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1.0 PURPOSE AND NEED

1.1 Project Location and Purpose

The Federal Highway Administration (FHWA), in cooperation with the Colorado Department of Transportation (CDOT), is considering improvements to portions of Interstate 25 (I-25; the Valley Highway) and US 6 (6th Avenue) in south-central Denver. Also being considered are improvements to adjacent portions of Santa Fe Drive and Kalamath Street, including the crossing between these streets and the Consolidated Main Line railroad corridor.

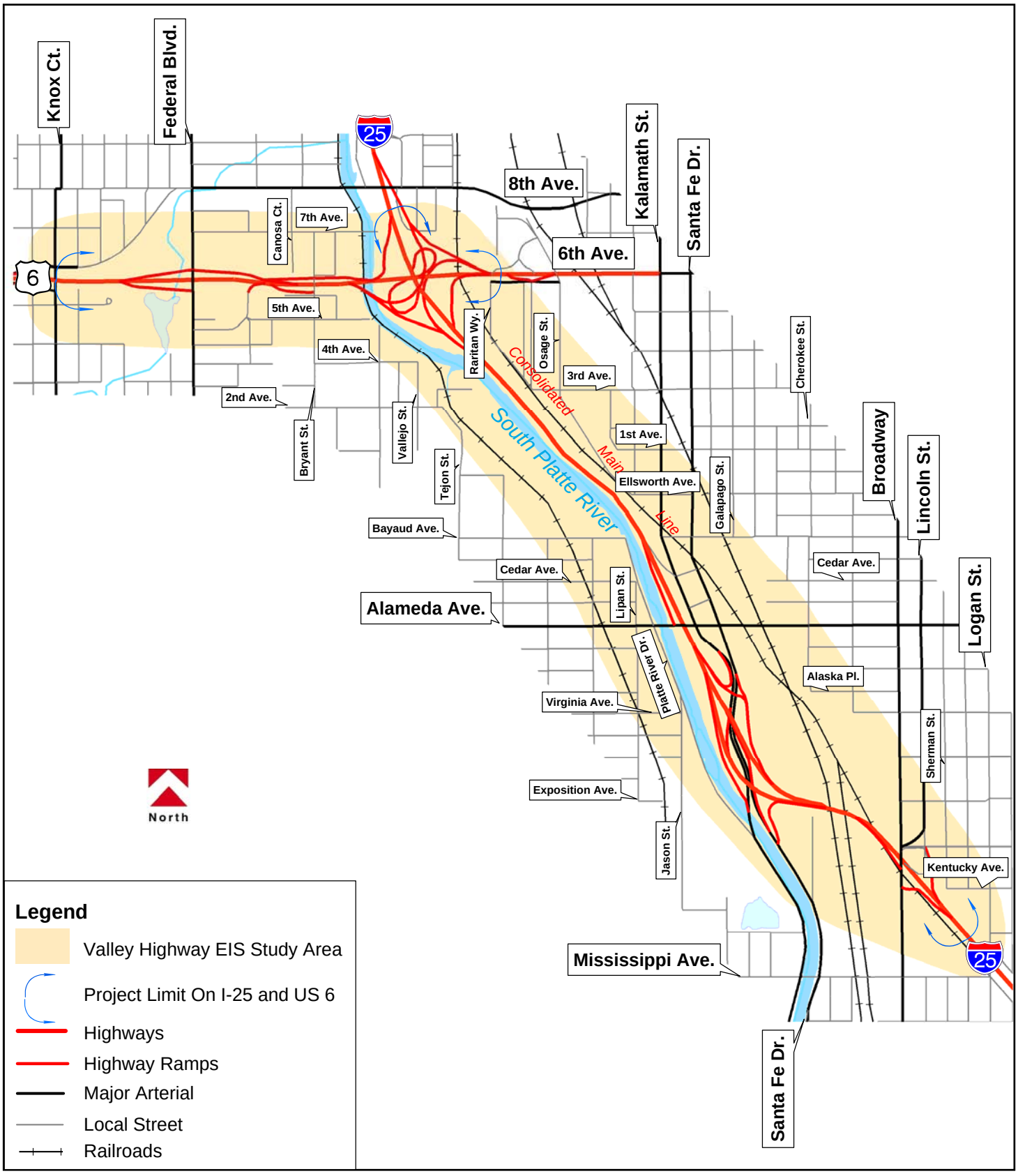
Planning for the freeway now known as I-25 began in 1944 with a preliminary engineering study for a freeway initially named the "Valley Highway." The highway originally extended from 58th Avenue on the north to Colorado Boulevard on the south. Much of the highway followed an alignment along the South Platte River. Construction began in 1948 with the first storm drains placed on the north end of the freeway. With the completion of the Broadway viaduct in 1958, the northern and southern sections were connected.

I-25 and US 6 are vital links in the freeway system serving Metro Denver and Colorado. At a national level, I-25 is designated as congressional "High Priority Corridor" No. 27 within the National Highway System. It is also designated as a Western Trade Transportation Network corridor for movement of national and international goods. At an international level, I-25 is part of a transportation trade corridor known as the Camino Real Corridor. This corridor traverses the nation from arterials in Mexico; along I-10 from El Paso, Texas, to Las Cruces, New Mexico; along I-25 from Las Cruces to Buffalo, Wyoming; and northward through Montana via various routes to the Canadian border.

Figure 1-1 shows the project area in which improvements are being considered. Improvements being considered for I-25, US 6, and the Santa Fe Drive/Kalamath Street crossing of the Consolidated Main Line are referred to collectively in this report as the "Valley Highway Project" or the "proposed action." The Valley Highway Project may also include ancillary improvements to adjacent streets. Specific alternatives are described in detail in **Chapter 2** *Alternatives*.

The ***purpose*** of the Valley Highway Project is to:

- Provide lane continuity and balance on I-25 from Logan Street to US 6, linking with sections of I-25 to the north and south
- Optimize highway system operations while recognizing the constraints on highway expansion identified through the regional transportation planning process
- Improve connectivity between transportation modes
- Improve pedestrian / bicycle mobility across the project corridor
- Increase safety along and across the corridor for motorists, pedestrians, and bicyclists
- Correct roadway deficiencies along I-25 and US 6 to meet current design standards to provide a safer, more efficient, and more reliable transportation system
- Increase safety and reduce congestion and delays related to the at-grade crossing of Santa Fe Drive / Kalamath Street and the Consolidated Main Line



Valley Highway, 02-069, 06/03/2004

0 0.25 0.5 1 Miles

Valley Highway EIS Study Area

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 1-1

This Final Environmental Impact Statement (Final EIS) for the Valley Highway Project describes the alternatives being considered for improvements within the project area, including the Preferred Alternative identified by FHWA and CDOT. The Final EIS has been prepared in accordance with National Environmental Policy Act (NEPA) provisions and corresponding regulations and guidelines of the Council on Environmental Quality and the FHWA, the lead federal agency for this proposed action. Other agencies cooperating in preparation of the Final EIS include the Federal Railroad Administration (FRA), the Federal Transit Administration (FTA), the Regional Transportation District (RTD), and the City and County of Denver.

1.2 Project History and Status

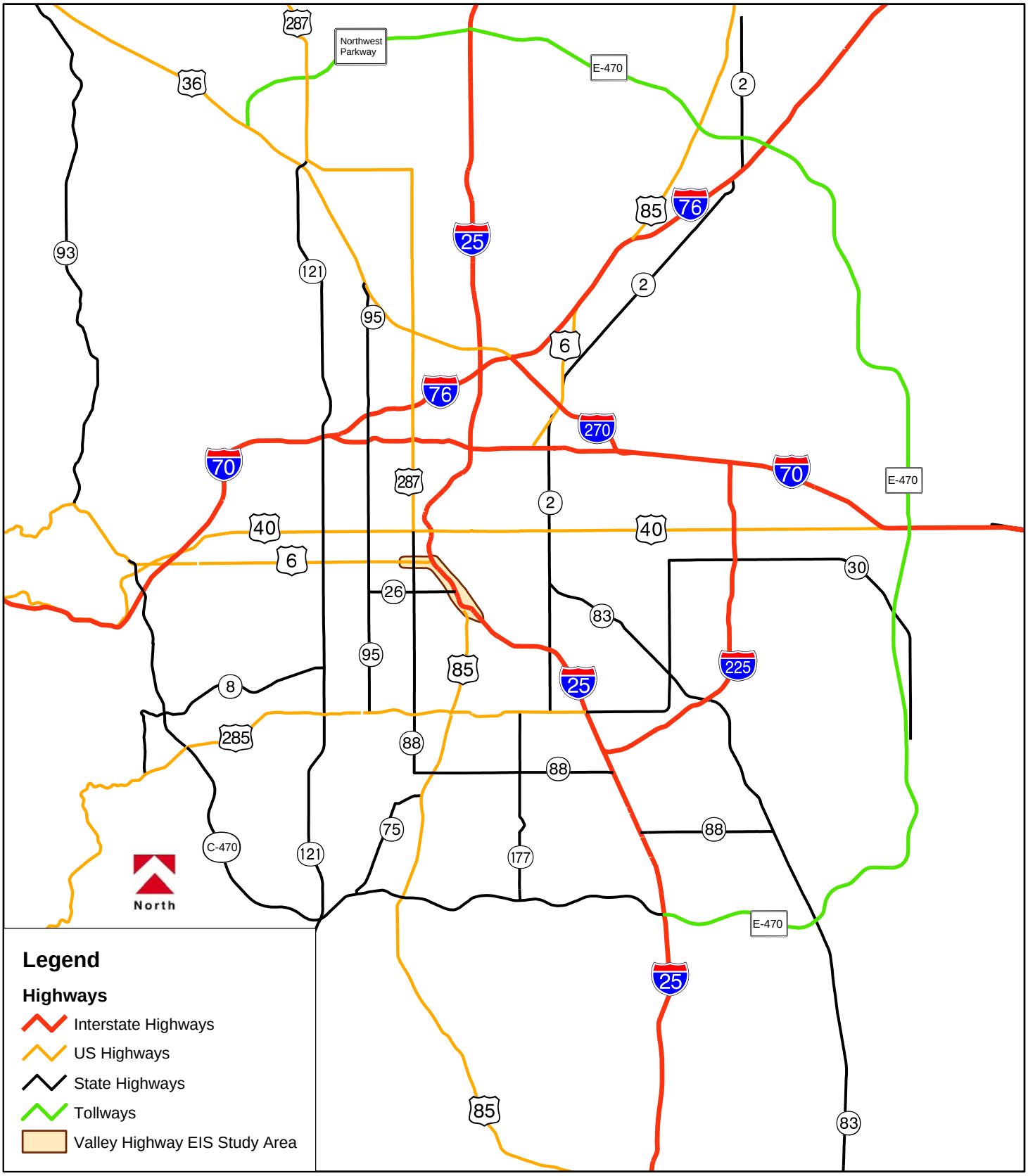
I-25 corridor studies from US 6 in Denver to Lincoln Avenue in Douglas County over the last two decades have examined the condition and operational context of this major interstate facility. **Figure 1-2** shows the Metro Denver regional highway system. The Valley Highway – Logan Street to US 6 segment was identified by CDOT as needing reconstruction of structures, and safety and capacity improvements. The Regional Transportation Plan for 2025 prioritized the Valley Highway Project by inclusion in the plan.

Previous corridor studies have recommended the following:

- *6th Avenue / I-25 Interchange Feasibility Study, January 1985* – recommended improvements to the interchange and 6th and I-25, many of which have been implemented
- *I-25 6th Avenue to Lincoln Avenue Corridor Evaluation Study, April, 1992* – recommended multimodal corridor enhancements including highway widening and high-occupancy vehicle (HOV) elements
- *Southeast Corridor Major Investment Study, July 1997* – recommended multimodal corridor enhancements for I-25 from US 6 south to Douglas County. Subsequent efforts from this study resulted in the Southeast Corridor Environmental Impact Statement, the Transportation Expansion Project (T-REX), and this EIS

The corridor/project development effort for the Valley Highway Project was initiated in 1998. Originally an Environmental Assessment (EA) was recommended to address transportation issues associated with the segment of the I-25 Valley Highway from Logan Street to and including US 6. However, CDOT and FHWA determined that planning and environmental concerns of the adjacent property and business owners and overall concerns and issues raised by the City and County of Denver warranted the requirements of a major action project to be addressed through an EIS. The federal Notice of Intent to prepare this EIS was published on July 23, 2002 in the *Federal Register*.

In 2002, reconstruction of the main structure of I-25 over Broadway began as an emergency measure. This segment was in extremely poor structural condition, which necessitated immediate action. The project was evaluated for environmental impacts, which resulted in issuance of a Categorical Exclusion in June 2000. Ramp connections to the new structure are being evaluated as part of this Final EIS.



Valley Highway, 02-069, 06/03/2004

0 2.5 5 10 Miles

Metro Denver Regional Highways

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 1-2

1.3 Project Needs and Objectives

This section summarizes the need for the project and identifies the objectives that have been established to address the needs. Further detail regarding the need for the project is provided in **Section 1.4**.

The ***need*** for the project arose primarily out of a number of identified roadway deficiencies that result in unsafe conditions. The age, condition, and geometric design of the roadway compromise the safety of the traveling public and require improvements to meet current design and safety standards.

Project objectives have been established based on identified needs and a series of discussions with cooperating agencies, resource agencies, and the public.

Specific project needs and objectives fall into several categories as follows.

System Linkages / Lane Continuity and Balance:

- **Need**: Completion of the T-REX Project and I-25 / Broadway viaduct Replacement Project to the south will result in a discontinuity of travel lanes on I-25 through the project area, with four lanes in each direction to the north and south and three lanes in each direction through a portion of the project area.
- **Objective**: Provide lane continuity and balance on I-25 between the existing and planned roadway sections to the north and south of the project

Transportation Demand and Operations:

- **Need**: The I-25 corridor is currently experiencing pervasive severe congestion, which is expected to continue to worsen.
- **Objective**: Optimize highway system operations as measured in reduced delay of vehicle hours/day, reduced hours of congestion, and/or levels of service

Inter-modal Relationships and Bicycle / Pedestrian Mobility:

- **Need**: The I-25 corridor restricts east-west mobility for pedestrians and bicyclists and limits access to transit facilities.
- **Objective**: Preserve existing or provide improved facilities for automobile, bus, and pedestrian connections. Upgrade bicycle/pedestrian facilities within and across the project corridor to provide improved access to the Platte River Trail, safer facilities at intersections, complete missing links of bicycle/pedestrian facilities, and provide better linkages between transportation modes

Safety:

- **Need**: Accident histories for I-25 and US 6 show greater accident frequency and severity than expected for similar facilities, due to congestion, close interchange spacing, and substandard geometric configuration.
- **Objective**: Increase safety and decrease the likelihood of accidents within the project corridor by improving the geometric design of the roadway system

Roadway Deficiencies:

- **Need**: I-25 and associated interchanges have substandard geometrics and design features and many roadway structures are nearing the end of their useable life.
- **Objective:** Address existing roadway deficiencies, and replace aging structures to provide for improved operation of and reduced maintenance costs for the roadway facilities

Consolidated Main Line Railroad Crossing at Santa Fe Drive and Kalamath Street:

- **Need**: Santa Fe Drive and Kalamath Streets cross the Consolidated Main Line railroad at-grade, causing congestion and safety concerns.
- **Objective**: Reduce system disruptions, and improve safety conditions related to the current at-grade crossing

1.4 Detailed Identification of the Project Needs

Specific project needs are detailed in **Sections 1.4.1** through **1.4.6** for each of the categories identified above.

1.4.1 System Linkages / Lane Continuity and Balance

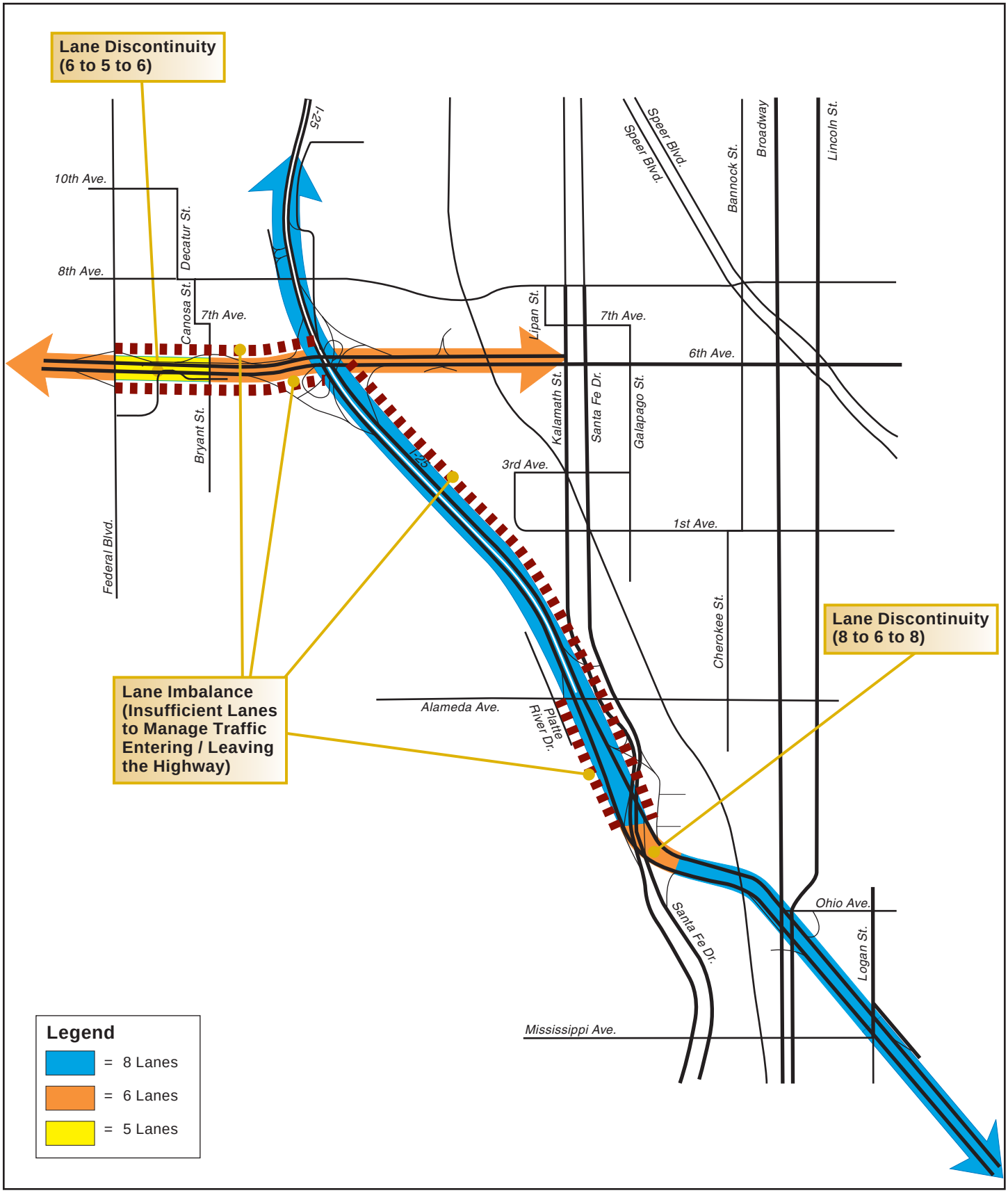
Existing lane configurations on the I-25 mainline in and adjacent to the project (see **Figure 1-3**) include four through-lanes in each direction north of Santa Fe Drive, three lanes in each direction between Santa Fe Drive and Logan Street, and four lanes in each direction currently being constructed south of Logan Street as a part of the T-REX project. Improvements to the Valley Highway are needed to provide a uniform connection between the eight-lane T-REX project to the south and the eight-lane section north of Santa Fe Drive.

The project corridor integrates a combination of overlapping route systems. For example, it serves as a primary connection between Santa Fe Drive, US 6, I-70, and US 36, in addition to carrying its own interstate level volume. Auxiliary lanes are lacking north of Santa Fe Drive to accept and disperse the traffic on these overlapping systems, thereby resulting in a lane imbalance.

I-25 from Broadway to US 6 provides access to a dynamically redeveloping area of the City and County of Denver. It is the interstate system's linkage to regional arterials, providing access to Downtown Denver as well as connections with other state and regional freeway systems. Improvements are needed to address the deficient operational configurations of the remaining interchanges that have not undergone substantial improvements over recent years.

1.4.2 Transportation Demand and Operations

The corridor connects the two largest employment centers in the region, Downtown Denver with approximately 117,000 employees and the Southeast Business District with approximately 130,000 employees in the year 2000. With employment centers at both ends of the corridor, traffic congestion occurs in both directions during the morning and evening rush hours and frequently during the noon hour along many segments of the corridor.



Existing Lane Continuity and Balance Deficiencies

Figure 1-3

The existing traffic volume on the Broadway viaduct is approximately 180,000 vehicles per day. When combined with the traffic to and from Santa Fe Drive, I-25 carries 265,000 vehicles per day just north of Santa Fe Drive. Currently, the peak-hour traffic is 7 percent of the daily traffic volume. This peak-hour traffic volume is maintained throughout much of the day. The heavy truck traffic is 5 percent of the daily traffic volume, and this segment of I-25 provides major access for through freight as well as local and regional distribution.

The Final EIS for the T-REX project forecasted a future demand of 210,000 to 240,000 vehicles per day south of Broadway by 2020. More recent studies indicate that I-25 from Alameda Avenue to US 6 is expected to carry 320,000 vehicles per day by 2025. Detailed analysis of existing and future traffic conditions is presented in **Chapter 3** *Transportation Analysis*.

The 2025 regional transportation planning process identifies the I-25 and Santa Fe Drive corridors as currently experiencing pervasive severe congestion. It further predicts that operating conditions along the project corridor will continue to deteriorate towards 2025.

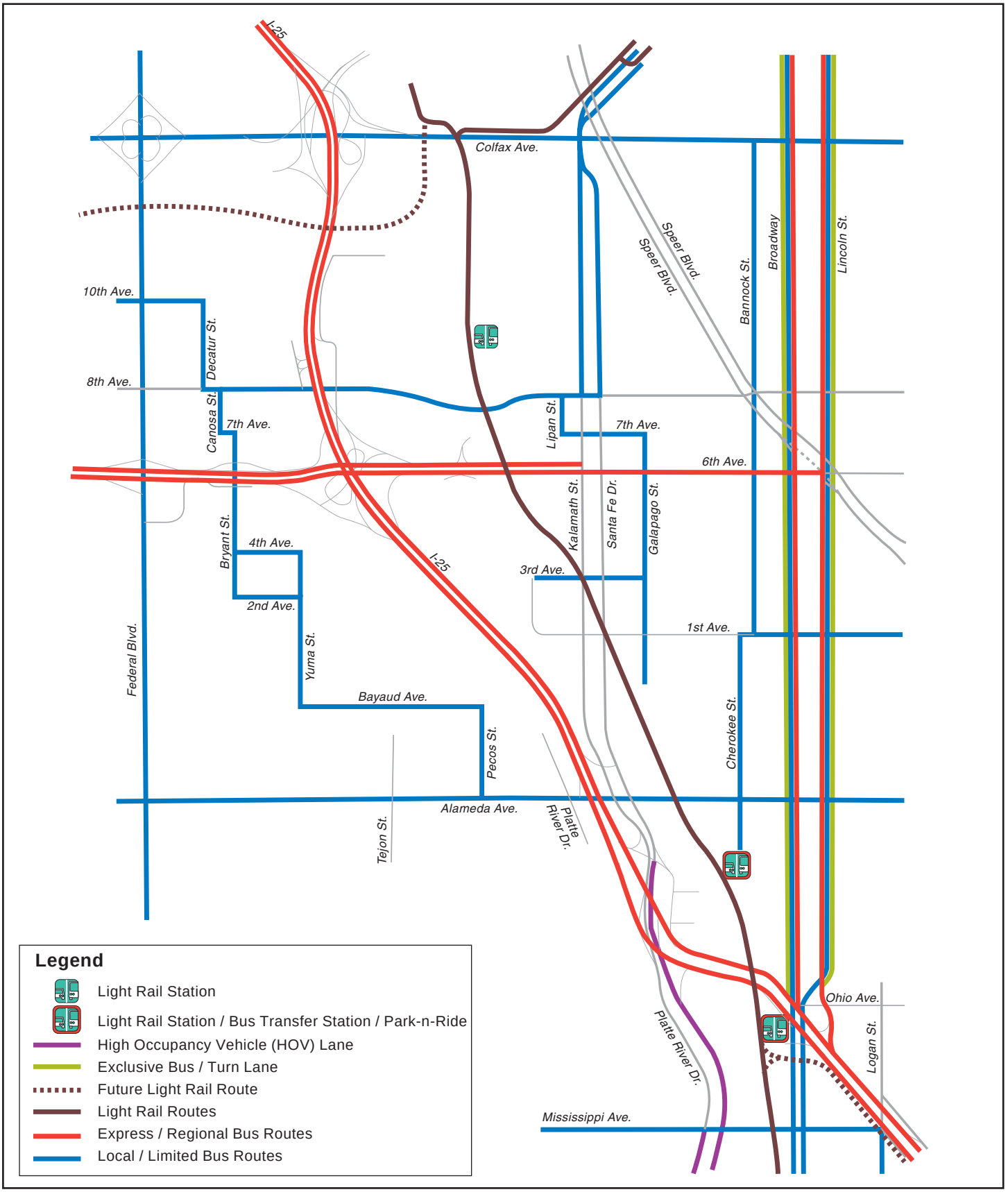
1.4.3 Inter-Modal Relationships and Bicycle/Pedestrian Mobility

A significant number of multimodal transportation facilities converge within the limits of the project corridor, as shown on **Figure 1-4**. These transportation facilities include Light Rail Transit (LRT), bus service, HOV lanes on Santa Fe Drive, and dedicated bus lanes on Broadway (PM peak) and Lincoln Street (AM peak). Local and regional pedestrian and bicycle facilities exist within the corridor as well. The southern terminus of the study area, located near the convergence of Santa Fe Drive, I-25, and Broadway, is one of the region's major junctions of current and future modal activities. Preservation and/or enhancement of these multimodal facilities must be considered with corridor enhancements.

1.4.3.1 LIGHT RAIL TRANSIT

RTD is currently constructing and implementing the southern portion of the LRT component of the MetroVision transit network. LRT is now in operation along Santa Fe Drive from Mineral to downtown Denver via the southerly access along California and Stout Streets or the Central Platte Valley spur connection to Denver Union Station. The 16th Street shuttle provides a distribution of downtown transit ridership from both buses and LRT. The T-REX project is currently constructing the LRT segment along I-25 from the I-25 and Broadway station south to Lincoln Avenue in Douglas County.

The planning process is continuing for development of the regional transit network. RTD's current FasTracks plan includes improvements to the Central Corridor and Central Platte Valley LRT lines to improve access into Downtown Denver. Within the Valley Highway project area, FasTracks includes modification of existing LRT stations to accommodate four-car trains and the construction of two additional tracks between Broadway and Alameda Avenue. The Valley Highway Project will need to consider these planned LRT improvements, such that they are complemented and not precluded.



North

Study Area Transit System

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 1-4

A transit oriented development is in the planning stages for the area in and around the I-25 and Broadway station. Future development footprints and associated local street modifications may require redefining the access at I-25 and Broadway. Coordination between planning efforts in this area is described in **Section 2.5.**

1.4.3.2 RTD PARK -N- RIDE ACCESSIBILITY

Two park-n-Rides exist within the study corridor – the I-25 and Broadway park-n-Ride and the Alameda park-n-Ride. The I-25 and Broadway park-n-Ride is accessed through a bus only entrance at Ohio, north of the interchange, and a full movement bus and auto access at Kentucky and Broadway, south of the interchange. Internal to the park-n-Ride, a ”kiss-n-Ride” area is provided and surface parking is available under, as well as south and north of the I-25 viaduct. Pedestrian accessibility is provided via sidewalks along Broadway, Ohio, and Kentucky. Access and internal circulation is inefficient with numerous modal conflict points. Bus access is limited to inbound only and shared outbound leading to operational difficulties.

Upon completion of the Southeast Corridor LRT as part of T-REX, RTD will modify their regional and local bus service including the I-25 and Broadway transit station. This will require redefinition of the bus access route from/to Broadway and a reconfiguration of available parking layouts for the park-n-Ride portion of the station to adjust for construction of the new Broadway viaduct.

The Alameda park-n-Ride is located south of Alameda along Cherokee Street. It provides a “kiss-n-Ride” location with limited parking availability. The station is accessed via automobile and bus principally through the signalized intersection at Alameda and Cherokee Streets although there is connectivity to Broadway through the shopping complex directly to the east. Pedestrians access the park-n-Ride via sidewalks along Cherokee Street. The limited on-site parking leads to overflow parking on Cherokee Street and illegal parking within the shopping center to the east. Connectivity with the I-25 and Broadway park-n-Ride, just to the south, is restricted by gates and fencing thereby limiting shared parking and station access between the two. This loads the intersection at Alameda and Cherokee or requires cut-through access to Broadway to the east.

1.4.3.3 BUS / HOV LANES

The bus/HOV lane component of the *2025 Regional Transportation Plan* includes the existing bus lanes on Broadway and Lincoln Street between I-25 and Downtown Denver and the bus/HOV lanes on Santa Fe Drive south of I-25.

The existing bus/HOV lanes in the left lanes of Santa Fe Drive are restricted only during peak-hour periods and integrate with general purpose lanes south of the I-25/Broadway area near Santa Fe Drive and Mississippi Avenue. The peak period bus-only lanes along Broadway/Lincoln Street are offered as parking lanes in the evenings along residential stretches.

For the project corridor, the function of the Santa Fe Drive HOV lanes needs appropriate definition at the confluence with the Valley Highway project. The transition to achieve connectivity with the general purpose lanes feeding into I-25 needs to be considered in the

interchange configuration evaluation of Santa Fe Drive with I-25. Buses and high occupancy vehicles also need access to the intermodal facility at Broadway.

1.4.3.4 BICYCLE AND PEDESTRIAN MOBILITY

Pedestrian and bicycle facilities occur sporadically in the project corridor. The highway, South Platte River, and rail corridor act as barriers to east-west mobility through the corridor while reasonable north-south mobility is offered via the Platte River trail and local street systems. Key components of the existing system include:

- The South Platte River Trail: The South Platte River Trail is a vibrant regional trail that offers both commuter and recreational bicycle and pedestrian mobility north and south through the metropolitan area. The trail starts at Chatfield Reservoir in Jefferson and Douglas Counties in the southern metropolitan Denver area and parallels the South Platte River through the City of Denver. Through the project corridor, it is generally adjacent to the South Platte River channel with connections to local streets at Mississippi Avenue and Alameda Avenue. The trail is a major destination for residents from adjacent neighborhoods east and west of the highway.

  Connections to the trail are problematic at Alameda Avenue due to steep grades and tight radius switchback turns. The low clearance under the US 6 bridge at the South Platte River is a challenge to maneuver under and is dark and uninviting.

- East-West Connectivity: East-west connectivity is limited through the project area. Two principal crossings of I-25 exist – Alameda Avenue and US 6. US 6 is a high-speed urban freeway and is not conducive for bicycle and pedestrian use. Alameda Avenue is the only east-west crossing of I-25 that offers bicycle/pedestrian accommodations within the project corridor. Sidewalks are narrow under the existing railroad crossing east of Santa Fe Drive. Crossing the one-way pair arterial streets of Santa Fe Drive and Kalamath Street at grade is difficult and intimidating for bicyclists, and pedestrians. Numerous accidents have occurred at these crossings. Alameda Avenue also serves as access to the Alameda RTD park-n-Ride station east of I-25 and the LRT system.
- At Broadway and I-25, east-west connectivity to the RTD park-n-Ride is a challenge. Ohio Avenue is designated as a neighborhood bike and pedestrian route providing access to the Broadway retail district and the transit station at the Broadway park-n-Ride. Crossing the high speed, unsignalized I-25 off ramp at Ohio Avenue is problematic for pedestrians and bicyclists, while sight distance restrictions at Broadway make the signalized crossing equally as difficult.
- Santa Fe Drive / Kalamath Street Pedestrian Facilities: Sidewalks occur sporadically along Santa Fe Drive and Kalamath Street through the project limits. North of Alameda Avenue 5-foot sidewalks are generally available on one or both sides of Santa Fe Drive and Kalamath Street. South of Alameda Avenue, there are no pedestrian provisions.

1.4.4 Safety

The freeway corridor accident history was evaluated for the three-year period from January 1, 1999 to December 31, 2001, and a *Traffic Safety Report* was prepared (CDOT, 2005). A total of 3415 accidents were reported in the three-year period and eight of them were fatal. A review of accident data reveals that rear-end and sideswipe accidents are predominant both on I-25, US 6, and at the interchanges. Further analysis reveals that this segment of I-25 is experiencing a greater frequency and severity of accidents than would be expected for facilities of this type with this volume of traffic. These accidents can be related to congestion, recurrent and frequent queuing, close interchange spacing, and the substandard geometric characteristics of I-25.

1.4.5 Roadway Deficiencies

The Valley Highway portion of I-25 was planned prior to enactment of the Federal-Aid Interstate Highway Program. Design features were developed using traffic volume projections, geographic constraints, cost considerations, and design criteria of the early 1950s. Consequently, the mainline and ramp configurations by today's standards have substandard geometrics and design features and non-standard interchange configurations that do not meet today's driver expectancy. In addition, several existing roadway structures within the project area are nearing the end of their useable life. The deteriorating condition of the structures, with increasing maintenance and repair requirements, point to the need to replace the structures in the near term.

Additional deficiencies within the project corridor include substandard lane widths, inadequate sight distances, and inadequate shoulder widths, all of which reduce relative levels of safety and restrict the smooth operation of vehicles. Geometric deficiencies at the Broadway interchange include inadequate shoulder widths, sight distance deficiencies, substandard taper lengths, and minimum curve radii. Similar deficiencies exist at the Alameda Avenue and Santa Fe Drive interchanges. Roadway deficiencies are also present at arterial street intersections directly adjacent to the interchanges at Broadway, Alameda Avenue, and Federal Boulevard.

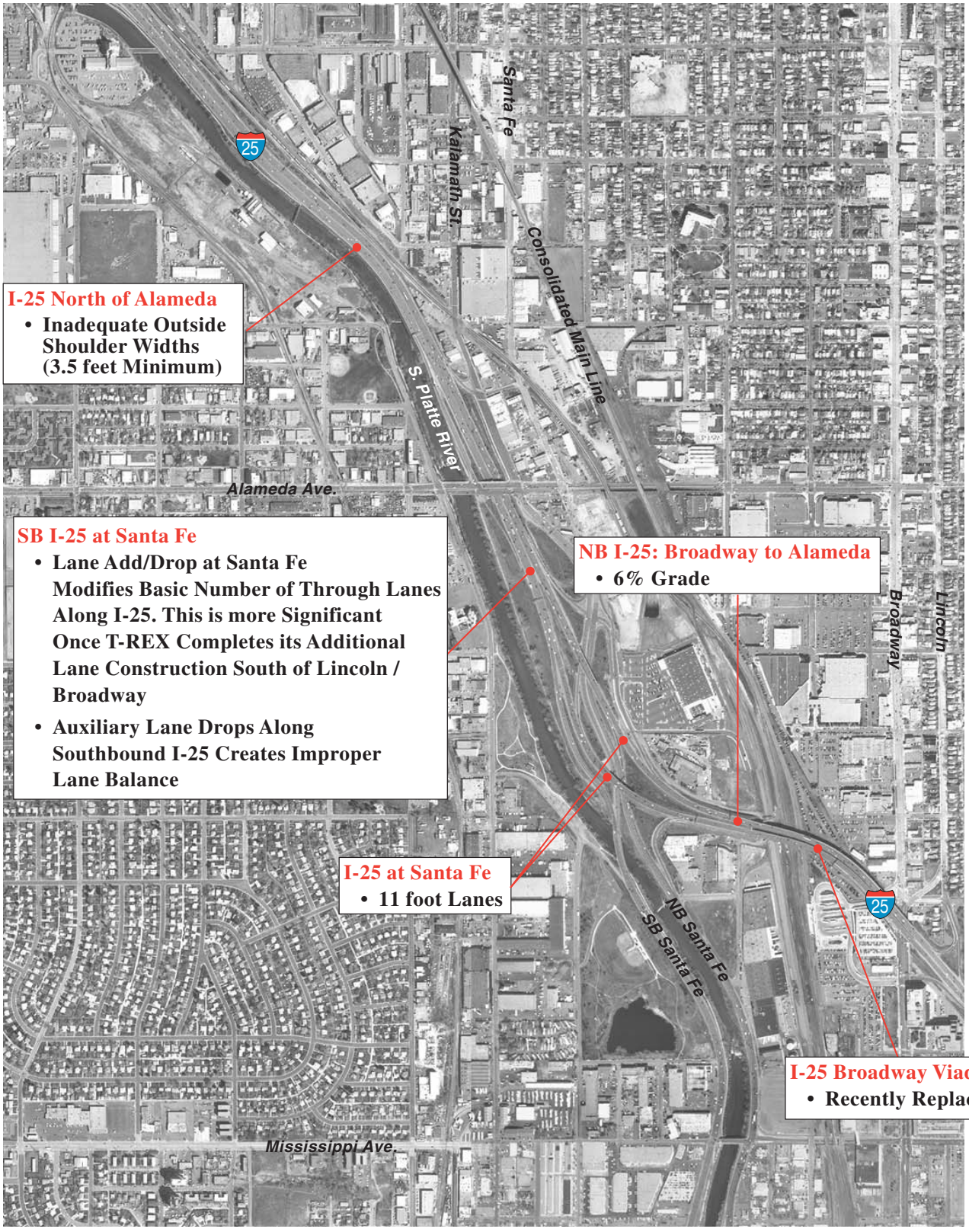
In addition to geometric deficiencies, several other factors contribute to the need to reconfigure the Broadway interchange. These include: integration of LRT from the T-REX project, bus access consideration by RTD, the existing need for enhanced pedestrian connectivity to the RTD park-n-Ride, and land use changes.

Left-hand on- and off-ramps tying to the expressway facility at Santa Fe Drive create merge and weave conditions that exacerbate current capacity and flow problems of the I-25 mainline. The I-25/Santa Fe Drive structures were built in the late 1950s and are showing signs of distress, as evidenced by exposed reinforcing steel and spalling concrete. The structures are currently sufficiency-rated at 38.4 (out of a possible 100) for southbound and 34.9 for northbound. For reference, the existing Broadway viaduct was replaced for similar reasons. Prior to replacement, the Broadway viaduct northbound structure had a sufficiency rating of 23.6 and the southbound structure had a sufficiency rating of 6.

The I-25/Alameda Avenue bridge structure has limitations in that sidewalks across the bridge are narrow and the length limits the ability for adequate acceleration of northbound on-ramps or the ability to provide continuous auxiliary lanes southbound. The sump created on I-25 under the bridge is frequently flooded during major storm events.

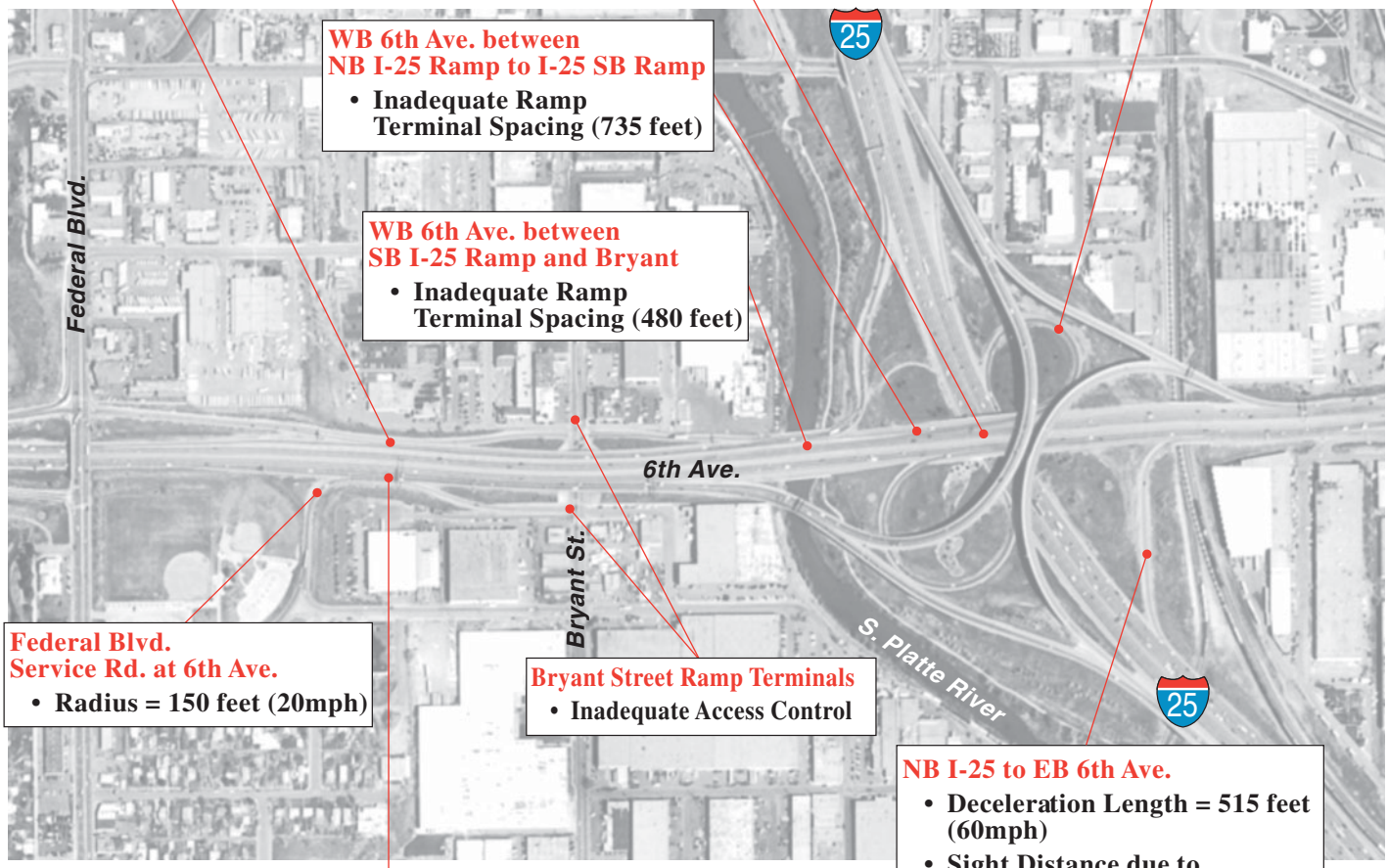
Along eastbound and westbound US 6, weave lengths between Federal Boulevard, Bryant Street, and I-25 are severely deficient. These weave lengths would need to be increased to provide safer vehicle movements among these access points. The US 6 bridge over the South Platte River is subject to flood water flows overtopping the bridge during a major (100-year) storm event.

Roadway deficiencies are highlighted on **Figures 1-5** through **1-9. Table 1-1** outlines deficiencies compared to current design standards. These design standards are the minimum standard currently applied as adopted by CDOT in agreement with FHWA.



North

Mainline I-25 Geometric Deficiencies



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I-25 / 6th Avenue Geometric Deficiencies

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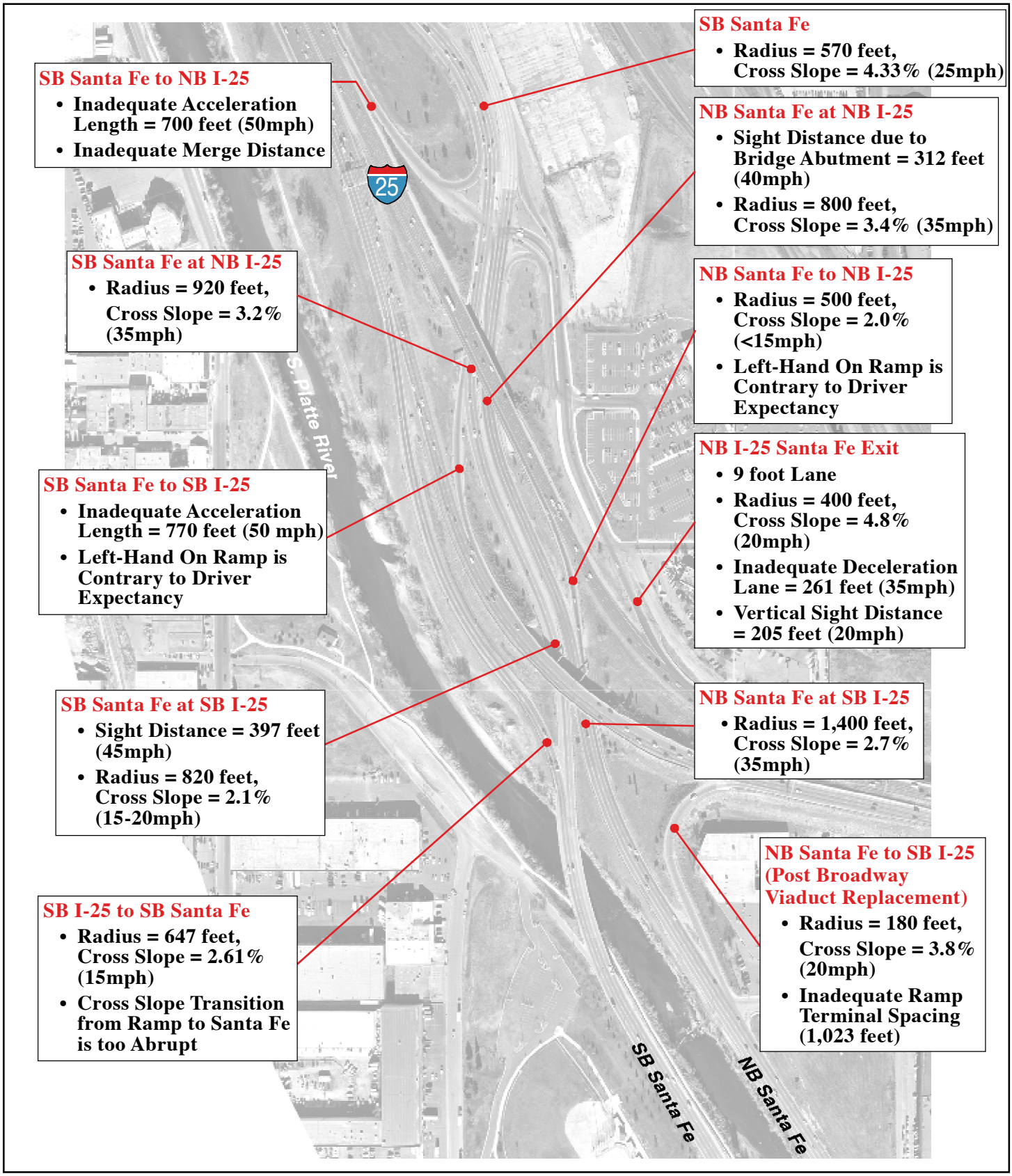
I-25 / Broadway Interchange Geometric Deficiencies



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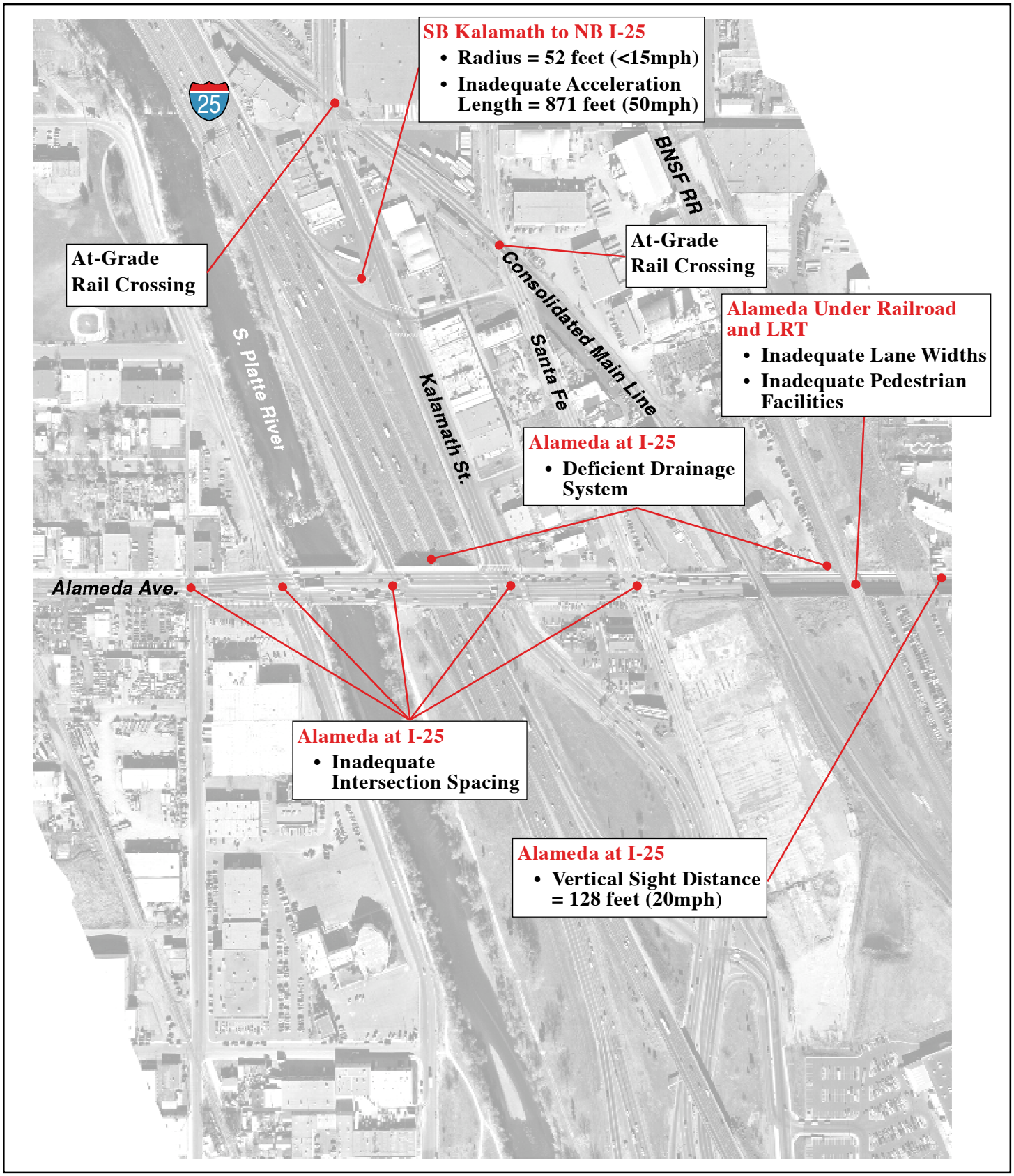
I-25 / Santa Fe Drive Geometric Deficiencies



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I-25 / Alameda Avenue Geometric Deficiencies

Table 1-1 Comparison of Roadway Deficiencies and Current Design Standards

Design Criteria	Existing Facility	Current Criteria	Comment
I-25 Mainline (refer to Figure 1-5):			
Lane Widths	11-foot lanes	12-foot lanes	12 feet lanes provide desirable clearances between larger vehicles. Narrow lanes force drivers to operate their vehicles closer to each other than normally desired, which affects the level of service of highway. The resultant erratic operation has an undesirable effect.
Shoulder Widths	Inside varies from 0–12 feet, Outside varies from 0–10 feet	Inside 10 feet–12 feet Outside 12 feet	Heavily traveled high-speed highways and highways carrying large numbers of trucks, such as I-25, should have useable shoulders at least 10–12 feet so a stopped vehicle on the shoulder clears the edge of traveled way by at least 1–2 feet. Narrow shoulders affect the level of service of highway.
Ramp Terminal Spacing	Washington Street to Lincoln Street – 1455 feet	1600 feet	Lane length between entrance at Washington Street and exit to Lincoln Street is too short for vehicles to accelerate and weave with vehicles on I 25 exiting subsequent off-ramp. Distance is not adequate for these maneuvers.
Basic Number of Lanes	Post T-REX and Broadway Viaduct Project, 4 lanes in each direction south of Santa Fe Drive exit; 3 lanes in each direction through the Santa Fe interchange; 4 lanes in each direction north of Santa Fe Drive to US 36.	4 lanes	A basic number of lanes should be maintained over a significant length along any route of arterial character. This becomes significant with completion of an 8-lane section south of Santa Fe creating a 6-lane bottleneck at Santa Fe.
Lane Balance	Lane Drop / Add at Santa Fe Drive		To achieve efficient traffic operation through and beyond an interchange, there should be a balance of the number of traffic lanes on the highway and on the ramp. This balance is determined through guidance published in the AASHTO guide.
Grade	6 percent on NB from Broadway to Alameda Avenue	4 percent Max	In urban areas where interchanges are closely spaced and frequent speed changes are needed, the use of flat grades is desirable.

Table 1-1 Comparison of Roadway Deficiencies and Current Design Standards *(Continued)*

Design Criteria	Existing Facility	Current Criteria	Comment
I-25 / US 6 Interchange and US 6 Mainline (refer to Figure 1-6):			
Stopping Sight Distance	NB I-25 to EB US 6 – 110 feet (15 mph)	200 feet (30 mph)	The stopping sight distance is the sum of the distance traversed during the brake reaction time and the distance to brake the vehicle to a stop. If obstructions occur within the distance of lower design speeds, the odds of vehicle accidents increase.
Curve Radius (Horizontal Curves) and Cross Slope	NB I-25 to EB US 6 – 380 feet, 2.2 percent (<15 mph) 150 feet, 5.5 percent (<15 mph) NB I-25 to WB – 135 feet, 6.8 percent (15 mph) Federal Boulevard Service Road 150 feet (20 mph)	30 mph design speed: Min. radius of 250 feet with 8 percent cross slope, or 380 feet with 7.1 percent cross slope, etc.	Design speed through curves is a function of the curve radius and cross slope. AASHTO provides various design elements in tables based on cross slope and design speeds.
Acceleration Lanes	NB I-25 to EB US 6 – 394 feet (45 mph)	546 feet	Inadequate acceleration lanes require vehicles to merge into traffic at a speed less than what vehicles will likely be traveling (design speed).
Ramp Terminal Spacing on US 6	NB I-25 Ramp / US 6 Collector – 700 feet NB I-25 Ramp / SB I-25 Ramp – 735 feet SB I-25 Ramp / Bryant Street – 480 feet Bryant Street / Federal Boulevard – 700 feet Bryant Street / Federal Boulevard – 300 feet	1600 feet 800 feet 1600 feet 1600 feet 1600 feet	The length of the ramp terminal spacing is determined by the type of ramps in the pair and the weaving potential. The 1600 feet distance is required when an entrance ramp is followed by an exit ramp, while 800 feet is required between two entrance ramps. The distances are required to allow for weaving of vehicles.
I-25 / Broadway Interchange (see Figure 1-7):			
Curve Radius (Horizontal Curves) and Cross Slope	Lincoln Street at Ohio Avenue – 150 feet (20 mph) Lincoln Street N. of Ohio Avenue – 280 feet (25 mph) NB I-25 On Ramp – 114 feet, 1.76 percent (15 mph) SB I-25 On-Ramp – 150 feet, 8 percent (20 mph)	Lincoln Street, 40 mph design speed: Min. radius of 565 feet with 4 percent cross slope. Ramps, 30 mph design speed: Min. radius of 250 feet with 8 percent cross slope.	Drivers doing posted speed through curves which do not follow established guidelines, are too tight, or do not have the correct cross-slope and the vehicle may skid toward outside of curve or be unable to maneuver the curve and lose control of the vehicle.
Shoulder Widths	NB I-25 On-Ramp – 0 feet	6 feet outside, 4 feet inside	Ramps are turning roadways and if the shoulders are not at least 10 feet (combined right and left), the roadway width would need to be increased to account for the turning movements.
Stopping Sight Distance	Lincoln Street at I-25 due to East Building – 116 feet (20 mph) NB I-25 On-Ramp – 103 feet (20 mph)	Lincoln Street – 305 feet (40 mph) Ramp – 200 feet (30 mph)	The stopping sight distance is the sum of the distance traversed during the brake reaction time and the distance to brake the vehicle to a stop. If obstructions occur within the distance of lower design speeds, the odds of vehicle accidents increase.

Table 1-1 Comparison of Roadway Deficiencies and Current Design Standards *(continued)*

Design Criteria	Existing Facility	Current Criteria	Comment
I-25 / Santa Fe Drive Interchange (see Figure 1-8):			
Curve Radius (Horizontal Curves) and Cross Slope	NB Santa Fe Drive Ramp to SB I-25 – 185 feet (25 mph) NB Santa Fe Drive at SB I-25 – 1400 feet, 2.7 percent (35 mph) NB Santa Fe Drive at NB I-25 – 800 feet, 3.4 percent (35 mph) NB I-25 Santa Fe Drive Off-Ramp – 400 feet, 4.8 percent (20 mph) NB Santa Fe Drive to NB I-25 – 500 feet, 2.0 percent (<15 mph) SB Santa Fe Drive – 570 feet, 4.3 percent (25 mph) SB Santa Fe Drive at NB I-25 – 920, 3.2 percent (35 mph) SB Santa Fe Drive at SB I-25 – 820 feet, 2.1 percent (20 mph) SB I-25 to SB Santa Fe Drive – 647 feet, 2.6 percent (15 mph)	Santa Fe Drive, 50 mph design speed – Min. radius of 930 feet with 4 percent cross slope. Ramps, 30 mph design speed – Min. radius of 250 feet with 8 percent cross slope.	Drivers doing posted speed through curves which do not follow established guidelines, are too tight, or do not have the correct cross slope may skid toward outside of curve or be unable to maneuver the curve and lose control of the vehicle.
Acceleration Lanes	SB Santa Fe Drive to NB I-25 – 700 feet (50 mph) SB Santa Fe Drive to SB I-25 – 770 feet (50 mph)	1020 feet (60 mph) 910 feet (60 mph)	Inadequate acceleration lanes require vehicles to merge into traffic at a speed less than what vehicles will likely be traveling (design speed).
Deceleration Lanes	NB I-25 Santa Fe Drive Off-Ramp – 261 feet (35 mph)	516 feet (60 mph)	Causes excessive braking or backup onto I-25 because braking will take place earlier than the exit.
Ramp Terminal Spacing	NB Santa Fe Drive Ramp to SB I-25 / Broadway Off-Ramp – 1023 feet	1600 feet	The length of the ramp terminal spacing is determined by the type of ramps in the pair and the weaving potential. The 1600 feet distance is required when an entrance ramp is followed by an exit ramp. Lane length between entrance at Santa Fe and exit to Broadway is too short for vehicles to accelerate and weave with vehicles on I-25 exiting subsequent off-ramp. Distance is not adequate for these maneuvers.
Stopping Sight Distance	NB Santa Fe Drive at NB I-25 Bridge Abutment – 312 feet (40 mph)	570 feet (60 mph)	The stopping sight distance is the sum of the distance traversed during the brake reaction time and the distance to brake the vehicle to a stop. If obstructions occur within the distance of lower design speeds, the odds of vehicle accidents increase.

Table 1-1 Comparison of Roadway Deficiencies and Current Design Standards *(continued)*

Design Criteria	Existing Facility	Current Criteria	Comment
I-25 / Santa Fe Drive Interchange (see Figure 1-8):continued			
Vertical Sight Distance	NB I-25 Santa Fe Drive Off-Ramp – 205 feet (20 mph)	200 feet (30 mph)	Minimum vertical curves are established to make sure that the driver can see an object in enough time to stop. If this object is out of sight due to a curve that is too small, an accident is more likely to occur.
Left-Hand On-Ramp	NB Santa Fe Drive to NB I-25 SB Santa Fe Drive to SB I-25	Right-hand on-ramps	Slower speed traffic from ramps traditionally merges with the slower moving mainline highway lanes on the right. It is therefore contrary to current driver's expectation that they merge with the higher speed left-hand lanes as currently occurs.
Cross Slope	SB I-25 to SB Santa Fe Drive Ramp – not sufficient runout lengths between reverse curves, too abrupt	4 percent with proper runout lengths	Having insufficient runout lengths within reverse curves can cause a roller coaster effect. This, along with merging with Santa Fe traffic at 50 mph, has caused tractor trailers to overturn.
I-25 / Alameda Avenue Interchange (see Figure 1-9):			
Curve Radius (Horizontal Curves)	SB Kalamath Street to NB I-25 – 52 feet (<15 mph)	Ramps, 30 mph design speed – Min. radius of 250 feet with 8 percent cross slope.	Drivers doing posted speed through curves which do not follow established guidelines, are too tight, or do not have the correct cross-slope may skid toward outside of curve or be unable to maneuver the curve and lose control of the vehicle.
Intersection Spacing	310 feet – 360 feet	450 feet-600 feet	Adequate intersection spacing is necessary for the efficient operation of the traffic and provides necessary space for queuing, turning, and lane changes.
Stopping Sight Distance (Vertical Curves)	Alameda Avenue – 128 feet (20 mph)	305 feet (40 mph)	Minimum vertical curves are established to make sure that the driver can see an object in enough time to stop. If this object is out of sight due to a curve that is too small, an accident is more likely to occur.
Lane Widths	Alameda Avenue Under Railroads / LRT – 10 feet	11 feet	11-foot lanes provide desirable clearances between larger vehicles. Narrow lanes force drivers to operate their vehicles closer to each other than normally desired, which affects the level of service of highway. The resultant erratic operation has an undesirable effect on driver comfort and crash rates.
Acceleration Lane	SB Kalamath Street to NB I-25 – 871 feet (50 mph)	1140 feet (60 mph)	Inadequate acceleration lanes require vehicles to merge into traffic at a speed less than what vehicles will likely be traveling (design speed).

AASHTO – American Association of State Highway and Transportation Officials
EB – eastbound
LRT – light rail transit
SB – southbound
mph – miles per hour
NB – northbound
WB – westbound

1.4.6 Consolidated Main Line Railroad Crossing at Santa Fe Drive and Kalamath Street

The one-way arterial street pair of Santa Fe Drive and Kalamath Street crosses the Consolidated Main Line railroad at-grade north of Alameda Avenue. This causes periods of substantial congestion as traffic queues and/or diverts to neighborhood streets while waiting for the train to cross the intersections. In addition, access to the existing northbound I-25 on ramp at Cedar Avenue and Kalamath Street is restricted when trains are present.

The Santa Fe Drive and Kalamath Street one-way couplet crosses the Consolidated Main Line tracks approximately ¼ mile north of Alameda Avenue. Bayaud Avenue connects Santa Fe Drive and Kalamath Street and crosses the main line tracks just east of Kalamath Street. These crossings are protected by signals, bells, and gating. Santa Fe Drive and Kalamath Street are principal north-south oriented arterial streets that carry automobile traffic to/from Downtown Denver to/from points southwest of the metropolitan area. The Consolidated Main Line railroad is the principal north-south freight rail route in and out of Denver. The Burlington Northern and Santa Fe Railroad and the Union Pacific Railroad operate in this corridor, principally transporting coal from the Powder River Basin of Wyoming to customers in Oklahoma and Texas.

There is a history of train and automobile accidents at the crossing. From 1975 to the present there have been seven train/automobile accidents at the Santa Fe Drive crossing – all involving property damage without injury or death. There have been 15 accidents at the Kalamath Street crossing – all involving property damage and three involving injuries with no fatalities.

Current and future traffic on each of these systems are shown in **Table 1-2.**

Table 1-2 Current and Future Traffic at the Consolidated Main Line

System	Current Average Daily Traffic	Projected (2025) Average Daily Traffic
Kalamath Street (vehicles per day)	14,800	22,700
Santa Fe Drive (vehicles per day)	15,000	19,300
Consolidated Main Line (trains)	60	60 [a]

[a] Future train volumes are uncertain. Current traffic has been noted.

The City and County of Denver has long considered this crossing a priority for grade separation. The traffic volumes on Kalamath Street and Santa Fe Drive are among the largest volumes of traffic crossing the Consolidated Main Line railroad in Denver. As a result, these are listed as the highest priority railroad grade-separation projects in the *Denver Citywide Railroad Study and Plan* (City and County of Denver and CRSS Civil Engineers, 1992a).

Exposure factor is a measure used to assess the conflict and resulting safety risk associated with a road crossing a railroad at grade. The exposure factor is computed using the following equation:

Exposure Factor = Average Daily Traffic Volume x Average Daily Number of Trains

The Colorado Public Utilities Commission uses a minimum criteria exposure factor of 75,000, actual or projected, at urban locations to warrant grade separation cost allocation (Colorado Public Utilities Commission, 2003). **Table 1-3** identifies current and future exposure factors at the Consolidated Main Line. This calculation shows that both Kalamath Street and Santa Fe Drive currently have exposure factors that are more than ten times those that warrant consideration of grade separation.

Table 1-3 Current and Future Exposure Factors at the Consolidated Main Line

Crossing	Current Exposure Factor	Future Exposure Factor [1]
Kalamath Street Crossing	888,000	1,362,000
Santa Fe Drive Crossing	900,000	1,158,000

[1] Future exposure factors have assumed current daily train traffic.

The crossing also meets FRA conditions for consideration of a grade separation, with an estimated 310 vehicle-hours of delay based on current conditions, compared with the FRA's threshold of 40 vehicle hours of delay (FRA, 2002).

Effects on traffic operations associated with the Kalamath Street and Santa Fe Drive Consolidated Main Line railroad crossings are summarized below. Additional detail is provided in **Chapter 3** *Transportation Analysis*.

- Vehicle Delay: Based on the current number of train movements and the traffic volumes on Kalamath Street and Santa Fe Drive, there is an estimated 310 vehicle hours of delay per day caused by trains blocking the two roads.
- Queuing Effects: Queues (vehicles waiting) that would form on northbound Santa Fe Drive when the street is blocked by a 95-car coal train crossing during the AM peak period are estimated to extend approximately 1325 feet under current conditions and approximately 1600 feet under forecasted year 2025 conditions. The available storage distance on Santa Fe Drive between the Consolidated Main Line railroad and Alameda Avenue is approximately 880 feet. Therefore, peak period vehicle queues currently exceed the available storage length by more than 400 feet and are projected to exceed available storage by more than 700 feet in the future. Thus, train movements that occur during peak traffic periods have the effect of not only delaying Santa Fe Drive and Kalamath Street traffic, but also of severely impacting operations on Alameda Avenue.
- Other Transportation Modes: In addition to general vehicular effects, other modes of travel are also affected by delays associated with the at-grade railroad crossings. Bicycles and pedestrians experience the same delays and accident exposure as motor vehicles, and bicyclists particularly are affected by the railroad crossing surface. Emergency services vehicles, RTD buses and school buses either experience delays or avoid Kalamath Street and Santa Fe Drive due to the unpredictability of travel times