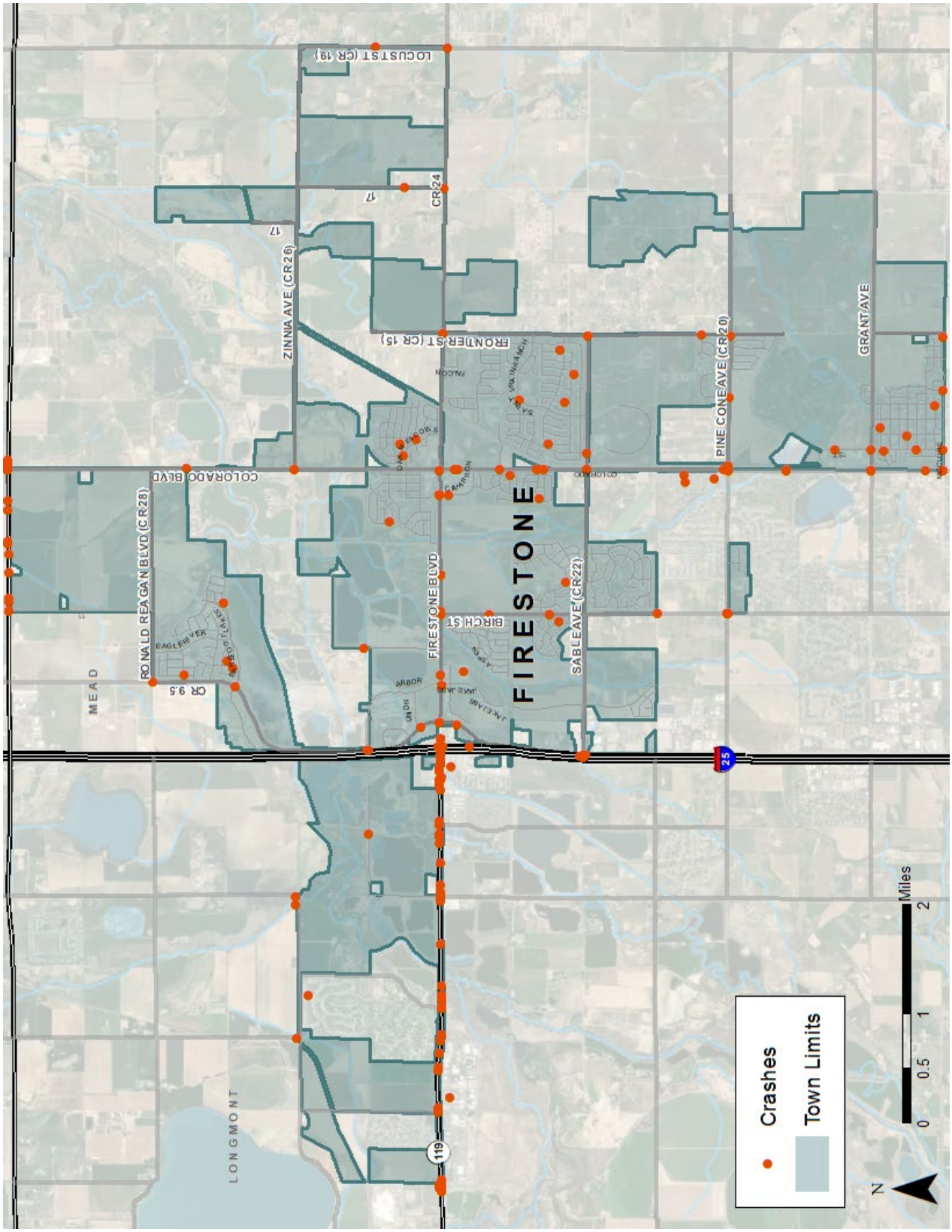
Long-Range Roadway Network (Figure 10)



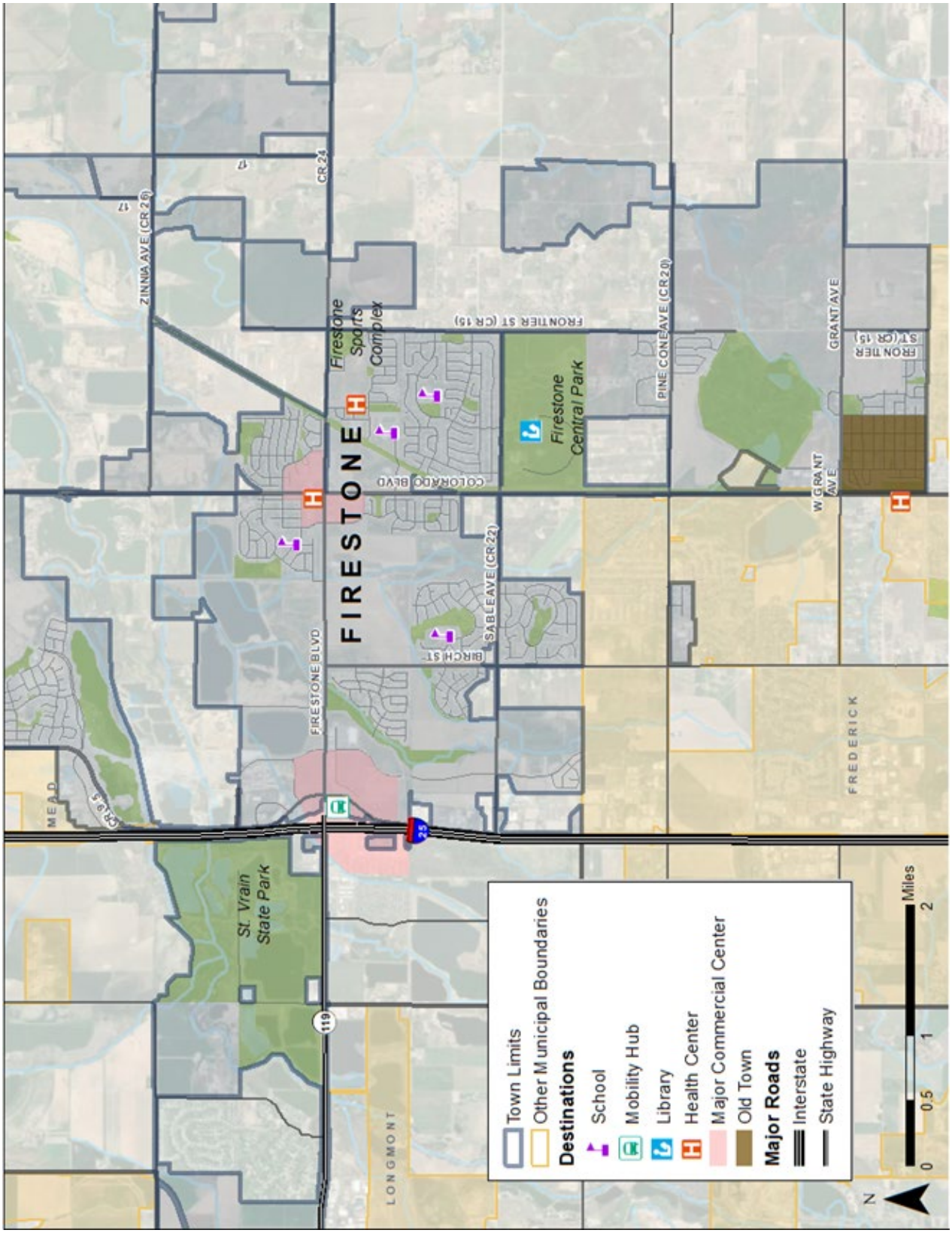
24-Hour Traffic Volumes by Location (Figure 12)



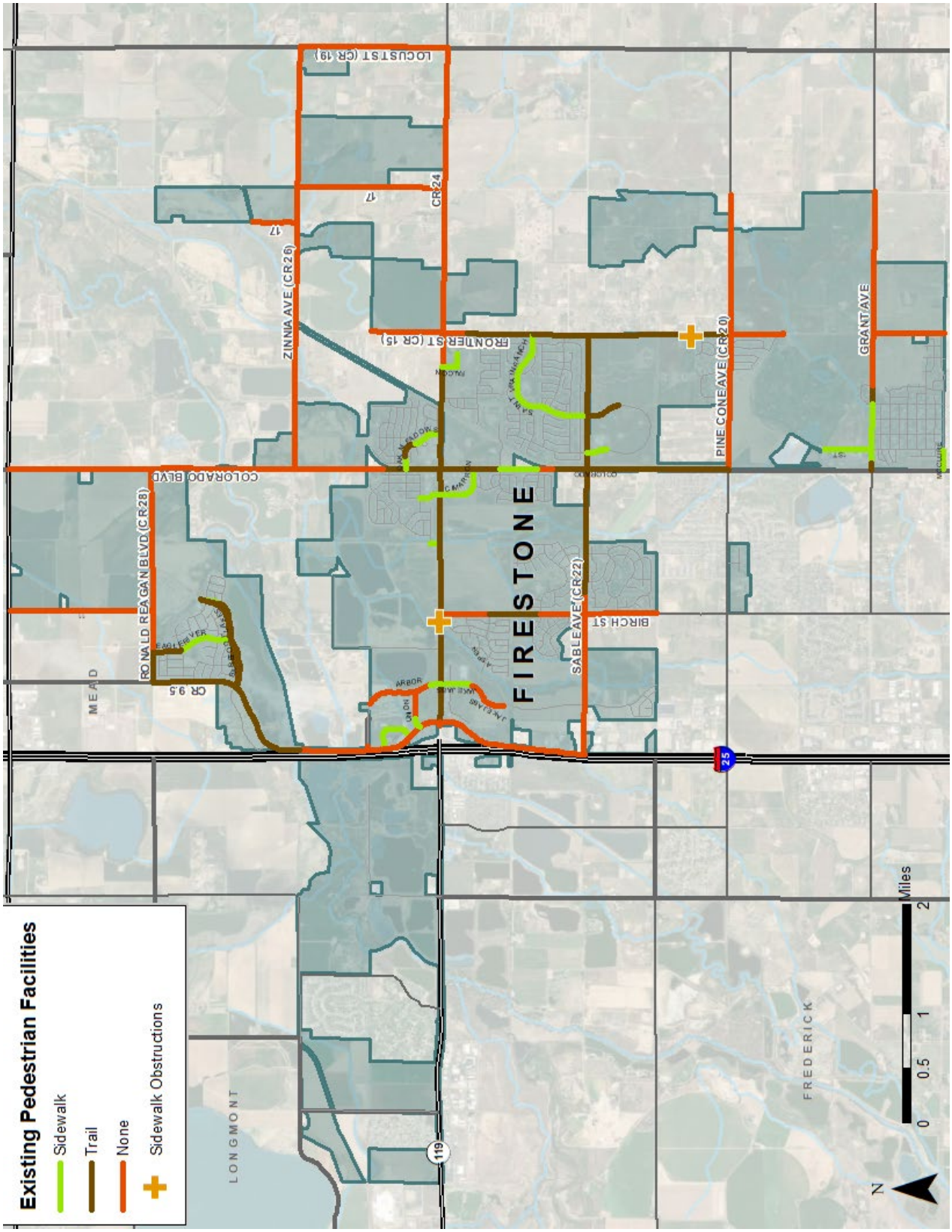
Firestone Area Crashes, DRCOG 2019 (Figure 13)



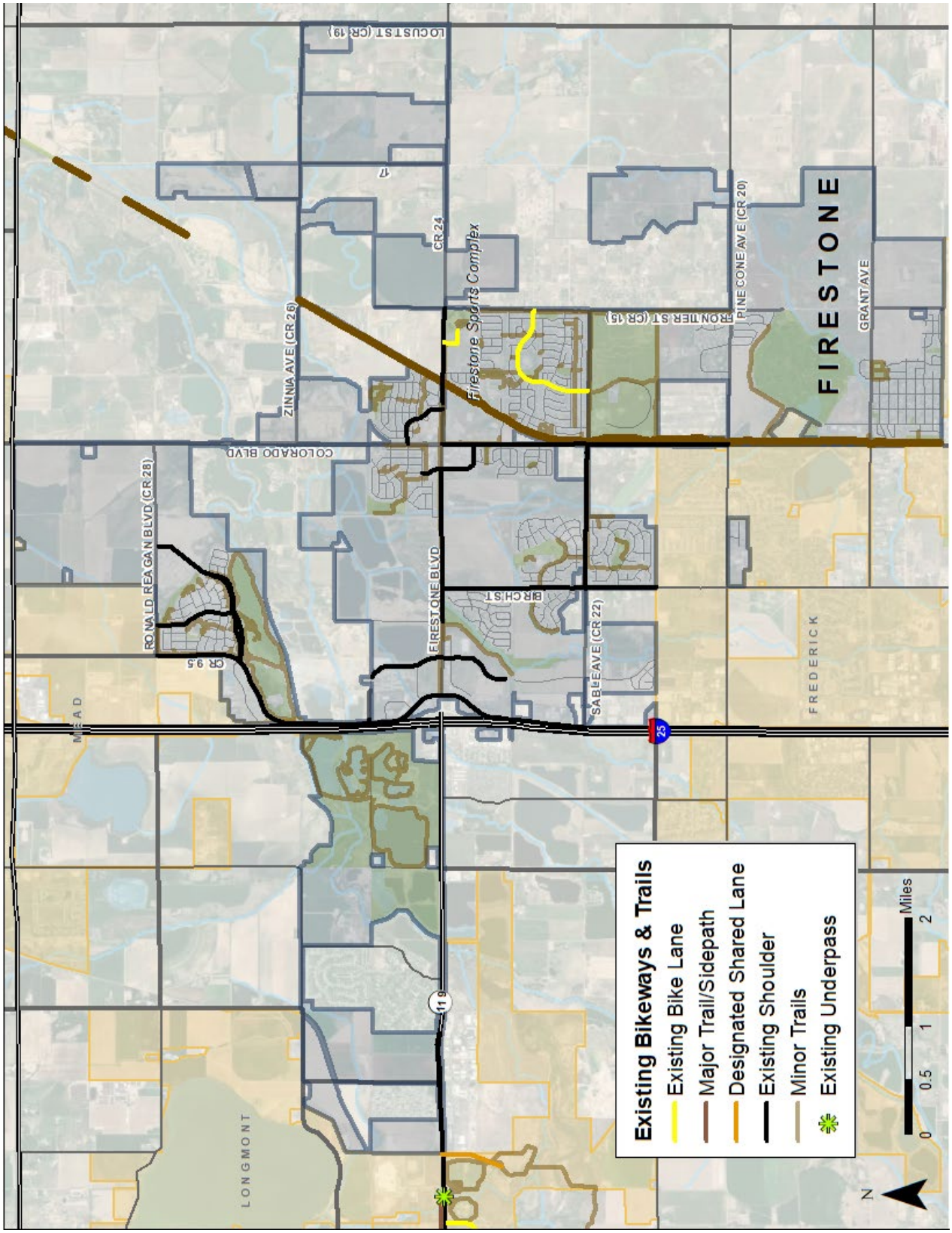
Major Destinations within the Town of Firestone (Figure 14)



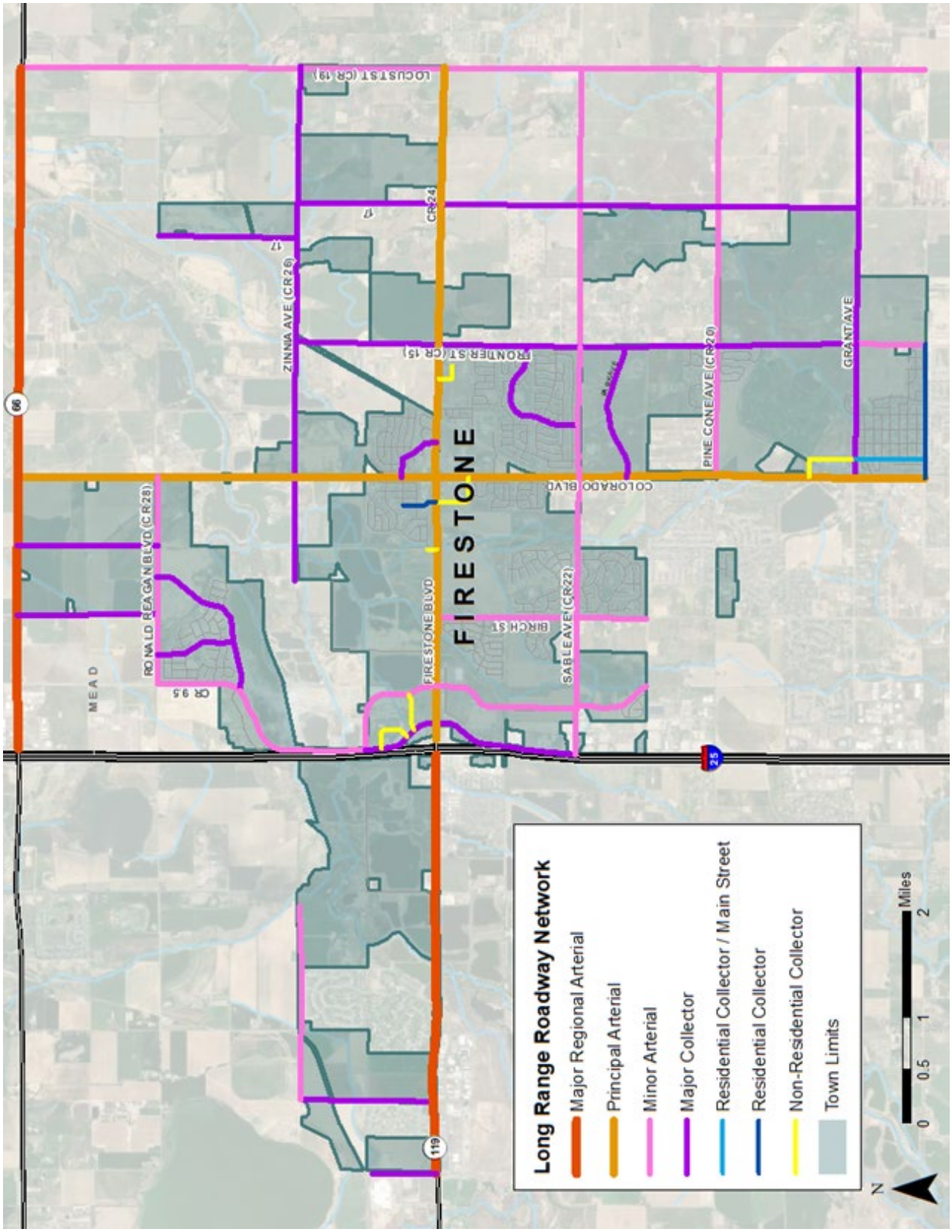
Existing Pedestrian Facilities along Major Roads (Figure 15)



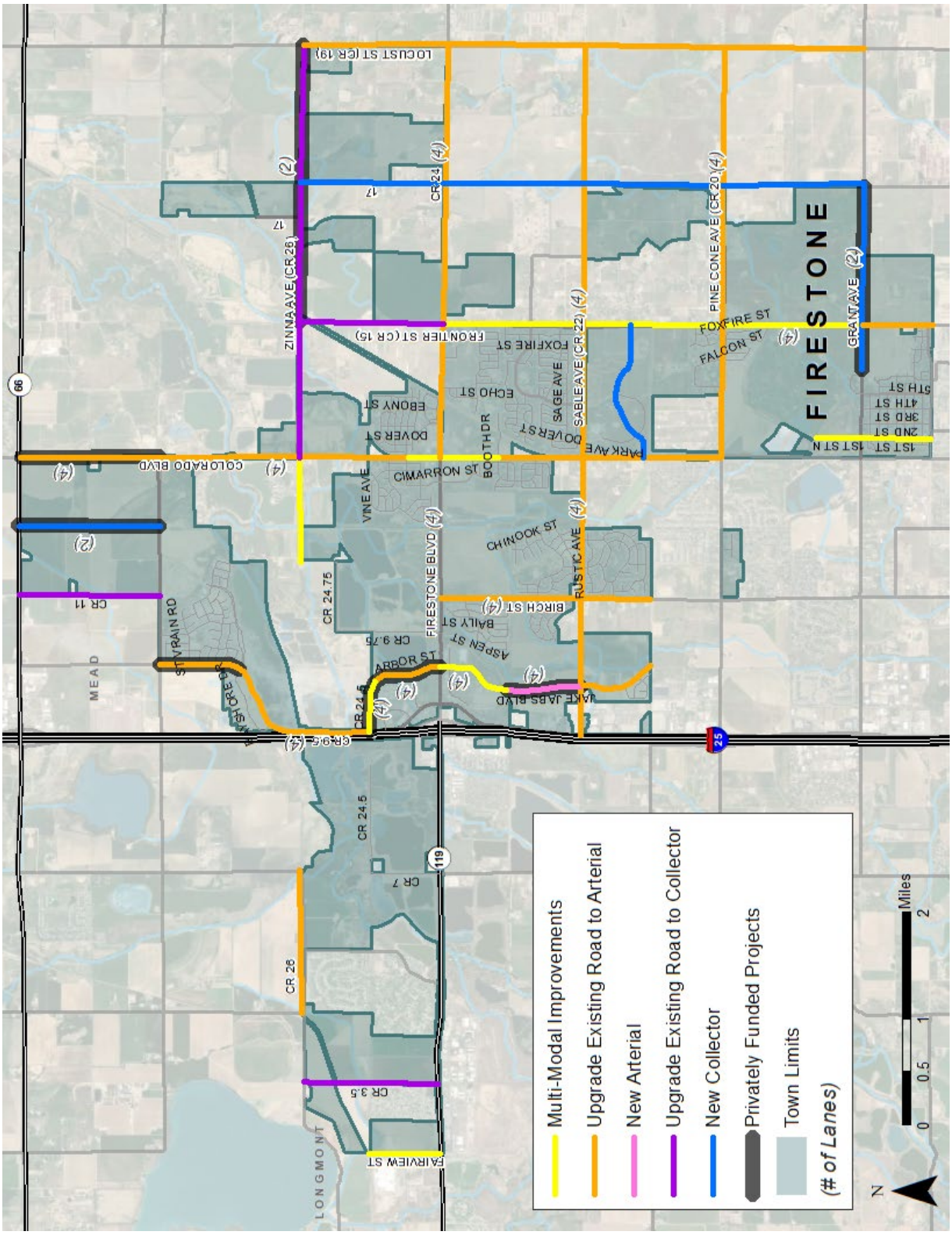
Existing Bikeways and Trails (Figure 16)



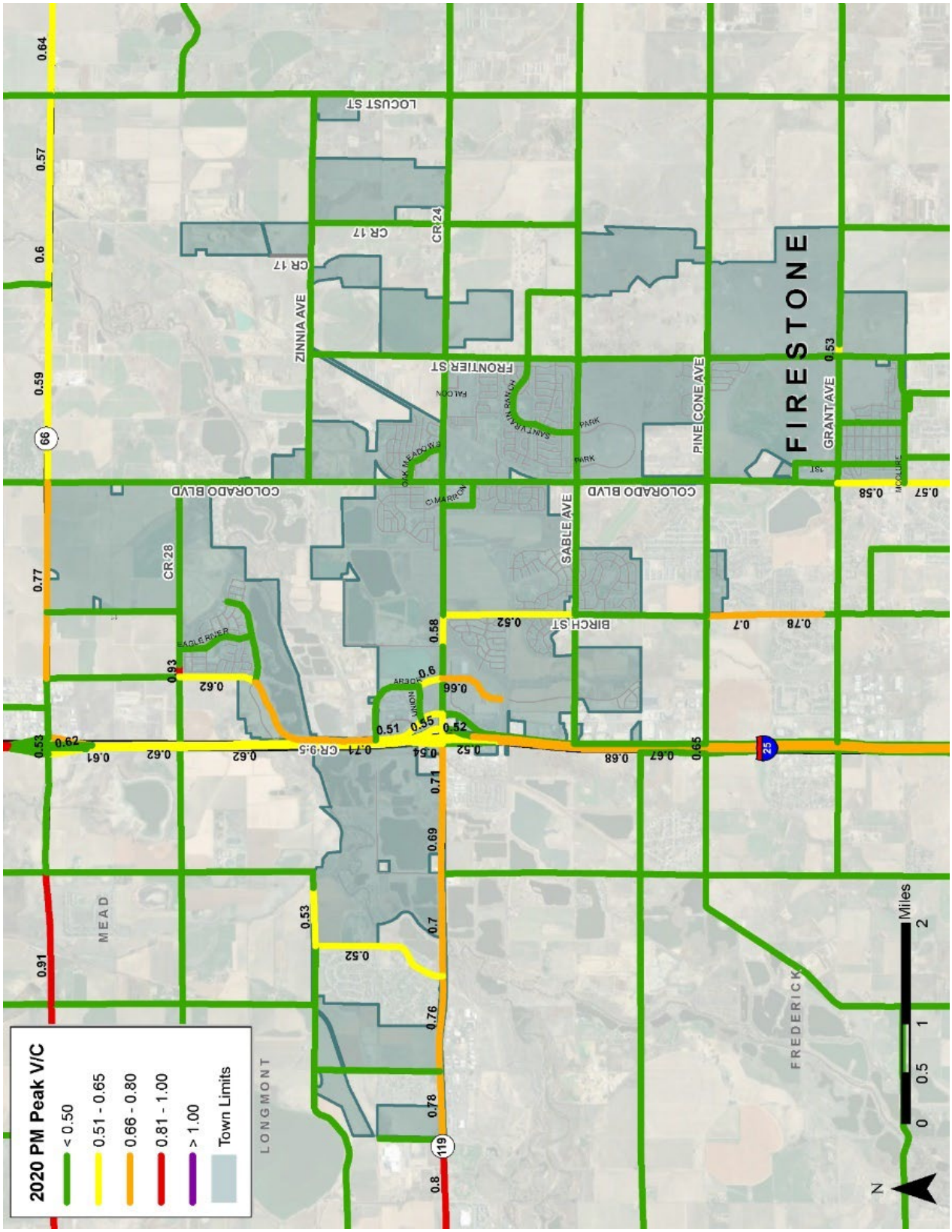
Proposed Long-Range Roadway Network (Figure 17)



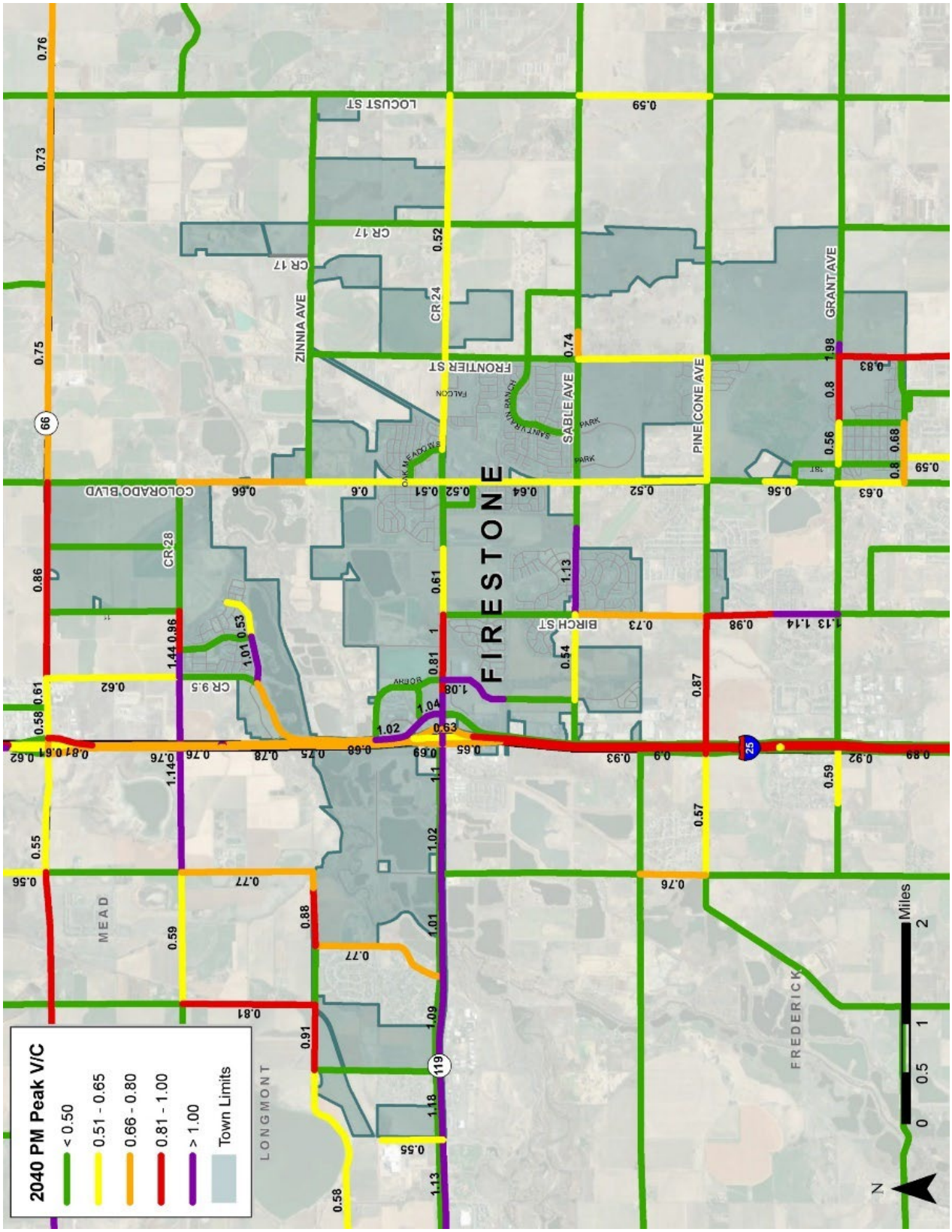
Key Firestone Roadway Projects (Figure 18)



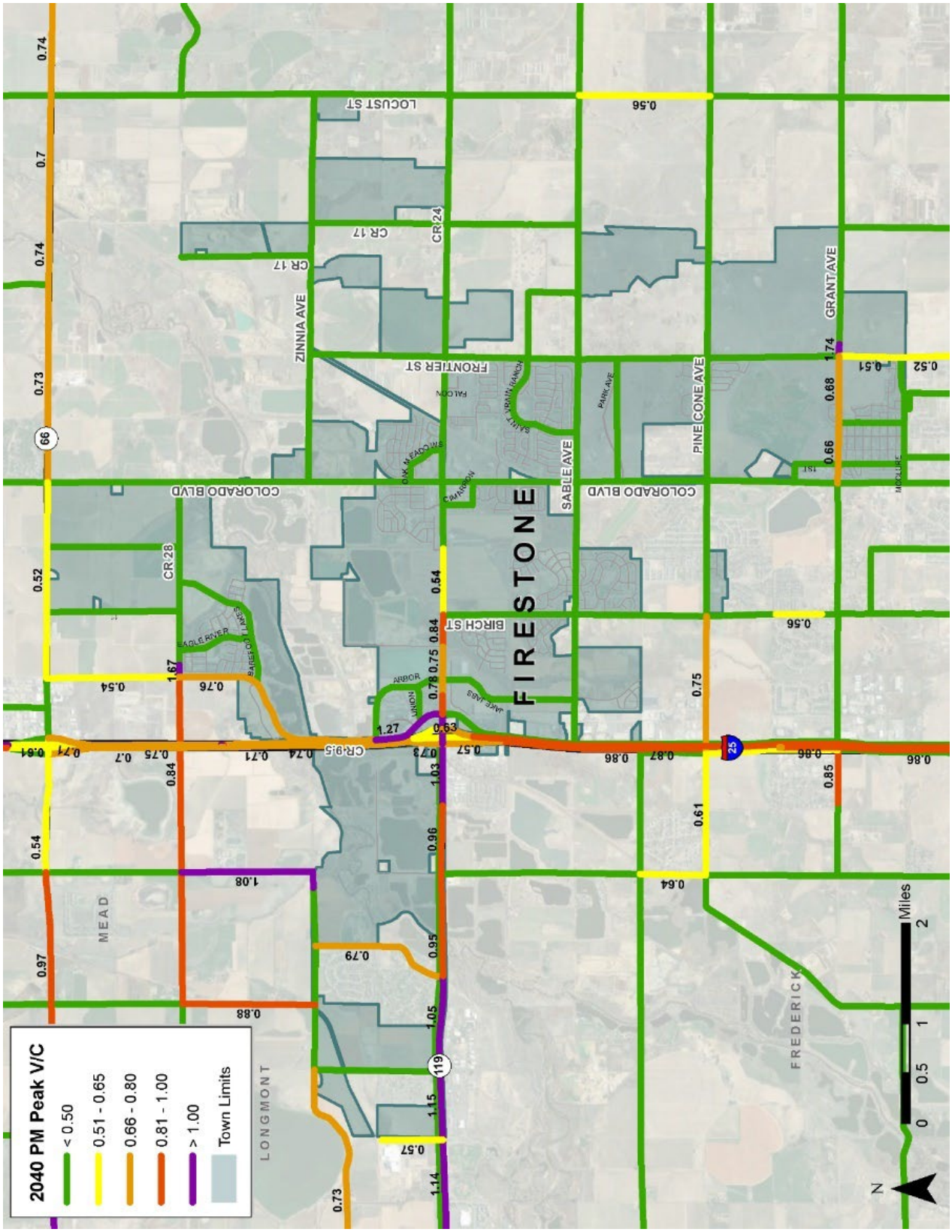
2020 Base Scenario PM Peak Period V/C Ratios (Figure 20)



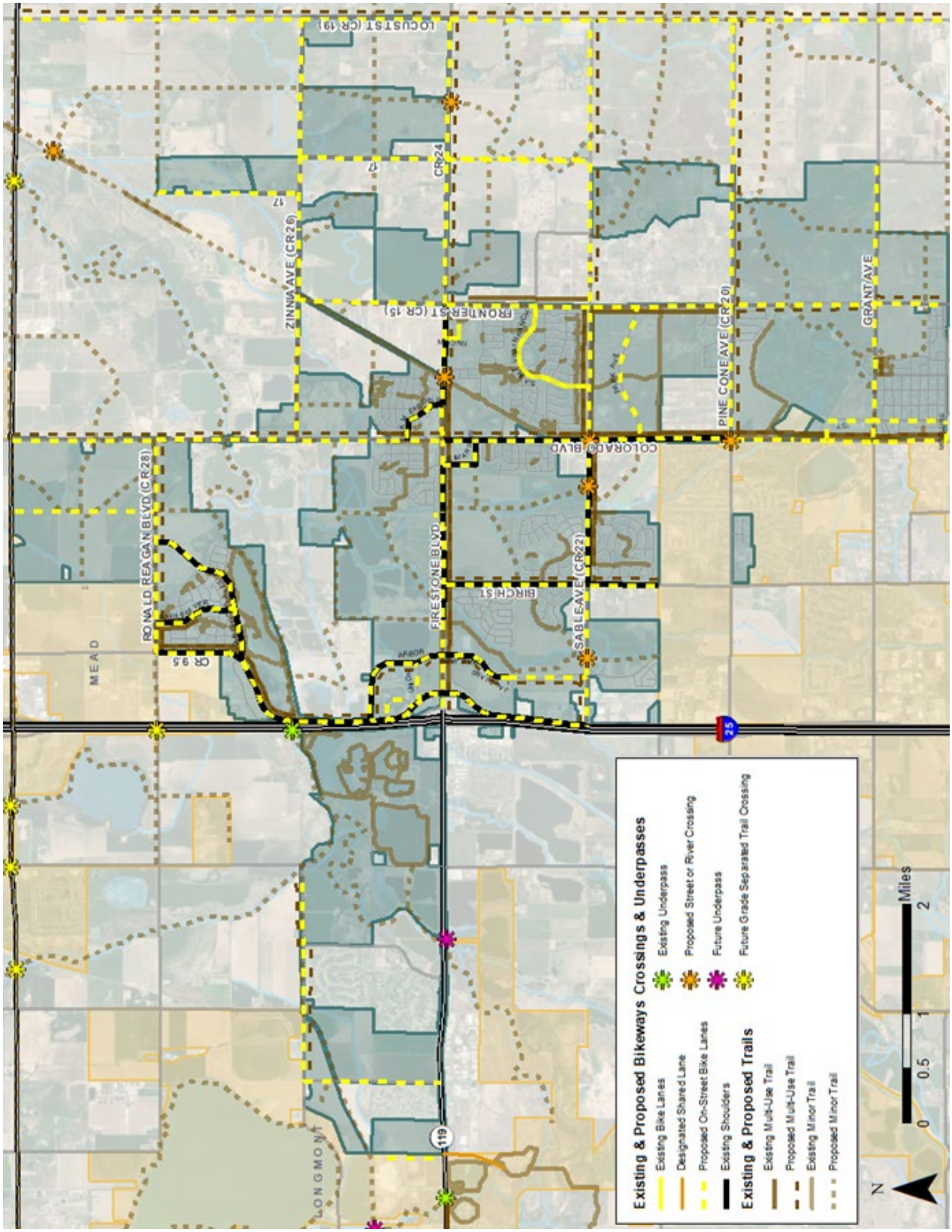
2040 Base Scenario PM Peak Period V/C Ratios (Figure 21)



2040 Build Scenario PM Peak Period V/C Ratios (Figure 22)



Long-Range Bikeways and Trails Network (Figure 24)



Major Publicly Funded Roadways with Implementation Timeframe (Figure 25)