



I-35 Connects

MIC and MnDOT

I-35 CORRIDOR PLAN

Alternatives Development Plan | November 2023



Duluth-Superior
Metropolitan Interstate Council
A Division of ARDC



**BOLTON
& MENK**



DEPARTMENT OF
TRANSPORTATION



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METHODOLOGY

A 14+ mile long urban interstate corridor cannot be rebuilt at one time for a number of reasons, cost being one of the most prominent. Considering the initial construction costs of the various segments of I-35, historic inflation rates and subsequent increases in construction costs as learned with the Twin Port Interchange Project, a full reconstruction of the full study area could easily exceed \$2 billion in construction costs alone. Such a price tag on one piece of infrastructure, much of which has considerable service life remaining, is not feasible under current state and federal funding scenarios.

As such, spot improvements at critical locations identified in the existing and future conditions reports of this study are considered where the most benefit can be made to the interstate and local systems without significant cost, impacts and risks. Problem areas where mobility, safety and comfort deficiencies are identified are targeted by a range of solutions in terms of size, scope, and cost, in order to remediate the identified issues.

Considering various degrees of improvement allows for the analysis of alternatives ranging from broadly applied low-cost, high-impact solutions to well-defined infrastructure improvements. This is crucial to identifying appropriate and feasible improvements due to the limited scope and schedule of the study. Additionally, the range of improvements all require varying levels of impact, cost, and type/scale of issue targeted for remedy. Three levels of alternative scaling were developed for consideration: Macro, Meso, and Micro-scales.

Macro-scale improvements target well defined issues with low-impact solutions throughout the study area. Analysis of these countermeasures is conducted at a planning level and seeks to find priority areas where improvements are needed in the short-term. **Meso-scale** improvements provide a more tangible and better-defined result than a macro-scale improvement but often have more impacts in order to implement. Analysis of these alternatives may contain concept development and planning level cost estimates or detailed modeling but not at that level of complexity is unnecessary. **Micro-scale** improvements are the most impactful and complex, and often feature the most unclear benefit before detailed analysis can be performed. These require detailed modeling and preliminary concept design to better understand the potential benefits.

ALTERNATIVE SCALE	ALTERNATIVE CONSIDERATION
 <p>MACRO-LEVEL</p>	<ul style="list-style-type: none"> • Ped-Bike Crossing Prioritization Plan • Intelligent Transportation Systems
 <p>MESO-LEVEL</p>	<ul style="list-style-type: none"> • Traffic Control • Access Management • Lane Configuration
 <p>MICRO-LEVEL</p>	<ul style="list-style-type: none"> • Downtown Focus Area • Spirit Valley Focus Area

VALUE PROFILE

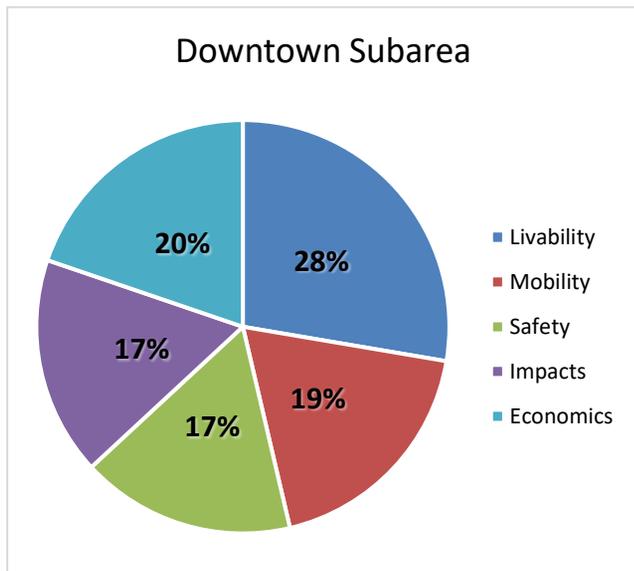
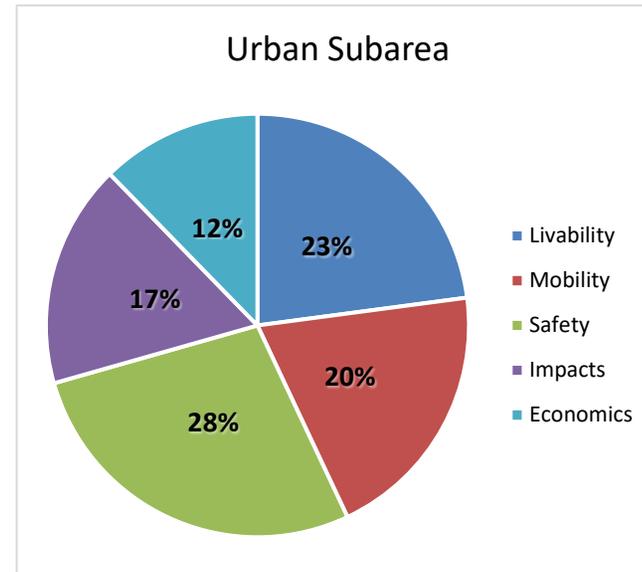
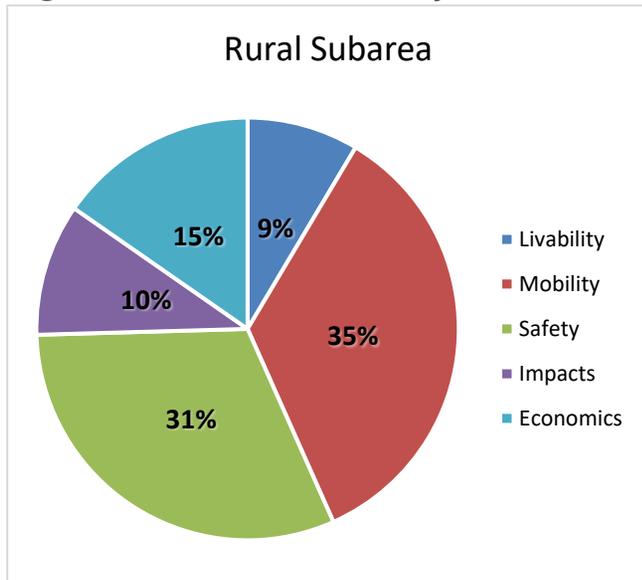
Value profile survey was sent to agency stakeholders and asked participants to assign a value, between 0 and 100, on five categories including livability, mobility, safety, impacts, and economics. These are reflective of the project goals and align with how potential alternatives are scored and diagnosed. The scores were used to help identify and evaluate alternatives that best meet these values and consider them in the technical evaluation process. This process helps to recognize the evolutionary needs of the corridor.

For this activity, the study corridor was scored by subarea (rural, urban, and downtown). The review committee completed a unique value profile for each subarea and all received scores were equally aggregated across the various agencies and averaged to create a value profile for each of the three subareas as shown in Figure 1.

Key findings from the survey results include:

- In the rural subarea, mobility and safety are identified as important factors whereas livability and impacts are less important.
- In the urban area, a more balanced factor prioritization is present. Safety is the most favored category while economics received the lowest average score.
- In the downtown subarea, livability received the highest average score while the other four factors are viewed as having similar levels of importance.

Figure 1: Value Profiles by Subarea



MACRO-SCALE ANALYSIS

MULTIMODAL CROSSINGS

Approach

A major issue identified and voiced by project stakeholders and the general public is the barrier I-35 poses to safe and comfortable pedestrian and bike travel. Due to the size of the corridor and number of existing crossing areas, a method to identify deficient crossing facilities and prioritize where improvements are most needed was developed.

- Prioritization scores were developed considering pedestrian and bicycle demand as well as the vehicular environment at the crossing location.
- Demand points were assigned based on the proximity to an area of environmental justice, the volume of daily pedestrians and bikes observed at the crossing, and the latent demand potential due to lack of adequate pedestrian and bike facilities.
- Vehicular environment points were earned where roadway speeds are such that the likelihood of severe pedestrian injury is likely, where adjacent traffic volumes are highest, where heavy truck traffic is typical and at interchanges.
- The demand and environment scores were totaled to an overall score and each existing crossing location was ranked based on this score to result in a prioritization list.

Figure 3: Downtown Area - Garfield Avenue to London Road



For example, the existing crossing under I-35 along Grand Avenue was ranked as among the highest priority crossing locations. Grand Avenue carries approximately 14,900 vehicles per day in this area, placing this crossing within the top 25% of all crossings within the study area and earning the location two priority points. However, 29 pedestrians and bikes per day were recorded, ranking in the bottom 50% of all crossings and earning zero priority points. The crossing is within a census tract with a medium amount of short trips ($2 >$ miles), indicating there may be some latent pedestrian demand and earning one priority point. The area surrounding the crossing features several EPA defined environmental justice factors (as documented in the Existing Conditions Report) that are above the Minnesota averages, earning an additional priority point. The total priority point score was tallied and compared to the same score for all other crossing locations and ranked.

Figure 2: Grand Avenue under I-35, looking northeast



Diagnosis

The resulting prioritization on the existing crossing areas reveals that the top four ranking crossing locations are within the Downtown and Spirit Valley study areas. Further analysis of improving the pedestrian facilities in these areas will be studied further as part of the Micro-scale analysis. Many of the middle-ranked crossings are located within areas covered in the Meso-scale analysis with the exception of Garfield Avenue where a planned road diet is in development and plans to reallocate existing roadway to non-motorized movements.

One area identified is the over and underpasses of I-35 in the Mesaba Avenue interchange area. Both of these crossings are part of the City of Duluth's Cross City Trail (Phase 1) and the Superior Hiking Trail. However, the overpass of I-35 features narrow width high chain-link fencing that creates a 'jail cell' like feeling that can be uncomfortable for potential users. The structure is also in need of rehabilitation and MnDOT has expressed interest in evaluating replacing and potentially relocating the structure. The structure was initially constructed at the location to connect to an industrial facility that is no longer in use. Therefore, the primary purpose and need for the crossing has changed.

A StreetLight analysis of pedestrian and bike activity in the surrounding areas, particularly Bayfront Park, was conducted in attempt to better understand the need for this crossing and if its current placement is appropriate.

StreetLight data indicates that very few short trips to the land uses west of Bayfront Park on the lake-side of I-35 are made. An analysis of bicycle activity shows only 10% of Bayfront Park trips begin or end west of the park and across the interstate. Finally, bike count data obtained from the ARDC shows that nearly twice as much bike activity uses the overpass of I-35 in comparison to the underpass which connects to downtown. This may indicate that approximately half the bike traffic using the overpass is destined for the Bayfront and Canal Park areas while the other half is destined for downtown.

Relocating the crossing location may provide better connectivity to Bayfront via downtown but doing so will make accessing the crossing more difficult for Lincoln Park residents. While the 'jail cell' structure may be uncomfortable, it provides a near direct route across the interstate to Bayfront and avoids the complex crossings of the Mesaba Avenue ramps, railroad facilities, and avoids challenging topography. Once planned pedestrian and bike improvements are made to the Garfield Avenue bridge, this may provide an alternative route for accessing the waterfront. Other potential alignments may feature W 1st Street or a grade separated crossing near the Michigan Street parking garage, shown in the figure below. Engaging the public to better understand local needs and travel sheds should be considered before selecting a final route.

Figure 3: StreetLight Analysis of Pedestrian Activity to Bayfront Park

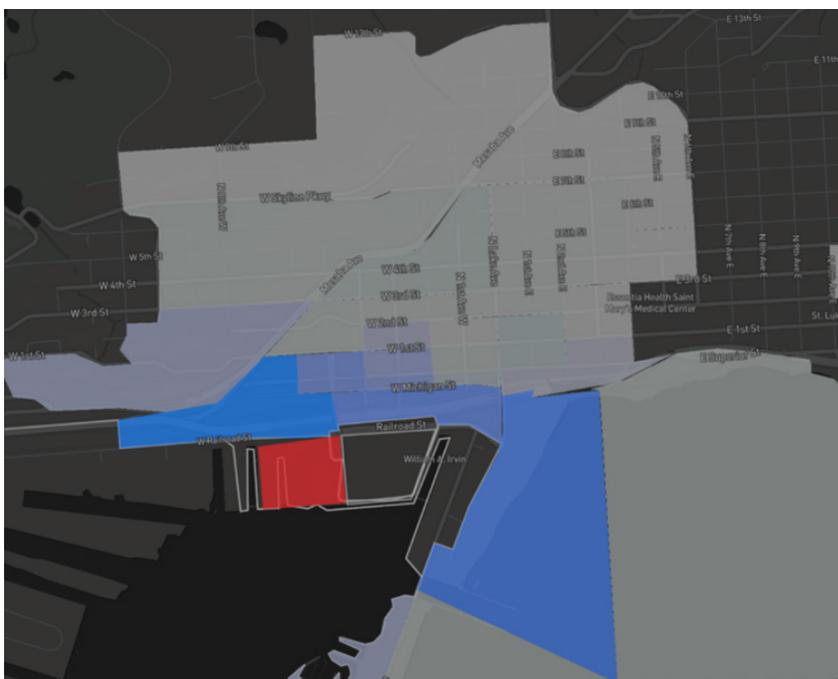
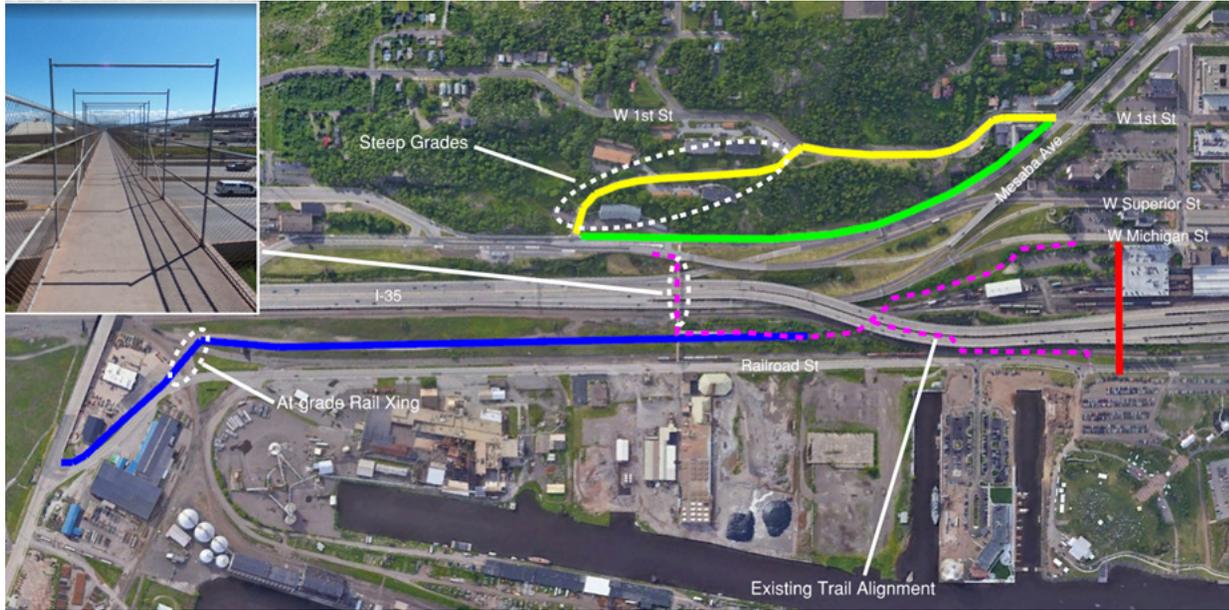


Figure 4: Alternate Trail Routes southwest of Downtown



	YELLOW	GREEN	BLUE
Advantages of New Routes	Uses local, low-volume roadways	Shortest path to downtown	Uses existing structure
Challenges with New Routes	Steep grades	Challenging ROW, uncomfortable proximity to Mesaba Avenue	Railroad Crossings, ROW needs

The priority analysis also finds that there are a limited number of bike-friendly crossings of I-35 between the downtown and urban subareas creating a miles long gap through the middle of the City. However, there is low trip generation potential in much of the Lakeside area so additional crossings are a lower priority. Additionally, published Cross City Trail plans show the alignment is planned to be extended south along I-35, eventually crossing to the south side of the interstate near Wade Park, and crossing again in the Spirit Valley focus area.

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Intelligent Transportation Systems, or ITS, are becoming more prevalent and more practical as our world becomes more interconnected, and technology continues to advance. These systems can often be easily implemented with little impact to the existing infrastructure and tangible benefits can be realized as soon as these systems become online. Regional Transportation Management Systems already in place are able to communicate with and operate these systems, giving agencies the ability to monitor and operate their roadways in real time. Below is a list of identified logical ITS solutions that fit the needs established in the earlier sections of the project.

Strategies

Dynamic Curve Warning systems bring extra visibility to curves where a high risk of vehicle crashes or roadway departures is present. These systems can be triggered by vehicle factors such as speed or height, or by roadway conditions such as weather and surface conditions. These systems have been found to provide a 58% reduction in run off road crashes and a 60% reduction in fatal/injury crashes and are listed as an FHWA Proven Safety Countermeasure. A crash analysis of the I-35 corridor found that 50%-60% of all crashes occur under poor roadway conditions (rain, ice, snow) and hot spots in run off road crashes are commonly seen at vertical and horizontal curves and on elevated structures.



Pavement Warning Systems and Automated Anti-Icing Systems are able to continuously monitor pavement surface conditions for the accumulation of ice and snow, alert drivers or slippery conditions and apply anti-icing compounds to the surface as needed. Dynamic weather patterns within the study area are attributed to nearly 100 winter weather crashes per year. These systems may provide an 18% reduction (Pavement Warning System) and 40% reduction (Anti-Icing System) in crashes when adverse weather conditions are present and ease the strain on agency plowing and surface treatment operations. Anti-icing systems may be most impactful on elevated surfaces such as bridges and overpasses where icy conditions are most common.

Variable Speed Limits (VSLs) have a wide range of applications including the control of traffic flow, maximizing roadway capacity to best handle fluctuations in traffic volumes due to event/seasonal traffic, improved safety in adverse roadway surface conditions and inclement weather, and work zone accommodation. VSLs are listed as a FHWA Proven Safety Countermeasure and are included in the Safe Systems Approach framework. They are shown to be able to reduce all crashes by up to 34%, rear end crashes by 65% and fatal and injury crashes by 51%. VSL Application are growing rapidly across the county, with more than a dozen recently applied or in late stage planning, including in neighboring state such as North Dakota and South Dakota.



Dynamic Lane Assignment systems utilize dynamic message signs mounted overhead to display lane assignment information to the traveling public. These systems are able to assist drivers find the proper lane assignment in areas where complex accesses are present and weaving is common. Short-term activations can close lanes to aid in short-term road work, clearing of crashes, and assisting in capacity needs due to event-related congestion and during peak freight activity periods. These systems are also able to be integrated with other ITS systems previously noted for a complete and consolidated system.

Diagnosis

Planning level cost estimates based on real world implementation and operations & maintenance costs are compiled and documented by FHWA and MnDOT has performed research work on the cost effectiveness of several ITS-type systems. Using these sources and the estimated number of ITS implementations along the study corridor, high-level cost estimates can be established for the recommended systems, shown in Table 1. All costs are in 2023 dollars.



Table 1: Value Profiles by Subarea

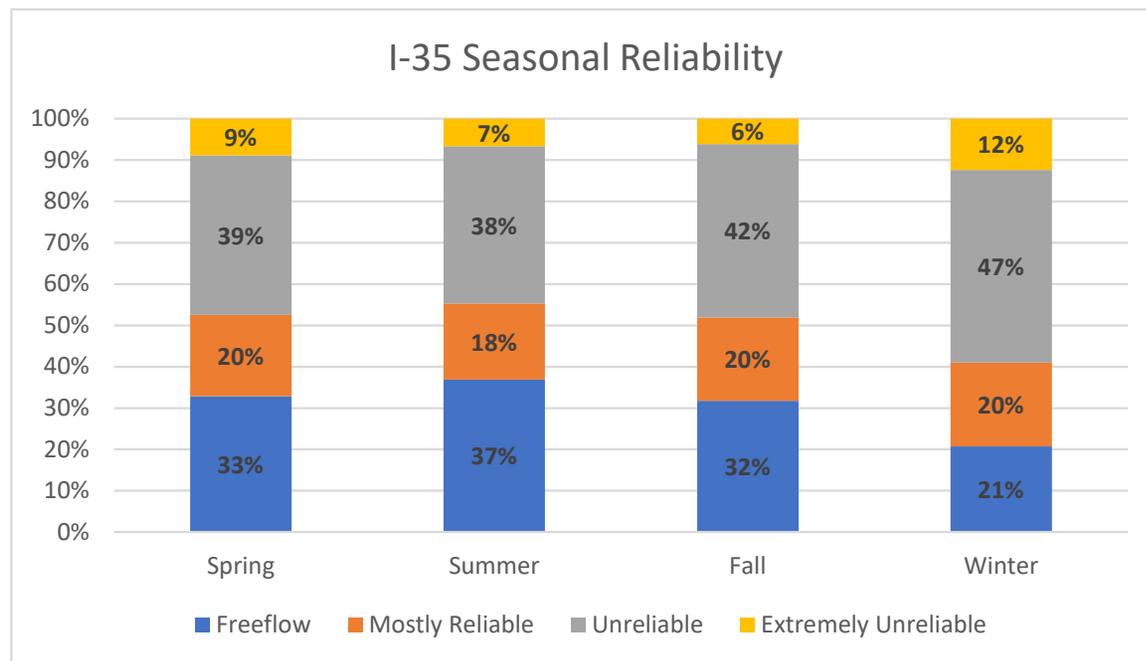
ITS System Type	Unit Cost	Corridor Systems	Corridor Cost	Notes
Curve Warning	\$ 15,000	2	\$ 30,000	(1)
Surface Warning	\$ 500,000	1	\$ 500,000	(2)
Anti-Icing	\$ 250,000	3	\$ 750,000	(3)
Variable Speed Limit	\$ 25,000	7	\$ 175,000	(2)
Overhead Dynamic Lane Assignment + VSL	\$ 400,000	8	\$ 3,200,000	(2)
Total			\$ 4,655,000	

Notes:
(1) *Cloud-Based Dynamic Warning System - Minnesota Department of Transportation.*
<https://www.dot.state.mn.us/research/reports/2019/201919.pdf>.
(2) FHWA: TOPS-BC
(3) "Roadside Control (RS-C): Its Deployment Evaluation." *Roadside Control (RS-C) | ITS Deployment Evaluation*,
<https://www.itskrs.its.dot.gov/costs/adjusted/rsc>.

Current state statutes on establishment and enforcement of speed limits on public roadways do not contain language relating to VSL's. Historically, variable advisory speeds have been piloted in several instances in Minnesota to varying degrees of success. VSL implementation of VSL's within the study area would require an engineering study looking at multiple speed scenarios and likely need special authorization through the legislative process if VSL's aren't adopted into State Statutes. In either case, VSL implementation will need to be legislative approval.

To further explore the potential effectiveness of VSL's in the study area, a speed variability analysis was performed using speed data from Iteris ClearGuide. Free flow speed data was collected for one full year along I-35 in both the northbound and southbound directions and was aggregated by season and deviation from the posted speed limit for that segment of interstate. Segments where the free flow speed was significantly less than the posted speed limit (based on HCM Level of Service thresholds for freeway facilities) were classified as being unreliable during those select time periods. Using 5-minute intervals, a percentage of the year in which a segment is performing reliably or unreliable could be determined.

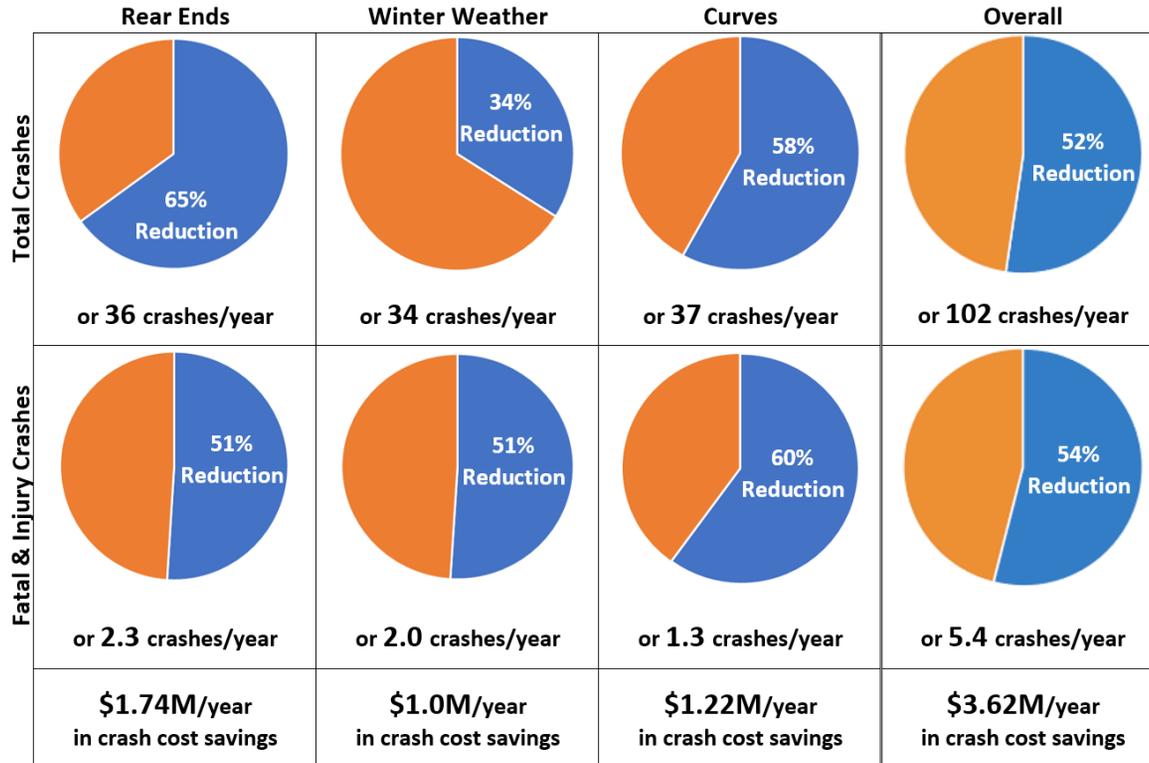
Figure 5: Seasonal Speed Variability



Analysis found that reliability of I-35 is degraded during the winter months as the amount of time where free flow travel is provided is decreased by over 11%. Unreliability during the winter accounts for nearly 60% of the time. A potential VSL implementation could help ease this speed and travel time variability by improving traffic flow which is more appropriate for roadway conditions.

Using documented ITS safety benefits and collected crash data throughout the study area, estimated crash reductions can be developed on a crashes per year basis. The considered ITS countermeasures largely target crashes that fall into three categories: rear ends, winter weather, and curve-related crashes. The charts below show the potential crash reductions for these categories in terms of overall and injury crashes as well as the potential annual crash cost savings (in 2023 dollars). Note, some of the identified crashes could be grouped into more than one of these three categories. The overall crash reduction numbers remove any redundant crashes in the estimated reductions.

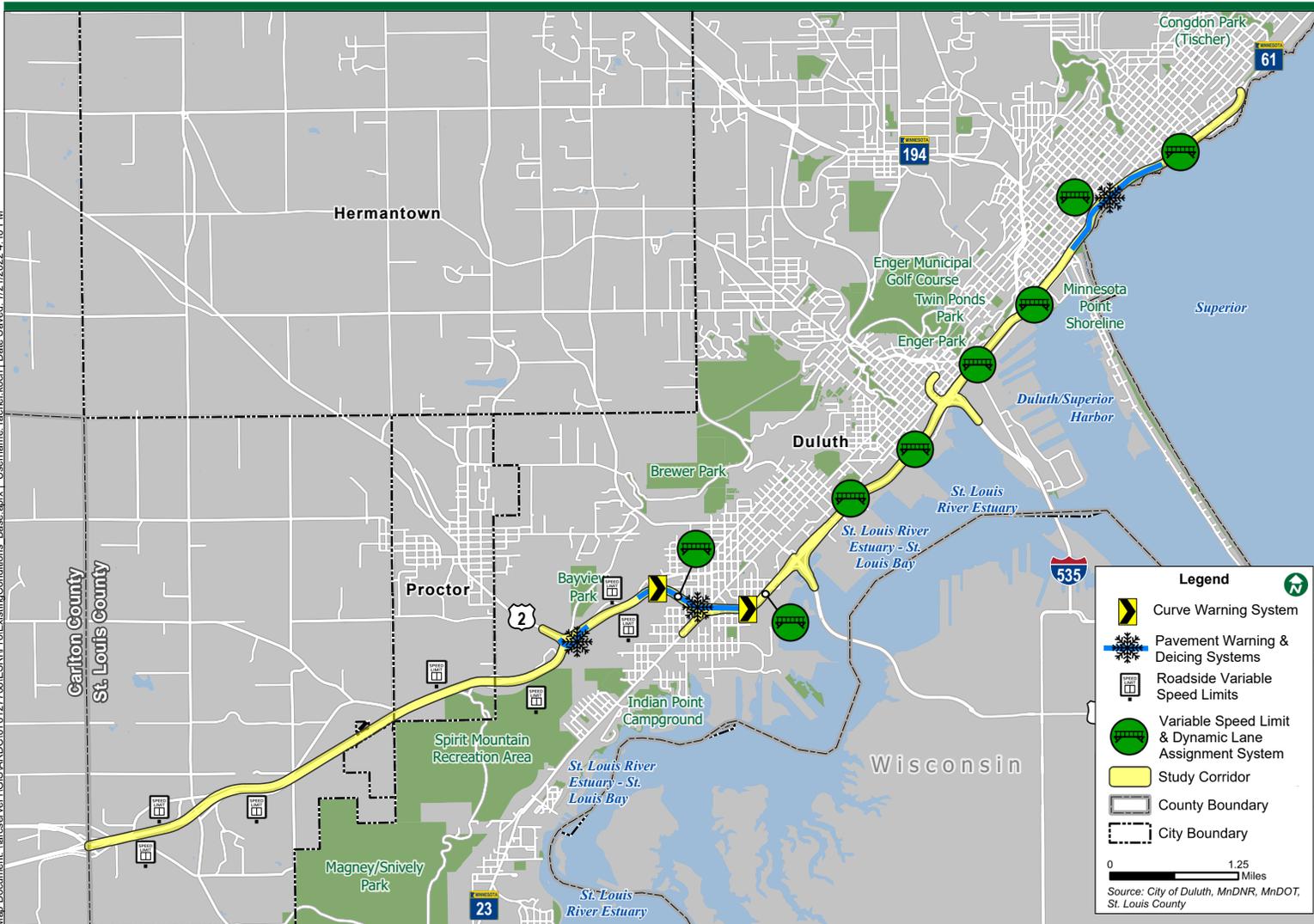
Figure 6: ITS Crash Reductions and Crash Cost Savings



The data above doesn't include operational time savings; nationally, 75% of congestion in major urban areas and 77% in rural areas are attributed to crashes, weather, and work zones. ITS can help ease congestion in all these scenarios. It was beyond the scope of this project to estimate these results, but experience in similar environments indicates that benefits are likely to double once these considerations are factored.



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Legend

- Curve Warning System
- Pavement Warning & Deicing Systems
- Roadside Variable Speed Limits
- Variable Speed Limit & Dynamic Lane Assignment System
- Study Corridor
- County Boundary
- City Boundary

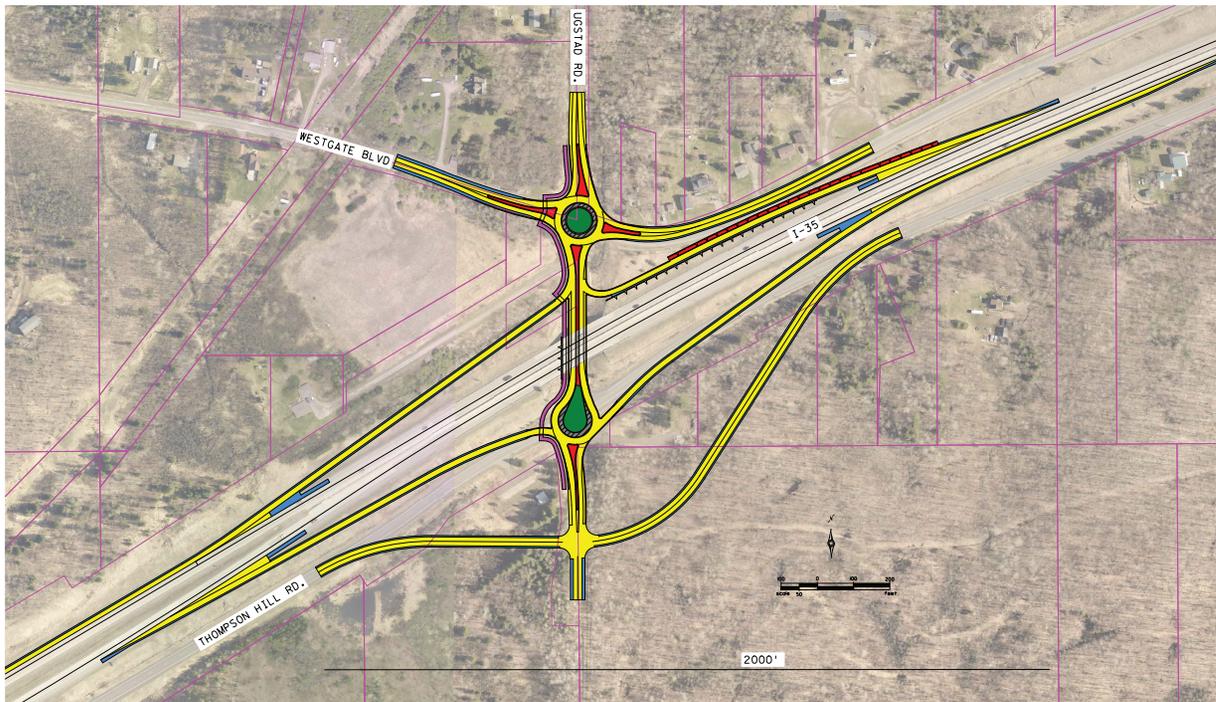
0 1.25 Miles

Source: City of Duluth, MnDNR, MnDOT, St. Louis County

MESO-SCALE ANALYSIS

Meso-scale solutions were developed and evaluated using similar methodology as described above. However, less detailed analyses were performed and therefore the grading is simplified on a "good, better, best" scale. The following alternatives were developed with project partners to find solutions to low to medium impact issues identified earlier in the study.

UGSTAD ROAD

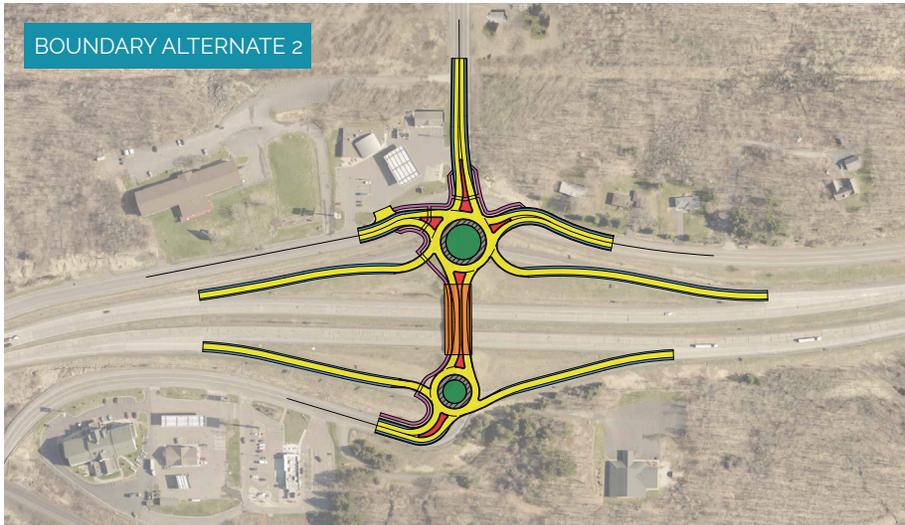
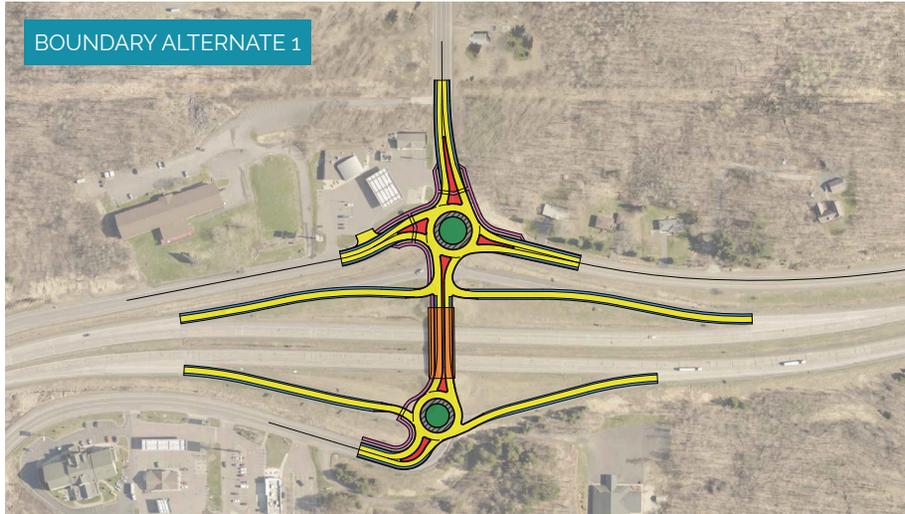


Criteria

- Worse
- Neutral
- Better

CRITERIA	LIVABILITY	SAFETY	MOBILITY	IMPACT	COST
BEFORE					
AFTER					
DESCRIPTION	<ul style="list-style-type: none"> • Issues with land use conflicts on Ugstad Road (i.e. school)* 	<ul style="list-style-type: none"> • 1 mile spacing to Boundary Ave interchange • High amount of accesses on/near Ugstad Road difficult to resolve 	<ul style="list-style-type: none"> • Ugstad Road not built for significant traffic volumes, does not provide key connections 	<ul style="list-style-type: none"> • Significant ROW needs, 5+ properties impacts • Potential for biological impacts to south • Negligible change in GHG emissions 	<ul style="list-style-type: none"> • Estimated Construction Cost = \$10M - \$15M (2023 dollars)

BOUNDARY AVE



Criteria

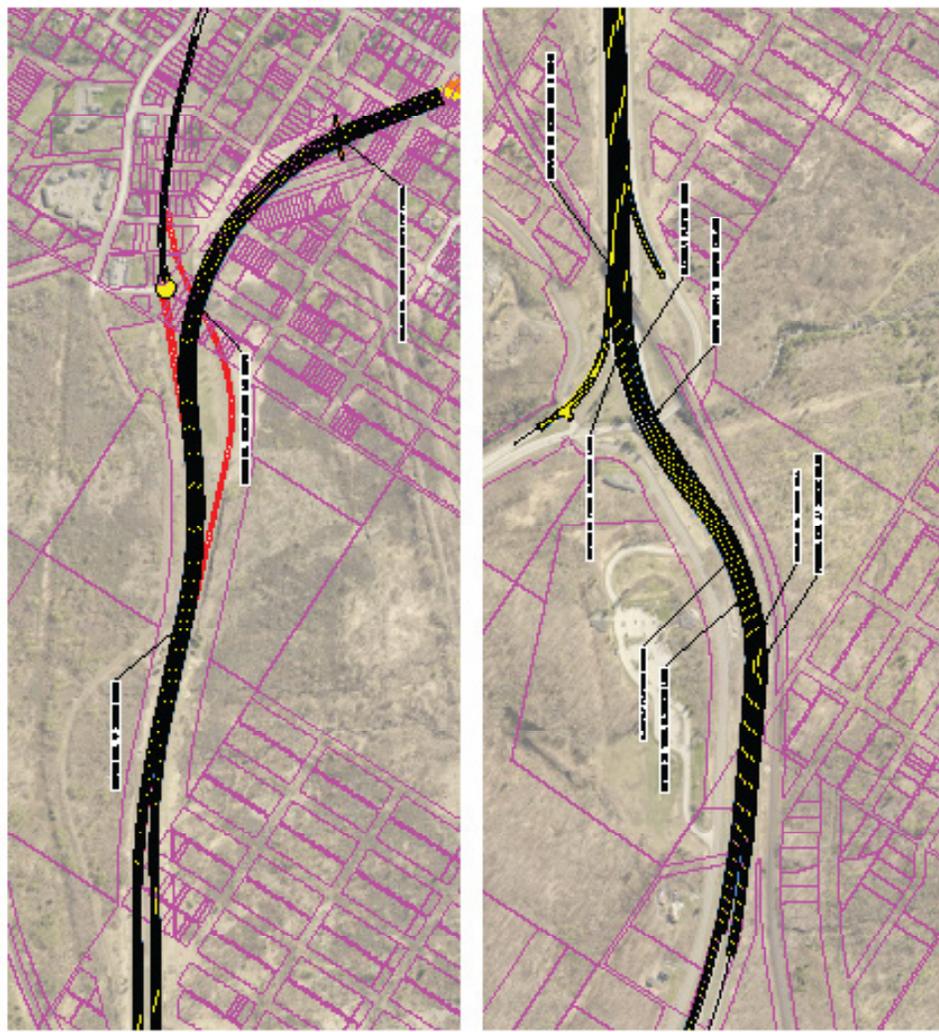
Worse

Neutral

Better

CRITERIA	BEFORE	AFTER	DESCRIPTION
LIVABILITY			<ul style="list-style-type: none"> Added trail crossing of I-35 in rural subarea Aligns with Proctor's Boundary Ave Multimodal Improvements plan
SAFETY			<ul style="list-style-type: none"> Rectifies sightline issues at southern ramp terminal and associated crash issues
MOBILITY			<ul style="list-style-type: none"> Increased ramp terminal capacity
IMPACT			<ul style="list-style-type: none"> Minimal ROW needs Potential for business access impacts Negligible change in GHG emissions
COST			<ul style="list-style-type: none"> Estimated Construction Cost - \$10M - \$15M (2023 dollars)

THOMPSON HILL



Criteria

- Worse
- Neutral
- Better

	BEFORE	AFTER	DESCRIPTION
LIVABILITY			<ul style="list-style-type: none"> • Reconstructed trailhead to DWP Trail
SAFETY			<ul style="list-style-type: none"> • Substandard shoulders and curvature corrected • Remove deficient partial interchange that doesn't meet spacing standards
MOBILITY			<ul style="list-style-type: none"> • Truck climbing lane improved freight reliability and mainline operations • Turn lanes at US 2 & Skyline Pkwy improve local mobility
IMPACT			<ul style="list-style-type: none"> • Environmentally sensitive areas with potential for impacted • Potential for 4 bridge replacements at US 2 interchange
COST			<ul style="list-style-type: none"> • Estimated Construction Cost - \$35M - \$45M (2023 dollars)

27TH AVE



Criteria

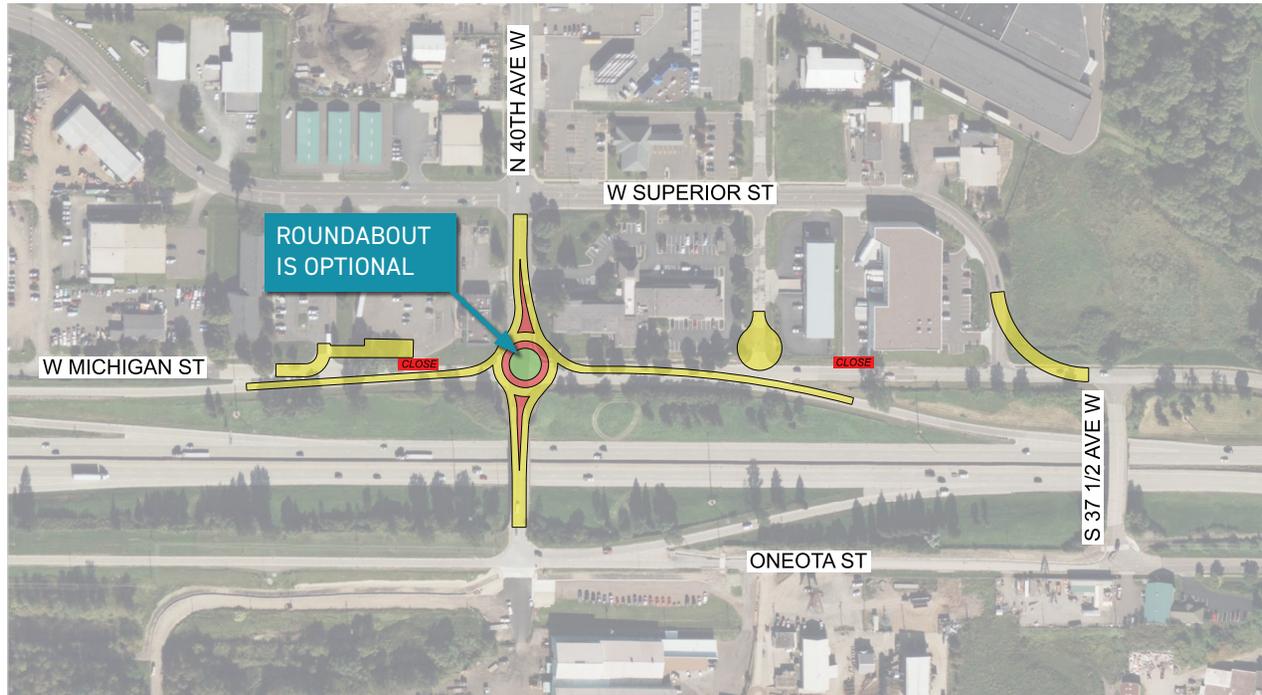
Worse

Neutral

Better

CRITERIA	BEFORE	AFTER	DESCRIPTION
LIVABILITY			<ul style="list-style-type: none"> Recently reconstructed bridge features sidewalk on both sides but no ped/bike facilities are provided over railroad tracks due to low lakeside demand
SAFETY			<ul style="list-style-type: none"> Eliminates complex merge and diverge conflicts between ramps and Michigan St Both ramp terminal intersections are operating with above average crash rates due to complex interactions, heavy truck traffic and poor sightlines
MOBILITY			<ul style="list-style-type: none"> Local access diverted away from I35 influence area Allows proper functionality of interchange
IMPACT			<ul style="list-style-type: none"> Low impacts Reduced pavement areas Access management mitigated by alternative routes
COST			<p>Estimated Construction Cost = \$100,000 - \$250,000 (2023 dollars)</p>

40TH AVE



Criteria

- Worse
- Neutral
- Better

CRITERIA	LIVABILITY	SAFETY	MOBILITY	IMPACT	COST
BEFORE					
AFTER					
DESCRIPTION	<ul style="list-style-type: none"> • Pedestrian facilities may be included with roundabout but will not fit on existing bridge section • Add ped/bike facilities when bridge is replaced 	<ul style="list-style-type: none"> • Eliminates complex merge and diverge conflicts between ramps and Michigan St • Both ramp terminal intersections are operating with significant crash rates due to complex interactions, heavy truck traffic and poor sightlines 	<ul style="list-style-type: none"> • Increased capacity at north ramp terminal • Local access diverted away from I35 influence area 	<ul style="list-style-type: none"> • Low impacts • Reduced pavement areas • Access management mitigated by alternative routes 	<p>Estimated Construction Cost = \$2.5 M - \$5 M (2023 dollars)</p>

Several less impactful and more clearly defined improvements were identified and evaluated, though a less throughout evaluation was performed to better reflect the scope of the considered improvement:

21st Ave E Interchange Traffic Control

The 21st Ave E Interchange provides the most direct route from I-35 to the University of Minnesota Duluth campus. The northbound exit ramp experiences significant delay during peak periods and an elevated crash history was identified. A reevaluation of traffic control of the northbound ramp is recommended as the stop-control condition on the northbound exit ramp is the likely cause for the experienced congestion and crash history. Reassigning the stop condition to the east leg of 23rd Ave E is likely to remedy these issues with little impact. A roundabout could be considered as the bridge approached the end of its useful life as an operations and safety improvement.



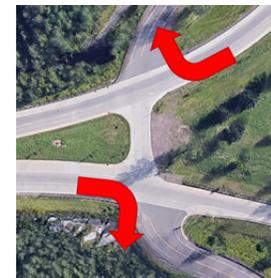
London Rd/26th Ave E Roundabout

The northern terminus of I-35 at London Rd/26th Ave E presents several operational and safety issues. These issues are anticipated to become worse as area traffic volumes grow and are particularly unacceptable under recreational peak conditions experienced today. The proposed roundabout has been shown to provide improved operations and provides multiple safety benefits that an expanded signal system does not. London Road is planned to be converted to a roundabout corridor in the near-term which is conducive to an added roundabout at 26th Ave E. Right-of-way impacts and construction costs are anticipated to be moderate.



Skyline Pkwy at U.S. 2 Turn Lanes

Located within a transition area between I-35 and a rural expressway, the Skyline Pkwy at US 2 intersection was found to have an elevated crash history. A lack of clear turn lane areas, high speed differentials, poor sightlines, and large amounts of vertical and horizontal curvature create complex interactions at this key freight junction connection Duluth to Proctor. Minor geometric improvements, including clearly delineated turn lane areas on US 2, may help reduce the high number of sideswipe crashes while balancing impacts to a topographically challenging area.



MICRO-SCALE ANALYSIS

Micro-scale solutions were developed and evaluated using refined methodology including two-dimensional CAD drawings of potential concepts, preliminary cost estimates, and detailed microsimulation of traffic conditions. However, less detailed analyses were performed and therefore the grading is simplified on a "good, better, best" scale. The following alternatives were developed with project partners to find solutions to high-impact and high-profile issues identified earlier in the study. Scorecards were developed for each concept to illustrate how each alternative performs in key areas.

Scorecard Metrics Explanation

ITEM AND ICON		METRIC EXPLANATION
Survivability		Higher vehicles speeds lead to more severe injuries to pedestrians in vehicle-pedestrian crashes. Percentages based on ITE crash safety research.
Exposure		Based on length of pedestrian crossings and whether a pedestrian faces conflicts from one or two directions of moving traffic at a time. More exposure to traffic increases the potential for a crash.
Comfort Level		Based on the separation from moving traffic and width of pedestrian facilities along the section. Studies have found that greater distances and boulevard amenities increase pedestrian comfort levels.
Crash Potential		Crash potential due to modeled conflict points, traffic volumes and national safety study supported data.
Crash Types		Based on modeled or calculated reduction of targeted crash types. High severity crash types include high-speed conflicts and right-angle or left-turn conflicts. Low severity crashes are those that occur at lower-speeds and less critical conflict angles such as rear ends or sideswipes.
Local Delays		Based on simulated delays using simulated traffic models throughout the day for local (non-interstate) traffic
Network Delays		Based on modeled vehicle hours of delay across the entire network
Traffic Redistribution		The proportions of traffic which redistributes to lower classification roadways or is unable to use the facility due to overcapacity areas
Greenhouse Gasses		The estimated change in vehicle emissions due to increased or decreased efficiency
Impact		The estimated number of buildings, properties, and areas of environmental sensitivity impacted by construction
Cost and Reinvestment Potential		<p>Cost: Planning level cost estimates were developed for each alternative, considering both construction and engineering/administration costs. All estimates are in 2023 dollars.</p> <p>Reinvestment: An estimate of how study area property values may change with roadway improvements. This is based on the likelihood of a parcel redeveloping, current property values relative to comparable sites, estimated property value impacts from changes in traffic delays, and research-supported data connecting public investments to private investments.</p>

SPIRIT VALLEY

Key Issues

The Spirit Valley area, which includes the interchanges with Grand Avenue and Central Avenue, was earlier identified as an area failing to meet the local and regional needs in several key areas. Several closely spaced access points and left exit/entry points which are no longer allowed by FHWA create a higher than desired amount of friction between vehicles. This creates an increase in conflict points and is the likely cause for the crash hot spot identified at this location where the crash rate is 70% higher than the critical rate.

Further, the added friction makes the area susceptible to congestion during peak traffic periods. The interchanges and local system do not operate well together; the Grand Avenue interchange a partial interchange which strains the local network during peak periods. High volumes of freight traffic utilize the Central Avenue interchange to access industrial areas north and south of the interchange.

The surrounding area has an elevated amount of Environmental Justice factors, most notably population without access to a vehicle and population living in poverty. The existing infrastructure lacks clearly defined, protected, and comfortable pedestrian and bike facilities, forming a major barrier to localized mobility to those who most depend on multimodal travel.

MnDOT has up to \$32M programmed for the reconstruction of I-35 from Boundary Avenue through the Grand Avenue bridges in 2029.

Land Use

The Spirit Valley area contains one of the most significant redevelopment opportunity sites in Duluth. The approximately 10-acre site around the old K-Mart building provides a west bookend to major commercial corridors extending from downtown, and is a major node within West Duluth. Bounded to the south by I-35, Spirit Valley's location on N Central Ave creates the first major gateway into the city from northbound interstate travelers. The City's Comprehensive Plan indicated Spirit Valley as a core investment area and recommended actively seeking out redevelopment opportunities that align with city goals and visions for West Duluth.



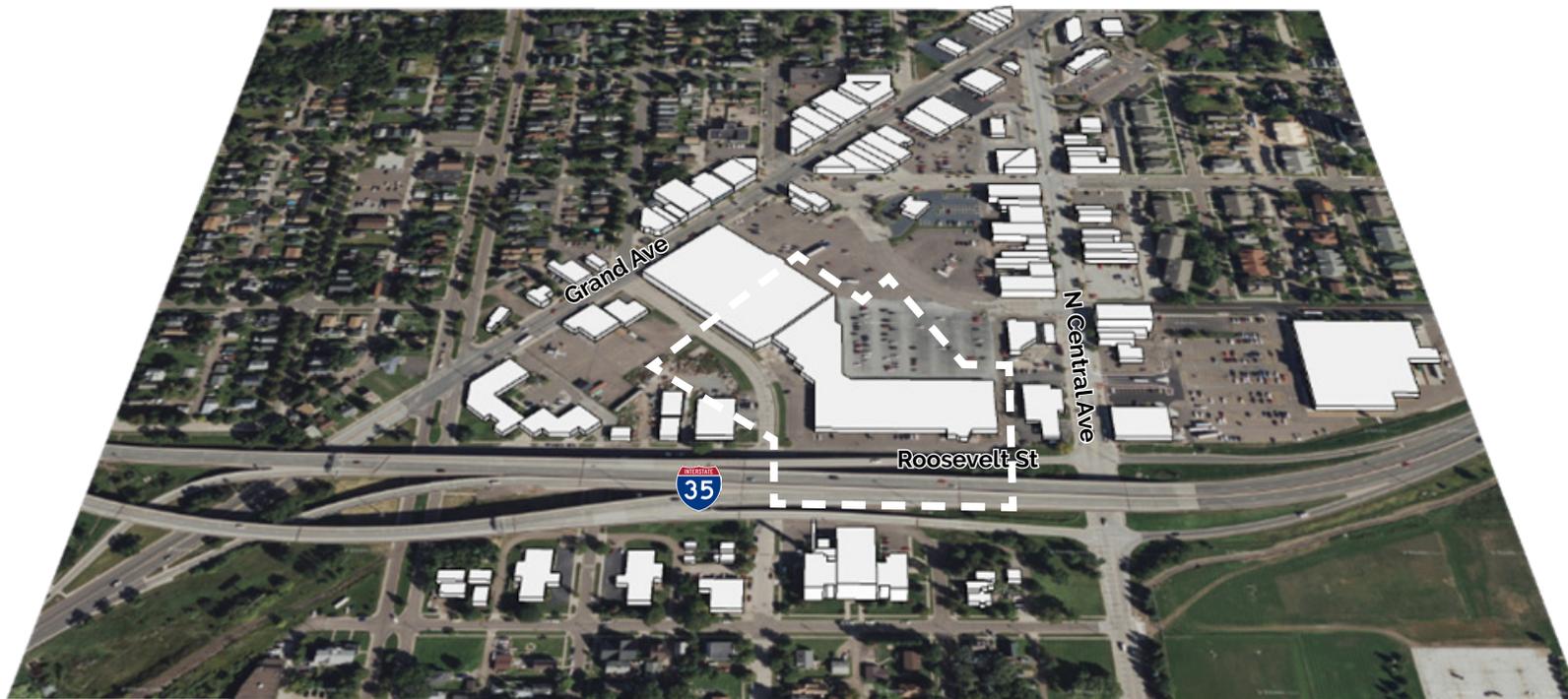
The former Kmart site is a large impervious site, home to the Spirit Valley Mall. The sites private roadways and large parking lots are quickly deteriorating, and the parking area in front of Kmart has been barricaded from use.

Future land use guidance for the area envisions allowing for a broad mix of industrial, office, retail, and residential uses. While the future General Mixed-Use designation does allow for industrial uses, such uses would likely conflict with the surrounding commercial and residential uses and scales. Additionally, land use guidance encourages the provision of clear and comfortable pedestrian circulation, and open space amenities. Future development of the site would therefore be well suited to investment in improving multimodal connections from N Central Ave to Grand Ave, through the interior of the site by rethinking interior site routes.

When considering Spirit Valley's redevelopment potential in relation to the future of the I-35 corridor, ease of regional and state-wide access via I-35 will remain attractive for many non-residential uses. Because Spirit Valley does have some buffering from the interstate however, most interchange design decisions will likely not have a significant impact on the site so long as interstate access is maintained.

N 57th Ave / Spirit Dr does however provide south access and currently crosses at grade below the interstate. Should a future interstate design remove access from N 57th Ave, that will increase pressure on maintaining clear access from N Central Ave, and Grand Ave. Similarly, the Irving and Fairmount Brownfields Revitalization Plan identifies several development opportunities along N Central Ave and Grand Ave, and suggests improving crossing below the interstate for safer and more comfortable access.

Figure 7: Spirit Valley Mall and Kmart Site Today



Developed Concepts

Two primary concepts were developed for reconstructing the interchange to better serve the immediate area and the regional connections it serves.

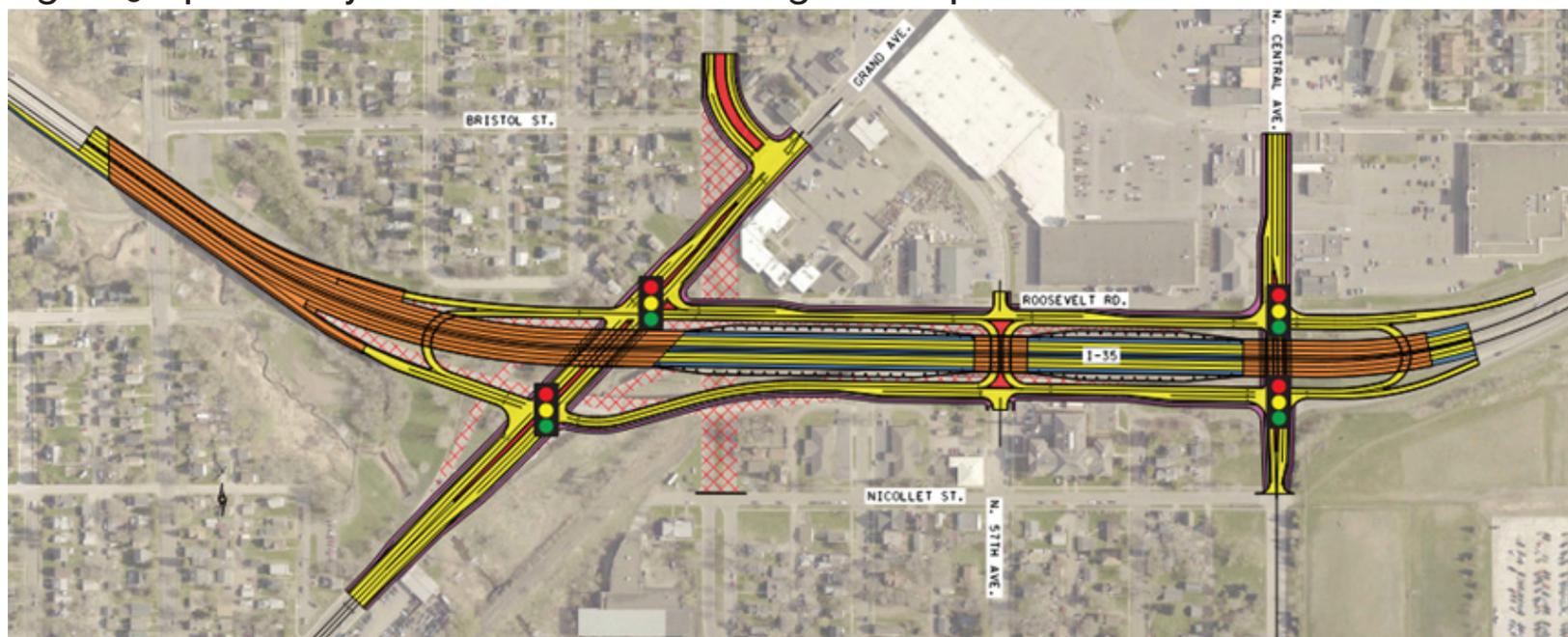
The first alternative, an offset single point urban interchange (SPUI) reconfigures the I-35 at Grand Ave junction to feature an at-grade intersection which serves access to and from both directions of I-35, whereas the existing interchange is partial at this location. Further, all left exit ramps are removed. Frontage road connections are made between Grand and Central Avenues forming the west side of the diamond interchange and Central Ave. Traffic signals at the three interchange intersections and improved sidewalk/trail connections improve pedestrian and bike comfort. Access under I-35 at 57th and 59th Avenues is closed as part of this concept.

Figure 8: Spirit Valley Offset Single Point Urban Interchange Concept



The second original alternative features a median u-turn interchange (MUTI) with directional ramp terminal intersection restricting left turns which increases terminal capacity and reduces left turn conflicts. The main u-turn location, located under I-35 at 57th Ave, would provide for left turning movements via a channelized u-turn node. Additional u-turn locations would be provided north of Central Ave and south of Grand Ave, both going under I-35. Four traffic signals would be installed at the 4 ramp terminal intersections. Improved pedestrian facilities under I-35 are provided under I-35 at Central and Grand Avenues. Access under I-35 at 59th Ave is closed as part of this concept.

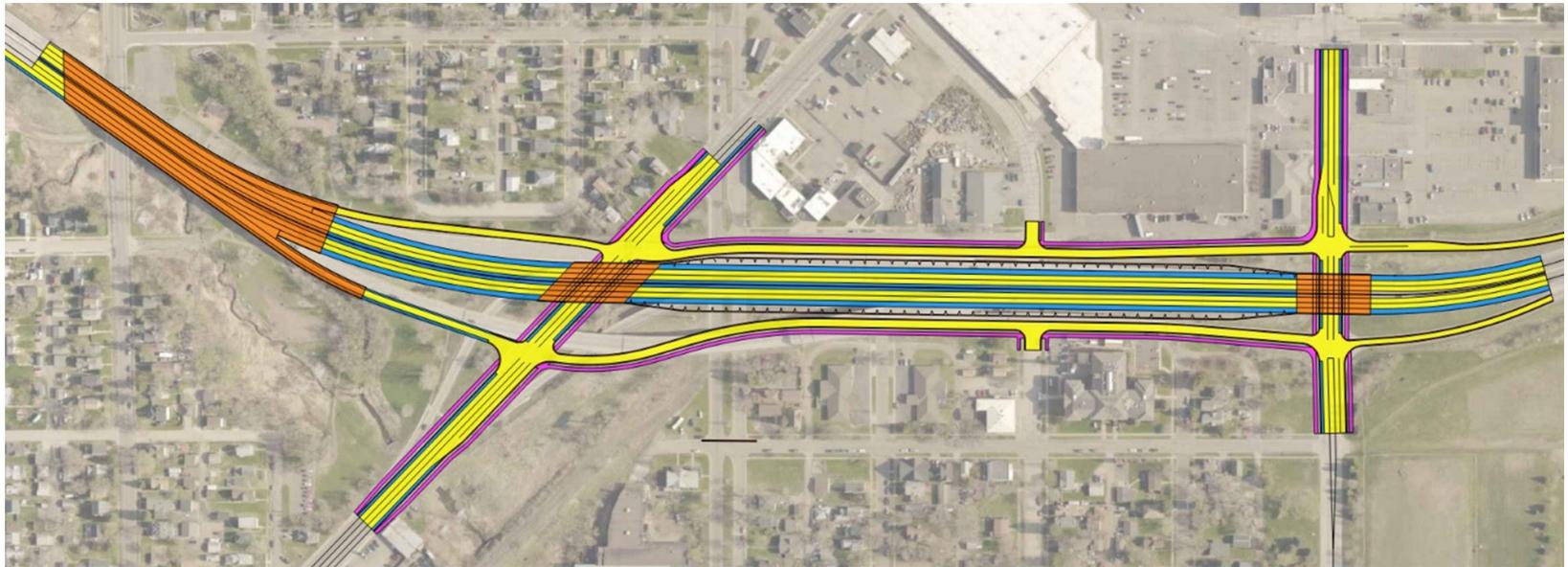
Figure 9: Spirit Valley Median U-Turn Interchange Concept



A diagnosis of these two alternatives finds that both offer slight improvement in operations. However, no significant change in level of service is anticipated to be gained from either alternative when compared to the no build condition. Pedestrian and bike benefits are also minor; crossing distances and exposure rates are reduced but little is done to calm traffic speeds or protect non-motorized traffic. Mainline crash potential is equally reduced due to reduction of left exits, however, the MUT alternative offers a greater reduction on conflict points than the SPUI. Both concepts show a likely increase in emissions, impact one existing structure, and estimated costs are between \$78M-\$84M.

A concept was developed but not fully assessed showing a split diamond interchange at Central and Grand Avenues. The concept includes a similar length of I-35 and local road reconstruction as the Single-Point and Median U-turn interchange concepts but is less impactful to existing travel patterns while cleaning up some of the existing access density issues. This option was not fully evaluated due to access concerns to new development to the south.

Figure 10: Spirit Valley Split Diamond Interchange Concept



Project stakeholders voiced concerns that the three developed concepts do little to benefit the immediate areas, both commercial and residential. While the considered concepts do show improved vehicular flow and safety, they do little to promote non-motorized mobility in a neighborhood where many walk, bike or take transit to work.

The developed concepts were evaluated against the various criteria previously outlined and scorecards were developed for each concept to illustrate how each alternative performs in these key areas.



SCORECARD - SPIRIT VALLEY CONSOLIDATED INTERCHANGE

LIVABILITY

EXPOSURE

Before: ██████████
 After: ██████████

PED BIKE FACILITY COMFORT LEVEL

Before: Uncomfortable for all modes
 After: Comfortable for all modes

+1 Net Crossing Areas

Total Pedestrian Space (feet)

Category	Before	After
Total Pedestrian Space (feet)	5	10

SAFETY

CRASH POTENTIAL

Potential Mainline Crash Reduction

40%

Conflict Points

Category	Before	After
Conflict Points	60	58

FHWA Interchange Policy Violations

Before: 3
 1 Mile Spacing
 Left Exit
 Partial Interchange

After: 0

MOBILITY

NETWORK DELAYS

Before AM Peak
 After AM Peak
 Before PM Peak
 After PM Peak

IMPACT

EMISSIONS

19%↑ Increase

Before
 After

IMPACTS

1 Building Impacted

ECONOMICS

\$78M* Cost

*Study area programmed for reconstruction.

SCORECARD - SPIRIT VALLEY MUT



LIVABILITY

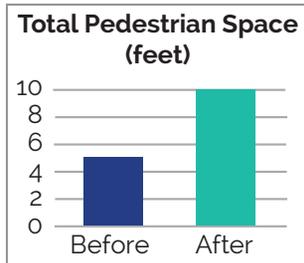


PED BIKE FACILITY COMFORT LEVEL

Before:
Uncomfortable for all modes
After:
Comfortable for all modes



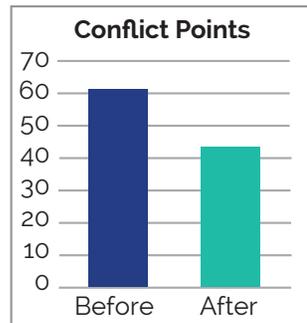
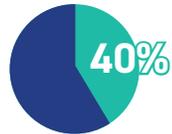
+3 Net Crossing Areas



SAFETY



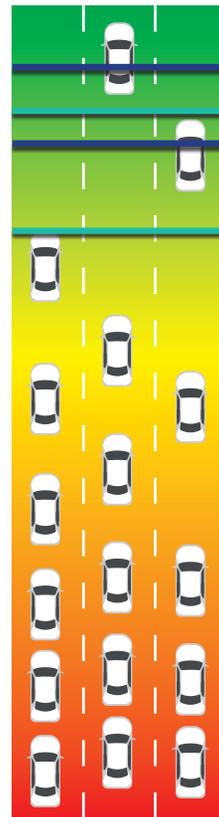
Potential Mainline Crash Reduction



FHWA Interchange Policy Violations

Before
3 1 Mile Spacing
Left Exit
Partial Interchange
After
0

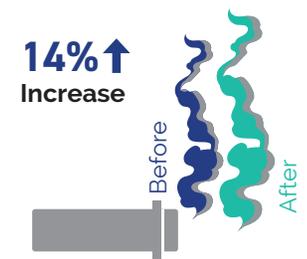
MOBILITY



Before
AM Peak
After
AM Peak
Before
PM Peak

After
PM Peak

IMPACT



IMPACTS



ECONOMICS



*Study area programmed for reconstruction.

SCORECARD - SPIRIT VALLEY SPLIT DIAMOND



LIVABILITY

EXPOSURE

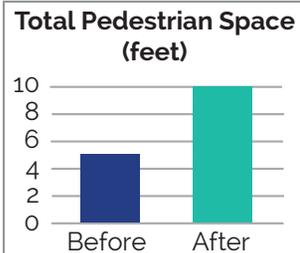


PED BIKE FACILITY COMFORT LEVEL

Before:
Uncomfortable for all modes
After:
Comfortable for all modes



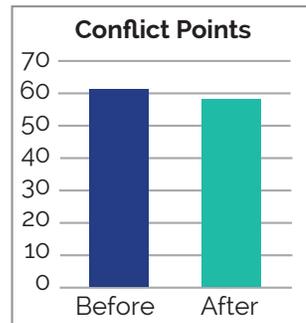
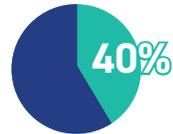
+3 Net Crossing Areas



SAFETY

CRASH POTENTIAL

Potential Mainline
Crash Reduction



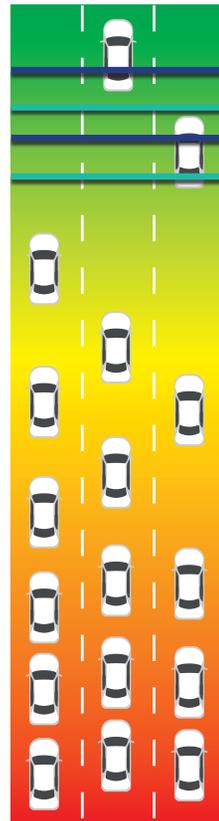
FHWA Interchange Policy Violations

Before
3 1 Mile Spacing
Left Exit
Partial Interchange

After
0

MOBILITY

NETWORK DELAYS

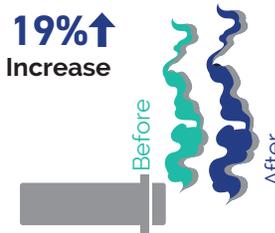


Before AM Peak
After AM Peak
Before PM Peak
After PM Peak

IMPACT

EMISSIONS

19%↑
Increase



IMPACTS

1 Building Impacted

ECONOMICS

\$59M*
Cost

*Study area programmed for reconstruction. 57th St pedestrian underpass adds \$4M.

Summary of Results

Evaluation and scoring of the developed concepts must consider the priorities established by project stakeholders as determined in the Value Profile activity. Scores for the five project priorities; livability, safety, mobility, impacts, and costs, will be based on the quantitative data developed in the analysis of each concept and evaluated qualitatively. A five-point scoring scale was used in assigning points to each concept in each category. Once a raw score was developed, weighted overall scores could be developed using the results of the Value Profile survey depending on the study subarea.

Figure 11: Spirit Valley Alternative Scoring Summary

Concept	Criteria					Total	Weighted Score
	Livability	Safety	Mobility	Impacts	Costs*		
Do Nothing	2	1	5	5	5	18	3.5
Consolidated Interchange	5	4	4.5	4	5	22.5	4.5
Median U-Turn	5	5	4	4	4.5	22.5	4.5

Notes:

* Study Area Programmed for Reconstruction

Analysis finds that both the MUT and SPUI/Consolidated Interchange concepts received equal raw and weighted scores. Further analysis of these and the third sub-alternative option may be warranted to determine which best serves the needs of project stakeholders.

DOWNTOWN

Issues

The issues found in the Downtown area largely fall under one category – livability. Narrow and uncomfortable pedestrian and bike facilities are present at both crossing of I-35 at Lake Avenue and 5th Avenue. Multiple pedestrian and bike related crashes have been reported in the area. Surround land use, featuring dense commercial, recreational and tourist attractions make this the most active non-motorized area along the study corridor – over 700 crossings of I-35 were observed during data collection efforts in the downtown area. A disproportional number of people living in poverty is the driving environmental justice factor in the surrounding area.

The existing interstate infrastructure is found to feature excess capacity throughout the entire normal day. However, the area attractions cause severe increases in vehicle traffic during events – up to 50% increases in daily traffic are observed. The surrounding area is the hub of the Duluth tourism industry as over 6.7M tourists visit the Canal Park area annually. The large amount of land area dedicated to roads and parking lots may better serve the local economy if the ability for redevelopment was provided.

Land Use

Rethinking the design of the interstate through downtown provides the generational opportunity to consider restitching together the two halves of Duluth's Core – Downtown and Canal Park – into a single, cohesive district. The economic and tourism heart of the region, Downtown land uses must consider and cater to employees, hospitals, major employers, restaurants, non-profits, residents, tourists, shipping and port, entertainment, civic, rail, public spaces, and many more demands.

An alternative design of the interstate that "right sizes", realigns, or caps the interstate, may present opportunities to pursue new public space and development along either side of the interstate, should viable excess land be created from a reduced or realigned interstate footprint.



There is a growing economic case to be considered as more communities rethink the design and operations of interstates. A recent research study conducted by the University of Minnesota Duluth¹, found that of four case study communities who transitioned a downtown segment of their respective interstate, each saw a positive ROI and post-construction investment from repurposing the interstate.

The study also noted that other community variables tended to see small gains as well, such as green space, retail and dining sales, and citywide employment. Further, using the DWC concept as a design case study, the study team estimated a likely positive fiscal output that could be generated during the conversion (reconstruction) period of I-35 through Downtown Duluth².

Downtown land uses and I-35 maintain a complex relationship – while the interstate provides the major transportation pipeline into downtown, it simultaneously severs the two halves of the downtown core. While access from I-35 will always be a necessity for Downtown vitality, an interstate conversion could usher in economic and livability benefits beyond the hard capital costs necessary for interstate conversion.

Findings **Potential Conversion Impacts: Post-Construction Results From Similar Projects**

<p>New Investment</p> <p>\$4.8 Billion Chattanooga, TN</p> <p>\$1.0 Billion Milwaukee, WI</p> <p>\$670 Million Providence, RI</p> <p>\$200 Million Rochester, NY</p>	<p>Finding a specific number for anticipated long-term investments after a freeway conversion in Downtown Duluth will take more research, but the case studies indicate a generally positive long-term impact can be expected in the range of the following values.</p>
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¹Economic Effects of the Potential I-35 Conversion in Downtown Duluth

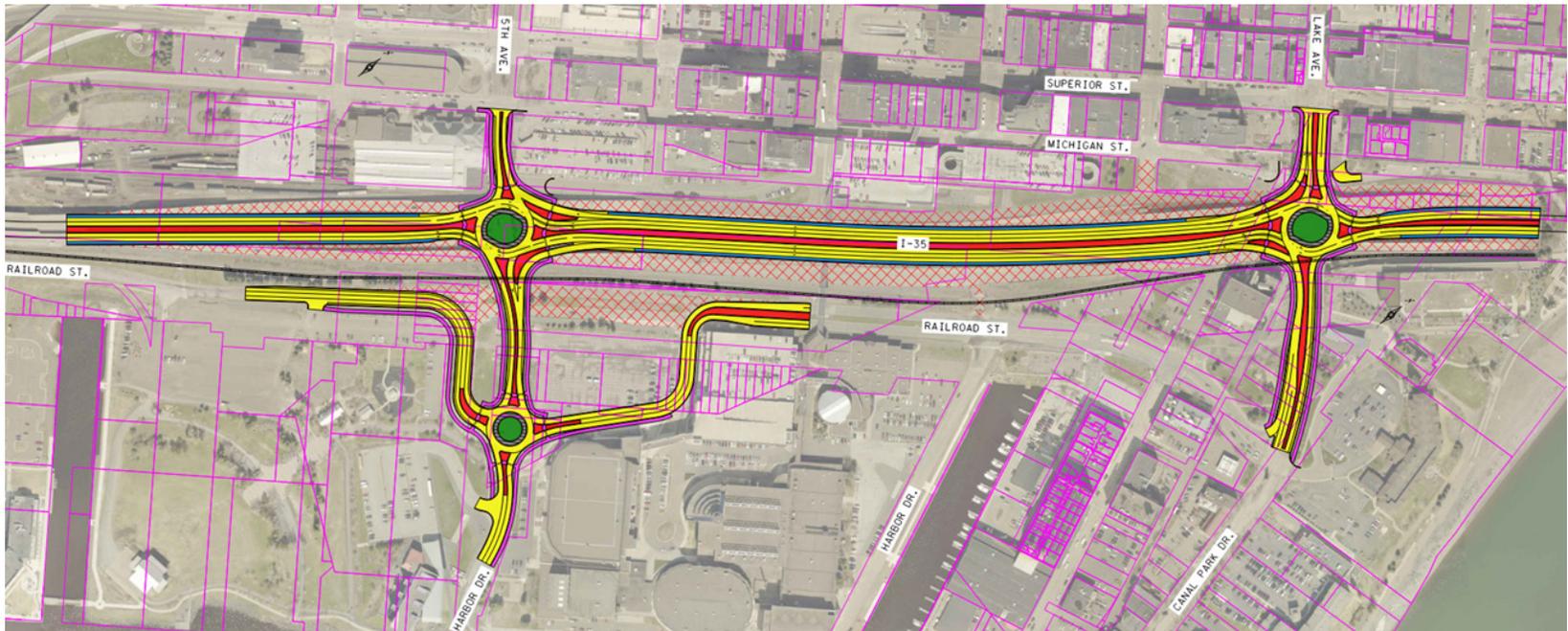
²The UMD economic study evaluated anticipated fiscal outcomes of construction using the DWC urban parkway concept, with an estimated construction cost of \$50M. The study noted however that as this MIC feasibility study and other studies progress, additional and future economic impact studies should be conducted to understand actual impacts that can be expected from I-35 improvement projects.

Developed Concepts

Three alternatives were developed in reconfiguring the I-35 interchanges with Lake Dr and 5th Ave.

The first concept considered was developed to reflect the vision presented by the Duluth Waterfront Collective which converts the interstate and two interchanges to an at-grade parkway and two multi-lane roundabout intersections. The parkway would remove frontage roads on both sides of the interstate and add a third roundabout intersection at 5th Ave and Railroad St.

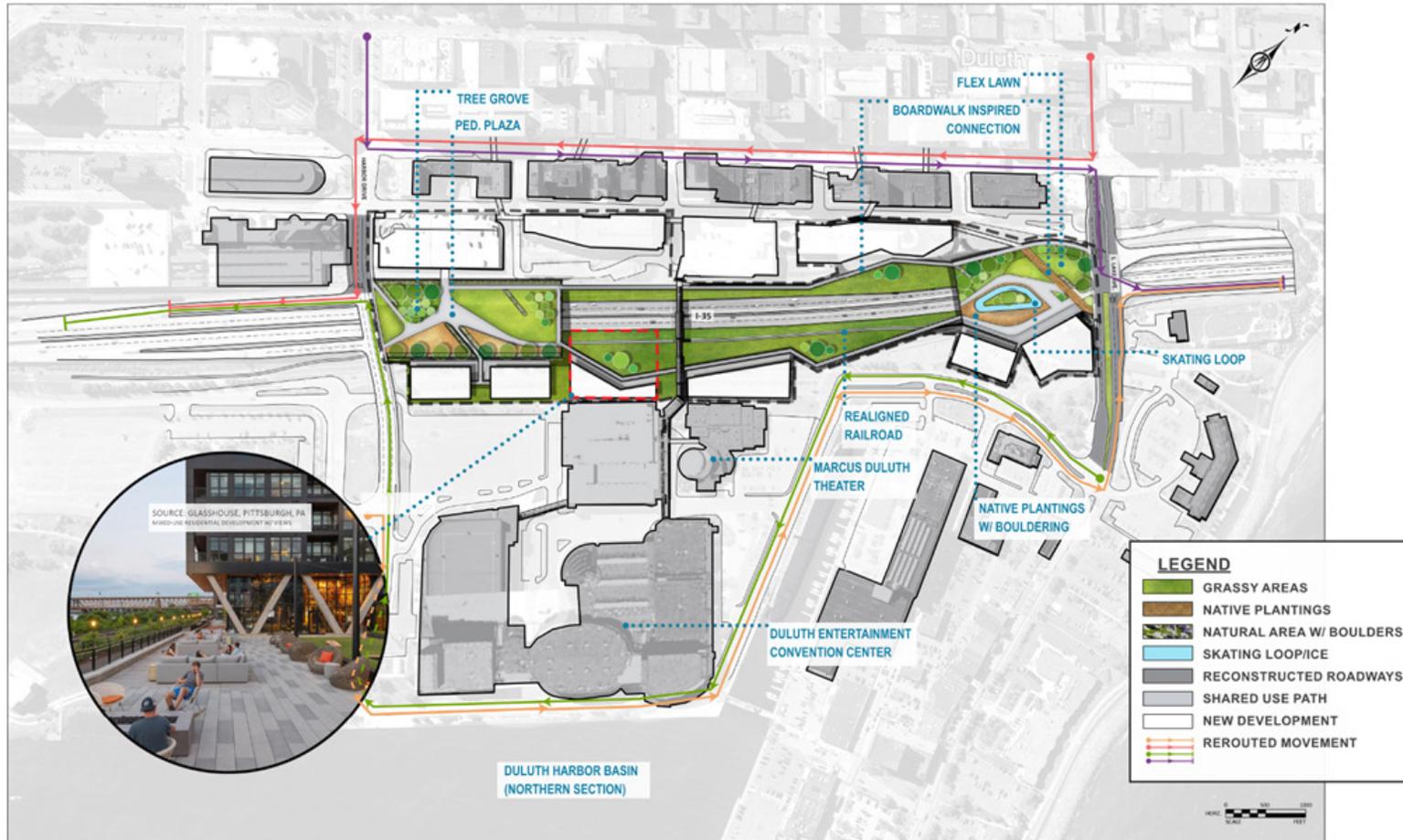
Downtown Roundabout Parkway Concept



The developed concept features a number of key differences from the DWC renderings:

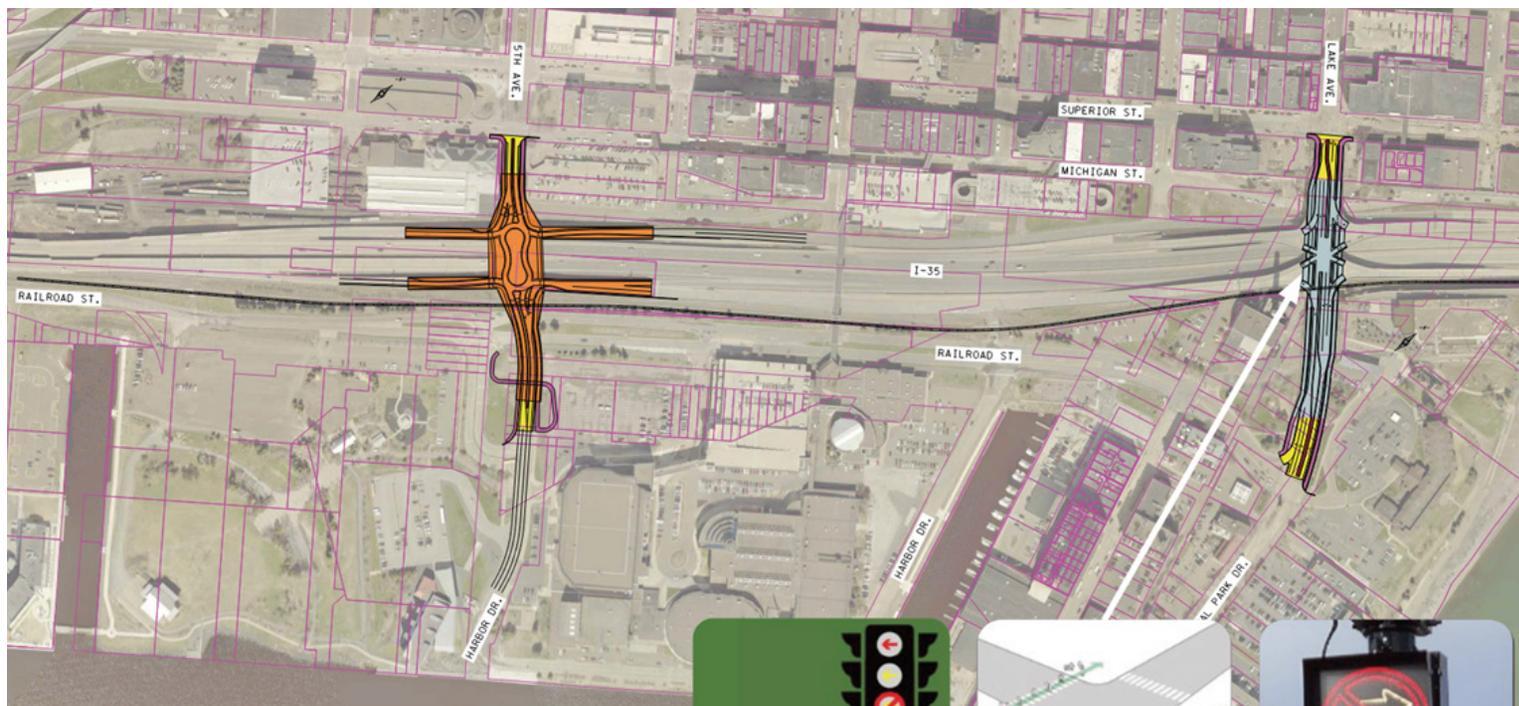
- The DWC concept features three-lane roundabouts which are not currently used in Minnesota. Technical analysis and design in accordance with MnDOT design preferences proposes unbalanced 2x1 roundabouts with bypass right turn lanes on I-35 and a single lane of approach on the local roads. Even with the proposed roundabout cross sections, the higher traffic volumes and multiple crossings that must be made by pedestrians and bikes, improvement in pedestrian safety is negligible when compared to the grade separated crossing provided today.
- The DWC concept proposed realigning the railroad line south of I-35 down the median of the parkway and through the center of the three-lane roundabouts. Rerouting the rail poses several challenges, the most substantial of which is the cost of doing so. Additionally, the existing rail alignment must return to the lake side of the tunnel north of Lake Dr. doing so would require crossing the railroad at-grade across I-35 at the north and south end of the project area. This would be a major inhibitor to regional mobility and a major safety concern.
- The DWC concept is rendered on a flat plane and ignores the substantial grade between downtown and Canal Park. Existing grades between the two sides are up to 10%. Design guidance for grades on approach to roundabout intersections suggests a 4% maximum. Larger roundabout footprints reduce the ability to make up the difference in grade and expand the project limits and costs. Mitigating the impacts of the grading would require substantial retaining wall needs which would add considerable costs and even still may not do enough to prevent the need to remove existing buildings and structures.

Downtown Lid Concept



A second concept was developed proposing the construction of two lids over I-35, one north of 5th Ave and one south of Lake Dr. The lids, or freeway caps, would mimic the tunnel system north of the Canal Park area on I-35 and create additional green space and pedestrian connectivity between I-35 and Canal and Lakefront Parks. Railroad St and the interchange ramps in between the two interchanges would need to be removed, forcing the rerouting of traffic through the area as the interchanges become partial/directional. The removal of these ramps and roadway would create additional green space to buffer the interstate from nearby amenities.

Downtown Interchange Improvement Plan Concept



A final concept was developed focusing on smaller, more readily implementable improvements. The 'road diet' or Downtown Interchange Improvement concept, recommends a road diet of Lake Dr across the existing SPUI interchange, making more room for non-motorized movements. Additional improvements to the signal system are recommended to further improve pedestrian safety at the most heavily used and highest demand pedestrian crossing of I-35. Finally, a peanut roundabout interchange at 5th Ave is proposed at the bridge which is already programmed for replacement as it may serve traffic better than the options considered by the 5th Ave Bridge Study and provide improved pedestrian safety.

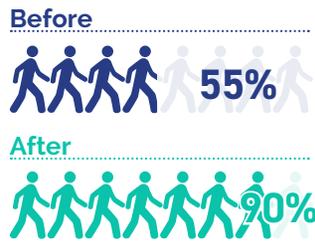


SCORECARD - DOWNTOWN ROUNDABOUT PARKWAY CONCEPT

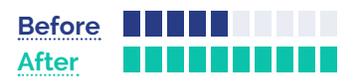


LIVABILITY

SURVIVABILITY



EXPOSURE



PED BIKE FACILITY COMFORT LEVEL

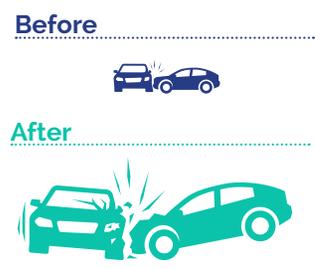
Before:
Uncomfortable for all modes

After:
Comfortable for all modes



SAFETY

CRASH POTENTIAL - LOW SEVERITY



159%↑ Increase in the peak hours

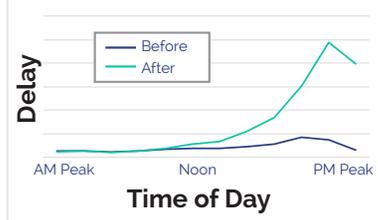
CRASH POTENTIAL - HIGH SEVERITY



447%↑ Increase in the peak hours

MOBILITY

LOCAL DELAYS

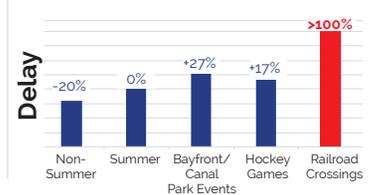


TRIP REDISTRIBUTION

30% of I-35 traffic redistributes to local network

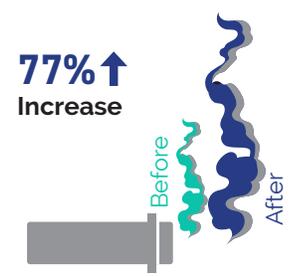


EVENT TRAFFIC



IMPACT

EMISSIONS



IMPACTS

2+ Buildings Impacted

ECONOMICS

Cost \$100M-\$150M*

Reinvestment Potential \$7-10M

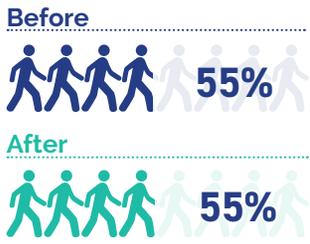
*High degree of uncertainty and risk

SCORECARD - DOWNTOWN LID CONCEPT



LIVABILITY

SURVIVABILITY



EXPOSURE



PED BIKE FACILITY COMFORT LEVEL

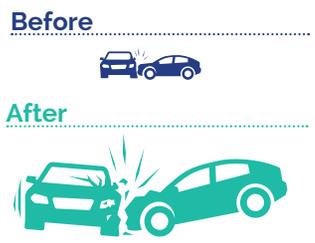
Before:
Uncomfortable for all modes

After:
Comfortable for all modes



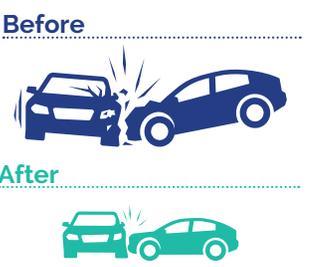
SAFETY

CRASH POTENTIAL - LOW SEVERITY



182%↑ Increase in the peak hours

CRASH POTENTIAL - HIGH SEVERITY



41%↓ Decrease in the peak hours

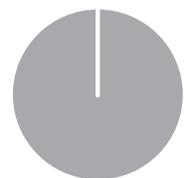
MOBILITY

LOCAL DELAYS

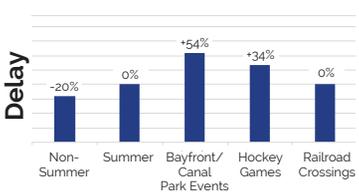


TRIP REDISTRIBUTION

No I-35 traffic redistributes to local network

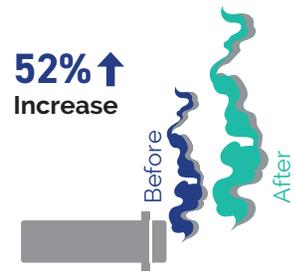


EVENT TRAFFIC



IMPACT

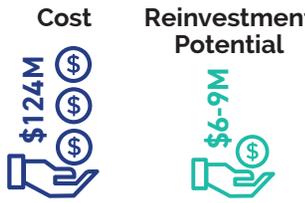
EMISSIONS



IMPACTS



ECONOMICS



SCORECARD - DOWNTOWN INTERCHANGE IMPROVEMENT PLAN



LIVABILITY	SAFETY	MOBILITY	IMPACT
<p>SURVIVABILITY</p> <p>Before 55%</p> <p>After 55%</p>	<p>CRASH POTENTIAL - LOW SEVERITY</p> <p>Before</p> <p>After</p>	<p>LOCAL DELAYS</p>	<p>EMISSIONS</p> <p>26% ↑ Increase</p>
<p>EXPOSURE</p> <p>Before</p> <p>After</p>	<p>CRASH POTENTIAL - HIGH SEVERITY</p> <p>Before</p> <p>After</p>	<p>TRIP REDISTRIBUTION</p> <p>No I-35 traffic redistributes to local network</p>	<p>IMPACTS</p> <p>0 Buildings Impacted</p>
<p>PED BIKE FACILITY COMFORT LEVEL</p> <p>Before: Uncomfortable for all modes</p> <p>After: Comfortable for all modes</p>	<p>3% ↓ Decrease in the peak hours</p>	<p>EVENT TRAFFIC</p>	<p>ECONOMICS</p> <p>Cost \$4.8M* \$40.1M**</p> <p>Reinvestment Potential \$0</p> <p>*\$4.8M for Lake Dr improvements **\$40.1M for 5th Ave bridge replacement</p>

Summary of Results

Evaluation and scoring of the developed concepts must consider the priorities established by project stakeholders as determined in the Value Profile activity. Scores for the five project priorities; livability, safety, mobility, impacts, and costs, will be based on the quantitative data developed in the analysis of each concept and evaluated qualitatively. A five-point scoring scale was used in assigning points to each concept in each category. Once a raw score was developed, weighted overall scores could be developed using the results of the Value Profile survey depending on the study subarea.

Downtown Alternative Scoring Summary

Concept	Criteria					Total	Weighted Score
	Livability	Safety	Mobility	Impacts	Costs		
Do Nothing	1	2	5	5	4	17	3.2
Roundabout Parkway	3	1	1	3	2	10	2.1
Lid	5	4	3	4	2	18	3.7
Road Diet	4	5	4	5	4	22	4.4

Analysis finds that the road diet alternative provides the highest raw and weighted scores due to maximum scores in the safety and impacts categories as well as high scores in the other remaining categories. The lid concept also scores well overall but loses points due to the high construction cost and impacts to local mobility. The do nothing alternative scores better than the roundabout parkway due to the parkways inability to accommodate local and regional traffic, high costs, and poor safety performance.