

CDOT PROJECT IM 0703-294

I-70/32nd AVENUE INTERCHANGE ENVIRONMENTAL ASSESSMENT

TRAFFIC ANALYSIS TECHNICAL REPORT

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LIST OF ABBREVIATIONS AND ACRONYMS

ADT	average daily total
CDOT	Colorado Department of Transportation
DRCOG	Denver Regional Council of Governments
EA	Environmental Assessment
FHU	Felsburg Holt & Ullevig
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
I-70	Interstate 70
LOS	level of service
NEPA	National Environmental Policy Act
pc/mi/ln	passenger cars per mile per lane
RTD	Regional Transportation District
SH 58	State Highway 58
SPF	Safety Performance Function
VHT	vehicle-hours of travel
vpd	vehicles per day

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1.0 INTRODUCTION

In accordance with the National Environmental Policy Act of 1969 (NEPA) and its related regulations, the Federal Highway Administration (FHWA), as the Lead Agency, in cooperation with the Colorado Department of Transportation (CDOT) as the Applicant Agency, is preparing an Environmental Assessment (EA) for proposed improvements to the I-70/32nd Avenue interchange (the Proposed Action) and the surrounding area. The project is sponsored by the City of Wheat Ridge.

Felsburg Holt & Ullevig (FHU), acting on behalf of CDOT and the City of Wheat Ridge, prepared this technical memorandum to describe the traffic analysis conducted as part of the EA. In 2005, the City of Wheat Ridge, in association with CDOT, conducted a System Level Feasibility Study for the I-70/32nd Avenue and I-70/Ward Road interchanges in accordance with CDOT Policy Directive 1601 to address the traffic impacts associated with a nearby development. The development proposal includes approximately 800,000 square feet of commercial and retail use, including the construction of a 225,000 square foot Cabela's store and an additional 575,000 square feet of retail and commercial development. The *I-70/32nd Avenue Interchange System Level Feasibility Study* evaluated numerous alternatives for improvements to the transportation network and was approved by the Colorado Transportation Commission in September 2005.

The *I-70/32nd Avenue Interchange System Feasibility Study* examined alternatives to address the non-standard configuration of the existing I-70/32nd Avenue interchange and to accommodate year 2030 traffic projections, including traffic generated by the proposed development. Alternatives were developed to address operational and safety needs while responding to input from a variety of sources, including FHWA, CDOT, Jefferson County, City of Wheat Ridge, City of Lakewood, homeowners' associations, and the public. As some alternatives were screened during the process, others were added as the analyses provided additional insights to potential solutions. Three levels of screening resulted in three alternative packages of improvements for further consideration as part of the EA. The purpose of this *Traffic Analysis Technical Memorandum* is to document the traffic analyses conducted for the three alternative packages and the No-Action alternative which have been used, in conjunction with other screening criteria, to establish the Proposed Action.

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2.0 EXISTING CONDITIONS

2.1 Traffic Volumes

Morning and afternoon peak hour turning movement data were recorded at numerous study area intersections. Twenty-four hour counts were also collected at selected locations in the study area, and other daily traffic data were obtained from CDOT, the City of Wheat Ridge, and Jefferson County websites. These data are summarized in **Figure 2-1**.

I-70 carries the highest volume of traffic in the study area, carrying between 81,000 and 105,000 vehicles per day (vpd). SH 58 carries as much as 28,000 vpd. Other than the two freeway facilities, Ward Road, Youngfield Street and 32nd Avenue carry the highest volumes of traffic. Sections of each of these facilities carry over 20,000 vpd; Ward Road carries approximately 40,000 vpd.

The peak hour directional volumes on I-70 show a predominant westbound travel pattern during the AM peak hour and a predominant eastbound travel pattern during the PM peak hour. On SH 58, the eastbound traffic is heavier than westbound traffic during both the AM and PM peak hours. A general review of peak hour traffic reveals that PM peak hour traffic is generally heavier than the AM peak hour traffic (both directions combined).

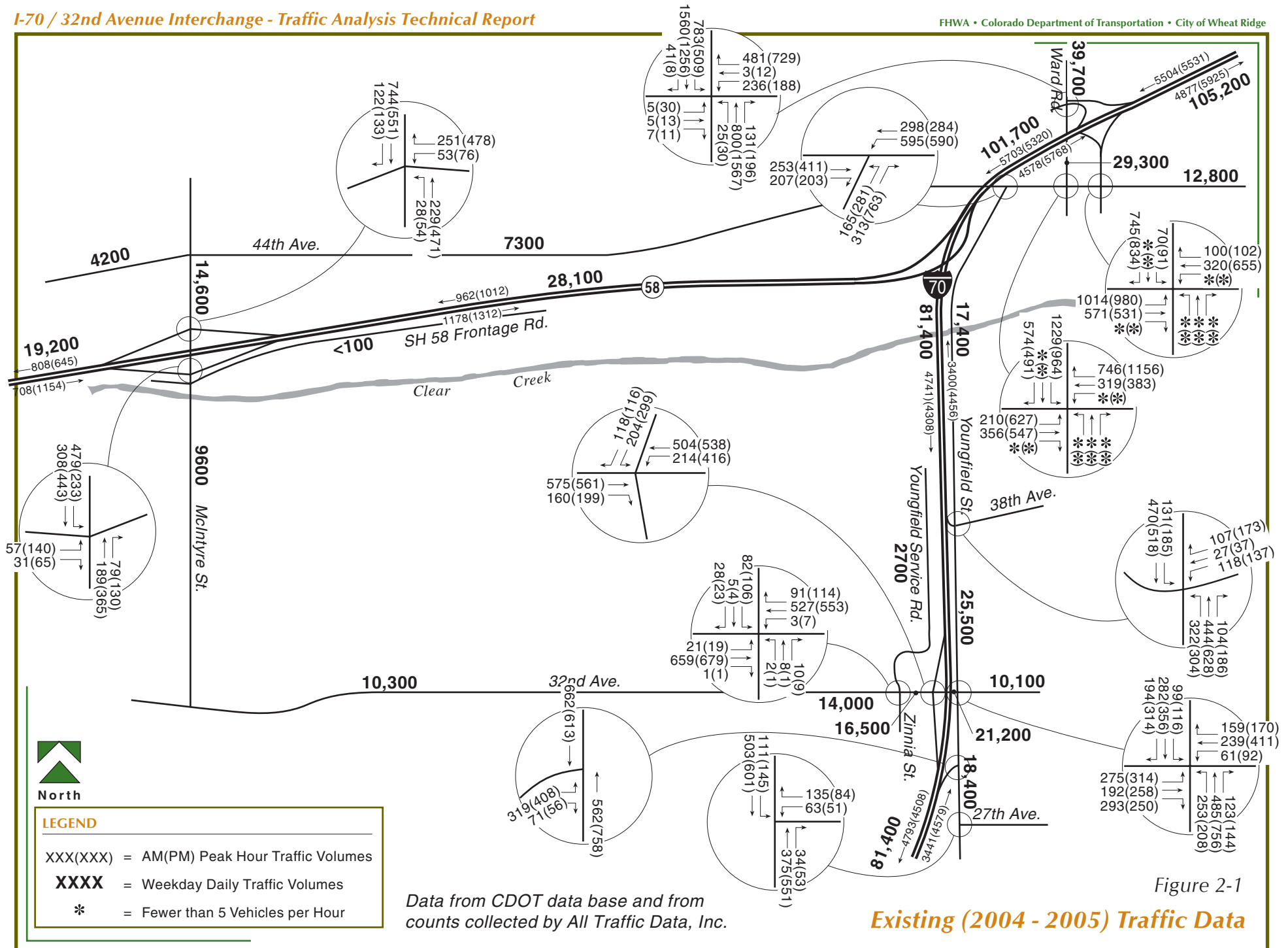
At the I-70/32nd Avenue interchange, about two-thirds of interchange traffic is oriented to/from the east side of I-70 and one-third is to/from the west. A notable component of the one-third to/from the west is traffic associated with McIntyre Street to/from the north of SH 58. With the lack of ramp connection between SH 58 and I-70 west, traffic is forced to use McIntyre Street and 32nd Avenue to serve this pattern.

2.2 Traffic Operations

Level of service (LOS) is a qualitative measure of operating characteristics at an intersection or along a stretch of highway based on the roadway capacity and motorist delay. The 2000 Highway Capacity Manual defines six levels of service, ranging from A to F, with LOS A representing the best possible operating conditions and LOS F representing over-capacity, or congested conditions. In urbanized areas, LOS D is generally considered to be acceptable for peak hour traffic operations. LOS calculations were performed for the study area freeway system and for the key arterial intersections.

2.2.1 Freeway Analysis

The analysis method described in the *Highway Capacity Manual* was used to analyze the operation of the I-70 and SH 58 mainline, as well as the merge, diverge and weave areas at the interchanges throughout the study area. The freeway facility analysis module of the Highway Capacity Software has been used in this analysis; this methodology accounts for the queuing from one segment to another in oversaturated freeway conditions and the metering that results from bottleneck conditions. The resulting LOSs are shown on **Figure 2-2**.



Data from CDOT data base and from counts collected by All Traffic Data, Inc.

Figure 2-1
Existing (2004 - 2005) Traffic Data

The merge/diverge area is the space where vehicles enter or exit the freeway. Studies indicate that operational impacts are greatest within 1,500 feet upstream of an off-ramp and 1,500 feet downstream of an on-ramp. For right side on and off-ramps, the two lanes farthest to the right are the most impacted. The majority of the interchanges in the study area include a merge and diverge in each direction of travel. The merge and diverge areas at the I-70 interchange with 32nd Avenue operate at LOS D or better. The eastbound on-ramp and the westbound off-ramp at the Ward Road interchange have poor levels of service (LOS E) during peak hours due primarily to the heavy mainline traffic flow. All merge and diverge areas along SH 58 operate at LOS B or better during the peak hours.

A freeway weaving section is formed when an on-ramp is closely followed by an off-ramp (2,500 feet or less). When the distance exceeds 2,500 feet, the merge/diverge methodology is typically used for analysis. There are currently two weave sections in the study area; one along eastbound I-70 between the SH 58 and Ward Road interchanges, and one along westbound I-70 between the Ward Road and SH 58 interchanges. Both of these weave sections currently operate at LOS D or better during the peak hours.

A basic freeway segment is a section along a freeway that is not in a merge, diverge or weave area. Analysis of a basic freeway segment is based on the segment's vehicular density. With 0-11 passenger cars per mile per lane (pc/mi/ln), a segment would operate at LOS A. The opposite extreme includes densities that are over 45 pc/mi/ln which represent a LOS F, over capacity. I-70 through the study area operates at LOS D or better during the peak times. SH 58 currently operates at LOS B or better during the peak hours.

2.2.2 Intersection Analysis

At signalized intersections, LOS is based on the average delay in seconds per vehicle. LOS A indicates very low levels of intersection delay averaging less than ten seconds per vehicle. LOS F indicates highly congested conditions, with the average driver experiencing more than 80 seconds of delay at the intersection. LOS D, which is the desired minimum LOS, represents an average vehicle delay ranging from 35 and 55 seconds. The overall intersection LOS at a signalized intersection is a weighted average of the delay at each movement.

Interchange cross-street intersection LOSs were calculated from the Synchro/SimTraffic simulation software package which has the ability to incorporate vehicular stacking impacts that can result between closely spaced intersections. This is an advanced feature over the Highway Capacity Manual (HCM) since the HCM procedures calculate an intersection's LOS under isolated conditions, not as part of a system. Three simulation "runs" were conducted using the existing traffic volumes and results were averaged to calculate each intersection's LOS in the study area for the AM and PM peak hours. The existing signal timing was used to simulate the existing intersection operations. The resulting LOSs are shown on **Figure 2-3**.

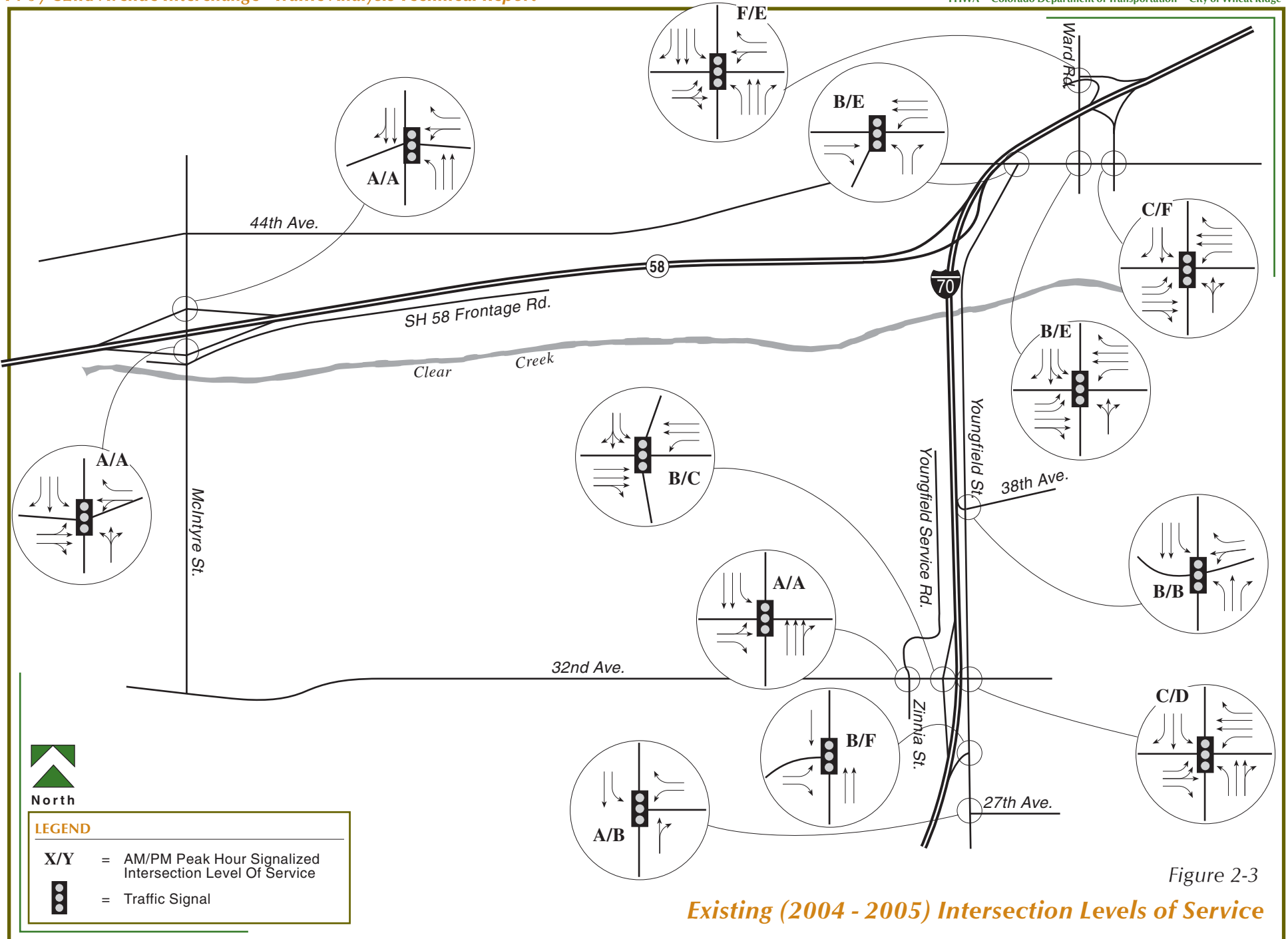


Figure 2-3

Existing (2004 - 2005) Intersection Levels of Service

As shown on **Figure 2-3**, several interchange cross-street intersections in the study area currently operate at poor levels of service (LOS E or F) during the peak hours. Congestion is experienced at the I-70/Ward Road/44th Avenue interchange and the adjacent intersections, as well as at the I-70 eastbound off-ramp intersection onto Youngfield Street. Although the intersections along 32nd Avenue (at Youngfield Street and the I-70 westbound ramps intersections) show overall acceptable levels of service, congestion and queuing are known to occur along certain approaches at these intersections during the peak hour, particularly at the Youngfield Street/32nd Avenue intersection (which is shown to operate at LOS D, nearly an E).

2.3 Accident History

A safety analysis was conducted as part of the System Level Feasibility Study. This effort considered five years of accident data (1999 to 2003) in the area, including the I-70 and SH 58 mainline, ramps and the ramp intersections. The data were provided by CDOT's Safety and Engineering Office; accident data for the intersections were provided by the City of Wheat Ridge and the City of Lakewood.

2.3.1 Freeway Accident History

Between Denver West Boulevard and Ward Road, I-70 experienced 993 accidents within the five-year period including the interchange intersections. Three were fatalities while 237 were injury accidents. The remaining 754 were property damage only accidents. The resulting accident rate for this time period was 1.74 accidents per million vehicle-miles of travel which is below the state average for an urban interstate (2.09 accidents per million vehicle-miles of travel in 2002).

Between McIntyre Street and I-70, SH 58 experienced 56 accidents in five years including the interchanges. None of these were fatalities and 25 were injury-related accidents. The resulting accident rate for this time period was 0.85 accidents per million vehicle-miles of travel which is well below the state average for facilities like SH 58.

Figures 2-4 and 2-5 show the Weighted Hazard Index for I-70 and SH 58. These types of data figures show concentrations of accident experience. As **Figure 2-4** shows, the interchanges are the locations of greatest accident experience. Along I-70, the 32nd Avenue interchange and the Ward Road interchange are both characterized by a spike in the index. Along SH 58, there has been a mild concentration of accidents at the McIntyre Street interchange according to **Figure 2-5**.

Figures 2-6 and 2-7 show the Safety Performance Function diagram for the I-70 and SH 58 segments. These diagrams can be used to gauge a freeway's relative safety in comparison to similar roadway facilities. As these figures show, I-70 and SH 58 show better than expected safety performance for these types of facilities.

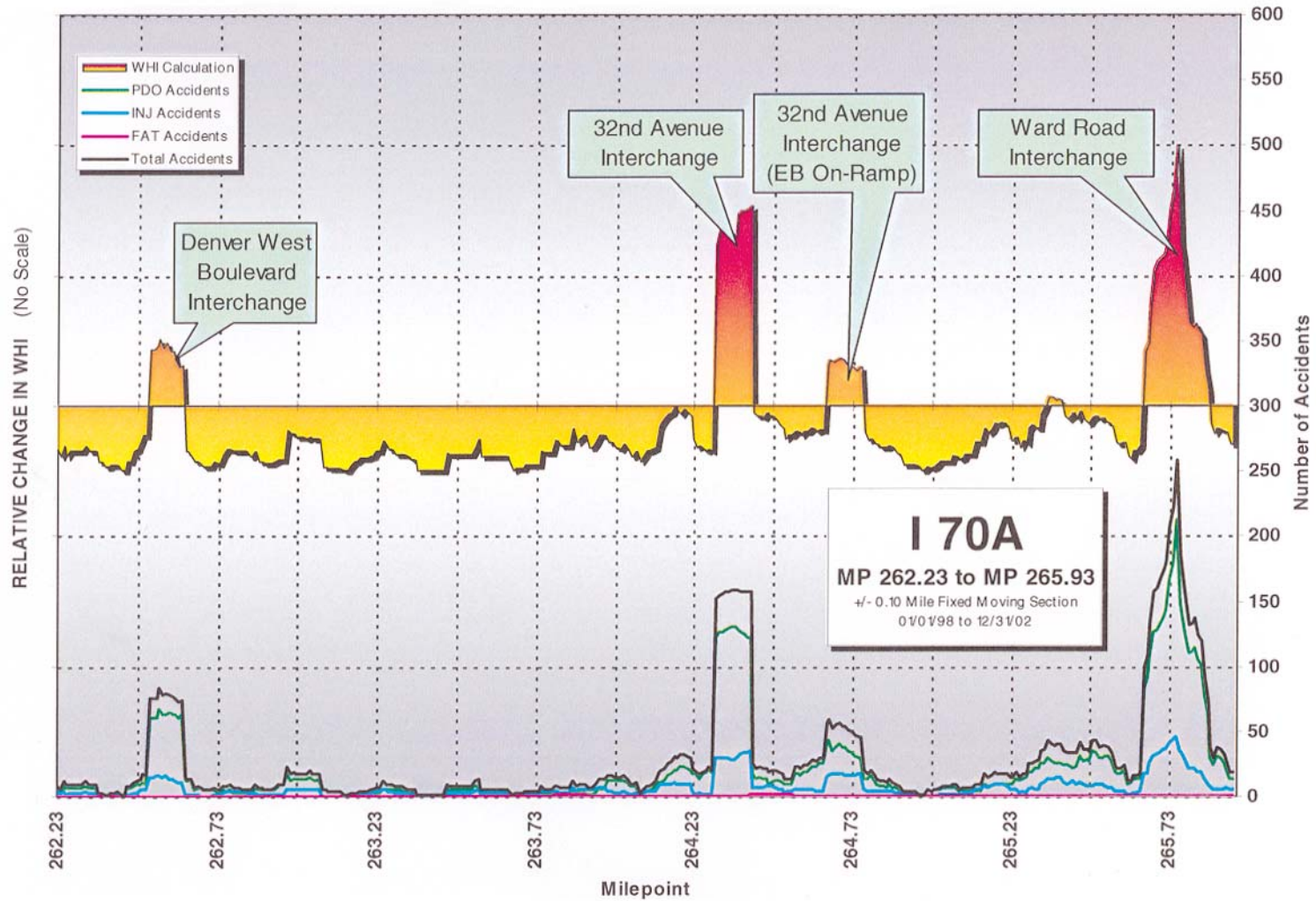


Figure 2-4

I-70 Weighted Hazard Index Diagram

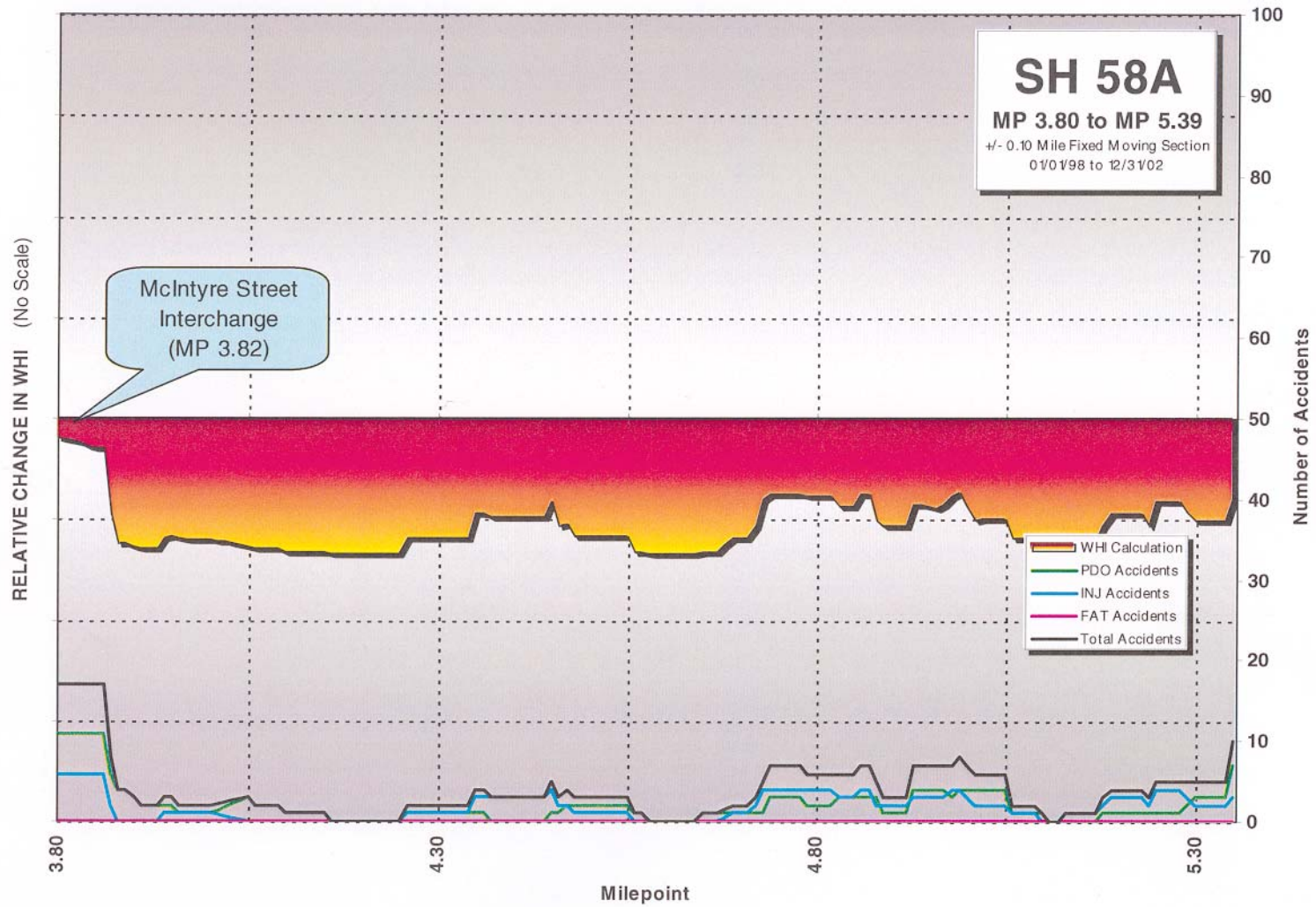


Figure 2-5

SH 58 Weighted Hazard Index Diagram

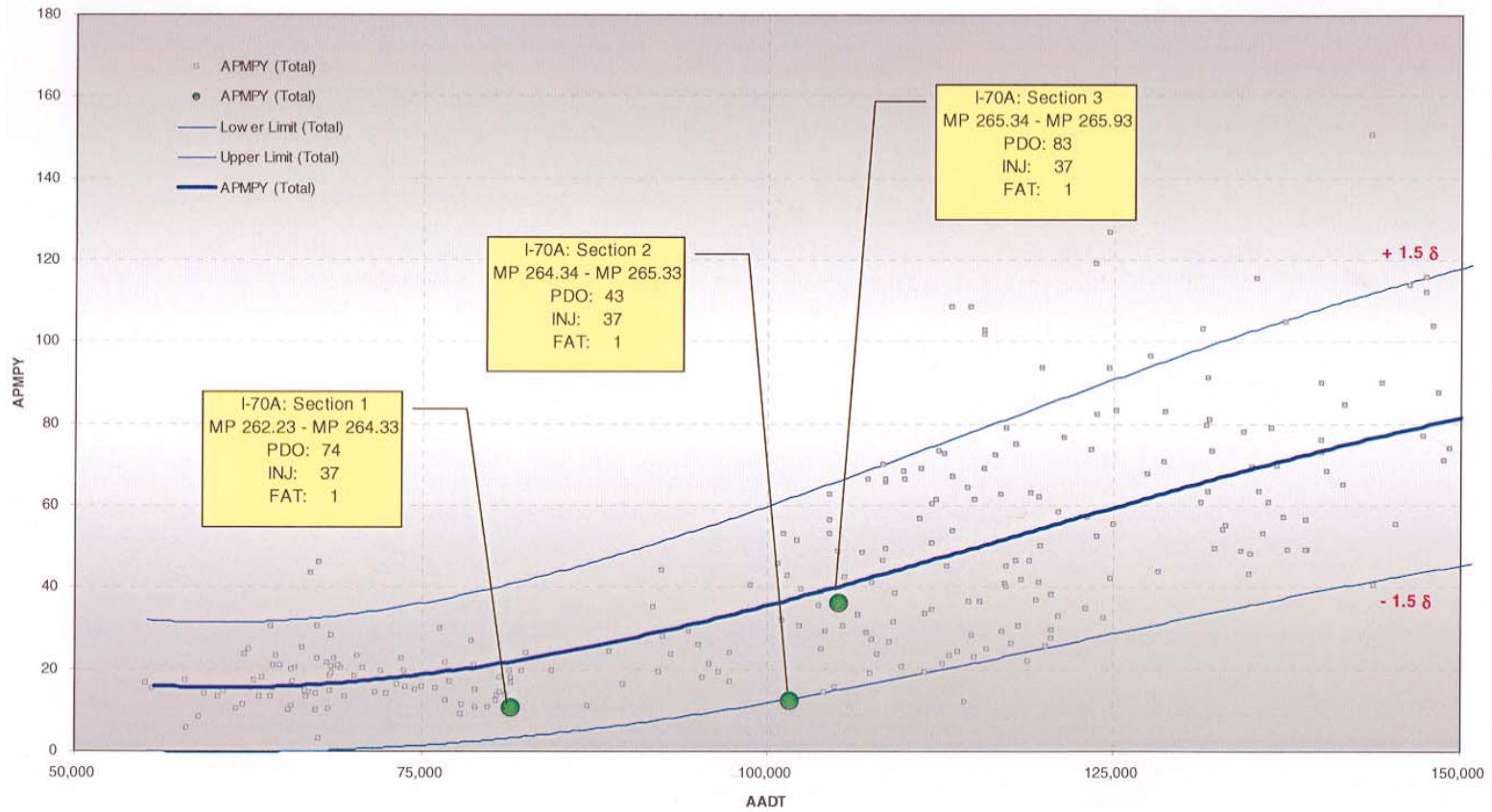


Figure 2-6
Urban 6- Lane Freeway
I-70 Safety Performance Function Diagram

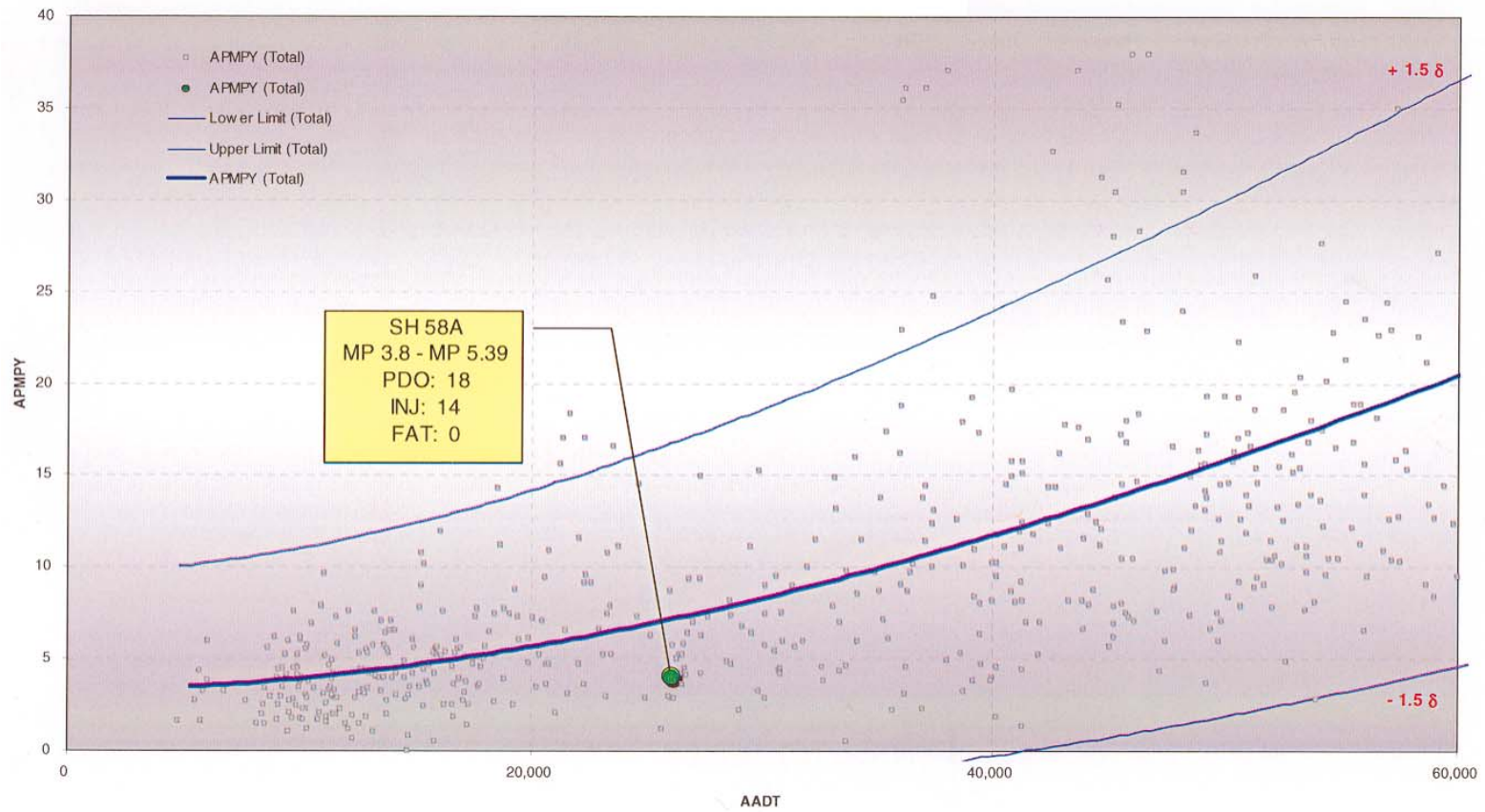


Figure 2-7
**Urban 4 Lane Freeway
SH 58 Safety Performance Function Diagram**

2.3.2 Intersection Accident History

The City of Wheat Ridge and the City of Lakewood provided detailed accident data for the individual intersections in the study area. **Table 2-1** shows the accident experience at the intersections, including the ramp terminal intersections as well as several local intersections in the study area.

Table 2-1 Intersection Accident History

Intersection	Accident Types					Coverage Period
	Rear End	Broadside ¹	Sideswipe	Other	Total	
32 nd Avenue/Youngfield Service Road/Zinnia Street	6	3	0	0	9	4/00 to 7/04
32 nd Avenue/I-70 West Ramps	11	27	13	6	57	1/00 to 10/04
32 nd Avenue/Youngfield Street	54	30	26	7	117	1/00 to 11/04
Youngfield Street/38 th Avenue/I-70 On-Ramp	31	47	9	9	96	2/00 to 10/04
Youngfield Street/I-70 East Off-Ramp	7	4	2	7	20	1/00 to 10/04
44 th Avenue/Youngfield Street	31	31	6	13	81	2/00 to 11/04
44 th Avenue/Ward Road	47	12	23	10	92	1/00 to 10/04
44 th Avenue/I-70 East Ramps	25	9	16	11	61	1/00 to 10/04
Ward Road/I-70 West Ramps	52	8	7	10	77	1/00 to 11/04
27 th Avenue/Youngfield Street	6	3	3	4	16	1/02 to 8/05

¹ Based on Wheat Ridge and Lakewood databases; CDOT's accident recording system may classify some of these accidents as approach turn accidents.

At the I-70/32nd Avenue interchange area, the 32nd Avenue/Youngfield Street intersection experienced the greatest number of accidents given the approximate 57 month data collection period. The Youngfield Street/38th Avenue/I-70 On-Ramp intersection experienced a surprisingly high number of accidents as well. This intersection experienced a disproportionate number of broadside accidents.

At the I-70/Ward Road interchange area, the 44th Avenue/Youngfield Street and 44th Avenue/Ward Road intersections experienced the greatest number of accidents. Rear end collisions were the predominant pattern.

No fatal accidents were recorded in the database provided by Wheat Ridge or Lakewood.

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3.0 FUTURE CONDITIONS

3.1 Traffic Forecasts

3.1.1 No-Action Without Cabela's Shopping Center

Year 2030 forecasted ADT and peak hour volumes for the No-Action alternative without the Cabela's Shopping Center are shown on **Figure 3-1**. These traffic volumes were developed from the DRCOG 2030 regional travel demand model.

As a worst-case scenario, the Northwest Corridor alternative, which includes a freeway facility along SH 93 and US 6 through Golden and McIntyre Street as a four-lane arterial, has been used to develop the No-Action traffic forecasts. As such, this analysis incorporates the latest NW Corridor alternative relative to traffic demands.

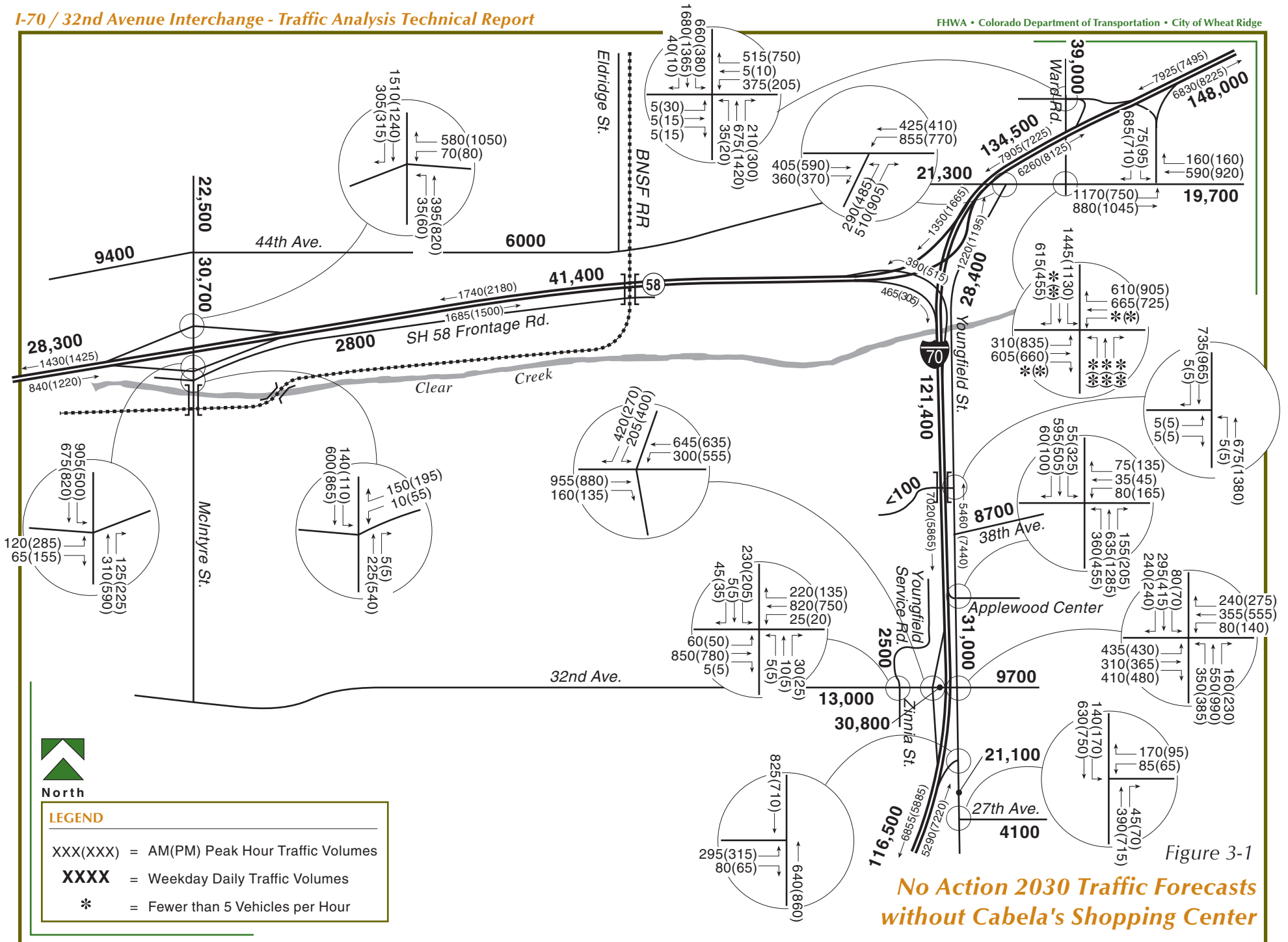
The No-Action roadway network includes the proposed SH 58 to I-70 west ramps. This is part of a CDOT project to enhance the I-70/SH 58 interchange. No-Action also includes the planned widening of Youngfield Street to four lanes between 38th Avenue and 44th Avenue. These improvements are part of the local agency projects that the City of Wheat Ridge is leading.

The daily traffic forecasts generated by the model were used as a starting point in developing 2030 peak hour traffic projections. Calibration of these daily numbers was based on a comparison of the actual 2005 recorded traffic volumes with the results from DRCOG's current-day travel demand model. The 2030 daily volume projections were manually adjusted to reflect observed and anticipated travel patterns in the area.

3.1.2 No-Action

The DRCOG model was updated to include the proposed land use associated with the Cabela's shopping center. Traffic volumes generated by the Cabela's shopping center were estimated from the trip rates and equations published in the Institute of Transportation Engineers' Trip Generation, and from other Cabela's store facilities. As documented in the Cabela's Shopping Center traffic impact study (first edition prepared in January 2005), the Cabela's Shopping Center is expected to generate approximately 24,000 trips per day, with approximately 700 trips during the AM peak hour and 2,200 trips during the PM peak hour. The Cabela's trip generation is based on a 230,000 square foot facility. The proposed store has subsequently been reduced in size to 185,000 square feet; therefore the traffic projections included herein are conservatively high.

Because Cabela's (and retail development in general) attracts a greater number of customers during weekends than weekdays, a review of weekend traffic conditions was conducted to determine if this is a critical time period. The Cabela's Shopping Center is estimated to generate approximately 45 percent more daily traffic during the weekend than the weekday (approximately 35,000 trips per day versus 24,000 trips per day). While the proposed development is expected to generate more traffic during the weekend, the "background" peak hour traffic along the study area roadways is approximately 20 percent less during the weekend. From analysis conducted in the Cabela's Shopping Center traffic impact study, the net effect generally results in lower (10 to 15 percent) weekend peak hour traffic than weekday peak hour traffic flows along most study area roadways. The weekday PM peak hour is the critical time



period when considering the combination of Cabela's related traffic and background traffic along study area roadways. Access to the Cabela's shopping center in the No-Action alternative is via a 40th Avenue underpass connecting into Youngfield Street.

The No-Action (which includes the Cabela's Shopping Center) 2030 traffic forecasts are shown on **Figure 3-2**.

2030 daily traffic projections along I-70 in the No-Action alternative range from 35 to 55 percent higher than existing traffic volumes, and 2030 projections along SH 58 are approximately 50 percent higher. I-70 is projected to carry approximately 121,000 vpd west of the 32nd Avenue interchange and 154,000 vpd east of the Ward Road interchange. SH 58 is projected to carry approximately 42,000 vpd between I-70 and McIntyre Street. 32nd Avenue is expected to see a significant increase in traffic at I-70 carrying approximately 36,600 vpd adjacent to and just west of I-70. Youngfield Street is project to carry between 35,000 and 43,000 vpd in 2030. These increases are due to anticipated regional growth including the addition of the Cabela's shopping center.

3.1.3 Alternative Package #1

The refined DRCOG travel demand model (as described above) was used to establish the 2030 traffic volume shifts that would result for each of the three Alternative Packages. Traffic forecasts for Alternative Package #1 are shown on **Figure 3-3**. Alternative Package #1 includes a single point urban interchange at I-70/32nd Avenue, and additional connections to the proposed Cabela's shopping center from 32nd Avenue (at the Youngfield Service Road) and from McIntyre Street south of Clear Creek. Compared to the No-Action alternative, this alternative would attract more traffic to 32nd Avenue and McIntyre Street, providing significant relief to the planned 40th Avenue underpass and Youngfield Street and slight relief to the I-70/Ward Road interchange.

3.1.4 Alternative Package #2

Alternative Package #2 includes offset hook ramps at the I-70/32nd Avenue interchange and a new intersection along SH 58. The traffic forecasts are provided on **Figure 3-4**. The proposed interchange on SH 58 is estimated to attract additional traffic onto SH 58 west of I-70, resulting in a decrease in volume along I-70 between SH 58 and the 32nd Avenue interchange and through the I-70/32nd Avenue and the I-70/Ward Road interchanges. The new interchange on SH 58 would increase the traffic along 44th Avenue, particularly to the west of the Cabela Drive connection.

The Cabela Drive connection to 32nd Avenue would provide relief to Youngfield Street. The proposed hook ramps at the I-70/32nd Avenue interchange would generate minor shifts in ramp traffic compared to the No-Action roadway network. The traffic demand along 32nd Avenue would decrease given the proposed hook ramps since Cabela's traffic to and from westbound I-70 would not travel 32nd Avenue. In the eastbound direction, with both hook ramps being proposed south of 32nd Avenue, traffic passing through the 32nd Avenue/Youngfield Street intersection is expected to shift orientation slightly (today only the off ramp is south of 32nd Avenue). The location of the eastbound hook ramps would increase traffic on 26th and 27th Avenues east of Youngfield Street.

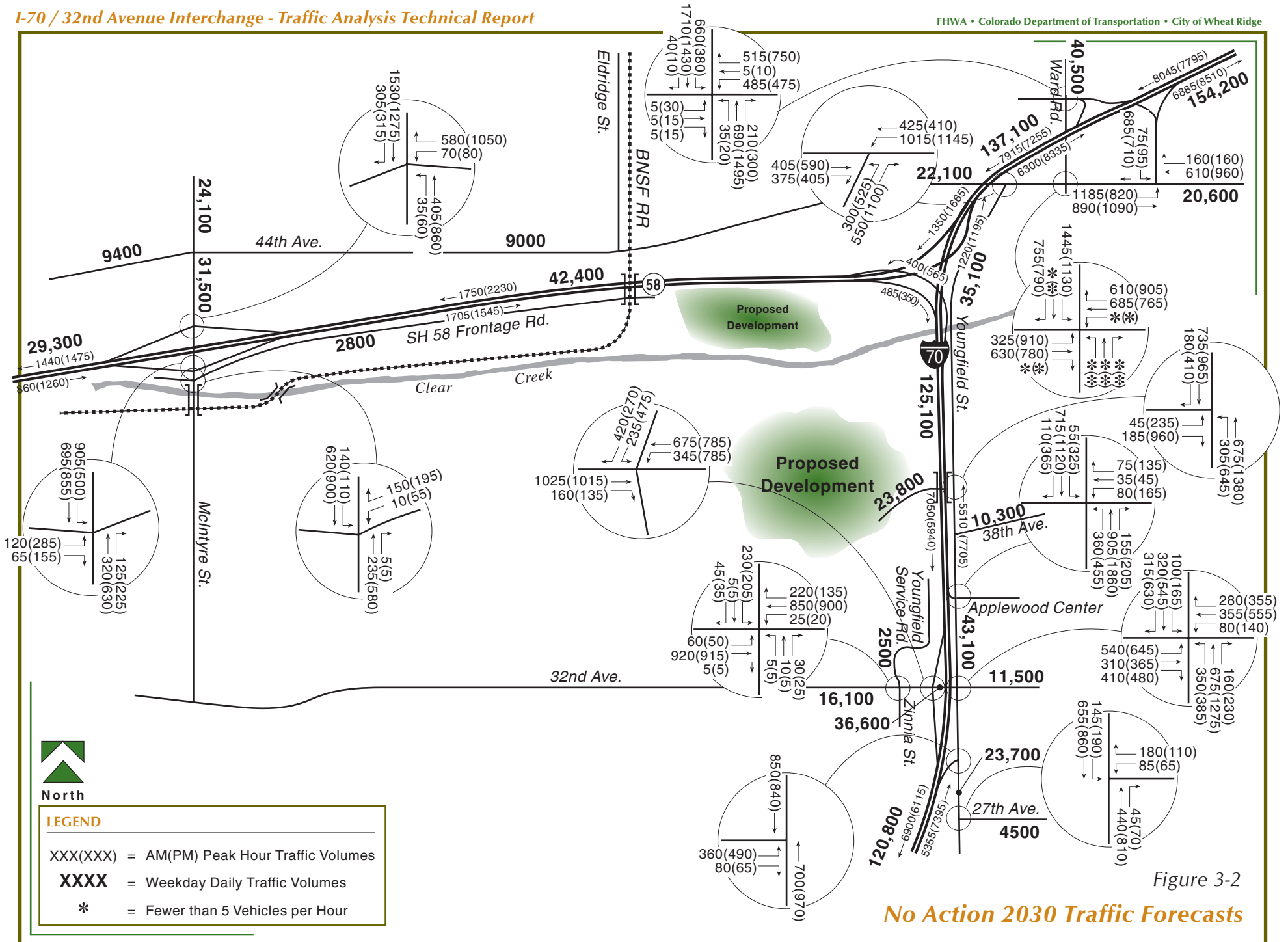
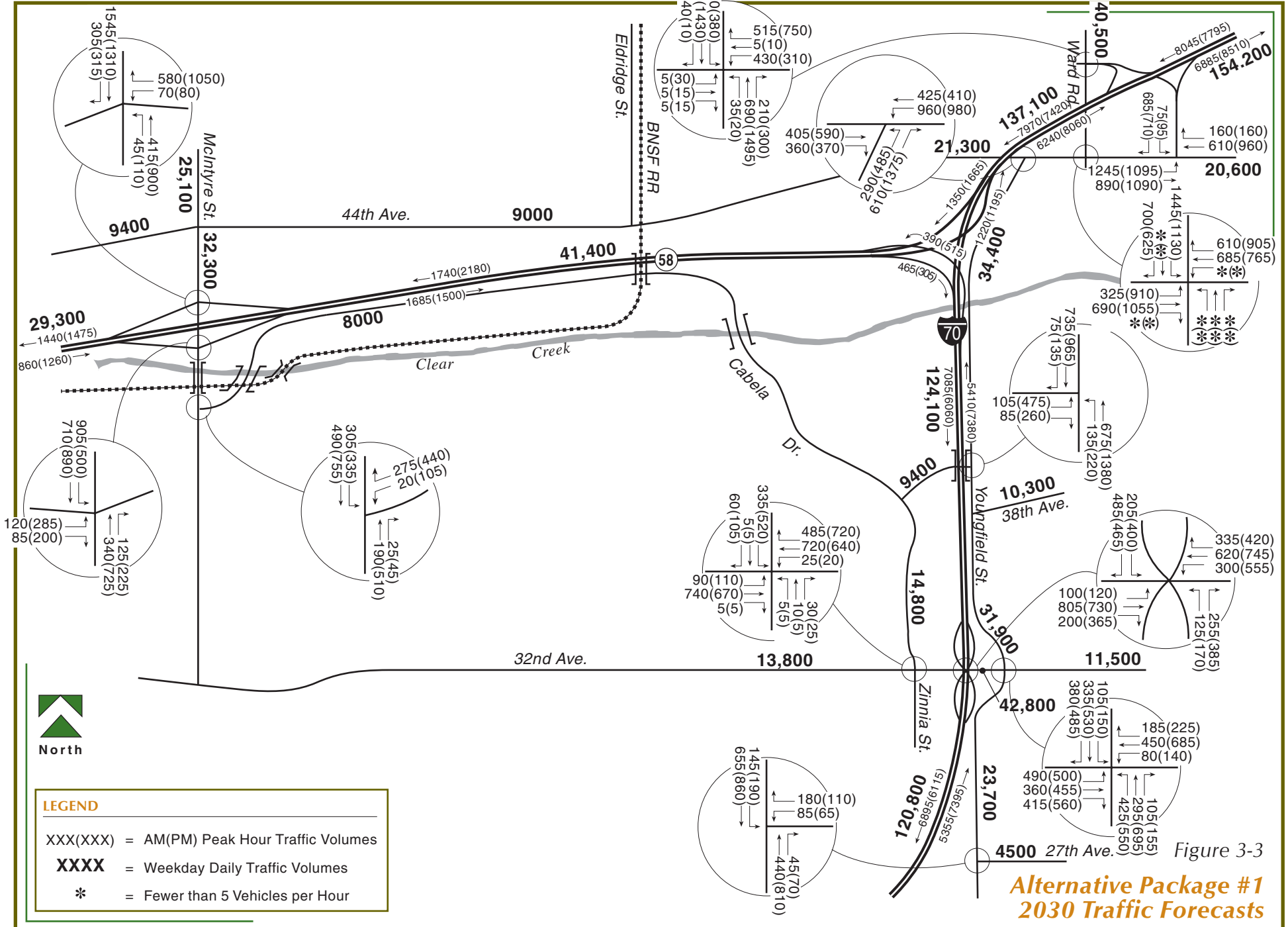
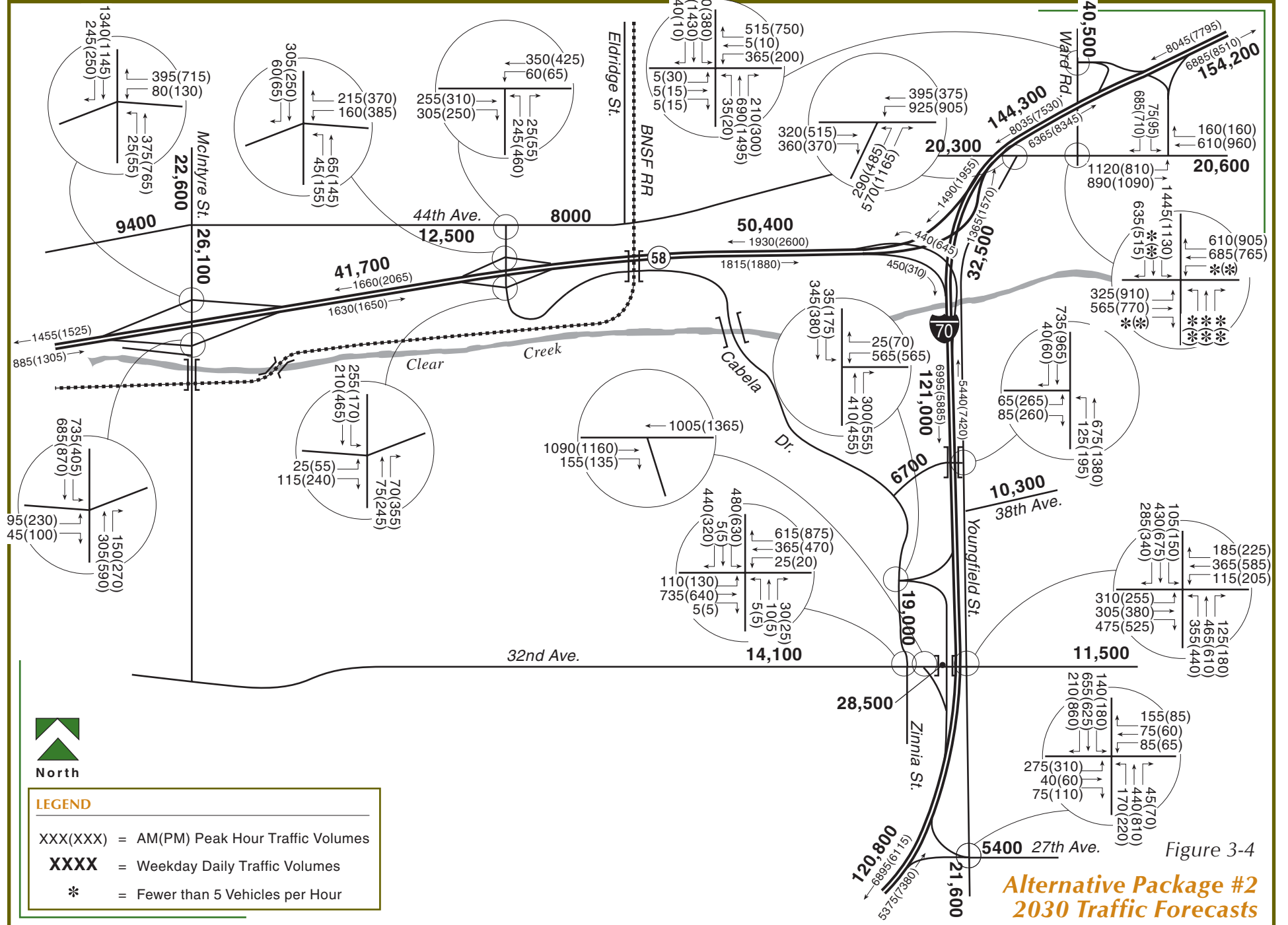


Figure 3-2

No Action 2030 Traffic Forecasts





The traffic volume projections shown as part of Alternative Package #2 reflect an I-70 guidance signing scheme that would encourage Cabela's-bound drivers to use the SH 58/Cabela Drive interchange. Guidance signing procedures generally do not allow identification of commercial businesses. However, signing could identify the Cabela Drive interchange via SH 58.

3.1.5 Alternative Package #3

Alternative Package #3 combines elements of the first two alternative packages; it includes the offset hook ramps at the I-70/32nd Avenue interchange and a connection to McIntyre Street south of Clear Creek but no new interchanges are included. The traffic forecasts are shown on **Figure 3-5**. Compared to the No-Action alternative, this alternative would provide relief to the planned 40th Avenue underpass and Youngfield Street and slight relief to the Ward Road interchange. Similar to Alternative Package #2, the proposed westbound hook ramp configuration would allow traffic destined for the Cabela's shopping center from westbound I-70 to access the site without using 32nd Avenue or Youngfield Street. Some increase along 26th and 27th Avenues would be expected as described as part of Alternative Package #2.

3.2 Future Freeway Operations

3.2.1 No-Action without Cabela's Shopping Center

The 2030 freeway LOSs were calculated using the 2000 Highway Capacity Manual procedures. Using the No-Action roadway network, which includes construction of the I-70 west/SH 58 west ramps, the resulting 2030 freeway levels of service were calculated and are shown on **Figure 3-6**. With the addition of the I-70 west/SH 58 west ramps, a new weave section is introduced along eastbound I-70 between 32nd Avenue and SH 58. In the westbound direction, an additional merge condition is created on I-70. The LOSs shown on **Figure 3-6** do not include the traffic generated by the Cabela's Shopping Center.

3.2.2 No-Action

The 2030 freeway LOSs were also calculated for the No-Action roadway network with the traffic generated by the Cabela's Shopping Center. **Figure 3-7** shows that many of the merge, diverge, weave and mainline LOSs on I-70 are projected to be at E or F in the 2030 No-Action alternative. The poor LOSs projected along the I-70 mainline are primarily due to the heavy traffic that this freeway is anticipated to carry. On SH 58, all freeway operations are projected to be at LOS C or better during the peak hours. There are only minor differences in the freeway LOSs between the No-Action scenario with and without the Cabela's Shopping Center.

3.2.3 Alternative Package #1

Similarly, the freeway operations were analyzed for the Alternative Package #1, as shown on **Figure 3-8**. The configuration of the I-70 and SH 58 on and off ramps is similar to the No-Action Alternative (new ramps added between SH 58 and I-70 west). The primary difference between the two is that the weave distance on eastbound I-70 between the 32nd Avenue interchange and the SH 58 interchange is greater in Alternative Package #1, resulting in a better LOS (D) during the PM peak hour. All other freeway LOSs are similar.

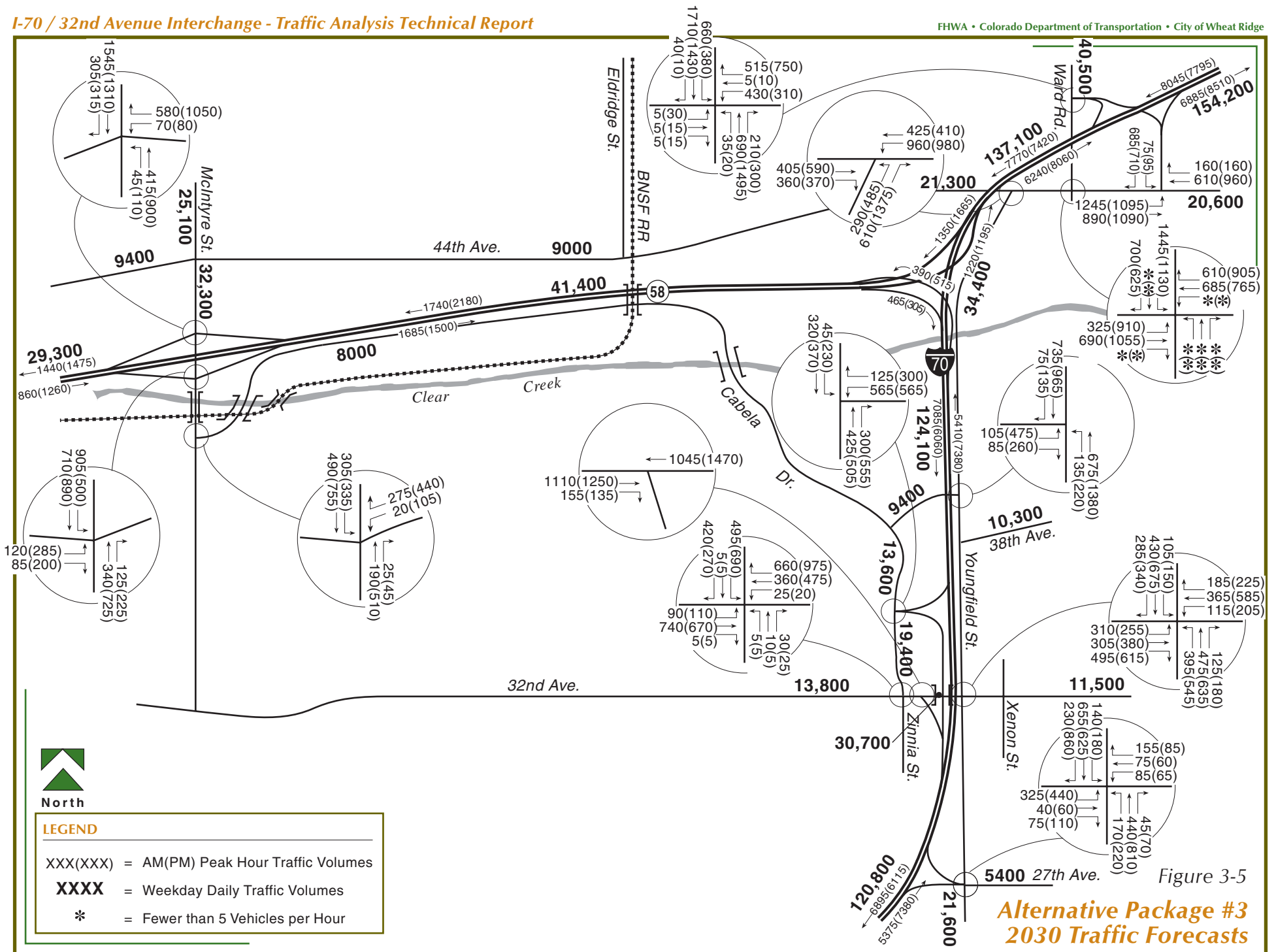


Figure 3-5

**Alternative Package #3
2030 Traffic Forecasts**

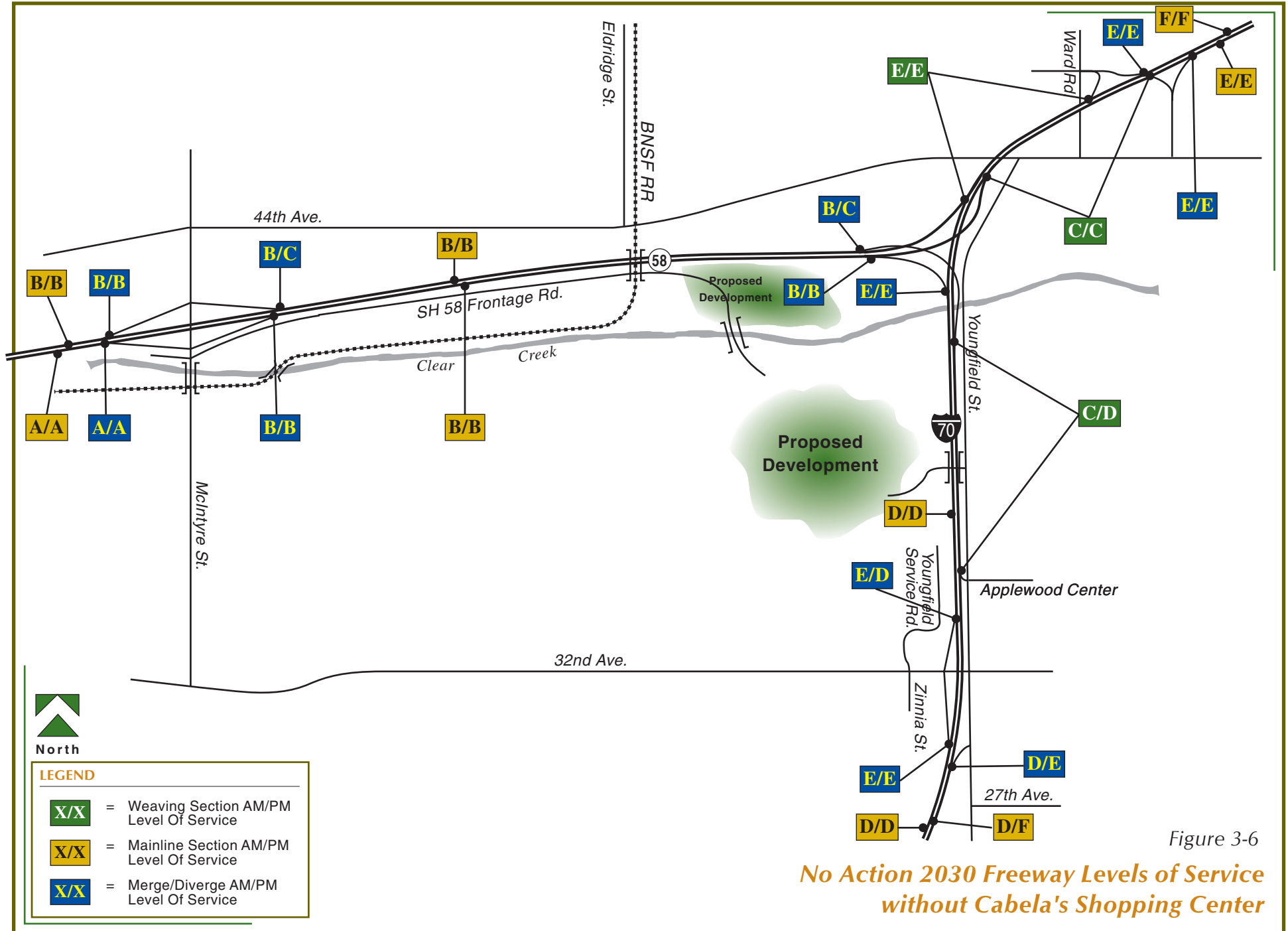


Figure 3-6

No Action 2030 Freeway Levels of Service without Cabela's Shopping Center

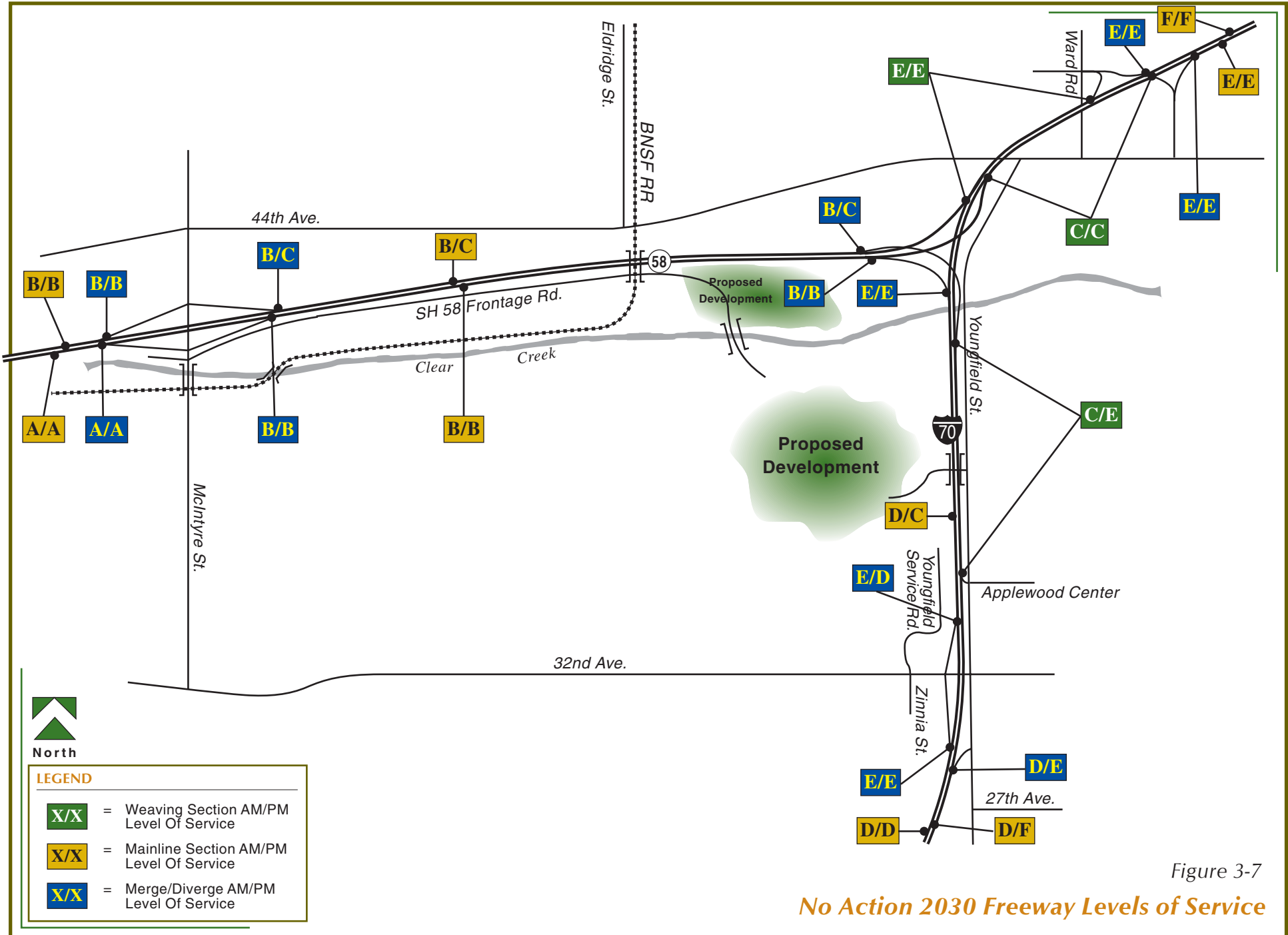


Figure 3-7

No Action 2030 Freeway Levels of Service

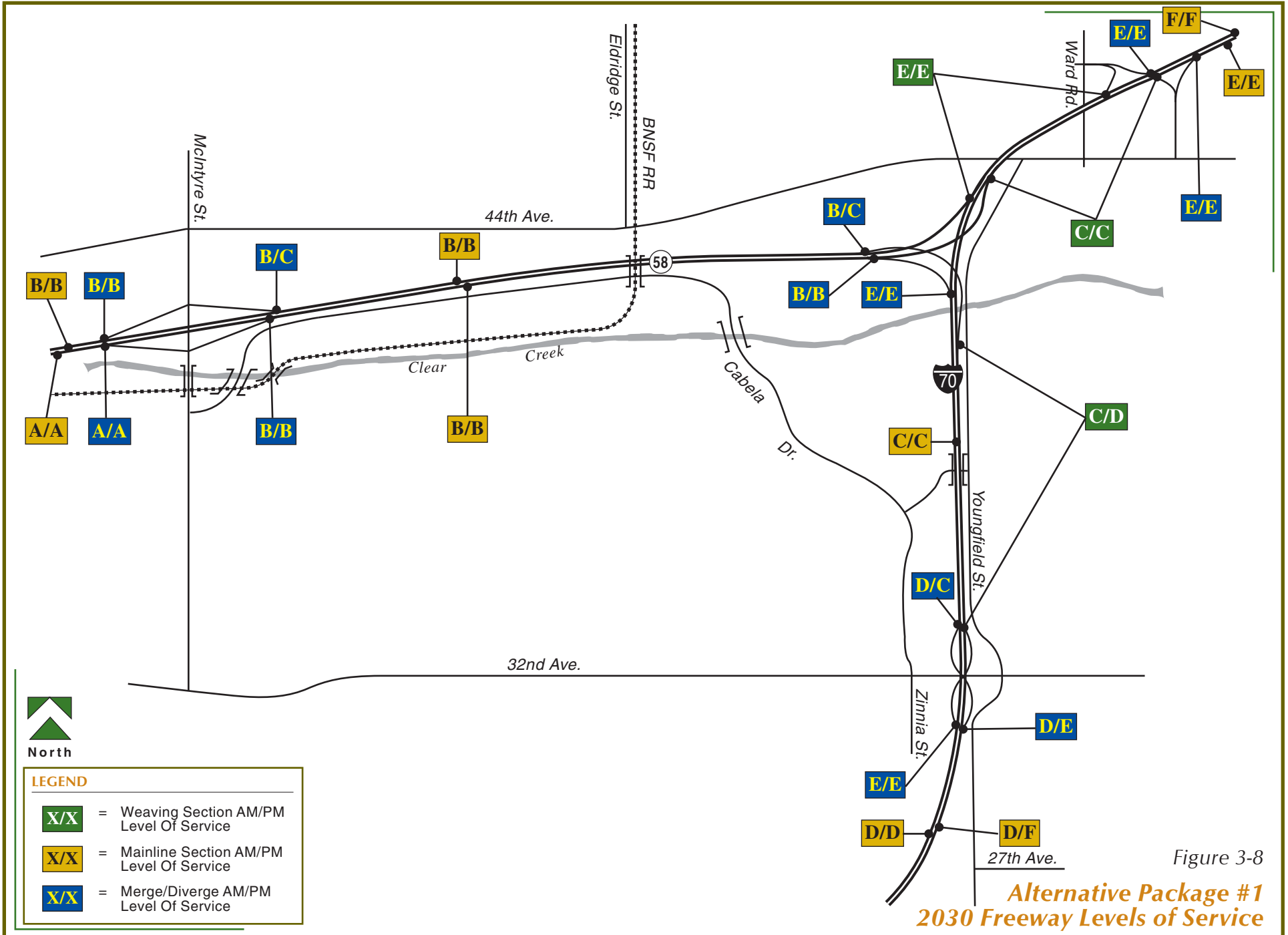


Figure 3-8
Alternative Package #1
2030 Freeway Levels of Service

3.2.4 Alternative Package #2

Alternative Package #2 introduces additional merge and diverge points on SH 58 at the new interchange. However, as shown on **Figure 3-9**, all freeway operations on SH 58 are projected to remain at LOS D or better in Alternative Package #2. Along I-70, a new weave section would be created in the westbound direction between SH 58 and the 32nd Avenue off ramp given the location of the hook ramps. However, this weave is expected to operate at LOS D or better during the peak hours. In the eastbound direction the weave section created by the additional I-70 to SH 58 fly-over ramp (in the No-Action) is eliminated with the relocation of the 32nd Avenue on-ramp to opposite 27th Avenue.

3.2.5 Alternative Package #3

The configuration of I-70 in Alternative Package #3 is the same as Alternative Package #2, with similar LOS results, as shown on **Figure 3-10**. Alternative Package #3 does not include a new SH 58 interchange; therefore the SH 58 freeway analysis results are similar to the No-Action.

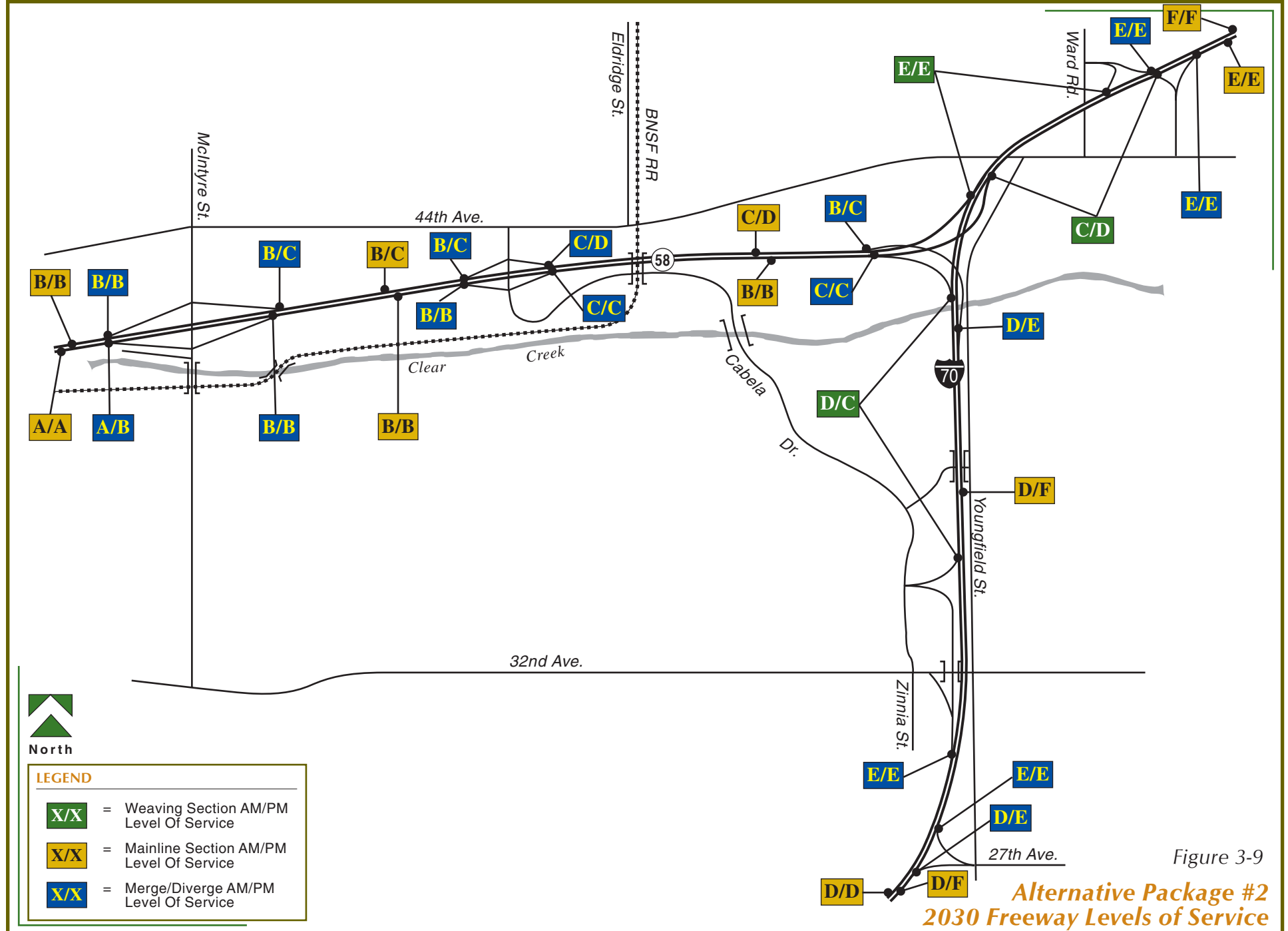
3.3 Future Intersection Operations

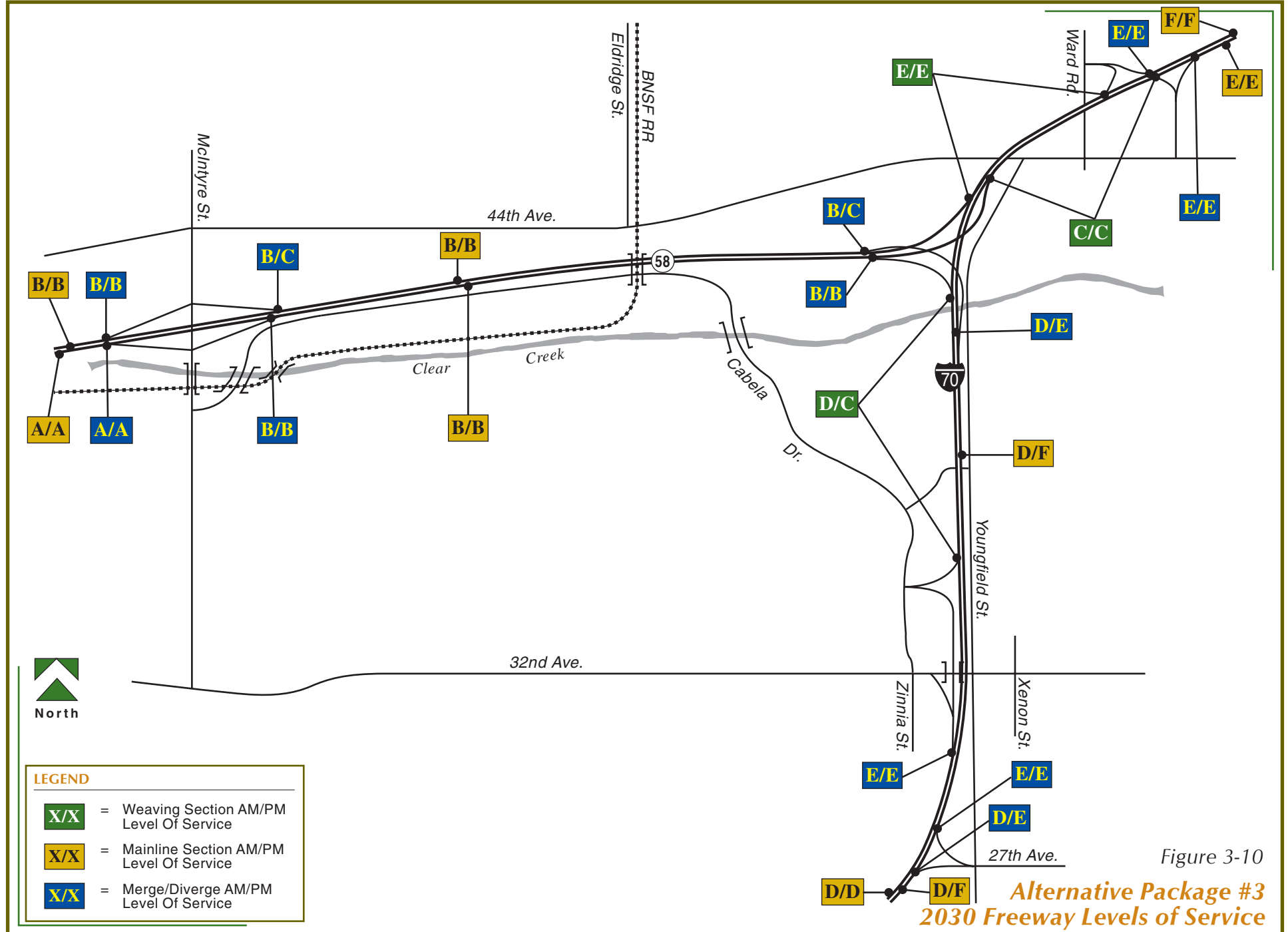
3.3.1 No-Action without Cabela's Shopping Center

The 2030 No-Action without Cabela's Shopping Center intersection lane geometry and projected LOSs are shown on **Figure 3-11**. This lane geometry, along with the forecasted AM and PM peak hour intersection turning movements (**Figure 3-1**), were used to analyze the future operations of the study intersections. Similar to the analysis of existing intersection operations, the future LOSs were calculated using the average of three simulation "runs" (using the Synchro/SimTraffic software).

3.3.2 No-Action

The intersection LOSs were also calculated for the No-Action roadway network with the Cabela's Shopping Center. The results are shown on **Figure 3-12**. As shown, many of the cross-street intersections are projected to operate at poor LOSs under the No-Action alternative in 2030. The three signalized intersections along 32nd Avenue are projected to operate at LOS F during the PM peak hour (in part due to their close proximity), as is the Youngfield Street/I-70 Eastbound off-ramp intersection. The two ramp terminal intersections at the I-70/Ward Road intersection also are projected to operate at LOS F, along with the adjacent intersection of 44th Avenue and Ward Road. The McIntyre Street/SH 58 Westbound Ramp intersection is projected to operate at LOS F during the PM peak hour, and the unsignalized intersection of McIntyre Street/SH 58 Frontage Road is projected to operate with long delays along the westbound approach in the PM peak hour given 2030 traffic projections. A comparison between the No-Action results with and without Cabela's Shopping Center reveals that the additional trips generated by Cabela's are expected to increase the delays at several of the study area intersections.





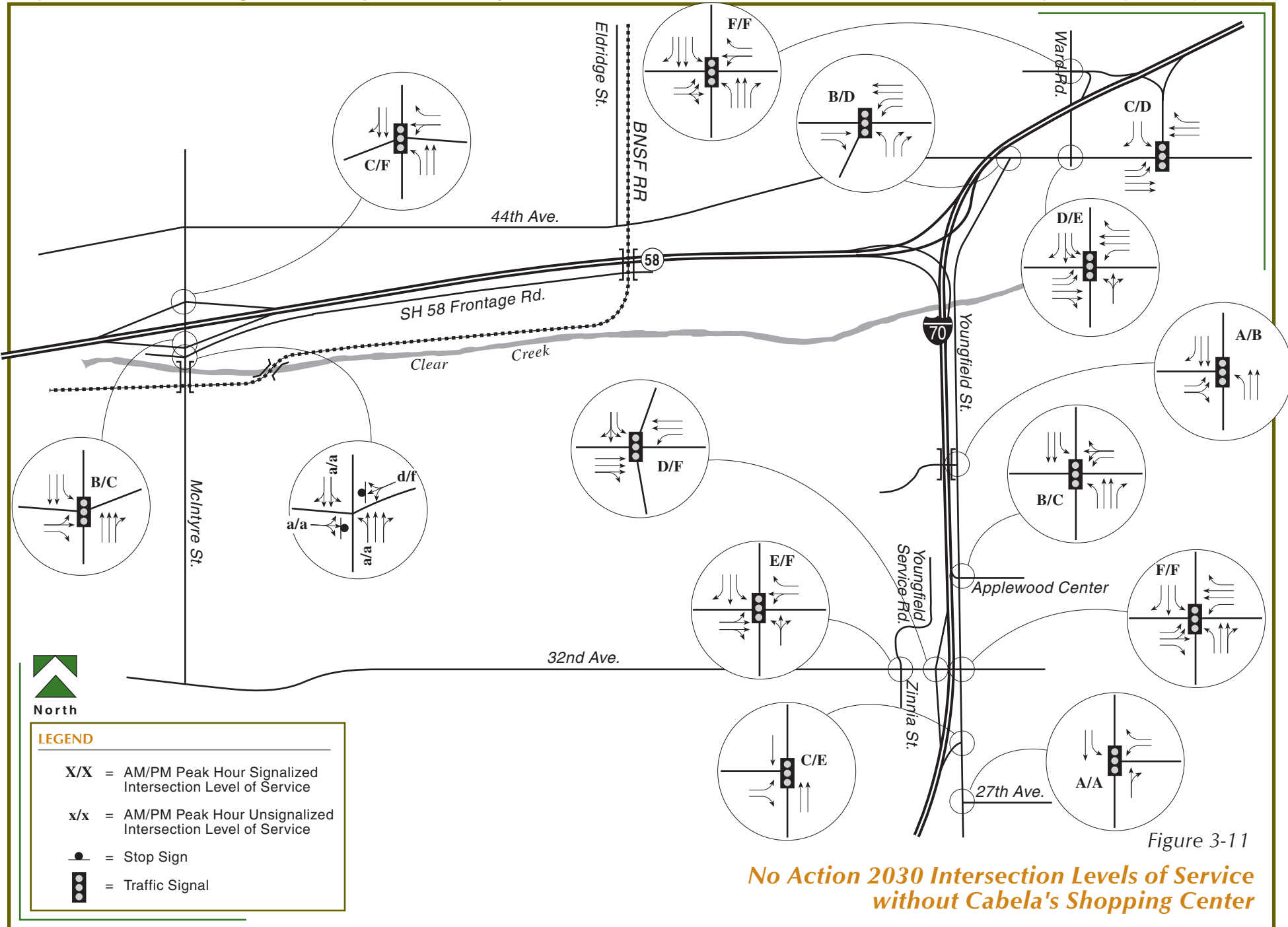


Figure 3-11

No Action 2030 Intersection Levels of Service without Cabela's Shopping Center

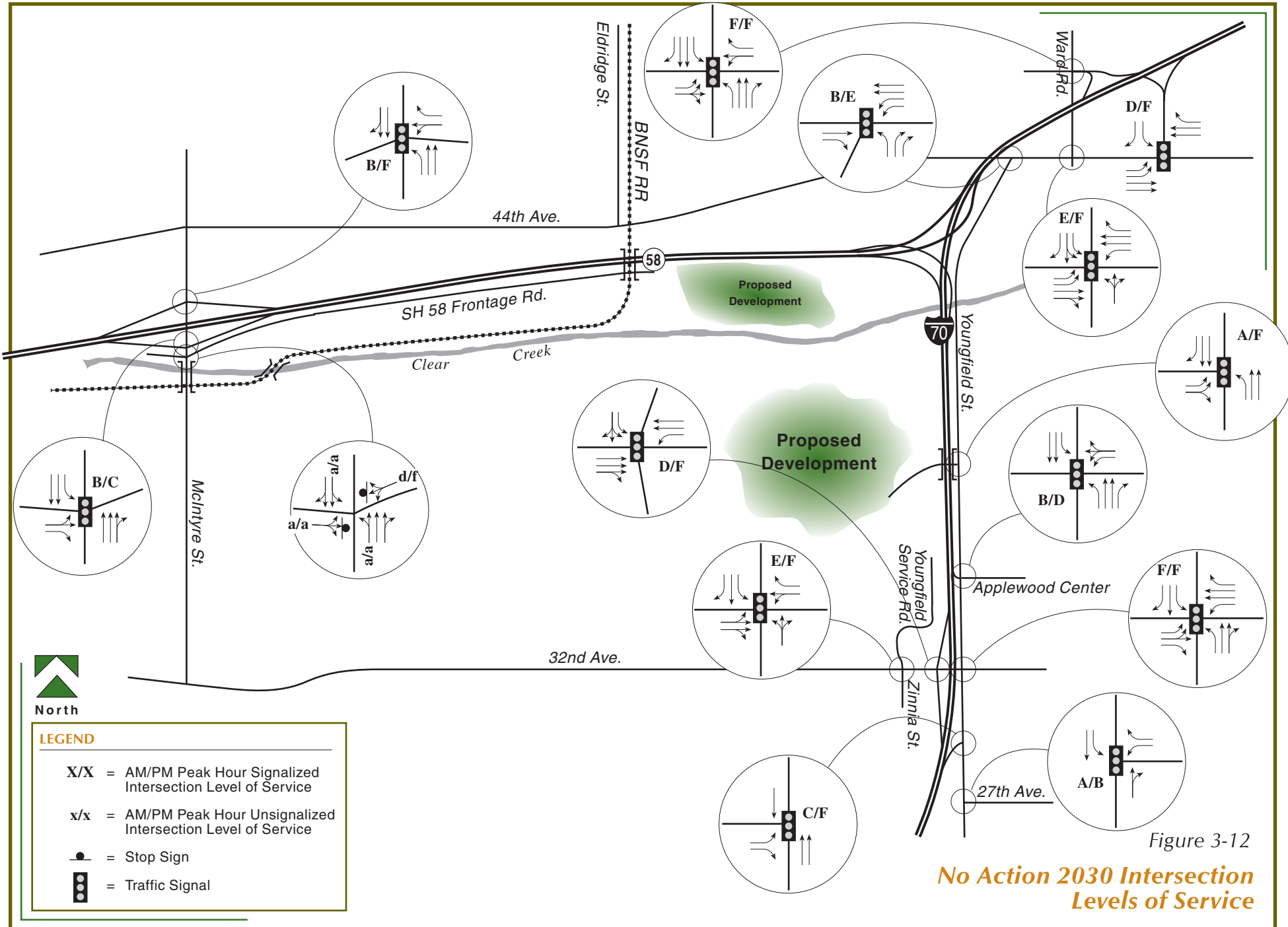


Figure 3-12

No Action 2030 Intersection Levels of Service

LEGEND

X/X	= AM/PM Peak Hour Signalized Intersection Level of Service
x/x	= AM/PM Peak Hour Unsignalized Intersection Level of Service
●	= Stop Sign
🚦	= Traffic Signal

3.3.3 Alternative Package #1

As shown on **Figure 3-13**, the roadway and intersection widening improvements associated with Alternative #1 alleviate the majority of the poor intersection levels of service. The intersection operations in the vicinity of the I-70/Ward Road interchange are still projected to be poor; however, average delays will decrease compared to No-Action given the proposed lane improvements.

3.3.4 Alternative Package #2

The Alternative Package #2 intersection lane geometry and projected LOSs are shown on **Figure 3-14**. As shown, the majority of the poor LOSs in the No-Action alternative would be mitigated with Alternative Package #2. All intersection operations in the vicinity of the I-70/32nd Avenue interchange are projected to operate at LOS C or better. Likewise, the SH 58/McIntyre Street interchange would be relieved by the addition of the new SH 58 interchange. Although the operations of the intersections in the vicinity of the I-70/Ward Road interchange would be improved, the Ward Road/I-70 Westbound Ramps intersection and the 44th Avenue/Youngfield Street intersections are still expected to have delays associated with LOS E or F during the peak hours.

3.3.5 Alternative Package #3

The Alternative Package #3 intersection lane geometry and projected LOSs are shown on **Figure 3-15**. Similar to Alternative Packages #1 and #2, this alternative is expected to alleviate the most of the intersection problems associated with the No-Action alternative. Again, the operations at the intersections in the vicinity of the I-70/Ward Road interchange are projected to show some improvement over the No-Action; however, long delays are still expected at these intersections (similar to Alternative Packages #1 and #2).

3.4 Street and Highway Safety

3.4.1 Freeway Accident Predictions

Safety projections along the mainline freeways in the study area were completed for the No-Action and Alternative Packages using a variation of the Safety Performance Function (SPF) procedures developed by the CDOT Traffic and Safety Engineering department. CDOT's SPF graphs were used to estimate the future number of accidents on I-70 and SH 58 based on the historic accident rates, existing traffic volumes and projected future traffic volumes. Using this methodology, the No-Action and Alternative Packages #1 and #3 freeway configurations are expected to result in essentially the same number of freeway-related accidents (210 to 230 per year) in 2030 on I-70 and SH 58 through the study area. Alternative Package #2 is expected to result in a slightly higher number of accidents (230 to 250 per year) because this alternative introduces new merge and diverge conflict points on SH 58 at the new interchange.

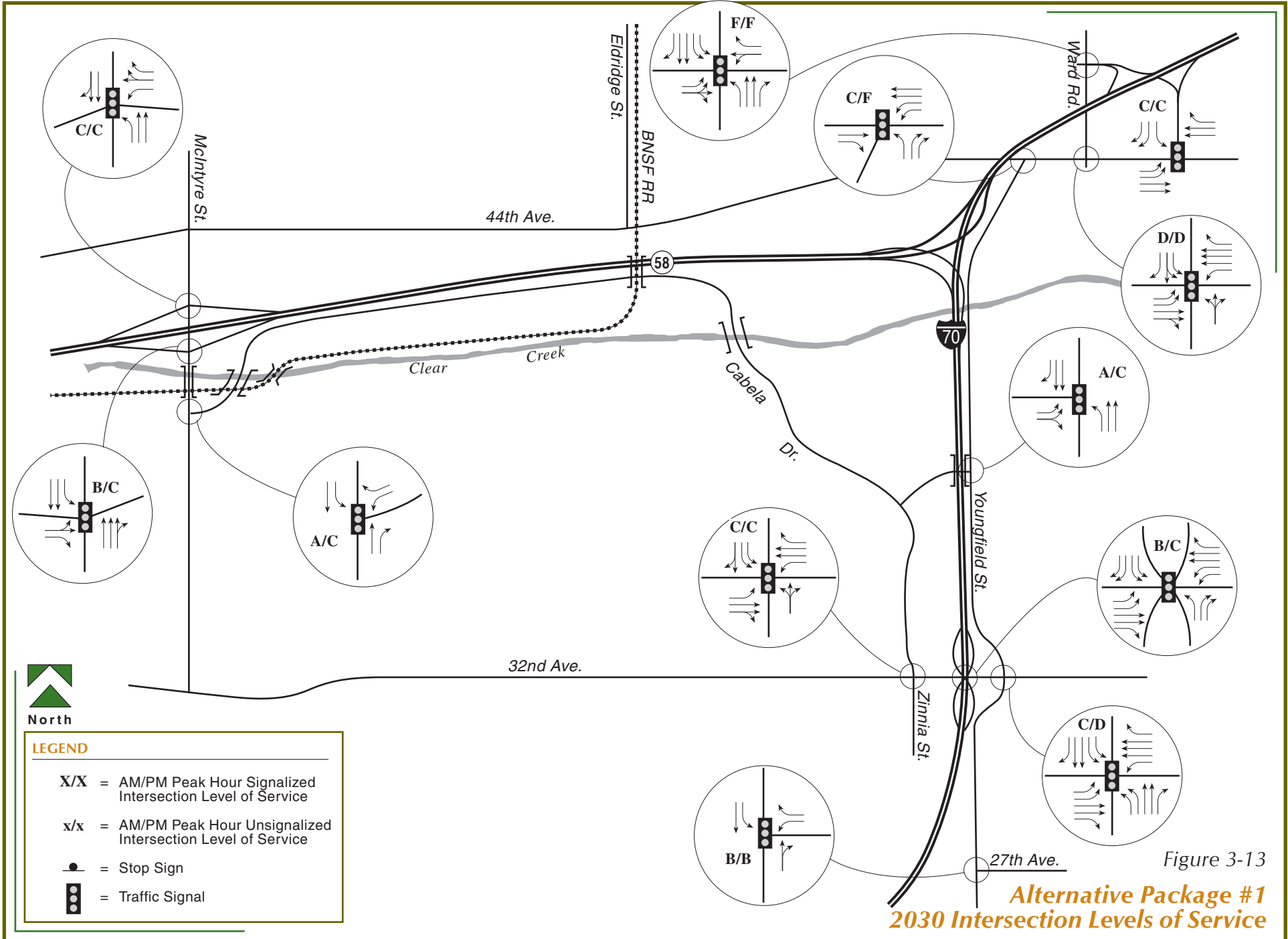


Figure 3-13

**Alternative Package #1
2030 Intersection Levels of Service**

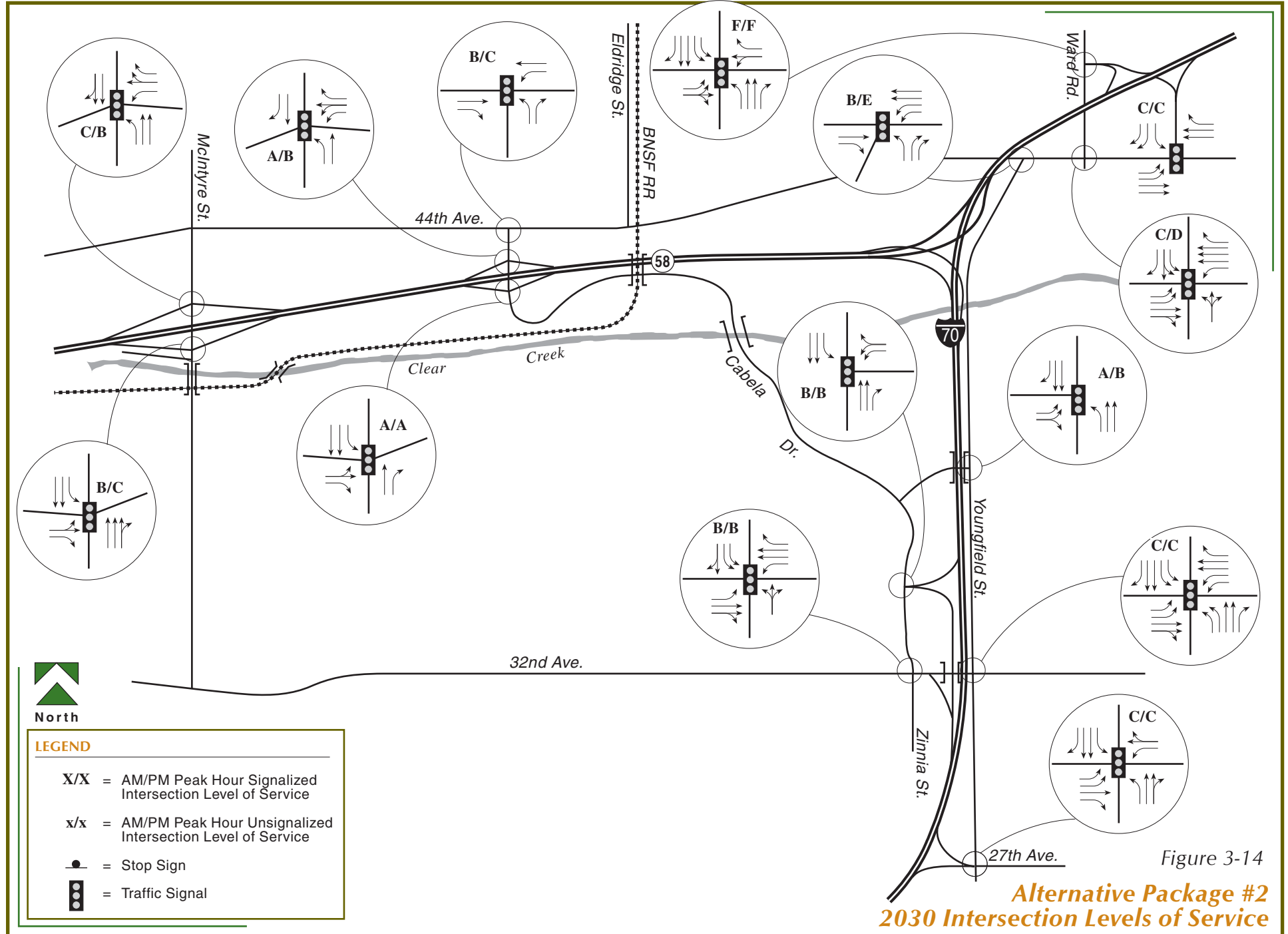


Figure 3-14

**Alternative Package #2
2030 Intersection Levels of Service**

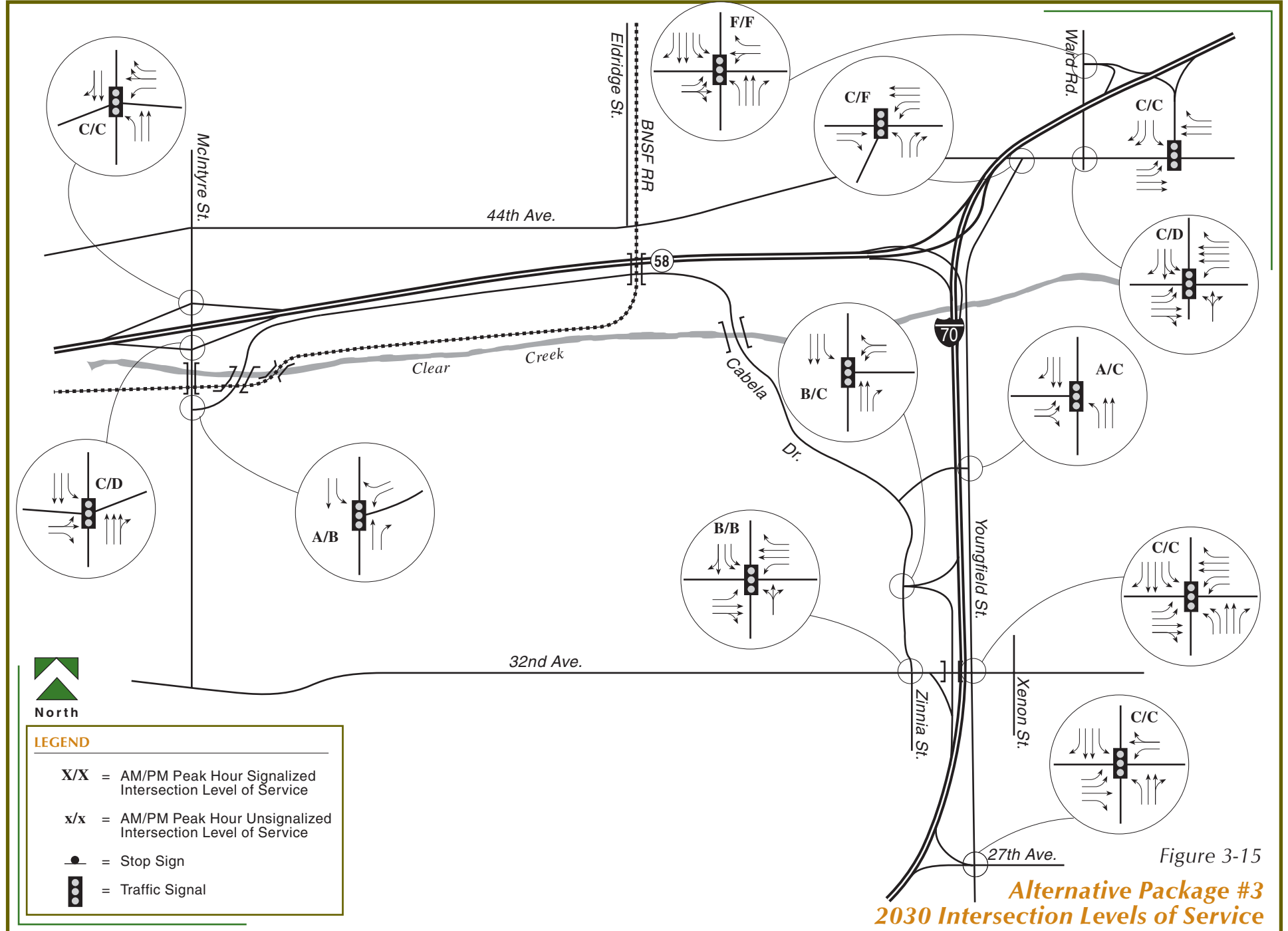


Figure 3-15

**Alternative Package #3
2030 Intersection Levels of Service**

3.4.2 Intersection Accident Predictions

In order to predict accident expectancy at intersections, a rudimentary relationship between intersection laneage and peak hour turning volumes and accident experience was derived. A proportion of the turning volume divided by the number of turning lanes (for right, through and left turn movements) was used to represent an “exposure” value. The historic number of accidents divided by this exposure value translates to a fixed value, which was then used to “back” into the predicted number of future accidents based on the future intersection turning volumes and approach lanes. An increase in traffic produces a greater exposure value, which results in a greater number of predicted accidents. An increase in the number of lanes for a movement produces a decrease in the exposure value, which results in a decrease in the number of predicted accidents.

This methodology was applied to the No-Action and the three Alternative Packages using the projected 2030 traffic volumes. The results are shown in **Table 3-1**.

Table 3-1 2030 Intersection Accident Predictions

Alternative	Predicted Annual Accidents
No-Action	180 – 200
Alternative Package #1	110 – 130
Alternative Package #2	140 – 160
Alternative Package #3	130 – 150

Each of the three Alternative Packages is expected to reduce the number of intersection accidents compared to the No-Action alternative. Alternative Package #1 is expected to provide the greatest reduction in accidents because of the standard configuration of the single point urban intersection. Alternative Package #2 is expected to provide the least reduction in accidents compared to the No-Action alternative. Even with the additional planned traffic signals associated with the new SH 58/Cabela Drive interchange, the net result is a decrease in intersection accidents due to the numerous lane additions planned at the other study area intersections and the diversion of traffic from higher accident locations (such as 32nd Avenue/Youngfield Street) to the new interchange.

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4.0 ALTERNATIVES ANALYSIS

4.1 2030 Freeway Traffic Operations

As described in Section 3.2, the freeway operations were analyzed for each of the four alternatives given 2030 travel demands. Several freeway mainline, merge/diverge and weave movements are projected to operate at poor LOSs even with the Alternative Packages. This is primarily a result of heavy peak hour through travel along I-70, particularly at the Ward Road interchange. Although the freeway ramp configurations are different in the four alternatives, the resulting LOSs are generally comparable. The freeway operations analysis was not a major determining factor in selecting the Proposed Action.

4.2 2030 Intersection Traffic Operations

The intersection operational analysis (Section 3.3) reveals that each of the three Alternative Packages would provide significant relief to the intersections in the study area as compared to the No-Action alternative. The analysis results are generally consistent between the three Alternative Packages; the majority of the poor levels of service in the No-Action would be alleviated, with the exception of the intersections in the vicinity of the I-70/Ward Road interchange. These intersections are projected to improve under any of the Alternative Package scenarios over the No-Action; however, delays are still expected. The intersection operational analysis was not a major determining factor in selecting the Proposed Action.

4.3 System Delay

Vehicle-hours of travel (VHT) is a measure that can be used to compare the overall efficiency of different transportation networks. The VHT for the local street system and the freeway system in the study area were calculated for each of the four alternatives during the AM and PM peak hours. The local system VHT was calculated using the Synchro/SimTraffic simulation runs, and the freeway system VHT was calculated using the facilities module of the Highway Capacity Software. The results are shown on **Table 4-1**.

Table 4-1 Vehicle-Hours of Travel (VHT)

	No-Action		Alternative Package #1		Alternative Package #2		Alternative Package #3	
	AM	PM	AM	PM	AM	PM	AM	PM
Local System VHT	1045	2055	820	1100	775	985	805	1140
Freeway System VHT	255	275	250	310	265	295	260	320
Total VHT	1300	2330	1070	1410	1040	1280	1065	1460

As shown in **Table 4-1**, all three of the Alternative Packages would reduce the system VHT compared to the No-Action Alternative, indicating a more efficient system. Alternative Package #2 is expected to provide the greatest reduction in VHT, due in part to the additional access and circulation options provided by the new SH 58 interchange.

4.4 Impact on Residential Areas

The study area includes several residential areas that will potentially be impacted by the traffic generated by the proposed development and by the roadway network modifications associated with the Alternative Packages. There are four primary residential areas for which the impacts of the Alternative Packages have been addressed, as follows:

- 1) The neighborhoods north and south of 32nd Avenue between McIntyre Street and the Youngfield Service Road, which are in unincorporated Jefferson County,
- 2) The neighborhoods along 26th/27th Avenue east of Youngfield Street, which are in the City of Lakewood,
- 3) The neighborhoods north of 44th Avenue approximately between McIntyre Street and Eldridge Street, which are in unincorporated Jefferson County, and
- 4) The neighborhoods along 38th Avenue east of Youngfield Street.

The projected daily traffic volumes on each of this roadway links are shown in **Table 4-2** for the No-Action alternative and the three Alternative Packages.

Table 4-2 Traffic in Residential Areas (Vehicles per Day)

	No-Action without Cabela's Shopping Center	No-Action	Alternative Package #1	Alternative Package #2	Alternative Package #3
32 nd Avenue west of Youngfield Service Road	13,000	16,100	13,800	14,100	13,800
26 th /27 th Avenue east of Youngfield Street	4,100	4,500	4,500	5,400	5,400
44 th Avenue east of Indiana Street	9,600	10,400	9,600	14,300	9,600
38 th Avenue east of Youngfield Street	8,700	10,300	10,300	10,300	10,300
Total	35,400	41,300	38,200	44,100	39,100

32nd Avenue between McIntyre Street and the Youngfield Service Road is classified by Jefferson County as a Minor Arterial. This segment of 32nd Avenue is projected to carry 16,100 vpd in the No-Action alternative. Each of the three Alternative Packages would provide some relief to 32nd Avenue west of the Youngfield Service Road because of the addition of a Cabela Drive connection to either McIntyre Street (in Alternative Packages #1 and #3) or to a new SH 58 interchange (in Alternative Package #2). The additional connection (either to McIntyre Street or to 44th Avenue) would serve a small amount of traffic otherwise served by 32nd Avenue.

27th Avenue east of Youngfield Street is classified by the City of Lakewood as a Major Collector. The City's standards indicate that a Major Collector can accommodate up to 7,000 vpd. In the No-Action alternative and Alternative Package #1, 27th Avenue is projected to carry 4,500 vpd. Alternative Packages #2 and #3 include hook ramps aligning with 27th Avenue for eastbound I-70; these hook ramps are expected to increase the traffic along 27th Avenue by approximately

20 percent (900 vpd) compared to the No-Action alternative. The projected daily traffic in each of the four alternatives is well within the City of Lakewood’s standard for a Major Collector.

44th Avenue is classified by Jefferson County as a Minor Arterial. 44th Avenue in the vicinity of Eldridge Street is projected to carry 10,400 vpd in the No-Action alternative. Alternative Packages #1 and #3 include a Cabela Drive connection between McIntyre Street and 32nd Avenue through the proposed development; this proposed connection would provide some relief to 44th Avenue, reducing the projected traffic volume to 9,600 vpd. The proposed interchange on SH 58 in Alternative Package #2 is expected to draw more traffic (an approximate 40 percent increase over No-Action) onto 44th Avenue east of Indiana Street.

Along 38th Avenue (east of Youngfield Street), traffic projections in 2030 are expected to increase relative to existing traffic levels. Besides regional growth, this roadway can be expected to also serve some Cabela’s traffic accessing the site via the 40th Avenue underpass. Traffic increases along 38th Avenue are projected to be on the order of 1,600 vpd specifically due to the Cabela’s Shopping Center which represents roughly a 21 percent increase relative to current 38th Avenue traffic levels just east of Youngfield Street. This increase is anticipated as part of No-Action and the Alternative Packages since the 40th Avenue underpass is included in each scenario.

4.5 Transit Considerations

Currently, the Regional Transportation District (RTD) operates several bus routes serving the study area. Routes 17, 28, 32, 38L, 44 and 44L serve the study area making use of all study area roadways. The 6X also passes through the area along I-70 serving the Denver West area. A park-n-Ride facility exists northwest of the I-70/Ward Road interchange being served by routes 17, 44L, 6X, and 72X. Along Youngfield Street, a small bus transfer center exists in front of the Wal-Mart on the southeast corner of Youngfield Street and 38th Avenue.

The current RTD routes could be maintained in any of the alternatives. However, the three Alternative Packages would provide more flexibility in routing options because additional roadway connections within the study area would be provided. The Ward Road park-n-Ride facility will serve as the end of the line for the “Gold Line” light rail line, which is part of RTD’s FasTracks program. “Feeder” bus routes are anticipated to serve the light rail station, and the additional roadway connections throughout the study area will provide more bus circulation options. Alternative Package #2, in particular, could potentially improve the routing options with the addition of a new SH 58 interchange.

4.6 Bicycle and Pedestrian Considerations

There is currently pedestrian and bicycle activity in the area which is expected to continue in the future. A regional bike trail exists along Clear Creek through the study area. Local access to the trail is provided via a parking area along the SH 58 frontage road, but it is also provided along the Youngfield Service Road near the Table Mountain Animal Center just west of I-70. Bicycle and pedestrian activity is evident in the area, but this type of activity does not overwhelm the system. Traffic and pedestrian counts collected along the 32nd Avenue intersections indicated that 15 to 25 pedestrians per hour occur at peak times. This is in light of the Manning Middle

School and the Maple Grove Elementary School located along Alkire Street south of 32nd Avenue (see Section 5). An eight-foot detached path is provided along the south side of 32nd Avenue to help facilitate this type of activity. Near the southern limits of the study area, a bicycle/pedestrian bridge spans I-70 at approximately 26th Avenue. This facility is not ADA compliant and is used by approximately 10 pedestrians per hour at peak times.

The three Alternative Packages each include an attached sidewalk along the south side of 32nd Avenue through the I-70/32nd Avenue interchange. Attached sidewalks will be provided on both sides of 40th Avenue through the I-70 underpass, improving east/west bicycle/pedestrian connectivity across I-70. A north/south bicycle/pedestrian connection will be provided through the Cabela's site. Trail connectivity to the Clear Creek Trail from 32nd Avenue will be maintained and better defined through the Cabela's site planning process. Improvements to the I-70/32nd Avenue interchange in Alternative Packages #2 and #3 would require replacement of the pedestrian bridge at 26th Avenue with an ADA compliant bicycle/pedestrian bridge.

Bicycle and pedestrian activity can be accommodated in any of the three Alternative Packages and is not a determining factor in selecting the Proposed Action.

4.7 Emergency Vehicle Access

There are three fire protection districts that service the study area. The Fairmount Fire Protection District serves the proposed development area north of Clear Creek and west of Youngfield Street. In addition, by agreement, they are the first to respond to accidents/emergencies on I-70 between Ward Road and 32nd Avenue and along SH 58. They can also be requested to assist West Metro Fire Rescue in the event of an incident occurring south of Clear Creek. Alternative Package #2 would improve the Fairmount Fire Protection District's ability to respond to incidents in the proposed development area by providing a more direct route via 44th Avenue/Cabela Drive.

West Metro Fire Rescue serves the proposed development south of Clear Creek and west of Youngfield Street. They can be requested to assist the Fairmount Fire Protection District in the event of an incident occurring north of Clear Creek or on I-70 or SH 58. Alternative Packages #1 and #3 would provide an additional route (via 32nd Avenue) for West Metro Fire Rescue to access the proposed development area. Alternative Package #2 would provide two options for West Metro Fire Rescue to access the proposed development area; via 32nd Avenue or the proposed new SH 58 interchange. These would be above and beyond the 40th Avenue underpass.

The Wheat Ridge Fire Protection District serves Wheat Ridge from Youngfield Street eastward, which includes the Applewood Shopping Center. They too can be requested to assist either the Fairmount Fire Protection District or West Metro Fire Rescue in the event of an emergency occurring within the proposed development on the west side of Youngfield Street. In any of the three Alternative Packages, access would be provided by either the planned I-70 underpass at 40th Avenue or the proposed 32nd Avenue connection.

The enhanced circulation from the street connections included as part of the Alternative Package #2 would provide all three Districts maximum flexibility and routing options to serve the area.

4.8 School Safety

Each of the three Alternative Packages includes the same pedestrian embellishments along 32nd Avenue near Manning School. The proposed embellishments include signing modifications to meet current standards and the construction of sidewalk segments along the north side of 32nd Avenue as far west as Braun Court.

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5.0 PROPOSED ACTION CONSIDERATIONS

Alternative Package #2 has been selected as the Proposed Action based on the analyses documented in this and the other technical reports. Since many of the traffic-related measures were not significantly different, other factors played a more dominant role toward the selection of Alternative Package #2 (as documented in the *Alternative Package Screening Technical Memorandum*, January 2006). Beyond the screening measures, there are other considerations and impacts that should be addressed as part of the Proposed Action.

5.1 Residential Areas

The Proposed Action includes hook ramps for eastbound I-70 which align with the 27th Avenue/Youngfield Street intersection. Traffic mitigation measures were considered to restrict or limit traffic from directly crossing Youngfield onto 27th Avenue. The City of Lakewood, who maintains 27th Avenue, does not support such restrictions in light of the possible enforcement required and given the fact that the estimated 2030 traffic on 27th is expected to be well within the capacity of a two lane Major Collector. Further, traffic that may be restricted from 27th Avenue may instead opt to use 20th Avenue.

Some concern has been expressed by the public as to the adequacy or safety of the dam (located approximately 600 feet east of Youngfield Street) since eastbound 27th Avenue is now restricted to trucks less than 7,000 pounds empty weight. Through investigation and conversations with the City of Lakewood, CDOT Staff Bridge and Consolidated Mutual Water, it was discovered that the load posting by the City of Lakewood was a voluntary effort by the City to keep heavy truck traffic off of local streets. The increased traffic on the dam and bridge is of no concern as the dam and bridge are not deficient from a load capacity perspective.

The Proposed Action also includes a new interchange on SH 58, with a connection to 44th Avenue. The additional traffic 44th Avenue would serve in the vicinity of the new interchange can be accommodated through the incorporation of acceleration and deceleration lanes for left and right turning traffic at the Cabela Drive intersection. Because of the residential uses along the north side of 44th Avenue, neighborhood entry “treatments” and signing should be incorporated to discourage traffic from traveling neighborhood streets. Recreation use in the area (ball fields at 44th Avenue/Indiana Street) occasionally generates parking along 44th Avenue including the roadway and spilling over into unused parking lots for commercial uses along 44th Avenue. It may be necessary to manually accommodate increased parking and traffic conflicts at the time of major events at the ball fields.

5.2 School Safety Improvements

Another concern that has been raised is the impact of additional improvements and of the Proposed Action on 32nd Avenue near The Manning School. Currently, the school is a magnet school for 7th and 8th graders. Immediately to its south is Maple Grove Elementary School. The schools generate some pedestrian activity along 32nd Avenue, and two separate pedestrian counts were collected during the 2004-2005 school year to ascertain this level of activity. As mentioned, 15 to 25 pedestrians per hour occur through the nearby intersections at peak times.

The busier intersections include 32nd/Alkire and 32nd/Youngfield Service Road, both experiencing more pedestrian activity than the 32nd/Youngfield intersection.

An inventory of the existing pedestrian facilities along 32nd Avenue is shown in **Figure 5-1** (along with the pedestrian counts). Currently, school warning signing is installed along 32nd Avenue near the schools including:

- ▶ 20 MPH speed reduction signs with double flashing beacons
- ▶ Crosswalk ahead signing
- ▶ Painted Crosswalks with identification signing at Alkire
- ▶ Right-turn on red prohibition (when pedestrians are present) from Alkire onto eastbound 32nd Avenue
- ▶ An eight-foot wide detached walk along the south side of the roadway.

While pedestrian accommodation is already provided along 32nd Avenue, there are some area improvements that should be considered. These include the completion of sidewalk segments along the north side of 32nd Avenue and the enhancement of school signing to meet the current signing guidance (Manual on Uniform Traffic Control Devices, 2003). **Figure 5-2** shows the recommended signing and sidewalk improvements along 32nd Avenue to meet current requirements. As part of the transportation improvements associated with the Proposed Action, these signing and sidewalk improvements should be implemented along 32nd Avenue.

5.3 Safety Considerations

As described in **Section 3.4**, simplistic methodologies were used to predict the accident experience along the freeways and at the intersections in 2030 under with the proposed roadway configurations. Already planned improvements and those identified as part of the Proposed Action will enhance the safety in the area. For example, CDOT's I-70/SH 58 project can be expected to improve safety in the study area by keeping traffic on the freeway system rather than on the local streets. Additionally, this project will lengthen the weave section on eastbound I-70 between SH 58 and Ward Road, providing additional distance for vehicles to change lanes.

The Proposed Action includes the reconfiguration/relocation of several intersections in the vicinity of the I-70/32nd Avenue interchange. The close spacing of the intersections along 32nd Avenue that exists today would be eliminated in the Proposed Action, cutting down on abrupt lane changes between closely spaced intersections which could contribute to accidents. By combining the I-70 eastbound ramps to a single location, the Proposed Action not only eliminates an intersection, but also prevents the potential for wrong-way movements onto the interstate ramp. Another consideration is that southbound right turns from Youngfield Street onto eastbound I-70 are currently prohibited because of the tight turn radius, but this does not necessarily prevent drivers from making this awkward movement. This movement would be properly accommodated under the Proposed Action, thereby eliminating potential driver confusion.



Maple Grove Elementary School



LEGEND

- = Sign
- = Pedestrian Crosswalk
- = Sidewalk
- = Traffic Signal
- = Pedestrian Signal Head
- = AM(PM) Peak Hour of School Pedestrian Volumes
- X(X) February 2005
- X(X) May 2005 (includes bicycles)

Figure 5-1
Existing Pedestrian Volumes and Traffic Control

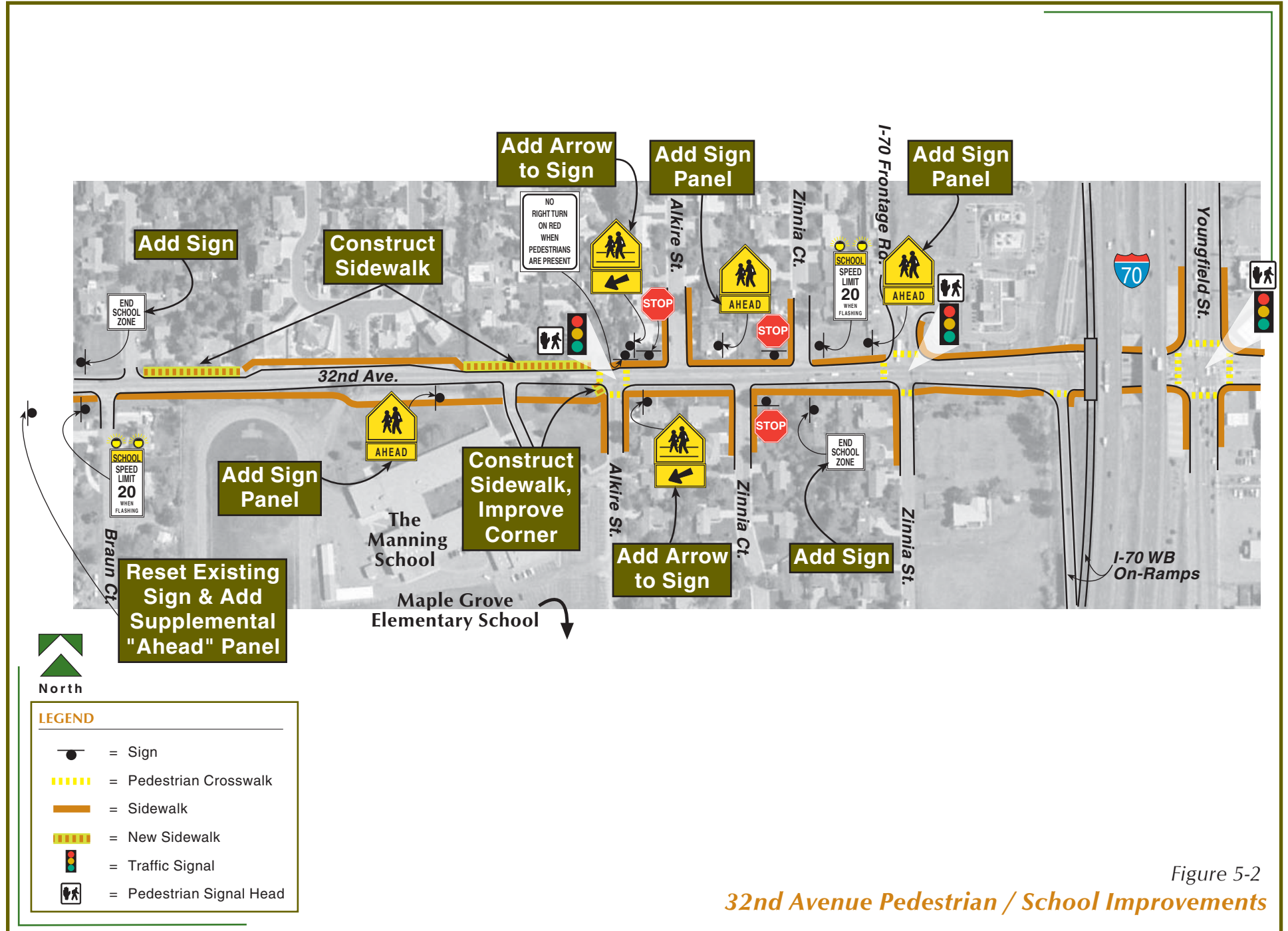


Figure 5-2
32nd Avenue Pedestrian / School Improvements

The 32nd Avenue/Youngfield Street intersection would be widened significantly with the Proposed Action. Nearly half of the accidents at this intersection between 2000 and 2004 were rear-end accidents. The additional through lanes and approach turn lanes are expected to reduce the number of rear-end accidents for the applicable movements by approximately 25 percent. The Proposed Action also includes an additional westbound through lane at the 44th Avenue/Ward Road intersection. Nearly 20 percent of all accidents at this intersection were rear-end accidents in the westbound direction. The additional through lane can be expected to reduce these accidents by approximately 25 percent.

5.4 Cabela's Shopping Center Access

The proposed action results in an access scheme that includes a five-lane Cabela Drive connection to 32nd Avenue, a three-lane connection to Youngfield Street, and a two-lane connection to the new HS 58 interchange. The following describes characteristics of each:

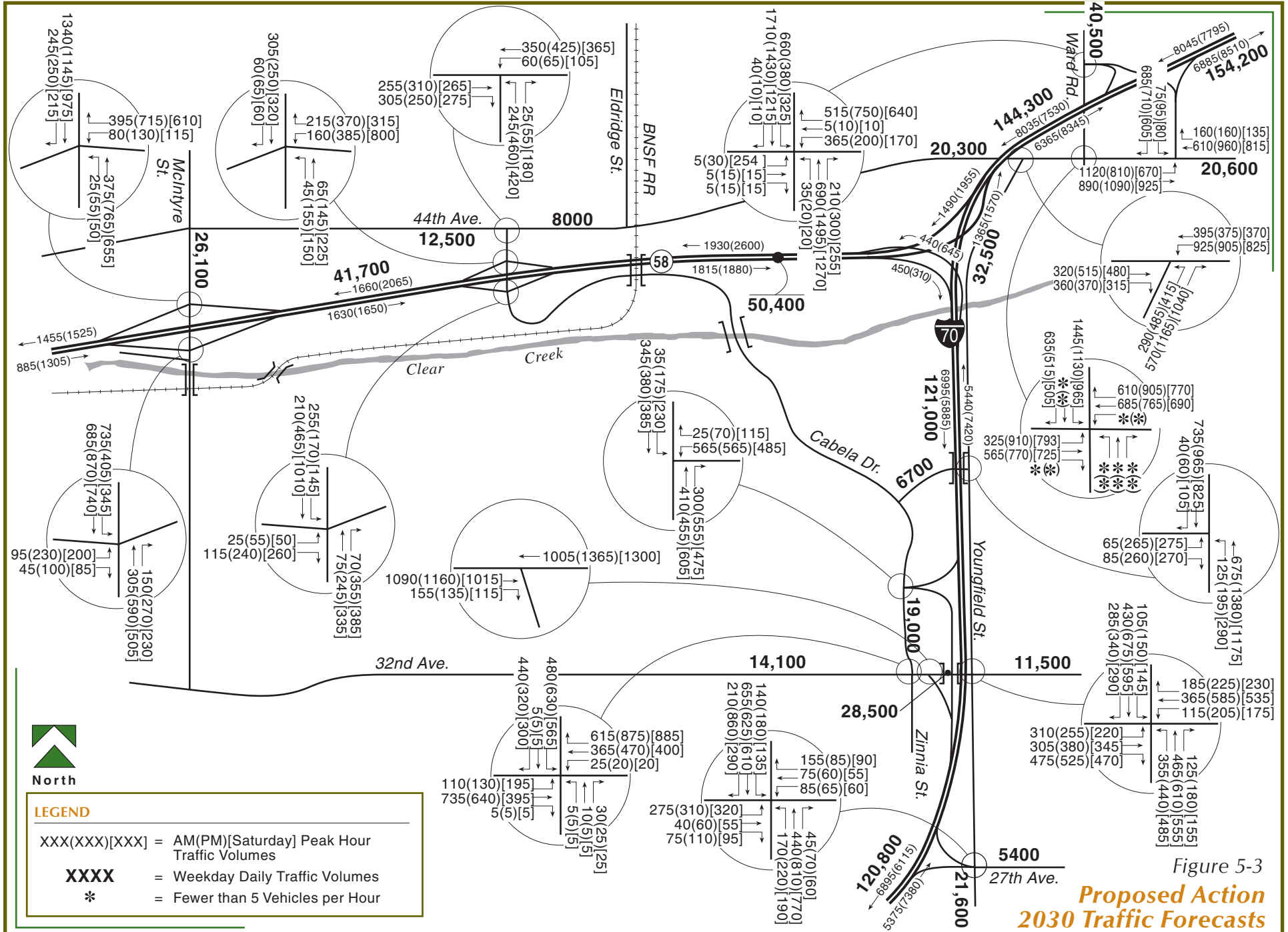
- ▶ **SH 58 Connection** – This roadway connection to SH 58 is projected to carry 11,000 vpd, most of which is associated with the Cabela's shopping center. A four-lane cross section has been provided to accommodate this level of traffic. This four lane section includes two lanes heading to the proposed development from SH 58, one outbound lane from the proposed development to SH 58 and a common center left turn lane. Between 40 and 45 percent of the Cabela's shopping center traffic is expected to utilize this access roadway to the SH 58 interchange.
- ▶ **40th Avenue Underpass** – This roadway connection is projected to carry 6,700 vpd, most of it being Cabela's-related traffic. Three lanes have been provided from Cabela Drive widening to four lanes underneath I-70 to Youngfield Street. The Youngfield Street/40th Avenue planned intersection provides four lanes; one lane heading into the proposed development and two lanes from the proposed development and an additional right turn lane to southbound Youngfield. Between 25 and 30 percent of the Cabela's shopping center traffic is expected to utilize this means of access.
- ▶ **Connection to 32nd Avenue** – Cabela Drive will be a five lane section from Clear Creek to the I-70 westbound hook ramps. South of the I-70 westbound hook ramps, this roadway is projected to carry 19,000 vpd. This level of traffic requires four through-lanes with a common center left turn lane for access to the development. Between 30 and 35 percent of the Cabela's shopping center traffic is expected to utilize this means of access.

5.5 Analysis of Saturday Traffic

The initial work completed for the draft *Cabela's Traffic Impact Study* (January 2005) indicated that Saturday times were not the critical time frames. While the Cabela's shopping center generated more traffic on a Saturday (than a weekday), the background traffic along the study area roadways (particularly Youngfield Street and 32nd Avenue) was less on Saturday, and this more than offsets the increase in weekend Cabela's shopping center traffic impact. Weekday AM and PM peak hour traffic projections were used to develop the alternatives.

In the Proposed Action Alternative, very little weekend "background" traffic is anticipated to use the SH 58 interchange; most of the interchange's traffic will be associated with the Cabela's shopping center. The greater impact of the Cabela's shopping center on a Saturday is not offset

by lower background traffic at the SH 58 interchange since there is very little background traffic anticipated to use the interchange. The critical time period for the SH 58 interchange is when Cabela's shopping center traffic is peaking, during Saturday. Therefore, a separate analysis of the Saturday peak hour has been completed (Proposed Action only), as shown on **Figures 5-3** and **5-4**.



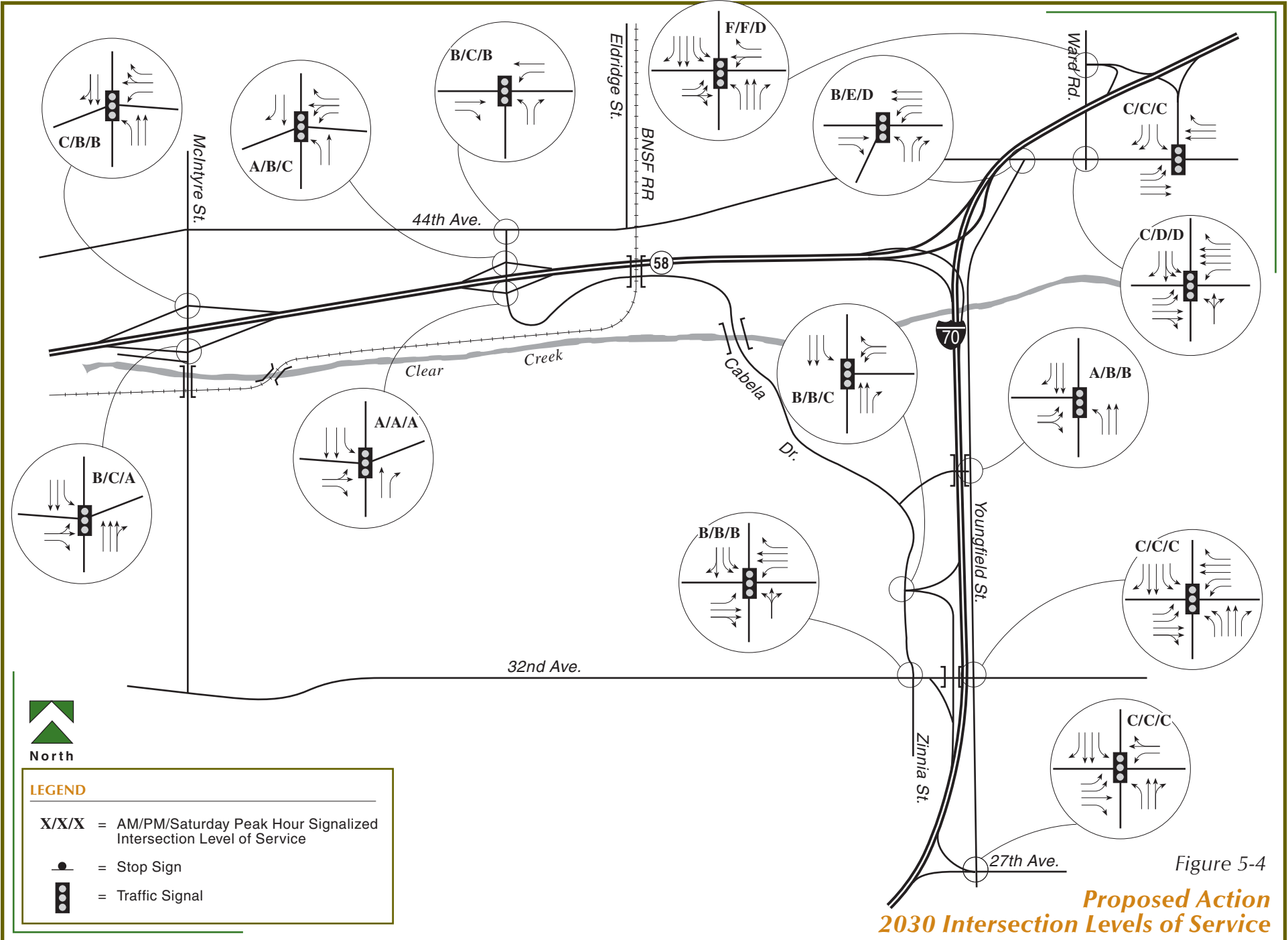


Figure 5-4

Proposed Action
2030 Intersection Levels of Service