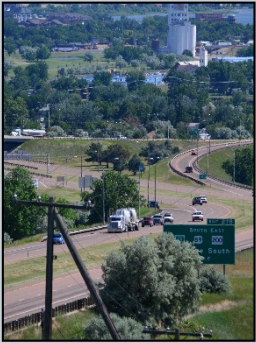


Appendix 5:

Improvement Options Report



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IMPROVEMENT OPTIONS REPORT

May 14, 2015

prepared for:
Montana Department of Transportation



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IMPROVEMENT OPTIONS REPORT

1.0 INTRODUCTION

The purpose of this memorandum is to describe and evaluate options for improving the study corridor. The study corridor consists of Interstate 15 (I-15) between the Gore Hill (Exit 277) and Emerson Junction (Exit 282) interchanges, as well as Interstate 315 (I-315) and 10th Avenue South to the west of the Missouri River. **Figure 1.1** shows the study area.

The potential improvement options were identified to address previously defined issues or areas of concern, and they are intended to satisfy the corridor needs and objectives. Improvement options contained in this report reflect input from stakeholders and the public, as well as a thorough evaluation of the existing and projected conditions of the study corridor. Three steps are applied to develop improvement options:

1. Identify roadway issues and areas of concern based on field review, engineering analysis of as-built drawings, crash data analysis, consultation with resource agencies, and information provided by the public.
2. Identify overall corridor needs and objectives.
3. Analyze the information gathered to develop a range of improvement options to address the roadway issues and areas of concern, as well as to satisfy corridor needs and objectives.

Implementation of improvement options ultimately depends on the availability of funding, personnel resources, right-of-way needs, and other project delivery elements. Recommended timeframes for implementation are defined as follows:

- Short-term timeframe: Implementation is recommended within a 0- to 5-year period.
- Mid-term timeframe: Implementation is recommended within a 5- to 10-year period.
- Long-term timeframe: Implementation is recommended within a 10- to 20-year period.

Planning level cost estimates are listed in 2015 dollars for each improvement option. The planning level costs include estimates for right-of-way, preliminary engineering, construction engineering, construction, and indirect costs (IDC). In addition, an inflationary factor of 3 percent per year was applied to the planning level costs to account for estimated year of expenditure. Cost ranges are provided in some cases, indicating unknown factors at the particular planning level stage. **Appendix A** contains planning level cost estimates, including all assumptions.

The following sections discuss general strategies explored, recommended improvement options (and associated planning level cost estimates), potential implementation timeframes, benefits, limitations, and drawbacks.

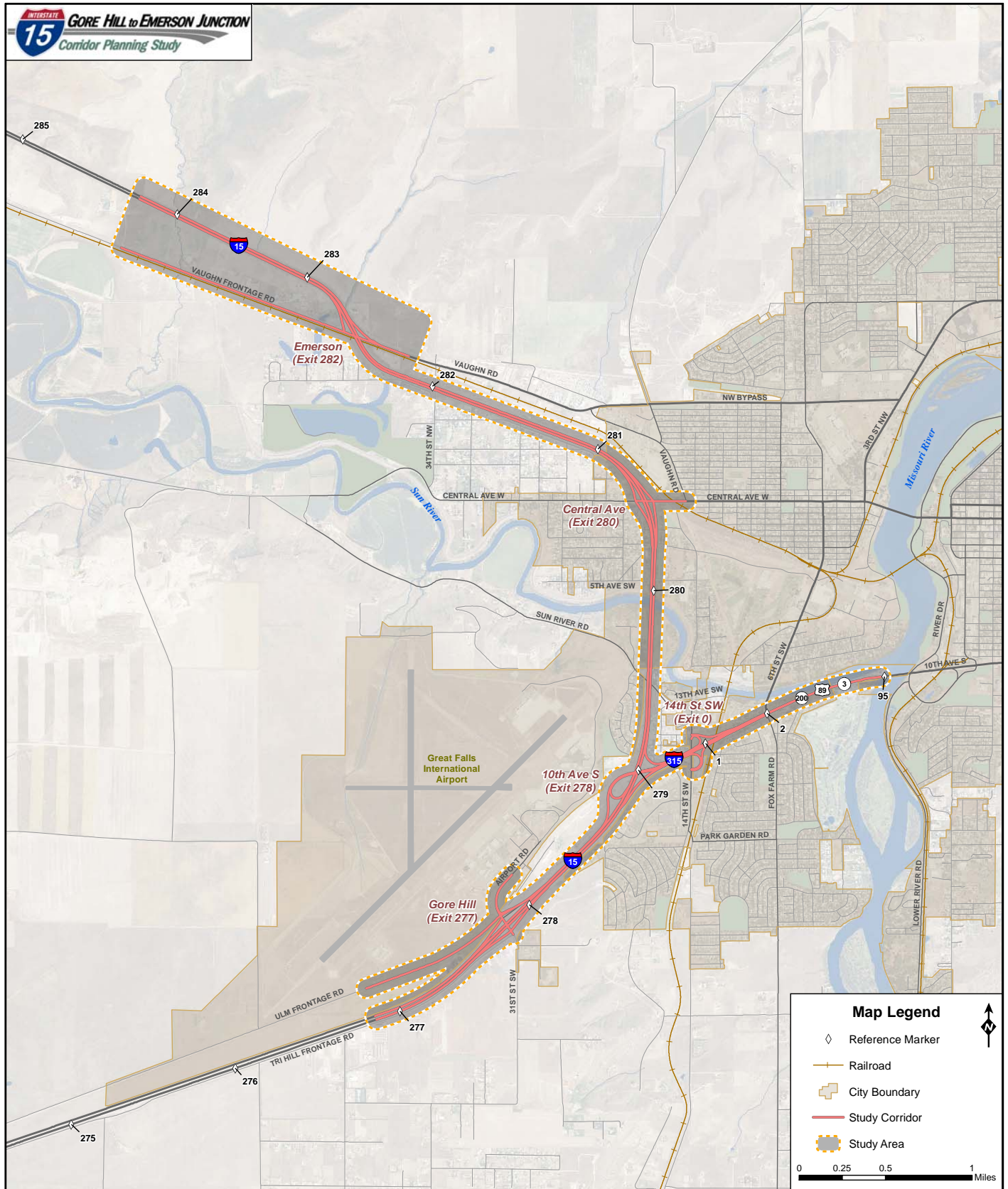


Figure 1.1: Study Area

2.0 IMPROVEMENT OPTIONS CONSIDERED

This section contains an evaluation of potential improvement options intended to address previously defined issues and areas of concern. For each of these locations, an evaluation was made to determine if a potential improvement option(s) would address the needs and objectives of the corridor.

Five general strategies for developing potential improvement options were identified in response to previously defined areas of concern. Each general strategy contains various options, and it is discussed in the following sections. The strategies explored were derived from a full assessment of the previously developed needs and objectives for the corridor, which are as follows:

Need 1 – Improve the safety of the corridor.

- Reduce the frequency and severity of crashes.
- Improve roadway elements to meet current design criteria to address identified safety concerns.
- Reduce conflicts between vehicles of varying types and speeds.
- Address identified crash trends and clusters.

Need 2 – Accommodate existing and future capacity demands.

- Maintain level of service (LOS) standards for mainline segments and interchange ramps.
- Improve operations and maintain LOS standards for intersections.

Need 3 – Provide for the mobility of people and freight.

- Provide for the movement and transfer of people and goods.
- Maintain the roadway for effective and prompt emergency response.

Not all of the improvement options under consideration are carried forward as recommendations. Rather, this memo identifies the range of improvements currently being contemplated. A recommendation was made whether or not to advance an improvement option for further consideration. Those options recommended to be advanced for further consideration are discussed in **Section 3** of this report.

2.1 DESIGN FEATURES

Roadway and ramp design features were compared to current Montana Department of Transportation (MDT) standards. A list of areas that do not meet current standards was developed previously in the *Existing and Projected Conditions Report*. The analysis identified potential options to correct some of the identified issues and to minimize potential effects. In some circumstances, it may not be cost-effective to address minor design issues unless there are safety concerns directly attributable to roadway geometry. Some of the strategies examined are listed below:

- Modify sub-standard horizontal and vertical curves to meet current standards.
- Modify interchange ramps to meet current standards.

Improvement options that arise from this strategy tie directly to ***Need 1 – Improve the safety of the corridor***. The evaluation of locations that do not meet current standards was based on assumptions for terrain and design speed. **Table 2.1** summarizes the areas of concern that were identified in the *Existing and Projected Conditions Report*, as well as the recommended action for the development of potential improvement options.

Table 2.1: Evaluation of Corridor Design Features

Location	Description			Evaluation	Needs Addressed	Recommended Action*
	Feature	Existing	Standard			
I-15	RP 277.9 to 278.9	Vertical grade	5.0%	3.0%	The steep grade results in a mixture of slow-moving trucks and faster-moving vehicles. There were 48 reported crashes between the 10th Avenue South and Gore Hill interchanges over the five-year analysis period. It is likely not feasible to flatten the existing grade; however, an additional lane in the southbound direction may help to improve safety and operations related to vehicle speed differentials.	#1 ADVANCE: • Option 1
	RP 280.5	Vertical curvature	173.9	181	There were no identified safety or operational concerns related to design features.	NONE DO NOT ADVANCE: • Does not address needs.
	RP 282.2 to 283.0	Horizontal curve radius	1,637 ft	1,820 ft	There were 41 reported crashes at this location over the five-year analysis period, 20 of which occurred at night. A major rehabilitation project (IM 15-5(123)282) will result in roadway resurfacing, ditch flattening, pavement markings, signing, delineation, and bridge deck improvements. The mainline alignment will not be modified with this project.	#1 ADVANCE: • Option 2
		Stopping sight distance	690 ft	730 ft		
I-15	RP 0.07	Horizontal curve radius	739 ft	760 ft	There were no identified safety or operational concerns related to design features.	NONE DO NOT ADVANCE: • Does not address needs.
Gore Hill	SB On-ramp	Acceleration length	1,513 ft	1,620 ft	There were no identified safety or operational concerns related to design features.	NONE DO NOT ADVANCE: • Does not address needs.
		Vertical curvature	60.4	96		
	SB Off-ramp	Vertical grade	5.80%	5.00%	There were no identified safety or operational concerns related to design features.	NONE DO NOT ADVANCE: • Does not address needs.
	NB On-ramp	Acceleration length	1,604 ft	1,620 ft	There were no identified safety or operational concerns related to design features.	NONE DO NOT ADVANCE: • Does not address needs.
		Vertical curvature	80.4	84		
	NB Off-ramp	Deceleration length	323 ft	340 ft	There were no identified safety or operational concerns related to design features.	NONE DO NOT ADVANCE: • Does not address needs.
		Vertical curvature	60.7	96		
		Vertical curvature	76.5	84		
10 th Ave S	SB On-ramp	Vertical grade	5.5%	5.0%	The steep grade of the ramp and interstate mainline results in a mixture of slow-moving trucks and faster-moving vehicles. An additional southbound lane between the 10th Avenue South and Gore Hill interchanges may help to improve safety and operations related to vehicle speed differentials.	#1 ADVANCE: • Option 1
	SB Off-ramp	Deceleration length	463 ft	490 ft	There were nine reported crashes at the ramp during the five-year analysis period. Of the nine crashes, five were rollovers, two were fixed objects, and two were wild animal crashes. Extending the length of the ramp to provide for additional deceleration length may help to improve safety at this location.	#1 ADVANCE: • Option 8
		Vertical grade	6.8%	5.0%		
		Vertical curvature	51.7	84		
	NB On-ramp	Acceleration length	590 ft	1,230 ft	There were no identified safety concerns related to design features. However, reconstruction of this ramp may be necessary as part of improvements recommended for the 14th Street Southwest westbound on-ramp.	NONE DO NOT ADVANCE: • Included as part of Option 6.

Location	Description			Evaluation	Needs Addressed	Recommended Action*
	Feature	Existing	Standard			
Central Ave	NB Off-ramp	Vertical curvature	74.1	96	NONE	DO NOT ADVANCE: • Does not address needs.
		Vertical curvature	57.1	84		
	NB On-ramp	Acceleration length	1,491 ft	1,620 ft	NONE	DO NOT ADVANCE: • Does not address needs.
		Vertical curvature	75.8	96		
	SB On-ramp	Acceleration length	1,379 ft	1,620 ft	NONE	DO NOT ADVANCE: • Does not address needs.
Emerson Junction	NB On-ramp	Acceleration length	266 ft	2,160 ft	NONE	DO NOT ADVANCE: • Planned for reconstruction.
		Vertical curvature	76.2	84		
	SB Off-ramp	Deceleration length	0 ft	340 ft	NONE	DO NOT ADVANCE: • Planned for reconstruction.
		Vertical curvature	55.6	96		
14 th St SW	EB Shared Ramp	Vertical curvature	65.4	96	NONE	DO NOT ADVANCE: • Does not address needs.
	WB On-ramp	Acceleration length	505 ft	550 ft	#1	ADVANCE: • Option 6
		Gap acceptance length	305 ft	350 ft		
	WB Off-ramp	Vertical curvature	69.4	84	NONE	DO NOT ADVANCE: • Does not address needs.

* See **Section 3** for those options advanced for further consideration.

2.2 OPERATIONS

Operational areas of concern were identified relating to vehicle interaction and interchange function. Improvement options were evaluated to address these concerns with the intent to improve the overall function of the corridor. These potential improvement options tie directly to **Need 1 – Improve the safety of the corridor**, **Need 2 – Accommodate existing and future capacity demands**, and **Need 3 – Provide for the mobility of people and freight**. The following subsections describe these operational areas of concern. A summary of the corridor operations evaluation is contained in **Table 2.2**.

Vehicle Types and Speeds

As part of the existing and projected conditions analysis, vehicle speed and origin-destination data were collected between the 10th Avenue South and Gore Hill Interchanges in the southbound direction. The results of the data showed that a high percentage of vehicles (65 percent during the AM peak and 48 percent during the PM peak) traveling southbound enter the Interstate at 10th Avenue South and immediately exit at Gore Hill. Additionally, speed data collected along the I-15 southbound mainline between the 10th Avenue South and Gore Hill interchanges showed that vehicles are generally traveling

at higher speeds in the left lane than in the right lane. Further analysis of the speed data shows a large distribution of vehicle speeds, particularly in the right travel lane. The varying vehicle speeds is likely a result of a mixture of slower moving heavy truck traffic combined with faster moving passenger vehicles.

Interchange Spacing

Providing for standard interchange spacing is necessary to accommodate vehicular maneuvers, to enable signing, and to achieve optimal capacity. In urban areas such as Great Falls, interchanges are more likely to be spaced closer together than in rural areas. The recommended spacing from an exit ramp to an entrance ramp is 500 feet. Conversely, 2,000-foot spacing is recommended between an entrance ramp and an exit ramp. For locations where recommended spacing lengths are unachievable, auxiliary lanes may be used to accommodate weaving and merging/diverging traffic characteristics. Auxiliary lanes should be provided where the distance between entrance and exit ramps is less than 1,500 feet. The 10th Avenue South and 14th Street Southwest Interchanges along I-315 are spaced closer than 1,500 feet. The close proximity of the interchanges creates weaving and merging/diverging characteristics that reduce capacity and result in operational concerns.

Access

The Interstate System is characterized by controlled access and high vehicle speeds. Access to the Interstate is controlled to promote the highest level of service in terms of safety and mobility. Approval by the Federal Highway Administration (FHWA) is required for new or modified access points. The Emerson Junction was constructed as a partial interchange, and it does not provide for all traffic movements.

Table 2.2: Evaluation of Corridor Operations

Location	Description	Evaluation	Needs Addressed	Recommended Action*
I-15 SB	Between 10th Avenue South and Gore Hill interchanges	There are vehicle mixture and speed differentials in southbound travel lane.	This area experiences operational issues, particularly in the southbound direction due to the steep grade and interactions between the 10th Avenue South and Gore Hill interchanges. There were 26 reported crashes at this location in the southbound direction during the five-year analysis period.	#1 ADVANCE: • Option 1
I-315 EB	Between 10th Avenue South and 14th Street Southwest interchanges	Distance between interchanges is approximately 570 feet. Standards recommend a minimum spacing of 2,000 feet.	This area experiences undesirable weaving characteristics, which result in safety and operational concerns. There were 15 reported crashes at this location in the eastbound direction during the five-year analysis period. It is likely not feasible to increase the distance between interchanges due to land use constraints. Additional signing may help improve driver awareness at this location.	#1, #2 ADVANCE: • Option 5
I-315 WB	Between 10th Avenue South and 14th Street Southwest interchanges	Distance between interchanges is approximately 780 feet. Standards recommend a minimum spacing of 2,000 feet.	There are experience undesirable merging / diverging characteristics, which result in safety and operational concerns. There were 12 reported crashes at this location in the westbound direction during the five-year analysis period. Adding an auxiliary lane between interchanges will allow for increased acceleration and gap acceptance lengths.	#1, #2 ADVANCE: • Option 6
I-315 WB	Fox Farm to 14th St SW	Vehicle stacking at the intersection with Fox Farm Rd along the westbound approach.	There is a high percentage of westbound vehicles utilizing the right-hand through lane due to the 14th Street Southwest exit. Vehicle stacking can lead to blocking of the right-turn lane. A westbound auxiliary lane between Fox Farm and 14th Street Southwest may help reduce vehicle stacking and improve traffic operations.	#1, #2 ADVANCE: • Option 7
I-15	Emerson Junction (Exit 282)	Existing partial interchange does not support full vehicle movements.	The existing partial interchange does not fully support the movement of people and freight at this location. Further analysis for construction of a full movement interchange is necessary to determine the feasibility of such a project.	#3 ADVANCE: • Option 10
Central Ave	West of Interchange	Three westbound lanes merge to a single lane within approximately 300 feet.	There does not appear to be proper signage and/or markings indicating the merging of two travel lanes. Improvements to signing and striping may help improve driver expectation.	#1 ADVANCE: • Option 9

* See **Section 3** for those options advanced for further consideration.

2.3 SURFACING

MDT annually tracks and measures pavement condition indices in the corridor. MDTs Pavement Management System (PvMS) is used to analyze the collected data to determine the relative performance of the pavement. Items of primary interest include the presence and degree of cracking and rutting, as well as overall ride quality. The most important performance measure is the Overall Performance Index (OPI), which provides an overall summary of the pavement condition. An OPI of 80 to 100 is considered “good,” 60 to 79.9 is “fair,” and 0 to 59.9 is “poor.”

Improvement options that arise from this strategy tie to **Need 1 – Improve the safety of the corridor**. **Table 2.3** shows the locations where the OPI indicates that pavement conditions are less than good. Deteriorated surface conditions may create safety concerns due to roadway unevenness. Additionally, roadway surfacing impacts driver comfort and maintenance needs.

Table 2.3: Evaluation of Corridor Surfacing Conditions

Location		Description	Evaluation	Needs Addressed	Recommended Action*
I-15 NB	RP 282.2 to 286.6	The surface OPI is 43.1, which indicates poor pavement condition.	This segment is planned for resurfacing as part of a major rehabilitation project (IM15-5(123)283).	#1	DO NOT ADVANCE: • Planned for reconstruction.
I-15 SB	RP 282.2 to 286.6	The surface OPI is 51.0, which indicates poor pavement condition.	This segment is planned for resurfacing as part of a major rehabilitation project (IM15-5(123)283).	#1	DO NOT ADVANCE: • Planned for reconstruction.
I-315 EB	RP 0.0 to 1.4	The surface OPI is 60.5, which indicates fair pavement condition.	Resurfacing this segment is needed to improve the condition of the roadway.	#1	ADVANCE: • Option 3
I-315 WB	RP 0.0 to 1.4	The surface OPI is 57.6, which indicates poor pavement condition.	Resurfacing this segment is needed to improve the condition of the roadway.	#1	ADVANCE: • Option 3

* See **Section 3** for those options advanced for further consideration.

2.4 BRIDGES

Narrow bridge width can contribute to fixed object collisions, including guard and bridge rail crashes. MDT standards for the Interstate System recommend that bridges have enough width to accommodate 12-foot driving lanes, 4-foot left-side shoulders, and 10-foot right-side shoulders. In addition to bridge width, the structural and deck condition for each bridge were evaluated. All bridges within the study area have a structural condition of good, which indicates that they are candidates for continued preservation. The deck conditions vary from “good” (possible candidate for sealing), to “fair-1” (candidate for healer/sealer), to “fair-2” (candidate for resurfacing).

Table 2.4 shows the bridges along the Interstate that do not meet existing standards for width. Improvement options that arise from this strategy tie directly to **Need 1 – Improve the safety of the corridor**.

Table 2.4: Evaluation of Existing Bridges

Location			Description				Evaluation	Needs Addressed	Recommended Action*
			Lanes	Width	Standard	Deck			
I-15	RP 279.98	Sun River (2 bridges)	2	28 ft	38 ft	Good	There are no identified safety concerns related to the existing bridge.	NONE	DO NOT ADVANCE: • Does not address needs.
	RP 280.09	5th Ave SW (2 bridges)	2	37 ft	38 ft	Good	There are no identified safety concerns related to the existing bridge.	NONE	DO NOT ADVANCE: • Does not address needs.
	RP 282.55	Vaughn Road/BNSF RR (2 bridges)	2	28 ft	38 ft	Fair-1	This bridge is located between two horizontal curves. There were nine reported crashes near this bridge over the five-year analysis period. The crashes involved the bridge rails, guardrail, or median barrier. The bridge deck is planned for rehabilitation as part of project IM 15-5(123)282. The bridge width will not be modified as part of this project.	#1	DO NOT ADVANCE: • Planned for rehabilitation. • Included as part of Option 2.
I-315	RP 0.01	I-15	3	45 ft	50 ft	Fair-1	There were eight reported crashes near this bridge over the five-year analysis period. The crashes involved bridge rails or guardrail. The bridge deck is a candidate for healer/sealer treatment.	#1	ADVANCE: • Option 4
	RP 0.34	14th St SW – Eastbound	2	36 ft	38 ft	Fair-2	The bridge deck is a candidate for resurfacing.	#1	ADVANCE: • Option 4
	RP 0.34	14th St SW – Westbound	3	45 ft	50 ft	Fair-1	The bridge deck is a candidate for healer/sealer treatment.	#1	ADVANCE: • Option 4
	RP 0.34	14th St SW – Eastbound off	1	23 ft	26 ft	Good	There are no identified safety concerns related to the existing bridge.	NONE	DO NOT ADVANCE: • Does not address needs.
	RP 1.06	BNSF RR – Eastbound	3	45 ft	50 ft	Fair-2	The bridge deck is a candidate for resurfacing. This location is planned for repair as part of the minor bridge rehabilitation project NHPB STWD(206).	#1	DO NOT ADVANCE: • Planned for repair.
	RP 1.06	BNSF RR – Westbound	2	37 ft	38 ft	Fair-2	The bridge deck is a candidate for resurfacing. This location is planned for repair as part of the minor bridge rehabilitation project NHPB STWD(206).	#1	DO NOT ADVANCE: • Planned for repair.
	RP 1.06	BNSF RR – Westbound off	1	23 ft	26 ft	Good	There are no identified safety concerns related to the existing bridge.	NONE	DO NOT ADVANCE: • Does not address needs.

* See [Section 3](#) for those options advanced for further consideration.

2.5 CAPACITY

A capacity analysis was conducted under existing and projected conditions for the interstate mainline, interchange ramps, and intersections. All mainline segments and ramps were shown to have an LOS B or better under existing and projected conditions. At the intersections, 6 of the 12 locations evaluated currently have an LOS of D or worse during one or both peak hours. Under projected conditions, 7 of the 12 intersections are shown to have an LOS of D or worse during both peak hours.

An analysis of left-turn bay lengths was also conducted under existing conditions. The analysis showed that the following locations may have left-turn bay lengths that do not meet existing standards:

- 14th Street Southwest/I-15 Eastbound Ramps
- Fox Farm Road/10th Avenue South (eastbound)
- Central Avenue/Southbound Ramps (westbound)

Potential improvement options were identified to address existing and projected capacity concerns. These potential improvement options tie directly to **Need 2 – Accommodate existing and future capacity demands**. The results of the intersection evaluation are shown in **Table 2.5**.

Table 2.5: Evaluation of Intersection Performance

Location		LOS (AM / PM)		Evaluation	Needs Addressed	Recommended Action*
		Existing	Projected			
Tri Hill Frontage and Airport Rd	Two-way Stop	B / B	D / E	This intersection is projected to have a failing LOS during the peak hours. Additional traffic control is needed to accommodate projected traffic volumes.	#2	ADVANCE: • Option 11
I-15 NB and Airport Rd	Two-way Stop	C / F	E / F	This intersection currently has a failing LOS during the PM peak hour, and it is projected to fail during both peak hours. Additional traffic control is needed to accommodate existing and projected traffic volumes.	#2	ADVANCE: • Option 11
I-15 SB Off and Airport Rd	Two-way Stop	B / E	F / F	This intersection currently has a failing LOS during the PM peak hour, and it is projected to fail during both peak hours. Additional traffic control is needed to accommodate existing and projected traffic volumes.	#2	ADVANCE: • Option 11
14th St SW / I-315 EB Ramps	Signalized	B / B	B / B	The existing westbound left-turn lane does not appear to provide adequate storage. Lengthening of the off-ramp is needed to accommodate left-turn storage, while providing for an appropriate deceleration length.	#2	ADVANCE: • Option 7
Fox Farm and 10th Ave S	Signalized	C / D	D / E	This intersection is projected to have a failing LOS during the peak hours. The eastbound left-turn lane does not provide adequate storage. Additional traffic control is needed to accommodate existing and projected traffic volumes.	#2	ADVANCE: • Option 13
Central Ave and I-15 SB	Two-way Stop	D / E	F / F	This intersection has a failing LOS during both peak hours. The westbound left-turn lane does not provide adequate storage. Additional traffic control is needed to accommodate existing and projected traffic volumes.	#2	ADVANCE: • Option 12
Central Ave and I-15 NB	Two-way Stop	C / D	F / F	This intersection currently has a failing LOS during the PM peak hour, and it is projected to fail during both peak hours. Additional traffic control is needed to accommodate existing and projected traffic volumes.	#2	ADVANCE: • Option 12
Central Ave and Vaughn Rd	Two-way Stop	D / F	F / F	This intersection has a failing LOS during both peak hours. Additional traffic control is needed to accommodate existing and projected traffic volumes.	#2	ADVANCE: • Option 12

* See **Section 3** for those options advanced for further consideration.

3.0 RECOMMENDED IMPROVEMENT OPTIONS

The improvement options advanced for further consideration are detailed in this section. Each improvement option contains a description, a list of the potential benefits, limitations, drawbacks, estimated implementation time frame, and a planning level cost estimate. For ease of identification, the improvement options receive unique identifiers via a numbering scheme and have been grouped based on location.

3.1 INTERSTATE 15 (I-15)

1. Southbound Auxiliary Lane (RP 278.1 to 278.5)

The existing grade between the Gore Hill and the 10th Avenue South interchanges is 5 percent. The steep grade results in a mixture of varying vehicle types and speeds. A speed differential of approximately 6 miles per hour (mph) was measured between the left and right lanes in the southbound direction.

Approximately 65 percent of AM peak hour traffic and 48 percent of PM peak hour traffic entering the Interstate at 10th Avenue South exits at Gore Hill. This high percentage of vehicles that only travel between the two interchanges results in vehicle weaving and operational issues.

There were 26 reported crashes in the southbound direction between the two interchanges during the five-year analysis period. Of the 26 reported crashes, 10 involved multiple vehicles, and 11 involved a fixed object.

Note that improvements made at this location may influence the Gore Hill Interchange. It is recommended that this improvement option be coordinated with those recommended improvement options for the Gore Hill Interchange (see Option 11).

Recommendation: Construct an auxiliary lane between the Gore Hill and 10th Avenue South interchanges in the southbound direction.

Benefits:

- Would improve safety and operations.

Limitations/Constraints:

- There is a steep slope on the northwest side of the roadway.
- May require narrower median between northbound and southbound Interstate mainlines.
- It is unknown if additional right-of-way would be required depending on design.

Estimated Cost: \$1,900,000

Implementation Timeframe: Mid-term

2. Interstate Alignment (RP 282.3 to 283.0)

This location has existing horizontal and vertical curves that do not meet existing standards. There were 41 reported crashes at this location over the five-year analysis period. Of the 41 crashes, 36 involved only a single vehicle, 16 were fixed-object related, and 10 were rollover crashes. Additionally, 21 crashes occurred during inclement weather, and 20 occurred during nighttime conditions.

A major rehabilitation project (IM 15-5(123)282) is planned for I-15 between RP 282.2 and 285.9. The alignment of the Interstate will remain unchanged under this project. Design exceptions were requested for the design elements that do not meet existing standards. The planned project would result in new roadway surfacing, ditch flattening, new pavement markings, signing, and delineation. Improvements would also be made to the Emerson Junction bridge structures including installation of signing, deck drains, deck sealing, and transverse grooves to improve skid resistance. In addition, a request was made to the MDT Safety Engineering Section to evaluate adding a temperature-related, flashing safety beacon to warn drivers of icy deck conditions.

2(a). Roadway Illumination

This location has averaged four nighttime crashes per year over the past five years. There is currently street lighting at the Emerson Junction Interchange between approximately RP 282.6 and 282.8. The planned major rehabilitation project IM 15-5(123)282 will include additional lighting at this location.

Recommendation: Install additional illumination along the Interstate mainline in accordance with existing standards.

Benefits:

- Would improve nighttime visibility.
- Would improve safety.

Limitations/Constraints:

- Does not change substandard design elements.

Estimated Cost: \$500,000

Implementation Timeframe: Mid-term

2(b). Reconstruct Roadway

The planned project (IM 15-5(123)282) may help to improve safety in the area; however, it will not improve the roadway alignment. If crash trends continue after the planned major rehabilitation project, improvements to the roadway geometrics may be necessary to improve safety. Reconstruction of the existing bridge structures at Emerson Junction would likely be required if the Interstate alignment were improved to meet current standards. This option should be considered a long-term solution if other short-term solutions fail to address existing crash trends.

Recommendation: Reconstruct the roadway and bridge structures to meet current design standards.

Benefits:

- Would improve safety by addressing roadway design features.

Limitations/Constraints:

- Would require new bridge structures over Vaughn Road and the BNSF railroad.
- Would likely require an additional right-of-way.

Estimated Cost: \$24,000,000

Implementation Timeframe: Long-term

3.2 INTERSTATE 315 (I-315)

3. Pavement Rehabilitation (RP 0.0 to 1.4)

The westbound lanes of I-315 have an OPI rating of 57.6, which indicates poor pavement conditions. The eastbound lanes have an OPI of 60.5, which indicates fair conditions. The roadway received an overlay and seal in 2007 under project IM 315-5(14)0.

Recommendation: Resurface both directions of I-315.

Benefits:

- Would improve surface conditions.

Limitations/Constraints:

- None

Estimated Cost: \$1,000,000

Implementation Timeframe: Mid-term

4. Bridge Deck Treatment

Maintaining the bridge decking helps to ensure proper surface conditions and to extend the overall life. Minor rehabilitation of the deck could include patching, sealing, resurfacing, restriping, etc., and would not modify the existing structures. The bridge deck widths would remain unchanged during rehabilitation.

The bridge deck over I-15 (RP 0.01) is rated as fair-1 condition. The existing bridge deck over 14th Street Southwest (RP 0.34) is rated as fair-2 in the eastbound direction and as fair-1 in the westbound direction. There may be opportunity to include this recommendation in the planned minor bridge rehabilitation project NHPB STWD(206).

Recommendation: Minor bridge deck rehabilitation.

Benefits:

- Would improve surface conditions.
- Would extend bridge deck life.

Limitations/Constraints:

- None

Estimated Cost: \$600,000

Implementation Timeframe: Mid-term

5. Diagrammatic Guide Signing (10th Ave S to 14th St SW)

The existing distance between the I-15 off-ramps at the 10th Avenue South Interchange and the I-315 eastbound off-ramp at the 14th Street Southwest Interchange is approximately 570 feet. Standards recommend a minimum distance of 2,000 feet. This area experiences operational concerns due to vehicle weaving and merging/diverging maneuvers.

Due to existing developments and additional design constraints, it is likely not feasible to reconstruct the existing ramps to provide for additional distance between the two interchanges. Ramp metering was evaluated as a potential Intelligent Transportation System (ITS) solution; however, existing and projected traffic volumes are likely too low for ramp metering to be considered viable.

Providing advance diagrammatic guide signing for eastbound traffic before entering I-315 may help to improve safety by providing drivers with a visual warning about the lane use configurations at this location. **Figure 3.1** shows a conceptual guide sign layout for eastbound traffic.

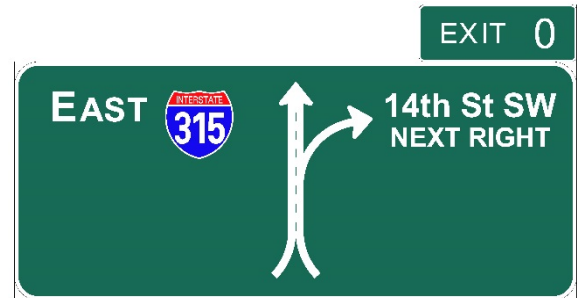


Figure 3.1: Conceptual Guide Sign

Recommendation: Install overhead diagrammatic guide signage for eastbound traffic.

Benefits:

- Would improve traffic operations.
- Would improve safety.

Limitations/Constraints:

- Would not address design concerns.
- Vehicle weaving and merging/diverging interactions would still occur.

Estimated Cost: \$200,000

Implementation Timeframe: Short-term

6. Westbound Auxiliary Lane (14th St SW to 10th Ave S)

The existing distance between the I-315 westbound on-ramp at the 14th Street Southwest Interchange and the I-315 westbound off-ramp at the 10th Avenue South Interchange is 780 feet. Standards recommend a minimum distance of 2,000 feet between entrance and exit ramps. The existing acceleration and gap acceptance lengths of the I-315 westbound on-ramp do not meet existing standards. This area experiences traffic operational issues related to vehicle weaving and merging/diverging. Additionally, the I-15 northbound on-ramp at the 10th Avenue South Interchange does not meet existing standards for acceleration length.

Providing a westbound auxiliary lane between the 14th Street Southwest and 10th Avenue South interchanges would enable additional acceleration and gap acceptance length for vehicles entering I-315 at 14th Street Southwest. Reconstructing the I-15 northbound on-ramp would enable increased acceleration length and would allow for a longer auxiliary lane between the interchanges.

Figure 3.2 provides a graphical concept of a westbound auxiliary lane and reconstructed I-15 northbound on-ramp. This concept was developed using a 25-mph design speed for the on-ramp horizontal curve. Actual design speed and geometrics would be determined during project development. The modified ramps are shown to provide for sufficient acceleration and deceleration length.



Figure 3.2: I-315 Westbound Auxiliary Lane Concept

Recommendation: Reconstruct the westbound lane of I-315 and the I-15 on-ramp to provide an auxiliary travel lane and sufficient ramp lengths.

Benefits:

- Would improve traffic operations.
- Would improve safety.
- Would increase capacity.

Limitations/Constraints:

- Would lower design speed along I-15 on-ramp.

Estimated Cost: \$2,000,000

Implementation Timeframe: Mid-term

7. Westbound Auxiliary Lane (Fox Farm Rd to 14th St SW)

The westbound off-ramp terminates at a signalized intersection with 14th Street Southwest. The predominant movement at this intersection is the westbound left turn. The length of the westbound off-ramp does not provide for adequate vehicle storage and deceleration length. Evaluation of traffic

operations at this intersection show long vehicle queues related to left-turning traffic, particularly during the PM peak hour.

At the intersection with Fox Farm Road, a disproportionate amount of westbound through traffic is concentrated in the right through lane. The close proximity of the 14th Street Southwest interchange influences driver lane decisions at the intersection. Drivers traveling westbound and wishing to exit I-315 at 14th Street Southwest are likely to travel in the right lane through the Fox Farm intersection. This results in vehicles stacking at the intersection which can block the right-turn lane.

Providing a westbound auxiliary lane between Fox Farm Road and 14th Street Southwest will increase vehicle storage along the off-ramp and would help to improve traffic operations at the intersection with Fox Farm Road. The addition of an auxiliary lane would require some reconstruction of the intersection, particularly along the east approach leg. Coordination of the signal timing between the 14th Street Southwest and Fox Farm Road intersections should also be evaluated to determine if further improvements can be made to traffic operations.

Recommendation: Construct a westbound auxiliary lane between Fox Farm Road and the 14th Street Southwest off-ramp.

Benefits:

- Would improve safety.
- Would improve traffic operations.
- Would increase capacity.

Limitations/Constraints:

- Would require some reconstruction of the intersection with Fox Farm Road.

Estimated Cost: \$1,200,000

Implementation Timeframe: Mid-term

3.3 INTERCHANGES

8. Lengthen Southbound Off-ramp (10th Ave S Interchange)

The I-15 southbound off-ramp at the 10th Avenue South Interchange does not meet current standards for deceleration length and vertical profile. The existing configuration is a loop ramp that is signed for a 35-mph exit speed. During the five-year analysis period, there were nine reported crashes at the ramp. Five of the nine reported crashes were rollovers, while two crashes were fixed-object related. Providing for additional deceleration length along the off-ramp would provide vehicles more time to slow down prior to exiting the Interstate.

Recommendation: Lengthen the southbound off-ramp to provide for additional deceleration length.

Benefits:

- Would improve safety.

Limitations/Constraints:

- The existing bridge structure limits the overall length of the off-ramp and reduces sight distances.
- Lengthening the ramp may require cutting into the steep hillside along the west side.

Estimated Cost: \$260,000

Implementation Timeframe: Mid-term

9. Modify Lane Merge (West of Central Ave Interchange)

The southbound off-ramp at Central Avenue has a channelized stop-controlled right-turn lane. There is a dedicated receiving lane along Central Avenue for right-turning traffic. Just west of the intersection are three westbound lanes that merge into a single lane within approximately 300 feet. There does not appear to be adequate signage and/or markings indicating the merging of two travel lanes.

Recommendation: Modify the signing and striping for the lane merge segment.

Benefits:

- Would improve safety.
- Would improve operations.

Limitations/Constraints:

- None

Estimated Cost: \$20,000

Implementation Timeframe: Short-term

10. Feasibility Analysis (Emerson Junction)

The Emerson Junction Interchange, Exit 282 on I-15, provides partial access to Vaughn Road and the surrounding area. The interchange is currently configured as a partial diamond interchange consisting of a northbound on-ramp and a southbound off-ramp. Local officials have an interest in expanding the current partial interchange at Emerson Junction to a full movement interchange. A recommendation for a full movement interchange at, or near, Emerson Junction has been made as an illustrative project in local planning documents, including federally-approved Long Range Transportation Plans, dating back to 1968.

The corridor study process evaluated this improvement option and determined a full movement interchange at Emerson Junction does not clearly meet the identified needs of the interstate corridor. Further analysis is necessary to advance this recommendation and demonstrate to FHWA that existing interchanges and/or local roads and streets can neither provide the necessary access, nor be improved to satisfactorily accommodate the design year traffic demands. Justification for proposed Interstate access revisions must follow the *Interstate System Access Informational Guide*¹.

FHWA's interest is to ensure all new or revised access points:

- Are considered using a decision-making process that is based on information and analysis of the planning, environmental, design, safety, and operational effects of the proposed change.
- Support the intended purpose of the Interstate System.
- Do not have an adverse impact on the safety or operations of the Interstate System and connecting local roadway network or other elements of the transportation system.

¹ FHWA *Interstate System Access Informational Guide*, August 2010, <http://www.fhwa.dot.gov/design/interstate/pubs/access/access.pdf>.

- Are designed to acceptable standards.

In addition to the aforementioned interests, the *Guide* also outlines eight policy requirements that must be satisfied for approval. According to the *Guide*, a typical Interstate System Access Change Request begins with the statewide or metropolitan planning process. The work done in the transportation planning process, be it a long-range transportation plan or a corridor study, can be used to define the initial scope and nature of the project. The next step in the process is to refine the scope and conduct the required analysis, then to make an initial determination if the project is reasonable.

Specific to the Emerson Junction process, it is envisioned that a feasibility study would be conducted to determine the most appropriate interchange configuration. The feasibility study would provide a detailed evaluation of potential interchange locations/configurations based on operational and safety considerations, right-of way and land use impacts, costs, environmental resources constraints, and agency/public acceptance.

Once a preferred configuration is selected, and after a determination is made as to its reasonableness, the Interstate System Access Change Request can be completed and submitted to FHWA. After FHWA receives the request, the operational and engineering acceptability in accordance with the eight policy requirements is determined. If the project is found to be acceptable, the project development process is allowed to continue.

The next stage of the project development process consists of developing the environmental document and initiating preliminary engineering for the preferred configuration. FHWA approval is considered a Federal action, and as such, requires following NEPA procedures. After completion of the NEPA process, final FHWA approval may be granted. For these steps to occur, a project funding source should be identified.

Per Montana Transportation Commission policy², sponsorship by a local government is a prerequisite for the consideration of a new interchange. The sponsor is responsible for preparing feasibility and environmental studies, arranging the financial package for the project, utility moves, and securing necessary right-of-way.

Recommendation: Secure a local project sponsor to fund an operational analysis/feasibility study, conducted by a qualified traffic engineer, of the Emerson Junction Interchange which considers state and federal regulations including the *Interstate System Access Informational Guide* and Montana Transportation Commission Policy.

Benefits:

- Determination of feasibility and need.

Limitations/Constraints:

- Identification of local project sponsor.
- Identification of funding.

Estimated Cost: \$250,000

Implementation Timeframe: Mid-term

² Montana Transportation Commission Policy Statement, policy number 13, adopted June, 1992, http://www.mdt.mt.gov/other/dir/external/commission/policies/13-additional_interchanges.pdf.

3.4 INTERSECTIONS

11. Intersection Improvements (Gore Hill Interchange)

The Gore Hill Interchange services the Great Falls International Airport and surrounding areas. The Gore Hill Interchange is configured as a compact diamond interchange with stop-control along the interchange ramps and frontage roads.

Four intersections exist within the vicinity of the Gore Hill Interchange. The intersections of the I-15 ramps with Airport Drive both have existing and projected LOS of D or worse during the peak hour(s). Additionally, the intersection of Tri Hill Frontage Road and Airport Drive is projected to have failing peak hour LOS. All four intersections are closely spaced, which results in operational concerns.

This area experiences high percentages of truck traffic due to access to the truck stop to the south and airport and freight facilities to the north. Large trucks particularly have difficulty with the left-turn movement coming from the I-15 southbound off-ramp. The restricted roadway width creates operational and safety issues with this movement. Additionally, the existing overpass bridge has a deck roadway width of 28 feet, which does not allow for roadway widening or installation of dedicated turn bays to help improve traffic operations.

Modifications to the intersections are needed to improve the operations and capacity of this interchange. Due to the proximity of the four intersections, it is desirable to evaluate the intersections as a network rather than individually when analyzing potential improvements.

Five planning-level concepts were developed as potential improvements to the Gore Hill Interchange intersections. The following sections provide a description and summary of traffic operations for the concepts. A more detailed traffic engineering study would need to be conducted during project development to determine the appropriate intersection treatments.

Note that these concepts are aimed at providing a 20-year design life. If a new overpass structure is constructed, the structure would be built for a 75-year design life. Given the long-term needs of the area, and the constraints at the existing interchange location, it may be appropriate to evaluate the location of the interchange to ensure long-term growth is accommodated.

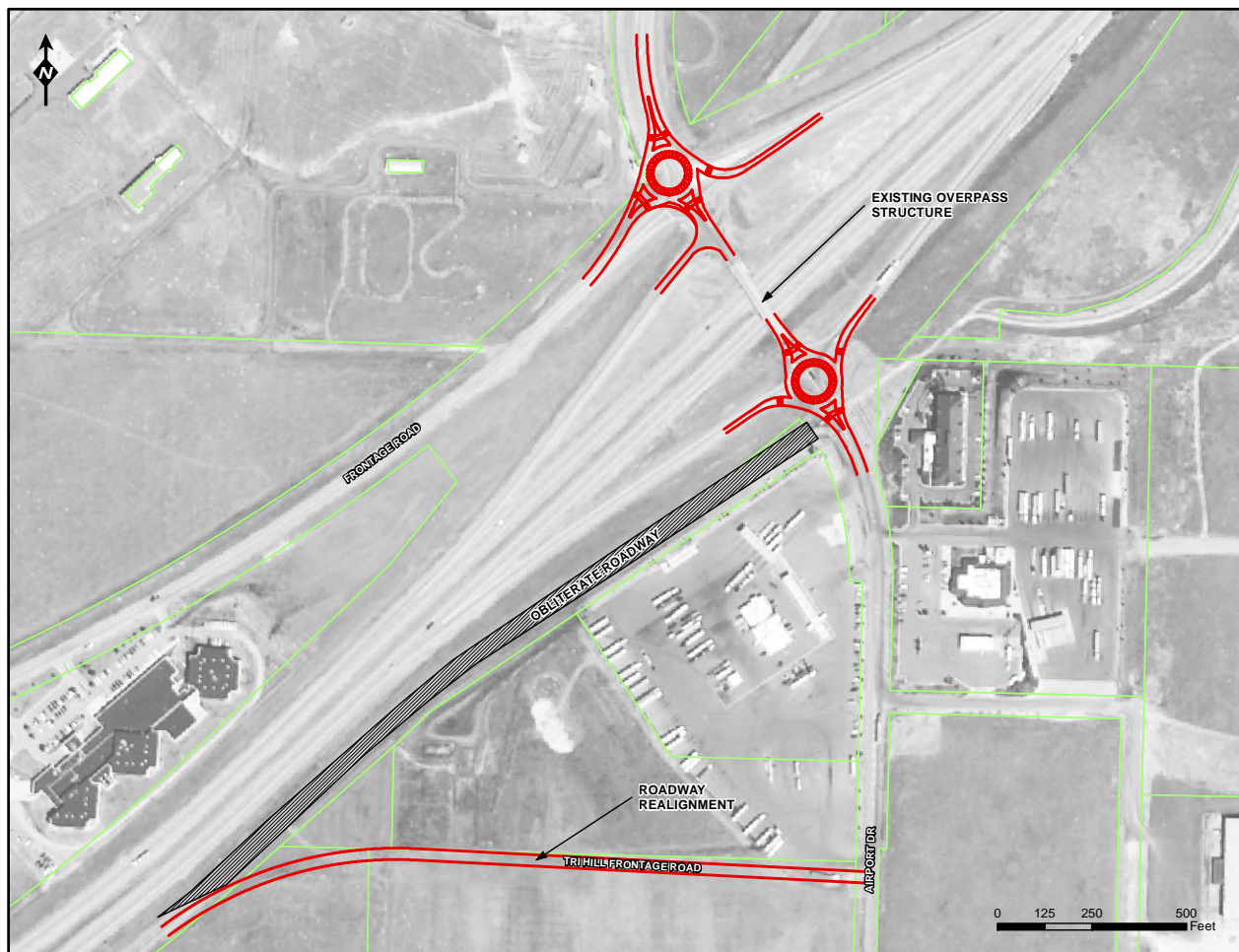
Concept A—Roundabouts with Intersections Relocated

Concept A consists of two, four-legged roundabouts and the relocation of the southbound on-ramp and Tri Hill Frontage Road. On the north side of the Interstate, a four-legged roundabout would be created that would combine the southbound off-ramp, Frontage Road, and Airport Drive approaches. The southbound off-ramp approach would be located on the southeast side of the roundabout, outside the influence of the splitter island. A minimal amount of new right-of-way is anticipated along the northwest quadrant of the roundabout to accommodate the realignment of the Frontage Road approach.

South of the Interstate, new right-of-way would be necessary to reroute the Tri Hill Frontage Road south of the existing Flying J Travel Plaza. This concept would result in an LOS of C or better along all approaches at both roundabouts during the peak hours under existing and projected conditions.

Table 3.1: Gore Hill Concept A Traffic Operations

Location	Existing Conditions				Projected Conditions			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Airport Drive / I-15 SB	5.4	A	6.5	A	7.4	A	10.8	B
<i>Airport Drive (SE)</i>	3.3	A	3.8	A	3.4	A	3.9	A
<i>SB Off-ramp (NE)</i>	5.9	A	6.3	A	8.4	A	9.0	A
<i>Airport Drive (NW)</i>	4.0	A	7.2	A	4.8	A	13.8	B
<i>Frontage Road (SW)</i>	4.2	A	5.4	A	5.2	A	8.2	A
Airport Drive / I-15 NB	6.4	A	8.8	A	8.7	A	15.8	C
<i>Airport Drive (SE)</i>	7.5	A	8.9	A	10.8	B	15.9	C
<i>Airport Drive (NW)</i>	5.3	A	8.8	A	6.7	A	16.1	C
<i>NB Off-ramp (SW)</i>	5.0	A	7.6	A	5.8	A	10.8	B


Figure 3.3: Gore Hill Concept A

Benefits:

- Would improve geometrics for large vehicles.
- Would improve safety.
- Standard roundabout footprint.
- Can use existing overpass structure.

Limitations/Constraints:

- New right-of-way required for relocated Tri Hill Frontage Road.
- Proximity of approaches to roundabouts may create traffic operation issues.

Estimated Cost: \$7,700,000**Concept B—Five-legged Roundabouts**

Concept B would result in single-lane, five-legged roundabouts to the north and south of the Interstate. The five-legged roundabouts would combine all existing approaches. On the north side of the Interstate, the Frontage Road approach would be shifted to the north, and the southbound off-ramp would shift to the south to align with the roundabout. No new right-of-way is anticipated north of the Interstate.

South of the Interstate, the northbound off-ramp would shift to the north, closer to the I-15 mainline. The southern Airport Drive approach would be realigned to the east, which may require a minimal amount of new right-of-way. This concept would result in an LOS of B or better along all approaches at both roundabouts during the peak hours under existing and projected conditions.

Table 3.2: Gore Hill Concept B Traffic Operations

Location	Existing Conditions				Projected Conditions			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Airport Drive / I-15 SB	5.7	A	6.6	A	7.7	A	10.1	B
<i>Airport Drive (SE)</i>	4.4	A	4.2	A	4.7	A	4.5	A
<i>SB Off-ramp (NE)</i>	6.3	A	6.1	A	8.7	A	8.3	A
<i>Airport Drive (NW)</i>	5.3	A	7.6	A	7.1	A	13.2	B
<i>Frontage Road (SW)</i>	4.9	A	6.1	A	6.1	A	8.6	A
Airport Drive / I-15 NB	6.0	A	8.6	A	7.5	A	13.5	B
<i>Airport Drive (SE)</i>	7.1	A	8.7	A	9.5	A	13.2	B
<i>Airport Drive (NW)</i>	5.4	A	9.0	A	6.5	A	14.7	B
<i>NB Off-ramp (W)</i>	5.1	A	7.7	A	5.8	A	10.2	B
<i>Tri Hill Frontage (SW)</i>	5.3	A	5.9	A	6.4	A	8.2	A



Figure 3.4: Gore Hill Concept B

Benefits:

- No impacts to access.
- Would improve geometrics for large vehicles.
- Would improve safety.
- Can use existing overpass structure.
- Minimal new right-of-way required.

Limitations/Constraints:

- Non-standard five-legged roundabout configuration.
- Larger intersection footprint.

Estimated Cost: \$7,600,000

Concept C—Roundabouts with Intersections Shifted

Concept C would include single-lane, four-legged roundabouts on both sides of the Interstate. On the north side, a four-legged roundabout would be created by combining the southbound off-ramp, Frontage Road, and Airport Drive approaches. The southbound off-ramp approach would be located on the southeast side of the roundabout, outside the influence of the splitter island. A

minimal amount of new right-of-way is likely needed along the northwest quadrant of the roundabout to accommodate the realignment of the Frontage Road approach.

On the south side of the Interstate, the Airport Drive and I-15 northbound ramps would be combined into a four-legged roundabout. The Tri-Hill Frontage Road approach would be shifted to the southeast of the roundabout. The realigned approach would require new right-of-way and it would result in minor impacts to the existing truck stop. This concept would result in an LOS of C or better along all approaches at both roundabouts during the peak hours under existing and projected conditions.

Table 3.3: Gore Hill Concept C Traffic Operations

Location	Existing Conditions				Projected Conditions			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Airport Drive / I-15 SB	5.4	A	6.5	A	7.4	A	10.8	B
<i>Airport Drive (SE)</i>	3.3	A	3.8	A	3.4	A	3.9	A
<i>SB Off-ramp (NE)</i>	5.9	A	6.3	A	8.4	A	9.0	A
<i>Airport Drive (NW)</i>	4.0	A	7.2	A	4.8	A	13.8	B
<i>Frontage Road (SW)</i>	4.2	A	5.4	A	5.2	A	8.2	A
Airport Drive / I-15 NB	6.4	A	8.8	A	8.7	A	15.8	C
<i>Airport Drive (SE)</i>	7.5	A	8.9	A	10.8	B	15.9	C
<i>Airport Drive (NW)</i>	5.3	A	8.8	A	6.7	A	16.1	C
<i>NB Off-ramp (SW)</i>	5.0	A	7.6	A	5.8	A	10.8	B

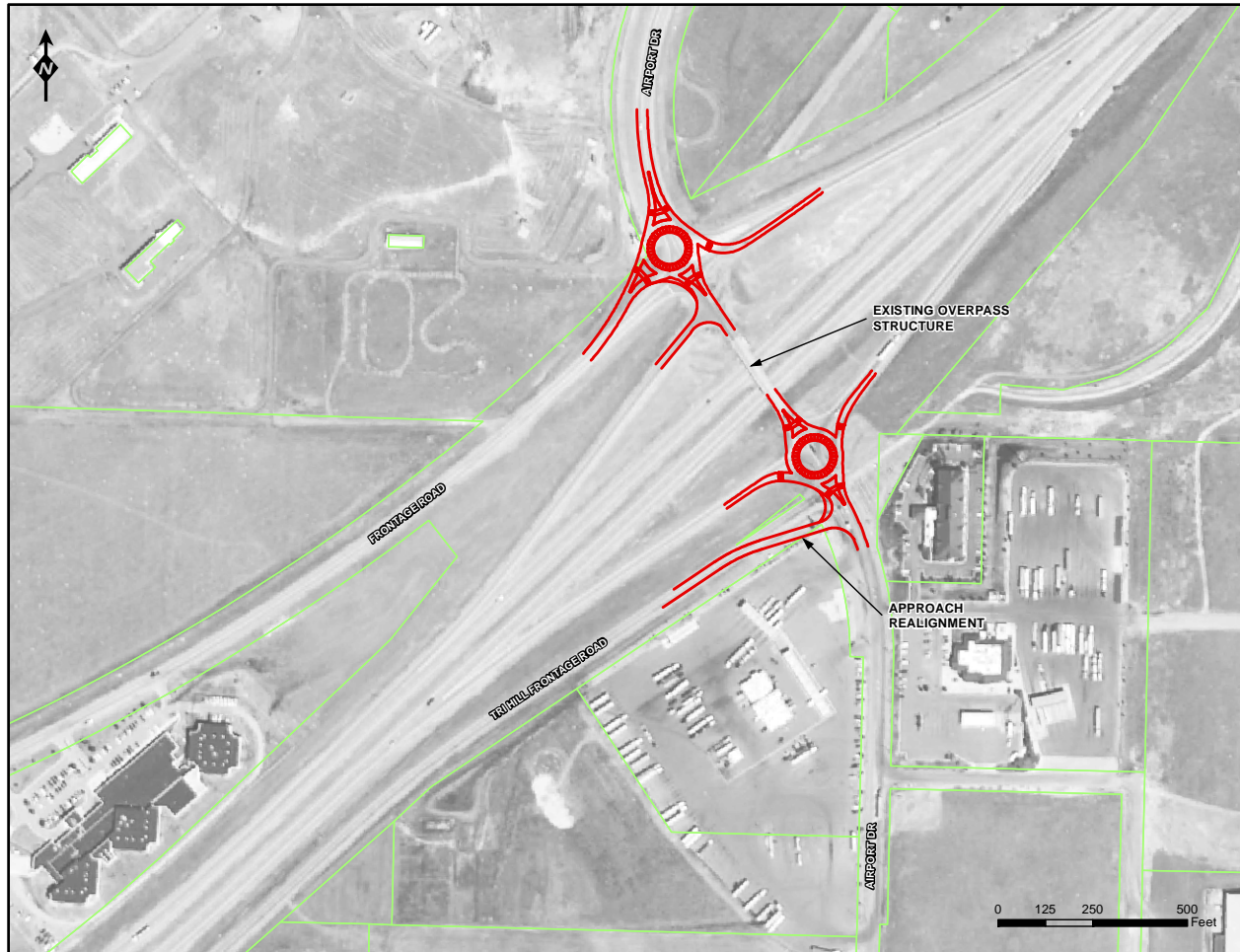


Figure 3.5: Gore Hill Concept C

Benefits:

- Standard roundabout footprint.
- No impacts to access.
- Would improve geometrics for large vehicles.
- Would improve safety.
- Can use existing overpass structure.
- Minimal new right-of-way required.

Limitations/Constraints:

- Minor impact to northern corner of the Flying J site.
- Proximity of approaches to roundabouts may create traffic operation issues.

Estimated Cost: \$5,200,000

Concept D—Traffic Signals without Realignment

This concept would include installing traffic signals at the existing four-legged intersections. No major alignment changes are envisioned under this concept. No new right-of-way is anticipated with this concept.

North of the Interstate, a signal would be installed at the intersection of Airport Drive, Frontage Road, and the southbound off-ramp. The southbound on-ramp approach would remain at its current location. South of the Interstate, a traffic signal would be installed at the intersection of Airport Drive and the northbound ramps. The Tri Hill Frontage approach would be unchanged under this concept.

Both intersections have an LOS C or better for all approaches under both existing and projected conditions. In order to accommodate a southbound left-turn lane at the southern intersection, a new or widened overpass structure is needed.

Table 3.4: Gore Hill Concept D Traffic Operations

Location	Existing Conditions				Projected Conditions			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Airport Drive / I-15 SB	6.8	A	14.5	B	8.8	A	19.0	B
<i>Frontage Road (SW)</i>	4.1	A	12.7	B	6.3	A	13.3	B
<i>SB Off-ramp (NE)</i>	3.7	A	13.9	B	6.8	A	18.5	B
<i>Airport Drive (SE)</i>	23.9	C	12.0	B	20.3	C	14.1	B
<i>Airport Drive (NW)</i>	24.7	C	15.7	B	21.1	C	21.0	C
Airport Drive / I-15 NB	11.4	B	11.7	B	14.4	B	20.4	C
<i>NB Off-ramp (SW)</i>	17.4	B	17.1	B	22.6	C	29.8	C
<i>Airport Drive (SE)</i>	16.1	B	16.0	B	20.8	C	22.0	C
<i>Airport Drive (NW)</i>	5.9	A	9.5	A	6.7	A	19.1	B



Figure 3.6: Gore Hill Concept D

Benefits:

- No impacts to access.
- Would result in increased capacity.
- Would improve geometrics for large vehicles.
- No new right-of-way anticipated.

Limitations/Constraints:

- Would require a new or widened overpass structure to accommodate dedicated turn lanes.
- Not as safe as roundabout configurations.
- Proximity of approaches to signalized intersections may create traffic operation issues.

Estimated Cost: \$5,200,000 (widen existing structure) to \$6,700,000 (replace structure)

Concept E—Traffic Signals with Intersections Relocated

This concept would be a combination of Concept D and Concept A. Traffic signals would be installed at the existing four-legged intersections. In addition, the Tri Hill Frontage Road would be relocated as shown in Concept A.

North of the Interstate, a signal would be installed at the intersection of Airport Drive, Frontage Road, and the southbound off-ramp. The southbound on-ramp approach would remain at its current location. No new right-of-way is anticipated north of the Interstate.

On the south side of the Interstate, a traffic signal would be installed at the intersection of Airport Drive and the northbound ramps. The Tri Hill Frontage Road would be rerouted to the south of the Flying J Travel Plaza. New right-of-way would be necessary for the rerouted Tri Hill Frontage Road.

This concept offers comparable intersection delay and LOS to Concept D. Both signalized intersections have an LOS C or better under existing conditions, which would continue under projected conditions. As with Concept D, a new or widened overpass structure would be needed to accommodate a southbound left-turn lane at the southern intersection.

Table 3.5: Gore Hill Concept E Traffic Operations

Location	Existing Conditions				Projected Conditions			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Airport Drive / I-15 SB	6.8	A	14.5	B	8.8	A	19.0	B
<i>Frontage Road (SW)</i>	4.1	A	12.7	B	6.3	A	13.3	B
<i>SB Off-ramp (NE)</i>	3.7	A	13.9	B	6.8	A	18.5	B
<i>Airport Drive (SE)</i>	23.9	C	12.0	B	20.3	C	14.1	B
<i>Airport Drive (NW)</i>	24.7	C	15.7	B	21.1	C	21.0	C
Airport Drive / I-15 NB	11.4	B	11.7	B	14.4	B	20.4	C
<i>NB Off-ramp (SW)</i>	17.4	B	17.1	B	22.6	C	29.8	C
<i>Airport Drive (SE)</i>	16.1	B	16.0	B	20.8	C	22.0	C
<i>Airport Drive (NW)</i>	5.9	A	9.5	A	6.7	A	19.1	B

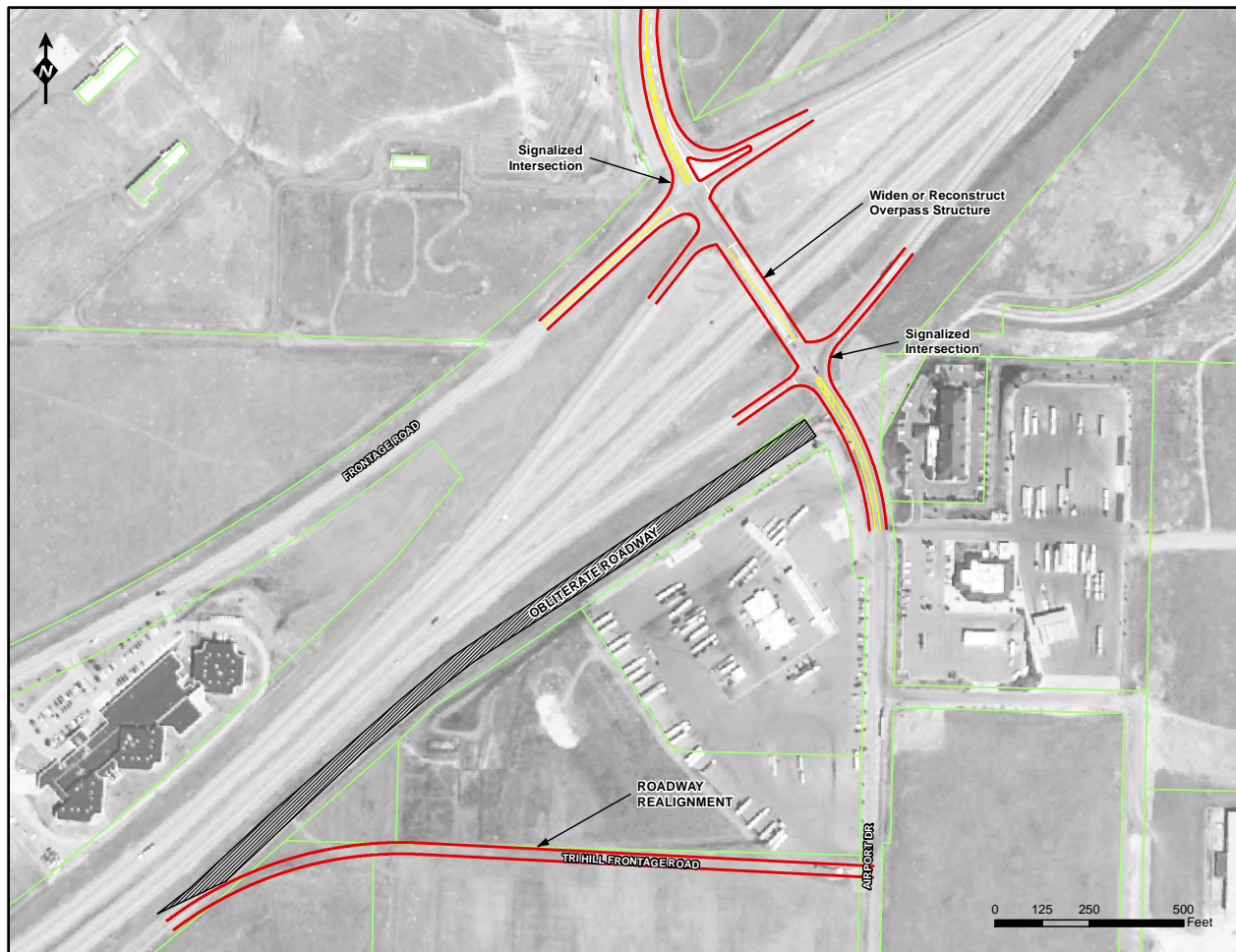


Figure 3.7: Gore Hill Concept E

Benefits:

- Would result in increased capacity.
- Would improve geometrics for large vehicles.

Limitations/Constraints:

- Would require a new or widened overpass structure to accommodate dedicated turn lanes.
- Not as safe as roundabout configurations.
- New right-of-way required for relocated Tri Hill Frontage Road.

Estimated Cost: \$7,600,000 (widen existing structure) to \$9,000,000 (replace structure)

Concept Comparison

Five conceptual options (in addition to the existing configuration) were evaluated for the intersections at the Gore Hill Interchange. **Table 3.6** shows the overall intersection LOS of the concepts during the peak hours. The appropriate traffic control for this location should be evaluated further during the project development process. A detailed traffic engineering study would be completed during project development. Other design issues may ultimately impact the final recommended configuration for these intersections.

Table 3.6: Gore Hill Interchange Intersection LOS

Scenario	Airport Drive/I-15 SB		Airport Drive/I-15 NB	
	Existing LOS (AM/PM)	Projected LOS (AM/PM)	Existing LOS (AM/PM)	Projected LOS (AM/PM)
No Action - Existing Configuration	B / E	F / F	C / F	E / F
Concept A - Roundabouts with Intersections Rerouted	A / A	A / B	A / A	A / C
Concept B - Five-legged Roundabouts	A / A	A / B	A / A	A / B
Concept C - Roundabouts with Intersections Shifted	A / A	A / B	A / A	A / C
Concept D - Traffic Signals without Realignment	A / B	A / B	B / B	B / C
Concept E - Traffic Signals with Intersections Rerouted	A / B	A / B	B / B	B / C

Recommendation: Install additional traffic controls, such as roundabouts or traffic signals, at the Gore Hill Interchange intersections.

Benefits:

- Would improve safety and traffic operations.
- Would result in increased capacity.
- Would improve geometrics for large vehicles.

Limitations/Constraints:

- Signalized configurations require a new or widened overpass structure to accommodate dedicated turn lanes.
- New right-of-way may be required.

Estimated Cost: \$5,200,000 to \$9,000,000

Implementation Timeframe: Mid-term

12. Intersection Improvements (Central Ave Interchange)

The Central Avenue Interchange is configured as a standard diamond interchange with stop-control provided on the off-ramps. In addition to the intersections directly at the interchange, the intersection of Central Avenue and Vaughn Road was evaluated due to its proximity and resulting impacts on interchange operations.

The three Central Avenue intersections have an existing peak hour LOS of D or worse, and they are all projected to have an LOS of F. Additional traffic control, such as roundabouts or traffic signals, are needed to accommodate existing and future traffic volumes. **Table 3.7** provides an LOS comparison of traffic signal and single-lane roundabout concepts for the three intersections. Based strictly on traffic operations, both traffic signals and single-lane roundabouts provide enough capacity for projected conditions.

The appropriate traffic control for this location should be evaluated further during the project development process. Other design issues may ultimately impact the final recommended configuration for these intersections.

Table 3.7: Central Ave Intersection LOS

Scenario	Central Ave/I-15 SB		Central Ave/I-15 NB		Central Ave/Vaughn Rd	
	Existing LOS (AM/PM)	Projected LOS (AM/PM)	Existing LOS (AM/PM)	Projected LOS (AM/PM)	Existing LOS (AM/PM)	Projected LOS (AM/PM)
No Action - Existing Configuration	D / E	F / F	C / D	F / F	D / F	F / F
Traffic Signals	B / B	B / B	B / B	B / B	B / B	B / B
Single-lane Roundabouts	A / A	A / B	A / A	A / C	A / A	B / B

Recommendation: Install additional traffic controls such as roundabouts or traffic signals.

Benefits:

- Would improve traffic operations.
- Would increase capacity.

Limitations/Constraints:

- Include existing land use.
- Include existing overpass structure.

Estimated Cost: \$8,100,000 (traffic signals) to 10,600,000 (roundabouts)

Implementation Timeframe: Long-term

13. Intersection Improvements (Fox Farm Road Intersection)

The Fox Farm intersection is a four-way, stop-controlled intersection between 10th Avenue South and Fox Farm Road. The intersection is projected to have a failing LOS during the peak hours. The length of the eastbound left-turn bay is approximately 200 feet, and it does not appear to provide enough vehicle storage. Lengthening the existing turn bay would improve storage for left-turning vehicles, however, the overall delay of the intersection would remain the same.

The northbound approach leg consists of a shared left-turn/through, dedicated through, and dedicated right-turn lane. Because of this configuration, the existing signal timing is split-phased in the northbound and southbound directions. Split-phased signal timing can result in inefficiencies for traffic movements. Ultimately, it would be desirable to provide a dedicated northbound left-turn lane so that the signal timing could be modified to increase efficiency. However, existing development constrains the width of the northbound approach leg.

In the interim, the delay of the intersection could be reduced by installing dual left-turn lanes along the eastbound approach leg. This configuration could be achieved by narrowing (or removing) the existing median separating the left-turn and through lanes on the eastbound approach leg. **Table 3.8** shows the LOS of the existing configuration and the LOS of the configuration with dual eastbound left-turn lanes.

Table 3.8: Fox Farm Road Intersection LOS

Location	Existing Conditions				Projected Conditions			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Existing Configuration	33.7	C	45.9	D	40.9	D	73.1	E
<i>Fox Farm Rd (S)</i>	16.4	B	35.8	D	19.3	B	43.1	D
<i>6th St SW (N)</i>	27.9	C	65.1	E	48.5	D	78.7	E
<i>I-315 (W)</i>	45.6	D	48.0	D	57.9	E	70.1	E
<i>10th Ave S (E)</i>	36.4	D	38.4	D	34.5	C	81.0	F
Recommended Configuration	25.5	C	36.9	D	29.4	C	51.9	D
<i>Fox Farm Rd (S)</i>	11.9	B	27.4	C	18.6	B	50.1	D
<i>6th St SW (N)</i>	23.3	C	38.7	D	39.2	D	62.0	E
<i>I-315 (W)</i>	35.5	D	41.0	D	34.6	C	56.2	E
<i>10th Ave S (E)</i>	26.3	C	36.0	D	27.7	C	44.9	D

Recommendation: Modify the intersection to provide for dual dedicated left-turn lanes along the eastbound approach.

Benefits:

- Would improve traffic operations.
- Would increase capacity.

Limitations/Constraints:

- Would require changes to signal timing.

Estimated Cost: \$100,000

Implementation Timeframe: Short-term

4.0 SUMMARY

This memorandum identifies improvement options for the I-15 corridor between RP 277 (southwest of the Gore Hill Interchange) to RP 284 (northwest of Emerson Junction), including I-315 and 10th Avenue South to RP 95 (west of the Missouri River). The options were identified based on the evaluation of several factors, including, but not limited to, field review, engineering analysis of as-built drawings, crash data analysis, consultation with various resource agencies, and information provided by the public.

The recommended improvement options are intended to offer a range of potential mitigation strategies for corridor issues and areas of concern. Small-scale improvement options were identified, and they may be as simple as modifying signing and striping. Larger, more complex reconstruction improvements were also envisioned. The potential may exist to combine improvement options during project development for ease of implementation and other efficiencies. **Table 4.1** summarizes the improvement options, including estimated implementation timeframe and planning-level cost estimate. The improvement options are also shown graphically in **Figure 4.1**.

Table 4.1: Recommended Improvement Options

Improvement Option		Location	Description	Estimated Implementation Timeframe	Cost Estimate
INTERSTATE 15					
1.0	Southbound Auxiliary Lane	RP 278.1 to 278.5	Construct auxiliary lane between Gore Hill and 10th Ave S interchanges in southbound direction.	Mid-term	\$1.9M
2(a)	Roadway Illumination	RP 282.3 to 283.0	Install additional illumination along the Interstate.	Mid-term	\$500k
2(b)	Reconstruct Roadway	RP 282.3 to 283.0	Reconstruct roadway and bridge structures to meet current design standards.	Long-term	\$24.0M
INTERSTATE 315					
3.0	Pavement Rehabilitation	RP 0.0 to 1.4	Resurface both directions of I-315.	Mid-term	\$1.0M
4.0	Bridge Deck Treatment	<ul style="list-style-type: none"> I-15 Overpass (RP 0.01) 14th St SW Overpass (EB) 14th St SW Overpass (WB) 	Rehabilitate bridge decks.	Mid-term	\$600k
5.0	Diagrammatic Guide Signing	10th Ave S to 14th St SW	Install overhead diagrammatic guide signage for eastbound traffic.	Short-term	\$200k
6.0	Westbound Auxiliary Lane	14th St SW to 10th Ave S	Reconstruct I-315 westbound and the I-15 on-ramp to provide an auxiliary travel lane.	Mid-term	\$2.0M
7.0	Westbound Auxiliary Lane	Fox Farm Rd to 14 th St SW	Reconstruct I-315 westbound and the Fox Farm Road intersection to provide an auxiliary travel lane	Mid-term	\$1.2M
INTERCHANGES					
8.0	Lengthen Southbound Off-ramp	10th Ave S Interchange	Lengthen southbound off-ramp.	Mid-term	\$260k
9.0	Modify Lane Merge	Central Ave West of Interchange	Modify signing and striping.	Short-term	\$20k
10.0	Feasibility Analysis	Emerson Junction	Secure a local project sponsor to fund an operational analysis/feasibility study of the Emerson Junction Interchange.	Mid-term	\$250k
INTERSECTIONS					
11.0	Intersection Improvements	Gore Hill Interchange	Install additional traffic control such as roundabouts or traffic signals.	Mid-term	\$5.2M to \$9.0M
12.0	Intersection Improvements	Central Ave Interchange	Install additional traffic control such as roundabouts or traffic signals.	Long-term	\$8.1M to \$10.6M
13.0	Intersection Improvements	Fox Farm Intersection	Install dual eastbound left-turn lanes.	Mid-term	\$100k

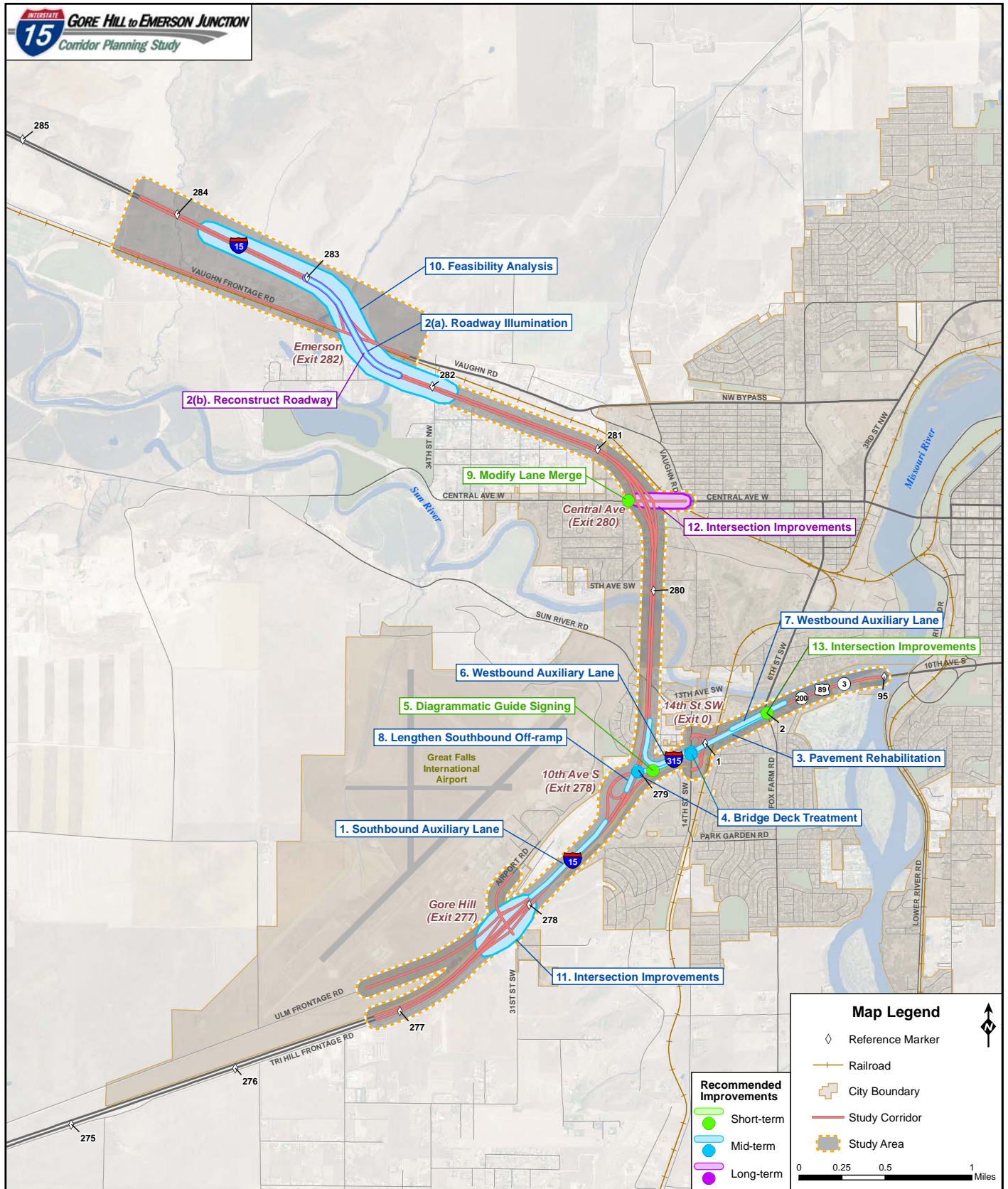


Figure 4.1: Recommended Improvement Options

APPENDIX A

Planning Level Cost Estimates



APPENDIX A
Planning Level Cost Estimates

Planning level cost estimates are listed in 2015 dollars for each improvement option. The planning level costs include estimates for right-of-way, preliminary engineering, construction engineering, construction, and indirect costs (IDC). In addition, an inflationary factor of 3 percent per year was applied to the planning level costs to account for estimated year of expenditure. Construction cost estimates were based on unit quantity estimates and price information determined from the MDT Preliminary Estimating Tool (PET). Cost ranges are provided in some cases, indicating unknown factors at the particular planning level stage.

1.0 SOUTHBOUND AUXILIARY LANE (RP 278.1 to 278.5)					\$	1,900,000	TOT
					LENGTH (FT)	4000	
					WIDTH (FT)	20	
					SURFACING (IN)	5	
					BASE (IN)	18	
TYPE	UNITS	UNIT PRICE	QUANTITY	COST			
Excavation-Unclassified	CUYD	\$ 4.35	15762.00	\$ 68,565			
Excavation-Unclass Borrow	CUYD	\$ 5.09	1576.20	\$ 8,023			
Special Borrow-Excavation	CUYD	\$ 8.05	788.10	\$ 6,344			
Topsoil-Salvaging and Placing	CUYD	\$ 4.06	6802.54	\$ 27,618			
Crushed Aggregate Course	CUYD	\$ 21.69	7996.30	\$ 173,440			
Cover - Type 1	SQYD	\$ 0.54	8889.00	\$ 4,800			
Traffic Gravel	CUYD	\$ 14.61	592.59	\$ 8,658			
Commercial Mix-PG 64-28	TON	\$ 144.22	2719.22	\$ 392,166			
Emulsified Asphalt CRS-2P	TON	\$ 613.48	15.90	\$ 9,754			
Signs - Urban	MI	\$ 52,000.00	0.76	\$ 39,394			
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.76	\$ 15,152			
Drainage Pipe - Rural	MI	\$ 82,000.00	0.76	\$ 62,121			
Temporary Erosion Control	MI	\$ 5,000.00	0.76	\$ 3,788			
Estimated Right-of-Way	ACRE	\$ -	0.00	\$ -			
Traffic Control			5%	\$ 40,991			
	Subtotal 1			\$ 860,814			
Mobilization			10%	\$ 86,081			
	Subtotal 2			\$ 946,895			
Contingencies			20%	\$ 189,379			
	Subtotal 3			\$ 1,136,274			
Mid-term Inflation	% PER YEAR	3%	10	\$ 390,783			
	Subtotal 4			\$ 1,527,057			
Construction Engineering (CE)			10%	\$ 152,706			
	Subtotal 5			\$ 1,679,763			
Indirect Costs (IDC)			10.91%	\$ 183,262			
	Total			\$ 1,863,025			

2.0 INTERSTATE ALIGNMENT (RP 282.3 TO 283.0)					\$	500,000	TOT
2(a) ROADWAY ILLUMINATION					\$	500,000	TOT
					LENGTH (FT)	3500	
					SPACING (FT)	240	
TYPE	UNITS	UNIT PRICE	QUANTITY	COST			
Standard-Stl Type 10-A-500-6	EACH	\$ 3,800.00	30	\$ 114,000			
Luminaire Assembly - 250 W S.V.	EACH	\$ 394.09	30	\$ 11,823			
Service Assembly-20 Amp	EACH	\$ 2,815.00	1	\$ 2,815			
Foundation Concrete	CUYD	\$ 832.52	16	\$ 13,237			
Conduit - Plastic 1.5"	LNFT	\$ 5.34	7000	\$ 37,380			
Conductor - Copper AWG8 - 600 V	LNFT	\$ 0.78	14000	\$ 10,920			
Conductor - Copper AWG10 - 600 V	LNFT	\$ 0.60	7000	\$ 4,200			
Cable - Copper 3AWG14 - 600 V	LNFT	\$ 1.15	100	\$ 115			
Estimated Right-of-Way	ACRE	\$ 15,000.00	0.00	\$ -			
Traffic Control			5%	\$ 9,724			
	Subtotal 1			\$ 204,214			
Mobilization			10%	\$ 20,421			
	Subtotal 2			\$ 224,636			
Contingencies			20%	\$ 44,927			
	Subtotal 3			\$ 269,563			
Mid-term Inflation	% PER YEAR	3%	10	\$ 92,707			
	Subtotal 4			\$ 362,270			
Construction Engineering (CE)			10%	\$ 36,227			
	Subtotal 5			\$ 398,497			
Indirect Costs (IDC)			10.91%	\$ 43,476			
	Total			\$ 441,973			

2(b) RECONSTRUCT ROADWAY**\$ 20,000,000 TOT**

LENGTH (FT) 5280
 WIDTH (FT) 76
 SURFACING (IN) 5
 BASE (IN) 18

TYPE	UNITS	UNIT PRICE	QUANTITY	COST
Excavation-Unclassified	CUYD	\$ 4.35	79654.40	\$ 346,497
Excavation-Unclass Borrow	CUYD	\$ 5.09	7965.44	\$ 40,544
Special Borrow-Excavation	CUYD	\$ 8.05	3982.72	\$ 32,061
Topsoil-Salvaging and Placing	CUYD	\$ 4.06	8979.36	\$ 36,456
Crushed Aggregate Course	CUYD	\$ 21.69	19439.85	\$ 421,650
Cover - Type 1	SQYD	\$ 0.54	46934.00	\$ 25,344
Traffic Gravel	CUYD	\$ 14.61	3128.89	\$ 45,713
Commercial Mix-PG 64-28	TON	\$ 144.22	13012.71	\$ 1,876,693
Emulsified Asphalt CRS-2P	TON	\$ 613.48	83.80	\$ 51,410
Signs - Urban	MI	\$ 52,000.00	1.00	\$ 52,000
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	1.00	\$ 20,000
Drainage Pipe - Rural	MI	\$ 82,000.00	1.00	\$ 82,000
Temporary Erosion Control	MI	\$ 5,000.00	1.00	\$ 5,000
New Bridge larger than 100 lineal feet	SQFT	\$ 114.00	26600.00	\$ 3,032,400
Remove large multiple span bridge	EACH	\$ 132,000.00	2.00	\$ 264,000
Estimated Right-of-Way	ACRE	\$ -	0.00	\$ -
Traffic Control			5%	\$ 316,588
				\$ 6,648,357
Mobilization			10%	\$ 664,836
				\$ 7,313,192
Contingencies			20%	\$ 1,462,638
				\$ 8,775,831
Long-term Inflation	% PER YEAR	3%	20	\$ 7,074,296
				\$ 15,850,127
Construction Engineering (CE)			10%	\$ 1,585,013
				\$ 17,435,139
Indirect Costs (IDC)			10.91%	\$ 1,902,174
Total				\$ 19,337,313

3.0 PAVEMENT REHABILITATION (RP 0.0 TO 1.4)**\$ 1,000,000 TOT**

LENGTH (FT) 4372
 WIDTH (FT) 48
 SURFACING (IN) 2
 BASE (IN) 0

TYPE	UNITS	UNIT PRICE	QUANTITY	COST
Cover - Type 1	SQYD	\$ 0.54	23317.00	\$ 12,591
Commercial Mix-PG 64-28	TON	\$ 144.22	2496.81	\$ 360,090
Emulsified Asphalt CRS-2P	TON	\$ 613.48	41.70	\$ 25,582
Cold Milling	SQYD	\$ 1.42	5829.12	\$ 8,277
Estimated Right-of-Way	ACRE	\$ -	0.00	\$ -
Traffic Control			5%	\$ 20,327
				\$ 426,868
Mobilization			10%	\$ 42,687
				\$ 469,554
Contingencies			20%	\$ 93,911
				\$ 563,465
Mid-term Inflation	% PER YEAR	3%	10	\$ 193,785
				\$ 757,250
Construction Engineering (CE)			10%	\$ 75,725
				\$ 832,975
Indirect Costs (IDC)			10.91%	\$ 90,878
Total				\$ 923,853

4.0 BRIDGE DECK TREATMENT (VARIOUS)**\$ 600,000 TOT**

BRIDGE ID WIDTH (FT) LENGTH (FT) AREA (SQFT)

I00315000+00001 45 294 13231

I00315000+03421 36 150 5394

I00315000+03422 45 145 6494

TYPE	UNITS	UNIT PRICE	QUANTITY	COST
Bridge Deck Rehab*	SQFT	\$ 8.92	25120	\$ 223,946
Traffic Control			5%	\$ 11,197
				\$ 235,144
Mobilization			10%	\$ 23,514
				\$ 258,658
Contingencies			20%	\$ 51,732
				\$ 310,390
Mid-term Inflation	% PER YEAR	3%	10	\$ 106,748
				\$ 417,138
Construction Engineering (CE)			10%	\$ 41,714
				\$ 458,852
Indirect Costs (IDC)			10.91%	\$ 50,061

Total **\$ 508,913**

*Unit price calculated from project NHPB STWD(206).

5.0 DIAGRAMMATIC GUIDE SIGNING (10TH AVE S TO 14TH ST SW)	\$	200,000 TOT
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TYPE	UNITS	UNIT PRICE	QUANTITY	COST / EA
Signs-Alum Refl Sheet IX	SQFT	\$ 31.61	\$ 600.00	\$ 18,966
Overhead Structure/Metal	EA	\$ 27,800.00	\$ 2.00	\$ 55,600
Traffic Control			5%	\$ 3,728
Subtotal 1				\$ 78,294
Mobilization			10%	\$ 7,829
Subtotal 2				\$ 86,124
Contingencies			20%	\$ 17,225
Subtotal 3				\$ 103,348
Short-term Inflation	% PER YEAR	3%	5	\$ 16,461
Subtotal 4				\$ 119,809
Construction Engineering (CE)			10%	\$ 11,981
Subtotal 5				\$ 131,790
Indirect Costs (IDC)			10.91%	\$ 14,378
Total				\$ 146,168

6.0 WESTBOUND AUXILIARY LANE (14TH ST SW TO 10TH AVE S)	\$	2,000,000 TOT
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			LENGTH (FT)	3500	
			WIDTH (FT)	24	
			SURFACING (IN)	5	
			BASE (IN)	18	
				</	

7.0 WESTBOUND AUXILIARY LANE (FOX FARM RD TO 14TH ST SW)	\$	1,200,000 TOT
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			LENGTH (FT)	2500	
			WIDTH (FT)	20	
			SURFACING (IN)	5	
			BASE (IN)	18	

Mobilization			10%	\$	55,172
	Subtotal 2			\$	606,889
Contingencies			20%	\$	121,378
	Subtotal 3			\$	728,267
Mid-term Inflation		% PER YEAR	3%	10	\$ 250,463
	Subtotal 4			\$	978,730
Construction Engineering (CE)			10%	\$	97,873
	Subtotal 5			\$	1,076,603
Indirect Costs (IDC)			10.91%	\$	117,457
	Total			\$	1,194,060

8.0 LENGTHEN SOUTHBOUND OFF-RAMP (10TH AVE S INTERCHANGE)

\$ 260,000 TOT

LENGTH (FT)	550
WIDTH (FT)	20
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	UNIT PRICE	QUANTITY	COST
Excavation-Unclassified	CUYD	\$ 4.35	2167.29	\$ 9,428
Excavation-Unclass Borrow	CUYD	\$ 5.09	216.73	\$ 1,103
Special Borrow-Excavation	CUYD	\$ 8.05	108.36	\$ 872
Topsoil-Salvaging and Placing	CUYD	\$ 4.06	935.35	\$ 3,798
Crushed Aggregate Course	CUYD	\$ 21.69	1099.49	\$ 23,848
Cover - Type 1	SQYD	\$ 0.54	1223.00	\$ 660
Traffic Gravel	CUYD	\$ 14.61	81.48	\$ 1,190
Commercial Mix-PG 64-28	TON	\$ 144.22	373.89	\$ 53,922
Emulsified Asphalt CRS-2P	TON	\$ 613.48	2.20	\$ 1,350
Cold Milling	SQYD	\$ 1.42	733.33	\$ 1,041
Signs - Urban	MI	\$ 52,000.00	0.10	\$ 5,417
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.10	\$ 2,083
Drainage Pipe - Rural	MI	\$ 82,000.00	0.10	\$ 8,542
Temporary Erosion Control	MI	\$ 5,000.00	0.10	\$ 521
Estimated Right-of-Way	ACRE	\$ -	0.00	\$ -
Traffic Control			5%	\$ 5,689
	Subtotal 1			\$ 119,464
Mobilization			10%	\$ 11,946
	Subtotal 2			\$ 131,411
Contingencies			20%	\$ 26,282
	Subtotal 3			\$ 157,693
Mid-term Inflation	% PER YEAR	3%	10	\$ 54,233
	Subtotal 4			\$ 211,926
Construction Engineering (CE)			10%	\$ 21,193
	Subtotal 5			\$ 233,118
Indirect Costs (IDC)			10.91%	\$ 25,433
	Total			\$ 258,552

9.0 MODIFY LANE MERGE (WEST OF CENTRAL AVE INTERCHANGE)

\$ 20,000 TOT

LENGTH (MI)	500.0
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TYPE	UNITS	UNIT PRICE	QUANTITY	COST
Signs - Urban	MILE	\$ 52,000.00	0.09	\$ 4,924
Striping & Pavement Markings - Urban	MILE	\$ 20,000.00	0.09	\$ 1,894
Traffic Control			5%	\$ 341
	Subtotal 1			\$ 7,159
Mobilization			10%	\$ 716
	Subtotal 2			\$ 7,875
Contingencies			20%	\$ 1,575
	Subtotal 3			\$ 9,450
Short-term Inflation	% PER YEAR	3%	5	\$ 1,505
	Subtotal 4			\$ 10,955
Construction Engineering (CE)			10%	\$ 1,096
	Subtotal 5			\$ 12,051
Indirect Costs (IDC)			10.91%	\$ 1,315
	Total			\$ 13,365

10.0 FEASIBILITY ANALYSIS (EMERSON JUNCTION)

\$ 250,000 TOT

	Subtotal 1			\$	180,000
Mid-term Inflation		% PER YEAR	3%	10	\$ 61,905
	Total			\$	241,905

11.0 INTERSECTION IMPROVEMENTS (GORE HILL INTERCHANGE)

CONCEPT A - ROUNDABOUTS WITH INTERSECTIONS RELOCATED					\$	7,700,000	TOT
					LENGTH (FT)	4000	
					WIDTH (FT)	32	
					SURFACING (IN)	5	
					BASE (IN)	18	
TYPE	UNITS	UNIT PRICE	QUANTITY	COST			
Excavation-Unclassified	CUYD	\$ 4.35	33084.98	\$ 143,920			
Excavation-Unclass Borrow	CUYD	\$ 5.09	99254.94	\$ 505,208			
Special Borrow-Excavation	CUYD	\$ 8.05	1654.25	\$ 13,317			
Topsoil-Salvaging and Placing	CUYD	\$ 4.06	6802.54	\$ 27,618			
Crushed Aggregate Course	CUYD	\$ 21.69	10662.96	\$ 231,280			
Cover - Type 1	SQYD	\$ 0.54	14223.00	\$ 7,680			
Commercial Mix-PG 64-28	TON	\$ 144.22	4147.00	\$ 598,080			
Emulsified Asphalt CRS-2P	TON	\$ 613.48	59.00	\$ 36,195			
Cold Milling	SQYD	\$ 1.42	5333.33	\$ 7,573			
Signs - Urban	MI	\$ 52,000.00	0.76	\$ 39,394			
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.76	\$ 15,152			
Drainage Pipe - Urban	MI	\$ 240,000.00	0.76	\$ 181,818			
Concrete Roundabout - One Lane	EA	\$ 750,000.00	2.00	\$ 1,500,000			
Estimated Right-of-Way	ACRE	\$ 15,000.00	4.02	\$ 60,262			
Traffic Control			5%	\$ 165,362			
	Subtotal 1			\$ 3,532,858			
Mobilization			10%	\$ 353,286			
	Subtotal 2			\$ 3,886,144			
Contingencies			20%	\$ 777,229			
	Subtotal 3			\$ 4,663,373			
Mid-term Inflation	% PER YEAR	3%	10	\$ 1,603,810			
	Subtotal 4			\$ 6,267,184			
Construction Engineering (CE)			10%	\$ 626,718			
	Subtotal 5			\$ 6,893,902			
Indirect Costs (IDC)			10.91%	\$ 752,125			
	Total			\$ 7,646,027			
CONCEPT B - FIVE-LEGGED ROUNDABOUTS					\$	7,600,000	TOT
					LENGTH (FT)	3000	
					WIDTH (FT)	32	
					SURFACING (IN)	5	
					BASE (IN)	18	
TYPE	UNITS	UNIT PRICE	QUANTITY	COST			
Excavation-Unclassified	CUYD	\$ 4.35	24813.73	\$ 107,940			
Excavation-Unclass Borrow	CUYD	\$ 5.09	74441.19	\$ 378,906			
Special Borrow-Excavation	CUYD	\$ 8.05	1240.69	\$ 9,988			
Topsoil-Salvaging and Placing	CUYD	\$ 4.06	5101.91	\$ 20,714			
Crushed Aggregate Course	CUYD	\$ 21.69	7997.22	\$ 173,460			
Cover - Type 1	SQYD	\$ 0.54	10667.00	\$ 5,760			
Commercial Mix-PG 64-28	TON	\$ 144.22	3110.25	\$ 448,560			
Emulsified Asphalt CRS-2P	TON	\$ 613.48	19.10	\$ 11,717			
Cold Milling	SQYD	\$ 1.42	4000.00	\$ 5,680			
Signs - Urban	MI	\$ 52,000.00	0.57	\$ 29,545			
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.57	\$ 11,364			
Drainage Pipe - Urban	MI	\$ 240,000.00	0.57	\$ 136,364			
Concrete Roundabout - One Lane	EA	\$ 1,000,000.00	2.00	\$ 2,000,000			
Estimated Right-of-Way	ACRE	\$ 15,000.00	0.10	\$ 1,500			
Traffic Control			5%	\$ 167,000			
	Subtotal 1			\$ 3,508,497			
Mobilization			10%	\$ 350,850			
	Subtotal 2			\$ 3,859,347			
Contingencies			20%	\$ 771,869			
	Subtotal 3			\$ 4,631,216			
Mid-term Inflation	% PER YEAR	3%	10	\$ 1,592,751			
	Subtotal 4			\$ 6,223,967			
Construction Engineering (CE)			10%	\$ 622,397			
	Subtotal 5			\$ 6,846,363			
Indirect Costs (IDC)			10.91%	\$ 746,938			
	Total			\$ 7,593,302			
CONCEPT C - ROUNDABOUTS WITH INTERSECTIONS SHIFTED					\$	5,200,000	TOT
					LENGTH (FT)	1750	
					WIDTH (FT)	32	
					SURFACING (IN)	5	
					BASE (IN)	18	

TYPE	UNITS	UNIT PRICE	QUANTITY	COST
Excavation-Unclassified	CUYD	\$ 4.35	14474.68	\$ 62,965
Excavation-Unclass Borrow	CUYD	\$ 5.09	43424.04	\$ 221,028
Special Borrow-Excavation	CUYD	\$ 8.05	723.73	\$ 5,826
Topsoil-Salvaging and Placing	CUYD	\$ 4.06	2976.11	\$ 12,083
Crushed Aggregate Course	CUYD	\$ 21.69	4665.05	\$ 101,185
Cover - Type 1	SQYD	\$ 0.54	6223.00	\$ 3,360
Commercial Mix-PG 64-28	TON	\$ 144.22	1814.31	\$ 261,660
Emulsified Asphalt CRS-2P	TON	\$ 613.48	11.20	\$ 6,871
Cold Milling	SQYD	\$ 1.42	2333.33	\$ 3,313
Signs - Urban	MI	\$ 52,000.00	0.33	\$ 17,235
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.33	\$ 6,629
Drainage Pipe - Urban	MI	\$ 240,000.00	0.33	\$ 79,545
Concrete Roundabout - One Lane	EA	\$ 750,000.00	2.00	\$ 1,500,000
Estimated Right-of-Way	ACRE	\$ 15,000.00	0.10	\$ 1,500
Traffic Control			5%	\$ 114,085
	<i>Subtotal 1</i>			\$ 2,397,286
Mobilization			10%	\$ 239,729
	<i>Subtotal 2</i>			\$ 2,637,014
Contingencies			20%	\$ 527,403
	<i>Subtotal 3</i>			\$ 3,164,417
Mid-term Inflation	% PER YEAR	3%	10	\$ 1,088,295
	<i>Subtotal 4</i>			\$ 4,252,712
Construction Engineering (CE)			10%	\$ 425,271
	<i>Subtotal 5</i>			\$ 4,677,984
Indirect Costs (IDC)			10.91%	\$ 510,368
Total				\$ 5,188,352

CONCEPT D - TRAFFIC SIGNALS WITHOUT REALIGNMENT	\$ 5,200,000	\$ 6,700,000	TOT
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Widen bridge	New bridge
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LENGTH (FT)	1500
WIDTH (FT)	32
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	UNIT PRICE	QUANTITY	COST
Excavation-Unclassified	CUYD	\$ 4.35	12406.87	\$ 53,970
Excavation-Unclass Borrow	CUYD	\$ 5.09	1240.69	\$ 6,315
Special Borrow-Excavation	CUYD	\$ 8.05	620.34	\$ 4,994
Topsoil-Salvaging and Placing	CUYD	\$ 4.06	2550.95	\$ 10,357
Crushed Aggregate Course	CUYD	\$ 21.69	5194.60	\$ 112,671
Cover - Type 1	SQYD	\$ 0.54	7726.00	\$ 4,172
Commercial Mix-PG 64-28	TON	\$ 144.22	2195.48	\$ 316,632
Emulsified Asphalt CRS-2P	TON	\$ 613.48	13.90	\$ 8,527
Cold Milling	SQYD	\$ 1.42	2000.00	\$ 2,840
Signs - Urban	MI	\$ 52,000.00	0.28	\$ 14,773
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.28	\$ 5,682
Drainage Pipe - Urban	MI	\$ 240,000.00	0.28	\$ 68,182
Signals	EA	\$ 350,000.00	2.00	\$ 700,000
	<i>Road Construction Subtotal</i>			\$ 1,309,114
New Bridge larger than 100 lineal feet	SQFT	\$ 114.00	13000.00	\$ 1,482,000
Remove large multiple span bridge	LS	\$ 132,000.00	1.00	\$ 132,000
Estimated Right-of-Way	ACRE	\$ 15,000.00	0.00	\$ -
Traffic Control			5%	\$ 146,156
	<i>Subtotal 1</i>			\$ 3,069,270
Mobilization			10%	\$ 306,927
	<i>Subtotal 2</i>			\$ 3,376,197
Contingencies			20%	\$ 675,239
	<i>Subtotal 3</i>			\$ 4,051,437
Mid-term Inflation	% PER YEAR	3%	10	\$ 1,393,355
	<i>Subtotal 4</i>			\$ 5,444,792
Construction Engineering (CE)			10%	\$ 544,479
	<i>Subtotal 5</i>			\$ 5,989,271
Indirect Costs (IDC)			10.91%	\$ 653,429
Total (new bridge)				\$ 6,642,701
	<i>Road Construction Subtotal (from above)</i>			\$ 1,309,114
Widen existing bridge	SQFT	\$ 150.00	6500.00	\$ 975,000
Estimated Right-of-Way	ACRE	\$ 15,000.00	0.00	\$ -
Traffic Control			5%	\$ 114,206
	<i>Subtotal 1</i>			\$ 2,398,320
Mobilization			10%	\$ 239,832
	<i>Subtotal 2</i>			\$ 2,638,152
Contingencies			20%	\$ 527,630
	<i>Subtotal 3</i>			\$ 3,165,783
Mid-term Inflation	% PER YEAR	3%	10	\$ 1,088,764
	<i>Subtotal 4</i>			\$ 4,254,547
Construction Engineering (CE)			10%	\$ 425,455
	<i>Subtotal 5</i>			\$ 4,680,002
Indirect Costs (IDC)			10.91%	\$ 510,588
Total (widen bridge)				\$ 5,190,590

CONCEPT E - TRAFFIC SIGNALS WITH INTERSECTION RELOCATED				\$	7,600,000	\$	9,000,000	TOT
				Widen bridge		New bridge		
				LENGTH (FT)	4500			
				WIDTH (FT)	32			
				SURFACING (IN)	5			
				BASE (IN)	18			
TYPE		UNITS	UNIT PRICE	QUANTITY	COST			
Excavation-Unclassified		CUYD	\$ 4.35	37220.00	\$	161,907		
Excavation-Unclass Borrow		CUYD	\$ 5.09	3722.00	\$	18,945		
Special Borrow-Excavation		CUYD	\$ 8.05	1861.00	\$	14,981		
Topsoil-Salvaging and Placing		CUYD	\$ 4.06	7652.86	\$	31,071		
Crushed Aggregate Course		CUYD	\$ 21.69	13191.82	\$	286,131		
Cover - Type 1		SQYD	\$ 0.54	18932.00	\$	10,223		
Commercial Mix-PG 64-28		TON	\$ 144.22	5305.73	\$	765,192		
Emulsified Asphalt CRS-2P		TON	\$ 613.48	32.90	\$	20,183		
Cold Milling		SQYD	\$ 1.42	6000.00	\$	8,520		
Signs - Urban		MI	\$ 52,000.00	0.85	\$	44,318		
Striping & Pavement Markings - Urban		MI	\$ 20,000.00	0.85	\$	17,045		
Drainage Pipe - Urban		MI	\$ 240,000.00	0.85	\$	204,545		
Signals		EA	\$ 350,000.00	2.00	\$	700,000		
Road Construction Subtotal						\$	2,283,062	
New Bridge larger than 100 lineal feet		SQFT	\$ 114.00	13000.00	\$	1,482,000		
Remove large multiple span bridge		LS	\$ 132,000.00	1.00	\$	132,000		
Estimated Right-of-Way		ACRE	\$ 15,000.00	4.02	\$	60,262		
Traffic Control				5%	\$	194,853		
Subtotal 1						\$	4,152,177	
Mobilization				10%	\$	415,218		
Subtotal 2						\$	4,567,395	
Contingencies				20%	\$	913,479		
Subtotal 3						\$	5,480,874	
Mid-term Inflation		% PER YEAR	3%	10	\$	1,884,962		
Subtotal 4						\$	7,365,836	
Construction Engineering (CE)				10%	\$	736,584		
Subtotal 5						\$	8,102,420	
Indirect Costs (IDC)				10.91%	\$	883,974		
Total (new bridge)						\$	8,986,394	
Road Construction Subtotal (from above)						\$	2,283,062	
Widen existing bridge		SQFT	\$ 150.00	6500.00	\$	975,000		
Estimated Right-of-Way		ACRE	\$ 15,000.00	4.02	\$	60,262		
Traffic Control				5%	\$	162,903		
Subtotal 1						\$	3,481,227	
Mobilization				10%	\$	348,122.73		
Subtotal 2						\$	3,829,350	
Contingencies				20%	\$	765,870		
Subtotal 3						\$	4,595,220	
Mid-term Inflation		% PER YEAR	3%	10	\$	1,580,371		
Subtotal 4						\$	6,175,591	
Construction Engineering (CE)				10%	\$	617,559		
Subtotal 5						\$	6,793,151	
Indirect Costs (IDC)				10.91%	\$	741,133		
Total (widen bridge)						\$	7,534,283	

12.0 INTERSECTION IMPROVEMENTS (CENTRAL AVE INTERCHANGE)

WITH TRAFFIC SIGNALS				\$	8,100,000	TOT
				LENGTH (FT)	2640	
				WIDTH (FT)	72	
				SURFACING (IN)	5	
TYPE	UNITS	UNIT PRICE	QUANTITY	COST		
Crushed Aggregate Course	CUYD	\$ 21.69	14294.64	\$	310,051	
Cover - Type 1	SQYD	\$ 0.54	27416.00	\$	14,805	
Commercial Mix-PG 64-28	TON	\$ 144.22	7339.48	\$	1,058,500	
Emulsified Asphalt CRS-2P	TON	\$ 613.48	49.10	\$	30,122	
Cold Milling	SQYD	\$ 1.42	3520.00	\$	4,998	
Signs - Urban	MI	\$ 52,000.00	0.50	\$	26,000	
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.50	\$	10,000	
Drainage Pipe - Urban	MI	\$ 240,000.00	0.50	\$	120,000	
Signals	EA	\$ 350,000.00	3.00	\$	1,050,000	
Estimated Right-of-Way	ACRE	\$ -	0.00	\$	-	
Traffic Control			5%		\$ 131,224	
Subtotal 1					\$	2,755,699

Mobilization			10%	\$	275,570
	Subtotal 2			\$	3,031,269
Contingencies			20%	\$	606,254
	Subtotal 3			\$	3,637,523
Long-term Inflation		% PER YEAR	3%	20	\$ 2,932,248
	Subtotal 4			\$	6,569,771
Construction Engineering (CE)			10%	\$	656,977
	Subtotal 5			\$	7,226,748
Indirect Costs (IDC)			10.91%	\$	788,438
	Total			\$	8,015,186

WITH ROUNDABOUTS	\$	10,600,000	TOT
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			LENGTH (FT)	2640	
			WIDTH (FT)	72	
			SURFACING (IN)	5	
TYPE	UNITS	UNIT PRICE	QUANTITY	COST	
Crushed Aggregate Course	CUYD	\$ 21.69	10706.67	\$	232,228
Cover - Type 1	SQYD	\$ 0.54	20240.00	\$	10,930
Commercial Mix-PG 64-28	TON	\$ 144.22	5418.42	\$	781,445
Emulsified Asphalt CRS-2P	TON	\$ 613.48	36.20	\$	22,208
Cold Milling	SQYD	\$ 1.42	3520.00	\$	4,998
Signs - Urban	MI	\$ 52,000.00	0.50	\$	26,000
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.50	\$	10,000
Drainage Pipe - Urban	MI	\$ 240,000.00	0.50	\$	120,000
Concrete Roundabout - One Lane	EA	\$ 750,000.00	3.00	\$	2,250,000
Estimated Right-of-Way	ACRE	\$ -	0.00	\$	-
Traffic Control			5%	\$	172,890
	Subtotal 1			\$	3,630,699
Mobilization			10%	\$	363,070
	Subtotal 2			\$	3,993,768
Contingencies			20%	\$	798,754
	Subtotal 3			\$	4,792,522
Long-term Inflation		% PER YEAR	3%	20	\$ 3,863,306
	Subtotal 4			\$	8,655,828
Construction Engineering (CE)			10%	\$	865,583
	Subtotal 5			\$	9,521,411
Indirect Costs (IDC)			10.91%	\$	1,038,786
	Total			\$	10,560,197

13.0 INTERSECTION IMPROVEMENTS (FOX FARM ROAD INTERSECTION)	\$	30,000	TOT
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TYPE	UNITS	UNIT PRICE	QUANTITY	COST	
Remove Median Curb	LNFT	\$ 3.08	1000.00	\$	3,080
Remove Concrete	SQYD	\$ 3.84	500.00	\$	1,920
Sig-Traf 3 Col-1 Way 12-12-12	EACH	\$ 820.14	1.00	\$	820
Sig-Standard Type 2-A-900-0	EACH	\$ 1,250.00	1.00	\$	1,250
Remove and Reset Existing Pole	EACH	\$ 350.00	1.00	\$	350
Striping & Pavement Markings - Urban	MI	\$ 20,000.00	0.14	\$	2,841
Estimated Right-of-Way	ACRE	\$ -	0.00	\$	-
Traffic Control			5%	\$	513
	Subtotal 1			\$	10,774
Mobilization			10%	\$	1,077
	Subtotal 2			\$	11,852
Contingencies			20%	\$	2,370
	Subtotal 3			\$	14,222
Short-term Inflation		% PER YEAR	3%	5	\$ 2,265
	Subtotal 4			\$	16,487
Construction Engineering (CE)			10%	\$	1,649
	Subtotal 5			\$	18,136
Indirect Costs (IDC)			10.91%	\$	1,979
	Total			\$	20,114