

2020 E-470 Master Plan

July 2020



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2020 E-470 Master Plan

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2020 Master Plan Introductory Statement

The first edition of the E-470 Master Plan was completed December 2017 and adopted in 2018 (2018 Master Plan). The object of this Master Plan was to consolidate and incorporate the following four (4) previous study efforts into one document.

- ▶ Long range planning horizon
- ▶ Close coordination with local and regional transportation planning
- ▶ Focus on individual interchanges (in addition to mainline E-470)
- ▶ Combines roadway and other asset investments

As it has always been the intention of the E-470 PHA to make the Master Plan a living document, it was updated in 2020 with the same objective as the 2018 document. The 2020 Master Plan incorporated changed conditions in the following areas:

- traffic volumes,
- growth and development in the corridor,
- local agency transportation planning, and
- evolving transportation technology.

The 2020 Master Plan updates any budgetary modifications that have been approved over the two years, updates the existing traffic volumes, and evaluates whether recently published planning documents impact the year 2040 traffic volume forecasts.

The 2020 Toll Revenue Study was reviewed and determined that the 2040 forecasted volumes would not be modified in this Master Plan refresh because the changes were not significant.

The 2020 Master Plan takes into account these changes as part of that dynamic process, compiling the information and evaluating data to set planning and budgetary forecasts for the corridor.

The following includes the major revisions included in this 2020 E-470 Master Plan refresh:

- Literature Review: Reviewed area planning studies published in the last two years to determine the developmental impacts that necessitate modifications to the Master Plan.
- 2019 Comprehensive Safety Study Results Summary: Results of the safety study conducted by DiExSys was included in the Master Plan along with its recommended safety improvements.
- Existing Volume Updates: Existing volumes were updated from 2018 volumes to 2020 volumes per E-470 toll data along the corridor as well as input from local agencies for cross streets.
- Additional detail on improvements years of need: E-470 provided their updated programming schedule and budget. Updated volumes were also evaluated for revised widening improvements years of need.
- 2020 Toll Revenue Study: The most recent toll revenue study was used to determine whether the 2040 model required updating. It was determined that the 2040 model did not need to be updated by the most recent toll revenue study.
- Development and jurisdictional maps: Local jurisdictions offered updates to their boundaries as well as recent development boundaries to be included and revised in the maps within the Master Plan.

1.0 INTRODUCTION

1.1 E-470 Description

E-470 is a 47-mile toll road in the eastern Denver metropolitan area, serving as the eastern circumferential highway connecting with I-25 in the southern and northern parts of the metro area. As shown on **Figure 1**, E-470 passes through the Colorado counties of Adams, Arapahoe and Douglas and the municipalities of Aurora, Brighton, Commerce City, Parker, and Thornton, representatives of which form the eight voting members of the E-470 Board of Directors. There are also eight non-voting members including the cities of Arvada, Lone Tree, and Greeley, City and County of Broomfield, Weld County, and the following agencies; Colorado Department of Transportation (CDOT), Denver Regional Council of Governments (DRCOG), and Regional Transportation District (RTD). E-470 also passes through the City and County of Denver at Peña Boulevard.

1.1.1 Facility

E-470 consists of six through-lanes in the southern part of the corridor from South I-25 to Quincy Avenue. Widening from four to six through lanes between Quincy Avenue and I-70 is currently under construction and should be completed in late 2020. The remainder of the toll road, north of I-70, has four through-lanes. There is a total of 24 interchanges, including the I-25 interchanges on either end of the highway and 22 freeway or arterial roadway interchanges in between. Tolls are collected via the 956,000 customers with Express Toll Accounts and by license plate readers.

1.1.2 Historical Background

E-470 was built in four phases, beginning with the opening of the southernmost 5-mile segment between South I-25/C-470 and Parker Road in 1991. Phases II and III were completed in 1998-1999, extending the road northward to 120th Avenue. The final 12-mile phase between 120th Avenue and North I-25 was completed in 2003, with the Northwest Parkway toll road to the west of I-25 completed later in 2003.

1.1.3 Organizational Structure

Policy direction for the E-470 Public Highway Authority (PHA) is provided by a Board of Directors consisting of elected officials from each of the eight jurisdictions listed above. Staff leadership is provided by the Executive Director and Directors of Operations, Technology, Finance, and Engineering & Roadway Maintenance.

1.1.4 Budgeting Process

E-470 PHA budgeting is implemented through 2-year operating and 5-year capital budgeting cycles. The 2020 capital budget is approximately \$95 million and the operating budget is \$62 million.

Longer range financial and needs assessments are accomplished using traffic and revenue studies that have been prepared every two to three years projecting traffic, toll revenues and general E-470 capacity expansion needs over an approximate 20-year time horizon. The last three such studies are the 2017 *E-470 Toll Rate Structure Traffic and Revenue Study*, *E-470 2014 Investment Grade Traffic and Revenue Study*, and 2012 *E-470 Potential Interchanges*

Traffic and Revenue Study, all prepared for the E-470 PHA 2020 Toll Revenue Study by CDM Smith.

1.1.5 Literature Review

A review of available literature was performed regarding the E-470 impact area to quantify any improvements not contained within the current *E-470 Master Plan*, and determine what impacts if any, those improvements would have to E-470 and whether future 2040 projected volumes are expected to change. The 2018 *E-470 Master Plan*, completed December, 2017 was used as a basis for comparison. Multiple County and Municipal transportation plans were reviewed including:

- *Northeast Area Transportation Study Refresh*, completed October, 2018 (*NEATS Refresh*)
- *Planning Level Traffic and Revenue Impact Study: Proposed Interchange at 38th Avenue and the Aurora Highlands Development*, completed March, 2018
- *2017 E-470 Toll Rate Structure Traffic and Revenue Study Table 2*
- *2040 Douglas County Transportation Master Plan*, completed September, 2019
- *Parker Road Corridor Plan*, completed November 2019, included eastbound ramp safety improvements, increasing the eastbound left turn lanes to northbound Parker Road to three lanes, and reducing the exit speed from the ramp to southbound Parker Road. Further improvements include constructing a slip ramp from the eastbound off-ramp to Twenty Mile Road while also tightening the right turn radius at eastbound E-470 ramp intersection with Parker Road.
- *Parker Master Plan*, 2035 mentions maintaining a working relationship with E-470 and goals to expand the E-470 trail.
- *2020 Investment Grade Traffic and Revenue Study*, completed in April 2020, from data and information provided in the study, the 2040 forecasted volumes were not modified in the *2020 E-470 Master Plan*.
- *E-470 & Jewell, 56th, and 64th Signal Warrant Analysis Summary Letter*, 11-05-2019, included results from three signal warrant studies conducted for the City of Aurora Public Works Department. Signal warrants were completed for the northbound and southbound ramps for each of the following interchanges; Jewell Avenue, 56th Avenue, and 64th Avenue. Based on signal warrant criteria and measures Jewell Avenue at E-470 was found to require signalization in the immediate future, while the E-470 interchanges at 56th and 64th Avenues did not meet warrant criteria for signalization. Full build out of developments occurring near the 56th and 64th Avenue interchanges are expected to be complete by 2035. Therefore, signalization may be warranted for 56th Avenue by 2025 and for 64th Avenue by 2026.
- *I-70 / E-470 Interchange Complex Study*
- *I-70 / Picadilly Road Interchange Reevaluation Project*
- *Development Plans for Aurora Highlands and Green Valley Ranch*
- *Safety Assessment Report for E-470*, completed February, 2019

The purpose of the *NEATS Refresh* for the City of Aurora was to take into account planned development and forecasted traffic volumes. As a result of the *NEATS Refresh*, a recommendation was made to build both 38th and 48th Avenue interchanges, instead of the and/or option proposed in the *2018 E-470 Master Plan*, as such, both interchanges are

accounted for in this master plan. Through conversations with FHU, the 2040 volumes in these studies were held constant to those reported in the *2018 E-470 Master Plan*.

Planning Level Traffic and Revenue Impact Study: Proposed Interchange at 38th Avenue and the Aurora Highlands Development, completed March, 2018 was also reviewed for the northeast Aurora area of impact. No changes to 2040 volumes were noted per the *2018 E-470 Master Plan*.

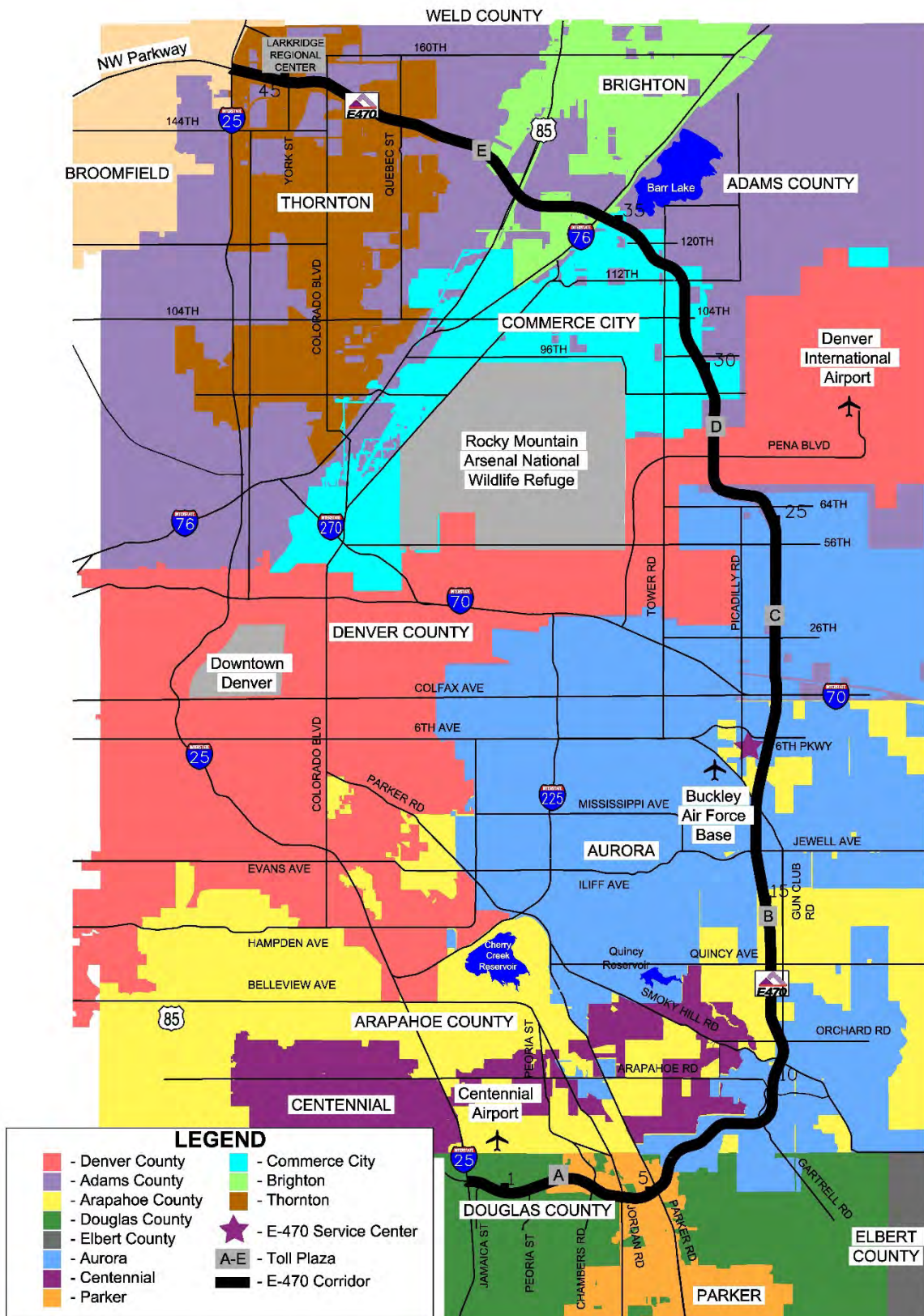
In conversations with FHU, 2040 volumes were held constant to the 2017 *E-470 Toll Rate Structure Traffic and Revenue Study Table 2*, just as in *2018 E-470 Master Plan* was, therefore 2040 volumes for mainline E-470 remain constant for this master plan as well.

2040 Douglas County Transportation Master Plan included E-470 widening from I-25 to Parker Road by 2040 in the Transportation Improvement Summary, and is included in this report. Direct impacts to E-470 were not topics for this document and do not impact volumes reported in the *2018 E-470 Master Plan*.

Other literature reviewed for planned impacts to the E-470 corridor includes the *I-70 / E-470 Interchange Complex Study* along with the I-70 / Picadilly Road Interchange Reevaluation Project to evaluate most recent developments for this interchange including design and costs. Development plans for the Aurora Highlands and Green Valley Ranch developments were also included in this literature review. The plans were reviewed for any future traffic volume projections for side streets or planned impacts to E-470. These projects are taken into account and do not impact 2040 volumes as reported in the *2018 E-470 Master Plan*.

Additional E-470 literature items include the most recent *Safety Assessment Report for E-470* for purposes of the safety evaluation in this report, and the *2018 E-470 Master Plan* for comparison. The 2040 volume projections from the existing *2018 E-470 Master Plan* are unchanged per this literature review. The proposed projects and developments impacting the E-470 corridor studied in these documents were taken into account for this updated master plan.

Figure 1. Vicinity Map



1.2 Purpose of Master Plan

Now almost 30 years since the opening of the first phase of E-470, E-470 is a mature facility entering into its second phase. The E-470 PHA has determined that it would be beneficial to begin a master planning process to identify, prioritize and guide capital rehabilitation and expansion needs for the facility. The initial version of the E-470 Master Plan was completed in December 2017 to expand upon previous study efforts and consolidate planning that incorporates:

- ▶ Long range planning horizon
- ▶ Close coordination with local and regional transportation planning
- ▶ Focus on individual interchanges (in addition to mainline E-470)
- ▶ Combines roadway and other asset investments

The purpose of this revised 2020 Master Plan is to update the data and information to reflect current conditions. It is the E-470 PHA's intention that the master plan will be a living document that will be periodically updated to respond to changing conditions, including traffic volumes, growth and development in the corridor, local agency transportation planning, and evolving transportation technology.

2.0 EXISTING CONDITIONS

2.1 Roadway Characteristics

E-470 was originally constructed as a 4-lane toll road for its entire 47-mile length, with land purchased for the ultimate 8 lane configuration. One through lane has been added in each direction to create a 6-lane highway for the 13-mile southern segment between South I-25 and Quincy Avenue. Widening from 4-lanes to 6-lanes for the 7-mile segment between Quincy Avenue and I-70 is currently under construction and should be completed in late 2020. The E-470 PHA has included the planning, design and construction of the High Plains Trail where possible along the corridor in coordination with local trail plans. The funding for the trail expansion is described in Section 5.2 of this report.

E-470 currently has a total of 24 interchanges. Freeway-to-freeway interchanges are at:

- ▶ North I-25
- ▶ I-76 (partial interchange)
- ▶ Pena Boulevard
- ▶ I-70 (includes freeway-to-freeway and arterial ramps via Gun Club Road)
- ▶ South I-25

Interchanges with arterial streets are at:

- | | |
|--------------------------------------|------------------------------------|
| ▶ York Street (diamond) | ▶ Jewell Avenue (diamond) |
| ▶ Colorado Boulevard (diamond) | ▶ Quincy Avenue (diamond) |
| ▶ Quebec Street (diamond) | ▶ Smoky Hill Road (diamond) |
| ▶ US 85 (partial cloverleaf) | ▶ Gartrell Road (diamond) |
| ▶ 120 th Avenue (diamond) | ▶ Parker Road (partial cloverleaf) |
| ▶ 104 th Avenue (diamond) | ▶ Jordan Road (diamond) |
| ▶ 96 th Avenue (diamond) | ▶ Chambers Road (diamond) |
| ▶ 64 th Avenue (diamond) | ▶ Peoria Street (diamond) |
| ▶ 56 th Avenue (diamond) | ▶ Jamaica Street (partial diamond) |
| ▶ 6 th Parkway (diamond) | |

2.2 Traffic Conditions

2.2.1 Traffic Volumes

Existing average daily traffic volumes on E-470 and its major crossroads are shown on **Figure 2**. Volume data on E-470 represents 2018 data collected by the E-470 PHA and documented in the 2017 *E-470 Toll Rate Structure Traffic and Revenue Study*. Daily traffic volumes range from 56,200 vehicles per day near South I-25 to 33,500 in the north-central part of the corridor north of 56th Avenue. Current volumes reflect increases for the past two years from the 2018 Master Plan, increases range from -0.40 percent to 10.36 percent annually seen on different segments of the highway. Volumes for 2040 were not modified for this Master Plan refresh as a result of a review of the 2020 Toll Revenue Study.

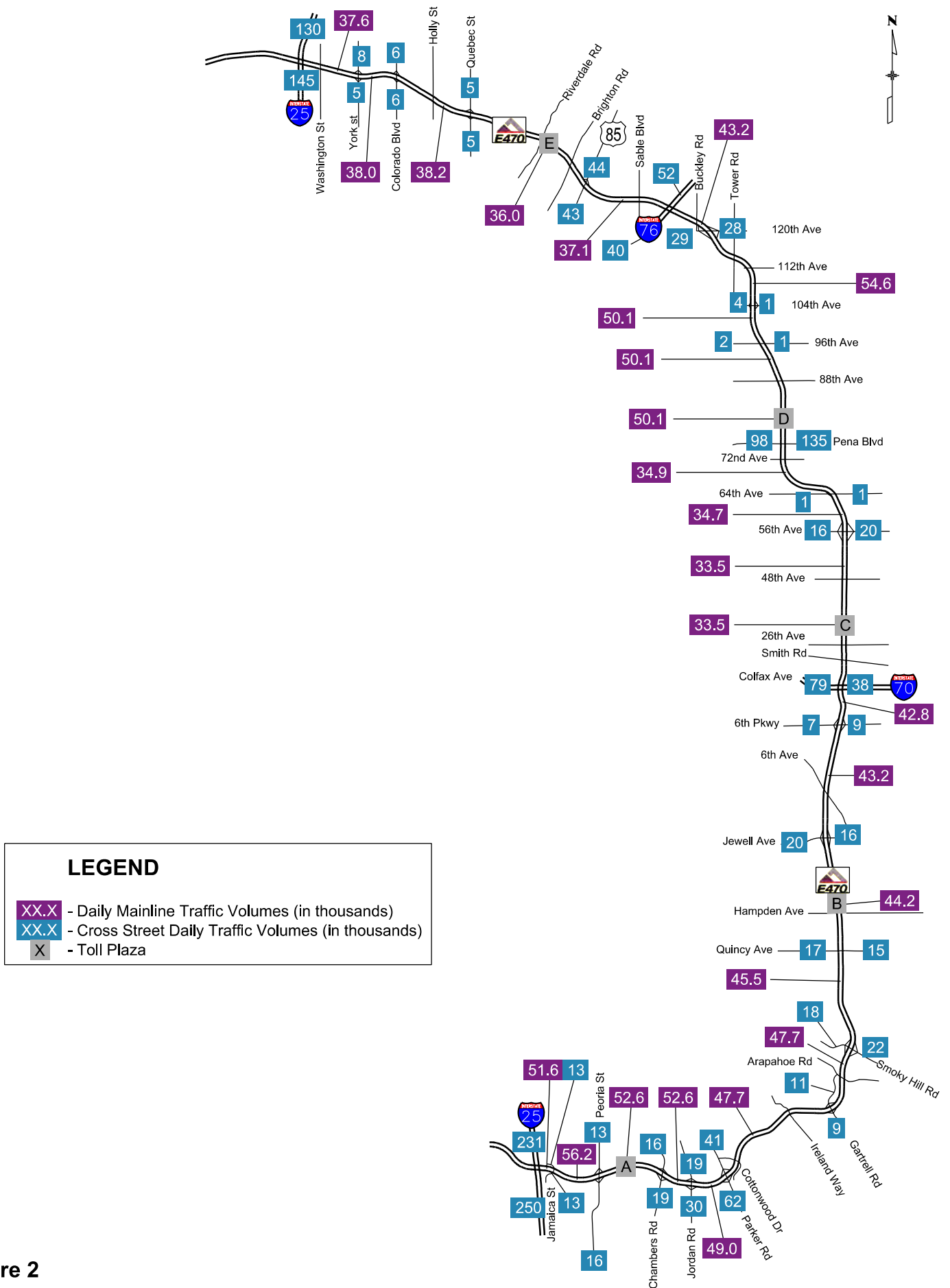


Figure 2
Existing Daily Traffic Volumes

Crossroad traffic volumes were assembled from a number of sources including Denver Regional Council of Governments (DRCOG), Colorado Department of Transportation (CDOT), counties and municipalities, and traffic studies prepared for corridor developments. In several cases, counts that were taken in earlier years or were taken at locations some distance from E-470 were adjusted to represent reasonable estimates of 2018-2019 crossroad volumes adjacent to E-470.

To evaluate traffic operations and improvement needs at interchanges, individual traffic movements during AM and PM peak hours are needed. That detailed information is provided in **Appendix A, Figure A-1**. The information was derived from the daily crossroads volumes, available peak hour counts from similar sources as listed above, and adjustment and estimation procedures as required to derive reasonable estimates as shown on the Appendix A maps.

2.2.2 Operations Analysis

Level of Service (LOS) is a standard scale (documented in the *Highway Capacity Manual*, 2016 by the Transportation Research Board) used to characterize traffic operations and congestion levels for freeways, signalized intersections, stop-controlled intersections and other roadway system components. Measurement considers factors such as speed, delay, traffic interruptions, safety, driver comfort, and density to determine peak hour LOS on a scale from A to F, with LOS A representing free-flow conditions with minimal delay and LOS F representing extreme congestion with traffic volumes exceeding roadway capacity. **Figure 3** provides illustrations of LOS A through F conditions.

The E-470 PHA has set a standard of LOS C or better for its facility. This is a high standard that is maintained to ensure that customers are provided with reliable service with minimal delays all hours of the day and throughout the year.

AM and PM peak hour traffic volumes for the peak month were developed for each segment using detailed data developed by CDM Smith and documented in the 2017 *E-470 Toll Rate Structure Traffic and Revenue Study*. Count data show that August is the peak month for E-470 traffic, with volumes approximately 13 percent higher than the annual average. To ensure that desired LOS is achieved throughout the year, average annual traffic was converted to an August level to assess capacity needs for the peak traffic month.

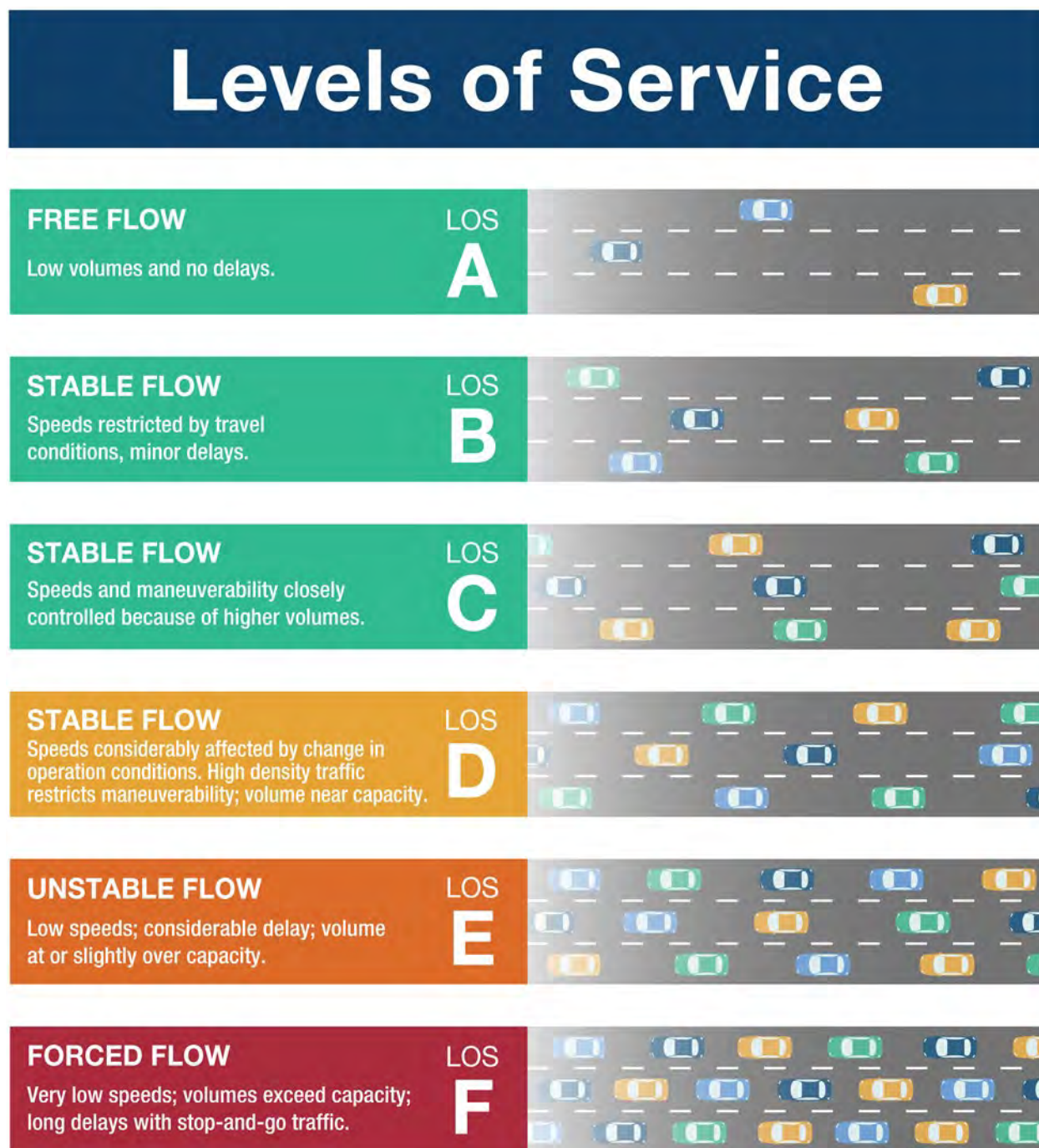
Mainline LOS were evaluated for peak hours based on existing traffic volumes for each segment of E-470 using Highway Capacity Software and using the LOS analysis factors shown on **Table 1**. Mainline E-470 LOS analysis shows that all segments are currently operating at the target LOS C or better during AM and PM peak hours during E-470's peak traffic season.

It should be noted that this finding does not guarantee that drivers will not occasionally encounter higher levels of congestion and subsequently a lower LOS that may be caused by such non-recurring conditions such as crashes, disabled vehicles or construction impacts.

Table 1. Factors for Level of Service Analysis

Annual Average to Peak Month Factor	Free Flow Speed	Terrain	Percent Heavy Vehicles	Peak Hour Factor
+13%	75 MPH	Level	4.7%	0.9

Figure 3. Level of Service Illustrations



LOS were also calculated for E-470 interchanges, including ramps and ramp terminal intersections (see **Appendix A, Figure A-2**). Growth factors were low enough that changes in present LOS from the 2018 Master Plan are not anticipated. Substandard current peak hour LOS were found at four interchanges, all associated with left-turns from exit ramps at unsignalized ramp terminal intersections as summarized in **Table 2**.

Table 2. Existing Level of Service Deficiencies – Ramp Terminal Intersection

Location	Traffic Control	Movement(s)	Level of Service AM/PM Peak Hours
Quebec St Interchange - North and South Intersections	STOP Signs	Westbound Left Turn Eastbound Left Turn	f/f f/f
120 th Ave Interchange – West and East Intersections	STOP Signs	Southbound Left Turn Northbound Left Turn	f/f c/f
Quincy Ave Interchange – East and West Intersections	STOP Signs	Southbound Left Turn Northbound Left Turn	f/f f/f
Gartrell Road Interchange – South Intersection	STOP Signs	Eastbound Left Turn	c/f

Based on these findings, adding traffic signals at ramp terminal intersections at these four interchanges is a short-range recommendation included in the capital improvements plan shown in this report. It should be noted that prior to installing traffic signals, all agencies are required to perform detailed traffic signal warrant analyses based on national signalization standards and poor LOS findings may or may not correspond to meeting signal warrants.

An additional note for stop-controlled intersections is that LOS worse than C is commonly found for some left-turns during peak hours and is generally accepted by drivers, so a LOS D threshold was used for unsignalized intersections in this plan rather than the stricter LOS C threshold for mainline capacity.

2.2.3 Safety Assessment

A comprehensive E-470 corridor safety assessment report was completed by DiExSys on February 26, 2019. Crash history for the 5-year period from 2012 to 2016 was reviewed to determine how E-470's safety record compares to similar highway facilities in Colorado and to identify any notable crash patterns that are susceptible to correction. The full safety assessment is provided upon request to the E-470 PHA. The executive summary of this study is found in **Appendix B**.

The assessment of the magnitude of safety problems on roadway segments and intersections was developed through the use of CDOT's most recent Safety Performance Functions (SPF). The SPF reflects the relationship between traffic exposure measured in Annual Average Daily Traffic (AADT), and crash count for a unit of road section measured in crashes per mile per year for segments, or crashes per year for intersections. The SPF models provide an estimate of the normal or expected crash frequency and severity for a range of AADT among similar facilities. Two kinds of SPFs were developed. The first one addresses the total number of crashes and the second one looks only at crashes involving an injury or fatality. Together they allow us to assess the magnitude of the safety problem from the frequency and severity standpoint.

Development of the SPF lends itself well to the conceptual formulation of the Level of Service of Safety (LOSS). The concept of level of service of safety uses quantitative measures and qualitative description that characterize safety of a roadway segment in reference to its expected frequency and severity. If the level of safety predicted by the SPF represents a normal or expected number of crashes at a specific level of AADT, then the degree of deviation from the norm can be stratified to represent specific levels of safety. The four LOSS descriptions that correlate to the various degrees of deviation are as follows.

- LOSS I - Indicates low potential for crash reduction
- LOSS II - Indicates low to moderate potential for crash reduction
- LOSS III - Indicates moderate to high potential for crash reduction
- LOSS IV - Indicates high potential for crash reduction

Table 3 below summarizes the LOSS from the DiExSys report for frequency and severity for segments along the E-470 mainline.

Table 3. Existing LOSS – E-470 Mainline Segments

Mile Post	Cross Streets	LOSS	
		Frequency	Severity
0.00-1.71	I-25 to Peoria Street	II	III
1.72-3.50	Peoria Street to Chambers Road	I	II
3.51-4.38	Chambers Road to Jordan Road	I	I/II
4.39-5.18	Jordan Road to Parker Road	I	II
5.19-8.89	Parker Road to Gartrell Road	III	III
8.90-10.68	Gartrell Road to Smoky Hill Road	II	II
10.69-13.35	Smoky Hill Road to Quincy Avenue	II	II
13.36-16.35	Quincy Avenue to Jewell Avenue	I/II	II
16.36-19.00	Jewell Avenue to 6th Parkway	II	II
19.01-20.55	6th Parkway to I-70/Colfax Avenue	II	II
20.56-24.48	I-70/Colfax Avenue to 56th Avenue	II	II
24.49-25.52	56th Avenue to 64th Avenue	II	III
25.53-27.85	64th Avenue to Pena Boulevard	III	III/IV
27.86-30.56	Pena Boulevard to 96th Avenue	I	II
30.57-31.61	96th Avenue to 104th Avenue	I/II	II
31.62-34.13	104th Avenue to 120th Avenue	II	II
34.14-35.49	120th Avenue to I-76	I	II
35.50-37.83	I-76 to US 85	II	III
37.84-41.59	US 85 to Quebec Street	II	II
41.60-43.65	Quebec Street to Colorado Boulevard	I	II
43.66-44.84	Colorado Boulevard to York Street	II	II
44.85-46.38	York Street to I-25/Northwest Parkway	II	II

E-470 mainline continues to deliver better than average safety performance when compared to other similar freeways in Colorado. It operates in a free-flow state throughout the day characterized by low to moderate density of flow which is inherently safer than more congested freeways with similar geometrics. A few segments and interchanges, however, do present some potential for crash reduction. The following locations and improvements have Benefit/Cost ratios greater than 1.0 and are considered cost effective solutions that should be considered along with future roadway design and traffic operational projects. The recommendation is followed by the benefit cost ratio.

- Smoky Hill Road, East Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Smoky Hill (269.11)
- Peoria Street, North Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Peoria (240.04)
- Jamaica Street, South Intersection – Traffic Signal Modifications, Full Protected Left Turns from Jamaica (222.01)
- Ramp from Southbound I-25 to Northbound E-470 (South Terminus) – Cable Rail, Right Shoulder (181.08)
- MP 0.00-0.50 (Just East of I-25) – Add Shoulder Rumble Strips on All 4 Shoulders (161.77)
- Smoky Hill Road, West Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Smoky Hill (112.92)
- Ramp from Northbound I-25 to Southbound E-470 (North Terminus) – Cable Rail, Both Shoulders (60.61)
- Ramp from Northbound E-470 to Eastbound I-76 – Cable Rail, Both Shoulders (58.59)
- Parker Road/Crown Crest Boulevard, South Intersection – Traffic Signal Modifications, Upgrade Westbound Faces (27.08)
- MP 0.00-0.51 (Just East of I-25) – Snow Fence (If Feasible), Both Directions (23.22)
- Ramp from Eastbound I-70 to E-470 C/D Road – Cable Rail, Both Sides (20.82)
- Chambers Road, North Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Chambers (18.03)
- MP 8.90-9.20 (North of Gartrell) – Snow Fence (If Feasible), Both Directions (7.43)
- Ramp from US-85 to Northbound E-470 – Rumble Strips, Both Shoulders (6.89)
- MP 1.25-1.40 (West of Peoria) – Cable Rail, Right Shoulder, Northbound (6.43)
- MP 0.00-0.50 (Just East of I-25) – Widen Left Shoulders from 4-feet to 10-feet, Both Directions (6.08)
- Ramp from Northbound I-25 to Northbound E-470 (South Terminus) – Cable Rail, Both Shoulders (6.04)
- Ramp from Westbound I-76 to Southbound E-470 – Cable Rail, Left Shoulder (5.97)
- Ramp from Northbound E-470 to US-85 – Cable Rail, Right Shoulder (5.21)
- MP 35.50-36.00 (West of I-76) – Cable Rail, Right Shoulder, Northbound (4.94)
- Ramp from Northbound E-470 to Eastbound Pena Boulevard – Curve Warning Signs (4.87)
- MP 9.80-10.10 (North of Arapahoe Road) – Snow Fence (If Feasible), Both Directions (4.37)
- Quincy Intersections – Intersection Conflict Warning System (Possibly as a Short- Term Countermeasure, until Signalization) (4.31)
- Ramp from Southbound E-470 to US-85 – Cable Rail, Both Sides (4.28)
- 19th Avenue and E-470 C/D Road – Convert Westbound Double-Lefts to Single- Left (3.86)
- 120th Avenue Intersections – Signalize (3.73)

- Ramp from Northbound E-470 to Eastbound Pena Boulevard – Cable Rail, Both Shoulders (3.49)
- MP 25.60-26.10 (North of 64th) – Overhead Feedback Curve Speed Warning System, By Lane, Both Directions (3.40)
- Ramp from Southbound E-470 to Northbound I-25 (South Terminus) – Cable Rail, Both Shoulders (2.60)
- MP 33.00-33.70 (south of 120th) – Overhead Feedback Curve Speed Warning System, By Lane, Both Directions (2.26)
- Ramp from E-470 to Southbound US-85 – Cable Rail, Both Sides (2.25)
- Ramp from Northbound E-470 to Northbound I-25 (North Terminus) – Cable Rail, Both Sides (2.14)
- Ramp from US-85 to Southbound E-470 – Cable Rail, Both Shoulders (1.75)
- MP 31.62-34.13 (104th to 120th) – Cable Rail, Right Shoulders, Both Directions E-470 (1.40)
- MP 1.30-1.71 (West of Peoria) - Highway Lighting, Both Directions (1.39)
- Quincy Intersections – Signalize (1.00)

3.0 FORECASTED CONDITIONS

Traffic forecasts were developed recently by the CDM Smith team for the 2017 *E-470 Toll Rate Structure Traffic and Revenue Study*. That study developed forecasts for the base years of 2018, 2021, and 2035 for E-470. To allow this master plan to provide the desired 20-year improvement plan and to make the plan compatible with long-range regional, county and municipal transportation plans, the 2035 forecasts were extrapolated to a 2040-time horizon.

3.1 Corridor Growth Assessment

To develop forecasts for the *E-470 Toll Rate Structure Traffic and Revenue Study*, Economic and Planning Systems (EPS) provided an independent assessment of the Denver Regional Council of Governments (DRCOG) demographic forecasts and made relatively modest modifications to the DRCOG forecasts for the E-470 influence area, shown on **Figure 4**. The map shows major anticipated commercial, residential and mixed-use development areas within the eastern part of the metro area. Major developments of all three types are planned throughout the entire E-470 corridor.

Table 4 summarizes the demographic forecasts for the entire DRCOG region and the E-470 influence area. Forecasts show a 47 percent increase in population and 48 percent increase in employment in the E-470 influence area between 2015 and 2040. Although the entire region is expected to continue to grow at a rapid pace, forecasts show especially dramatic growth in the eastern part of the metro area. To illustrate this comparison, the E-470 influence area represents approximately one-third of the current regional population and employment, but approximately half of the region's growth is expected to occur in the E-470 influence area.

Figure 4. Influence Area and Major Development Plans

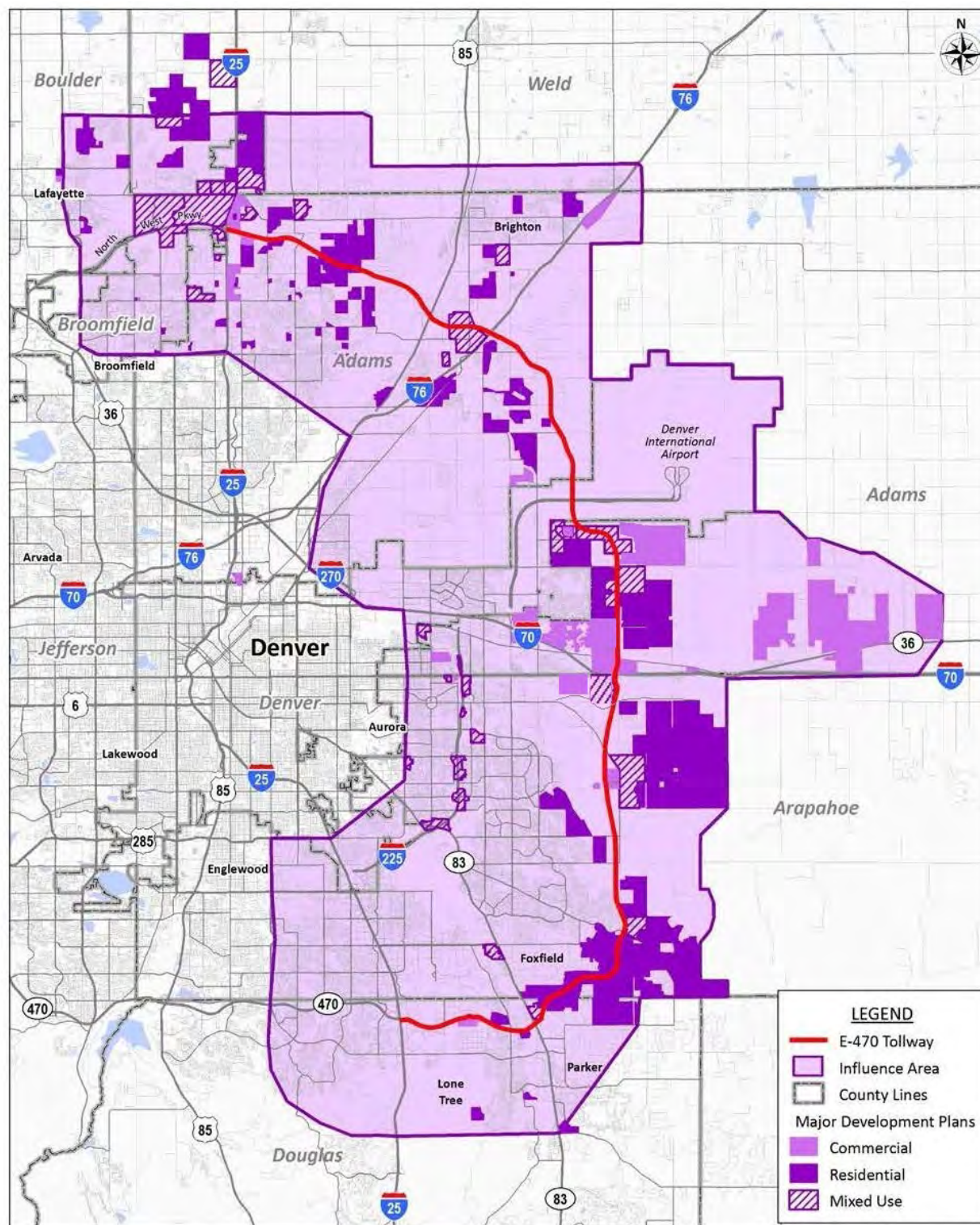


Table 4. Population and Employment Growth Forecasts

	2015	2040	2015 - 2040 Growth
Population			
DRCOG Region	3,181,312	4,361,968	37%
E-470 Influence Area	987,128	1,450,780	47%
Employment			
DRCOG Region	1,713,437	2,393,336	40%
E-470 Influence Area	444,765	659,496	48%

3.2 Planned Improvements

Traffic forecasting performed for the *E-470 Toll Rate Structure Traffic and Revenue Study* by CDM Smith, with assistance from subconsultants EPS and FHU, was based on the demographic forecasts described above and the transportation network contained in the DRCOG 2040 Fiscally Constrained Regional Transportation Plan (RTP) (Cycle 2, 2015). **Appendix C** contains a listing and map showing the regional highway improvements contained in the 2040 RTP.

3.3 Traffic Forecasts

Figure 5 shows the forecasted 2040 daily traffic volumes on E-470. The 2020 Toll Revenue Study was reviewed and it was determined that the 2040 forecasted volumes would not be modified in this Master Plan refresh. These volumes are based on the 2040 model. Forecasts are shown along with existing traffic volumes to show the dramatic growth that is anticipated throughout the corridor. An average traffic growth of 80 percent is projected throughout the corridor between 2018 and 2040, with volumes projected to reach over 100,000 vehicles per day near South I-25. Annual growth rates range from 2.5% to 6.4% along the corridor. The most rapid increases show more than a doubling of traffic in some segments in the central part of the corridor, both north and south of I-70. Comparing E-470 growth rates to overall demographic and travel growth in the E-470 influence area shows that E-470 traffic is expected to grow at a considerably faster pace than overall area growth. This may largely reflect the fact that many adjacent untolled highways and arterials are expected to reach their capacity and show increasing congestion while E-470 is expected to maintain adequate capacity to fully accommodate growth in travel demand.

Figure 6 shows 2040 cross-street traffic, again also showing existing volumes for comparison. All cross-streets show substantial growth as the E-470 influence area continues to develop; however, particularly dramatic growth is expected on a few crossing arterial streets. 64th Avenue and 6th Parkway/Stephen D. Hogan Parkway are two examples of arterials with low volumes now but anticipated exponential growth: on 64th Avenue due to the recently built Gaylord Resort, the anticipated High Point development, and other major developments on currently vacant land and on 6th Parkway/Stephen D. Hogan Parkway due to both area development and the new connection of 6th Avenue (Stephen D. Hogan Parkway) from the west to the E-470 interchange. The Aurora Highlands development also lends itself to the need for two new interchanges at 38th Avenue and 48th Avenue. The forecasted 2040 ADTs with improvements for these two crossroads were found in the City of Aurora's *NEATS Refresh* and are also shown on Figure 6.

These daily traffic forecasts, along with existing peak hour counts and patterns and accepted traffic volume balancing techniques, were used to develop planning level forecasts of 2040 peak hour turning movements at E-470 interchanges (see **Appendix A, Figure A-3**).

3.4 Future Operations

3.4.1 E-470 Mainline

Using existing E-470 traffic counts and 2040 forecasts, and assuming straight-line growth between now and 2040, traffic forecasts were developed for 3-year periods between now and 2040. Using similar peak hour and traffic characteristic assumptions, along with analysis techniques as described for existing conditions, LOS analysis was performed for each segment to determine when additional lanes are anticipated to be needed to maintain LOS C with growing traffic. The 2.5% to 6.4% annual growth rates were used. **Figure 7** provides estimates of the year at which widening (one lane in each direction) needs would be triggered on different segments.

The Authority has recognized that in order to meet the demand for additional capacity in the form of road widening, a programmed approach is needed. It is essential that the toll road maintains an adequate LOS and minimizes congestion in order to continue to offer a viable alternative to the adjacent highway system. Section 4 of this Master Plan will describe the planned widening program that will be implemented to achieve the LOS goals.

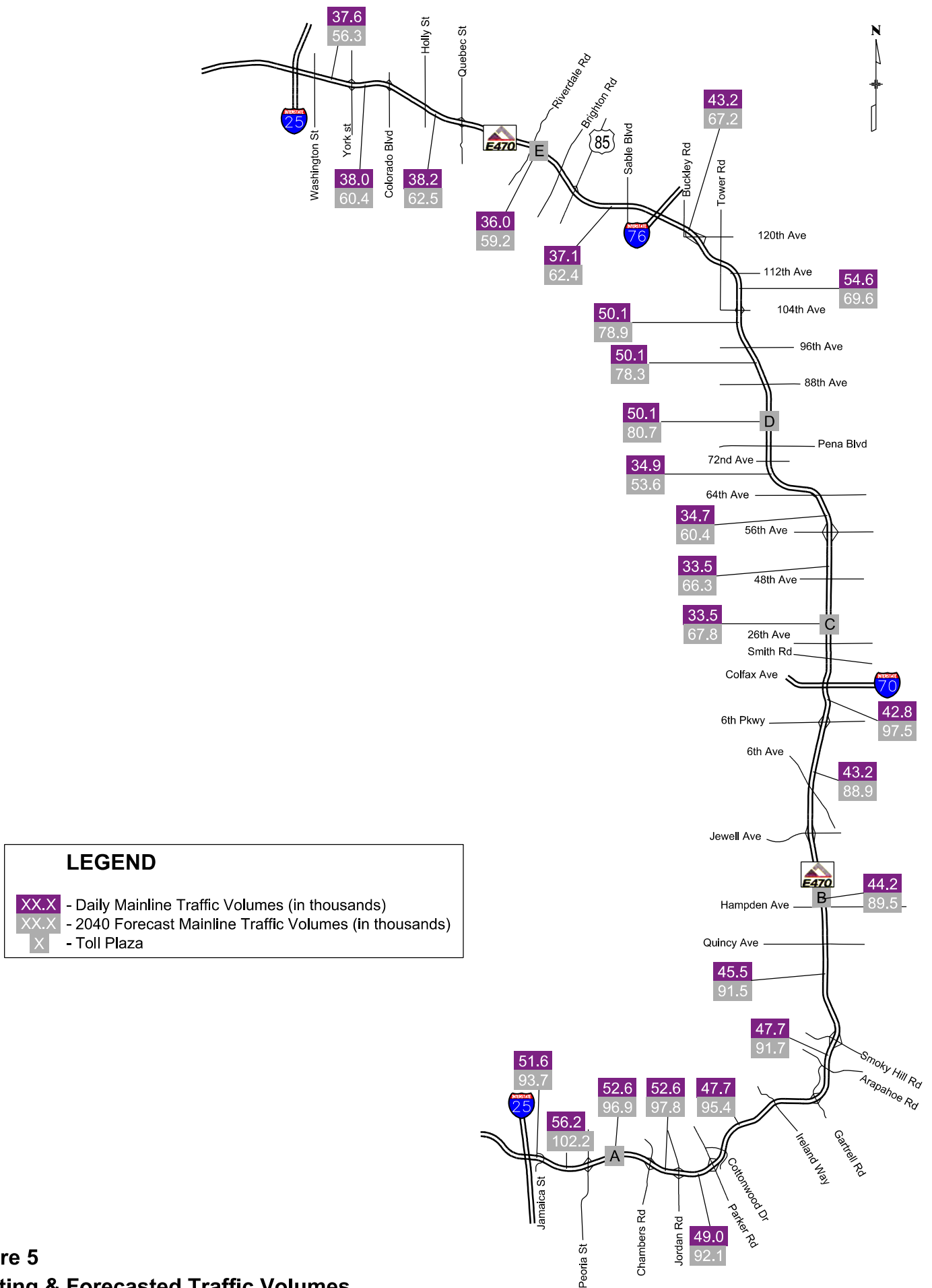


Figure 5
Existing & Forecasted Traffic Volumes

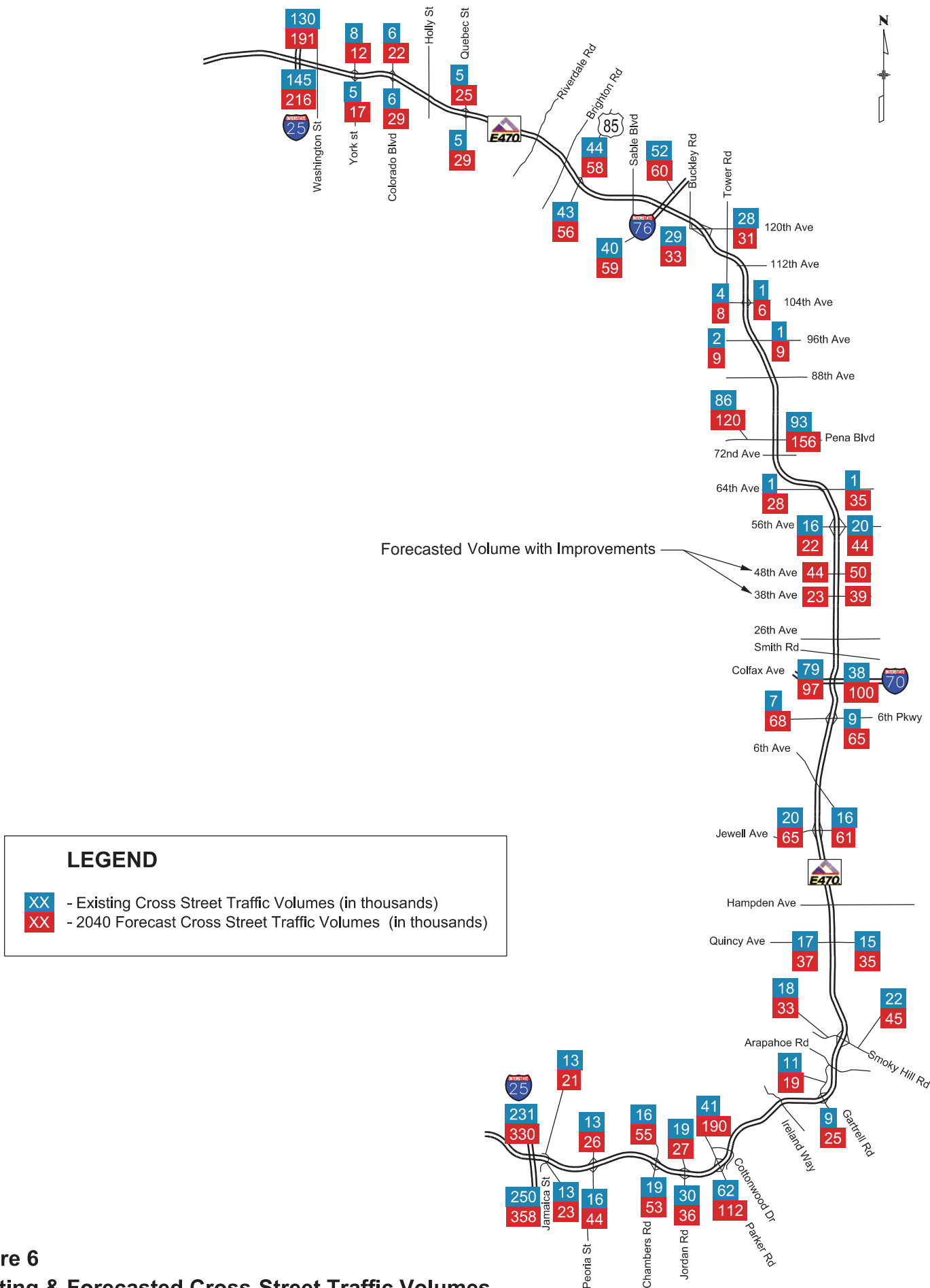


Figure 6
Existing & Forecasted Cross-Street Traffic Volumes

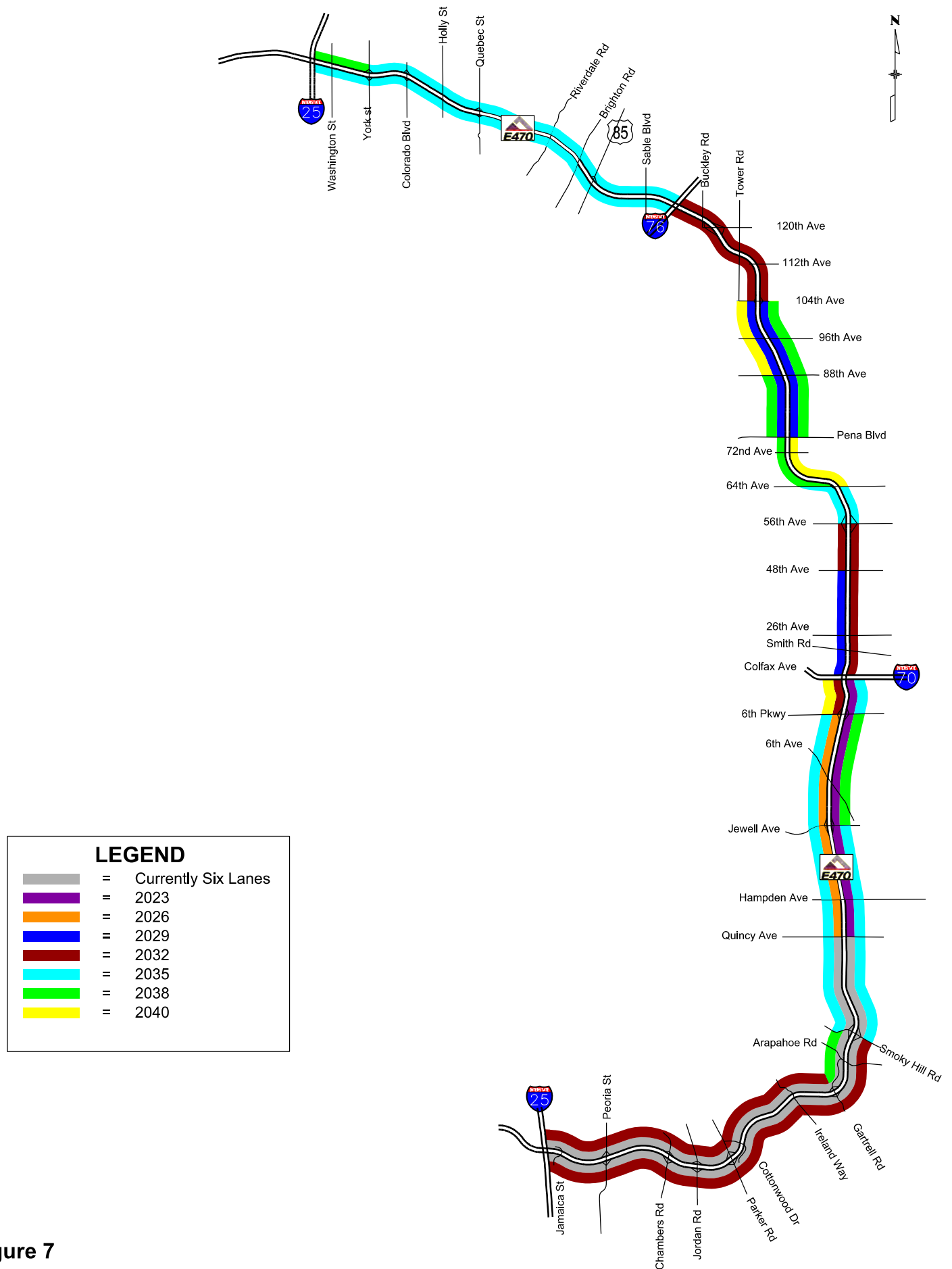


Figure 7
Future Widening Requirements

3.4.2 Interchanges

LOS were calculated at all E-470 interchanges with 2040 forecasts and with existing lane geometry and traffic control. The results are shown on Appendix A, **Figure A-4**. As can be expected, with the dramatic traffic growth anticipated but without any interchange improvements, a majority of the interchanges would have traffic exceeding the existing design capacity and resulting in poor LOS.

Traffic analysis was performed at each of the interchanges to determine what improvements are needed to improve operations to the target LOS C during 2040 peak hours. Conceptual improvements were identified to expand interchanges to accommodate forecasted traffic volumes at desired LOS. **Appendix A, Figure A-5** shows the traffic signals and additional through and turn lanes that have been initially identified as needed to accommodate forecasted traffic. **Table 5** shows the estimated 2040 peak hour LOS with existing interchanges and with the geometric and signalization improvements shown on **Appendix A, Figure A-5**.

It is important to highlight the high, planning level nature of these analyses. Forecasting of specific peak hour traffic movements over a 20-plus year period, and doing so for a long corridor with many interchanges, is a highly uncertain exercise. But such planning-level forecasts and analyses are needed to develop an initial basis for long-range needs identification and budgeting.

Table 5. 2040 Interchange Ramp Terminal Level of Service Summary

Interchange	Ramp	2040 No Build LOS		2040 Proposed Change LOS	
		AM	PM	AM	PM
York Street	WB Off	f	f	A	A
	EB Off	a	f	A	A
Colorado Boulevard	WB Off	c	f	A	A
	EB Off	f	f	A	A
Quebec Street	WB Off	f	f	B	B
	EB Off	f	f	B	B
120th Avenue	NB Off	f	f	B	C
	SB Off	f	f	B	C
104th Avenue	NB Off	f	f	A	C
	SB Off	e	f	A	B
96th Avenue	NB Off	a	c	A	A
	SB Off	a	d	A	A
64th Avenue	NB Off	f	f	B	C
	SB Off	f	f	A	A
56th Avenue	NB Off	f	f	A	A
	SB Off	f	f	A	B
I-70	NB Off	B	C	Future Directional Interchange	
	SB Off	A	C		

Table 5. (Continued) 2040 Interchange Ramp Terminal Level of Service Summary

Interchange	Ramp	2040 No Build LOS		2040 LOS with Improvements	
		AM	PM	AM	PM
6th Parkway	NB Off	f	f	A	A
	SB Off	f	f	A	A
Jewell Avenue	NB Off	f	f	A	A
	SB Off	f	f	A	B
Quincy Avenue	NB Off	f	f	B	C
	SB Off	f	f	B	B
Smoky Hill Road	NB Off	C	C	B	C
	SB Off	B	C	B	C
Gartrell Road	WB Off	f	f	B	A
	EB Off	e	f	A	A
Parker Road	WB Off	B	C	B ¹	C ¹
	EB Off	D	C	C ¹	C ¹
Jordan Road	WB Off	F	B	A	A
	EB Off	B	F	B	C
Chambers Road	WB Off	F	F	B	B
	EB Off	D	F	A	B
Peoria Street	WB Off	D	C	B	A
	EB Off	D	B	B	A

Notes:

x = Unsignalized LOS

X = Signalized LOS

3.5 Alternative Futures

The forecasts upon which this plan are based rely on a series of predictions relative to future growth, economic conditions, travel behaviors and the transportation system. Future traffic volumes and characteristics and associated roadway needs, are dependent on the interplay of a number of future variables, for example:

- ▶ How will regional and national economic growth follow or differ from current projections?
- ▶ How will millennials and future generation travel choices influence travel demand?
- ▶ How will new vehicles, including new fuel sources and new autonomous features, influence traffic volumes, characteristics and operations?
- ▶ How will regulatory responses to these technological changes further influence travel and roadway systems?

Automated Vehicles (AV) are currently being studied by multiple private and public transportation entities. As of yet, no preferred method of modeling or equipment required has been developed. USDOT is working in partnership to develop legislature for equipment and to maintain an open market for technology and guidelines that will work cohesively between states. Updates to the MUTCD are also in the works to address signing and striping needs. Currently, we are unable to predict the impacts of this new technology on future volumes, traffic

maintenance and operations. The forecasts in this document do not include potential AV impacts in its conclusions. As data and standardized methods become available, future master plans will incorporate this information and impacts.

Since these future variables cannot be predicted with certainty, it is not possible to fully account for all alternative futures in long-range planning over a 20-plus year period. Therefore, this master plan is based on a foundation of established regional forecasts which, in turn, are based on general continuations of existing trends. As a result of this uncertainty, the short-range forecasts and needs identification should be viewed with more certainty than longer-range forecasts. Moreover, the difficulty in predicting conditions in the longer-range makes it important that this master plan be treated as a living document that should be updated on a regular basis to respond to changing conditions.

4.0 E-470 CONSTRUCTION NEEDS ASSESSMENT

The E-470 widening and interchange improvement needs identified in the previous chapter were assembled, previously identified improvements like new interchanges were added, and individual projects were aggregated into logical construction projects to develop a conceptual roadway improvement program for E-470 over the next 20 years. This chapter describes the resulting roadway improvement program and provides estimated phasing and planning-level cost estimates to construct needed improvements.

4.1 Road Widening

The individual segment E-470 widening needs identified in the previous chapter were aggregated into larger segments including improvements in both directions to represent logical and efficient construction projects. Accordingly, **Figure 8** shows the illustrative widening program which will achieve the required years of need, with each band representing an additional lane in each direction. The program plans widening projects on a 3 year cycle with a minimum of 6 lanes (3 in each direction) by 2040 for the full length of E-470. **Table 6** lists the segments, number of lanes, and length by project priority.

Table 6 also summarizes the key segment features that went into cost estimation for each project and the resulting planning-level cost estimates in current (2019) dollars. Key segment features are significant factors that make construction of particular segments more or less expensive per-mile than others. One of the major factors affecting cost per mile is the need to construct costly structures. Segments with a high density of bridge structures will have higher per-mile costs. Conversely, projects that would widen E-470 from six to eight lanes will be less costly per mile because it is assumed that E-470 will continue to build structures and complete grading and drainage to accommodate future 8-lane widening with the prior 6-lane widening project. More detail on cost estimation is provided in **Appendix D**.

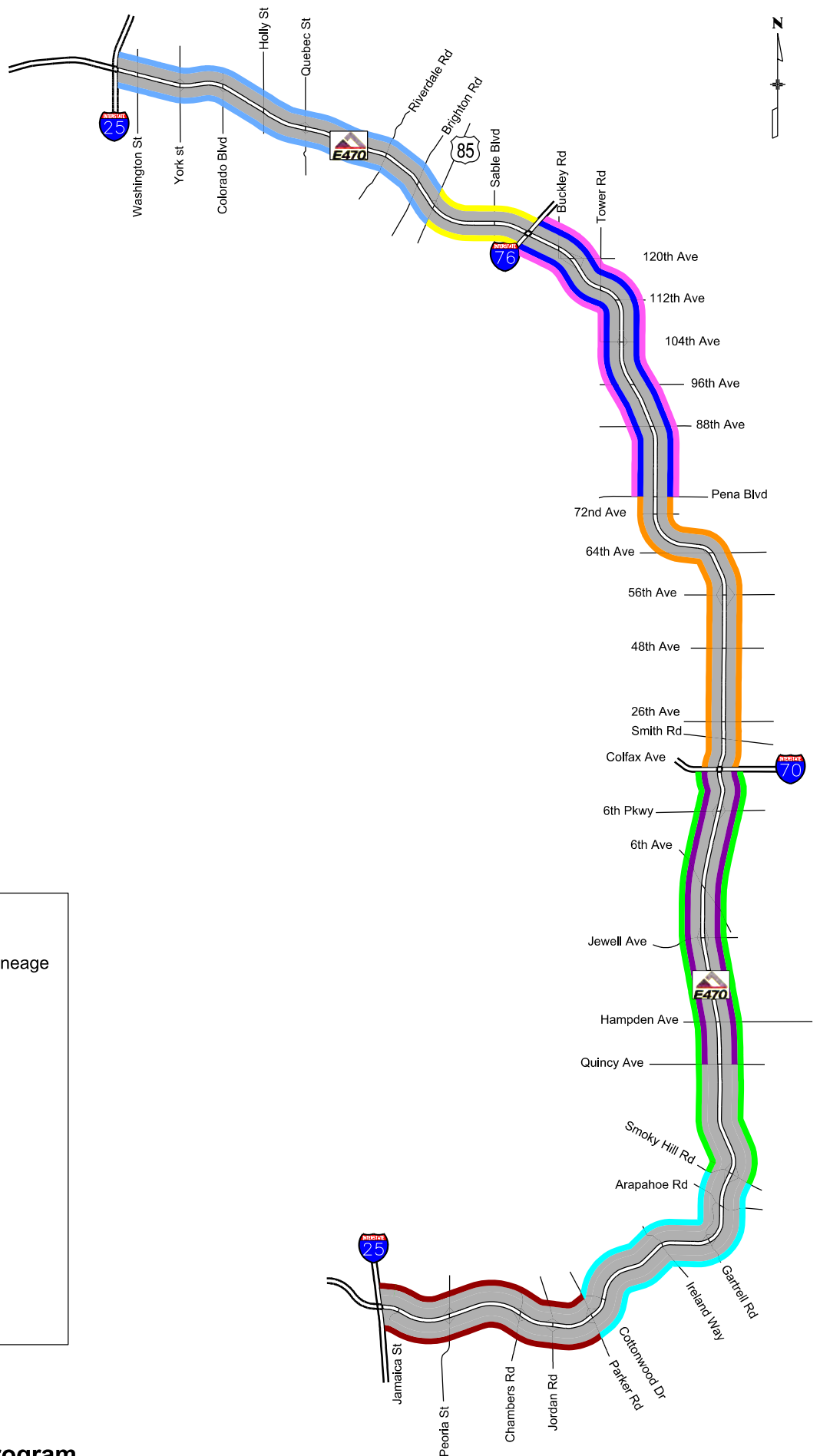
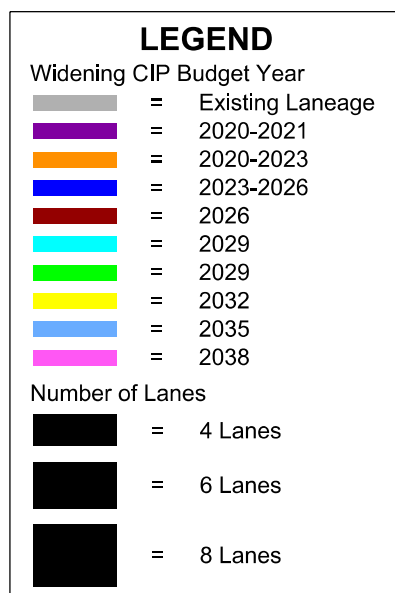


Figure 8
Illustrative Widening Program

Table 6. Mainline Improvement Summary

(In \$ 2017) (In \$ 2019)

Priority	Segment	Project Description	Year of Need	CIP Budget Year	Length (mi)	Key Segment Features	Estimated Cost		Pavement Segment Age
							2018 MP	2020 MP	
1	Quincy - I-70	Widen 4 lanes to 6	2023	2020-2021	7.00	Retrofit Toll Plaza B. Slope walls at Hampden, Jewell, and E 6th Pkwy. 14 Bridges Widened: Bridges over Coal Creek (2). 12 Bridges at I-70	\$57M	\$57M	2007
2	I-70 - Peña	Widen 4 lanes to 6	2029	2020-2023	7.50	Retrofit Toll Plaza C. Slope walls at 26th, 48th, 56th, 64th, and Pena Blvd. interchange improvements	\$70M	\$74M	2007 (I-70 - 68th) 2004 (68th - Pena)
3	Peña - I-76	Widen 4 lanes to 6	2029	2023-2026	7.75	Retrofit Toll Plaza D. Slope walls at 88th, 96th, 104th, 112th, and Tower Rd. 13 Bridges Widened: Over Peña (2), I-76 (2), Burlington Ditch (2), Buckley Rd (2), O'Brian Canal (3), and 120th (2). (Structure built to accommodate future 8 lane capacity)	\$96M	\$102M	2004 (Peña - Toll Plaza D) 2005 (Toll Plaza D - 120th) 2011 (120th - I-76)
4	I-25 (S) - Parker	Widen 6 lanes to 8	2032	2026	5.50	Widen to the inside. Retrofit Toll Plaza A. (No Bridges) Visual buffering considered.	\$17M	\$18M	2009 (I-25 - Toll Plaza A) 2012 (Toll Plaza A - Parker)
5	Parker - Smoky Hill	Widen 6 lanes to 8	2032	2029	5.25	Paving only. (No Bridges)	\$16M	\$16M	2017
6	Smoky Hill - I-70	Widen 6 lanes to 8	2035	2029	9.50	Paving only. (No Bridges)	\$29M	\$28M	2017 (Smoky Hill - Quincy) 2020 (Quincy - I-70)
7	I-76 - US 85	Widen 4 lanes to 6	2035	2032	2.50	Bridges over US 85 (2), and Second Creek (2). Slope walls at Sable Blvd.	\$37M	\$41M	2011
8	US-85 - I-25 (N)	Widen 4 lanes to 6	2035	2035	8.50	10 Bridges. Retrofit Toll Plaza E. Slope walls at Colorado, Quebec, and Brighton. Visual buffering considered.	\$103M	\$109M	2011 (US-85 - Toll Plaza E) 2010 (Toll Plaza E - I-25)
9	Peña - I-76	Widen 6 lanes to 8	2038	2038	7.50	Assume structure costs in 2026 build. Paving only.*	\$23M	\$23M	2026**

** Scheduled overlay 2026

* Cost Assumptions

- ▶ In 2019 dollars, prices not adjusted for future inflation.
- ▶ High level cost per mile assumptions.
- ▶ 4-6 Lane widening assumes ultimate bridge and grading build-out.
- ▶ Widening to the inside means the bridges already are in ultimate buildout.
- ▶ Additional costs for unique bridges (longer spans).
- ▶ 6-8 Lane widening assumes some kind of ramp reconstruction for a portion of ramps.

**Assumes pavement replacement in 2026.

4.2 Existing Interchange Improvements

Table 7 shows the estimated year of need for the interchange improvement projects described in the previous chapter. In many cases, interchange needs are listed in two parts: signalization and geometry. At these locations, signalizing ramp terminal intersections, accompanied by only minor geometric improvements, is an early identified need. The Year of Need: Geometry column refers to more major construction projects that involve additional through lanes and/or turn lanes.

Table 7. 2040 Ramp Terminal Level of Service Summary

Interchange	Ramp	2040 No Build LOS		Year of Need		2040 LOS with Improvements	
		AM	PM	Signalization	Geometry	AM	PM
York Street	WB Off	f	f	2029	2040	A	A
	EB Off	a	f			A	A
Colorado Boulevard	WB Off	c	f	2031	2040	A	A
	EB Off	f	f			A	A
Quebec Street	WB Off	f	f	2025	2025	B	B
	EB Off	f	f			B	B
120th Avenue	NB Off	f	f	2017	2017	B	C
	SB Off	f	f			B	C
104th Avenue	NB Off	f	f	2040	2040	A	C
	SB Off	e	f			A	B
96th Avenue	NB Off	a	c	2040	2040	A	A
	SB Off	a	d			A	A
64th Avenue	NB Off	b	f	2026	2035	B	C
	SB Off	f	f			A	A
56th Avenue	NB Off	d	f	2025	2040	A	A
	SB Off	f	f			A	B
I-70	NB Off	B	C	N/A	N/A	Future Directional Interchange	
	SB Off	A	C				
6th Parkway	NB Off	f	f	2034	2039	A	A
	SB Off	f	f			A	A
Jewell Avenue	NB Off	f	f	2019	2036	A	A
	SB Off	d	f			A	B
Quincy Avenue	NB Off	f	f	2017	2022	B	C
	SB Off	f	f			B	B
Smoky Hill Road	NB Off	C	C	Existing Signal	N/A	B	C
	SB Off	B	C			B	C

Table 7. (Continued): 2040 Ramp Terminal Level of Service Summary

Interchange	Ramp	2040 No Build LOS		Year of Need		2040 LOS with Improvements	
		AM	PM	Signalization	Geometry	AM	PM
Gartrell Road	WB Off	f	f	2022	2022	B	A
	EB Off	e	f			A	A
Parker Road	WB Off	F	F	N/A	2033	B	C
	EB Off	D	C			C	C
Jordan Road	WB Off	F	B	N/A	2025	A	A
	EB Off	B	F			B	C
Chambers Road	WB Off	F	F	N/A	2025	B	B
	EB Off	F	F			A	B
Peoria Street	WB Off	F	D	Existing Signal	N/A	B	A
	EB Off	F	C			B	A

Notes:

x = Unsignalized LOS

X = Signalized LOS

Table 8 provides more information on the specific improvement needs at each location:

- ▶ **Minor Improvements Needed** lists ramp terminal signalization projects, which may have accompanying minor geometric improvements.
- ▶ **Major Improvements Needed** lists interchanges where additional through and/or turn lanes are needed. In cases where the cross-street widening would necessitate widening or reconstruction of an existing cross-street bridge over E-470, that is listed in the improvement need description.
- ▶ **Reconstruction/Reconfiguration Needed** lists major interchange reconstruction projects including:
 - I-76 – Only two ramp connections are currently provided at the E-470/I-76 interchange; this improvement would add ramps to create a full movement interchange
 - Peña Boulevard – In coordination with Denver International Airport plans to widen Peña Boulevard, E-470 PHA will coordinate with DEN to identify needed E-470/Peña interchange improvements, potentially including separation of the northbound auxiliary lane from the mainline and ramp widening or reconfiguration for high volume ramps.
 - I-70 – A fully directional freeway-to-freeway interchange.
 - Quincy Avenue – In conjunction with widening of Quincy Avenue, Aurora, Arapahoe County, and E-470 PHA have developed a plan to reconfigure northbound on- and off-ramps to connect directly with Gun Club Road south of Quincy Avenue. This project will be completed in 2020.

E-470 interchange improvements are joint responsibilities among the E-470 PHA and local jurisdictions. The right-hand column of **Table 8** lists the county and municipality that will or could be partnering agencies with E-470 to plan, finance and implement needed interchange area improvements.

Table 8. Interchange Improvement Needs

(In \$ 2019)

#	Interchange	Minor Improvements Needed	Major Improvements Needed	Reconstruction/ Reconfiguration Needed	2020 MP	Partnering Agencies
1	York Street	Ramp terminal intersections	Widen York Street to 4 through plus turn lanes		\$2.4M	Thornton, Adams County, E-470 PHA
2	Colorado Boulevard	Signalize ramp terminal intersections	Widen Colorado Blvd to 4 through plus turn lanes. Requires Colorado Blvd bridge idening.		\$3.4M	Thornton, Adams County, E-470 PHA
3	Quebec Street	Signalize ramp terminal intersections	Widen Quebec St to 4 through plus turn lanes. Requires Quebec St bridge widening.		\$4.6M	Thornton, Adams County, E-470 PHA
4	I-76	Extend southbound Merge from I-76 with widening or major interchange project.		Add ramps to create a fully directional interchange.	\$110.8M	CDOT, Adams County, Brighton, Commerce City, E-470 PHA
5	120th Avenue	Signalize ramp terminal intersections	Widen 120th Ave to 4 through plus turn lanes		\$0.8M	Adams County, Commerce City, E-470 PHA
6	104th Avenue	Signalize ramp terminal intersections	Provide lanes for movements to/from the east.		\$1.9M	Adams County, Commerce City, E-470 PHA
7	96th Avenue	Signalize ramp terminal intersections			\$1.0M	Adams County, Commerce City, E-470 PHA
8	Peña Boulevard			Coordinate with DEN on interchange improvements with Phase 3 or Phase 4 Peña Blvd Widening project; Evaluate needs for NB barrier separated auxiliary lane, 2nd SB to WB lane, and 2nd EB to NB lane.	\$19.9M	Denver, E-470 PHA
9	64th Avenue	Signalize ramp terminal intersections	Widen 64th Ave to 4 through plus turn lanes. Requires 64th Ave bridge widening.		\$12.0M	Adams County, E-470 PHA, City of Aurora
10	56th Avenue	Signalize ramp terminal intersections	Widen 56th Ave to 4 through plus turn lanes.		\$1.9M	Adams County, Aurora, E-470 PHA

■ The scope of the improvements for this interchange have changed from the previous Master Plan to coincide with the Town of Parker's preference to not limit access to Woodmen Dr. and Crown Crest, and align with the *Parker Road Corridor Plan, November 2019*.

Table 8. (Continued): Interchange Improvement Needs

(In \$ 2019)

#	Interchange	Minor Improvements Needed	Major Improvements Needed	Reconstruction/ Reconfiguration Needed	2020 MP	Partnering Agencies
11	I-70			Fully directional interchange	\$106.5M	CDOT, Aurora, E-470 PHA
12	6th Parkway	Signalize ramp terminal intersections	Widen 6th Pkwy to 4 through plus turn lanes. Requires 6th Pkwy bridge widening.		\$4.0M	Aurora, E-470 PHA
13	Jewell Avenue	Signalize ramp terminal intersections	Widen Jewell Ave to 4 through plus turn lanes. Requires Jewell Ave bridge widening.		\$4.0M	Aurora, E-470 PHA
14	Quincy Avenue	Signalize ramp terminal intersections		Widen Quincy Ave to 4 through plus turn lanes. Reconfigure northbound ramps to south of Quincy Project in conjunction with Aurora and Arapahoe County.	\$8.5M	Aurora, Arapahoe County, E-470 PHA
15	Gartrell Road	Signalize ramp terminal intersections	Widen Gartrell Dr to 4 through plus turn lanes. Requires Gartrell Dr bridge widening.		\$11.3M	Aurora, Arapahoe County, E-470 PHA
16	Parker Road	Lower off ramp speed		Increase eastbound off ramp to three left turn lanes from two, add slip ramp to Twenty Mile Road	\$2.3M	Parker, Douglas County, E-470 PHA
17	Jordan Road	Provide additional lanes at exit ramps and one additional lane on cross street			\$0.6M	Parker, Douglas County, E-470 PHA
18	Chambers Road		Widen Chambers Rd to 6 through plus turn lanes. Requires Chambers Rd bridge widening.		\$4.6M	Parker, Douglas County, E-470 PHA
19	Peoria Street		Widen Peoria St to 6 through plus turn lanes.		\$1.8M	Douglas County, E-470 PHA
20	Jamaica Street	No improvements identified at this location.	No improvements identified at this location.	No improvements identified at this location.	N/A	N/A

■ The scope of the improvements for this interchange have changed from the previous Master Plan to coincide with the Town of Parker's preference to not limit access to Woodmen Dr. and Crown Crest, and align with the *Parker Road Corridor Plan, November 2019*.

Table 8. (Continued): Interchange Improvement Needs

(In \$ 2019)

Interchange		Improvements	2020 MP	Partnering Agencies
New Interchanges				
	Potomac Street	Approved new interchange location per 2005 Board resolution. City of Brighton may petition to change this interchange from Potomac St. to Sable Blvd.	\$21.1M	Brighton, Adams County, E-470 PHA
	38th Avenue	Approved new interchange location per XXXX Board resolution	\$30.6M	Aurora, E-470 PHA
	48th Avenue	New Interchange in coordination with Aurora and property owners. Approved new interchange location per XXXX Board resolution	\$21.1M	Aurora, E-470 PHA
	88th Avenue	Approved for half diamond interchange with south ramps per 2005 Board resolution	\$15.8M	Commerce City, Adams County, E-470 PHA
	112th Avenue	Approved new interchange location per 2005 Board resolution.	\$15.8M	Commerce City, Adams County, E-470 PHA

■ The scope of the improvements for this interchange have changed from the previous Master Plan to coincide with the Town of Parker's preference to not limit access to Woodmen Dr. and Crown Crest, and align with the *Parker Road Corridor Plan, November 2019*.

4.3 New Interchanges

The five potential new interchanges that have been identified in previous planning are listed at the bottom of **Table 8**. Similar with improvement projects for existing interchanges, planning and implementation of these new interchanges will be a joint effort between E-470 PHA and the local jurisdictions listed. The timing of these new interchanges will be driven by access needs, economic development, and other considerations. Specific years of need are based on the estimated year of need table provided by E-470 PHA. It should be noted that the needs and improvements identified for the existing interchanges do not rely on these five interchanges being constructed. The new interchanges with the year of need are shown in **Table 9** below.

Table 9. New Interchanges Years of Need

Interchange Location	Estimated Year of Need
38th Avenue	2022
48th Avenue	2030
88th Avenue	2025
112th Avenue	2030
Potomac Street	2035

Planning level cost estimates were developed for the minor and major interchange improvements and new interchanges listed in **Table 8**. Some locations and the scope of work will be subject to funding IGA's with Local jurisdictions. More detail on cost estimation is provided in **Appendix D**. Cost estimates are shown in the capital improvement cost summaries presented in the next chapter.

Figure 9 shows the location of minor, major, reconstruction, and new interchange projects. Minor projects include signalization, major interchange projects include reconfiguration, new interchange, or signalization plus widening.

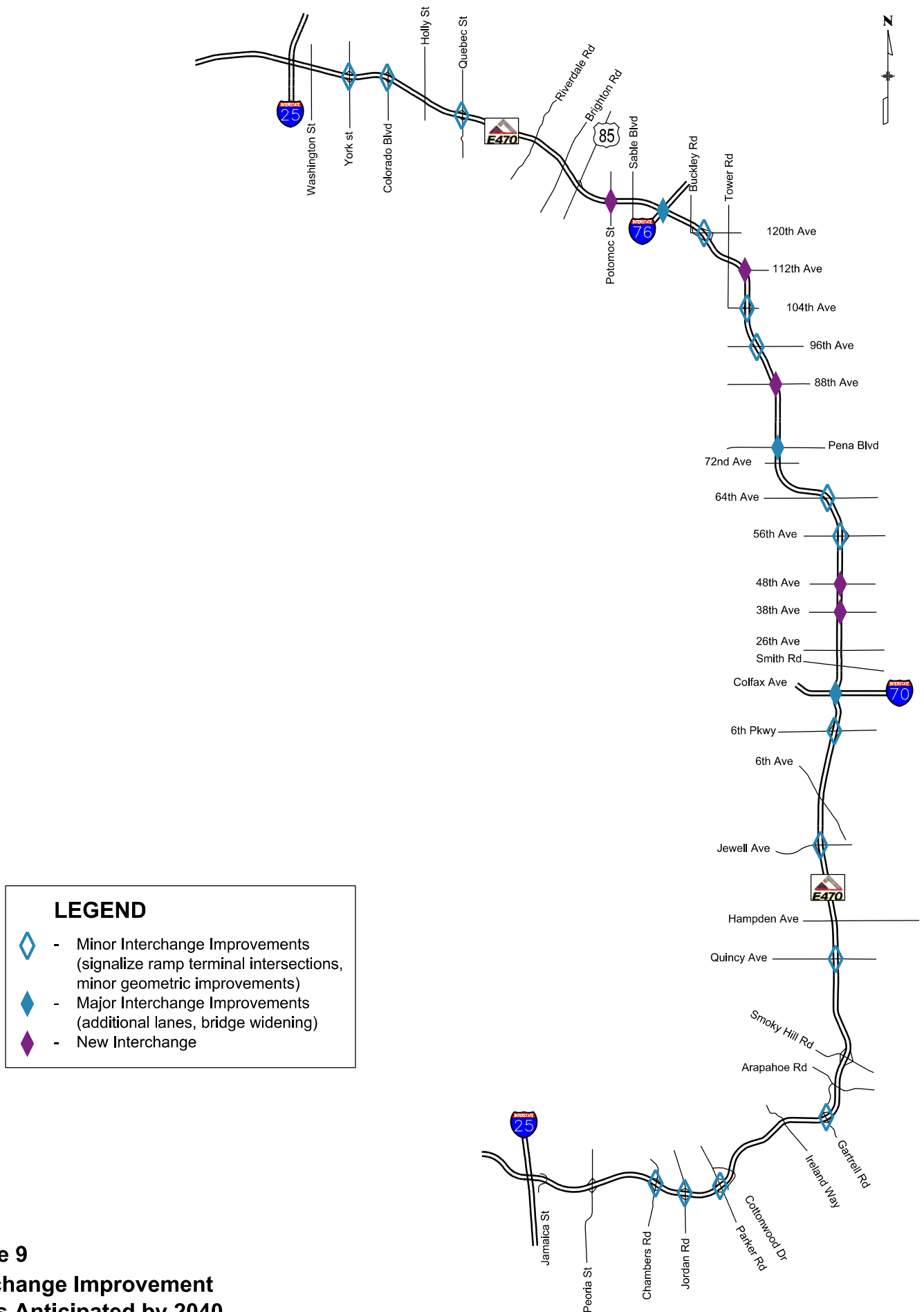


Figure 9
Interchange Improvement
Needs Anticipated by 2040

5.0 MASTER PLAN DEVELOPMENT

5.1 Capital Roadway Improvement Plan

The phased E-470 widening, interchange improvement, and new interchange projects were assembled to develop the Capital Roadway Improvement Phasing and Cost Summary shown on **Table 10**. **Table 11** provides a summary of this information by project category and year of need. The estimated project cost total is **\$875 million**, measured in constant 2019 dollars. The costs include \$468 million for widening that is expected to be solely E-470's funding responsibility. There are \$407 million for interchange projects, both improvements to existing and new interchanges, which may be implemented in partnership between E-470 PHA and local jurisdictions.

5.2 Other Capital Costs

In addition to roadway expansion projects, four other major capital improvement costs were included in the master plan:

- ▶ **Pavement Overlay** – Three E-470 sections are expected to need pavement overlays before the pavement reconstruction that will be included in widening of those sections. The I-25 to Parker Road segment is expected to need an overlay in approximately 2024 at a cost of \$7.4 million (in 2019 dollars), the I-76 to North I-25 section is expected to need an overlay starting in 2024 at a cost of \$10.6 million, and the Pena Boulevard to 120th Avenue section is scheduled for 2020/2021 at a cost of \$7.6 million (in 2019 dollars).
- ▶ **Multi-Use Trails** – Trail projects are anticipated to be linked to E-470 roadway widening projects with an estimated \$28.6 million cost (in 2019 dollars) starting in 2024.

These capital cost categories equal **\$54 million**, yielding a total of **\$929 million** in roadway and other capital costs in 2019 dollars.

5.3 Inflated Cost Estimates

For long-range budgetary planning purposes, these cost estimates were inflated to correspond to the anticipated year of need. A 1.94 percent annual cost inflation rate, based on the average annual increase in the Producer Price Index over the past 5 years, was used to bring 2019 cost estimates to the approximate anticipated year of construction. **Table 12** shows that the cost inflation would bring the \$929 million capital improvement program to **\$1.7 billion** over the period between now and 2040.

5.4 Renewal and Replacement

The E-470 PHA's regular budgeting process includes annual budget items for a series of infrastructure renewal, replacement and maintenance items. **Table 13** provides annual estimates for the major line items in this category, starting with an estimated \$25.7 million cost in 2020 to \$33.0 million in 2040, for a total 20-year cost of **\$583.1 million**.

Table 10. Capital Improvement Phasing and Cost Summary

CIP Budget Year	2020 MP Year of Need	Location	Description	Estimated 2019 Cost (\$ millions)
2020	2020	120th Ave Interchange	Signalize ramp terminal intersections	\$0.8
2020	2020	Quincy Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$8.5
2020-2021	2019-2020	Quincy to I-70	Widen 4 to 6 lanes	\$57.0
2020-2021	2020-2021	Gartrell Rd Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$11.3
2020-2022	2022	38th Ave Interchange	New Interchange	\$30.6
2020-2022	2022-2023	I-70 to Peña	Widen 4 to 6 lanes	\$40.2
2020-2022	2020-2029	I-70 Interchange complex *	Directional I-70 interchange	\$12.1
2021	2021	Jewell Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$4.0
2021-2022	2026	64th Interchange	Signalize ramp terminal intersection Geometric Interchange Improvements	\$11.0
2020-2022 Subtotal				\$175.5
2023-2025	2020-2029	I-70 Interchange complex *	Directional I-70 interchange	\$41.2
2023	2022-2023	I-70 to Peña	Widen 4 to 6 lanes	\$33.8
2023	2025	Quebec Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$4.6
2023	2025	56th Ave Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$1.9
2023	2026	64th Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$1.0
2023-2025	2025-2026	Peña to I-76	Widen 4 to 6 lanes	\$1.8
2024	2025	88th Ave Interchange	New Interchange	\$15.8
2024	2025	Parker Rd Interchange	Geometric Interchange improvements	\$2.3
2025	2025	Jordan Interchange	Geometric Interchange improvements	\$0.6
2025	2025	Chambers Interchange	Geometric Interchange improvements	\$4.6
2025	2025-2026	Peña Interchange	Add Separated Auxiliary Lanes	\$19.9
2023-2025 Subtotal				\$127.5
2026-2028	2020-2029	I-70 Interchange complex *	Directional I-70 interchange	\$26.6
2026	2025-2026	Peña to I-76	Widen 4 to 6 lanes	\$100.2
2026	2027-2028	I-25 (S) to Parker Rd	Widen 6 to 8 lanes	\$18.0
2026-2028 Subtotal				\$144.8

Table 10. (Continued): Capital Improvement Phasing and Cost Summary

CIP Budget Year	2020 MP Year of Need	Location	Description	Estimated 2019 Cost (\$ millions)
2029	2020-2029	I-70 Interchange complex *	Directional I-70 interchange	\$26.6
2029	2029-2030	Parker Road to Smoky Hill	Widen 6 to 8 lanes	\$16.0
2029	2030	York Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$2.4
2029	2030	112th Interchange	New Interchange	\$15.8
2029	2030	48th Ave Interchange	New Interchange	\$21.1
2029	2031-2032	Smoky Hill to I-70	Widen 6 to 8 lanes	\$28.0
2029-2031	2029-2040	I-76 Interchange**	Add ramps for fully directional interchange	\$27.7
2029-2031 Subtotal				\$137.6
2032-2034	2029-2040	I-76 Interchange**	Add ramps for fully directional interchange	\$27.7
2032	2032	Colorado Interchange	Signalize ramp terminal intersections Geometric Interchange Improvements	\$3.4
2032	2033-2034	I-76 to US 85	Widen 4 to 6 lanes	\$41.0
2032-2034 Subtotal				\$72.1
2035-2037	2029-2040	I-76 Interchange**	Add ramps for fully directional interchange	\$27.7
2035	2035	Potomac Interchange	New Interchange	\$21.1
2035	2035-2037	US 85 to I-25 (N)	Widen 4 to 6 lanes	\$109.0
2035	2036	6th Pkwy Interchange	Geometric Interchange improvements	\$4.0
2035-2037 Subtotal				\$161.8
2038	2029-2040	I-76 Interchange**	Add ramps for fully directional interchange	\$27.7
2038	2038	96th Avenue Interchange	Signalize Ramp Terminal Intersections	\$1.0
2038	2038-2039	Peña to I-76	Widen 6 to 8 lanes	\$23.0
2038	2040	Peoria Interchange	Widen Peoria Street to 6 thru lanes plus turn lanes	\$1.8
2038	2040	104th Ave Interchange	Geometric Interchange improvements	\$1.9
2038-2040 Subtotal				\$55.4
2018 to 2040 Total				\$874.7



The scope of the improvements for this interchange have changed from the previous Master Plan to coincide with the Town of Parker's preference to not limit access to Woodmen Dr. and Crown Crest, and align with the Parker Road Corridor Plan, November 2019.

*Note for I-70 Interchange Complex the total cost of \$106,534,800 was spread across 4 budgetary periods

**Note for I-76 Interchange Complex the total cost of \$110,754,000 was spread across 4 budgetary periods

Table 11. Roadway Improvement Projects and Costs (in \$2019)

	Widening	Interchange Improvements	New Interchanges	Total (2019 \$s)
2020-2022	\$97.2	\$47.7	\$30.6	\$175.5
2023-2025	\$35.6	\$76.1	\$15.8	\$127.5
2026-2028	\$118.2	\$26.6	\$0.0	\$144.8
2029-2031	\$44.0	\$56.7	\$36.9	\$137.6
2032-2034	\$41.0	\$31.1	\$0.0	\$72.1
2035-2037	\$109.0	\$31.7	\$21.1	\$161.8
2038-2040	\$23.0	\$32.4	\$0.0	\$55.4
Total Through 2040	\$468.0	\$302.3	\$104.4	\$874.7

Table 12. Capital Improvement Projects with Cost Inflation

Source: 2020 Budget (Green) / Master Capital Plan Draft Jan 2020 SEH (BLUE)

Proc: 2020 Budget (Green) / Master Capital Plan Draft Jan 2020 SEH (BLUE)		PPI Index*		1.94%													
Capital Improvement Projects (in millions)		Base Year	E-470 Budget or MCP					Est Value in Future Year - MCP					Total	Total - Full #	Total Rounded		
Location	Description	2019	2020**	2021**	2022	2023	2024	2026	2029	2032	2035	2038	(1,000s \$)				
Other Capital Projects																	
Pavement Overlay - Pena to 120th Ave	2020/2021 Budget Figures	Budget	\$100	\$7,525									\$7,625	7,625,000	\$ 7,625,000		
Pavement Overlay - I-25 to Parker Road	Overlay - 2020 MCP - 2024	\$7,409					\$8,001						\$8,001	8,000,671	\$ 8,001,000		
Pavement Overlay - I-76 to I-25	Overlay - 2020 MCP - 2024-25	\$10,584					\$11,430						\$11,430	11,429,529	\$ 11,430,000		
Multi-Use Trail - Linked to Widening	Estimate - MCP and Budget for 2024	\$28,577					\$6,000	\$1,968	\$12,702		\$14,183		\$34,853	34,852,547	\$ 34,853,000		
Widening																	
Quincy to I-70 Widening (Remaining in 2020-21)	Widen lanes from 4 to 6 (2020/21 Budget)	Budget	\$54,500	\$2,450									\$56,950	56,950,000	\$ 56,950,000		
I-70 to Pena Widening	Widen lanes from 4 to 6 (2020/21 budget, 22-23 MCP)	\$74,000	\$800	\$1,500	\$36,568	\$36,568							\$75,436	75,435,600	\$ 75,436,000		
Pena to I-76 Widening	Widen lanes from 4 to 6-2023-24 budget; MCP in 25-26	\$102,000				\$300	\$1,500	\$108,349					\$110,149	110,148,526	\$ 110,149,000		
I-25 to Parker Widening	Widen lanes from 6 to 8 - MCP	\$18,000						\$20,591					\$20,591	20,591,354	\$ 20,591,000		
Parker to Smoky Hill Widening	Widen lanes from 6 to 8 - MCP	\$16,000							\$19,389				\$19,389	19,389,485	\$ 19,389,000		
Smoky Hill to I-70 Widening	Widen lanes from 6 to 8 - MCP	\$28,000							\$33,932				\$33,932	33,931,599	\$ 33,932,000		
I-76 to US 85 Widening	Widen lanes from 4 to 6 - MCP	\$41,000								\$52,634			\$52,634	52,633,717	\$ 52,634,000		
US 85 to I-25(N) Widening	Widen lanes from 4 to 6 - MCP	\$109,000									\$148,232		\$148,232	148,231,521	\$ 148,232,000		
Pena to I-76 Widening	Widen lanes from 6 to 8 - MCP	\$23,000										\$33,134	\$33,134	33,134,147	\$ 33,134,000		
Interchange Improvements																	
Interchange - Signalization at 120th Ave	Signalize ramp terminal intersections-2020 Budget	Budget	\$750										\$750	750,000	\$ 750,000		
Interchange - Signalization at Gartrell Road	Signalize ramp terminal intersections-2020 Budget	Budget	\$1,000										\$1,000	1,000,000	\$ 1,000,000		
Interchange: Quincy	Interchange Improvements & Signals (in 2020 widen budg)	Budget	\$8,500										\$8,500	8,500,000	\$ 8,500,000		
Interchange: Gartrell	Interchange Improvements (2020/21 Budget)	Budget	\$750	\$9,500									\$10,250	10,250,000	\$ 10,250,000		
Interchange: I-70, Piccadilly, Harvest	Interchange Improvements-2020-22 Budget-MCP 23-31	\$106,534	\$500	\$750	\$10,850	\$15,050	\$28,761	\$30,468	\$32,276				\$118,655	118,655,000	\$ 118,655,000		
Interchange: 64th	Interchange Improvements & Signals-2021-23 budget	Budget	\$750	\$750	\$10,250	\$1,000							\$12,000	12,000,000	\$ 12,000,000		
Interchange: Jewell	Interchange Improvements & Signals - MCP	\$4,020		\$4,177									\$4,177	4,177,489	\$ 4,177,000		
Interchange: 56th	Interchange Improvements & Signals - MCP	\$1,846				\$1,993							\$1,993	1,993,364	\$ 1,993,000		
Interchange: Quebec	Interchange Improvements & Signals - MCP	\$4,560				\$4,924							\$4,924	4,924,287	\$ 4,924,000		
Interchange: Parker	Interchange Improvements - MCP	\$2,300					\$2,484						\$2,484	2,483,741	\$ 2,484,000		
Interchange: Jordan	Interchange Improvements-MCP-2023 value for 2025	\$587					\$634						\$634	633,894	\$ 634,000		
Interchange: Chambers	Interchange Improvements-MCP-2023 value for 2025	\$4,570					\$4,935						\$4,935	4,935,086	\$ 4,935,000		
Interchange: Pena	Separate NB Auxiliary Lanes-MCP kept 23 value for 25	\$19,885					\$21,474						\$21,474	21,473,563	\$ 21,474,000		
Interchange: York	Interchange Improvements & Signals - MCP	\$2,441						\$2,958					\$2,958	2,958,108	\$ 2,958,000		
Interchange: I-76	Add missing ramps - MCP	\$110,754						\$33,554	\$35,545	\$37,654	\$39,888		\$146,641	146,641,000	\$ 146,641,000		
Interchange: Colorado	Interchange Improvements & Signals - MCP	\$3,420							\$4,390				\$4,390	4,390,422	\$ 4,390,000		
Interchange: 6th Pkwy	Interchange Improvements & Signals	\$4,020								\$5,467			\$5,467	5,466,887	\$ 5,467,000		
Interchange: 104th	Interchange Improvements & Signals - MCP	\$1,846									\$2,659		\$2,659	2,659,231	\$ 2,659,000		
Interchange: 96th	Signals - MCP	\$949									\$1,368		\$1,368	1,367,605	\$ 1,368,000		
Interchange: Peoria	Interchange Improvements - MCP	\$1,750									\$2,521		\$2,521	2,521,076	\$ 2,521,000		
New Interchanges																	
Interchange: 38th	New Interchange (2020 budget, MCP for 2022)	\$30,589	\$200		\$30,983								\$31,183	31,182,630	\$ 31,183,000		
Interchange: 88th	New Interchange - MCP	\$15,822					\$17,086						\$17,086	17,085,980	\$ 17,086,000		
Interchange: 48th	New Interchange - MCP	\$21,096						\$25,565					\$25,565	25,565,036	\$ 25,565,000		
Interchange: 112th	New Interchange - MCP	\$15,822						\$19,174					\$19,174	19,173,777	\$ 19,174,000		
Interchange: Potomac	New Interchange	\$21,096								\$28,689			\$28,689	28,688,919	\$ 28,689,000		
Totals		\$831,477	\$67,100	\$26,652	\$88,650	\$59,835	\$102,304	\$161,375	\$179,550	\$92,569	\$234,224	\$79,570	\$1,091,831	\$ 1,091,830,793	\$ 1,091,833,000		
															\$1,091,831		

* PPI Index is based on a five year average of the Final Demand Construction Producer Price Index (PPI) from the Bureau of Labor Statistics website spanning January 2014 through December 2019.

R&R (Tab 2) 583,125,200

** Note that not all capital budget items are included for 2020, which includes other capital requirements, future service station improvements, CMF and Plaza C Relocation and NGL Test Lane totaling \$1.8M in 2020 and \$6.2M in 2021 (Estimated)

TOTAL \$ 1,674,955,993

Table 13. Renewal and Replacement Cost Summary

Renewal and Replacement	Current 5 Year Capital Budget					2025**	2026	2027	2028	2029
	2020	2021	2022	2023	2024					
Structure Maintenance	\$ 382,500	\$ 505,000	\$ 605,000	\$ 605,000	\$ 455,000	\$ 510,500	\$ 520,000	\$ 530,000	\$ 540,000	\$ 550,000
Electrical Repairs and Lighting	260,000	220,000	145,000	120,000	95,000	168,000	171,000	174,000	177,000	180,000
Sign Replacement	300,000	300,000	250,000	250,000	250,000	270,000	275,000	280,000	285,000	291,000
Pavement Replacement	460,000	315,000	315,000	225,000	225,000	308,000	314,000	320,000	326,000	332,000
Pavement Markings	300,000	300,000	300,000	300,000	300,000	300,000	306,000	312,000	318,000	324,000
Fence Replacement	60,000	60,000	60,000	60,000	60,000	60,000	61,000	62,000	63,000	64,000
Landscape Maintenance	400,000	400,000	300,000	300,000	300,000	340,000	347,000	354,000	361,000	368,000
Roadway Infrastructure & Support	950,000	1,300,000	1,150,000	1,200,000	1,130,000	1,146,000	1,168,000	1,191,000	1,214,000	1,238,000
Transportation Replacement	562,800	576,400	600,000	700,000	700,000	628,000	640,000	652,000	665,000	678,000
Facility Repairs and Upgrades	8,460,000	6,880,000	550,000	490,000	610,000	3,398,000	3,464,000	3,531,000	3,600,000	3,670,000
Vehicle Replacement	245,000	200,000	260,000	200,000	150,000	211,000	215,000	219,000	223,000	227,000
Software and Hardware Upgrades	8,695,000	21,960,000	21,645,000	6,035,000	5,755,000	12,818,000	13,067,000	13,320,000	13,578,000	13,841,000
Storage Environment	800,000	500,000	425,000	375,000	525,000	525,000	535,000	545,000	556,000	567,000
TCS Modifications	3,475,000	3,600,000	4,100,000	4,100,000	3,625,000	3,780,000	3,853,000	3,928,000	4,004,000	4,082,000
Plans and Studies - Capital	300,000	300,000	300,000	300,000	300,000	300,000	306,000	312,000	318,000	324,000
Subtotal Renewal and Replacement	\$ 25,650,300	\$ 37,416,400	\$ 31,005,000	\$ 15,260,000	\$ 14,480,000	\$ 24,762,500	\$ 25,242,000	\$ 25,730,000	\$ 26,228,000	\$ 26,736,000

Renewal and Replacement	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Structure Maintenance	\$ 561,000	\$ 572,000	\$ 583,000	\$ 594,000	\$ 606,000	\$ 618,000	\$ 630,000	\$ 642,000	\$ 654,000	\$ 667,000	\$ 680,000
Electrical Repairs and Lighting	183,000	187,000	191,000	195,000	199,000	203,000	207,000	211,000	215,000	219,000	223,000
Sign Replacement	297,000	303,000	309,000	315,000	321,000	327,000	333,000	339,000	346,000	353,000	360,000
Pavement Replacement	338,000	345,000	352,000	359,000	366,000	373,000	380,000	387,000	395,000	403,000	411,000
Pavement Markings	330,000	336,000	343,000	350,000	357,000	364,000	371,000	378,000	385,000	392,000	400,000
Fence Replacement	65,000	66,000	67,000	68,000	69,000	70,000	71,000	72,000	73,000	74,000	75,000
Landscape Maintenance	375,000	382,000	389,000	397,000	405,000	413,000	421,000	429,000	437,000	445,000	454,000
Roadway Infrastructure & Support	1,262,000	1,286,000	1,311,000	1,336,000	1,362,000	1,388,000	1,415,000	1,442,000	1,470,000	1,499,000	1,528,000
Transportation Replacement	691,000	704,000	718,000	732,000	746,000	760,000	775,000	790,000	805,000	821,000	837,000
Facility Repairs and Upgrades	3,741,000	3,814,000	3,888,000	3,963,000	4,040,000	4,118,000	4,198,000	4,279,000	4,362,000	4,447,000	4,533,000
Vehicle Replacement	231,000	235,000	240,000	245,000	250,000	255,000	260,000	265,000	270,000	275,000	280,000
Software and Hardware Upgrades	14,110,000	14,384,000	14,663,000	14,947,000	15,237,000	15,533,000	15,834,000	16,141,000	16,454,000	16,773,000	17,098,000
Storage Environment	578,000	589,000	600,000	612,000	624,000	636,000	648,000	661,000	674,000	687,000	700,000
TCS Modifications	4,161,000	4,242,000	4,324,000	4,408,000	4,494,000	4,581,000	4,670,000	4,761,000	4,853,000	4,947,000	5,043,000
Plans and Studies - Capital	330,000	336,000	343,000	350,000	357,000	364,000	371,000	378,000	385,000	392,000	400,000
Subtotal Renewal and Replacement	\$ 27,253,000	\$ 27,781,000	\$ 28,321,000	\$ 28,871,000	\$ 29,433,000	\$ 30,003,000	\$ 30,584,000	\$ 31,175,000	\$ 31,778,000	\$ 32,394,000	\$ 33,022,000

Total R&R - 2020 to 2040 \$583,125,200

* PPI Index is based on a five year average of Final Dam and Construction Producer Price Index (PPI) from the Bureau of Labor Statistics website spanning January 2014 through July 2019.

** Average of current five year capital budget

5.5 Total Master Plan Costs

Table 14 provides a summary of master plan component costs through 2040. The grand total is \$1.67 billion.

Table 14. Summary of Master Plan Costs: 2020-2040

Description	Total (Completion year \$)
Roadway Improvement Projects	\$1,029,923,046
Trail Completion	\$34,852,547
Renewal & Replacement	\$583,125,200
Pavement Overlays	\$27,055,200
Total Through 2040	\$1,674,955,993

5.6 Master Plan Updates

As stated earlier, this Master Plan document should be viewed as a long-range planning document that provides a high-level view of major capital needs over the next 20 years based on the best forecasts and analysis available at this time. It should be treated as a living document that will be updated frequently as conditions change.

Appendix A
Interchange Turning Movement Volumes

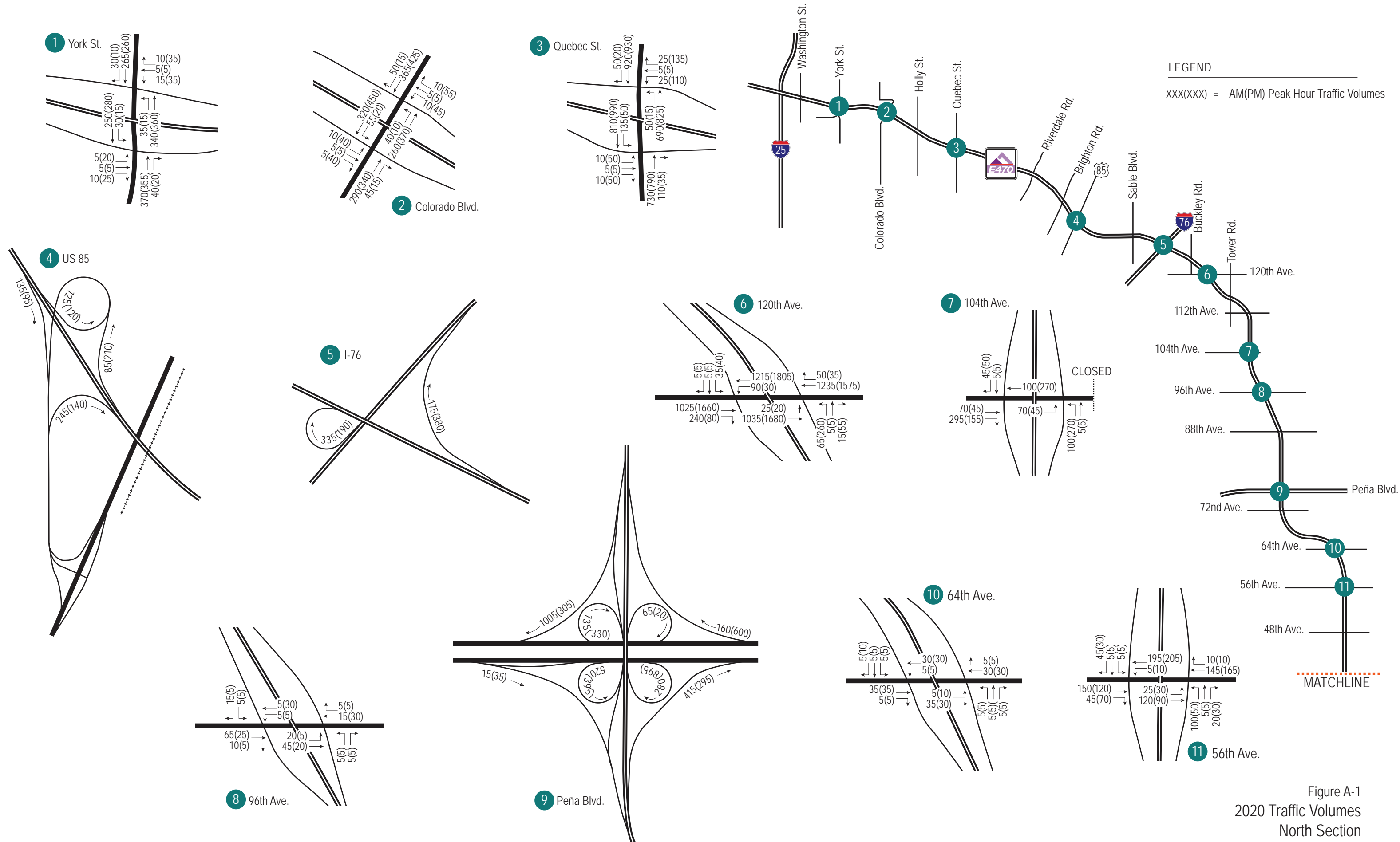


Figure A-1
2020 Traffic Volumes
North Section

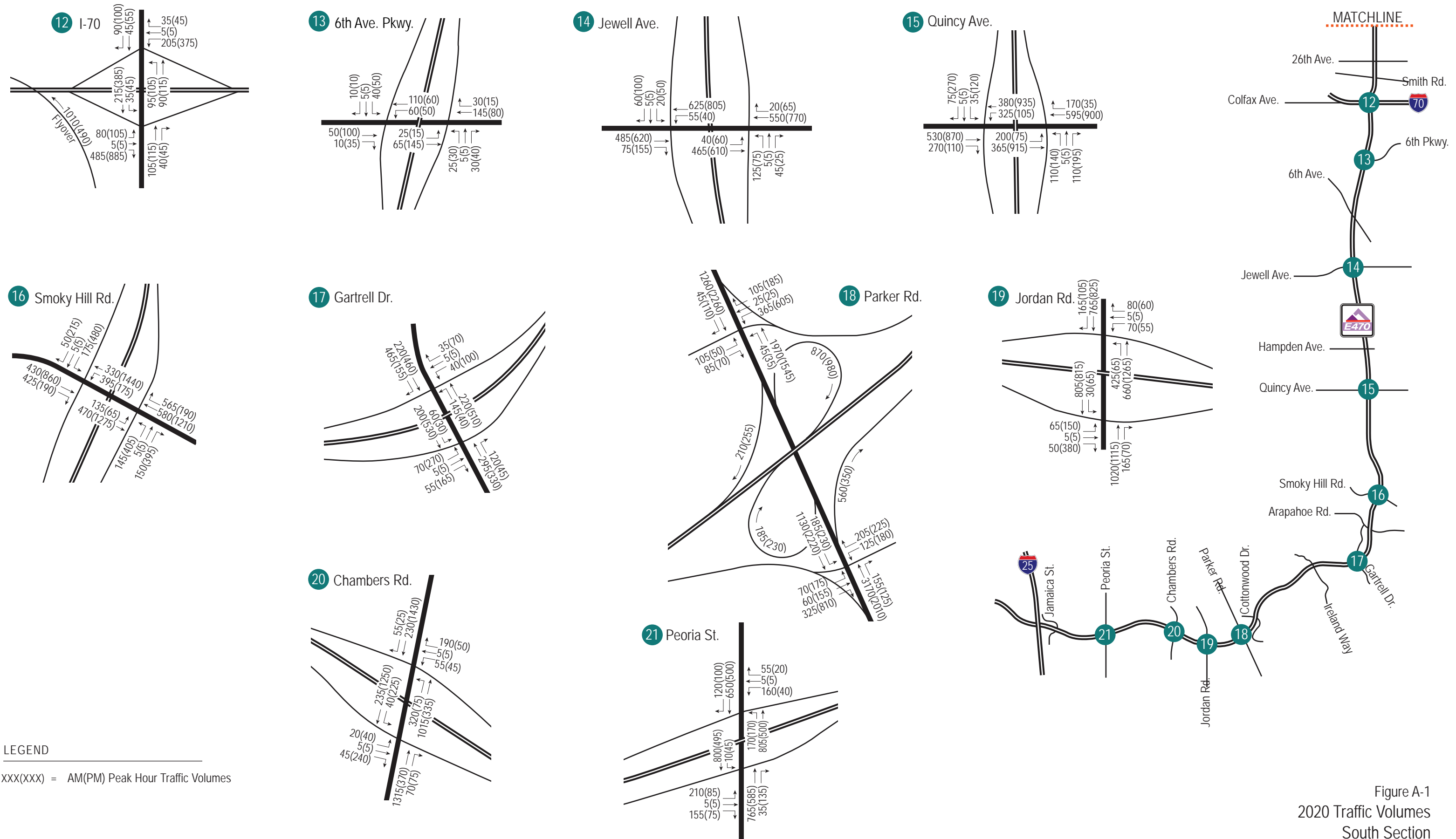


Figure A-1
 2020 Traffic Volumes
 South Section

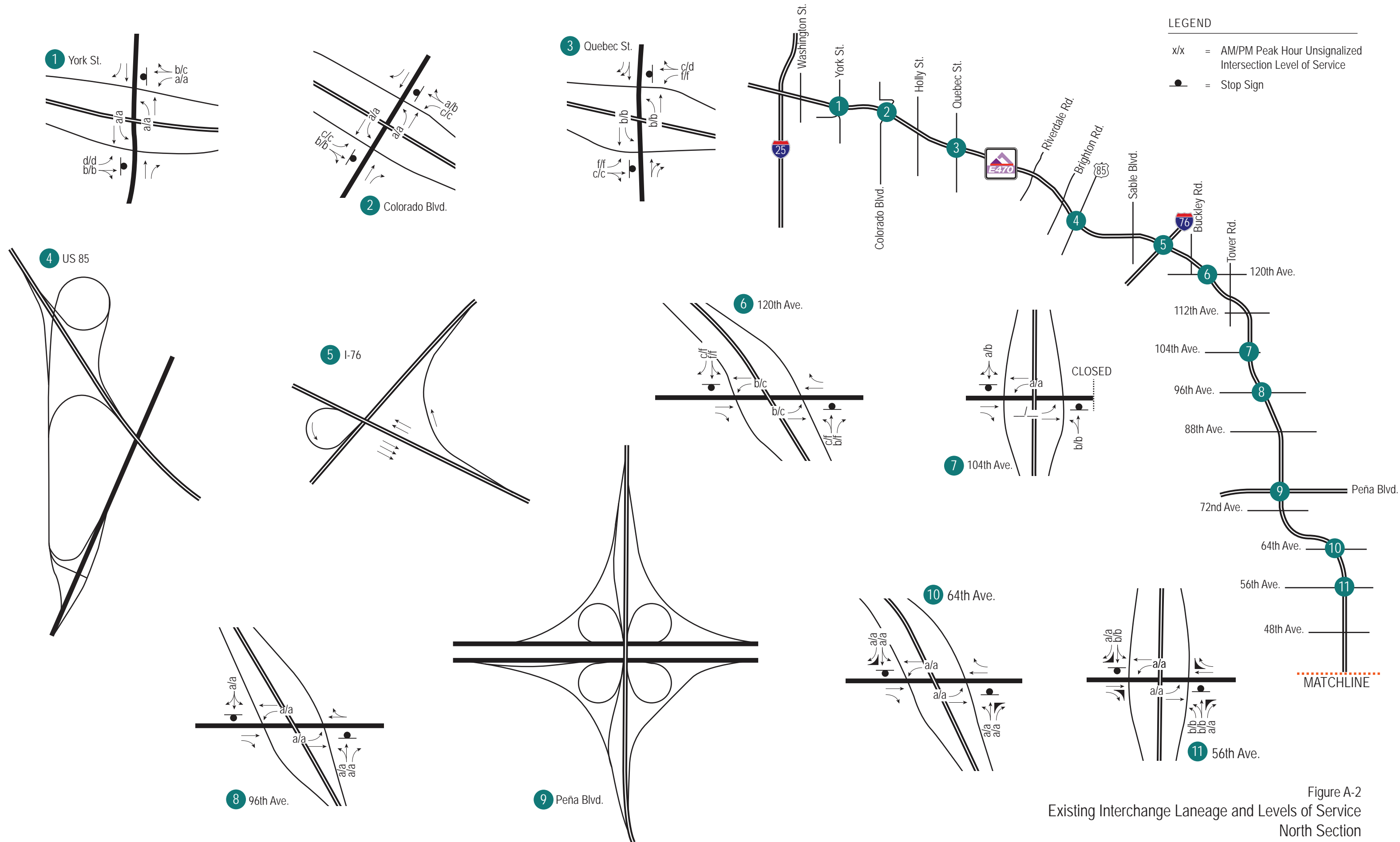


Figure A-2
Existing Interchange Laneage and Levels of Service
North Section

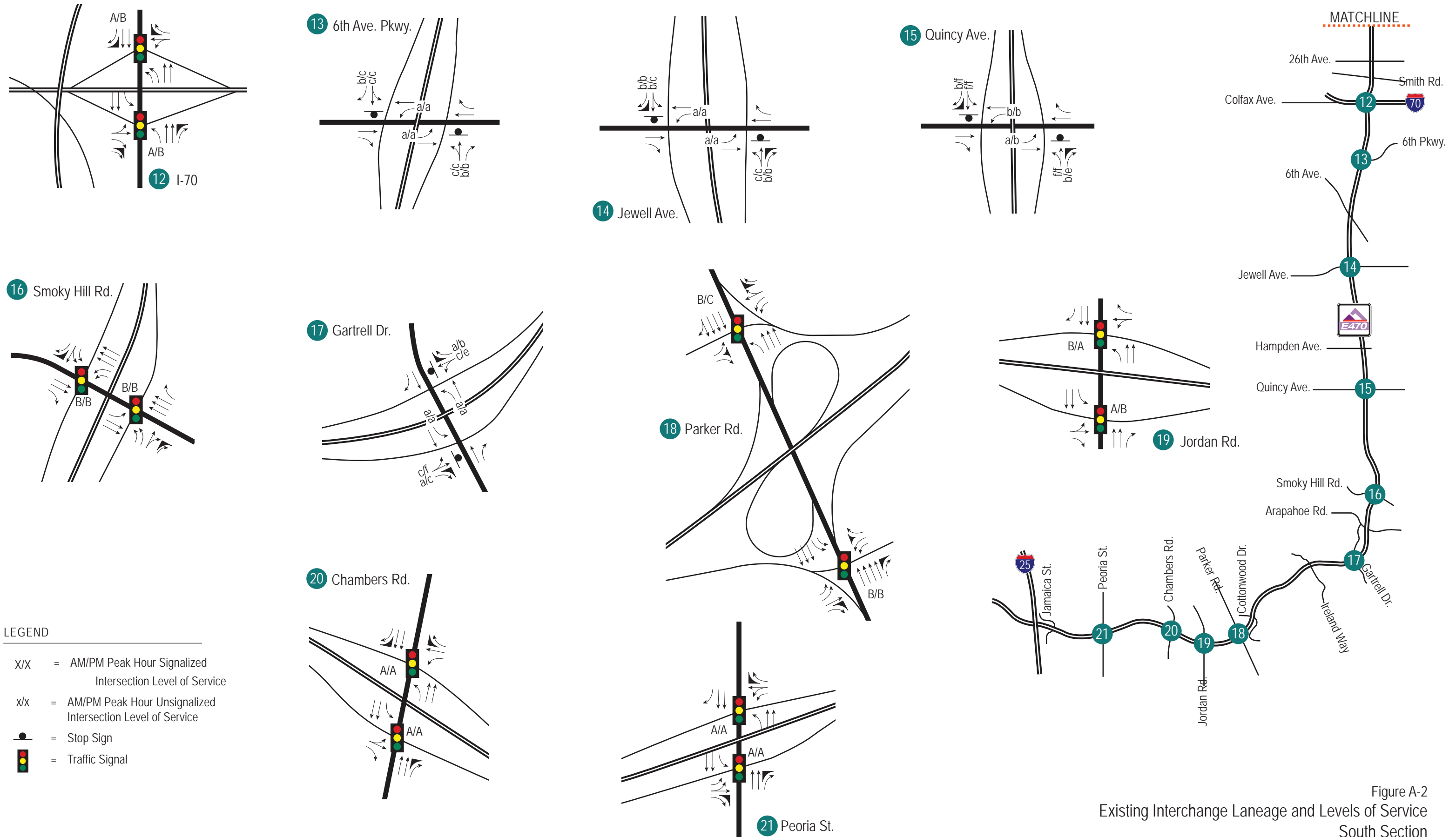


Figure A-2
Existing Interchange Laneage and Levels of Service
South Section

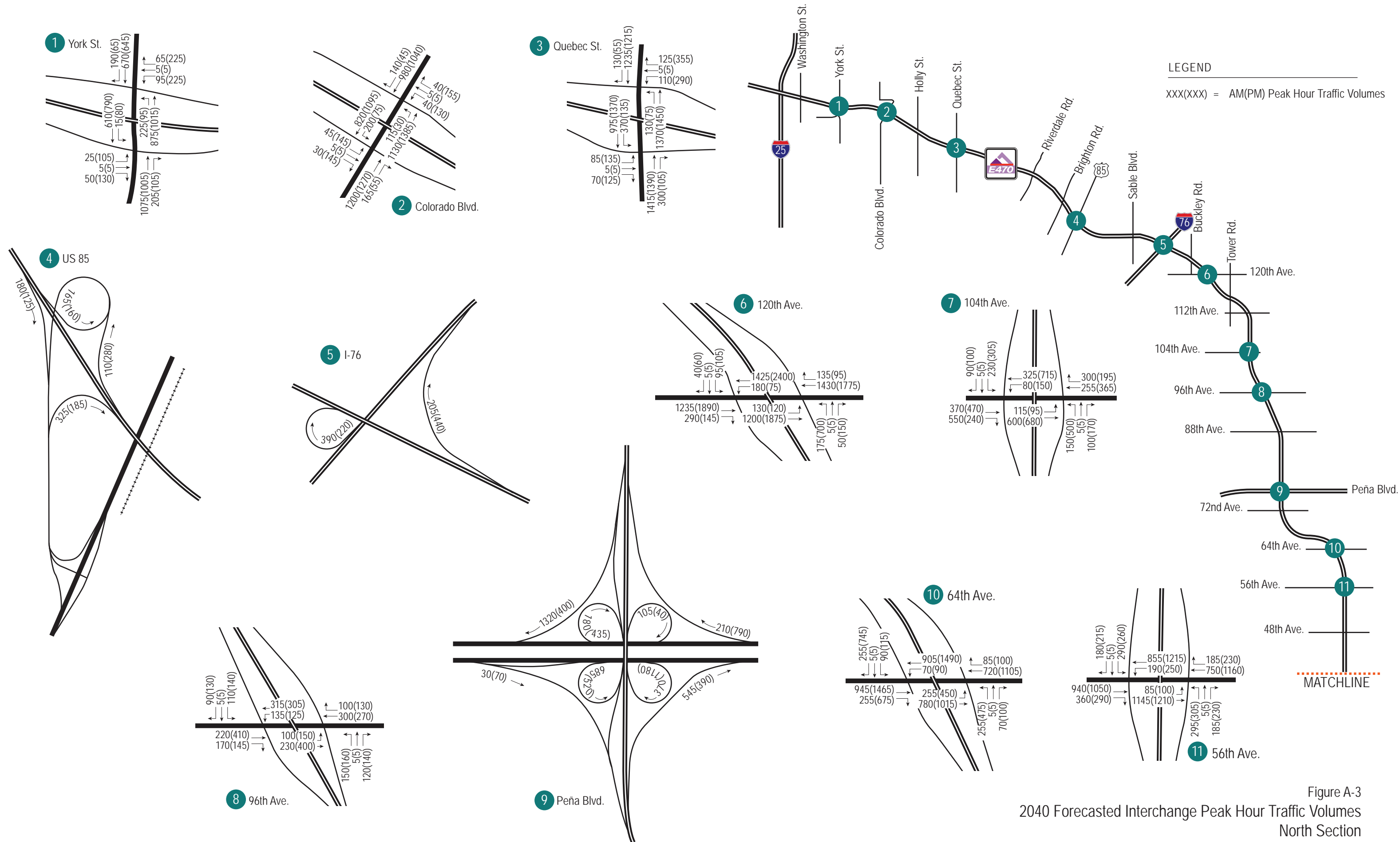


Figure A-3
2040 Forecasted Interchange Peak Hour Traffic Volumes
North Section

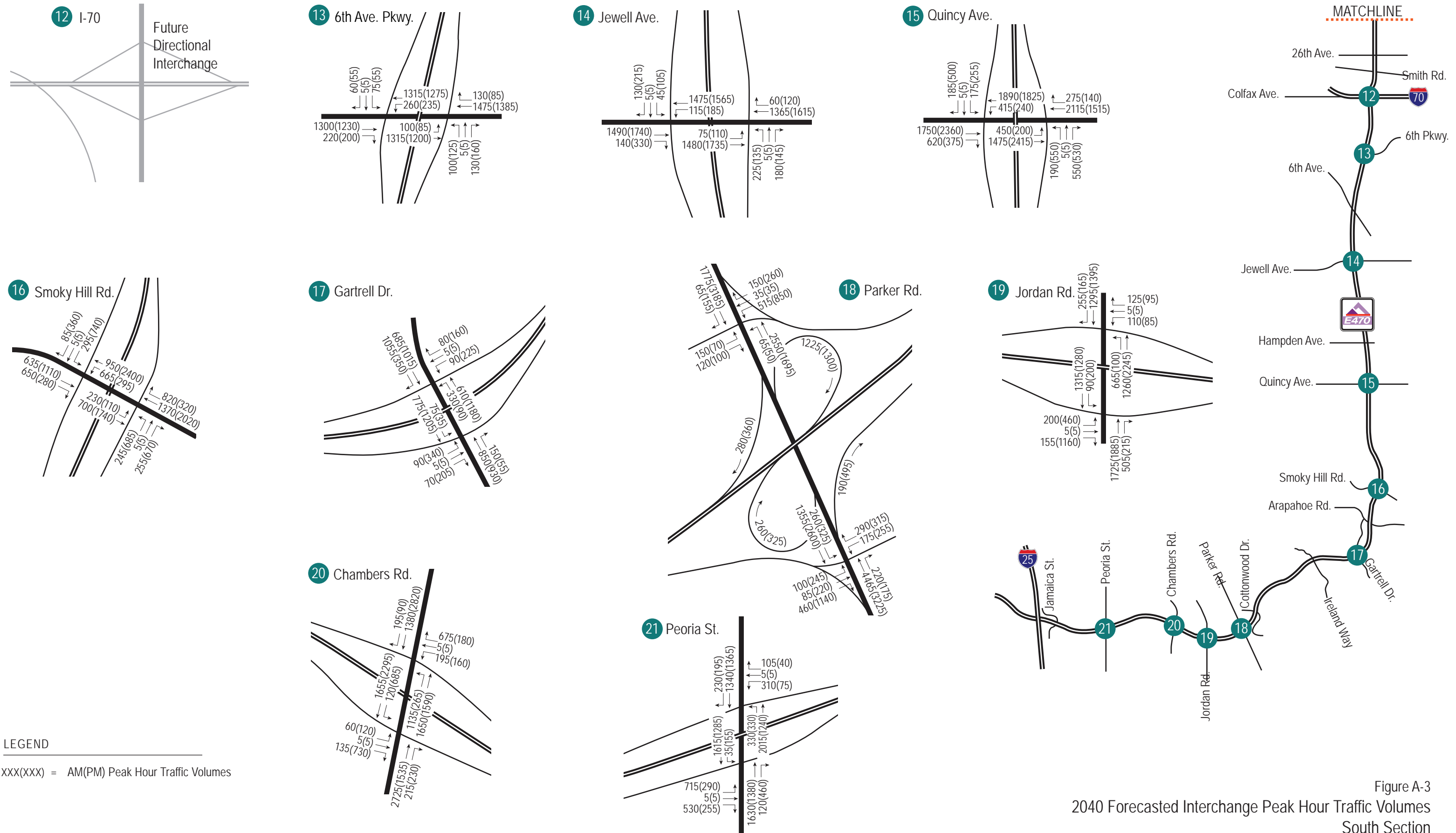


Figure A-3
2040 Forecasted Interchange Peak Hour Traffic Volumes
South Section

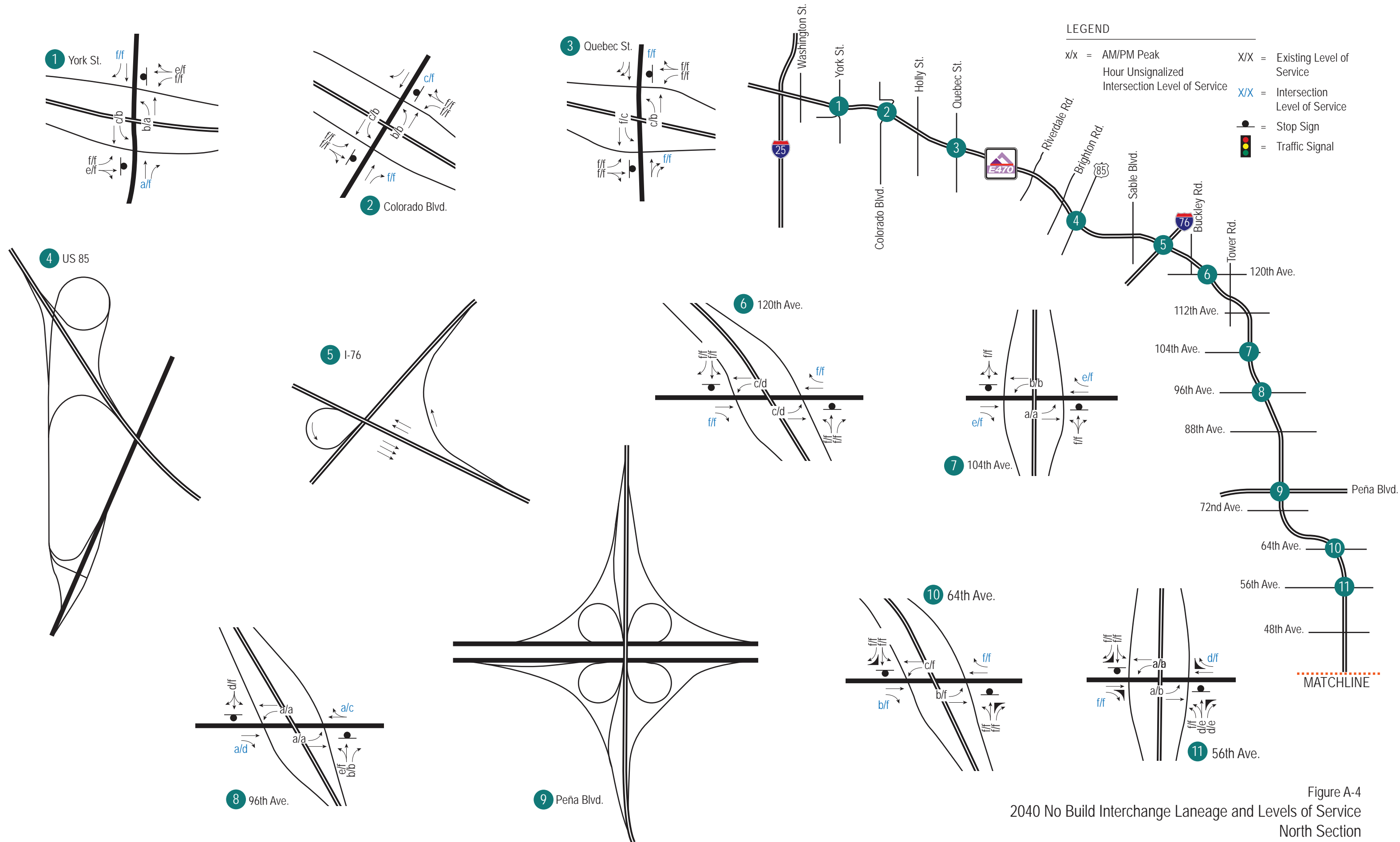


Figure A-4
2040 No Build Interchange Laneage and Levels of Service
North Section

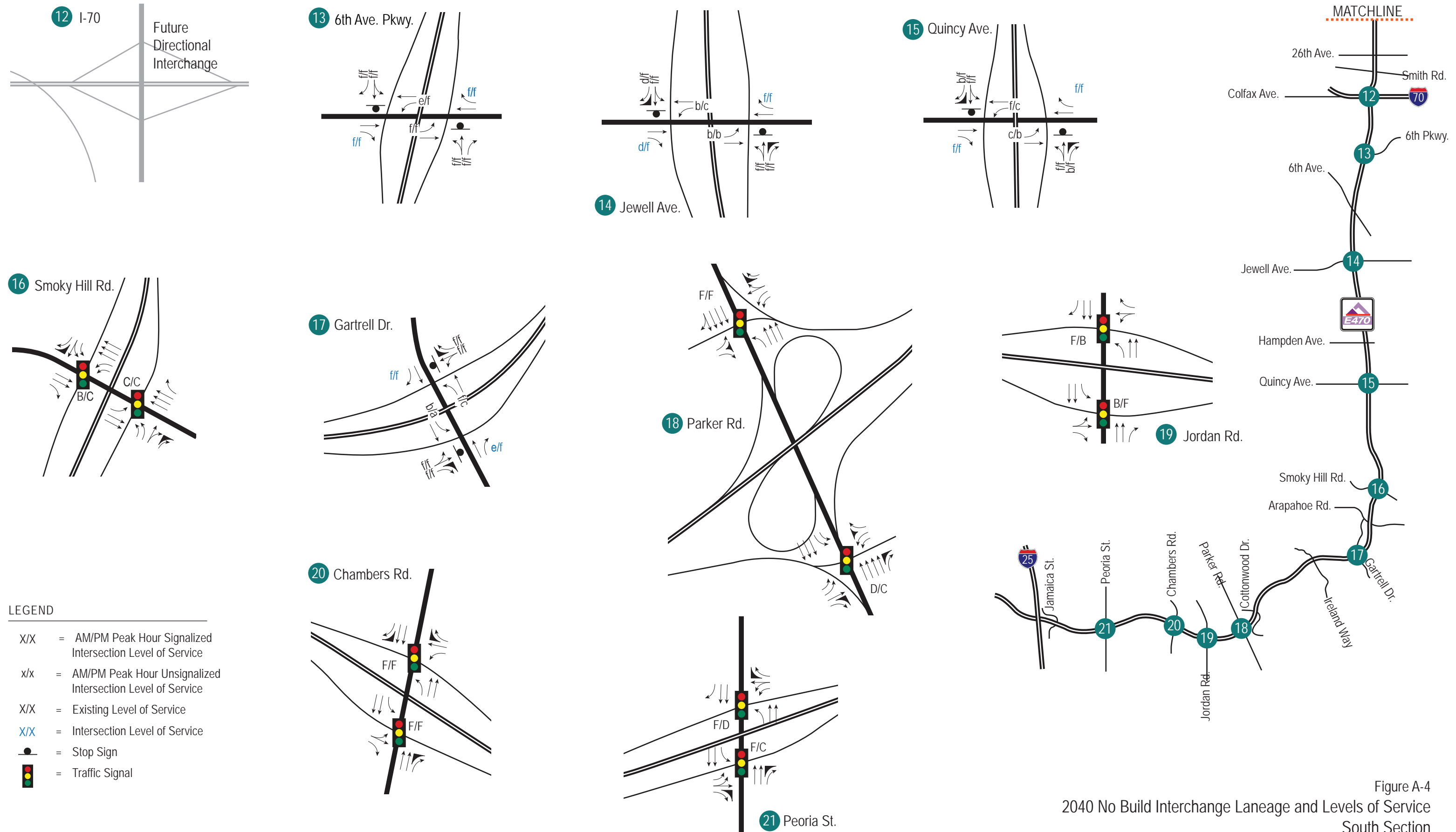


Figure A-4
2040 No Build Interchange Laneage and Levels of Service
South Section

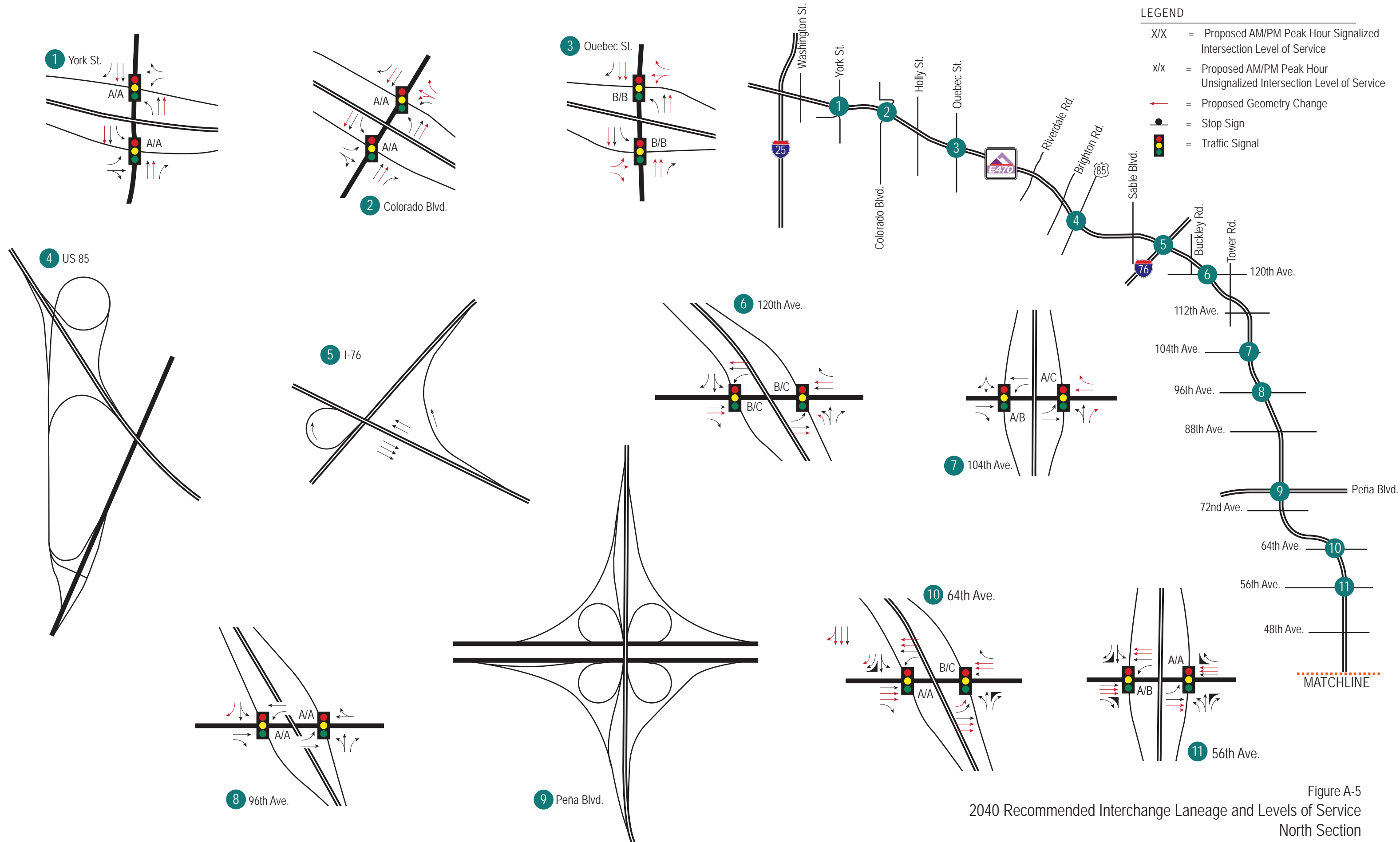


Figure A-5
2040 Recommended Interchange Laneage and Levels of Service
North Section

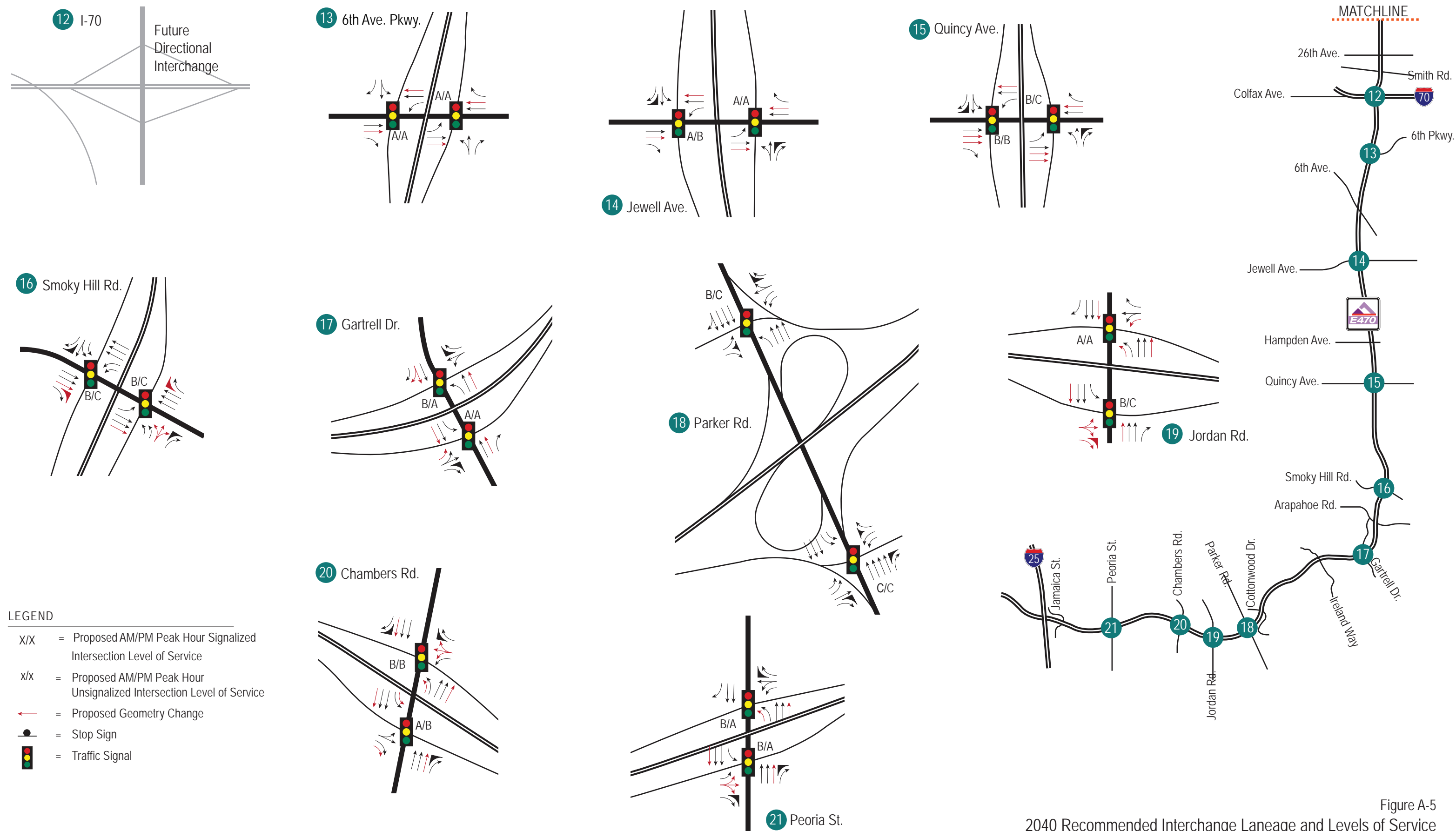


Figure A-5
2040 Recommended Interchange Laneage and Levels of Service

Appendix B
Safety Assessment Report for E 470:
Executive Summary by DiExSys: February 26, 2019

EXECUTIVE SUMMARY

E-470 tollway was designed and constructed as a high standard freeway intended to provide maximum safety and mobility for the traveling public. A road would be completely safe if no collisions occurred on it, but crashes occur on all roads in use. It is therefore inappropriate to say of any road that it is completely safe. However, it is correct to say that roads can be built safer or less safe. Road safety is a matter of degree. Consider two alternative road designs, connecting the same two points and carrying the same traffic. The road design that is likely to have fewer or less severe crashes would be deemed to be the safer one. It is the objective of the E-470 Public Highway Authority to attain the highest level of safety with resources available. In response to a request from the E-470 Public Authority, DiExSys LLC is pleased to submit this report intended to identify opportunities for the safety improvements on the E-470 Tollway through accident analysis. This is a follow up study of safety performance of E-470, the original study was conducted in 2006. Our findings are as follows:

E-470 mainline continues to deliver better than average safety performance when compared to other similar freeways in Colorado. In addition to generous and consistent geometric design characteristics the E-470 tollway is providing ample capacity to ensure high degree of mobility. It operates in free-flow state throughout the day characterized by low to moderate density of flow which is inherently safer than more congested freeways with similar geometrics. A few segments and interchanges, however, do present some potential for crash reduction. They are listed in descending order of their Benefit/Cost ratio below and described in greater detail in the body of the report. They are also summarized, including B/C, in a table at the end of this Executive Summary.

- Smoky Hill Road, East Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Smoky Hill
- Peoria Street, North Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Peoria
- Jamaica Street, South Intersection – Traffic Signal Modifications, Full Protected Left Turns from Jamaica
- Ramp from Southbound I-25 to Northbound E-470 (South Terminus) – Cable Rail, Right Shoulder
- MP 0.00-0.50 (Just East of I-25) – Add Shoulder Rumble Strips on All 4 Shoulders
- Smoky Hill Road, West Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Smoky Hill
- Ramp from Northbound I-25 to Southbound E-470 (North Terminus) – Cable Rail, Both Shoulders
- Ramp from Northbound E-470 to Eastbound I-76 – Cable Rail, Both Shoulders

- Parker Road/Crown Crest Boulevard, South Intersection – Traffic Signal Modifications, Upgrade Westbound Faces
- MP 0.00-0.51(Just East of I-25) – Snow Fence (If Feasible), Both Directions
- Ramp from Eastbound I-70 to E-470 C/D Road – Cable Rail, Both Sides
- Chambers Road, North Intersection – Traffic Signal Modifications, Fully Protected Left Turns from Chambers
- MP 8.90-9.20 (North of Gartrell) – Snow Fence (If Feasible), Both Directions
- Ramp from US-85 to Northbound E-470 – Rumble Strips, Both Shoulders
- MP 1.25-1.40 (West of Peoria) – Cable Rail, Right Shoulder, Northbound
- MP 0.00-0.50 (Just East of I-25) – Widen Left Shoulders from 4-feet to 10-feet, Both Directions
- Ramp from Northbound I-25 to Northbound E-470 (South Terminus) – Cable Rail, Both Shoulders
- Ramp from Westbound I-76 to Southbound E-470 – Cable Rail, Left Shoulder
- Ramp from Northbound E-470 to US-85 – Cable Rail, Right Shoulder
- MP 35.50-36.00 (West of I-76) – Cable Rail, Right Shoulder, Northbound
- Ramp from Northbound E-470 to Eastbound Pena Boulevard – Curve Warning Signs
- MP 9.80-10.10 (North of Arapahoe Road) – Snow Fence (If Feasible), Both Directions
- Quincy Intersections – Intersection Conflict Warning System (Possibly as a Short-Term Countermeasure, until Signalization)
- Ramp from Southbound E-470 to US-85 – Cable Rail, Both Sides
- 19th Avenue and E-470 C/D Road – Convert Westbound Double-Lefts to Single-Left
- 120th Avenue Intersections – Signalize
- Ramp from Northbound E-470 to Eastbound Pena Boulevard – Cable Rail, Both Shoulders
- MP 25.60-26.10 (North of 64th) – Overhead Feedback Curve Speed Warning System, By Lane, Both Directions
- Ramp from Southbound E-470 to Northbound I-25 (South Terminus) – Cable Rail, Both Shoulders
- MP 33.00-33.70 (south of 120th) – Overhead Feedback Curve Speed Warning System, By Lane, Both Directions
- Ramp from E-470 to Southbound US-85 – Cable Rail, Both Sides
- Ramp from Northbound E-470 to Northbound I-25 (North Terminus) – Cable Rail, Both Sides
- Ramp from US-85 to Southbound E-470 – Cable Rail, Both Shoulders
- MP 31.62-34.13 (104th to 120th) – Cable Rail, Right Shoulders, Both Directions

- MP 1.30-1.71 (West of Peoria) - Highway Lighting, Both Directions
- Quincy Intersections – Signalize

The following locations have Benefit/Cost of less than 1; but might be considered in light of observed crash patterns and general conformance with E-470 standards and goals. Still listed in order of decreasing Benefit/Cost.

- Southbound E-470 C/D Road Approaching Ramp to Eastbound Pena Boulevard – Overhead EXIT ONLY sign
- MP 5.19-8.89 (Parker to Gartrell) – Highway Lighting, Both Directions
- MP 0.00-46.38 (End to End) – Wrong Way Detection and Warning, Every Off-ramp
- MP 16.36-19.00 (Jewell to 6th) – Highway Lighting, Both Directions
- MP 22.80-24.88 (South of 56th) – Highway Lighting, Both Directions
- MP 43.66-44.84 (Colorado to York) – Highway Lighting, Both Directions
- MP 10.69-13.35 (Smoky Hill to Quincy) – Highway Lighting, Both Directions
- MP 28.80-30.30 (Pena to 96th) – Highway Lighting, Both Directions
- MP 19.01-20.55 (6th to Colfax) – Highway Lighting, Both Directions
- Ramp from SB US-85 to E-470 – Cable Rail, Both Sides

The following improvements are listed in rank (decreasing) order of their potential safety benefits, because uncertainty in estimating their construction/implementation costs makes calculating Benefit/Cost impractical.

- MP 1.72-3.50 (Peoria To Chambers) – Drainage Improvements, Southbound
- MP 8.90-10.40 (Between Gartrell and Smoky Hill) – Drainage Improvements, Northbound
- MP 1.30-1.71 (West of Peoria) – Drainage Improvements, Northbound
- MP 26.86-27.85 (North of 64th) – Drainage Improvements, Southbound
- MP 39.90-40.50 (West of Riverdale) – Drainage Improvements, Southbound
- MP 3.80-4.10 (Between Chambers and Jordan) – Drainage Improvements, Northbound
- MP 43.80-44.50 (Colorado to York) – Drainage Improvements, Northbound
- Parker Road, North Intersection – Signal Coordination Improvement on Parker Road

The following improvements are not supported by observed crash history, but represent good engineering practice, they will provide consistency and are intended to prevent low probability, but high severity crashes. They are listed in mile point order.

- Northbound at Jamaica Street – Close the Open Median Trap Between the E-470 Bridges
- Northbound at Peoria Street – Close the Open Median Trap Between the E-470 Bridges



- Southbound at Peoria Street – Close the Open Median Trap Between the E-470 Bridges
- Southbound at Happy Canyon Trail (West of Chambers) – Close the Open Median Trap Between the E-470 Bridges
- Both Directions on Chambers at E-470 – Replace Existing Bridge Rail End Treatments with Impact Attenuators in the Median of Chambers Over E-470
- Northbound at MP 3.58 (Just East of Chambers) – Extend Cable Rail to Shield Monotube Foundation in the Median
- Northbound at Jordan Road – Close the Open Median Trap Between the E-470 Bridges
- Northbound at Cherry Creek Trail (West of Parker) – Close the Open Median Trap Between the E-470 Bridges
- Southbound at Cherry Creek Trail (West of Parker) – Close the Open Median Trap Between the E-470 Bridges
- Northbound at Parker Road – Close the Open Median Trap Between the E-470 Bridges
- Southbound at Parker Road – Close the Open Median Trap Between the E-470 Bridges

After the original safety study was completed a number of safety improvement projects were undertaken by the E-470 Authority, these projects have produced significant crash reductions and are briefly discussed below.

- Median Cable Barrier: In a series of projects, median cable barrier was placed more or less from end to end of E-470:
 - MP 5.18-16.36 (Parker to Jewell), completed May 2007
 - MP 0.00-5.18 (I-25 to Parker), completed November 2008
 - MP 16.36-22.73 (Jewell to Toll Plaza C), completed November 2008
 - MP 22.73-35.49 (Toll Plaza C to I-76), completed December 2009
 - MP 35.49-46.38 (I-76 to I-25), completed October 2010.

The primary goal of median cable barrier is typically to reduce the potential for median crossover crashes, especially head on and sideswipe opposite. Median crossover crashes have been virtually eliminated in the after period. Cable barrier has a moderating effect on speed and sometimes results in a reduction of total crash frequency and severity. Crash frequency increased slightly in the MP 22.73-35.49 (Toll Plaza C to I-76) segment during the after period (by about 6% compared to what would have been expected due to traffic growth), but decreased in all other segments, by 0.5% to 25%. Severity decreased in the after period in all segments, by 4.6% to 32%.

- Longitudinal Rumble Strips: Rumble Strips were milled into all 4 shoulders from MP 0.50 to MP 46.38 (1/2 mile east of I-25, South Terminus to I-25, North Terminus) in 2006 and 2007, with a primary goal of reducing high severity run off the road, especially overturning crashes. Overturning crashes were reduced by 32% in the after period. In the 6-Lane portion of E-470 total crashes were reduced 20% in the after period, and severe crashes were reduced by 38% in the after period. In the 4-Lane portion total crashes were reduced by 19% and severe crashes were reduced by 15%.
- Nonstop Tolling: Project was completed in July 2009. The intention was to reduce rear-end crashes on ramps (away from intersections) and rear-end and same-direction sideswipes on the mainline near toll plazas. On the ramps, rear-end and sideswipe collisions were reduced in total by 30%, and severe collisions were reduced by 50%. Near the toll plazas, rear-end and sideswipe collisions were reduced in total by 83% and severe collisions were reduced by 60%.
- Flashing LEDs on Wrong Way Signs and Pavement Arrows, All Off-ramps: Project was completed in 2013 and was intended to reduce potential for crashes involving wrong way drivers on the mainline. Total wrong way crashes were

reduced by 33%, Severe by 50%. Detected wrong way drivers were reduced by more than 50%.

- Deer Fence, MP 5.50-10.68 (Cottonwood to Smoky Hill): Project completed in October 2013 was intended to reduce wildlife collisions. Total wildlife collisions were reduced 77%, Severe 83%.
- Widening (6-Laning), MP 5.18-13.35 (Parker to Quincy). Project completed in November 2017, intended to improve mobility and reduce total crashes on the mainline. No data available for the after period, at the time of this report.
- Restripe Southbound C/D road at Pena: Intended to reduce crashes on the C/D road approaching the ramp to eastbound Pena, and on that ramp. Total crashes reduced 25%, Severe 100%.

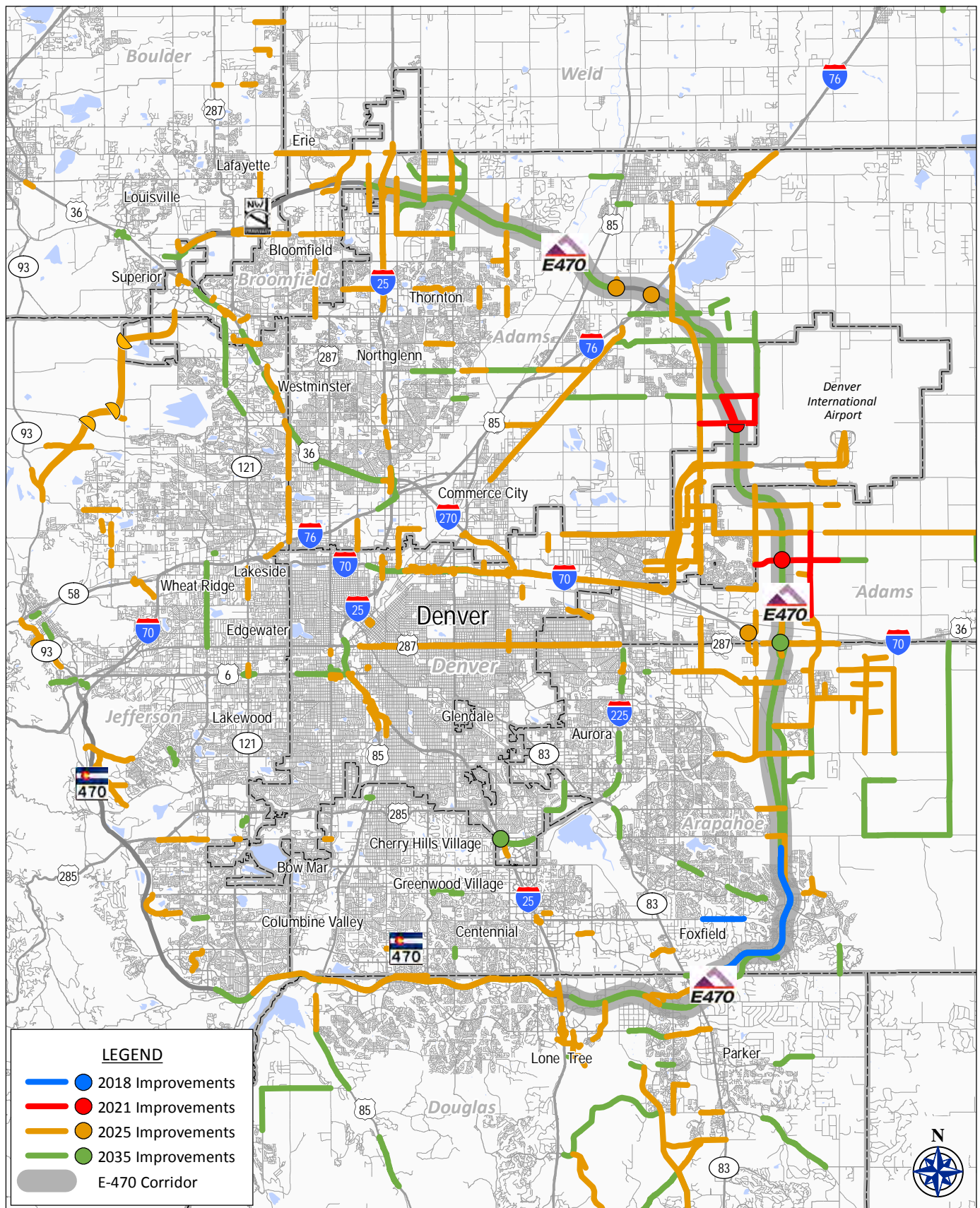
Speed limit was increased from 70 mph to 75 mph on the E-470 mainline in June 2011. Some chevrons and advisory curve speed signs were placed at the same time.

- The 6-Lane portion of E-470, between I-25 and Parker, after raising the speed limit, remains better than average when compared with similar urban 6-lane freeways in Colorado carrying the same amount of traffic; however, it appears that raising the speed limit may be correlated with increases in the frequency and severity of crashes in the after period. The amount of traffic, after raising the speed limit, went up approximately 12% (from 37,425 to 41,903) while the total number of crashes increased by 48% (99 to 147) and the number of injury crashes more than doubled (23 to 49). Interchange spacing and traffic operation on this 6-lane section most closely resembles a typical urban freeway, keeping this in mind in concert with the observed change in safety performance, we recommend that lowering the speed limit is evaluated.
- In the 4-Lane portion, Total crashes were virtually unchanged, and severity decreased by 15% after the speed limit change.

Summary of Recommendations Safety Assessment

B/C	Recommended Improvement	Locations	Impact to MP
>1.0	Protected Left Turn Phase	Smoky Hill, Peoria, Jamaica, Chambers	- Minor Operational impacts for left turning vehicles at ramp intersections. - Not anticipated to impact operations on E-470 mainline.
	Cable Rail (Ramp)	I-25 NB/SB Ramp, EB/WB I-76, I-70 to C/D Road, US 85, Pena	
	Cable Rail (Mainline)	MP 1.25 - 1.4, MP 31.62 - 34.13, MP 35.5 - 36.0	
	Shoulder Rumble Strips	MP 0 to 0.5, US85 ramp to NB E470	- Not anticipated to impact operations on E-470 mainline.
	Traffic Signal Face Upgrade	Parker/Crown Crest	- Could be incorporated as component of planned improvements.
	Snow Fence	MPs 0-0.51, 8.9-10.10	
	Widen Shoulders	MP 0-0.5	
	Curve Warning Sign	Pena, MP 25.60-26.10, MP 33.0-33.70	
	Intersection Laneage Reconfiguration	19th/E-470 C/D Road	
	Signalization	120th Avenue & Quincy intersections	- Expected to improve operations and safety at respective intersections. - Not anticipated to impact operations on E-470 mainline.
<1.0	Highway Lighting	MPs 1.3-1.71, 5.19-8.89, 10.69-13.35, 16.36-20.55, 22.8-24.88, 43.66-44.84, 28.8-30.30	- Not anticipated to impact operations on E-470 mainline.
	Wrong Way Detection	Entire Corridor	- Could be incorporated as component of planned improvements.
	Cable Rail (Ramp)	SB US 85 to E470	
	Drainage Improvements	MPs 1.3-4.1, 8.9-10.4, 26.86-27.85, 39.9-44.5	- Not anticipated to impact operations on E-470 mainline.
Uncertain B/C	Signal Coordination Timing	Parker Road	- Could be incorporated as component of planned improvements.
Not supported by Observed Crash History, but present good eng. Practice	Close Open Median Trap	Jamaica, Peoria, Happy Canyon, Jordan, Cherry Creek Trail, Parker	- Not anticipated to impact operations on E-470 mainline.
	Replace Bridge Rail End Treatment with Impact Attenuator	on Chambers at E-470	- Could be incorporated as component of planned improvements.
	Extend Cable Rail to shield monotube	MP 3.58	

Appendix C
Programmed Regional Highway Improvements
(Based on DRCOG RTP Improvements)



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SELECTED PROGRAMMED REGIONAL HIGHWAY IMPROVEMENTS

FIGURE 5-1

**TABLE 5-1
PROGRAMMED REGIONAL HIGHWAY IMPROVEMENTS**

Network Year of Improvement	Facility Name	From	To	Improvement	Length	Counties
2018	E-470	Parker Rd.	Quincy Ave.	Widen from 4 to 6 lanes	8.1	Arapahoe/Douglas
2021	E-470	48th Ave.		Add New Interchange		Adams
2021	E-470	88th Ave.		Add New Interchange		Adams
2025	104th Ave.	Grandview Ponds	McKay Rd.	Widen from 2 to 4 Lanes	0.7	Adams
2025	104th Ave.	US-85	SH-2	Widen from 2 to 4 Lanes	1.8	Adams
2025	144th Ave.	US-287	Zuni St.	Widen from 2 to 4 Lanes	3.5	Broomfield
2025	144th Ave.	Washington St.	York St.	Widen from 2 to 4 Lanes	1.0	Adams
2025	144th Ave.	York St.	Colorado Blvd.	Widen from 2 to 4 Lanes	1.0	Adams
2025	160th Ave.	Lowell Blvd.	Sheridan Pkwy.	New 2 Lanes	1.0	Broomfield
2025	48th Ave.	Picadilly Rd.	Powhatan Rd.	New 6 Lanes	3.0	Adams
2025	56th Ave.	Dunkirk St.	Himalaya St.	Widen from 4 to 6 Lanes	0.5	Denver
2025	56th Ave.	E-470	Imboden Rd.	Widen from 2 to 6 Lanes	7.0	Adams
2025	56th Ave.	Havana St.	Pena Blvd.	Widen from 2 to 6 Lanes	4.3	Denver
2025	56th Ave.	Himalaya St.	Picadilly Rd.	Widen from 2 to 6 Lanes	1.0	Denver
2025	56th Ave.	Pena Blvd.	Tower Rd.	Widen from 4 to 6 Lanes	0.7	Denver
2025	56th Ave.	Picadilly Rd.	E-470	Widen from 2 to 6 Lanes	1.0	Adams
2025	64th Ave.	Denver/Aurora City Limit	Himalaya St.	Widen from 2 to 6 Lanes	0.5	Adams
2025	64th Ave.	Harvest Rd.	Powhatan Rd.	New 2 Lanes	1.0	Adams
2025	64th Ave.	Himalaya Rd.	Harvest Rd.	Widen from 2 to 4 Lanes	3.0	Adams
2025	64th Ave.	Powhatan Rd.	Monaghan Rd.	New 4 Lanes	1.0	Adams
2025	64th Ave.	Tower Rd.	Denver/Aurora City Limits	Widen from 2 to 4 Lanes	0.5	Denver
2025	6th Ave.	Airport Blvd.	Tower Rd.	Widen from 2 to 6 Lanes	1.0	Arapahoe
2025	6th Ave./6th Pkwy.	6th Pkwy.	Harvest Rd.	Widen from 2 to 6 Lanes	0.4	Arapahoe
2025	6th Ave./SH 30	Tower Rd.	6th Pkwy.	Widen from 2 to 6 Lanes	1.6	Arapahoe
2025	6th Pkwy	SH-30	E-470	New 2 Lane Road	1.3	Arapahoe
2025	6th Pkwy.	E-470	Gun Club Rd.	Widen from 2 to 6 Lanes	0.3	Arapahoe
2025	96th St.	96th St. at Northwest	SH-128	Add Toll Lanes	2.3	Broomfield
2025	Arapahoe Rd.	Piney Creek Circle	Himalaya St.	Widen from 4 to 6 Lanes	1.3	Arapahoe
2025	Broncos Pkwy.	Jordan Rd.	Parker Rd.	Widen from 4 to 6 Lanes	0.8	Arapahoe
2025	Broncos Pkwy. (Easter	Havana St.	Peoria St.	Widen from 4 to 6 Lanes	1.0	Arapahoe
2025	Buckley Rd.	118th Ave.	Cameron Dr.	Widen from 2 to 6 Lanes	1.3	Adams
2025	Buckley Rd.	136th Ave.	Bromley Ln.	Widen from 2 to 4 lanes	2.0	Adams
2025	C-470	Colorado Blvd.	Wadsworth Blvd.	WB: Add New Managed Lanes	8.2	Douglas/Jefferson
2025	C-470	I-25	Colorado Blvd.	WB: Add New Managed Lanes	4.1	Douglas
2025	C-470	Wadsworth Blvd.	I-25	EB: Add New Managed Lanes	10.8	Douglas/Jefferson
2025	Chambers Rd.	Main Street	Lincoln Ave.	Widen from 2 to 4 Lanes	1.4	Douglas
2025	E. Bromley Ln.	Tower Rd.	I-76	Widen from 4 to 6 Lanes	1.1	Adams
2025	E-470	I-76 South Ramps		Add New Interchange		Adams

Network Year of Improvement	Facility Name	From	To	Improvement	Length	Counties
2025	E-470	Potomac		Add New Interchange		Adams
2025	Green Valley Ranch Blvd.	Chambers Rd.	Telluride St.	Widen from 4 to 6 Lanes	1.5	Denver
2025	Green Valley Ranch Blvd.	Chambers Rd.	Pena Blvd.	Widen from 2 to 4 Lanes	1.0	Denver
2025	Green Valley Ranch Blvd.	Telluride St.	Tower Rd.	Widen from 4 to 6 Lanes	0.5	Denver
2025	Gun Club Rd.	1.5 Miles s/of Quincy Ave.	Quincy Ave.	Widen from 2 to 6 Lanes	1.6	Arapahoe
2025	Hampden Ave.	Picadilly Rd.	Gun Club Rd.	Widen from 2 to 4 Lanes	1.1	Arapahoe
2025	Harvest Rd.	56th Ave.	64th Ave.	New 3 Lanes	1.0	Adams
2025	Harvest Rd.	6th Ave.	I-70	New 6 Lanes	1.1	Adams
2025	Harvest Rd.	Alameda Ave.	6th Ave.	Widen from 3 to 6 Lanes	1.0	Arapahoe
2025	Harvest Rd.	I-70	56th Ave.	New 6 Lanes	4.1	Adams
2025	Harvest Rd.	Mississippi Ave.	Alameda Ave.	New 6 Lanes	1.0	Arapahoe
2025	Huron St.	150th Ave.	160th Ave.	Widen from 2 to 4 lanes	1.3	Broomfield
2025	Huron St.	160th Ave.	SH-7	Widen from 2 to 4 lanes	1.2	Broomfield
2025	I-25	120th Ave.	SH-7	Add 1 Toll/Managed Lane each	6.0	Adams/Broomfield
2025	I-25	US-36	Thornton Pkwy.	Add 1 New SB Lane	2.8	Adams
2025	I-70	Harvest Rd.		Add New Interchange		Adams/Arapahoe
2025	I-70	I-25	Chambers Rd.	Add 2 New Managed Lanes	3.8	Denver/Adams
2025	I-70	Picadilly Rd.		Add New Interchange		Adams
2025	Jefferson Pkwy.	Candelas Pkwy.		New Partial Interchange		Jefferson
2025	Jefferson Pkwy.	Indiana St.s/o SH-128		New Partial Interchange		Jefferson
2025	Jefferson Pkwy.	SH-72		New Partial Interchange		Jefferson
2025	Jefferson Pkwy.	SH-93	SH-128	New 4 Lane Toll Road	10.2	Jefferson
2025	Jewell Ave.	E-470	Gun Club Rd.	Widen from 2 to 6 Lanes	0.5	Arapahoe
2025	Jewell Ave.	Gun Club Rd.	Harvest Rd.	Widen from 2 to 6 Lanes	1.0	Arapahoe
2025	Jewell Ave.	Himalaya Rd.	E-470	Widen from 3 to 6 Lanes	1.4	Arapahoe
2025	Lincoln Ave.	Keystone Blvd.	Parker Rd.	Widen from 4 to 6 Lanes	1.6	Douglas
2025	Lincoln Ave.	Peoria St.	1st Ave.	Widen from 4 to 6 Lanes	0.7	Douglas
2025	Pena Blvd.	Jackson Gap St. West	DIA Terminal	Widen from 6 to 8 Lanes	1.7	Denver
2025	Pena Blvd.	Tower Rd.		Add on-ramp to WB Pena		Denver
2025	Pena Blvd.	I-70	E-470	Widen from 4 to 8 Lanes	6.4	Denver
2025	Peoria St.	E-470	.75 miles s/o Lincoln Ave.	Widen from 2 to 4 Lanes	1.9	Douglas
2025	Picadilly Rd.	48th Ave.	56th Ave.	Widen from 2 to 6 lanes	1.2	Adams
2025	Picadilly Rd.	56th Ave.	70th Ave./Aurora City	New 6 Lanes	1.7	Adams
2025	Picadilly Rd.	6th Ave.	Colfax Ave.	Widen from 2 to 6 Lanes	1.6	Arapahoe
2025	Picadilly Rd.	70th Ave.	82nd Ave.	New 6 Lanes	1.5	Denver
2025	Picadilly Rd.	Colfax Ave.	I-70	New 6 Lanes	0.3	Adams
2025	Picadilly Rd.	Jewell Ave.	6th Pkwy.	New 4 Lanes	2.7	Arapahoe
2025	Picadilly Rd.	I-70	Smith Rd.	Widen from 2 to 6 Lanes	0.5	Adams

Network Year of Improvement	Facility Name	From	To	Improvement	Length	Counties
2025	Picadilly Rd.	Smith Rd.	48th Ave.	Widen from 2 to 6 Lanes	2.2	Adams
2025	Quebec St.	120th Ave.	128th Ave.	Widen from 2 to 4 Lanes	1.0	Adams
2025	Quebec St.	132nd Ave.	160th Ave.	Widen from 2 to 4 Lanes	3.5	Adams
2025	Quincy Ave.	Plains Pkwy./Copperleaf	Gun Club Rd.	Widen from 2 to 6 Lanes	0.6	Arapahoe
2025	Ridgegate Pkwy.	Havana St.	Lone Tree E. City Limit	Widen from 2 to 4 Lanes	1.8	Douglas
2025	SH-2	72nd Ave.	I-76	Widen from 2 to 4 Lanes	7.5	Adams
2025	SH-7	Boulder County Line	Sheridan Pkwy.	Widen from 2 to 4 Lanes	2.5	Broomfield
2025	SH-7	Sheridan Pkwy.	I-25	Widen from 2 to 6 Lanes	1.5	Broomfield
2025	Sherdan Pkwy.	NW Pkwy.	SH-7	Widen from 2 to 4 Lanes	1.3	Broomfield
2025	Sheridan Blvd.	Lowell Blvd.	NW Pkwy.	Widen from 2 to 4 Lanes	1.1	Broomfield
2025	Tower Rd.	38th/40th Ave.	Green Valley Ranch	Widen from 2/4 to 6 Lanes	1.0	Denver
2025	Tower Rd.	48th Ave.	56th Ave.	Widen from 4 to 6 Lanes	1.0	Denver
2025	Tower Rd.	56th Ave.	Pena Blvd.	Widen from 4 to 6 Lanes	2.4	Denver
2025	Tower Rd.	6th Ave.	Colfax Ave.	New 2 Lanes	1.0	Arapahoe
2025	Tower Rd.	Colfax Ave.	Smith Rd.	Widen from 2 to 6 Lanes	1.0	Adams
2025	Tower Rd.	Pena Blvd.	104th Ave.	Widen from 2 to 4 Lanes	3.8	Adams
2025	Tower/Buckley Rd.	105th Ave.	118th Ave.	New 4 Lanes	2.0	Adams
2025	Washington St.	144th Ave.	152 Ave.	Widen from 2 to 4 Lanes	0.7	Adams
2025	Washington St.	152nd Ave.	160 Ave.	Widen from 2 to 4 Lanes	1.4	Adams
2025	York St.	160th Ave. (SH-7)	168th Ave.	Widen from 2 to 4 Lanes	1.0	Adams
2025	York St.	E-470	SH-7	Widen from 2 to 4 Lanes	0.7	Adams
2035	104th Ave.	Marion St.	Colorado Blvd.	Widen from 4 to 6 Lanes	1.6	Adams
2035	104th Ave.	McKay Road	US-85	Widen from 2 to 4 Lanes	1.9	Adams
2035	120th Ave.	E-470	Picadilly Rd.	Widen from 2 to 6 Lanes	2.6	Adams
2035	120th Ave.	Sable Blvd.	E-470	Widen from 2 to 6 Lanes	2.0	Adams
2035	152nd Ave.	Washington St.	York St.	Widen from 2 to 4 Lanes	1.2	Adams
2035	48th Ave.	Imboden Rd.	Quail Run Rd.	Widen from 2 to 6 Lanes	1.0	Adams
2035	48th Ave.	Powhatan Rd.	Monaghan Rd.	New 6 Lanes	1.0	Adams
2035	64th Ave.	Harvest Rd.	Powhatan Rd.	Widen from 2 to 4 Lanes	1.0	Adams
2035	6th Pkwy.	SH-30	E-470	Widen from 2 to 6 Lanes	1.3	Arapahoe
2035	96th Ave.	SH-2	Tower Road	Widen from 2 to 4 Lanes	5.0	Adams
2035	96th Ave.	Tower Rd.	Picadilly Rd.	Widen from 2 to 6 Lanes	2.0	Adams
2035	Arapahoe Rd.	Himalaya Way	Liverpool St.	Widen from 4 to 6 lanes	0.5	Arapahoe
2035	C-470	Broadway	I-25	EB: Add 1 Toll/Managed Lane	6.6	Douglas
2035	C-470	Colorado Blvd.	Lucent Blvd.	WB: Add 1 Toll/Managed Lane	3.7	Douglas
2035	C-470	S. Kipling Pkwy.	Wadsworth Blvd.	EB: Add 1 Toll/Managed Lane	3.0	Jefferson
2035	C-470	Wadsworth Blvd.	S. Kipling Pkwy.	WB: Add 1 Toll/Managed Lane	1.4	Jefferson
2035	Colorado Blvd.	144th Ave.	168th Ave.	Widen from 0/2 to 4 Lanes	3.7	Adams

Network Year of Improvement	Facility Name	From	To	Improvement	Length	Counties
2035	E. Bromley Ln.	Hwy 85	Sable Blvd.	Widen from 4 to 6 Lanes	0.5	Adams
2035	E-470	I-25 South	Parker Rd.	Widen from 6 to 8 Lanes	5.5	Arapahoe
2035	E-470	I-25 North	I-76	Widen from 4 to 6 Lanes	11.0	Adams
2035	E-470	I-70	Pena Blvd.	Widen from 4 to 6 Lanes	7.4	Adams/Denver
2035	E-470	Pena Blvd.	I-76	Widen from 4 to 6 anes	7.6	Adams/Denver
2035	E-470	Quincy Ave.	I-70	Widen from 4 to 6 Lanes	7.0	Arapahoe
2035	E-470	Parker Rd.	Quincy Ave.	Widen from 6 to 8 lanes	8.1	Arapahoe/Douglas
2035	Gun Club Rd.	Yale Ave.	Mississippi Ave.	Widen from 2/4 to 6 Lanes	2.1	Arapahoe
2035	Hampden Ave./Havana St.	Florence St.	s/o Yale Ave.	Widen from 5 to 6 Lanes	1.4	Denver
2035	Harvest Rd.	56th Ave.	64th Ave.	Widen from 3 to 6 Lanes	1.0	Adams
2035	Harvest Rd.	Jewell Ave.	Mississippi Ave.	Widen from 2 to 6 lanes	1.0	Arapahoe
2035	I-225	I-25	Yosemite St.	Interchange Capacity		Denver
2035	I-70	E-470		Interchange Capacity		Adams/Arapahoe
2035	Imboden Rd.	48th Ave.	56th Ave.	Widen from 2 to 6 Lanes	1.0	Adams
2035	Lincoln Ave.	1st St.	Keystone Blvd.	Widen from 4 to 6 Lanes	1.8	Douglas
2035	Main Street	Lone Tree E. City Limit	Chambers Rd.	Widen from 2 to 4 lanes	0.9	Douglas
2035	Monaghan Rd.	Quincy Ave.	Yale Ave.	New 6 Lanes	2.0	Arapahoe
2035	Parker Rd. (SH-83)	Quincy Ave.	Hampden Ave.	Widen from 6 to 8 Lanes	1.0	Arapahoe
2035	Peoria St.	.75 miles s/o Lincoln Ave.	Main Street	Widen from 2 to 4 Lanes	0.5	Douglas
2035	Picadilly Rd.	82nd Ave.	96th Ave.	New 6 Lanes	1.8	Adams
2035	Picadilly Rd.	96th Ave.	120th Ave.	New 6 Lanes	3.0	Adams
2035	Powhatan Rd.	Smoky Hill Rd.	County Line Rd.	Widen from 2 to 6 Lanes	1.0	Arapahoe
2035	Quail Run Rd.	I-70	48th Ave.	New 6 Lanes	3.0	Adams
2035	Quincy Ave.	Hayesmount Rd.	Watkins Rd.	Widen from 2 to 6 Lanes	2.0	Arapahoe
2035	Quincy Ave.	Monaghan Rd.	Hayesmount Rd.	Widen from 2 to 6 Lanes	1.1	Arapahoe
2035	SH-7	Riverdale Rd.	US-85	Widen from 2 to 4 Lanes	1.1	Adams
2035	SH-7	164th Ave.	Dahlia St.	Widen from 2 to 4 Lanes	2.2	Adams
2035	Smoky Hill Rd.	Pheasant Run Pkwy.	Versailles Pkwy.	Widen from 4 to 6 Lanes	4.4	Arapahoe
2035	Tower Rd.	6th Ave.	Colfax Ave.	Widen from 2 to 6 Lanes	1.0	Arapahoe
2035	Tower Rd.	Pena Blvd.	104th Ave.	Widen from 4 to 6 Lanes	3.8	Adams
2035	Watkins Rd.	Quincy Ave.	I-70	Widen from 2 to 6 Lanes	7.1	Arapahoe
2035	Yale Ave.	Monaghan Rd.	Hayesmount Rd.	Widen from 2 to 6 Lanes	1.1	Arapahoe
2035	York St.	152nd Ave.	E-470	Widen from 2 to 4 Lanes	0.2	Adams

Appendix D

Cost Estimation Worksheets

1 Quincy - I-70: 6 Lanes (2026)

7 miles at \$9.5M/mile * \$66.5 M

Add Special Structures Bridges **

- Coal Creek \$6.2 M

- SB On-Ramp from Gun Club \$2.9 M

- Colfax \$2.9 M

- I-70 \$6.6 M

- 19th Street \$2.2 M

- SB Off-Ramp to Gun Club \$3.3 M

- Smith Road and Railroad \$6.0 M

Slope Paving Cut Back (\$317k x 4) \$1.3 M

Toll Plaza Retrofit \$1.1 M

Total Cost Quincy - I-70 \$99 M

Note: E-470 widening between Quincy and I-70 is currently in the construction phase. This budgetary estimate was not modified, since construction is not complete. However, **Table 6, Mainline Improvement Summary**, in the report narrative reflects the \$57M bid price as it is the most recent estimate for this project per the E-470 finance department.

Number	Length	Width	Unit Cost	Total Cost
2	430	34	\$210.00	\$6,140,400.00
2	250	34	\$170.00	\$2,890,000.00
2	250	34	\$170.00	\$2,890,000.00
2	460	34	\$210.00	\$6,568,800.00
2	190	34	\$170.00	\$2,196,400.00
2	280	34	\$170.00	\$3,236,800.00
2	415	34	\$210.00	\$5,926,200.00

2 I-70 - Peña: 6 Lanes

7.5 Miles at \$9.5M/mile * \$71.3 M

Add Special Structures Bridges **

Slope Paving Cut Back (\$317k x 4) \$1.3 M

Toll Plaza Retrofit \$1.1 M

Total Cost I-70 - Peña \$74 M**3 Peña - I-76: 6 Lanes**

7.5 Miles at \$9.5M/mile * \$71.3 M

Add Special Structures Bridges **

- Peña \$6.5 M

- I-76 \$10.0 M

- Burlington Ditch \$2.6 M

- Buckley Road \$2.4 M

- O'Brien Canal \$2.6 M

- 120th Avenue \$3.6 M

Slope Paving Cut Back (\$317K x 5) \$1.6 M

Toll Plaza Retrofit \$1.1 M

Total Cost Peña - I-76 \$102 M

Number	Length	Width	Unit Cost	Total Cost
2	450	34	\$210.00	\$6,426,000.00
2	700	34	\$210.00	\$9,996,000.00
2	220	34	\$170.00	\$2,543,200.00
2	200	34	\$170.00	\$2,312,000.00
2	220	34	\$170.00	\$2,543,200.00
2	310	34	\$170.00	\$3,583,600.00

4 I-25 (S) - Parker: 6 Lanes

5.5 miles widening to the inside

Detailed Cost Estimate *** \$18 M

(Includes Toll Plaza Retrofit)

5 Parker - Smoky Hill: 8 Lanes

5.25 miles paving only at \$2.8M/mile **** \$14.7 M

Ramp Reconfiguration

- Gartrell \$0.6 M

- Smoky Hill \$0.6 M

Total Cost Parker - Smoky Hill \$16 M

6 Smoky Hill - I-70: 8 Lanes

9.5 miles paving only at \$2.8M/mile ****	\$26.6 M
Ramp Reconfiguration	
- Quincy Avenue	\$0.6 M
- Jewell Avenue	\$0.6 M
- 6th Avenue	\$0.6 M
Total Cost Smoky Hill - I-70	\$28 M

7 I-76 - US 85: 6 Lanes

2.5 Miles at \$9.5M/mile *	\$26.6 M
Add Special Structures Bridges **	
- US 85	\$11.1 M
- Second Creek	\$3.1 M
Slope Paving Cut Back (\$317k x 1)	\$0.4 M
Total Cost I-76 - US 85	\$41 M

Number	Length	Width	Unit Cost	Total Cost
2	775	34	\$210.00	\$11,067,000.00
2	260	34	\$170.00	\$3,005,600.00

8 US 85 - I-25 (N): 6 Lanes

8.5 Miles at \$9.5M/mile *	\$80.8 M
Add Special Structures Bridges **	
- S Platte	\$12.8 M
- Cloverdale	\$3.4 M
- Holly	\$2.9 M
- York	\$3.2 M
- Irrigation Channel North of York	\$3.4 M
Slope Paving Cut Back (\$317k x 3)	\$1.0 M
Toll Plaza Retrofit	\$1.1 M
Total Cost US 85 - I-25 (N)	\$109 M

Number	Length	Width	Unit Cost	Total Cost
2	895	34	\$210.00	\$12,780,600.00
2	290	34	\$170.00	\$3,352,400.00
2	250	34	\$170.00	\$2,890,000.00
2	270	34	\$170.00	\$3,121,200.00
2	290	34	\$170.00	\$3,352,400.00

9 Peña - I-76: 8 Lanes

7.5 miles paving only at \$2.8M/mile ****	\$21.0 M
Ramp Reconfiguration	
- 96th Avenue	\$1.1 M
- 104th Avenue	\$0.6 M
- 120th Avenue	\$0.6 M
Total Cost Peña - I-76	\$23 M

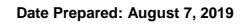
* Per mile cost is based on 2013 detailed estimate done for similar widening from Quincy to I-70 with structures and toll plaza modifications removed. Cost per mile was inflated to 2017 dollars using the latest US government CPI data (Cumulative rate of inflation 5.1%). Costs per mile were then inflated to 2019 dollars using the latest US Government CIP data (Cumulative rate of inflation 5.5%). Costs included capital construction, engineering, and contingencies.

** Structures to be widened to the full 4 lane width.

*** Unique widening to the inside. See detailed cost estimate "E-470 - I-25 to Parker Inside Widening" for cost calculation.

**** Cost per mile for 4th lane widening determined by detailed cost estimate. See detailed cost estimate "6-8 Lane Widening" for per mile cost calculation.

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Item		Unit	Unit Cost	Quantity	Extended Cost	Notes
1	Clearing and Grubbing	AC	\$5,000.00		\$0	Includes 7% Shrinkage and fluff factor based on typical sections based on typical sections 6" depth Crusher fines
2	Removal of Asphalt Mat	SY	\$9.00	21,511	\$193,599	
3	Earthwork (Embankment Material)	CY	\$12.00	0	\$0	
4	Pavement - Hot Mix Asphalt	Ton	\$85.00	50,000	\$4,250,000	
5	ABC (Class 6)	Ton	\$27.00	47,000	\$1,269,000	
6	Curb and Gutter	LF	\$30.00		\$0	
7	Sidewalk	SY	\$60.00		\$0	
8	Trail	SY	\$15.00		\$0	
9	Bridge - Roadway	SF	\$143.00		\$0	
ROADWAY AND BRIDGE SUB-TOTAL					\$5,712,599	
					\$5,712,599	
		% Range		% Used	Cost	
Project Construction Bid Items		Project Dependent		N / A	\$5,712,599	(A)
Contingencies		(10 - 30%) of (A)		30.0%	\$1,713,780	(B)
Minor Construction Revisions		(10 - 30%) of (A)		15.0%	\$856,890	(C)
Irrigation		(1 - 2%) of (A)		0.0%	\$0	(D)
Erosion Control		(2 - 5%) of (A)		5.0%	\$285,630	(E)
Environmental Mitigation		(1 - 5%) of (A)		5.0%	\$285,630	(F)
Signing and Striping		(1 - 5%) of (A)		5.0%	\$285,630	(G)
Construction Signing & Traffic Control		(2 - 20%) of (A)		10.0%	\$571,260	(H)
Lighting		(1 - 5%) of (A)		5.0%	\$285,630	(I)
Landscape		(1 - 20%) of (A)		5.0%	\$285,630	(J)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J)		10.0%	\$1,028,268	(K)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K)					\$11,311,000	(L)
Engineering and Construction						
Not Used						(M)
Design Engineering		10% of (L)		10.0%	\$1,131,100	(N)
Construction Engineering		15% of (L)		15.0%	\$1,696,650	(O)
Total Engineering and Construction (N+O)					\$2,828,000	(P)
Right of Way						
	Pay Unit	Unit Cost	Quantity			
Right-of-Way and Easements	AC	Varies	Varies		\$0	(Q)
Total ROW (Q)					\$0	(R)
Total Project Cost (L+P+R)					\$14,139,000	
Cost/MILE (L+P+R)					\$2,827,800	
Opinion of Probable Construction Costs						
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.						

E-470- I-25 to Parker Inside Widening

Opinion of Probable Construction Costs

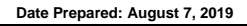
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Date Prepared: August 7, 2019

Item		Unit	Unit Cost	Quantity	Extended Cost	Notes
1	Toll Plaza Retrofit	AC	\$350,000.00	1	\$350,000	Includes 7% Shrinkage and fluff factor 11" Asphalt 12" ABC or CTS 6" depth Crusher fines
2	Removal of Asphalt Mat	SY	\$9.00	21,511	\$193,599	
3	Earthwork (Embankment Material)	CY	\$12.00	145,006	\$1,740,077	
4	Pavement - Hot Mix Asphalt	Ton	\$85.00	50,000	\$4,250,000	
5	ABC (Class 6)	Ton	\$27.00	47,000	\$1,269,000	
6	Curb and Gutter	LF	\$30.00		\$0	
7	Sidewalk	SY	\$60.00		\$0	
8	Trail	SY	\$15.00		\$0	
9	Bridge - Roadway	SF	\$143.00		\$0	
ROADWAY AND BRIDGE SUB-TOTAL					\$7,802,676	
					\$7,802,676	
			% Range	% Used	Cost	
Project Construction Bid Items			Project Dependent	N / A	\$7,802,676	(A)
Contingencies			(10 - 30%) of (A)	30.0%	\$2,340,803	(B)
Minor Construction Revisions			(10 - 30%) of (A)	15.0%	\$1,170,401	(C)
Irrigation			(1 - 2%) of (A)	0.0%	\$0	(D)
Erosion Control			(2 - 5%) of (A)	5.0%	\$390,134	(E)
Environmental Mitigation			(1 - 5%) of (A)	5.0%	\$390,134	(F)
Signing and Striping			(1 - 5%) of (A)	5.0%	\$390,134	(G)
Construction Signing & Traffic Control			(2 - 20%) of (A)	10.0%	\$780,268	(H)
Lighting			(1 - 5%) of (A)	5.0%	\$390,134	(I)
Landscape			(1 - 20%) of (A)	5.0%	\$390,134	(J)
Mobilization			(4 - 20%) of (A+B+C+D+E+F+G+H+I+J)	10.0%	\$1,404,482	(K)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K)					\$15,449,000	(L)
Engineering and Construction						
Not Used						(M)
Design Engineering			10% of (L)	10.0%	\$1,544,900	(N)
Construction Engineering			15% of (L)	15.0%	\$2,317,350	(O)
Total Engineering and Construction (N+O)					\$2,317,000	(P)
Right of Way						
		Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements		AC	Varies	Varies		\$0 (Q)
Total ROW (Q)						\$0 (R)
Total Project Cost (L+P+R)						\$17,766,000
Opinion of Probable Construction Costs						
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.						

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Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	based on typical sections based on typical sections 6" depth
2 Removal of Asphalt Mat	SY	\$9.00	4,500	\$40,500	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	4,000	\$340,000	
4 ABC (Class 6)	Ton	\$27.00	2,000	\$54,000	
5 Curb and Gutter	LF	\$30.00	1,500	\$45,000	
6 Sidewalk	SY	\$60.00	1,000	\$60,000	
ROADWAY AND BRIDGE SUB-TOTAL				\$544,500	
				\$544,500	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$544,500	(A)
Earthwork		(1 - 5%) of (A)	2.0%	\$10,890	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$163,350	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$81,675	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$27,225	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$27,225	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$27,225	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$54,450	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$27,225	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$27,225	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$99,099	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$1,090,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$109,000	(O)
Construction Engineering		15% of (M)	15.0%	\$163,500	(P)
Total Engineering and Construction (O+P)				\$273,000	(Q)
Traffic Signal					
	Pay Unit	Unit Cost	Quantity		
Traffic Signal Reset	EA	\$250,000.00	1		\$250,000 (R)
Total Traffic Signal (R)				\$250,000	(S)
Total Project Cost (M+Q+S)				\$1,613,000	
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

York St

Opinion of Probable Construction Costs

DRAFT



Date Prepared: June 10, 2020

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	6" depth
Removal of Concrete Pavement	SY	\$25.00	1,750	\$43,750	
2 Removal of Asphalt Mat	SY	\$9.00	750	\$6,750	
1 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,600	\$221,000	
3 ABC (Class 6)	Ton	\$27.00	2,250	\$60,750	
2 Pavement - Concrete	SY	\$45.00	1,500	\$67,500	
4 Curb and Gutter	LF	\$30.00	600	\$18,000	
3 Sidewalk	SY	\$60.00	700	\$42,000	
5 Signalization	LS	\$500,000.00	1	\$500,000	
ROADWAY AND BRIDGE SUB-TOTAL				\$964,750	
				\$964,750	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$964,750	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$48,238	(B)
Contingencies		(10 - 30%) of (A)	25.0%	\$241,188	(C)
Minor Construction Revisions		(10 - 30%) of (A)	10.0%	\$96,475	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$48,238	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$48,238	(G)
Signing and Striping		(1 - 5%) of (A)	3.0%	\$28,943	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$96,475	(I)
Lighting		(1 - 5%) of (A)	3.0%	\$28,943	(J)
Landscape		(1 - 20%) of (A)	10.0%	\$96,475	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	15.0%	\$254,694	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$1,953,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$195,300	(O)
Construction Engineering		15% of (M)	15.0%	\$292,950	(P)
Total Engineering and Construction (O+P)				\$488,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)					\$0 (S)
Total Project Cost (M+Q+S)					\$2,441,000
Opinion of Probable Construction Costs					
<p>In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.</p>					

Colorado Blvd

Opinion of Probable Construction Costs

DRAFT



Date Prepared: August 7, 2019

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	
2 Removal of Asphalt Mat	SY	\$9.00	5,000	\$45,000	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,200	\$187,000	based on typical sections
4 ABC (Class 6)	Ton	\$27.00	780	\$21,060	based on typical sections
5 Curb and Gutter	LF	\$30.00	900	\$27,000	
6 Sidewalk	SY	\$60.00	1,512	\$90,720	6" depth
7 Bridge - Roadway	SF	\$143.00	6,780	\$969,540	
ROADWAY AND BRIDGE SUB-TOTAL				\$1,345,320	
				\$1,345,320	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$1,345,320	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$67,266	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$403,596	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$201,798	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$67,266	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$67,266	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$67,266	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$134,532	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$67,266	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$67,266	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$248,884	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$2,738,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$273,800	(O)
Construction Engineering		15% of (M)	15.0%	\$410,700	(P)
Total Engineering and Construction (O+P)				\$685,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)					\$0 (S)
Total Project Cost (M+Q+S)					\$3,423,000
Opinion of Probable Construction Costs					
<p>In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.</p>					

Quebec

Opinion of Probable Construction Costs

DRAFT



Date Prepared: June 3, 2020

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	
2 Removal of Asphalt Mat	SY	\$9.00	5,000	\$45,000	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,600	\$221,000	based on typical sections
4 ABC (Class 6)	Ton	\$27.00	1,000	\$27,000	based on typical sections
5 Curb and Gutter	LF	\$30.00	900	\$27,000	
6 Sidewalk	SY	\$60.00	155	\$9,280	6" depth
7 Bridge - Roadway	SF	\$143.00	10,208	\$1,459,744	
8 Signalization	LS	\$500,000.00	1	\$500,000	
ROADWAY AND BRIDGE SUB-TOTAL				\$2,294,024	
				\$2,294,024	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$2,294,024	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$114,701	(B)
Contingencies		(10 - 30%) of (A)	20.0%	\$458,805	(C)
Minor Construction Revisions		(10 - 30%) of (A)	10.0%	\$229,402	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$114,701	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$114,701	(G)
Signing and Striping		(1 - 5%) of (A)	3.0%	\$68,821	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$229,402	(I)
Lighting		(1 - 5%) of (A)	1.0%	\$22,940	(J)
Landscape		(1 - 20%) of (A)	1.0%	\$22,940	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	5.0%	\$183,522	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$3,854,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$385,400	(O)
Construction Engineering		10% of (M)	10.0%	\$385,400	(P)
Total Engineering and Construction (O+P)				\$771,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)					\$0 (S)
Total Project Cost (M+Q+S)					\$4,625,000
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

PEÑA

Opinion of Probable Construction Costs

DRAFT



Date Prepared: August 7, 2019

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	5	\$25,000	
2 Removal of Asphalt Mat	SY	\$9.00	2,500	\$22,500	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	17,770	\$1,510,450	based on typical sections
4 ABC (Class 6)	Ton	\$27.00	15,755	\$425,385	based on typical sections
5 Curb and Gutter	LF	\$30.00		\$0	
6 Sidewalk	SY	\$60.00		\$0	6" depth
7 Wall	SF	\$200.00	8,000	\$1,600,000	
8 Bridge - Roadway	SF	\$200.00	20,140	\$4,028,000	
ROADWAY AND BRIDGE SUB-TOTAL				\$7,611,335	
				\$7,611,335	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$7,611,335	(A)
Earthwork		(10%) of (A)	10.0%	\$761,134	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$2,283,401	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$1,141,700	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$380,567	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$380,567	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$380,567	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$761,134	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$380,567	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$380,567	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K+L)	10.0%	\$1,446,154	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$15,908,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$1,590,800	(O)
Construction Engineering		15% of (M)	15.0%	\$2,386,200	(P)
Total Engineering and Construction (O+P)				\$3,977,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies	\$0	(R)
Total ROW (R)				\$0	(S)
Total Project Cost (M+Q+S)				\$19,885,000	
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

64th Ave

Opinion of Probable Construction Costs

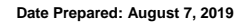
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Date Prepared: June 3, 2020

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Removal of Asphalt Mat	SY	\$9.00	1,920	\$17,280	
2 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,160	\$183,600	
3 ABC (Class 6)	Ton	\$27.00	1,600	\$43,200	based on typical sections
4 Curb and Gutter	LF	\$30.00	1,730	\$51,900	based on typical sections
5 Curb, Gutter, and Sidewalk	LF	\$90.00	1,785	\$160,650	
6 Median Cover Material	SF	\$10.00	14,750	\$147,500	6" depth
7 Guardrail	LF	\$70.00	265	\$18,550	
8 Bridge - Roadway	SF	\$200.00	16,750	\$3,350,000	
9 Signalization	LS	\$750,000.00	1	\$750,000	
ROADWAY AND BRIDGE SUB-TOTAL				\$4,722,680	
				\$4,722,680	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$4,722,680	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$236,134	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$1,416,804	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$708,402	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$236,134	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$236,134	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$236,134	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$472,268	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$236,134	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$236,134	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$873,696	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$9,611,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$961,100	(O)
Construction Engineering		15% of (M)	15.0%	\$1,441,650	(P)
Total Engineering and Construction (O+P)				\$2,403,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)					\$0 (S)
Total Project Cost (M+Q+S)					\$12,014,000
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

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Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	based on typical sections based on typical sections 6" depth
2 Removal of Asphalt Mat	SY	\$9.00	5,000	\$45,000	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,300	\$195,500	
4 ABC (Class 6)	Ton	\$27.00	850	\$22,950	
5 Curb and Gutter	LF	\$30.00	925	\$27,750	
6 Sidewalk	SY	\$60.00	175	\$10,480	
7 Bridge - Roadway	SF	\$143.00	8,908	\$1,273,844	
ROADWAY AND BRIDGE SUB-TOTAL				\$1,580,524	
				\$1,580,524	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$1,580,524	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$79,026	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$474,157	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$237,079	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$79,026	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$79,026	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$79,026	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$158,052	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$79,026	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$79,026	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$292,397	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$3,216,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$321,600	(O)
Construction Engineering		15% of (M)	15.0%	\$482,400	(P)
Total Engineering and Construction (O+P)				\$804,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)				\$0	(S)
Total Project Cost (M+Q+S)				\$4,020,000	
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Henckdrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

Jewell Ave

Opinion of Probable Construction Costs

DRAFT



Date Prepared: August 7, 2019

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	
2 Removal of Asphalt Mat	SY	\$9.00	5,000	\$45,000	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,300	\$195,500	based on typical sections
4 ABC (Class 6)	Ton	\$27.00	850	\$22,950	based on typical sections
5 Curb and Gutter	LF	\$30.00	925	\$27,750	
6 Sidewalk	SY	\$60.00	175	\$10,480	6" depth
7 Bridge - Roadway	SF	\$143.00	8,908	\$1,273,844	
ROADWAY AND BRIDGE SUB-TOTAL				\$1,580,524	
				\$1,580,524	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$1,580,524	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$79,026	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$474,157	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$237,079	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$79,026	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$79,026	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$79,026	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$158,052	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$79,026	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$79,026	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$292,397	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$3,216,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$321,600	(O)
Construction Engineering		15% of (M)	15.0%	\$482,400	(P)
Total Engineering and Construction (O+P)				\$804,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)					\$0 (S)
Total Project Cost (M+Q+S)					\$4,020,000
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

Gartrell Rd

Opinion of Probable Construction Costs

DRAFT



Date Prepared: June 3, 2020

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	
2 Removal of Asphalt Mat	SY	\$9.00	5,000	\$45,000	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,700	\$229,500	based on typical sections
4 ABC (Class 6)	Ton	\$27.00	1,050	\$28,350	based on typical sections
5 Curb and Gutter	LF	\$30.00	950	\$28,500	
6 Sidewalk	SY	\$60.00	177	\$10,600	6" depth
7 Bridge - Roadway	SF	\$243.00	12,190	\$2,962,170	
8 Signalization	LS	\$1,000,000.00	1	\$1,000,000	
ROADWAY AND BRIDGE SUB-TOTAL				\$4,309,120	
				\$4,309,120	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$4,309,120	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$215,456	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$1,292,736	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$646,368	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$215,456	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$215,456	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$215,456	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	15.0%	\$646,368	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$215,456	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$215,456	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$818,733	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$9,006,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$900,600	(O)
Construction Engineering		15% of (M)	15.0%	\$1,350,900	(P)
Total Engineering and Construction (O+P)				\$2,252,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)					\$0 (S)
Total Project Cost (M+Q+S)					\$11,258,000
Opinion of Probable Construction Costs					
<p>In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.</p>					

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Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	based on typical sections based on typical sections 6" depth
2 Removal of Asphalt Mat	SY	\$9.00	500	\$4,500	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	600	\$51,000	
4 ABC (Class 6)	Ton	\$27.00	300	\$8,100	
5 Curb and Gutter	LF	\$30.00	1,200	\$36,000	
6 Sidewalk	SY	\$60.00	800	\$48,000	
ROADWAY AND BRIDGE SUB-TOTAL				\$152,600	
				\$152,600	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$152,600	(A)
Earthwork		(1 - 5%) of (A)	2.0%	\$3,052	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$45,780	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$22,890	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$7,630	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$7,630	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$7,630	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$15,260	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$7,630	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$7,630	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$27,773	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$306,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$30,600	(O)
Construction Engineering		15% of (M)	15.0%	\$45,900	(P)
Total Engineering and Construction (O+P)				\$31,000	(Q)
Traffic Signals					
	Pay Unit	Unit Cost	Quantity		
Traffic Signal Reset	EA	\$250,000.00	1		\$250,000 (R)
Total Traffic Signals (R)				\$250,000	(S)
Total Project Cost (M+Q+S)				\$587,000	
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

Chambers

Opinion of Probable Construction Costs

DRAFT



Date Prepared: August 7, 2019

Item	Unit	Unit Cost	Quantity	Extended Cost	Notes
1 Clearing and Grubbing	AC	\$5,000.00	1	\$5,000	
2 Removal of Asphalt Mat	SY	\$9.00	5,000	\$45,000	
3 Pavement - Hot Mix Asphalt	Ton	\$85.00	2,250	\$191,250	based on typical sections
4 ABC (Class 6)	Ton	\$27.00	845	\$22,815	based on typical sections
5 Curb and Gutter	LF	\$30.00	1,050	\$31,500	
6 Sidewalk	SY	\$60.00	204	\$12,240	6" depth
7 Bridge - Roadway	SF	\$143.00	10,404	\$1,487,772	
ROADWAY AND BRIDGE SUB-TOTAL				\$1,795,577	
				\$1,795,577	
		% Range	% Used	Cost	
Project Construction Bid Items		Project Dependent	N / A	\$1,795,577	(A)
Earthwork		(1 - 5%) of (A)	5.0%	\$89,779	(B)
Contingencies		(10 - 30%) of (A)	30.0%	\$538,673	(C)
Minor Construction Revisions		(10 - 30%) of (A)	15.0%	\$269,337	(D)
Irrigation		(1 - 2%) of (A)	0.0%	\$0	(E)
Erosion Control		(2 - 5%) of (A)	5.0%	\$89,779	(F)
Environmental Mitigation		(1 - 5%) of (A)	5.0%	\$89,779	(G)
Signing and Striping		(1 - 5%) of (A)	5.0%	\$89,779	(H)
Construction Signing & Traffic Control		(2 - 20%) of (A)	10.0%	\$179,558	(I)
Lighting		(1 - 5%) of (A)	5.0%	\$89,779	(J)
Landscape		(1 - 20%) of (A)	5.0%	\$89,779	(K)
Mobilization		(4 - 20%) of (A+B+C+D+E+F+G+H+I+J+K)	10.0%	\$332,182	(L)
Total of Construction Bid Items (A+B+C+D+E+F+G+H+I+J+K+L)				\$3,654,000	(M)
Engineering and Construction					
Not Used					(N)
Design Engineering		10% of (M)	10.0%	\$365,400	(O)
Construction Engineering		15% of (M)	15.0%	\$548,100	(P)
Total Engineering and Construction (O+P)				\$914,000	(Q)
Right of Way					
	Pay Unit	Unit Cost	Quantity		
Right-of-Way and Easements	AC	Varies	Varies		\$0 (R)
Total ROW (R)					\$0 (S)
Total Project Cost (M+Q+S)					\$4,568,000
Opinion of Probable Construction Costs					
In providing opinions of probable construction cost, the Client understands that Short Elliott Hendrickson, Inc. has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. SEH makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.					

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