APPENDIX A: INFRASTRUCTURE AND UTILITIES

Introduction

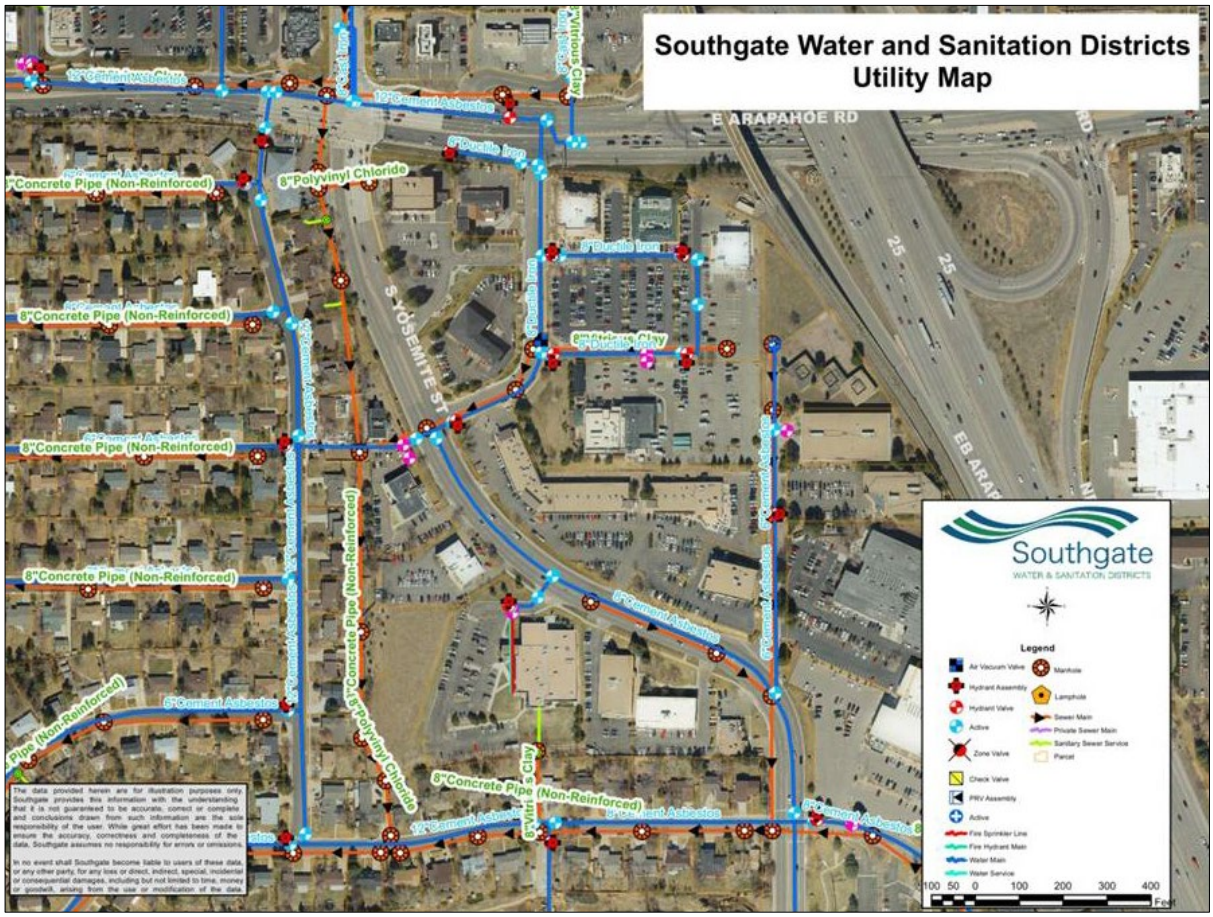
This chapter examines existing and proposed improvements to capital infrastructure in the study area focused on two primary areas: utilities and transportation.

Water and Sanitary Sewer

Figure 1 illustrates the existing water and sewer utilities in the study area.

Figure 1: Existing Water and Sewer Utilities in the Study Area

Source: Southgate Water & Sanitation Districts; Wilson & Co.



Water Utilities

Potable Water System

The site has both 6 and 8-inch water lines bifurcating the site, comprised of different materials, from Ductile Iron pipe to Asbestos Cement pipe. It will be our recommendation as the final layout of the master plan is completed to redistribute the location of the looped water distribution system to provide an increase in water pressures, removing all 6-inch water lines and using a minimum 8-inch diameter line. There are two large-diameter water lines adjacent to the site that can provide adequate water demands and pressure to the site. There are two 12-inch lines located in East Arapahoe Road and to the west along South Willow Street that will be part of the hydraulic grid for the overall future project. The proposed relocated system for the future project will be phased to support the gradual growth of the system.

Two types of water utilities are generally required to adequately serve development: a looped overall distribution system and required fire flows for the proposed and future development. Generally, the largest demand for any domestic water system is the fire flows demand for both internal fire suppression systems and the fire hydrants serving the site.

The study area has both six-inch and eight-inch water lines bifurcating the site, comprised of different materials, from ductile iron pipe to asbestos cement pipe. There are two water lines that are currently "dead-end" in the northeast corner of the study area near Finn McCool's.

As the final layout of the master plan is completed, the study area should include a looped water distribution system to provide an increase in water pressures, removing all six-inch water lines and using a minimum eight-inch diameter line. There are two large-diameter water lines adjacent to the site that can provide adequate water demands and pressure to the site. There are two twelve-inch lines located in East Arapahoe Road and to the west along South Willow Street that will be part of the hydraulic grid for the overall future project. The proposed relocated system for the future project will be phased to support gradual growth of the system.

Sanitary Sewer System

When preparing a master plan, we first look at the available capacity in the existing sanitary system. This analysis allows us to potentially use the available capacity of the sanitary system to reduce the infrastructure for future development. It also allows us to potentially phase the project, also reducing early infrastructure costs.

The study area currently is served by two eight-inch sanitary sewer lines, which convey sewage flows southerly toward South Yosemite Street. Figure 1 is a hybrid of the existing base mapping provided by the Southgate Water and Sanitation District, which shows design points and the flows from the existing retail, office, and restaurant buildings.

The first step was to calculate the existing average and peak demands from the different types of existing land uses. Flow rates were determined for the retail, office, and restaurants currently on

the site. Flow rates were established based on the number of seats in each restaurant and the total square footage of each office building or retail business. These flow rates then were combined along the linear aspects of the existing sanitary line creating design points that show the combined flows of the existing sanitary system.

Next, the maximum allowable flows for the overall system were determined to now include the available remaining capacity in the two sanitary lines for future development.

The future flows were then analyzed compared to the available capacity in the system which shows that over a million square feet of office uses could be constructed using the existing sanitary sewer system. Computations show the breakout for the future available land uses at two design points for the existing system. The results of the analysis allow insight into potential phasing, and maximum land use for the Regulating Plan, without impacts to the overall capacity of the serving sanitary system.

When projecting growth or new land uses, there are several constants that are used as part of the guidelines for the Sanitation District.

- Restaurants: 25 gallons per day per seat
- Office: 0.1 gallons per day per square foot
- Residential unit: 155 gallons per day per unit
- Retail: 0.15 gallons per day per square foot

Using these guidelines, the existing sewer system has enough capacity to serve any one of these scenarios:

- 1,716 residential dwelling units
- 2.66 million square feet of office development
- 1.77 million square feet of retail development
- 10,638 restaurant seats

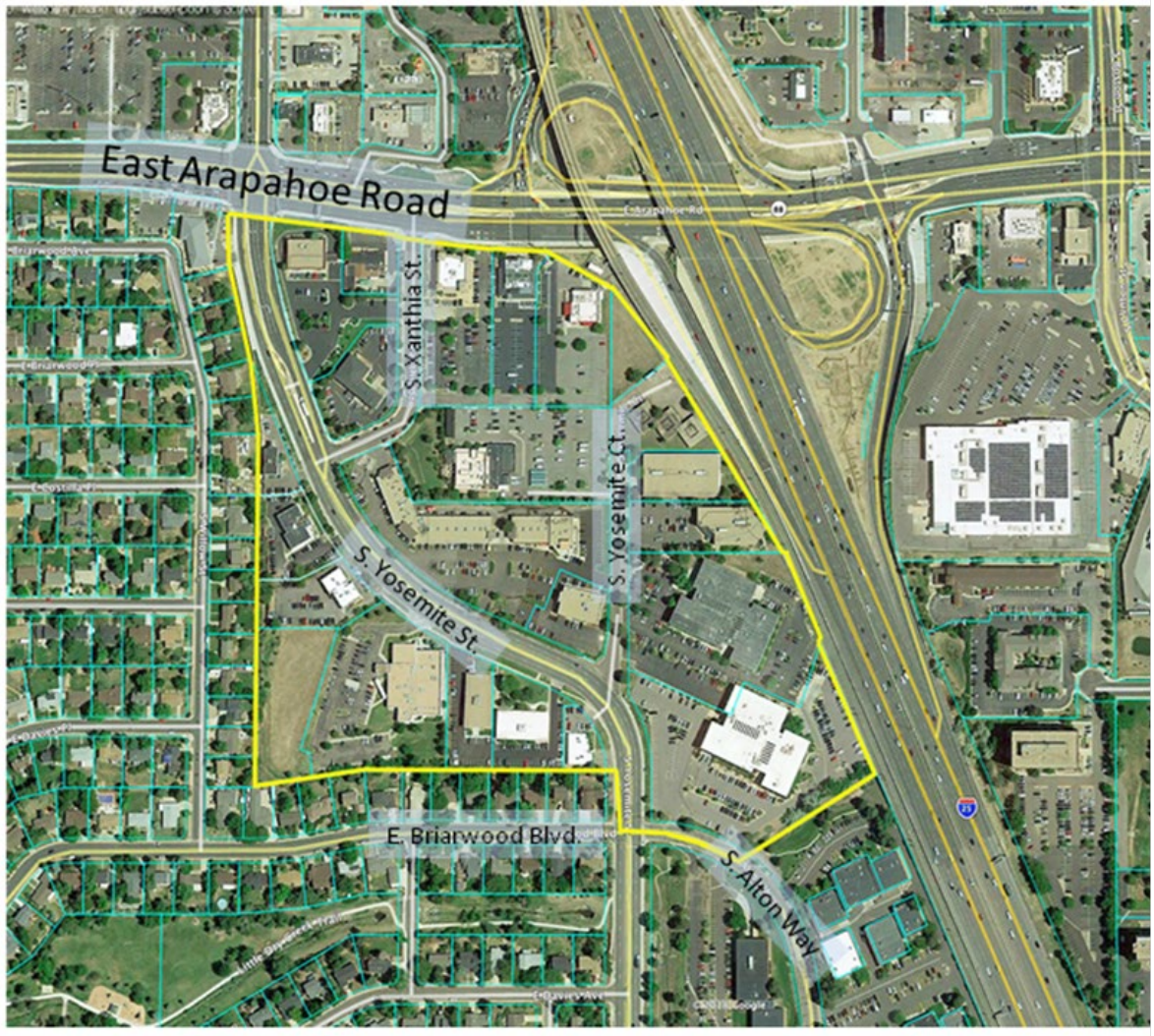
While these numbers reflect the existing capacity to serve any one use, the likely development scenario will incorporate smaller elements of all these uses that, when added together, will be adequately served by the existing sanitary sewer infrastructure. If future redevelopment proposals exceed existing capacity, improvements will be required as a part of the approval process.

Roadway Infrastructure

This section evaluates previous concepts and proposes new alternatives to improve access to the study area. It also identifies short-term and long-term transportation infrastructure improvements (including potential roadway and intersection improvements), potential phasing, and conceptual costs to improve mobility that will be incorporated into the conceptual Capital Improvement Plan.

Figure 2 shows the street layout in and near the study area. At the south end of the study area, South Yosemite Street intersects with South Alton Way (on the east side of Yosemite) and Briarwood Boulevard (on the west). The intersection is signalized with two through lanes in each direction on Yosemite, one through lane each way on Alton and Briarwood, and a single left-turn lane on each approach.

Figure 2: Roadway Configuration in Study Area



Source: Project Team

The two signalized intersections of East Arapahoe Rd./South Yosemite St. and East Briarwood Blvd./South Alton Way are 2,000 feet apart, and between those intersections, there are two

accesses into the main eastern part of the project area at South Xanthia Street and South Yosemite Court.

South Xanthia Street is the northernmost and principal access to the northeast part of the project area. South Xanthia Street is one lane in each direction with on-street parking and connects to Yosemite Street on the south and Arapahoe Road on the north, providing an opportunity for traffic to bypass the Arapahoe/Yosemite intersection.

South Yosemite Court is the southern street connection to the eastern part of the project area and is one lane in each direction. South Yosemite Court runs north-south, providing access to the properties on the eastern edge of the site that border I-25, and terminates at a private driveway. There is no public right-of-way connecting South Yosemite Court and South Xanthia Street, but there is informal connectivity via parking lots and a private drive west of Yosemite Court that allows traffic to access the entire eastern project area via indirect routes.

Multi-Modal Observations

The Arapahoe-Yosemite District study area is a unique combination of both positive and negative aspects related to mobility and access. On the positive side, its location at the interchange of I-25 and East Arapahoe Road as part of the growing and desirable South Denver metro area gives it regional access and exposure. The reconstruction of the I-25/Arapahoe Road interchange attempted to improve traffic flow and access throughout the immediate area. Additionally, the site has proximity to RTD's light rail network, being situated approximately ½ mile south of RTD's Arapahoe at Village Center Station, and one mile north of RTD's Dry Creek Station.

However, the study area site also has significant challenges related to mobility and access. South Yosemite Street (the prime access to the site from East Arapahoe Road) is constructed entirely for auto access, with its wide right-of-way and relatively high traffic volumes (estimated at 22,000 vehicles daily). While most sidewalks along Yosemite are relatively wide, the overall pedestrian environment is poor. Numerous driveways cross the sidewalks, and pedestrian crossing points are limited and often dangerous. There are no pedestrian amenities such as shade or lighting. The Little Dry Creek Trail, while a useful addition to the regional trail network, dead ends at South Yosemite just south of East Briarwood Boulevard. In addition to the lack of pedestrian amenities, there is no bicycle infrastructure along Yosemite. Figure 3 illustrates some of the issues associated with pedestrian movement and safety along Yosemite. In addition, pedestrian and bicycle access within the study area is limited, with non-continuous (and poorly delineated) street rights-of-way and large parking lots serving the multitude of businesses located there. Though two RTD stations are near the study area, both stations have significant barriers to access. RTD's 2015 onboard survey showed that most people (56%) access stations by walking. Pedestrians traveling to or from the study area are required to cross either East Arapahoe Road to access the Arapahoe at Village Center Station, or East Dry Creek Road to access the Dry Creek Station. Both roads have poor pedestrian crossing infrastructure.

Figure 3: Examples of the Pedestrian Environment on South Yosemite Street

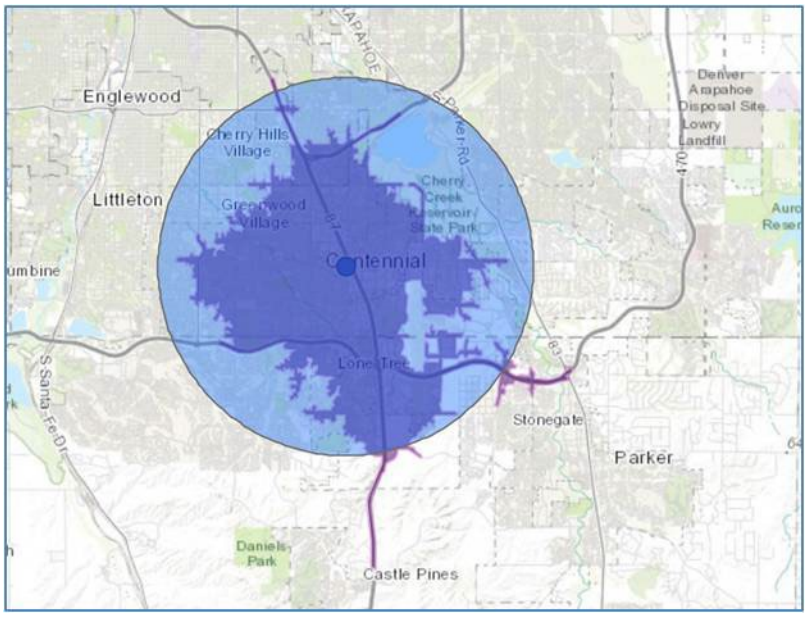
Source: Project Team

Access to the Study Area

When considering multimodal transportation options for the study area, it is important to first examine the accessibility of the study area by different modes of transportation by analyzing the ten-minute travel sheds (in other words, the ability to access the study area within ten minutes by different modes).

First, Figure 4 illustrates the ten-minute "driving shed" for people who want to access the core of the study area by auto. Due to auto congestion within the study area and surrounding areas, the ten-minute driving shed results in approximately a five-mile buffer around the study area, extending to approximately I-25 and I-225 to the north, approximately Parker Road on the east, RidgeGate to the south, and South University Boulevard to the west.

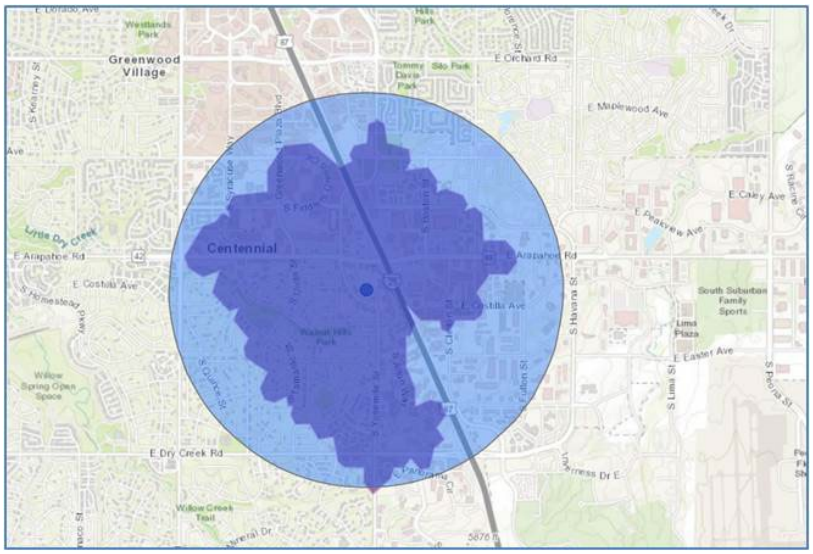
Figure 4: Ten-Minute Driving Shed



Source: UrbanTrans

Figure 5 illustrates the area that can access the core of the study area within ten minutes by bicycle. It shows an approximately two-mile buffer extending to the Arapahoe at Village Center light rail station and E. Caley Avenue to the north, E. Arapahoe Road near S. Galena Street to the east, S. Yosemite Street and Dry Creek Road to the south, and E. Arapahoe Road and S. Quebec Street to the west.

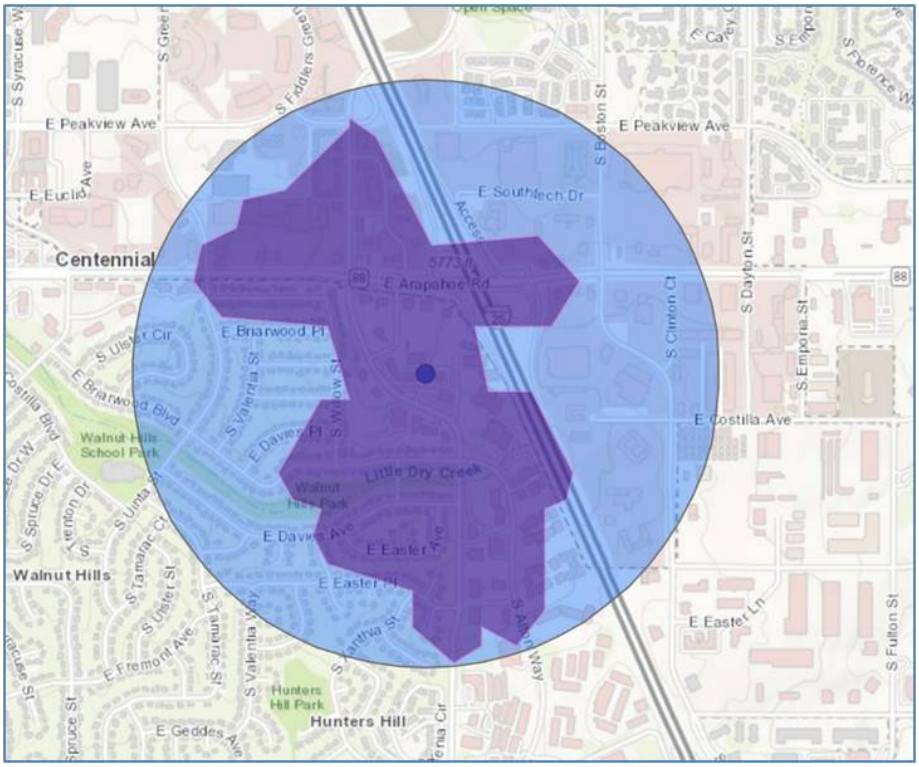
Figure 5: Ten-Minute Bicycling Shed



Source: UrbanTrans

Finally, Figure 6 illustrates the ten-minute walking shed around the core of the study area, resulting in a buffer area of approximately a half-mile. It shows an area extending to E. Peakview Avenue to the north, S. Boston Street to the east, just past E. Easter Place to the south, and S. Uinta Street to the west.

Figure 6: Ten-Minute Walking Shed

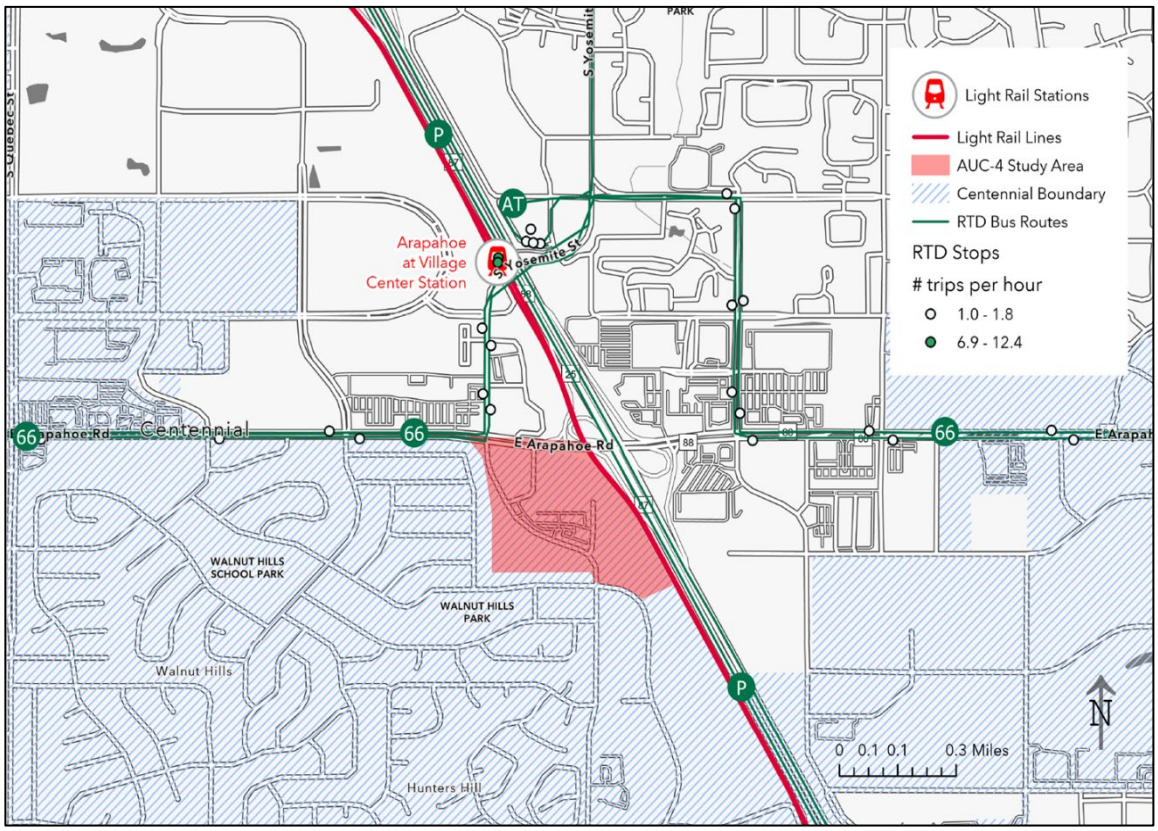


Source: UrbanTrans

Existing and Proposed Transit, Pedestrian, and Bicycle Facilities

Figure 7 shows existing transit services and facilities near the study area. It shows that the only transit service adjacent to the study area is the RTD bus route 66, which runs east-west along E. Arapahoe Road, turning north on S. Yosemite Street just north of the study area to serve the RTD light rail station at Arapahoe at Village Center. It operates on approximately 30-minute headways throughout most of the day (from roughly 6 am to 7:30 pm), after which it operates on roughly one-hour headways until approximately 11 pm.

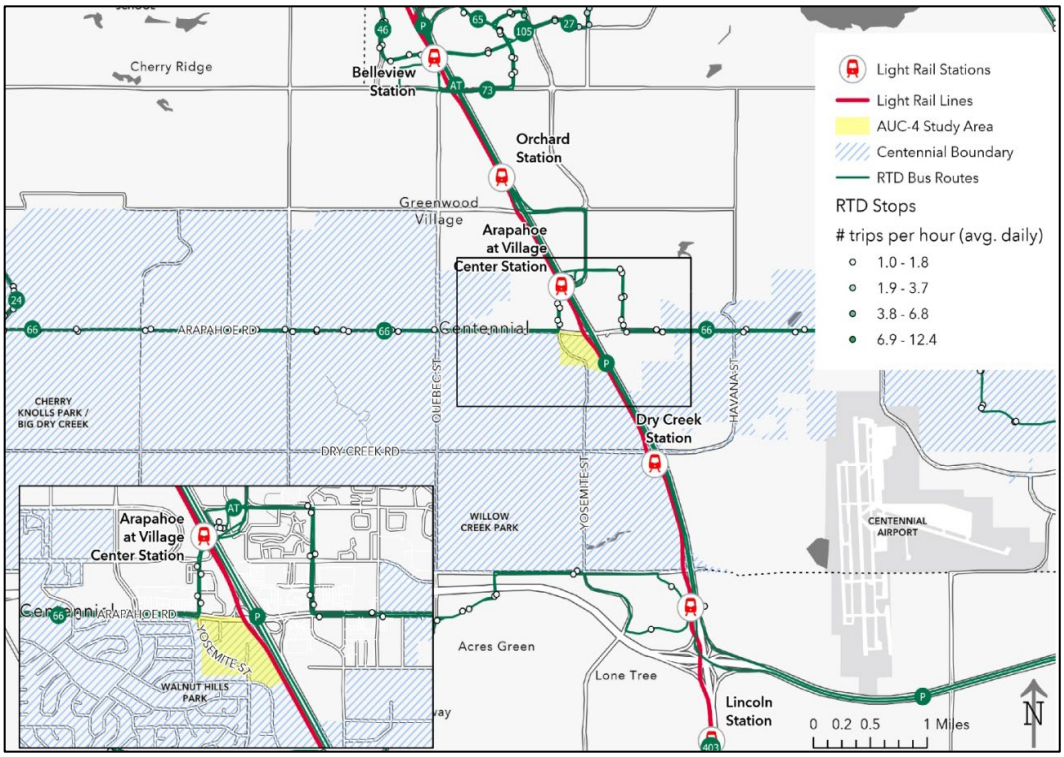
Figure 7: Existing Transit Services and Facilities Near Study Area



Source: RTD, UrbanTrans

Figure 8 shows transit services beyond the study area. The map shows where the Arapahoe at Village Center Station is located within the RTD system and connections to other transit services.

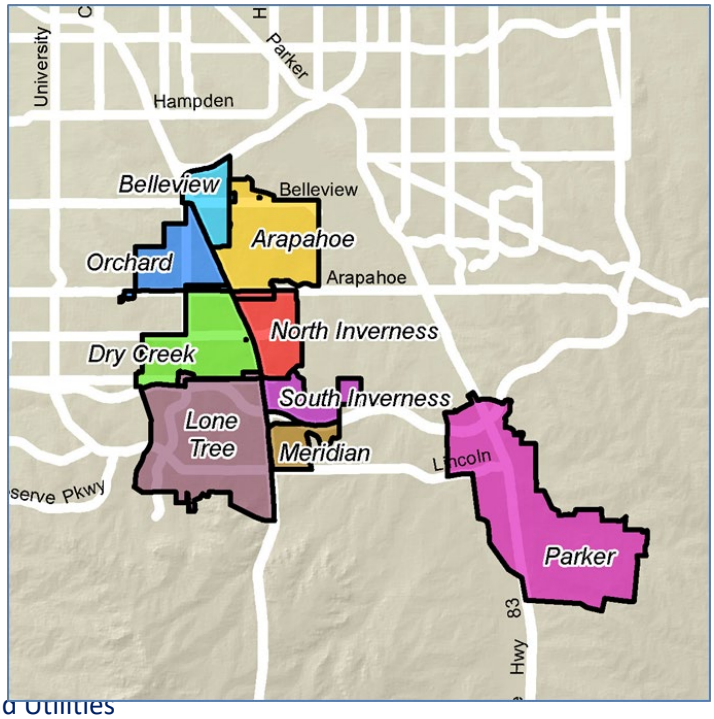
Figure 9: Existing Transit Services Beyond the Study Area



Source: RTD, UrbanTrans

In addition, the study area is in one of RTD's FlexRide zones, as shown in Figure 10. FlexRide allows users to request door-to-door service to RTD bus or train services at stations and Park-n-Rides, or get direct access to shopping malls, schools, businesses, recreational centers, libraries, and more by booking a trip online.

Figure 10: RTD FlexRide Zones Near Study Area

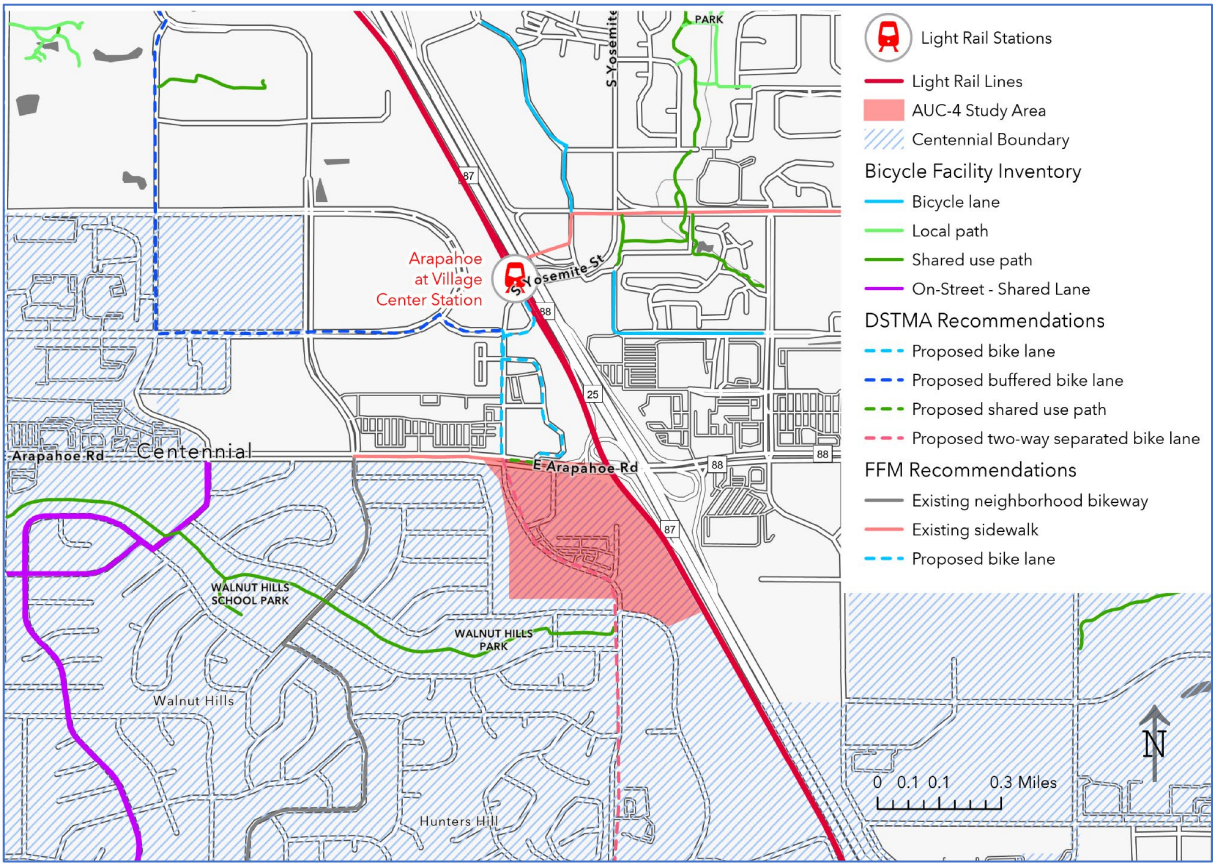


Source: RTD

Figure 11 shows existing and proposed pedestrian and bicycle facilities in the area adjacent to the study area.

The figure shows that, other than the Little Dry Creek trail to the south of the study area, there currently are no significant bicycle or pedestrian facilities in or near the study area. However, two recent studies have proposed new pedestrian and bicycle facilities in the area.

Figure 11: Existing and Proposed Pedestrian and Bicycle Facilities Near the Study Area



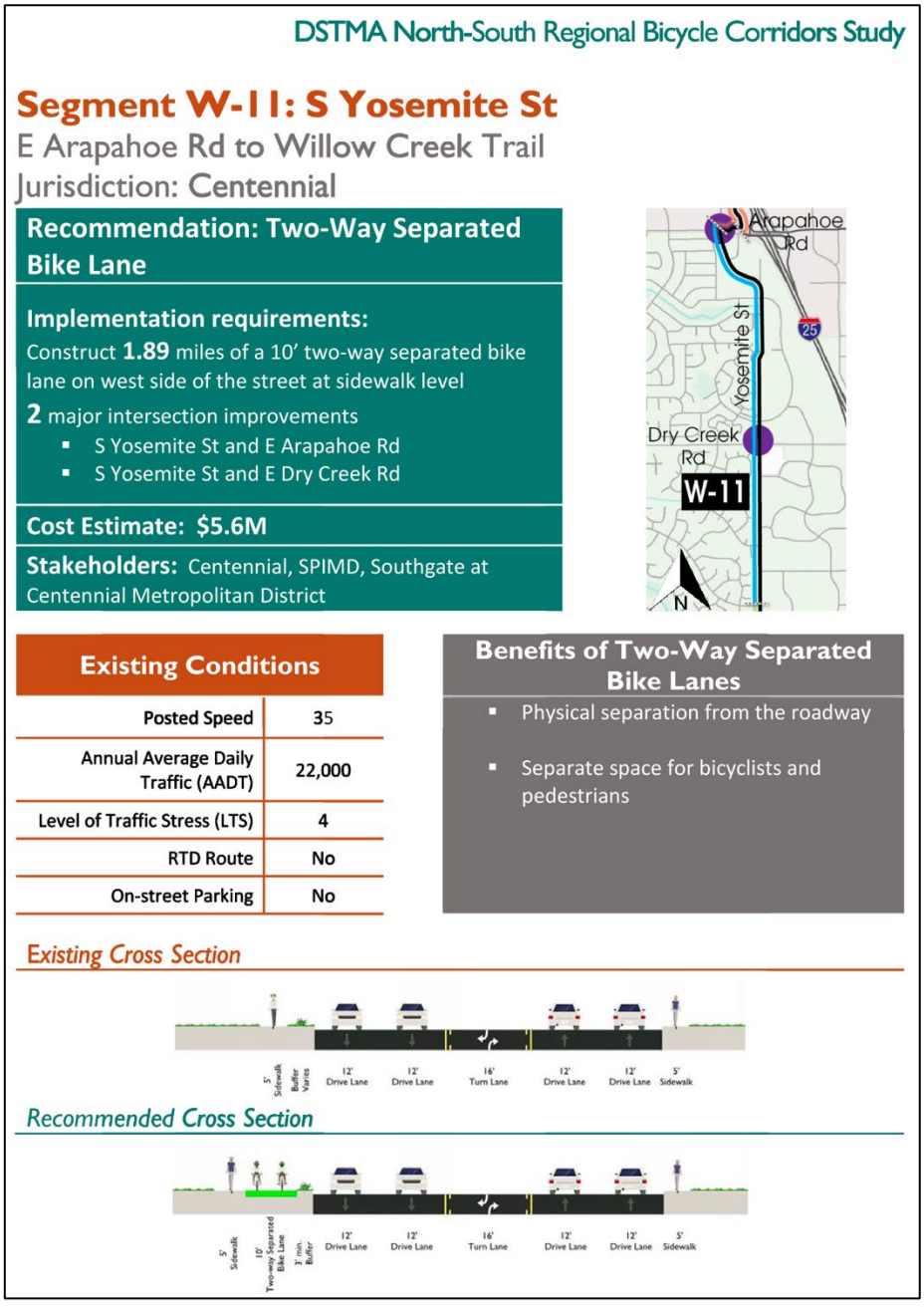
Source: UrbanTrans

The Denver South Transportation Management Association (DSTMA) completed the **North-South Regional Bicycle Corridors Study** in 2018. Its recommendations included bicycle facilities to better link the Arapahoe at Village Center LRT station with surrounding neighborhoods, including:

- Adding a five-foot bike lane in both directions on South Yosemite Street and South Yosemite Court from the LRT station to East Arapahoe Road.
- Widening a short section of sidewalk on the north side of East Arapahoe Road to better accommodate bicyclists and pedestrians and provide linkages on both sides of the road; and
- Implementing a ten-foot two-way separated bike lane on the west side of South Yosemite Street from East Arapahoe Road south to the Willow Creek Trail at the sidewalk level, providing

a physical separation from the roadway for bicyclists and pedestrians. Figure 12 illustrates that recommendation.

Figure 12: DSTMA Recommendation for Separated Bike Lane on South Yosemite St.



Source: DSTMA

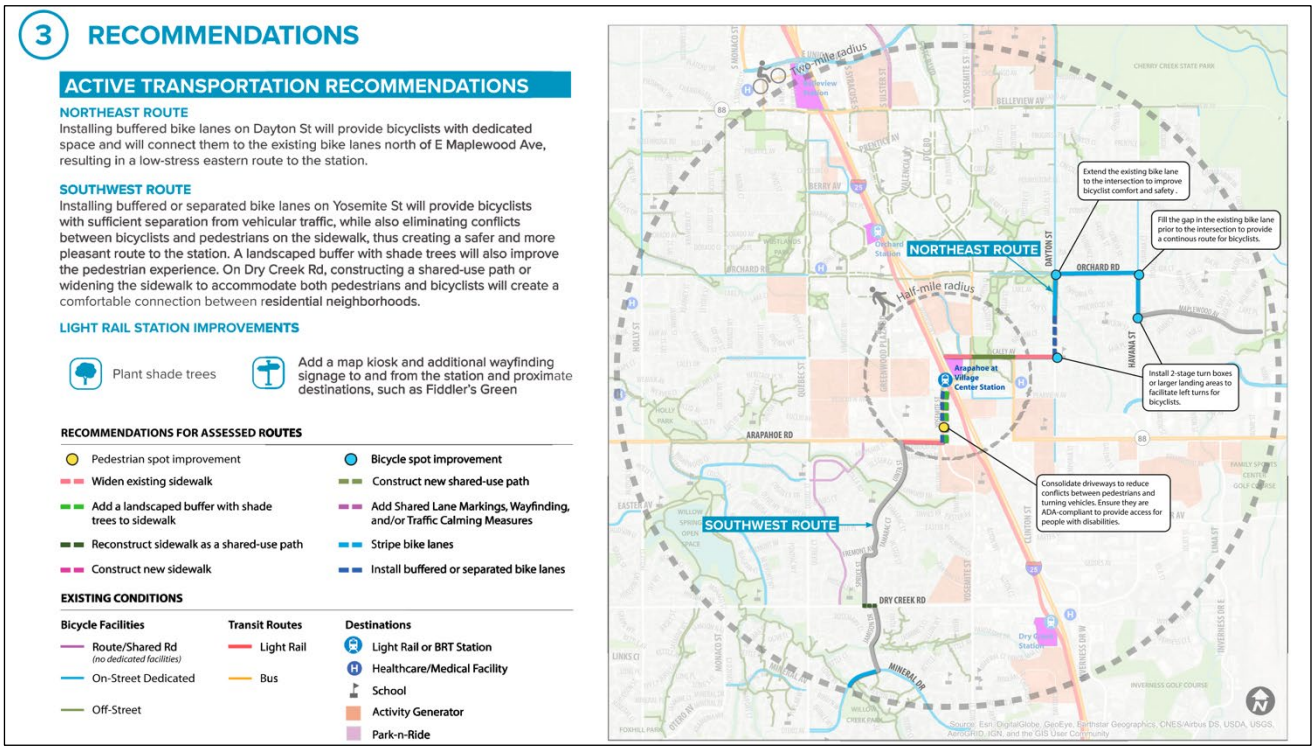
RTD completed its **First and Last Mile (FLM) Strategic Plan** in 2019. It focused on specific methods to improve access for transit riders by helping to solve "the problem of getting to transit (first mile) and getting to your final destination (last mile)." The report noted:

FLM is an essential concept for transit agencies. Improving access to and from transit for a wider breadth of people will ultimately lead to a better catchment for transit ridership. This includes providing better access to transit for multiple modes, rather than focusing on one specific mode, and introducing new incentives and travel options to access transit.

The report includes an analysis of the Arapahoe at Village Center Station for existing FLM conditions. The analysis notes that "The station is not visible from the surrounding roadways, making access difficult by active transportation. A lack of wayfinding and signage compounds this problem."

The FLM report made several “active transportation” or infrastructure-intensive recommendations on improving access to and from the LRT station, as shown in Figure 13. Like the DSTMA study, it recommends buffered or separated bike lanes on South Yosemite Street from the LRT station to East Arapahoe Road, with a widening of the sidewalk on the north side of East Arapahoe Road on the north edge of the study area. In addition, it recommends consolidating driveways on South Yosemite Street between the study area and the LRT station to reduce conflicts between pedestrians and turning vehicles.

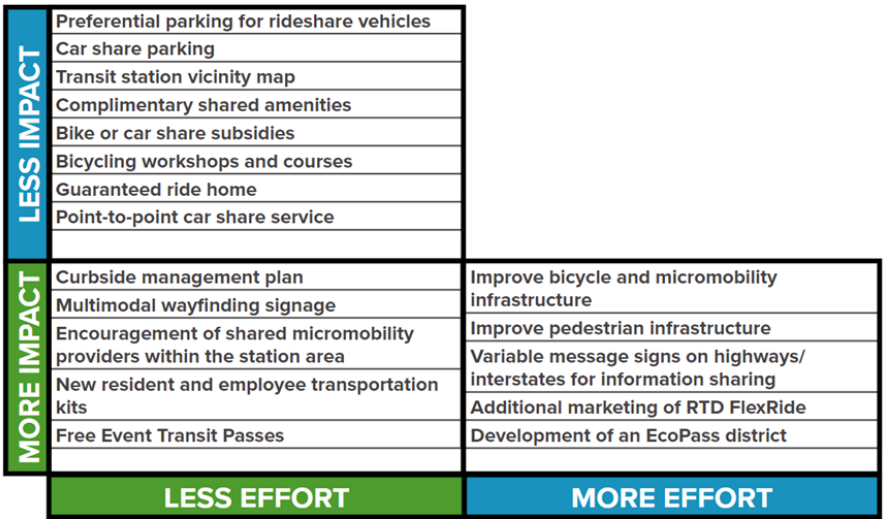
Figure 13: RTD FLM Study Active Transportation Recommendations for Arapahoe at Village Center LRT Station



Source: RTD

Figure 14 illustrates the FLM report’s recommendations for improving overall access to and from the LRT station.

Figure 14: RTD FLM Report Recommendations on Improving Access To and From Arapahoe at Village Center Station



Source: RTD

The report noted that recommended "quick wins" for improving access to the station (including to and from the study area) are in the lower left-hand corner of the graphic (less effort or cost/more impact). **All of these "quick wins" also could be applied to the study area.** Those actions include:

- Defining access for all modes through the development of a curbside management plan. This is defined as providing clear designation of curbsides near the station for transit, TNCs or transportation network companies (primarily ride-hailing services such as Uber and Lyft), micro-transit providers (including public or private flexible transit services), and carpools and vanpools. This could be applied at major origins or destinations throughout the study area. This would ensure that pick-up and drop-off activity is more organized, reducing conflicts with autos and transit vehicles and with people walking and bicycling to access the area.
- Implementing a multimodal wayfinding system that provides information while also promoting transit. Improved wayfinding throughout the study area could focus on funneling employees, visitors, and residents to and from alternative modes, including bicycle and pedestrian facilities. When good wayfinding is in place, study area employees, residents, and visitors would be more likely to walk or bike if the safest, most comfortable routes are clear and easy to follow.
- Encouraging shared micromobility providers to the area to improve first and last-mile access. Micromobility includes bike share and scooter share programs, which could improve the ability of study area employees, visitors, and residents to access origins and destinations within the study area in addition to transit and other transportation facilities nearby.
- Developing new employee and resident transportation kits to provide travel information and transit incentives to people new to the area to educate them about transportation options available at their new residence or employment site. The kits should include transit schedules, bicycle maps, information on available subsidies and transportation programs, and, ideally,

multiple free bus passes. Research shows that when someone makes a major life change (such as moving or changing employers), they are more open to changing travel behavior.

The FLM report and graphic also list a variety of other strategies in the "less impact" and "more effort" categories that could be utilized to improve and encourage multimodal transportation usage in the area, including improving bicycle and pedestrian infrastructure as noted in the DSTMA study. Most of these potential solutions fall under the umbrella of Transportation Demand Management (TDM) activities, generally defined as programs that incentivize transit use or encourage walking or biking, also a major focus of the DSTMA.

One overriding concept included in the RTD report is the idea of "mobility hubs." While there is no one definition of a mobility hub, they are generally defined as designated locations where local employees, residents, and visitors know they will have access to all multi-modal transportation options, including transit, bicycle, and pedestrian paths, bicycle and car sharing, and other options, with an over-arching emphasis on good, user-friendly information and wayfinding. One recent related study ("The Multistation Plan & Mobility Study – University and Colorado Stations", sponsored by Transportation Solutions) summarized key characteristics of a mobility hub:

- A strategic point of intersection on the regional transportation network that accommodates a higher intensity of use and degree of seamless connections.
- A central place where seamless connections are made between multiple forms of transportation with a priority placed on pedestrian connections.
- A place where buildings and transit interact effectively with streets.
- A vibrant place with a concentration of uses, including employment, living, shopping, and a mix of highly connected public and private accessible spaces.
- A high-tech mini-transportation center that is integrated into a transportation network where different modes connect or intersect. It provides 24/7 electronic access to transportation options (bus, rail, bicycle, car-sharing, taxis), an "electronically hip" convenient store for travelers.

One goal related to this concept is the aim that no employee, resident, or visitor is farther than a quarter mile (or five-minute walk) from designated points where they can access those multi-modal transportation options. RTD's FLM study recommends exploring pilot projects for mobility hubs throughout its service area. As the study area redevelops in the next few years, it could potentially be a good candidate for designation as a mobility hub.

The RTD report notes that the Arapahoe at Village Center station, while situated in Greenwood Village, is also near the City of Centennial. The report states, "It would be beneficial for both local governments to partner in order to best develop new infrastructure and reuse existing infrastructure to improve access to the station."

Building on the RTD FLM report, another option to consider is enhancing local transit options to better connect the study area with one or both adjacent light rail stations. These options could include:

- Exploring transit options and enhancement with RTD. Those options could include enhanced use and availability of RTD FlexRide services to enhance connections with the study area, and exploration of modification of existing RTD routes to better serve the study area.
- Exploring private microtransit options to provide both flexible and fixed-route shuttle service to and from the study area and nearby destinations (including RTD light rail stations). One of the best local examples is the Lone Tree Link, which connects the Lincoln light rail station with nearby businesses. This free, on-demand shuttle service is funded by the City of Lone Tree (including a DRCOG Congestion Mitigation and Air Quality Grant awarded to the City by the Regional Air Quality Council) and the Denver South TMA.

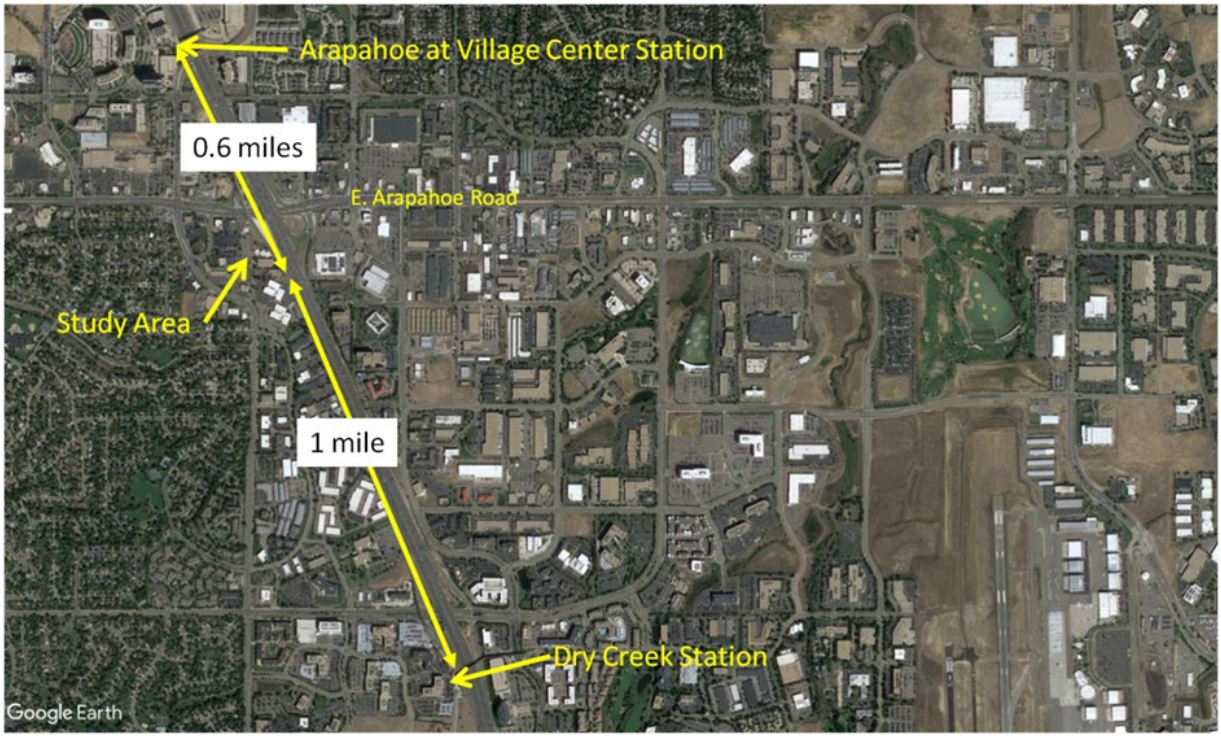
In addition, like other jurisdictions, the City of Centennial could explore the possibility of facilitating a pilot program for autonomous shuttles to serve the study area and connect to key destinations such as nearby light rail stations. Autonomous (driverless) shuttles are already being used in pilot projects at the National Renewable Energy Laboratory in Golden and at the Panasonic campus adjacent to the 61st/Pena commuter rail station near Denver International Airport. In addition, the University of Denver is exploring the potential for an autonomous shuttle on its campus. These projects should be monitored as to their potential applicability to the study area.

More recently, the DSTMA has partnered with the Colorado Smart Cities Alliance and local jurisdictions (including Centennial) to develop the Mobility Evolution Initiative (MEI), a "data-driven approach to investing in advanced mobility technologies" in the area to help make "informed decisions about the future of mobility throughout the region, and it provides the tools to evaluate innovative technologies, projects, and partnerships that can benefit commuters and residents alike." This project is examining seven light rail stations in the Southeast corridor (including the two closest to the study area) to help determine the "applicability for smart mobility tools at each station and is conducted using the typology analysis within RTD's First and Last Mile Plan (FLM). The screening will help prioritize which stations are most applicable for smart mobility application investments and automated transit service deployment."

A New Light Rail Station: Key Issues

The center of the Arapahoe-Yosemite District study area is located approximately 0.6 miles south of the Arapahoe at Village Center light rail station and approximately one mile north of the Dry Creek light rail station, as shown in Figure 15. One issue that has been under consideration by the City of Centennial is the construction of a new light rail station in the vicinity of the study area to provide direct light rail access for current and future study area employees, residents, and visitors.

Figure 15: Location of Study Area Relative to RTD Light Rail Stations



Source: Project Team

There are several issues related to the potential addition of another light rail station to serve the study area:

- Light rail stations must be on tangent (straight) track; most of the LRT alignment adjacent to the study area is on a slight curve as it descends from the rail bridge spanning East Arapahoe Road (as shown in Figure 16).
- Light rail stations must be virtually level; the LRT alignment adjacent to the study area is on a gradual slope from the bridge crossing Arapahoe Road to the southeast side of the study area.

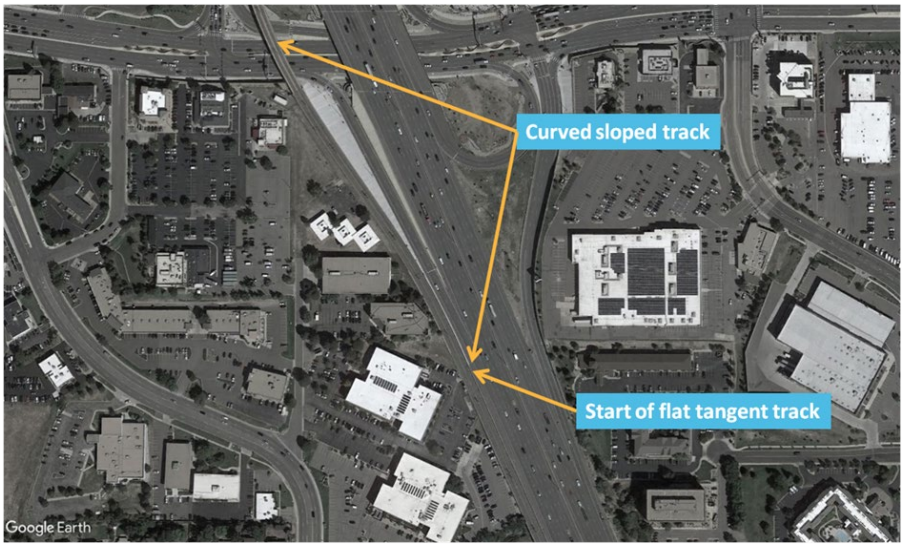


Figure 16: LRT Alignment Adjacent to the Study Area

Source: Project Team

As noted in Figure 16, the LRT alignment reaches a relatively flat tangent track on the far southeast side of the study area. RTD LRT stations require at least 400 feet of room for a passenger platform along with associated infrastructure on each end, resulting in the need for roughly 500 feet of construction space, which would theoretically be possible in that location. However, there are several issues related to the construction of a new LRT station in this or any location:

- Light rail stations are expensive. Construction costs alone for a typical new light rail station are in the vicinity of $3-5 million dollars. RTD has no funds in its budget for a new station at this or any other location. Theoretically, the cost could be paid by a developer or coalition of developers, as was done at the 61st/Pena station on the RTD commuter rail line to Denver International Airport.
- However, the station cost alone is not the only potential expenditure. Adding a new station to an existing light rail line would also require the construction of passing tracks to allow the continuation of current RTD operations without interruption. This would likely cost many millions more.
- One other consideration is the impact on overall RTD light rail operations and ridership. The addition of a new station would add travel time to the route, potentially affecting ridership. Of course, the intent would be to add ridership from the study area's future employees, residents, and visitors. However, this trade-off would need to be analyzed by conducting ridership forecasting, a long and costly analysis that would also likely need to be paid for by the funder of the station.

Overall, there are many difficult and expensive issues related to the possible construction of a new light rail station adjacent to the study area that would need to be considered by the City of Centennial and future developers. While not impossible, it would be more cost-effective for the City and its developer partners to focus on less-costly Transportation Demand Management options listed earlier to provide fast and convenient access to existing LRT stations for study area employees, residents, and visitors.