City of Thornton Transportation Plan

CHAPTER 5: ROADWAY PLAN

As part of the development of the *Thornton Transportation Plan*, roadway plans were prepared for 2035 and Buildout of the City. Several roadway alternatives were studied in this process to address transportation needs and problems that resulted from increased travel demand related to ongoing growth in the City and surrounding areas. The City's traffic model, which was developed concurrently with the transportation plan, was used to test and evaluate each alternative. The planning process and resulting roadway plans are presented in the following sections.

EXISTING CONDITIONS - BASE YEAR ROADWAY NETWORKS

Roadway networks were updated in the City's traffic model was calibrated to reflect local 2001 and 2003 roadway configurations and functional classifications. The networks are used in the travel model, along with socioeconomic/land use data to estimate trip-making and subsequently, the travel demand on the roadway system.

The network generally contains all roadway types except local and some residential collector streets due to the additional complexity and resources necessary to model them. Furthermore, the City's travel demand model does not require these streets since they are almost always two lanes with room for parking and rarely, if ever, congested. They are an important component of the transportation system particularly with regard to access to local land uses. However, local and residential collector streets carry a small amount of traffic relative to the large number of lane miles and percentage of the overall roadway system they comprise. The lane-mile statistic indicates the total miles of traffic lanes that are simulated by the travel model. The vehicle miles of travel (VMT) and vehicle hours of travel (VHT) statistics measure system performance using time and distance. For example, one vehicle traveling 20 miles over the course of a day would result in 20 vehicle miles traveled. If this vehicle made two 30-minute trips the result would be one vehicle hour traveled. Both VMT and VHT will rise with increased socioeconomic activity, increased traffic, and/or increased roadway congestion. Perhaps the most relevant measure is congestion delay. Congestion delay represents time wasted to congestion in the roadway system. Each of these measures, summarized in Table 3 for the 2005 roadway network, can provide insight into the performance of the transportation system.

The 2001 and 2003 roadway networks were used to calibrate the City's traffic model. In this manner, the model's estimates of traffic volume were compared to observed 24-hour traffic counts. Parameters and input data were adjusted to provide an acceptable degree of statistical similarity between the model's estimates and the observed data. Once calibrated, the model was used to forecast future travel demand for the 2035 and Buildout scenarios.

Table 3
2005 Roadway Characteristics

	Lane-Miles	**Vehicle Miles of Travel (miles per day)**	**Total Vehicle Hours of Travel (hours per day)**	**Congestion Delay (hours per day)**
Thornton Planning Area	1,435	1,936,000	45,700	4,300
Denver Region	32,786	56,433,000	1,533,900	249,200

Figure 12 shows the 2005 roadway network level-of-service characteristics from the City's traffic model. Traffic volumes are represented by the bandwidth thickness of each roadway segment. The latest City of Thornton Traffic Volumes can be found in Appendix B.

The following information is a brief overview on how the transportation model is derived from land use to roadway volumes and the relationship between volumes and roadway characteristics to level of service.

Analysis Tools – Thornton Traffic Model

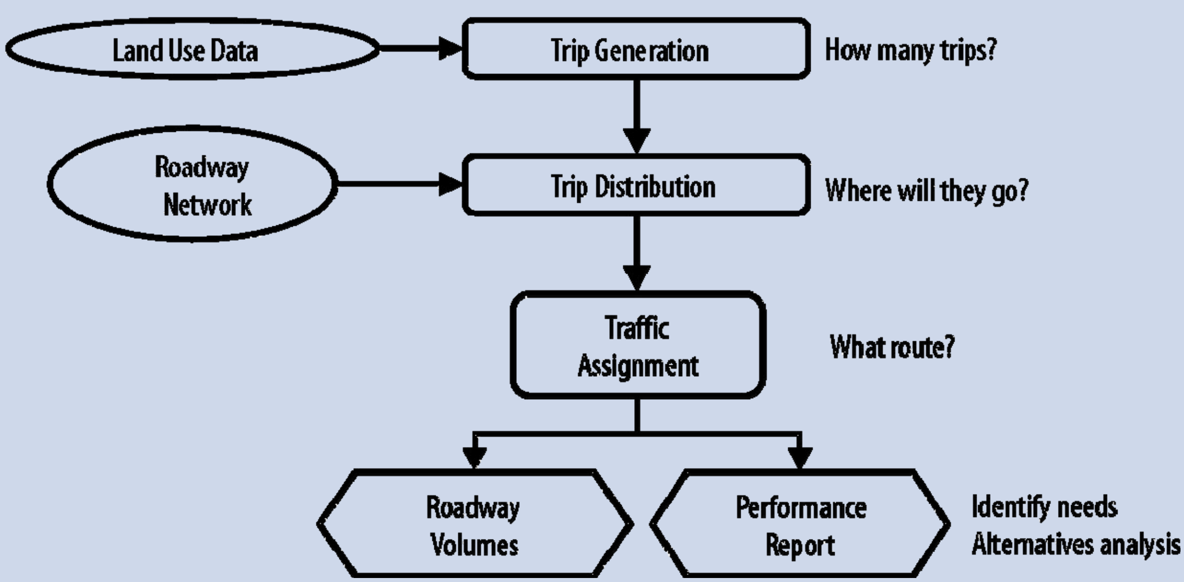
The *Thornton Transportation Plan* was developed through an analysis of system deficiencies and potential alternative solutions using estimates of future travel demand. Travel demand, including roadway traffic volumes, is forecasted using the Thornton Traffic Model.

The model process, shown graphically below, uses estimates of household and employment data and the existing roadway network as input assumptions. The Trip Generation module calculates the amount of trip-making that takes place based on activities associated with household and employment data. The Trip Distribution module determines the origin and destination of each trip. In the Traffic Assignment module, specific routes are computed through consideration of travel time/congestion, distance, and toll costs.

The model can produce reasonable results for several land use and roadway network scenarios. The intent is to produce estimates of average weekday traffic volumes for each roadway segment in the network. These are converted to peak hour traffic volumes for level of service analysis. In this manner, roadway deficiencies can be identified and potential alternative solutions evaluated.

A word of caution: the model is a tool that can be used to assist with the evaluation of potential roadway improvements, but it is not a crystal ball. While the model provides valuable information, it is not sensitive to all aspects of the planning process. Forecasted model results are estimates of future conditions based on specific assumptions of socioeconomic activity, transportation system characteristics, and travel behavior. Generally, the model assumes that travel behavior in the future will be similar to today, which may or may not be the case. On the other hand, the model is considered to be sensitive to changes in the transportation system. For example, if new travel mode options are introduced into the system, such as a new commuter rail line, the model will predict shifts in travel from other modes to this new mode.

Traffic Model



ROADWAY LEVEL OF SERVICE

A common measurement of operational performance by an intersection or corridor is level of service (LOS). In its simplest form, roadway LOS can be compared to a grading scale from "A" to "F," where "A" represents excellent level of service and "F" indicates failure. LOS takes into account vehicular delay, maneuverability, driver comfort, congestion delay, and travel speed. It is typically reported for the worst peak hour of a typical weekday, also known as rush hour.

The City of Thornton tries to maintain a minimum of LOS D for the roadway system and for intersection operations. As congestion reaches very high levels at specific corridor or intersection locations, the LOS standards can be relaxed.

	A	B	C	D	E	F
Driver Comfort	High	High	Some Tension	Growing Tension	Uncomfortable	Distressed
Average Travel Speed	Speed Limit	Close to Speed Limit	Close to Speed Limit	Some Slowing	Significantly Slower than Speed Limit	Stop and Go
Maneuverability	Almost Completely Unimpeded	Only Slightly Restricted	Somewhat Restricted	Noticeably Limited	Extremely Unstable	Almost None
Intersection Delay (control delay per vehicle, sec)	< 10	10 - 20	20 - 35	35 - 55	55 - 80	> 80
Arterial Volume/ Capacity Ratio	< 0.6	0.6 - 0.7	0.7 - 0.8	0.8 - 0.9	0.9 - 1.0	> 1.0

LOS D is Thornton's desired standard for roadway and intersection performance.

2035 ROADWAY PLAN

In order to develop the 2035 Roadway Plan, several updates were made within the City's traffic model. DRCOG's 2035 Metro Vision network was used as the starting point for the roadway system. It was reviewed and updated due to minor errors, and additional network detail was added within Thornton and the areas immediately adjoining the City, including the coding of several collector streets. Outside of Thornton, roadway plans for the cities of Westminster, Northglenn, and Broomfield were obtained (where available) to update the network. Adams County provided additional information to refine the roadway network.

Once the 2005 base network was established, several alternatives were tested. These included new and widened roadways, changes to roadway functional classifications, interchanges on I-25, regional arterial street connections, and detailed alignment changes in specific locations.

The model provided forecasts of traffic volumes for the 2035 scenario for each of the alternatives tested based on travel demand generated from DRCOG's official 2035 socioeconomic dataset. Lane warrants and roadway functional classifications were determined based on the 24 hour traffic volume forecasts and level-of-service capacity thresholds, which are shown in Table 4. The City tries to maintain a minimum of "D" level-of-service for roadways, so the figures in that column of the table are particularly relevant to the selection of functional classification and number of lanes necessary to accommodate the expected traffic demands in the future. However, the *Thornton Transportation Plan* does not recommend more than six lanes on major arterial streets due to the decreasing effectiveness relative to investment for roads with very large cross sections.

Table 4
Roadway Level-of-Service Thresholds by Functional Classification

	LOS				
	A	**B**	**C**	**D**	**E**
Major Regional Arterial					
6 Lane	36,700	48,200	56,900	64,800	72,000
Major Arterial					
6 Lane	27,500	36,200	42,700	48,600	54,000
4 Lane	18,400	24,100	28,400	32,400	36,000
Minor Arterial					
4 Lane	16,300	21,400	25,300	28,800	32,000
Collector					
2 Lane	6,100	8,000	9,500	10,800	12,000

The Thornton roadway plan for the year 2035 is shown in Figure 11 with lane and functional class designations. LOS results for the 2035 Roadway Plan are shown in Figure 12. Appendix A contains a map of the recommended 2035 Roadway Plan with forecasted traffic volumes. As the level of service map in Figure 12 shows, there are a few roadway segments in the LOS E and F (i.e., failing) categories. In the case of 120th Avenue east of I-25, the travel demand in the peak hour exceeds the 6-lane roadway capacity but the City's policy restricts arterial street cross-sections to six lanes, thus the bridge width over I-25 handles the six lane cross section with dual left turns onto. In the other cases, such as on Grant, Huron, and south Colorado, the relatively isolated capacity problems did not warrant wholesale improvements to these corridors. Each of these corridors is improved in the Buildout scenario.

CONCEPTUAL ROADWAY VISION PLAN FOR BUILDOUT

Once the 2035 roadway plan was established, an analysis of travel conditions and infrastructure improvements was conducted to develop a conceptual roadway vision for the Buildout of the City's land use plan, which is estimated to occur sometime beyond 2050. Of course, forecasting land use and transportation conditions that far into the future is speculative at best, but it nonetheless provides valuable information for preserving right-of-way needs into the long-term future.

Since the City's traffic model is based on DRCOG's regional model, it was necessary to update the roadway network assumptions for the entire modeling domain covering the Denver metropolitan area in order to simulate Buildout conditions in the City. Assumptions varied depending on the area of interest. The 2035 Roadway Plan was used as the basis for the roadway network inside the Thornton planning area. Additional alternatives/improvements were added from there to test Buildout conditions.

Outside of the Thornton Planning Area in the remainder of the Denver metro area, roadway functional classifications and lane assumptions were based on DRCOG's Metro Vision 2035 network with additional freeway, expressway, and major arterial capacity added where appropriate to simulate conditions beyond 2050. In some cases, alignments and other assumptions in this area were changed to reflect plans of local jurisdictions, especially those close to the City of Thornton. An Interchange on I-25 was assumed at 128th Avenue in addition to the existing locations. A new interchange was assumed at E-470 and Quebec as well.

Household, population, and employment assumptions for Buildout are described in the Land Use and Socioeconomic Assumptions chapter of this report. The Buildout model's trip-generating methodology also incorporated effects of increased transit patronage associated with RTD's FasTracks rail and FasConnects bus systems.

For roads in the older parts of Thornton, the 2035 Roadway Plan assumptions were initially used in the Buildout network. As the study progressed, some changes were made to the roadway network in these areas to properly coordinate lane and functional classification assumptions with travel needs associated with Buildout conditions.

Several roadway configurations inside the subarea were tested and refined to accommodate the traffic demands on the system. This was an ongoing process that considered various configurations on virtually all of the arterial streets in the City, including those under the jurisdiction of other entities, such as Highway 7 and Highway 44 by the Colorado Department of Transportation. Other roadway alternatives included:

- Disconnecting Yosemite and Quebec from Riverdale Road;
- A southern connection of Colorado Boulevard to I-76;
- Collector streets north and south of E-470;
- Various alignments and configurations of Sheridan Parkway. as it crosses I-25 to the east; and
- Several assumptions for the north-south and east-west arterial streets.

The model provided forecasts of traffic volumes for the Buildout scenario for each of the alternative networks tested. Lane warrants and roadway functional classifications were determined based on the traffic volume forecasts and level-of-service capacity thresholds, which were shown previously in Table 4. The City tries to maintain a minimum of "D" level-of-service for roadways, so the figures in that column of the table are particularly relevant to the selection of functional classification and number of lanes necessary to accommodate the expected traffic demands in the future.

In some cases in the Buildout scenario, however, the traffic demand was too great to maintain LOS D. The *Thornton Transportation Plan* does not recommend more than six lanes on major arterial streets due to the decreasing effectiveness relative to investment for roads with very large cross sections. In addition to reaching a point of diminishing return on investment, arterial street cross-sections with more than six through lanes will significantly hinder pedestrian activity due to the very large distance to cross the street. As a result, under the Buildout scenario, several roadways segments and corridors will be overcapacity at least in the peak hour of the day, also known as rush hour. Most of these roads are planned as six lane arterials. However, two corridors, Thornton Parkway and 88th Avenue, are limited to 4 lanes due to the character of the local land uses and right-of-way restrictions.

The six lane arterials that are over-capacity in the Buildout scenario are affected by both local and regional traffic. The Interstate facilities (i.e., I-25 and I-76) surrounding Thornton are also projected to be over-capacity in the Buildout scenario. This has the effect of pushing "latent demand" from the freeway onto the local arterial street system. With the additional stress of this cut-through traffic within Thornton, traffic volumes on a number of facilities in the City will be over-capacity. This leads to larger peak periods as more and more travelers adjust their schedules to avoid the peak rush hour. It also causes more travelers to switch to alternative modes, especially transit. In fact, traffic congestion is one of the key ingredients to a successful transit system. With RTD's FasTracks program, commuter rail should be up and running in Thornton long before the Buildout condition occurs. In theory, additional transit service and travel demand management programs could be implemented to address over-capacity situations in the Thornton Buildout scenario.

Based on a detailed analysis of travel demands and roadway alternatives, the recommended Buildout network for the City is shown in Figure 13. Level-of-service results for this network are shown in Figure 14. Appendix B contains a map of the recommended Buildout network with forecasted traffic volumes.

The *Thornton Transportation Plan* classifies 136th Avenue as a four-lane major arterial from Holly Street to Riverdale Road in the recommended Buildout network. This functional classification will allow the City to reserve adequate right-of-way to provide future transportation possibilities if Adams County and the City of Brighton decide to extend 136th Avenue east of Riverdale and to construct a future crossing of the South Platte River and E-470 to US 85.

ARTERIAL ACCESS MANAGEMENT

City of Thornton staff is in the process of creating an Arterial Access Management Plan. The purpose of an arterial access management plan is to define the vision for what the arterial corridors will look like, determine location and function of access points, enhance safety, preserve capacity and help to establish the City's desired LOS for arterials. The goal will be to limit non-signalized intersections while locating points that attract developers to the proposed future land use. With this Access Management Master Plan, future developers will be able to see the locations of City approved access points and can begin their designs with the locations known.

SIGNALIZED INTERSECTIONS

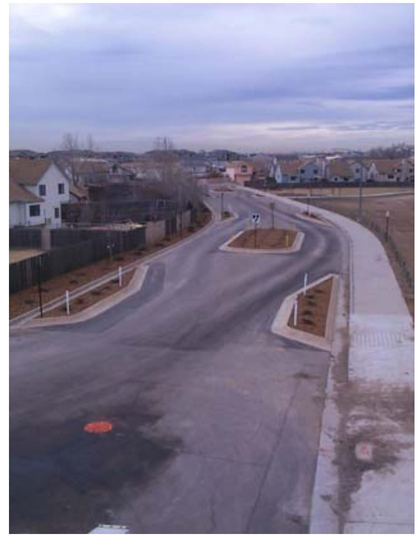
The City uses the Manual on Traffic Control Devices (MUTCD) as the guideline to determine the warrant for new traffic signals. Chapter 4 in the MUTCD clearly outlines the necessary steps to evaluate intersections for the need of a traffic signal. The MUTCD states "Standards for traffic control signals are important because traffic control signals need to attract the attention of a variety of road users, including those who are older, those with impaired vision, as well as those who are fatigued or distracted, or who are not expecting to encounter a signal at a particular location."

The existing locations of traffic signals can be found on the City of Thornton website.

http://www.cityofthornton.net/id/signals.asp

TRAFFIC CALMING

Thornton City Council has adopted traffic calming requirements for new developments. These requirements can be found in the City of Thornton resolution C.D. No.2005-094 "City Council Policy Pertaining to Traffic Calming in New Developments". The methods for controlling vehicular speeds per this policy include appropriate street layouts, roundabouts/traffic circles, speed tables, raised intersections, curb extensions and medians with the primary means of traffic calming focused on street layout.



ROADWAY FUNCTIONAL CLASSIFICATION AND DESIGN STANDARDS

The City of Thornton has adopted design standards for roadways constructed in newly developing areas. Design standards can be relaxed for retrofit improvements to existing roadways in already developed areas. The reader is referred to the City of Thornton Standards and Specifications for the Design and Construction of Public and Private Improvements for the most up-to-date roadway standards for both mid-block and intersection locations. The functional classification of a roadway reflects its role in the region's street and highway system and forms the basis for access management, corridor preservation, and street design guidelines and standards. Roadway function tends to vary to some degree depending on the amount of urbanization in a particular corridor. The differences in the nature and intensity of development in rural and urban areas warrant corresponding differences in design characteristics.

The roadway functions of the facilities described in the *Thornton Transportation Plan* represent a desired function for ultimate buildout. Existing roadways may not meet all of the desired characteristics described by their function, but strategic improvements can serve to fulfill the future vision over time. As proposed roadways are planned and developed, the guidelines and standards associated with their function should be considered to the degree practical and appropriate. Functional classifications are summarized as follows.

Freeway/Interstate/Tollway

These are divided, limited access facilities with no direct land access and no at-grade crossings or intersections. Freeways, interstates, and tollways are intended to provide the highest degree of mobility, serving higher traffic volumes and longer, regional trips. These include I-25 and E-470.

Major Regional Arterial

These are similar to freeways but can include some at-grade intersections at cross-streets. Access may be either full or partial control with a small number of locations with direct land access. Major regional arterials are intended to provide higher levels of mobility rather than local property access. State Highway 7 (160th Avenue) and 120th Avenue would be examples of this roadway in the City of Thornton

Major Arterial

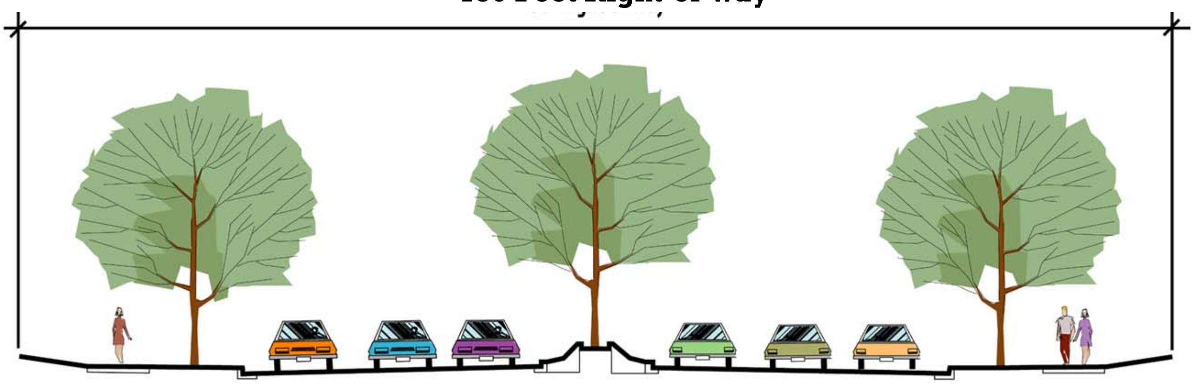
Major arterials permit traffic flows through the urban area and between major destinations. They are of great importance in the transportation system since they connect major traffic generators to other major activity centers. Major arterials carry a high proportion of the total urban travel on a minimum of roadway mileage. In urban areas, a gridded pattern of arterials is recommended with 1-mile spacings for major arterials.

Since movement and not necessarily access is the primary function of major arterials, access management is essential to preserve capacity and enhance safety. Medians can be used to control potential conflict points and to separate opposing traffic movements. Left turn lanes are essential at intersections to maintain mobility for through traffic. Dual left turn lanes are required for major arterials onto major or minor arterials. Right turn deceleration lanes are required at intersections on these facilities.

The *Thornton Transportation Plan* does not recommend more than six lanes on major arterial streets due to the decreasing effectiveness relative to investment for roads with very large cross sections.

Below is an example of the Major Arterial cross section.

150 Foot Right-of-way

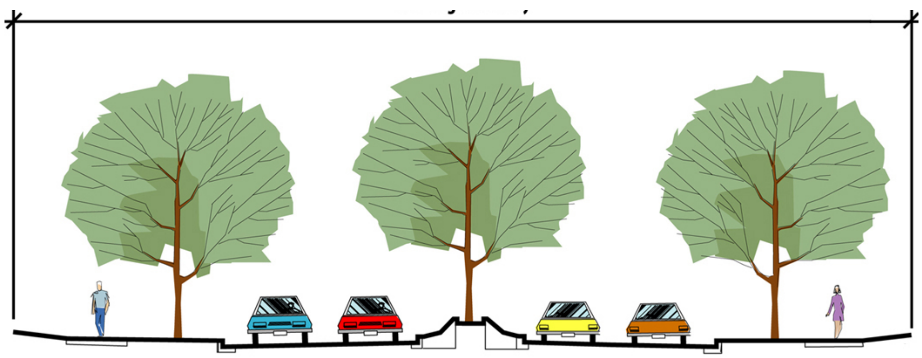


Minor Arterial

Minor arterials collect and distribute traffic from principal arterials and expressways to streets of lower classification and, in some cases, allow traffic to directly access destinations. They serve secondary traffic generators such as community business centers, neighborhood shopping centers, multifamily residential areas, and traffic between neighborhoods. Access to land use activities is generally permitted, but should be consolidated, shared, or limited to larger-scale users.

Below is an example of the Minor Arterial cross section.

100 Foot Right-of-way

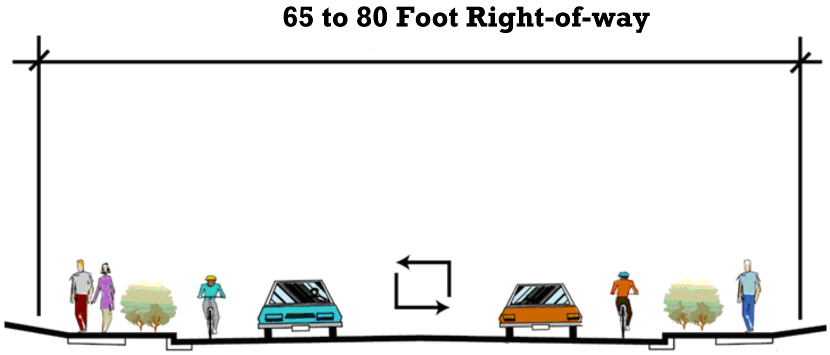


Collector Street

Collectors provide for land access and traffic circulation within and between residential neighborhoods and commercial and industrial areas. They distribute traffic movements from these areas to the arterial streets. Collectors do not typically accommodate long through trips and are not continuous for long distances. In areas where arterial streets are adequately spaced, collector streets should traverse through residential areas wherever possible. Individual accesses from residential lots are not allowed directly onto collector roadways. The cross section of a collector street may vary widely depending on the scale and density of adjacent land uses and the desired character of the local area. Left turn lanes should be considered on collector streets adjacent to nonresidential development.

Riverdale Road is classified as a collector street and is noteworthy due to its unique character as a scenic byway. The City of Thornton and Adams County have worked together to retain the special qualities of this corridor. Adams County has policies in place that restrict future widening of Riverdale Road, limit future access points, and encourage new development to use alternative access ways, shared driveways, or access from existing side streets. For these reasons, Riverdale Road does not and is not expected in the future to have the characteristics of a typical collector street.

Below is an example of a Collector Street cross section.



Residential Collector Street

A special category of collector streets, the residential collector, is characterized by lower speeds and the residential nature of land uses along the corridor. Bicycle and pedestrian facilities are strongly recommended for residential collectors. Various treatments, such as raised crosswalks and other traffic-calming devices, could be used to reduce travel speeds. All collectors should be limited to two lanes, but this standard is especially important for residential collector streets with adjacent single family and multifamily land uses.

The two primary roadway functions of access and mobility are represented in Figure 20 for the various roadway classifications.

ROADWAY IMPROVEMENT COSTS

The 2035 Roadway Plan and the Buildout Vision Plan represent substantial new roadway capacity in the Thornton planning area in the future. Appendix E identifies the specific arterial street improvements that are planned for implementation before 2035 and after 2035. The table also indicates the roadway cross-section associated with each improvement; estimated costs are included. The costs are based on either the application of unit costs or an estimate from a study or engineering cost analysis. Costs include design, engineering, and construction. Costs for bridges and other structures are included where known. Right-of-way costs are not included. In addition to the anticipated costs, Appendix E also listed potential funding sources. These sources could be Federal funds (F), Colorado Department of Transportation (CDOT), Developer funds (D), Adams County (AC), Weld County (WC), City and County of Broomfield (CCB), City of Westminster (CoW) and the City of Thornton (CoT).

Cost figures in Appendix E are for long-range planning purposes only and subject to refinement as each improvement nears budget, design and then construction. Also, the unit costs represent averages from past projects. Lane-mile costs between projects can vary considerably because each is unique and can have distinctive characteristics (such as drainage, elevation changes, interstate, highway and railroad crossings) that can increase or decrease costs, thus the prices shown are for general idea only. When a roadway is to be designed and constructed, more specific cost estimating will be required. When referencing these cost figures in Appendix E, the priority ranking was given numbers to associate the improvements with certain time frames. These time frames and priorities may change as conditions, funding sources and development continue to evolve. The priority dates were derived from anticipated development projects, level of service capacities needs and improvements needed to provide service to the FasTracks stations. These priority rankings follow the list below:

Priority	**Time Frame**
1	2010-2015
2	2015-2025
3	2025-2040
4	2040-2060
5	2060-2080