

FINAL REPORT | November 30th, 2019

Elton Hills Drive Traffic and Safety Study



Prepared for:



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1 Introduction

The City of Rochester has identified the need to perform a traffic study for Elton Hills Drive to help determine the street space, use, and lane configuration of the corridor. This study will evaluate existing conditions, identify safety and mobility concerns, and develop a conceptual plan and improvement strategies that can be applicable to the corridor without requiring full reconstruction.

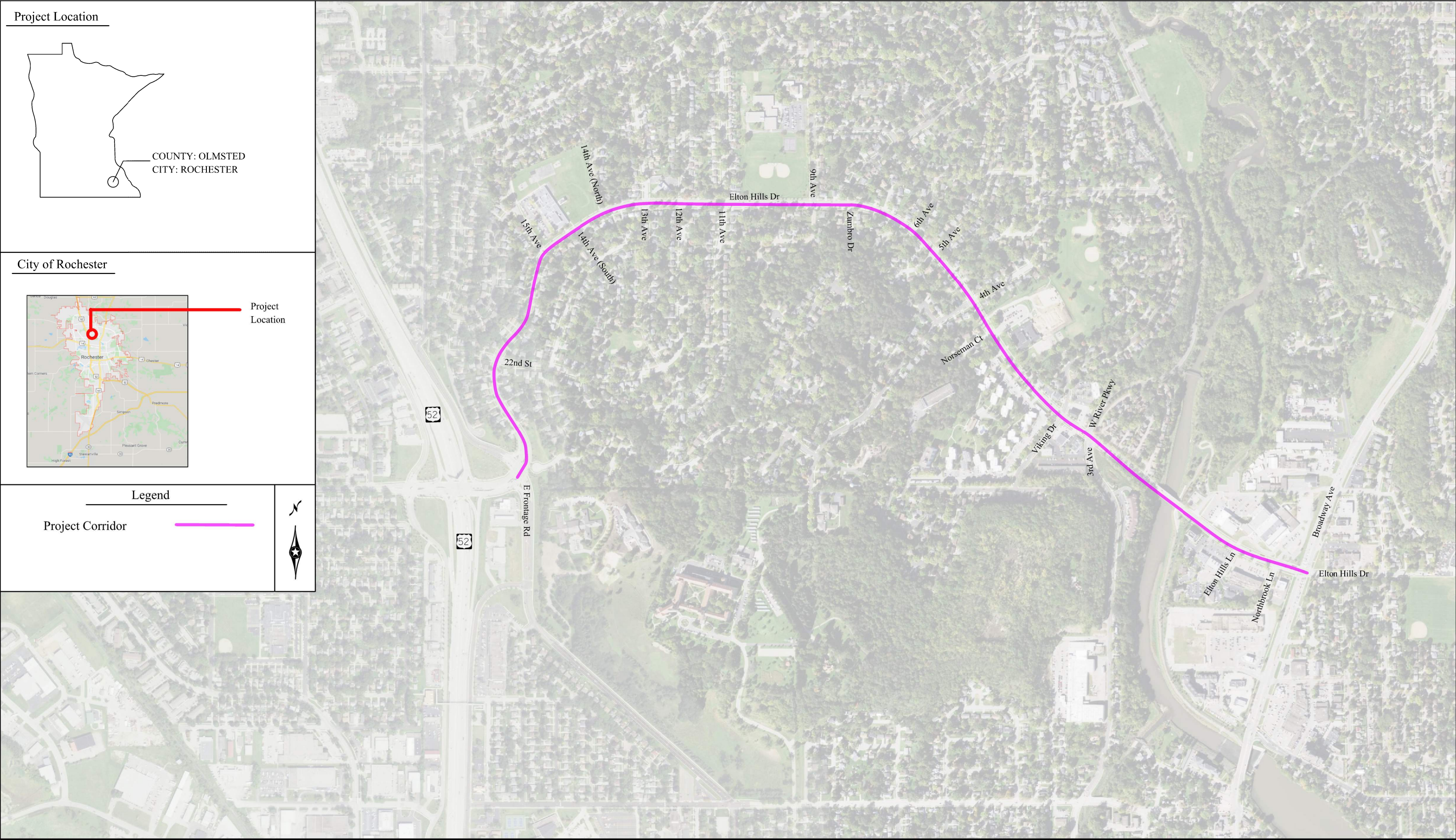
1.1 Project Study Area

Elton Hills Drive is a primary arterial roadway extending from County Road 22 to US 63 (Broadway Avenue), providing regional connectivity, interchange access to US 52 and direct access to adjoining neighborhoods. The study limits include the 1.8-mile segment of Elton Hills Drive between the East Frontage Road (US 52 interchange) and Broadway Avenue. The study corridor is illustrated in **Figure 1**.

1.2 Study Objective

Concerns have been raised regarding the safety of Elton Hills Drive, pedestrian and bicycle accessibility, mobility needs, and prevalence of speeding motorists. In 2016, Rochester Public Works had previously submitted a project proposal to reduce Elton Hills Drive from its 4-lane undivided cross-section to a 3-lane cross-section with on-street bicycle lanes. Ultimately that concept alternative did not move forward. There has been renewed interest in identifying potential safety and mobility improvements for the corridor. Key goals of this traffic and safety study are to identify cost-effective operational and safety improvements that can address corridor crash, speed and pedestrian/bicycle accessibility concerns in the near- and long-term. This feasibility review will include evaluation of key considerations:

- Traffic Volumes (vehicle, pedestrian and bicycle)
- Street Width and Function
- On Street Parking
- Access
- Transit and Freight
- Motorist Speeds
- Crash History
- Mobility and Capacity
- Multimodal Travel



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2 Corridor Evaluation

Key components of the Elton Hills Drive corridor evaluation include corridor characteristics, traffic volumes and roadway safety. Evaluation of the corridor mobility (traffic operations) considerations is discussed in Section 3. The existing transportation network conditions are defined in the following sections.

2.1 Corridor Characteristics

Elton Hills Drive is a two-way 4-lane undivided road that exhibits various roadway geometrics and traffic control, as shown in Figure 2. The corridor is generally posted as a 30 miles per hour (mph) roadway, with a short 35 mph segment. Five intersections operate under signalized control (three within the corridor subject area and two on the study limit ends), with the others as thru-stop control. Key characteristics along the corridor are generally as follows:

On Street Parking

On street parking is generally provided on both sides of the street from East Frontage Road to West River Parkway. Parking is lightly used as homes with direct access to the corridor have driveways and garage space. East of W River Parkway on street parking is prohibited.

Adjacent Land Use

The adjacent land use is primarily residential with commercial uses on the eastern end of the corridor (near Broadway Avenue). Several schools are accessed directly or indirectly from Elton Hills Drive.

Access

Elton Hills Drive provides direct driveway access to approximately 100 homes. Approximately 20 other commercial driveways and public streets exist along the corridor at less than 1/8 mile spacing

Lighting

Street lighting attached to utility poles with overhead power lines is provided on one side of the street along the length of the corridor.

Transit

Elton Hills Drive is a vital link in facilitating bus service for Rochester Public Transit. An overview of bus stops and routes currently operating along or crossing the study corridor is shown in **Figure 2**. The corridor is mainly serviced by routes 10, 11 and 26. Buses operate in mixed traffic lanes, and buses stopping to pick up or drop off passengers do so in the existing parking lane, and do not impede traffic flow. As shown, there are approximately 2 to 8 buses per hour (depending upon location) operating along Elton Hills Drive.

Bicycle and Pedestrian Facilities

Sidewalks are provided along both sides of Elton Hills Drive, separated by a grass boulevard. Currently there are no on or off-street bicycle accommodations along the corridor. Multiuse trails connect to Elton Hills Drive at West River Parkway (north side) and on the east side of the Zumbro River (south of Elton Hills). On street bicycle lanes exist along W River Parkway and on 19th Street, west of Valley High Drive. Elton Hills Drive is identified as a future bicycle corridor as identified in the 2040 Rochester Comprehensive Plan.¹

2.2 Motor Vehicle, Pedestrian and Bicycle Volumes

Existing motor vehicle, pedestrian, heavy trucks (freight) and bicycle traffic volumes were collected in the fall of 2019 (September/October). All signalized and unsignalized public streets and commercial accesses were collected. The a.m., p.m. peak hour and 13-hour traffic volumes are shown in **Figure 3**. The peak hour volumes illustrated also include the traffic associated with the area school activities.

Motor Vehicle Volumes

The peak hour volumes are necessary to evaluate intersection capacity needs and/or assessment of impacts associated with any alternative lane configurations or street operation. The annual average daily traffic (AADT) along Elton Hills Drive is approximately 11,000 vehicles per day. The 24-hour count collected on Wednesday October 9th, 2019 was approximately 12,000. The vehicle volume distribution is close to 50/50 split (balanced direction flow) with peak hour volumes generally less than 700 vehicles per hour per approach in the peak direction.

Pedestrian and Bicycle Volumes

Existing pedestrian and bicycle volumes were collected and are illustrated in Figure 3. Most intersections within the study area experience less than 10 pedestrian/bicycle crossings per day. However, several locations (signalized school crossings experience in excess of 150 pedestrians at 14th Avenue and greater than 50 at Norseman Court). 12th Avenue, 9th Avenue, Zumbro Drive and Viking Drive experienced the next highest pedestrian activity for unsignalized intersections. Along Elton Hills Drive, approximately 10 bicycles (13 hours) on the west end of the corridor and 40 bicycles on the east end were observed.

Heavy Trucks (Freight)

Elton Hills Drive prohibits vehicle traffic in excess of 10,000 gross pounds. As a result, a high level of truck traffic is not expected. However, Elton Hills Drive is primary arterial, provides regional connectivity and has interchange access to US 52; therefore, truck traffic does use the corridor. The data found between 2% and 6% truck traffic with the peak time periods observed to be early morning (before the a.m. peak) and early afternoon.

¹ Rochester Comprehensive Plan 2040, Non-Motorized Transportation Analysis, Figure 7, April 2015

Historical Traffic Volumes

Elton Hills Drive traverses through a fully developed area of Rochester. Growth in traffic may likely occur in the future as a result of localized redevelopment, changes in area traffic patterns, or induced through other regional system changes. Although there has been some up and down variation, historically, traffic volumes along Elton Hills Drive have shown to be constant.

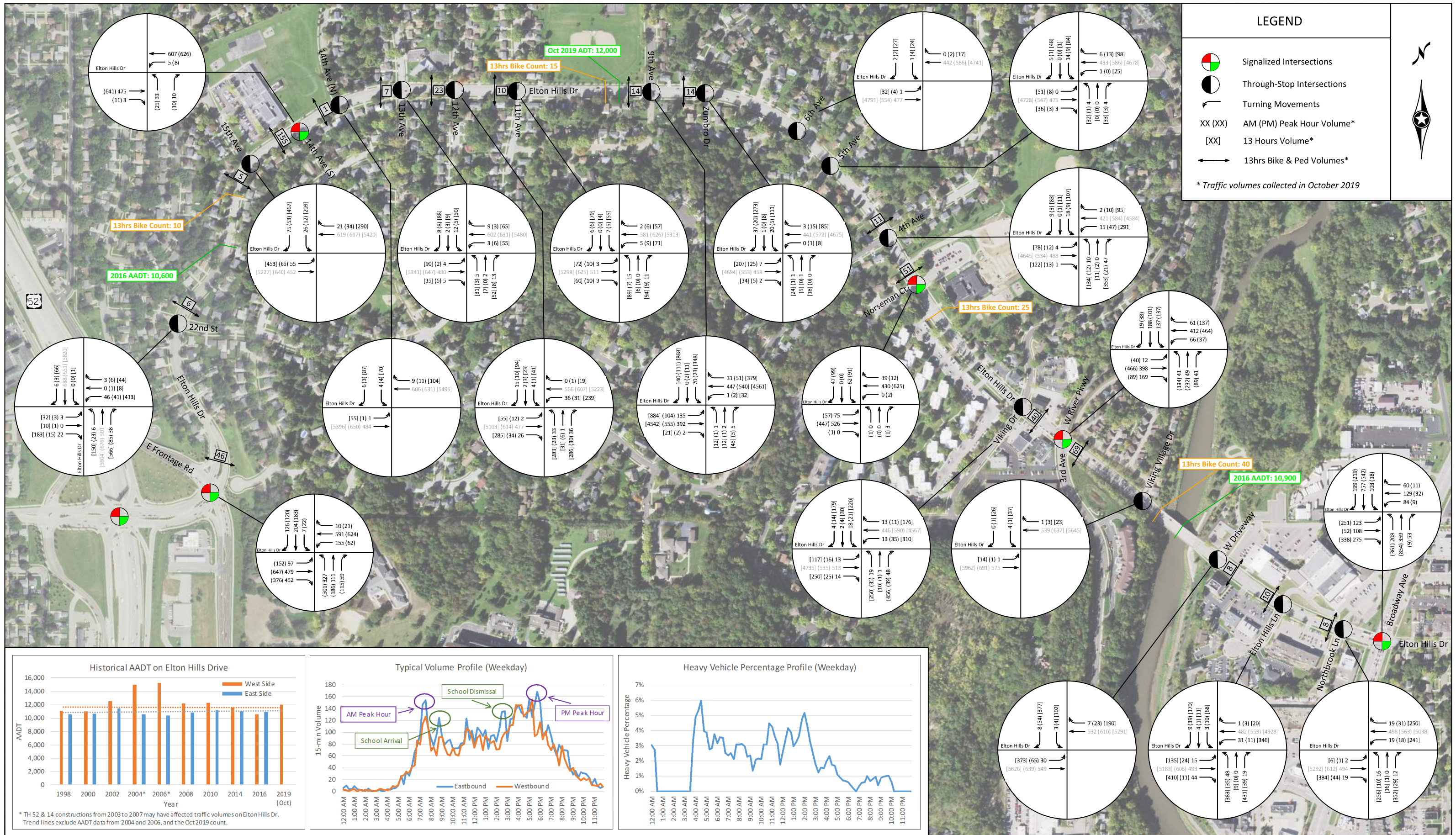
2.3 Motor Vehicle Speeds

A speed study is an important part of investigations into traffic safety. Drivers take many roadway environment factors into consideration when choosing a speed. The speed that most people consider reasonable is an important value. Data is collected by performing 48-hour continuous data collection. An analysis is done on the results to determine the average and 85th percentile speed. The posted speed limit near the 85th percentile speed is considered the maximum safe and reasonable speed. Studies show that traveling faster or slower than this value or speed differential can increase the chances of being in a crash. As the motor vehicle speed increases, the percent probability of a crash resulting in an injury and degree of injury severity also increases with motorist speed.

Simply lowering the posted speed limit will not change driver behavior. If a speed limit is artificially set at a speed inconsistent with driver behavior, motorists are not likely to comply with the posted speed limit. If a lower motor vehicle speed profile for a corridor is desired, changes to the roadway environment typically need to be made. **Figure 4** illustrates the existing average and 85th percentile speed for four locations along Elton Hills Drive as collected by the City of Rochester in fall 2019. The speed study indicates the following:

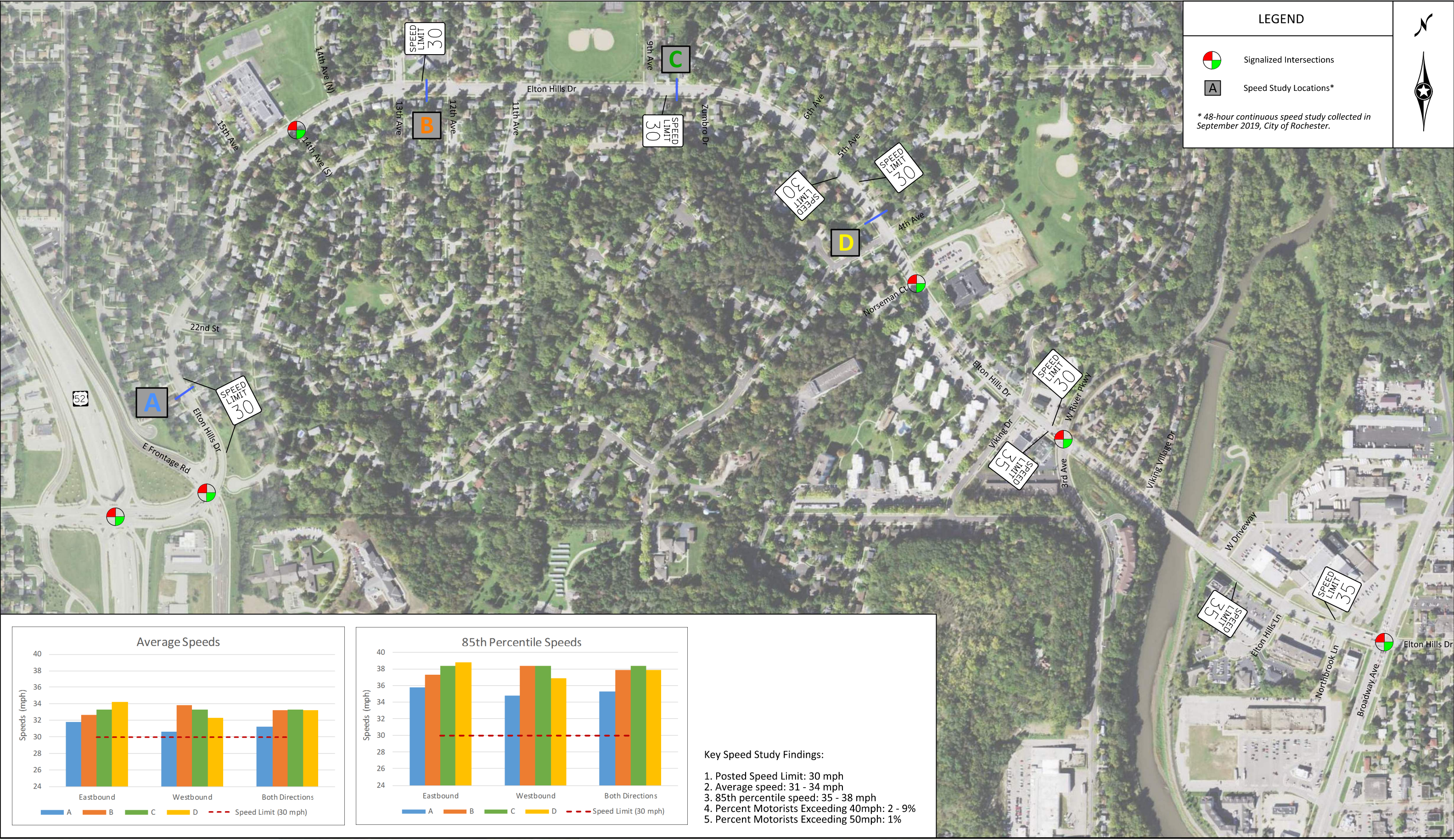
- The average speed to be 31-34 mph,
- The 85th percentile speed (85% of motorist traveling this speed or less) to be 35 to 38 mph
- Approximately 2 to 9% of all motorists are traveling faster than 40 mph; and
- Approximately 1% of motorists are traveling faster than 50 mph.

The speed study indicates that overall, there is an over representation of speeding motorists, the overall travel speed is in excess of the posted limit. Either the speed zone for the corridor is not appropriately set, or design changes are needed to achieve the targeted design speed. Currently, speed zones are enforced through routine patrol. Increasing enforcement and developing targeted speed zone enforcement strategies may also provide benefit.



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Figure 3
Motor Vehicle, Pedestrian, Bicycle and Truck Volumes



2.4 Roadway Safety

Historical crash data from the most 10-year period (2009-2019) was obtained from the City of Rochester. Police reports for the past three years were provided to supplement the evaluation. Evaluation of current crash characteristics may identify certain patterns correctable by design changes.

2.4.1 Key Factors in Safety Analysis

In examining the crash data obtained, four key factors were considered: (1) crash rate, (2) critical crash rate, (3) crash severity, and (4) crash type distribution.

Crash Rate

History has proven that crashes are a function of exposure. Roadways with higher traffic volumes experience more crashes than similar roadways with lower volumes. Rather than simply documenting the number of crashes that occur over a particular segment or at a particular intersection, crash rates must be considered. Crash rates normalize different locations with varying traffic volumes, providing a useful tool in comparing the locations with respect to safety.

Critical Crash Rate

Crash occurrence is somewhat random by nature. Identifying every segment or intersection with a crash rate above the average value in an analysis would produce a large amount of data that may not be statistically relevant with respect to safety deficiencies. The critical crash rate, the second key factor in safety analysis, identifies locations that have a crash rate higher than similar facilities by a statistically significant margin. The critical crash rate is calculated by adjusting the system-wide average based on the amount of exposure and a statistical constant indicating level of confidence.

Crash Severity

The third key factor in safety analysis is crash severity. Crash severity quantifies how severe the crashes are at a particular location. For Elton Hills Drive, understanding the percentage of crashes that resulted in an injury (all degrees) was the important consideration.

Crash Type

The fourth key factor in safety analysis is crash type distribution. Each crash is classified as rear-end, sideswipe (passing), right angle, head on, left turn, pedestrian, bicycle, etc. The crash type distribution for corridor segments and key intersections was investigated to determine if there are any underlying factors that could be explored to identify potential strategies for improvement.

2.4.2 Crash Summary

The intersection crash hot spot locations, crash rates, segment crash rate and crash type summaries are provided in **Figure 5**.

The crash analysis finds the following key conclusions:

- Most crashes are occurring at three locations – East Frontage Road, W River Parkway and Broadway Avenue (153 total crashes or approximately 50% of the corridor total)
- Elton Hills Drive between East Frontage Road and W River Parkway has incurred 136 crashes (44% of the corridor total). This segment crash rate is 2.46, excluding W River Parkway crashes, or 3.22 including W River Parkway crashes. This crash rate is significant.
 - 25% of the crashes have resulted in an injury (exceeds statewide average of 23%)
 - Over 70% of the crashes are rear end, left turn, sideswipe, run off road or head on. These types of crashes are potentially related to shared left turn/through lane and 4-lane undivided street design.
 - 2% (or 6 total crashes) involved a pedestrian or bicyclist. These occurred at 12th Avenue, 4th Avenue (3), W River Parkway and Northbrook intersections.
- Excluding the East Frontage Road and Broadway Avenue intersections, there were five locations (22nd Street, 9th Avenue, Viking Drive, W River Parkway and Northbrook Lane) identified to have a crash rate in excess of the statewide average. Crash rate at these locations did not exceed the critical crash rate.
 - 65% to 80% of the crashes at these intersections were rear end, left turn, sideswipe or head on related crashes occurring on Elton Hills Drive.
 - At 9th Avenue and W River Parkway, the percentage of head on crashes (15%) is notable. This crash type is likely directly related to the lack of exclusive turn lanes and crossing multiple shared lanes.

3 Four to Three Lane Conversion

Based on the characteristics of the corridor, and findings of the safety analysis, the most beneficial improvement for this corridor would be conversion to a 3-lane facility. Three-lane roadways have been successfully implemented for decades, but recent years have seen an increase in popularity and an upsurge in interest from agencies throughout Minnesota and nationally to convert existing 4-lane roadways to 3-lane. This is due to the variety of safety and mobility benefits that 3-lane roadways have, coupled with the opportunity of reallocating the extra space for other uses or travel modes, such as parking, pedestrian realm, bicycle lanes, transit use, turn lanes, medians or pedestrian refuge islands. Historically, 4-lane undivided roadways incur the highest rate of crashes compared to any other facility type. Elton Hills Drive's experience shows consistency with this stat. Statewide; the average crash rate of 4-lane undivided roadway has the highest rate of crashes by 25-50%. In addition to a prevalent rate of sideswipe, rear-end, run off road and head on crashes that are often associated with 4-lane undivided roadways, the accessibility and safety of motorists and pedestrian/bicyclists crossing the road is a primary safety and comfort consideration.

3.1 Benefits of a Three Lane Conversion

There are several benefits of converting 4-lane roadways to 3-lane roadways, including safety, operational, multimodal, and quality of life. Key benefits are discussed in **Table 1**.

Table 1. Three Lane Conversion Benefits

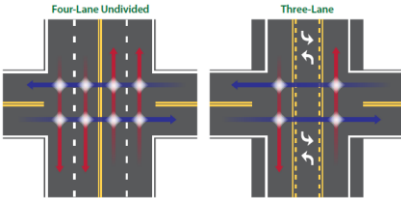
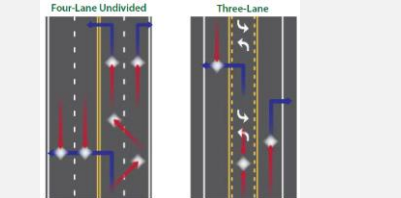
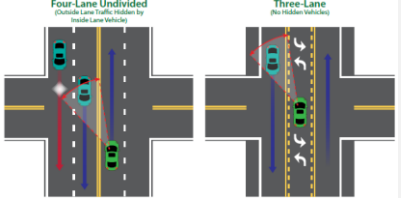
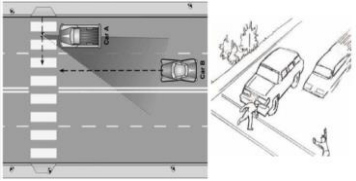
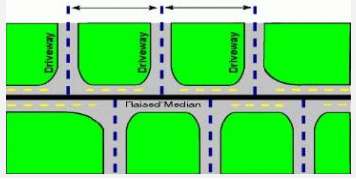
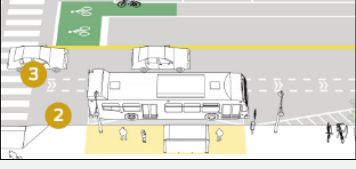
Metric	Key Benefit	Description
	Reduce Conflicts	 The number of conflict points at an intersection is halved, from 8 conflict points with a 4-lane to 4 conflict points with a 3-lane when the cross street is a two-lane roadway
Safety	Reduce Vehicle Interactions and Crash Severity	 The number of vehicle conflict points at mid-block locations decreases from 6 to 3 when comparing 4-lane roadways to 3-lane. Reduces weaving and lane change maneuvers
	Improve Left-turn Sight Distance	 Provides improved left turn movement lateral offset and reduces the potential for on-coming vehicle to be blocked from view.

Table 1. Three Lane Conversion Benefits Continued

Metric	Key Benefit	Description
Safety	Eliminate Multiple-threat Crashes	 Eliminates the double lane threat when crossing. When crossing on a roadway with more than one through lane, a stopped vehicle can block the view of a pedestrian from vehicles in the other lane
	Reduce Vehicle Speed and Speed Differential	 High motorist speeds result in greater potential for injury related crashes. Moving all through traffic to one lane, motorists are must travel the speed of the slowest vehicle which has been shown to reduce overall speeds. More consistent traffic flow
Mobility	Separating Left Turning Vehicles	 Improved safety at intersections (removes left turning motorist from through traffic) but also can improve delay and capacity at intersections by yielding cars not impeding the through lane.
	Easier Gap-taking from Side-street	 Side street traffic can more comfortably enter the mainline because there are fewer lanes to cross. This can reduce delay overall. However, the number of traffic gaps may be reduced and peak hour traffic may experience slight increase in wait time.
	Access Density	 Corridors with high density of street access, residential or commercial driveways and have a high number of turning movements generally have similar capacity between 4-lane and 3-lane. Separating the turn movements improves efficiency.
Multimodal	Easier Pedestrian Crossing and Refuge Island Opportunities	 Improves comfort, ease of crossing, reduced exposure to oncoming traffic and visibility. Pedestrians only have to be concerned with one direction, and one lane of traffic at a time.
	Bicycle Facilities	 Reallocated space provides opportunities to consider a bicycle facility, address system network gaps and connections or dedicated street space.
	Transit	 Reallocated space provides opportunity to incorporate bus pull outs at transit stops.
Quality of Life	Comfort and Environment	 Added to direct safety benefits, improves the quality of life in the corridor through a combination of bicycle lanes, pedestrian improvements, and reduced speed differential, which can improve the comfort level for all users

Although there are many benefits of a 3-lane conversion, there are several potential impacts (usually corridor specific) or design considerations that should be evaluated. These include:

- Appropriate reallocation of space. Providing too narrow or too wide of travel or parking lanes can have unintended lane use or lesser benefit to addressing motor vehicle speeds.
- The two-way center left turn lane design at overlapping high volume left turn accesses may require special design to avoid safety concerns. This has typically not been found problematic with residential driveways.
- Concerns with pedestrians using the center turn lane (without a refuge island) as a refuge space when crossing the road.
- At certain traffic volume levels or directionality of the peak hour volumes mobility concerns may arise. Such as;
 - Reduced capacity
 - An unacceptable increase in travel time along the corridor
 - Increased wait time at the stop sign approaches to enter the corridor
 - Longer vehicle queues at traffic signals. Though the delay may be acceptable, the perception of more cars in line makes the corridor feel busier.

3.2 Factors to Consider

While a conversion of a roadway from a 4-lane configuration to 3 lanes can provide a variety of benefits, it is important to make sure the roadway is well-suited for the conversion. **Table 2** highlights key factors that require consideration when evaluating a corridor for conversion. A comprehensive review of the Elton Hills Drive corridor with respect these considerations are discussed in Section 3.5.

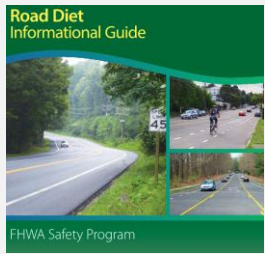
3.3 Local and National Experience

There are numerous case studies both locally and nationally that have documented various results of 4-lane to 3-lane conversions. Most of these case studies have focused on the resultant safety improvement metrics, whereas a few local conversions on high volume corridors have measured mobility metrics. Comparing experiences on other corridors can provide perspective on expectations that could be seen for Elton Hills Drive. **Table 3** highlights a few key local and national case studies.

Table 2. Key Three Lane Conversion Considerations

Key Factors	Description
Crash Patterns	Historical crash data should be analyzed to determine if crash patterns are of the type that can be addressed by a conversion. Conversions from 4-lane to 3-lane have been proven to lower rear end, sideswipe, head-on, and pedestrian crashes.
Parking	It is important to understand if parking is needed and can be provided with the new configuration. In some cases, continuous on-street parking can be provided as a result of a conversion. Trade off with other street uses (e.g., bicycle lanes or pedestrian space may require consideration)
Roadway Function	Roadways serve two major functions: access and mobility. Interstates and principal arterials provide the highest degree of mobility but are limited in providing land access. Local streets provide a high degree of land access with less mobility. It is important to understand if the intended roadway function can be maintained with a 3-lane cross section.
Average Daily Traffic (ADT)	Roadways with high Average Daily Traffic (ADT) may not be appropriate for a 3-lane configuration. Studies have shown that a 3-lane cross section can operate with acceptable levels of service with ADTs up to 24,000. FHWA (Federal Highway Administration), advises that 3-lane roadways with ADTs above 20,000 are reaching capacity and may experience poor levels of service.
Peak Hour Traffic Volumes	Roadways with peak hour volumes in one direction above 875 are likely to see a reduction in level of service on a 3-lane roadway. Volumes at or below 750 vehicles in one direction are good candidates and can typically be accommodated with minimal traffic flow impacts.
Traffic Volume Directional Distribution	The directionality of volumes must also be considered. If the directional distribution is not 50/50, an analysis should be performed in the direction of heavier traffic flow to determine any mobility or traffic capacity concerns.
Access Points and Turning Traffic Patterns	Roadways with a high number of left turns are generally good candidates for conversion. The spacing of access driveways and turning volumes should be considered. A TWCLTL is typically a good solution for higher access density corridors if the overlapping left turn volumes are appropriate.
Transit and Freight	Generally, these types of vehicles use the outer lane for stopping, so it may be necessary to provide a wide shoulder, or designated spacing shadowing on street parking; or accommodated in bike lane design to accommodate their needs. Maintaining the overall mobility of the corridor is important to transit service and reliability.
Roadway Width	Many 4-lane to 3-lane conversion projects can occur within the existing right-of-way and may only require pavement marking changes. This is low cost. The street width will inform the 3-lane conversion options, for example, what amount of parking or bicycle space or travel lane space may be accommodated.

Table 3. Three Lane Conversion Case Studies

Case Study	Description	Key Findings
	Rochester, MN 2nd Street (CR 22 to 23rd Avenue) Primary Land Use: Surrounding Residential AADT: 8,700	1. Crash rate between signals was reduced from 1.05 to 0.58 crashes (50%). 2. The crash rate (including the 2 signalized intersections) went up 20%. 3. The crash rate went up at the signalized intersections of 23rd Avenue and West Circle Drive, but reduced along the three lane segment between signals
	St. Paul, MN Maryland Ave (Payne Avenue - Johnson Parkway), St Paul, MN Primary Land Use: Residential AADT: 15,100 2 Traffic Signals Local Transit Service	1. 77.8% reduction of left-turn crashes (3m data) 2. Around 5 mph reduction in vehicle speeds 3. 18.5% total reduction in crashes (3m data) 4. Injury crashes reduced from 25.9% to 18.3% (3m data) 5. "Safer pedestrian crossing, cycling, driving", "slower speed", "more comfortable driving" feedbacks from community survey 6. Travel time through corridor increased about 25%. 7. 3-lane corridor determined to operate within acceptable levels and was community supported
	St. Paul, MN Maryland Ave (Arkwright Avenue to Payne Avenue) Primary Land Use: Residential AADT: 22,400 3 Traffic Signals No Transit Service Access: Approximately 30 Residential Driveways (7 blocks) Test Evaluation In Progress	1. Around 4-6 mph reduction in vehicle speeds 2. Travel time through corridor increased about 40s (25%) during peak hours and 20s (15%) during off peak hours (due to reduced overall speed). 3. Number of pedestrian crossings remained unchanged. 4. Wait time at stop signs to enter Maryland Avenue increased by approximately 10s on average 5. Longer vehicle queues at traffic signals, but 3-lane corridor determined to operate within acceptable levels 6. Traffic volume along corridor reduced about 5%. 7. Public feedback was generally positive to make 3-lane permanent and refuge island. The public felt the pedestrian and motorist safety was improved. The public did say the felt there was increased backup during rush hour and fewer traffic gaps.
	City of Minneapolis, MN Citywide 11 Corridors (2004-2012) in Minneapolis, MN 8.8 miles Primary Land Use: Residential and/or Commercial AADT: 10,000 in Average (2,700 to 16,000) Local Transit Service	1. Total crash reduction ranged from 5% to 65% with an overall average reduction of 25% 2. Total injury crashes changed from a slight increase (1 corridor) to a 65% reduction. On average a 36% reduction injury related crashes was found.
	National Experience Safety Evaluation, FHWA, 2010 45 sites in California, Iowa, and Washington ADT: 3,700 to 26,400	1. Iowa data: 47% reduction in total crashes 2. California and Washington data: 19% reduction in total crashes 3. Combined data: 29% reduction in total crashes Source: Road Diet Informational Guide, FHWA Safety Program, Appendix A

3.4 Mobility

Preserving the quality of traffic flow and mobility along Elton Hills Drive is an important priority for the City. An assessment of the existing quality of mobility (traffic operations) for the corridor and intersections was completed. The quality of traffic flow and mobility

is measured using Level of Service (LOS) methodology. A traffic operation analysis was conducted that focuses on the a.m. and p.m. peak hours (including peak hour of through traffic and peak hour of school related turning traffic) for the existing 4-lane configuration. An analysis of a potential 3-lane configuration was also completed to provide comparison.

3.4.1 Analysis Tool

The traffic operation analysis was completed using SimTraffic. SimTraffic is a microscopic simulation tool and was used to evaluate the operational performance of the signalized and unsignalized intersections. Due to the interaction of closely spaced intersections along the corridor, the traffic mobility of the corridor was evaluated using micro-simulation traffic modeling. The primary variables influencing capacity along the corridor include traffic volume (through and turning traffic), traffic signal timing at signalized intersections, pedestrian/bicycle volumes and lane configuration. Individual residential home driveways were not specifically included in the analysis, since the level of traffic activity at these locations will have a negligible effect on the roadway capacity.

3.4.2 Measurement of Effectiveness (MOE)

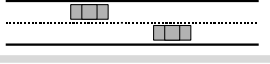
The following MOEs were selected to represent the traffic operation performance of Elton Hills Drive:

- Approach delay and intersection delay
- Corridor passenger vehicle travel time and average operating speed
- Intersection and corridor Level of Services (LOS)
- Planning level capacity assessment

These MOEs comprehensively represent the traffic operation performance of the corridor as well as the individual intersections and uncover areas of focus. The term level of service (LOS), as taken from the *Highway Capacity Manual (HCM)*², refers to the ability of an intersection to process traffic volumes. It is defined as the delay to vehicles caused by the traffic control at the intersection or average operating speed along an urban arterial. The results of this measure of effectiveness (MOE) are typically presented in the form of a letter grade (A-F) that provides a qualitative indication of the operational efficiency or effectiveness. The general relationship between intersection delay, average operating speed and LOS are presented in **Table 4**.

² Highway Capacity Manual, 6th Edition, Transportation Research Board.

Table 4. LOS Definition

LOS	Description	Signalized Intersection	Urban Street LOS
		Intersection Delay (Seconds / Vehicle)	Average Travel Speed (mph)
			Base Speed (30 mph)
A	 Free Flow. Low volumes and no delays.	0 - 10	>24
B	 Stable Flow. Speeds restricted by travel conditions, minor delays.	>10 - 20	>20
C	 Stable Flow. Speeds and maneuverability closely controlled due to higher volumes.	>20 - 35	>15
D	 Stable Flow. Speeds considerably affected by change in operating conditions. High density traffic restricts maneuverability, volume near capacity.	>35 - 55	>12
E	 Unstable Flow. Low speeds, considerable delay, volume at or slightly over capacity.	>55 - 80	>9
F	 Forced Flow. Very low speeds, volumes exceed capacity, long delays with stop and go traffic.	> 80	<=9

Source:

1. Highway Capacity Manual, 6th Edition (Published 2016), Transportation Research Board, Exhibit 18-1 for Signalized Intersections, Exhibit 19-8 for Un-Signalized Intersections, and Exhibit 16-3 for Urban Street Facilities.

2. Transportation Research Board (TRB), Highway Capacity Manual, Special Report 209

A planning level assessment was completed to compare the daily traffic volumes (ADT) against estimated capacity thresholds for various facility types. A daily volume capacity of a facility accounts for peak hour percentage, percentage of left turning traffic and industry standard lane type capacities.

3.4.3 Traffic Operation Analysis Summary

The intersection and corridor performance MOE summaries are provided in **Figure 6**. Key findings of the analysis are summarized below:

- All intersection and stop sign approaches are expected to operate at an acceptable LOS C or better. The analysis found no to minimal expected change at most intersections within the corridor between a 4-lane or 3-lane configuration.
- The analysis found that a motorist waiting at a stop sign might experience no change in delay to up to a 10 second longer wait on average if Elton Hills were a 3-lane configuration.
- Based on the characteristics, a 3-lane facility along Elton Hills Drive is expected to have a daily capacity of 19,000 or greater. The 4-lane facility has an estimated daily capacity of 25,000 vehicles. The existing and historical ADT of 12,000 vehicles per day is a LOS B and is greater than 40% below capacity.
- A delay reduction was found at the W River Parkway intersection. The optimization of the signal timing will improve efficiency at this location.

- Overall a motorist traveling through the corridor would experience minimal change in travel time between lane configuration alternatives. The analysis found a 0% to 4% change. In reality, if Elton Hills were a 3-lane configuration, a motorist is likely to experience a minimal travel time increase, as the overall free flow speed of the corridor would be expected to reduce.
- The signalized intersections at W River Parkway, US 52 and the East Frontage Road will benefit from updating the signal timing and will improve the capacity and efficiency of these intersections. Broadway is scheduled to receive updated signal timing this fall of 2019.

3.5 Three Lane Conversion Feasibility Assessment

Table 5 summarizes the feasibility assessment of converting Elton Hills Drive to a 3-lane configuration. The assessment highlights the key findings and metrics discussed in the previous sections of this document.



Elton Hills Drive Traffic and Safety Study



Figure 6
Intersection and Corridor Mobility Performance Analysis Summary

Table 5. Three Lane Conversion Feasibility Assessment Matrix

Key Factors	Key Findings	Favorability	Conclusion
Crash Patterns	153 crashes occurred at 3 signalized intersections - E Frontage Rd, W River Pkwy and Broadway Ave. This is approximately 50% of total corridor crashes. 136 crashes occurred between E Frontage Rd and W River Pkwy (Segment 1) and 20 crashes occurred between W River Pkwy and Broadway Ave (Segment 2), from 2009 to 2019. These are 44% and 6% of total corridor crashes. - Segment 1 crash rate (CR) ranges from 2.46 (exclude W River Pkwy intersection) to 3.22 (include W River Pkwy intersection) and exceeds Statewide Average CR 0.90 (non-junction) - 4.00 (include junctions) as well as critical CR 1.24 - 4.70. 2% of the crashes involve Bike and Ped. - About 70% were Sideswipe, Rear-end, Run off Road or Left-turn crashes. 25% injury crashes in Segment 1, exceeding state-wide average injury percentage (23%).	- The 3-lane conversion is expected to reduce Sideswipe, Rear-end, Run off Road, Left-turn and head on crashes that consist >70% of all historical crashes along Elton Hills Dr. - The conversion is expected to improve pedestrian crossing safety, and potentially improve cycling comfort if bike lanes are added. - The conversion is expected to reduce crash severity due to reduced vehicle speeds.	Feasible Benefit Expected
Parking	- On-street parking can be accommodated within the existing roadway width with the 3-lane conversion - On-street parking is currently lightly used	- Most cross-section alternatives accommodates on-street parking on both side of Elton Hills Dr. - Some alternatives trade off one or both side(s) of on-street parking for buffered bike lanes and/or wider center two-way left-turn lane.	Feasible Potential for No Impact (depends on cross-section alternative)
Roadway Function / Mobility	- All intersection and stop sign approaches are expected to operate at LOS C or better. - Motorist at stop sign approaches may experience 0 to 10s extra wait (on average). - Motorist travel time change is expected to be negligible (approximately -2% to +4%). - Existing and historical ADT is LOS B or better for 3-lane roadway (40% below capacity). - A delay reduction (intersection efficiency) improvement at W River Pkwy is expected with the 3-lane configuration.	- Roadway function is maintained with minimal traffic mobility impact from 3-lane conversion. - The slight travel time and side-street delay increase are not expected to negatively impact roadway mobility or access.	Feasible Minimal Impact
Average Daily Traffic (ADT)	The historical AADT along Elton Hills Dr is around 11,000. Insignificant volume growth was observed for the past 20 years.	The AADT (11,000-12,000) of Elton Hills Dr falls well below the capacity threshold of 19,000.	Feasible Minimal Impact
Peak Hour Traffic Volumes	The peak hour traffic volumes along Elton Hills Dr are well below the 875 threshold for 3-lane conversion.	The peak hour traffic volumes along Elton Hills Dr are, in fact, below the 750 threshold, which indicates that it's a good candidate for 3-lane conversion.	Feasible Minimal Impact
Traffic Volume Directional Distribution	The traffic volume directional distribution is roughly 50/50 along Elton Hills Dr.	A peak direction single lane capacity concern does not exist	Feasible No Impact
Motor Vehicle Speeds	- The average speed to be 31-34 mph, - The 85th percentile speed (85% of motorist traveling this speed or less) to be 35 to 38 mph - Approximately 2 to 9% of all motorists are traveling faster than 40 mph; and - Approximately 1% of motorists are traveling faster than 50 mph	An overall speed reduction is expected. Locally and national 3-lane conversions have resulted in vehicle speed reductions up to 5 mph or more	Feasible Benefit Expected
Access Points and Turning Traffic Patterns	- There are 14 unsignalized public side streets along the 1.8 miles of Elton Hills Dr; some of them are closely spaced (as little as 300 feet). - Peak hour left-turn volumes onto side streets range from 0 to 135.	- Close spacing of side streets indicates that it's a good candidate for center two-way left-turn lane. - Side-streets with high left turn volumes (e.g. 9th Ave and W River Parkway) may become more efficient from the 3-lane conversion due to addition of the exclusive left-turn lane.	Feasible Benefit Expected
Transit and Freight	- Elton Hills Dr prohibits trucks over 10,000 gross vehicle weight. - There are 2 transit routes (as well as their weekend versions) travel and stop along Elton Hills Dr. The 3-lane conversion will maintain curb-side bus stops and allow buses to stop out of travel lanes.	- The 3-lane conversion is not expected to negatively affect trucks movement. - The conversion will not impact transit operation. Design configurations will allow for buses to stop out of travel lanes.	Feasible No Impact
Roadway Width	- The existing roadway width is 56 feet. - All 3-lane cross-section alternatives could occur within the existing roadway width and allow for ability to serve existing and new corridor users	- The existing roadway width is sufficient to accommodate all existing features (parking, turn lanes, etc.) with the 3-lane conversion. - Some alternatives may include minimum lane width per State Aid standards, usually trade-offs between parking and bike lanes	Feasible Street Space Trade Off May be Required (depends on cross-section alternative)

4 Concept Alternatives

To provide corridor or intersection safety improvements along Elton Hills Drive concept alternatives under both 3-lane and the existing 4-lane configuration are evaluated. There are several lane configuration alternatives that can be considered; however, with each alternative the existing curbs would not be reconstructed. Considerations include; on-street parking, bicycle facility type, lane use and travel lane widths. In addition, strategies and treatments to improve intersection, pedestrian and bicycle safety are highlighted.

4.1 Typical Sections 3-Lane Facility

Table 6 highlights five potential 3-lane roadway configuration alternatives within the existing 56-foot roadway width, and key considerations or trade-offs.

Table 6. Typical Section Alternatives 3-Lane Facility

3-lane Cross-section Alternatives		
Alternative 1 - Bike Lanes and Parking on Both Sides		
Road Width: 56' Right-of-way Width: 82'	Key Features • 3-lane roadway with center two-way left-turn lane • Both sides parking and on street designated bike lanes	Considerations • Parking and bike lanes are at minimum width per State-aid standards. Since both lanes are adjacent, this cross-section may require a variance. • Lane widths and traffic volume may be uncomfortable for bicyclists. • Two-way left-turn lane is at minimum width - left turning may be uncomfortable.
Alternative 2 - Parking on Both Sides		
Road Width: 56' Right-of-way Width: 82'	Key Features • 3-lane roadway with center two-way left-turn lane • Both sides parking • No dedicated bike lanes	Considerations • Wide parking space increase parking comfort. • Wide center lane increase left turning comfort. • Lack of bike lanes may deter bicycle use; bicycles using the vehicle lane may slow down vehicle traffic. • Striped edge line is necessary. Low parking utilization could allow space for bicycle travel (not signed or marked as bike route).
Alternative 3 - Shared Vehicle/Bike Lanes and Parking		
Road Width: 56' Right-of-way Width: 82'	Key Features • 3-lane roadway with center two-way left-turn lane • Both sides parking • Shared bike lane facility	Considerations • Lack of designated bike lanes may deter bicycle use; bicycles using the vehicle lane may slow down vehicle traffic. • Roadway ADT may be too high for a comfortable designated shared lane facility. • Wide travel lane may increase vehicle speeds. • Striped edge line is necessary.

Table 6. Typical Section Alternatives Continued

Alternative 4 - Bike Lanes and One-side (either side) Parking					
Road Width: 56' Right-of-way Width: 82'	<table border="1"> <thead> <tr> <th>Key Features</th><th>Considerations</th></tr> </thead> <tbody> <tr> <td> • 3-lane roadway with center two-way left-turn lane • Designated on street bike lanes • One side parking </td><td> • The one side parking can be on either side of street (current parking utilization is very low). • Lack of on street parking convenience may be a neighborhood concern. • Improves bicycle lane design and bicyclist comfort with wider lanes. • Lane widths could be adjusted to introduce buffer striping. </td></tr> </tbody> </table>	Key Features	Considerations	• 3-lane roadway with center two-way left-turn lane • Designated on street bike lanes • One side parking	• The one side parking can be on either side of street (current parking utilization is very low). • Lack of on street parking convenience may be a neighborhood concern. • Improves bicycle lane design and bicyclist comfort with wider lanes. • Lane widths could be adjusted to introduce buffer striping.
Key Features	Considerations				
• 3-lane roadway with center two-way left-turn lane • Designated on street bike lanes • One side parking	• The one side parking can be on either side of street (current parking utilization is very low). • Lack of on street parking convenience may be a neighborhood concern. • Improves bicycle lane design and bicyclist comfort with wider lanes. • Lane widths could be adjusted to introduce buffer striping.				
Alternative 5 - Buffered Bike Lanes					
Road Width: 56' Right-of-way Width: 82'	<table border="1"> <thead> <tr> <th>Key Features</th><th>Considerations</th></tr> </thead> <tbody> <tr> <td> • 3-lane roadway with center two-way left-turn lane • Buffered on street bike lane (parking removal) </td><td> • Wide center lane increase left turning comfort. • Buffer space increase cycling comfort and may attract additional bicycle users. • Removes on street parking which may be a neighborhood concern. </td></tr> </tbody> </table>	Key Features	Considerations	• 3-lane roadway with center two-way left-turn lane • Buffered on street bike lane (parking removal)	• Wide center lane increase left turning comfort. • Buffer space increase cycling comfort and may attract additional bicycle users. • Removes on street parking which may be a neighborhood concern.
Key Features	Considerations				
• 3-lane roadway with center two-way left-turn lane • Buffered on street bike lane (parking removal)	• Wide center lane increase left turning comfort. • Buffer space increase cycling comfort and may attract additional bicycle users. • Removes on street parking which may be a neighborhood concern.				

The provision of a bicycle facility along Elton Hills Drive is consistent with the Non-motorized Transportation Analysis section of the 2040 Comprehensive Plan and does address a bicycle network gap. However, it should be noted that the conversion of Elton Hills Drive to a 3-lane configuration does not necessarily need to include a bicycle facility. In other words, the decision to convert the corridor to a 3-lane configuration should not be associated with provision of a bicycle facility. Alternative pavement marking concepts exist that would provide suitable corridor mobility and safety improvements.

4.2 Typical Sections 4-Lane Facility

Table 7, on the following page, highlights four potential 4-lane roadway configuration alternatives within the existing 56-foot roadway width, and key considerations or trade-offs.

4.3 Pedestrian, Bicycle and Motor Vehicle Safety Improvement Strategies

To improve intersection safety for motorists, or pedestrian/bicyclist crossing safety, comfort, and quality of experience, the strategies could range from establishing connections and improving accessibility, improving visibility, reducing exposure, enhancing awareness or providing protection. The implementation of such strategies is dependent upon intersection characteristics; but, are typically considered in the hierarchy of least restrictive measures first to the most restrictive measures only when warranted. Although there are many treatments that fit into each strategy category, Table 8, on page 25, illustrates and discusses a few treatments that might be beneficial to Elton Hills Drive at selected locations.

Table 7. Typical Section Alternatives 4-Lane Facility

4-lane Cross-section Alternatives		
Alternative 1 - Left-turn Lane at Intersection		
Road Width: 56' Right-of-way Width: 82'	Key Features • 4-lane roadway with left-turn lanes at key intersections • No dedicated bike lanes	Considerations • Parking removal (both sides) for the length of turn lane and travel lane tapers will be necessary • Center left-turn lanes are at minimum width • Lack of bike lanes, and loss of shoulder/parking lane space may deter bicycle use.
Alternative 2 - Refuge Median at Intersections		
Road Width: 56' Right-of-way Width: 82'	Key Features • 4-lane roadway with center refuge median at select intersections and/or driveways • No dedicated bike lanes	Considerations • Parking removal (both sides) for length of the median and travel lane tapers will be necessary • Center left-turn lanes are at minimum width - left turning may be uncomfortable. • Lack of bike lanes, and loss of shoulder/parking lane space may deter bicycle use. • If left turn movements are still allowed, the negative lateral offset is even greater. This affects sight lines and potentially safety
Alternative 3 - Curb Extension at Intersections		
Road Width: 56' Right-of-way Width: 82'	Key Features • 4-lane undivided roadway • On-street parking (7') and bump-out (5-6') at selection intersections • No dedicated bike lanes	Considerations • Maintains existing travel and parking lane widths. • Bump-outs improve pedestrian crossing experience while limit vehicle right-turn treatment options, reduce turning space and minimally reduce parking spaces. • Bump-outs at intersection would limit or negate a continuous bike lane
Alternative 4 - On Street Bike Lanes		
Road Width: 56' Right-of-way Width: 82'	Key Features • 4-lane undivided roadway • No on-street parking • Dedicated bike lanes on both sides of street	Considerations • Removes on street parking. Lack of on street parking convenience may be a neighborhood concern. • Dedicated bicycle lane improves bicyclist comfort; however the bike lane and adjacent travel lanes are at minimal width. This may be an uncomfortable bicycle facility • Does not allow for other intersection improvements, such as curb extensions or refuge medians

Table 8. Intersection and Pedestrian/Bicycle Safety Improvement Toolbox

4-to-3 Lanes Conversion			
	Description Convert a 4-lane undivided roadway to 3-lane with middle two-way left-turn lane. This conversion decreases the effective pedestrian crossing distance and provides opportunities for median pedestrian refuge treatment.	Benefits 1. Shortens the effective pedestrian crossing distance. 2. Provide a median space for easier pedestrian crossing. 3. The median space can be upgraded to a refuge island (see details below).	Considerations 1. The 3-lane conversion of Elton Hills Dr is expected to have minimal impact on vehicle mobility, while reducing side-swipe, rear-end, head on and left-turn crashes. 2. Reallocation of space for other corridor users or street use and appropriate lane width designations.
Left-turn Lane			
	Description Absent a two-way center left turn lane configuration, provide an exclusive left-turn lane to the mainline at signalized and unsignalized intersections. This allows the left turning vehicles to position out of the through traffic, minimizing the disruption to the	Benefits 1. Reduce disruptions to the through traffic from the left turning vehicles. 2. Reduce rear-end crashes with left turning vehicles. 3. Increase roadway capacity at intersections.	Considerations 1. May trade-off street space with other roadway elements (right turn lane, parking space, bike lane, etc.) . 2. Compatible with the typical 3-lane section with center two-way left-turn lane. 3. The length of left-turn lane should accommodate 95th percentile queues in the traffic operation study. 4. The lane width of left turn lanes can go down as low
Median Refuge Island			
	Description Medians and crossing islands (also known as refuge islands or center islands) are raised areas that are constructed in the center portion of a roadway that can serve as a place of refuge for pedestrians who cross the road mid-block or at an intersection. After crossing to the center island, pedestrians wait for motorists to stop or for an adequate gap in traffic before crossing the second half of the street.	Benefits 1. Provide a simplified crossing maneuver by allowing pedestrians to concentrate on only one direction of traffic at a time, creating the equivalent of two narrower one-way streets instead of one wide two-way street. 2. Crossing islands may also provide space for landscaping that can be used to change the visual cues of the roadway and reduce driver speeds.	Considerations 1. Crossing islands may not be appropriate or physically possible at all locations. May be most applicable at tee configuration intersections where a left turn movement is not provided. 2. Crossing islands must be fully accessible by ramps or cut through, and should provide tactile cues for pedestrians with visual impairments to indicate the border between the pedestrian refuge area and the motorized vehicle roadway. 3. Winter maintenance should be considered to keep the pedestrian route clear of snow.

Table 8. Intersection and Pedestrian/Bicycle Safety Improvement Toolbox Continued

ADA Ramps			
	Description When expanding/improving a pedestrian network, eliminating gaps in connectivity is recommended. If a sidewalk is added, or at existing and outdated intersection corners, upgrading pedestrian curb ramps to ADA standards will help provide an accessible route that people with disabilities can use to safely transition from a roadway to a curbed sidewalk and vice versa.	Benefits 1. Will establish a connection for pedestrians between streets, schools, regional trails, and parks that are accessible by all users. 2. Improving pedestrian access to transit routes will improve a multimodal transportation environment.	Considerations 1. There are numerous pedestrian ramps along Elton Hills Dr between the E Frontage Rd and Broadway Ave that may not be compliant with ADA design standards and could be considered for upgrade 2. Follow Americans with Disabilities Act (ADA) design guidelines. 3. Texture patterns must be detectable to visually impaired pedestrians. 4. Curb ramps can be easily accommodated within curb extensions. 5. Provide direction pedestrian ramps to properly orientate the user.
Curb Extensions			
	Description Curb extensions narrow the roadway and reduce crossing distance/vehicle exposure for pedestrians.	Benefits 1. Curb extensions can improve pedestrian safety by reducing the pedestrian crossing distance and reducing the time that pedestrians are in the street. 2. Drivers are encouraged to reduce speeds because of the restricted street width. 3. Tight curb radii result in slower running speeds. 4. The reduction in the street cross-section caused by curb extensions can also eliminate improper passing of turning vehicles by through movement vehicles.	Considerations 1. The turning needs of larger vehicles such as trucks and school buses need to be considered in the design of curb extensions. 2. Applicable at most intersections along Elton Hills Dr since a wide parking space is currently provided. The curb extensions could fill in the existing parking space. 3. However, may not be applicable at intersections depending upon the bicycle facility design.
High-Visibility Crosswalk Markings			
	Description A marked crosswalk is a type of pavement marking that indicates to pedestrians the recommended location to cross the roadway and also alerts approaching motorists as to where pedestrians may be crossing the street.	Benefits 1. Providing highly visible crosswalk locations can serve to bring greater attention to the motorist to expect pedestrian activity.	Considerations 1. Pavement marking material type is important. 2. Design style (i.e., parallel bar, zebra, or other). 3. Note that at uncontrolled intersections without related enhancements, marked crosswalks are unlikely to statistically increase pedestrian safety, however awareness is improved. 4. Frequent maintenance required due to vehicle tire wear and weather conditions.

Table 8. Intersection and Pedestrian/Bicycle Safety Improvement Toolbox Continued

Pedestrian Lighting			
	Description	Benefits	Considerations
	This strategy involves the installation of street lights at intersections and crosswalks. In practice, the design of the street lights can vary from low-level, pedestrian-scale decorative lighting to a typical highway intersection style that consists of a luminaire mounted on a davit arm on top of a 30- to 40-foot vertical pole. Street lights can also be located at individual intersections or crosswalks or can be continuous along roadway corridors.	1. Street lights can contribute to safety by providing an advance warning to drivers that they are approaching a point of potential conflict with crossing pedestrians and bicyclists. 2. Driver recognition of pedestrians and bicyclists is also improved because street lights illuminate them when it is dark. 3. Enhances the comfort and environment for pedestrians within the sidewalk space	1. The Elton Hills Dr corridor is entirely lit on one side, but the pedestrian environment could be improved by pedestrian-scale lighting. 2. While street light installation costs may be eligible to be covered by federal and state funds, ongoing maintenance and power costs are not eligible.
Rectangular Rapid Flashing Beacon (RRFB)			
	Description	Benefits	Considerations
	A rectangular rapid flashing beacon (RRFB) has two rapidly and alternatively flashing rectangular yellow indications attached to supplement the pedestrian warning sign (W11-2) or school crossing sign (S1-1) at a crosswalk. The beacon, when activated manually by a pedestrian or passively by a pedestrian detection system, uses an irregular flash pattern similar to emergency flashers on police vehicles, an alternating “wig-wag” flashing sequence (left light on, then right light on) with a rapid pulsing light source.	1. High rates of motorist “yield to pedestrians” compliance, up to 80 percent has been documented. 2. The RRFB has been shown to be more effective than standard yellow flashing beacons. Drivers were yielding or slowing down farther in advance of the crosswalk with RRFB than with standard round yellow flashing beacons. 3. Increases driver awareness of the presence of pedestrians. 4. Allows for normal traffic flow when not actuated.	1. The purpose of the RRFB is to increase driver awareness of crosswalks that are not across approaches controlled by YIELD signs, STOP signs, or traffic control signals. 2. Application of RRFB should be deployed at selective locations to improve effectiveness. 3. Consideration could be given if alternative treatments prove to be ineffective.

Table 8. Intersection and Pedestrian/Bicycle Safety Improvement Toolbox Continued

Leading Pedestrian Interval (LPI)			
	Description A Leading Pedestrian Interval (LPI) is a feature that displays the "Walk" indication, prior to the concurrent vehicle green indication for set amount of time (typically around 4 second). LPI allows the pedestrian to enter and be in the crosswalk to increase visibility and to establish right of way prior to allowing the concurrent motorist left turn and right movements. To enable LPI, a cycle length longer than the minimum cycle is often needed to create the additional time.	Benefits 1. Allows the pedestrian to get a "head start" into the intersection making them more visible and clearly indicating that the pedestrian in the crosswalk has the right of way. 2. Effective in reducing motorist right turn related conflicts with pedestrians 3. Increases driver awareness of the presence of pedestrians.	Considerations 1. May have potential to impact traffic flow or operations under certain circumstances, as the motor vehicle green time is reduced to accommodate the leading "walk" indication. A traffic capacity impact at intersections along Elton Hills Drive would not be expected. 2. The appropriate signal controller software is required to accommodate the leading pedestrian interval operation.
Pedestrian Countdown Timer			
	Description Countdown Pedestrian Timer Indications inform the pedestrian, or bicyclist how much time is left to cross the street on the "flashing don't walk". The time shown is based on the time it takes for a slow walking pedestrian (3.5 feet per second) to cross the full width of the roadway (curb to curb).	Benefits 1. Countdown timers are informative to all intersection users and are effective in reducing the number of pedestrians in the intersection when the signal turns yellow. 2. Easily understood by most users 3. Helps pedestrians judge if they have enough time to safely cross the street 4. Especially helpful to the mobility challenged, children and elderly intersection users	Considerations 1. All intersections along Elton Hills Drive are equipped with countdown timer indications. Currently, the south leg of 14th Ave signal does not have pedestrian indications and should. 2. Should be required with all new traffic signal installations and accessible pedestrian push buttons.
APS Pedestrian Push Buttons			
	Description APS push buttons provide guidance to the visually impaired on the location of the push button, status of the "walk" indication, and direction of the crosswalk at signalized intersections. These buttons greatly improve the walkability, safety, and comfort of accessing the sidewalk, intersection and crosswalks for visually impaired users.	Benefits 1. Provide audible indication for blind users on crosswalk direction and status of the walk and don't walk indications. 2. Are directionally oriented to provide specific direction of travel for blind users	Considerations 1. Should be required with all new traffic signal installations and accessible pedestrian push buttons. 2. May be a high cost installation as most intersections would require substantial signal modifications. 3. Would be most economical to install concurrent with an ADA pedestrian ramp improvement project.

5 Corridor Improvement Concept Plan

The corridor improvement concept plan is based on input from the City of Rochester Public Works, agency stakeholders, and the results of the technical analysis completed herein. The improvement alternatives illustrated will provide guidance to the city and may serve as a planning tool to develop a prioritization for future roadway and multimodal transportation improvements within the corridor.

Key elements of the concept plan are illustrated in **Figure 7** and were developed under the premise of retrofit construction (no reconstruction or relocation of curb lines). The illustration is high level to show the overall concept and the general allocation of space; it is not intended to provide specific details regarding design. In some cases, several options may be appropriate, but require further discussion with stakeholders and/or the public to define priority. Further preliminary engineering will be undertaken on measures identified should the project concept move into design and implementation.

Intersection safety and efficient mobility for all users is an important goal. The concept plan and associated improvement alternatives target specific deficiencies identified and are expected to improve the safety of motor vehicle, pedestrian and bicycle conflicts. Design considerations may vary depending upon the final typical section chosen. Key elements include:

- Consider a 3-lane cross-section beginning east of the East Frontage Road and ending just west of Northbrook Lane. Based on the characteristics of the corridor, and findings of the safety and mobility analysis, the most beneficial safety improvement for this corridor would be conversion to a 3-lane facility.
- Traffic signal reconstruction at the Elton Hills Drive/14th Avenue intersection and inclusion of a raised pedestrian refuge island, ADA compliant pedestrian ramps, high visibility crosswalk markings and current signal standard enhancements (e.g., leading pedestrian interval, countdown timers and APS push buttons).
- Intersection improvements at the Elton Hills Drive/9th Avenue intersection through provision of a dedicated left turn lane and crosswalk improvements (curb extension or raised refuge island)
- Access control improvements at Elton Hills Drive/Northbrook Lane.
- High visibility crosswalk markings at signalized intersections.
- Optimized traffic signal timing at several key intersections.

The potential intersection improvement measures identified are mutually exclusive of the 4-lane or 3-lane configuration. In other words, they could be compatible and provide value with either typical section. It should also be noted that the conversion of Elton Hills Drive to a 3-lane configuration does not necessarily need to or be contingent upon including a dedicated bicycle facility.

The concept plan developed provides the City and stakeholders a range of improvement measures at select location to improve the safety of Elton Hills Drive. To provide high level context to baseline potential project costs, typical construction (does not include

engineering, design or inspection related costs) for various treatments identified are provided in **Table 9**.

Table 9. Planning Level Typical Construction Cost by Improvement Measure

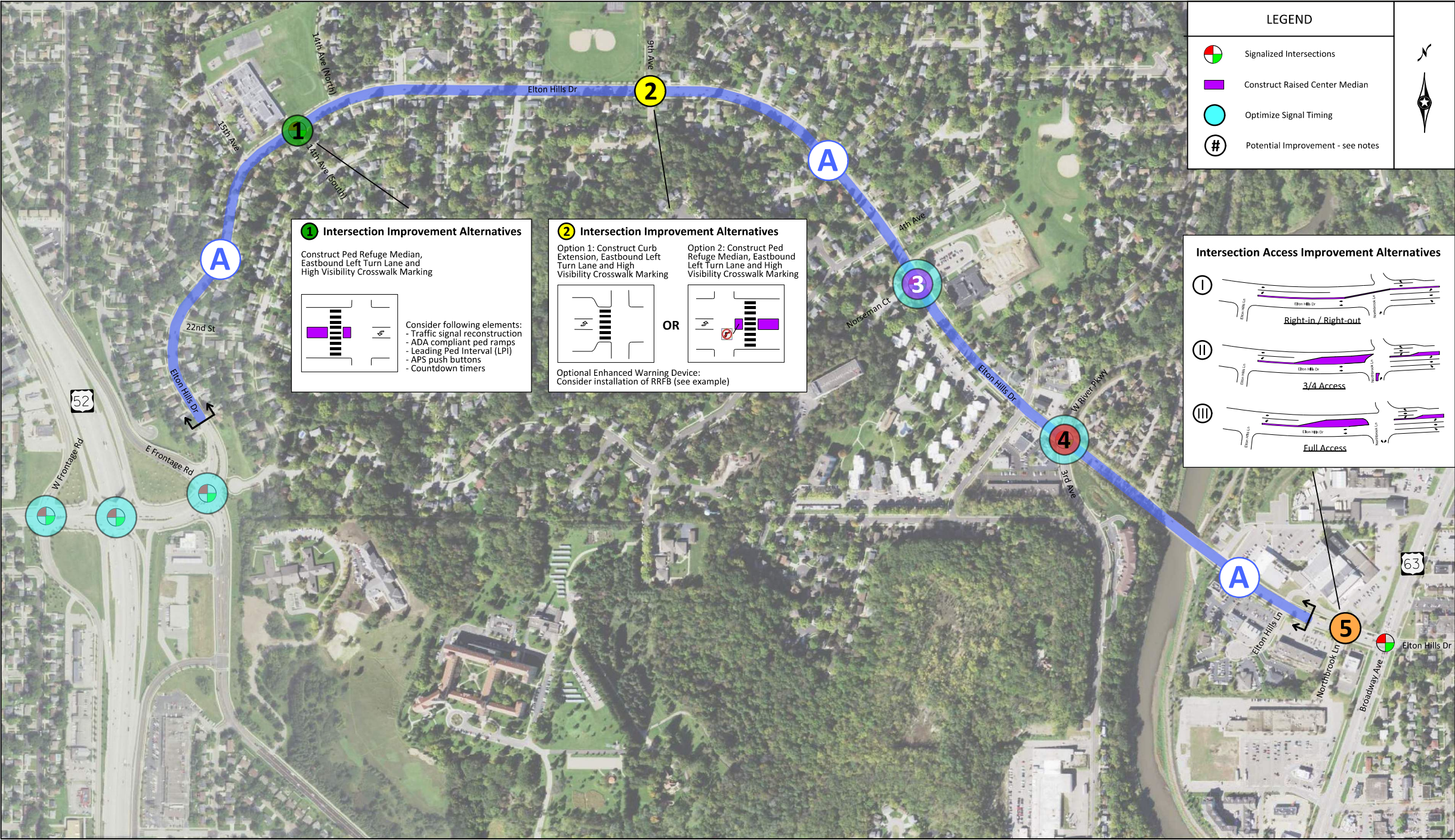
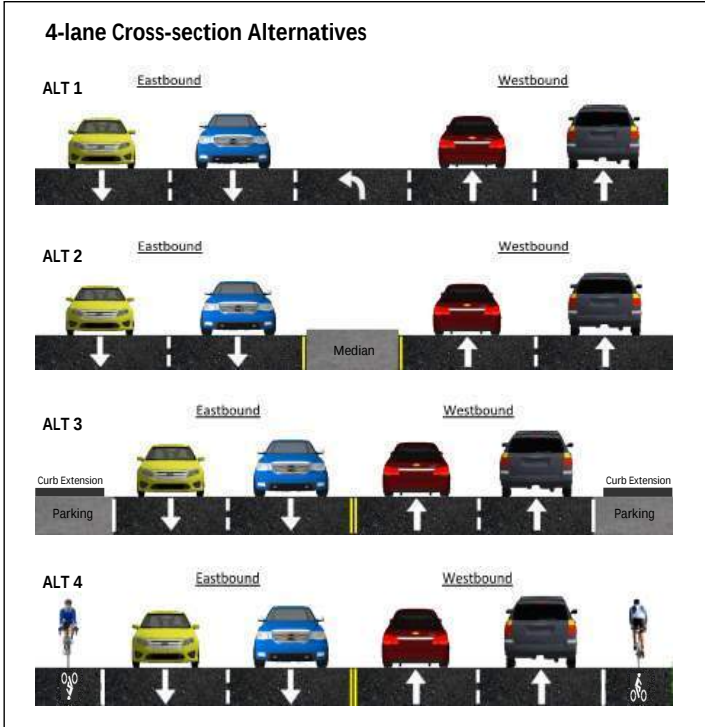
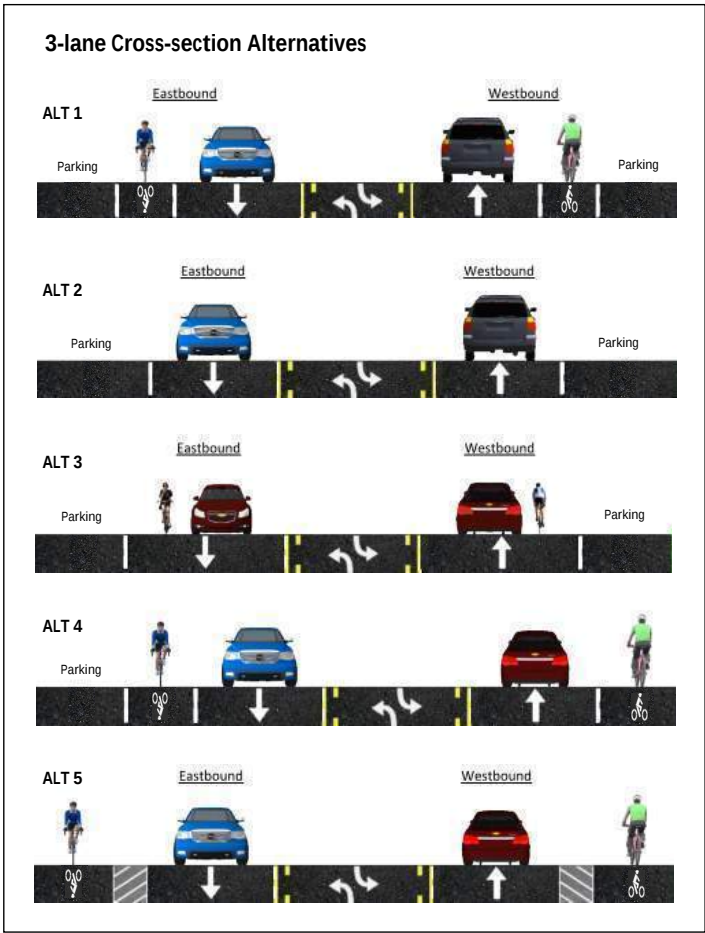
Improvement Measure	Typical Approximate Cost Range	Notes
3-Lane Conversion (1.8 mile)	\$200,000 - \$250,000	Pavement Marking and Signing Only. Depends On Material Type
Traffic Signal Replacement (including ADA Improvements)	\$350,000 - \$450,000	
Traffic Signal Pole / Mast Arm Modification	\$25,000 / Corner	Pole and Mast Arm Replacement Only
ADA Pedestrian Ramp Improvement	\$7,000 - \$20,000 / Corner	Depends On Complexity
Curb Extension	\$15,000 - \$30,000 / Corner	Includes ADA Ramps. Cost Depends On Drainage Considerations
50 Foot Raised Pedestrian Refuge Island	\$50,000 - \$100,000 / Approach	Depends On Construction Method and Materials
RRFB Pedestrian Warning Beacon	\$25,000 - \$30,000 / Crosswalk	Solar Powered
High Visibility Crosswalk Markings	\$3,000 / Crosswalk	Durable Pavement Marking

(1) Estimated construction costs are not site specific. Does not include engineering, design, administration or inspection costs.

The total project cost is dependent upon final typical section and the selected intersection improvement measures. A preliminary cost estimate should be developed upon selection of the final concept plan.

A

Segment Typical Section Alternatives



- Potential Improvement Strategies
- 1

Elton Hills Dr @ 14th Ave

Reconstruct traffic signal system and make the following improvements:
 - ADA compliant ped ramps
 - High visibility crosswalk
 - Refuge median
 - Leading Pedestrian Interval (LPI), countdown timers and APS push buttons
- 2

Elton Hills Dr @ 9th Ave

Improve pedestrian crosswalk (see sketches)
- 3

Elton Hills Dr @ Norseman Ct

Modify signal system as appropriate for traffic lane configuration
- 4

Elton Hills Dr @ W River Pkwy

- Modify signal mastarm as appropriate for traffic lane configuration
 - Provide high visibility crosswalk marking
 - Explore design options to improve right-turn / bike conflict
 - Construct ADA compliant ped ramps
- 5

Elton Hills Dr near Northbrook Ln

Access control alternatives (see sketches)

