Rapid City Quiet Zone Assessment

FINAL

City of Rapid City, South Dakota

SRF Consulting Group, Inc. | Engineers Planners Designers

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Table of Contents

Introduction 3

Study Purpose and Background 3

Minimum Warning Device Requirements 3

Quiet Zone Risk Calculations 6

Reducing Risk Below National Average 6

Reducing Risk Below Existing Levels 7

Types of Crossing Improvements 7

Wayside Horns 8

Diagnostic Meeting Discussion Items 10

Conversion to Pedestrian-Only Crossing 10

Potential for Constant Warning Time Waiver 11

Quiet Zone Length Requirement 12

Crossing Improvement Options 13

11th Street (190273R) 15

West Boulevard (190272J) 17

Mt. Rushmore Road (190271C) 18

7th Street (190270V) 20

6th Street (190269B) 21

5th Street (190268U) 23

3rd Street (190266F) 24

2nd Street (190265Y) 25

1st Street (190264S) 26

East Boulevard (190263K) 27

Maple Avenue (South) (190261W) 28

Maple Avenue (North) (190262D) 30

Omaha Avenue Crossings 31

Crossing Improvement Scenarios 32

Mainline Improvement Scenarios 32

Additional Crossings 35

Next Steps and Implementation Timeline 37

Appendix A: Diagnostic Meeting Minutes 38

Appendix B: Preliminary Construction Cost Estimates 39

Appendix C: Quiet Zone Risk Calculations 40

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Introduction

Study Purpose and Background

The City of Rapid City, South Dakota (the City) is investigating options to improve safety and minimize the impacts of train horn noise at multiple at-grade highway-rail crossings throughout the community. The Federal Railroad Administration's (FRA's) Train Horn Rule, issued in June 2005, offers an opportunity to accomplish this objective. The Train Horn Rule specifies the procedures and actions necessary to establish a train horn quiet zone for at-grade highway-rail crossings.

The City retained the services of SRF Consulting Group Inc. to conduct a Quiet Zone Assessment to identify the crossing improvements required for quiet zone implementation. This assessment includes 13 rail crossings on Rapid City Pierre & Eastern (RCPE) Railroad's trackage and one crossing along the State-owned Kadoka to Rapid City mainline. A map of the corridor with the locations of the proposed quiet zone crossings is shown in Table 1.

This assessment included a field diagnostic review of the crossings with representatives from the City, the FRA, and RCPE. This report provides a summary of the quiet zone assessment results, discussion items, and consultant recommendations. The report also includes proposed crossing improvement scenarios with planning level layouts, construction cost estimates for each crossing, and a discussion of the potential for a phased quiet zone implementation.

Minimum Warning Device Requirements

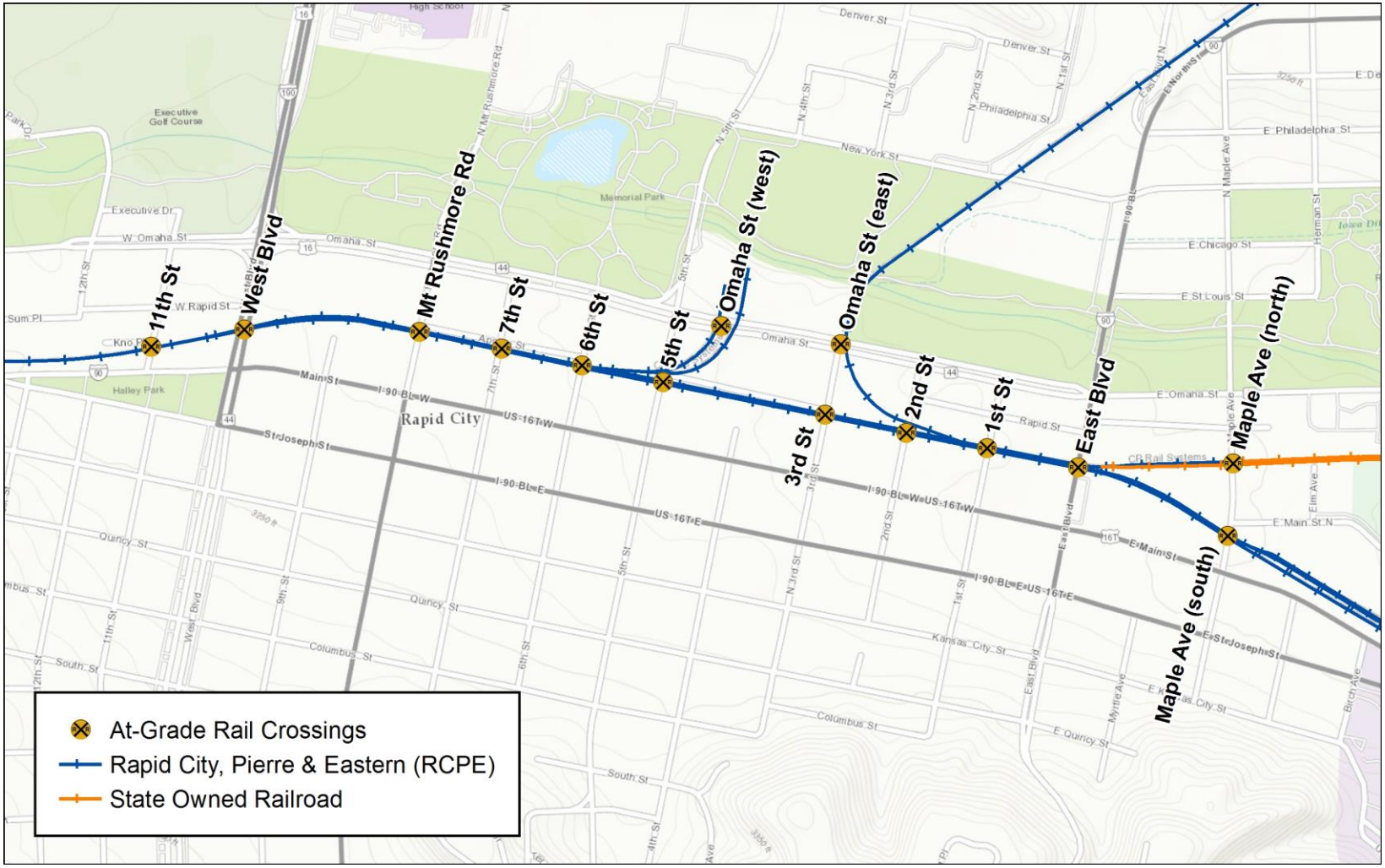
At a minimum, each public crossing in a proposed quiet zone must be equipped with entry gates and flashing lights with power-out indicators as well as constant warning time (CWT) detectors where reasonably practical. Information on the characteristics of the Rapid City crossings is summarized in Table 1 on the following page. While nearly all the crossings are equipped with flashing lights, none of the proposed quiet zone crossings are equipped with all the minimum requirements. The warning devices will need to be upgraded prior to quiet zone implementation. The locations of these crossings are also shown in Figure 1.

A summary of the discussion regarding the use of CWT detection at these crossings is included in the Diagnostic Meeting Discussion Items section of this report.

Table 1. Minimum Crossing Requirements

Crossing Name	Crossing ID	Milepost	Average Daily Traffic (ADT)	ADT Year of Collection	Gates	Flashing Lights	Constant Warning Time (CWT)
RCPE Mainline Crossings							
11th Street	190273R	100.08	1,706	2017	No	Yes	Yes
West Boulevard	190272J	99.97	13,509	2017	No	Yes	No
Mt Rushmore Road	190271C	99.77	11,498	2017	No	Yes	No
7th Street	190270V	99.68	2,200	2017	No	Yes	No
6th Street	190269B	99.59	3,200	2017	No	Yes	No
5th Street	190268U	99.45	18,365	2017	No	Yes	No
3rd Street	190266F	99.30	2,153	2017	No	Yes	No
2nd Street	190265Y	99.20	790	2017	No	Yes	No
1st Street	190264S	99.11	516	2017	No	Yes	No
East Boulevard	190263K	99.01	11,659	2017	No	Yes	No
Maple Avenue (south)	190261W	98.81	2,700	2017	No	Yes	No
Additional Crossings							
Maple Avenue (north)	190262D	98.81	2,700	2017	No	No	No
Omaha Avenue (east)	190267M	99.45	26,246	2017	No	Yes	No
Omaha Avenue (west)	190148D	649.25	26,246	2017	No	Yes	No

Figure 1. Crossing Locations



Quiet Zone Risk Calculations

The FRA evaluates potential quiet zones using a complex risk prediction and assessment calculation. The FRA's online Quiet Zone Calculator is used to calculate the risk index at each crossing. The risk calculations are based on factors such as train volumes and speed, highway traffic volumes, crossing geometry, and crash history.

The FRA determines the viability of quiet zone implementation by comparing three risk index values:

- **QZRI** – The Quiet Zone Risk Index is the average of the risk index values for each crossing in a proposed quiet zone assuming train horns are not routinely sounded. The current QZRI value of the mainline crossings (11th Street to Maple Avenue South) is **10,137** prior to the implementation of additional safety improvements.
- **RIWH** – The Risk Index With Horns is the average of the risk index values for each crossing in a proposed quiet zone assuming no additional safety improvements and the routine sounding of horns. The RIWH typically represents the existing risk levels. The current RIWH value of the mainline crossings is **6,077**.
- **NSRT** – The Nationwide Significant Risk Threshold is the average risk level of all highway-rail crossings in the United States that are equipped with flashing lights and gates and at which locomotive horns are routinely sounded. The NSRT is recalculated annually to reflect existing risk trends. The current value of the NSRT is **14,723**.

The QZRI for a proposed quiet zone is reduced through the implementation of FRA-approved Supplementary Safety Measures (SSMs) and/or Alternative Safety Measures (ASMs). A quiet zone may be implemented when SSMs and/or ASMs have been installed sufficient to bring the QZRI below either the RIWH or the NSRT. It is important to note that the QZRI and RIWH are measured as an average of the corridor as a whole rather than for individual crossings.

Reducing Risk Below National Average

If the QZRI is reduced below the NSRT alone, the quiet zone may be implemented, but the FRA will conduct an annual risk review to ensure that the quiet zone improvements still comply with the Train Horn Rule and that the QZRI is still below the NSRT. If an annual review finds that the quiet zone no longer qualifies, the public authority is given three years to install additional improvements to bring the quiet zone back into compliance. While the City has the option to implement a quiet zone by meeting the NSRT threshold, SRF encourages the City to consider alternative scenarios that will meet the RIWH threshold. By meeting the RIWH threshold, the City will avoid the annual risk review process while also making the corridor safer than the current conditions.

Reducing Risk Below Existing Levels

If the QZRI is reduced below the RIWH using SSMs at every crossing, the quiet zone may be implemented and the City must provide an update to the FRA every five years stating that the safety measures implemented to achieve the quiet zone are still in place as proposed. If the QZRI is reduced below the RIWH without the use of SSMs at every crossing, this update to the FRA must be provided every three years.

Types of Crossing Improvements

The FRA has pre-approved a variety of Supplementary Safety Measures (SSMs) to be used to improve safety at each crossing. These options and their corresponding risk reduction values are as follows:

- Closure or Grade Separation (100 percent risk reduction)
- Four-Quadrant Gates (77-82 percent risk reduction)
- Channelization Devices (e.g. Tuff Curb, Qwick Kurb) (75 percent risk reduction)
- Non-Traversable Medians (80 percent risk reduction)
- One-Way Street (82 percent risk reduction)

Examples of these improvements are shown on the following page.

Of these improvements, four quadrant gates and non-traversable medians are the most commonly used. Channelization devices are also frequently used in place of non-traversable medians where cost, narrow roadway width, or other roadway conditions must be considered. However, the channelization devices can be damaged by vehicles or during snow removal operations, necessitating ongoing monitoring and maintenance. Due to these factors, non-traversable medians were determined to be the most desirable crossing improvement option at most of the crossings in the corridor.

Non-traversable medians must meet minimum length requirements in order to be used for full risk reduction credit. The FRA mandates that medians and delineators must extend a minimum of 100 feet from the crossing gate arm. However, a 60-foot median is also acceptable if a longer median would interfere with either a public roadway or a commercial driveway. Medians that are shorter than these standards may still be used but are considered Alternative Safety Measures (ASMs) and require the submittal of a Quiet Zone Application to the FRA. Risk reduction for reduced length medians is applied on a prorated basis. For example, if the proximity of intersections limits median lengths to 30 feet instead of the minimum 60 feet, the median will be considered half as effective.

In some cases, crossing improvements may be difficult or impossible due to the configuration of roadways, accesses, and other factors. However, the Train Horn Rule does not require improvements at every crossing in a quiet zone.

Wayside Horns

In place of SSM or ASM improvements, the City may also implement wayside horns at one or more crossings. Wayside horns are stationary horn systems located at a highway rail grade crossing. These systems must meet the same decibel level requirements of standard train horns, but their stationary location creates a smaller area of noise impact. Crossings with wayside horns must also be equipped with the minimum warning device requirements of gates and flashing lights with power out indicators and CWT detection.

Four-Quadrant Gate



Non-Traversable Median



Channelization Devices



One-way Street



Closure



Diagnostic Meeting Discussion Items

As recommended by the Train Horn Rule, this assessment included an on-site diagnostic meeting with participation from key representatives from the City, the FRA, and RCPE. Note that due to inclement weather, the FRA representative was unable to attend in person, but participated via telephone for the non-field review portion of the meeting. Representatives from the South Dakota Department of Transportation (SDDOT) were also invited but did not attend. The diagnostic meeting was held on March 7, 2018. The diagnostic meeting minutes are provided in Appendix A.

Many factors and issues related to the FRA Train Horn Rule were discussed during the meeting. The following section summarizes the key points of these discussions and recommendations for how the City should proceed.

Conversion to Pedestrian-Only Crossing

As noted previously, crossing closure is one improvement option available to the City for risk reduction. During the diagnostic meeting, the City asked if the crossing could be closed only to motor vehicles, leaving a pedestrian crossing in its place. In follow-up discussions after the meeting, the FRA indicated that crossings need to be fully closed to both vehicles and pedestrians to qualify for risk reduction. The FRA noted that conversion to a pedestrian crossing would be allowed, but that the crossing should be excluded from the quiet zone risk calculations rather than being counted for risk reduction credit.

However, this guidance does not match a precise reading of the Train Horn Rule. Appendix A of the Rule outlines the requirements and effectiveness rates for the various SSM improvements. Table 2 summarizes the requirements for Permanent and Temporary crossing closures. Based on our interpretation of the requirements, conversion to a pedestrian-only crossing would completely block highway traffic from entering the crossing, thereby meeting the requirements of the Rule. To emphasize the fact that "highway traffic" does not include pedestrians, it is instructive to compare the requirements for a Permanent Closure to those for a Temporary Closure, which includes an additional requirement specific to closing adjacent pedestrian crossings. The omission of a reference to pedestrian crossings in the requirements for Permanent Closure indicates that the closure of adjacent pedestrian crossings is not required.

Based on our understanding of the Train Horn Rule requirements, conversion to a pedestrian-only crossing should qualify as a Permanent Closure. However, this will likely require further coordination with the FRA and it is possible that this interpretation may be overruled. We recommend that the City develop crossing improvement scenarios that do not rely on the risk reduction credit gained from any potential pedestrian crossing conversions.

Table 2. Permanent and Temporary Closure Requirements (emphasis added)

Permanent Closure of a Public Highway-Rail Grade Crossing	Temporary Closure of a Public Highway-Rail Grade Crossing
a. The closure system must completely block **highway traffic** from entering the grade crossing. b. Barricades and signs used for closure of the roadway shall conform to the standards contained in the MUTCD. c. The closure system must be tamper and vandal resistant to the same extent as other traffic control devices. d. Since traffic will be redistributed among adjacent crossings, the traffic counts for adjacent crossings shall be increased to reflect the diversion of traffic from the closed crossing.	a. The closure system must completely block **highway traffic** on all approach lanes to the crossing. **b. The closure system must completely block adjacent pedestrian crossings.** c. Public highway-rail grade crossings located within New Partial Quiet Zones shall be closed from 10 p.m. until 7 a.m. every day. Public highway-rail grade crossings located within Pre-Rule Partial Quiet Zones may only be closed during one period each 24 hours. d. Barricades and signs used for closure of the roadway shall conform to the standards contained in the MUTCD. e. Daily activation and deactivation of the system is the responsibility of the public authority responsible for maintenance of the street or highway crossing the railroad tracks. The public authority may provide for third party activation and deactivation; however, the public authority shall remain fully responsible for compliance with the requirements of this part. f. The system must be tamper and vandal resistant to the same extent as other traffic control devices. g. The closure system shall be equipped with a monitoring device that contains an indicator which is visible to the train crew prior to entering the crossing. The indicator shall illuminate whenever the closure device is deployed.

Potential for Constant Warning Time Waiver

Constant Warning Time (CWT) is a type of train detection required—where reasonably practical—by the FRA for all new QZ implementations. Simple train detection systems (e.g., motion sensors, track circuits) are designed to activate the crossing warning devices when they are triggered by a train a minimum of 20 seconds before the train enters the crossing. In cases where a train is approaching the crossing more slowly than usual, this warning time at the crossing will increase significantly. Motorists at the crossing may interpret the longer waiting time as a sign that the warning devices are malfunctioning and attempt to circumvent the gates. CWT addresses this issue by measuring the speed of the approaching train and adjusting the timing of the warning device activation to maintain consistent warning time durations.

During the diagnostic meeting, RCPE representatives noted that some crossings in the corridor have been equipped with CWT in the past, but that the winter road salt mixture used on roadways has caused operational issues, notably false positive signals where the warning devices activate despite no train being present. In these cases, RCPE has instead relied on the crossing island circuits for warning device activation. RCPE indicated that they would prefer to implement a phase shift overlay system for train detection in place of the CWT required by the Rule.

The Train Horn Rule notes that CWT is required "where reasonably practical." In some cases, the FRA can waive the requirement for CWT. The potential for a CWT waiver at all crossings in the corridor was discussed at the diagnostic meeting. Such waivers are typically allowed only at siding or yard tracks where operational conditions would prevent a CWT system from operating as intended. In follow-up conversations, the FRA has indicated that it is very unlikely that a CWT waiver would be granted for multiple mainline crossings. The FRA stated that it is the responsibility of the railroad to ensure that all warning device equipment is functioning correctly and noted that they have not been aware of similar road salt issues at other locations.

Quiet Zone Length Requirement

One important question for the City to consider is the precise locations to start and end the quiet zone. The Train Horn Rule says only the following about the required length/spacing of a quiet zone: "Except as provided in paragraph (a)(1)(ii) of this section, the minimum length of a New Quiet Zone or New Partial Quiet Zone established under this part shall be one half mile along the length of railroad right-of-way."

This rule has generally been interpreted to mean that there should be no regular (non-quiet) crossings within one quarter mile of the quiet zone crossings. With closely spaced crossings, a situation could occur where a train is required to sound its horn for a regular crossing before it has passed the last quiet zone crossing. The quarter mile minimum spacing is to address this issue.

In Rapid City, all the crossings are within this quarter mile spacing. However, due to low train speeds, the issue of a train sounding its horn at a quiet zone crossing is not an issue. The most closely spaced crossings are 500 feet apart and a train travelling at the 10-mph maximum timetable speed will be required to sound the horn only 294 feet prior to a crossing[1]. Therefore, the City will be able to exclude some crossings from the quiet zone in order to focus efforts in one area.

[1] 10 miles/hour x 1.47 (conversion to feet/second) x 20 seconds (required horn sounding time) = 294 feet

Crossing Improvement Options

At each crossing, the diagnostic team evaluated the site conditions to evaluate potential safety issues and identify potential crossing improvements. A summary of the potential improvement options is included below. High-level aerial layouts of the improvements and construction cost estimates are also included on the following pages. The preliminary estimates were developed for each improvement option based on SRF's previous experience with quiet zone implementation. It should be noted that many of these costs may vary based on region, season, scope of construction activity, and other factors. Many cost factors related to the signal equipment was based on information provided by RCPE. Cost estimation worksheets with additional detail on unit price and quantity estimates are included in Appendix B.

The following notes should be considered when evaluating each of the following commonly recommended improvement options:

- **Four-Quadrant Gates:** This gate system has the advantage of having minimal impact to access for adjacent properties, but in many instances it is more expensive than other available options. The costs associated with signal upgrades are determined solely by the railroad. Based on information provided by RCPE, our estimated cost for each four-quadrant installation is $350,000. It should be noted that this estimate is significantly lower than estimates provided to us from railroads on other projects. Four-quadrant gate installation costs typically range from $500,000 to $700,000. The precise costs of four-quadrant gate upgrades should be confirmed with RCPE prior to pursuing a quiet zone implementation. Four-quadrant gates are also subject to annual maintenance fees to the railroad for general maintenance and testing to ensure the equipment is functioning correctly. Annual fees of $5,000 are typical but should also be confirmed with RCPE prior to implementation.

- **Non-Traversable Medians:** These improvements prevent motorists from circumventing lowered gate arms. The Train Horn Rule dictates that medians must be at least six inches high and should be at least 100 feet long as measured from the gate arm to the last full-height section of the median. Commercial accesses should be closed or relocated if they are within the extents of the median, though some exceptions apply. In cases where a median would limit an access to right-in/right-out movements, these are labeled in the layouts with the designation, "RIRO". Medians shorter than 60 feet require the submittal of a Quiet Zone Application to the FRA. To qualify for risk reduction, some accesses near proposed medians will need to be closed or restricted.

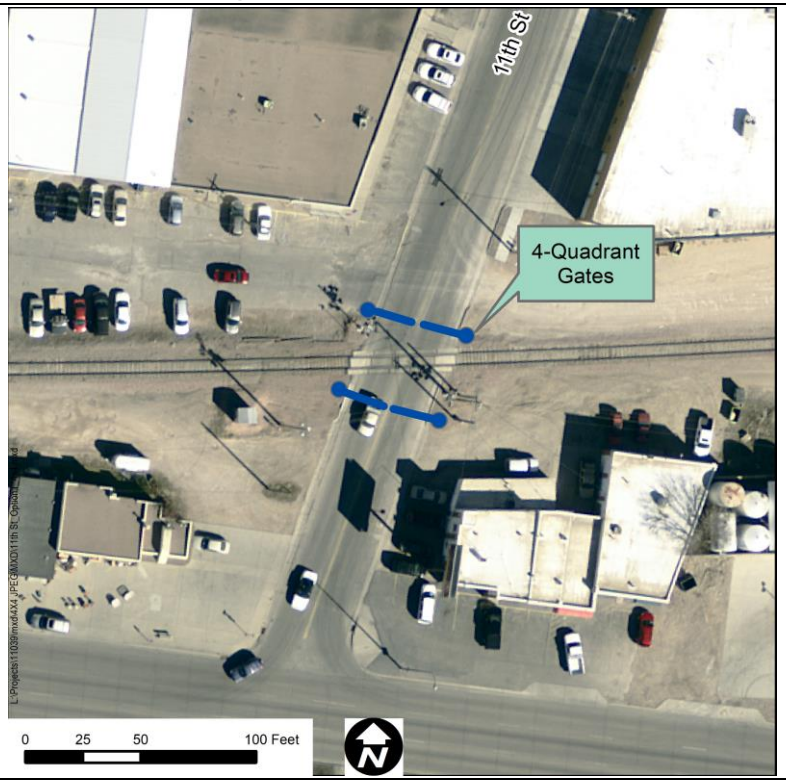
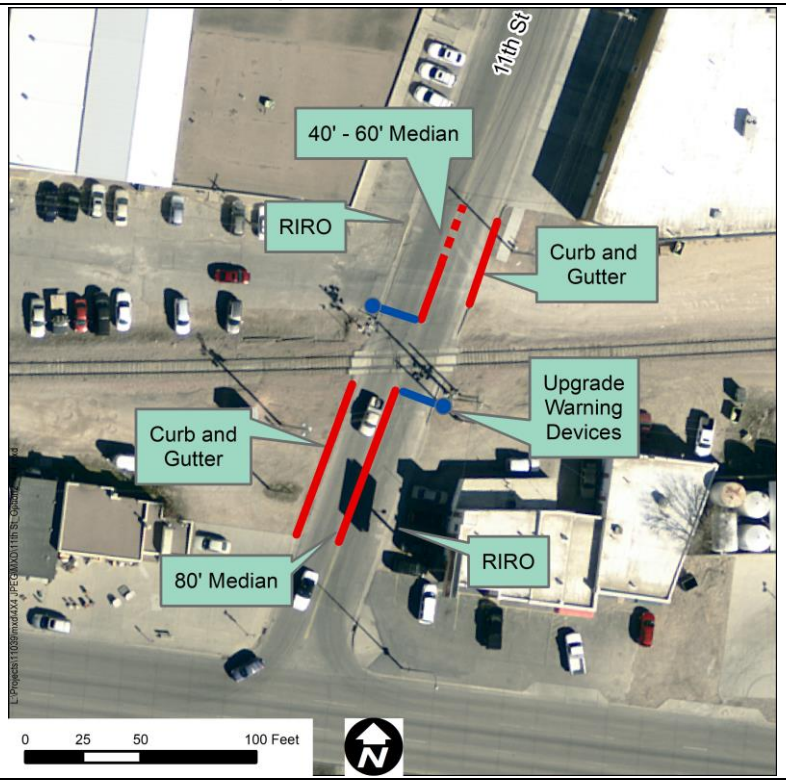
- **Wayside Horns:** These horn systems do not technically qualify as an SSM or ASM improvement, but they may be used as a substitute for train horns. For risk calculation purposes, crossings with wayside horns are removed from the calculations.

- **Closure:** Closure of a crossing will reduce risk by 100 percent but will have a significant impact on traffic circulation and access. An additional benefit is the cost savings of not upgrading the crossing with the minimum signal requirements. Incentive payments from the railroad and SDDOT may also be available. Standard closure incentive programs provide $7,500 per crossing closure from the State DOT with a $7,500 matching contribution from the railroad for a total incentive payment of $15,000.

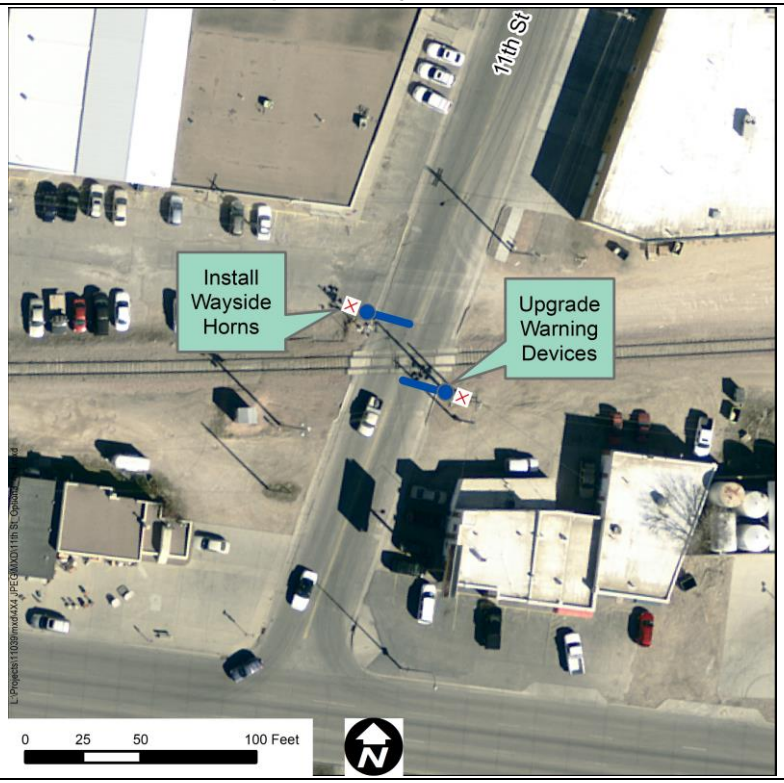
- **No Additional Improvements:** The Train Horn Rule does not require that additional improvements be installed at every crossing, so long as each is equipped with the minimum signal requirements. For each crossing, the option to install only the minimal requirements is available to the City.

The cost estimates provided in Appendix B included an itemized breakdown of the anticipated bid items and estimated unit costs for each improvement option at each crossing. The estimates are divided into crossing signal costs estimates, based on information provided by RCPE, and roadway cost estimates, based on the roadway modifications included in our proposed improvement options. The total estimates also include a 20 percent contingency as well as a 20 percent engineering fee estimate. The estimates should be considered planning-level only and may be affected by unknown site conditions or other factors that can only be identified through survey and design.

11th Street (190273R)

Option 1: Four-Quadrant Gates	Option 2: ASM Medians
	
Risk Reduction: 4,982 → 1,146 (77%) Signal Costs: $350,000 Roadway Costs: $14,256 **Total Cost: $364,256** **(+$5,000 Ann. Maint.)**	Risk Reduction: 4,982 → 1,661 (67%) (40' north median) Signal Costs: $250,000 Roadway Costs: $64,056 **Total Cost: $314,056**
Notes: This option has the smallest impact on access to adjacent properties but has high construction costs and ongoing annual maintenance fees.	**Notes:** This option would limit some accesses to right-in/right-out movements. The length of the north median may be extended to 60' if it is acceptable to further limit the access to the northwest property.

Option 3: Wayside Horns

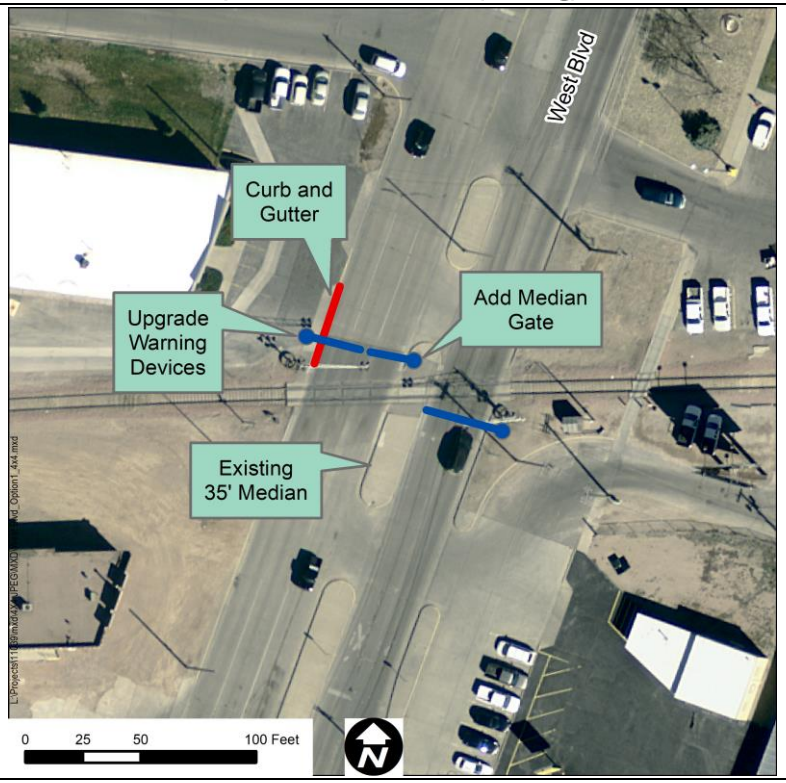


Risk Reduction:	n/a
Signal Costs:	$280,000
Roadway Costs:	$14,256
Total Cost:	**$294,256**
	(+$5,000 Ann. Maint.)

Notes: Wayside horns were discussed as an option at this crossing. However, due to the need to upgrade the warning devices, the estimated cost for this improvement is only slightly less than the other options.

West Boulevard (190272J)

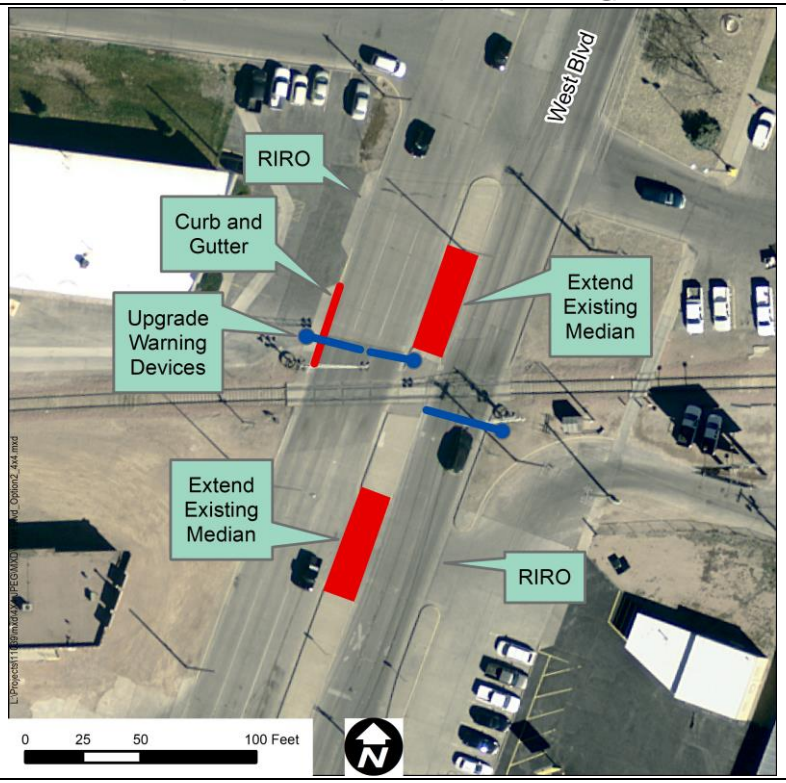
Option 1: ASM Medians (Existing)



Risk Reduction:	18,233 → 13,979 (23%)
Signal Costs:	$300,000
Roadway Costs:	$25,978
Total Cost:	**$325,978**

Notes: This option utilizes the existing medians for risk reduction. A median gate is required to account for the southbound roadway width. The diagnostic team recommended that the access to the northwest property be closed to not interfere with the gate operation.

Option 2: ASM Medians (Extend Existing)

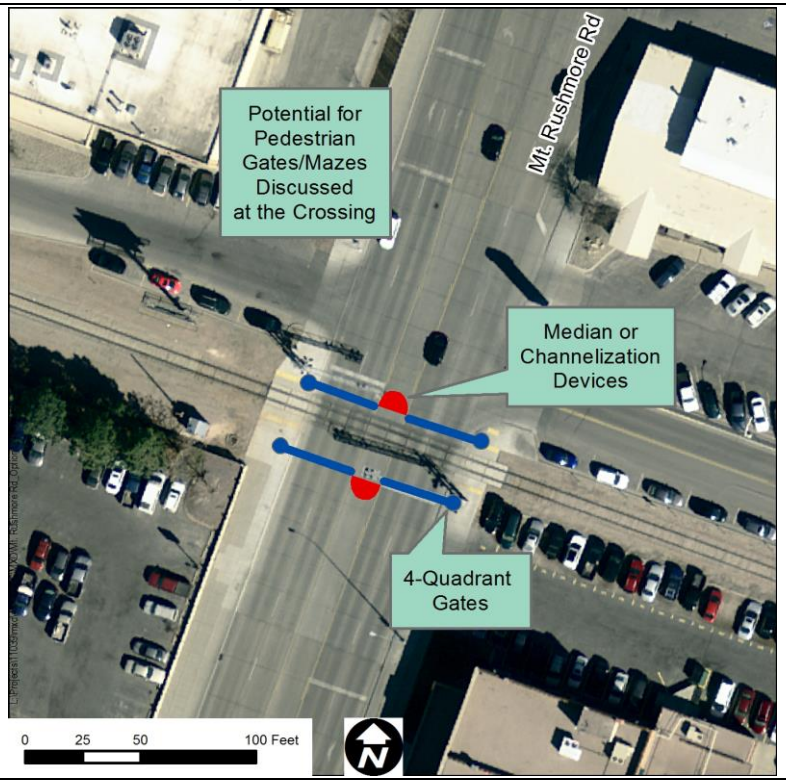


Risk Reduction:	18,233 → 3,647 (80%)
Signal Costs:	$300,000
Roadway Costs:	$57,820
Total Cost:	**$357,820**

Notes: Under this option, the median gaps are filled to result in full-length medians on each approach. This would limit accesses to right-in/right-out movements. Alternatively, if only the north median were extended, this would result in a risk reduction of 63 percent and approximately $25,000 less in roadway costs.

Mt. Rushmore Road (190271C)

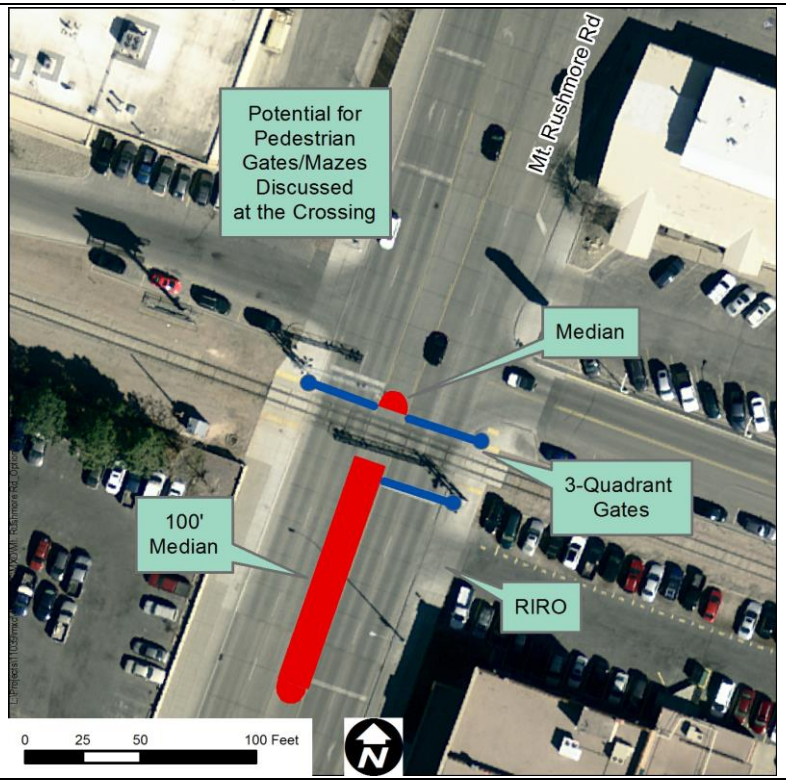
Option 1: Four-Quadrant Gates



Risk Reduction:	20,484 → 4,711 (77%)
Signal Costs:	$350,000
Roadway Costs:	$30,715
Total Cost:	**$380,715**
	(+$5,000 Ann. Maint.)

Notes: Four-quadrant gates are a suitable option at this crossing due to the conflicting intersections and accesses. Due to the roadway width, small sections of median or channelization devices will need to be installed in the center lane to qualify as an SSM improvement. Pedestrian gates and/or mazes were discussed as a potential option at this crossing but are not required by the Train Horn Rule.

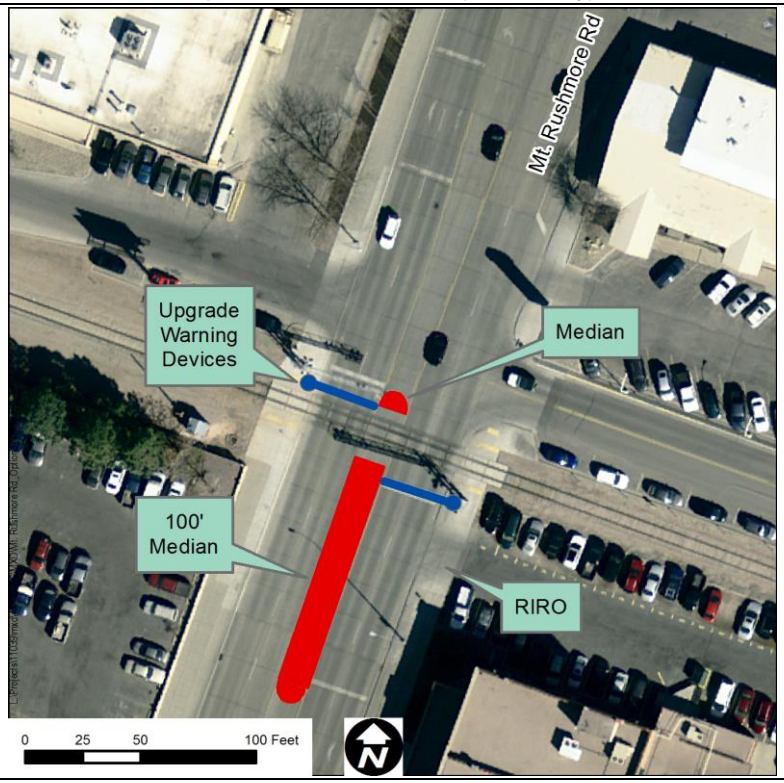
Option 2: Three-Quadrant Gates



Risk Reduction:	20,484 → 4,404 (79%)
Signal Costs:	$300,000
Roadway Costs:	$65,305
Total Cost:	**$365,305**
	(+$5,000 Ann. Maint.)

Notes: This option is a hybrid between a four-quadrant gate and non-traversable medians. This option achieves the highest risk reduction, but also carries the highest estimated cost. The access to the southeast property would be limited to right-in/right-out movements.

Option 3: ASM Medians (South Only)

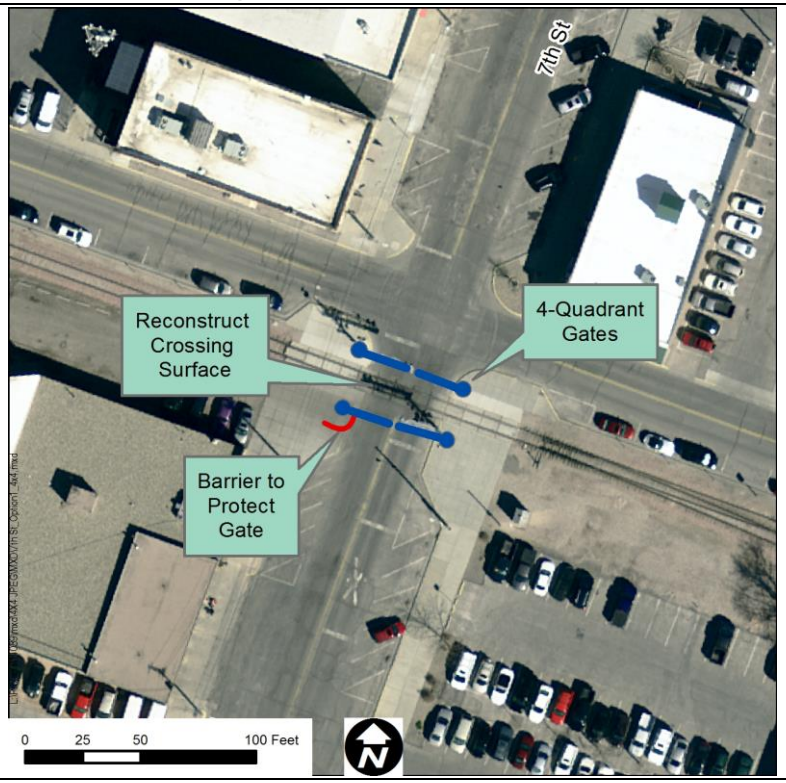


Risk Reduction:	20,484 → 12,291 (40%)
Signal Costs:	$250,000
Roadway Costs:	$65,305
Total Cost:	**$315,305**

Notes: Medians to the north of the crossing are not possible due to the proximity of Rapid Street. The access to the southeast property would also be limited to right-in/right-out movements. This option has the lowest estimated cost, but also the lowest risk reduction effect.

7th Street (190270V)

Option 1: Four-Quadrant Gates

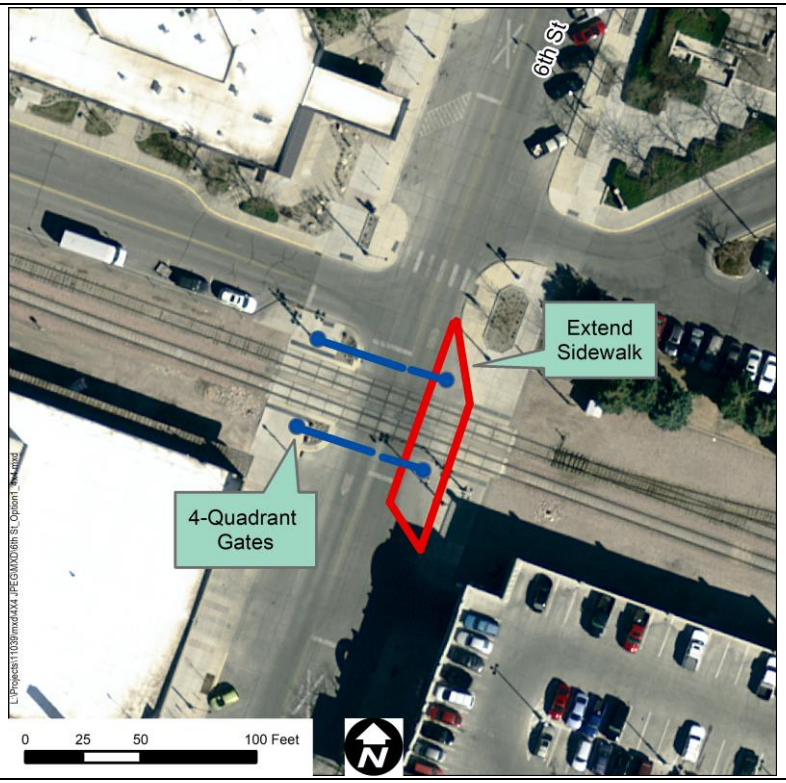


Risk Reduction:	6,007 → 1,382 (77%)
Signal Costs:	$350,000
Roadway Costs:	$98,208
Total Cost:	**$448,208**
	(+$5,000 Ann. Maint.)

Notes: Due to multiple nearby intersections and accesses, the diagnostic team determined that four-quadrant gates would be the only possible improvement option at this crossing. RCPE noted that physical protection of the southbound exit gate would be necessary to protect against trucks accessing the southwest property.

6th Street (190269B)

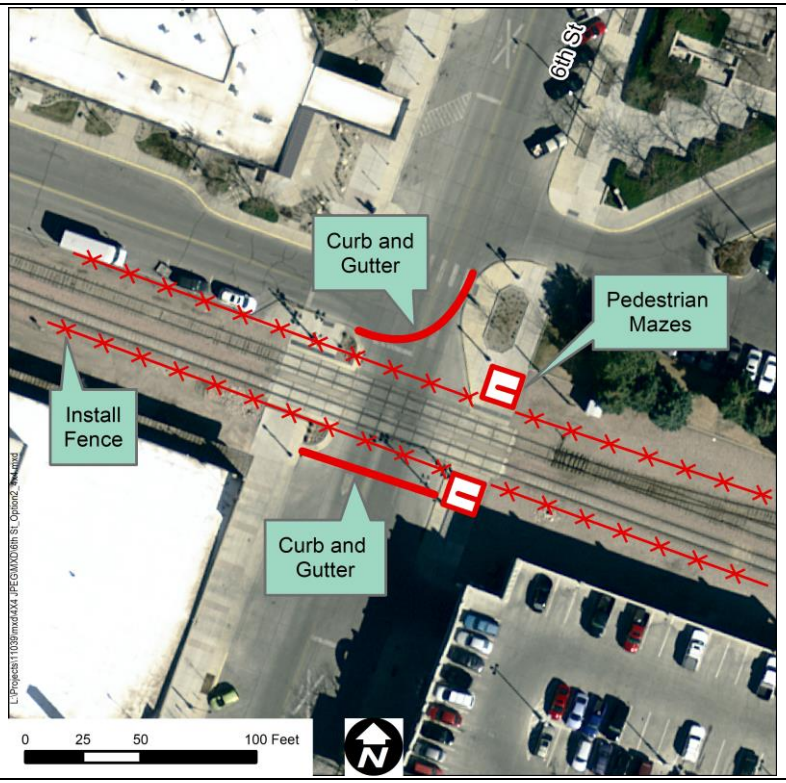
Option 1: Four-Quadrant Gates



Risk Reduction:	6,448 → 1,483 (77%)
Signal Costs:	$350,000
Roadway Costs:	$38,886
Total Cost:	**$388,886**
	(+$5,000 Ann. Maint.)

Notes: Trail crossing gates are limited to a maximum length of 32'. To accommodate this maximum length, the east sidewalk would need to be extended into the parking lane to allow for the placement of the northbound gates.

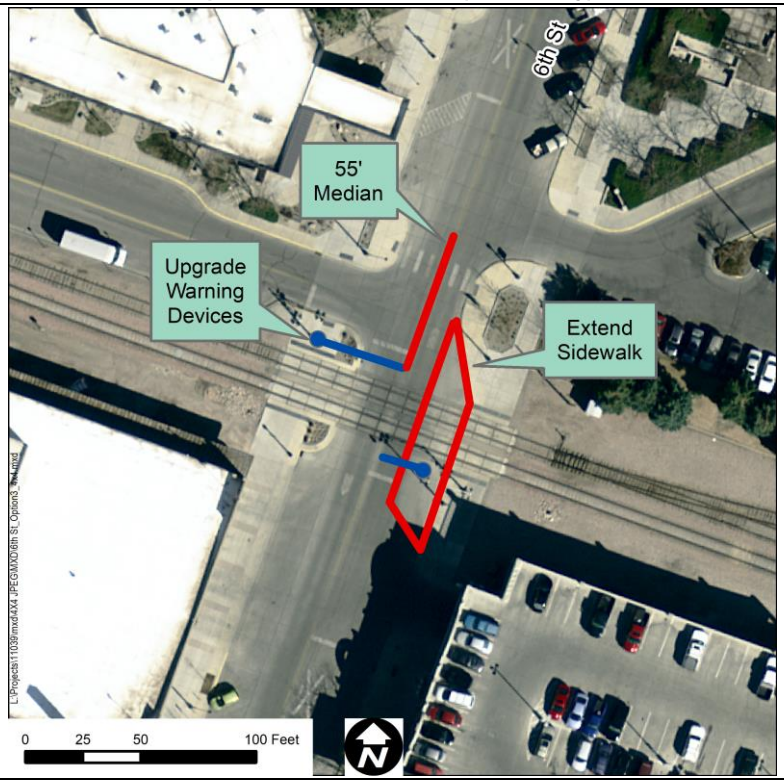
Option 2: Closure/Pedestrian Conversion



Risk Reduction:	6,448 → 0 (100%)
Signal Costs:	$0
Roadway Costs:	$82,606
Total Cost:	**$82,606**

Notes: This option closes the crossing to vehicles but remains open for pedestrians. The proposed pedestrian mazes force users to look down the tracks in each direction before proceeding. The additional fencing prohibits pedestrians from circumventing the mazes.

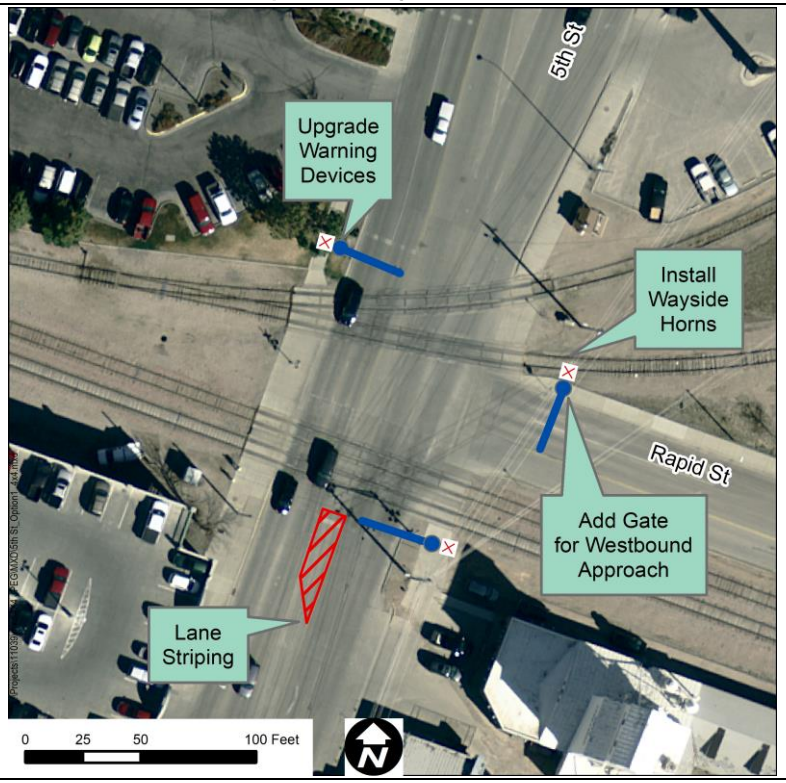
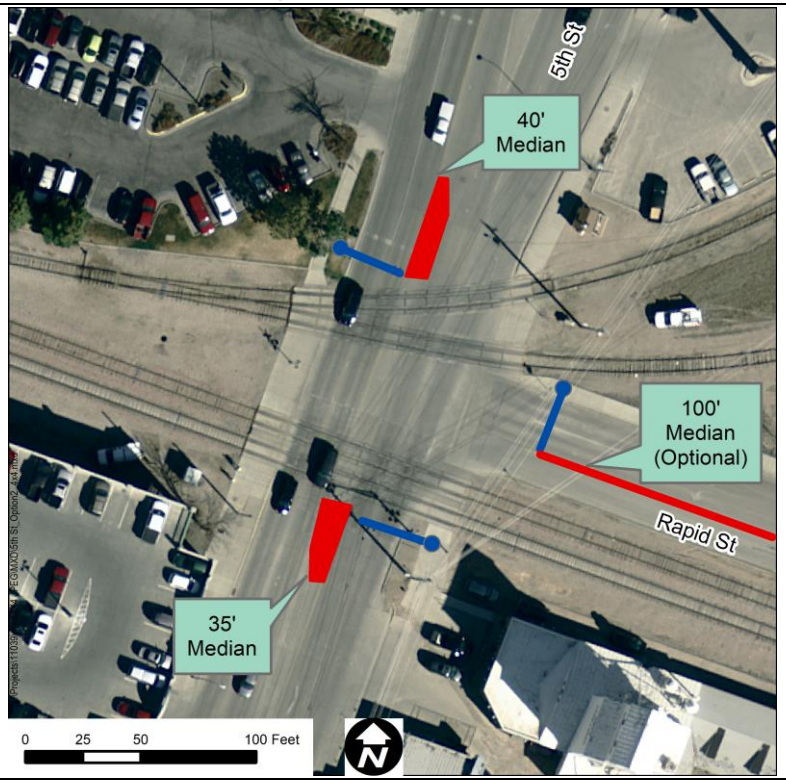
Option 3: ASM Medians (North Only)



Risk Reduction:	6,448 → 4,084 (37%)
Signal Costs:	$250,000
Roadway Costs:	$43,256
Total Cost:	**$293,256**

Notes: As with Option 1, this option extends the east sidewalk into the parking lane to allow for a northbound gate. Medians are not possible south of the crossing due to access requirements to the southwest property. The intersection with Rapid Street would also be limited to right-in/right-out movements.

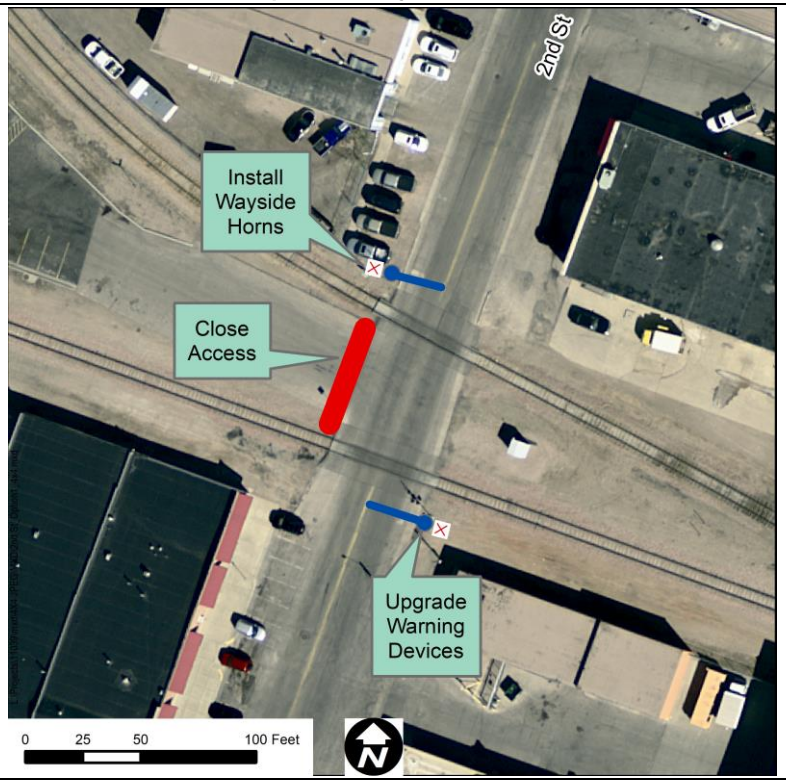
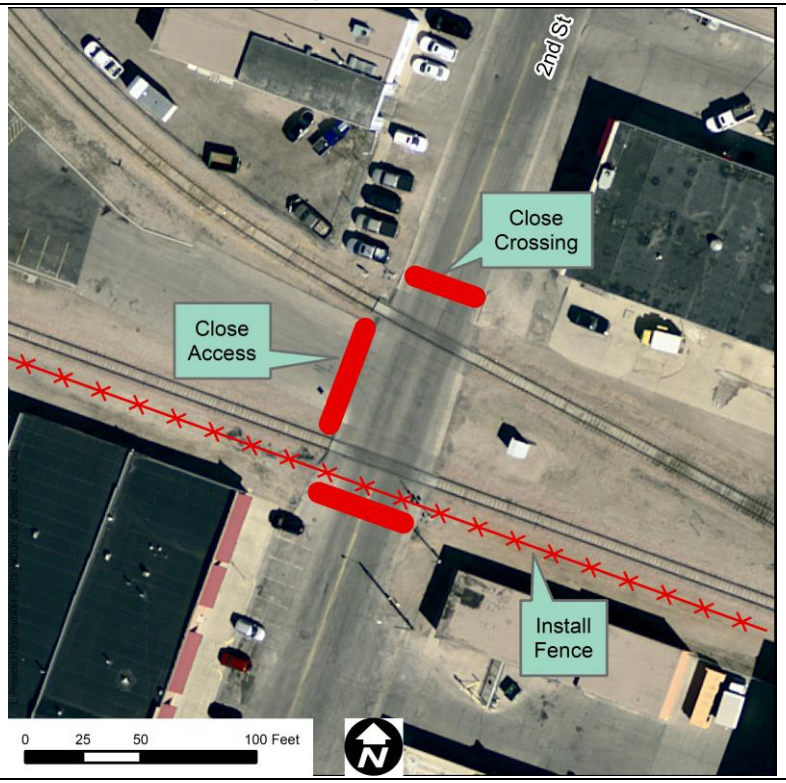
5th Street (190268U)

Option 1: Wayside Horns	Option 2: ASM Medians
	
Risk Reduction: n/a Signal Costs: $845,000 Roadway Costs: $22,176 **Total Cost: $867,176**	Risk Reduction: 19,263 → 9,631 (50%) Signal Costs: $800,000 Roadway Costs: $61,804 **Total Cost: $861,804**
Notes: The signal upgrade costs at this crossing are significantly higher due to the multiple mainline and industry tracks as well as the intersection with Rapid Street. An additional gate will be required for the Rapid Street approach.	**Notes:** This option proposes reduced-length medians on the northbound and southbound approaches. A median on the Rapid City approach is recommended but may not be not required by the FRA to meet Train Horn Rule standards.

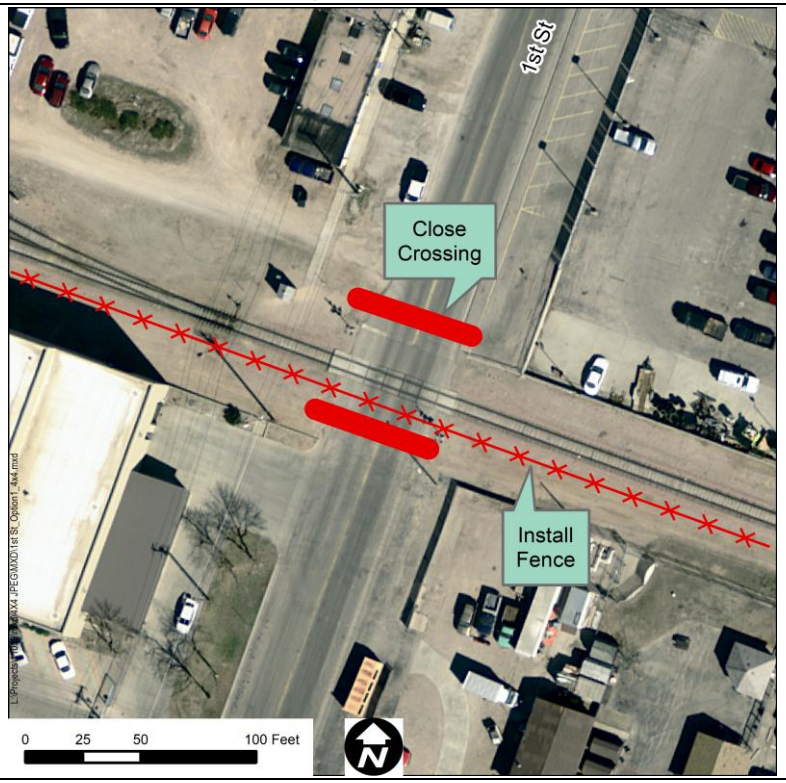
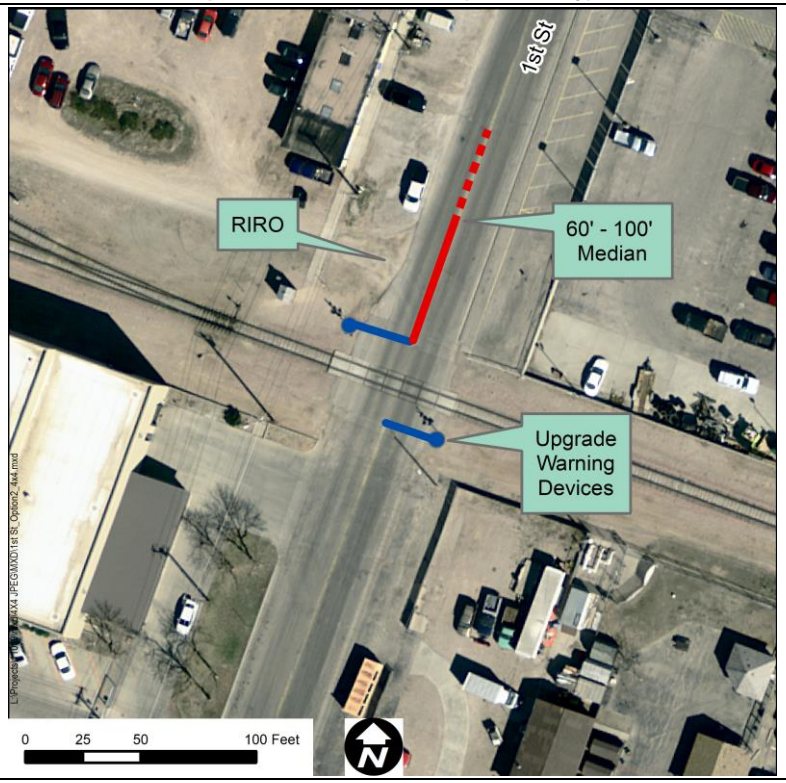
3rd Street (190266F)

Option 1: Four-Quadrant Gates	Option 2: Wayside Horns
	
Risk Reduction: 5,954 → 1,369 (77%) Signal Costs: $350,000 Roadway Costs: $14,256 **Total Cost: $364,256** **(+$5,000 Ann. Maint.)**	Risk Reduction: n/a Signal Costs: $280,000 Roadway Costs: $14,256 **Total Cost: $294,256** **(+$5,000 Ann. Maint.)**
Notes: Four-quadrant gates are only of the only available options due to the close proximity of intersections and commercial accesses.	**Notes:** Wayside horns were discussed as a potential option at this crossing. Alternatively, this crossing and the remainder of the crossings to the east may be excluded from the quiet zone.

2nd Street (190265Y)

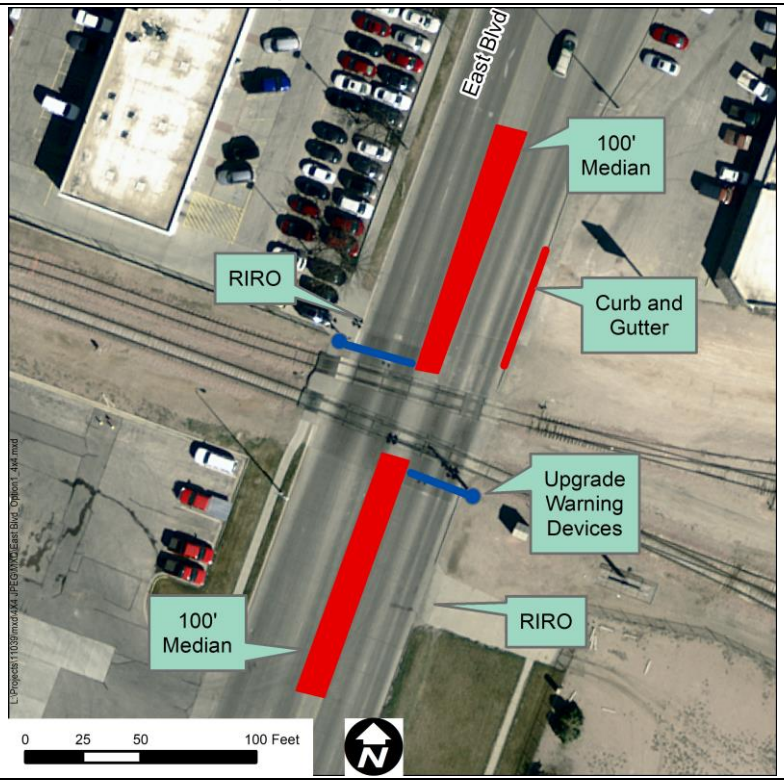
Option 1: Wayside Horns	Option 2: Closure
	
Risk Reduction: n/a Signal Costs: $280,000 Roadway Costs: $38,615 **Total Cost: $318,615** **(+$5,000 Ann. Maint.)**	Risk Reduction: 3,945 → 0 (100%) Signal Costs: $0 Roadway Costs: $59,541 **Total Cost: $59,541**
Notes: The commercial access located between the mainline and spur tracks will need to be closed under any option. Access to this property is primarily via 3rd Street.	**Notes:** TA full closure of this crossing will include closing the commercial between the tracks. The proposed fence will prohibit pedestrian access across the tracks.

1st Street (190264S)

Option 1: Closure	Option 2: ASM Medians (North Only)
	
Risk Reduction: 3,312 → 0 (100%) Signal Costs: $0 Roadway Costs: $55,845 **Total Cost: $55,845**	Risk Reduction: 3,312 → 1,987 (40%) Signal Costs: $250,000 Roadway Costs: $47,356 **Total Cost: $297,356**
Notes: This option fully closes the crossing. The proposed fence will prohibit pedestrian access across the tracks.	**Notes:** Median is not feasible south of the crossing due to the proximity of the commercial access to the southwest property. The median to the north may be between 60 and 100 feet in length depending on the need for access to the northwest property.

East Boulevard (190263K)

Option 1: SSM Medians

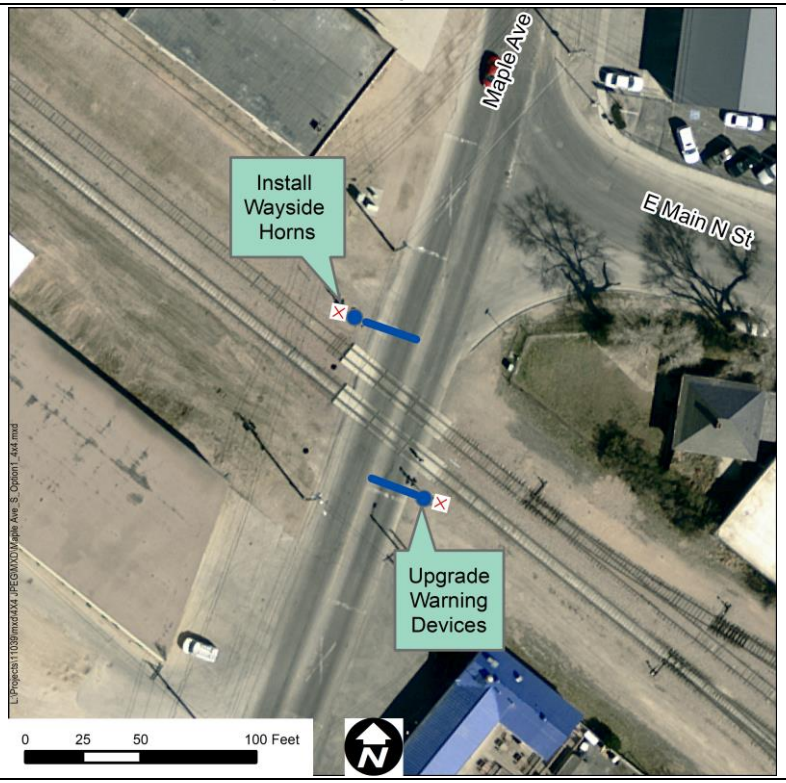


Risk Reduction:	15,797 → 3,159 (80%)
Signal Costs:	$250,000
Roadway Costs:	$101,900
Total Cost:	**$351,900**

Notes: This option proposes installing medians in the existing center lane. Commercial accesses to the northwest and southeast properties would be limited to right-in/right-out movements.

Maple Avenue (South) (190261W)

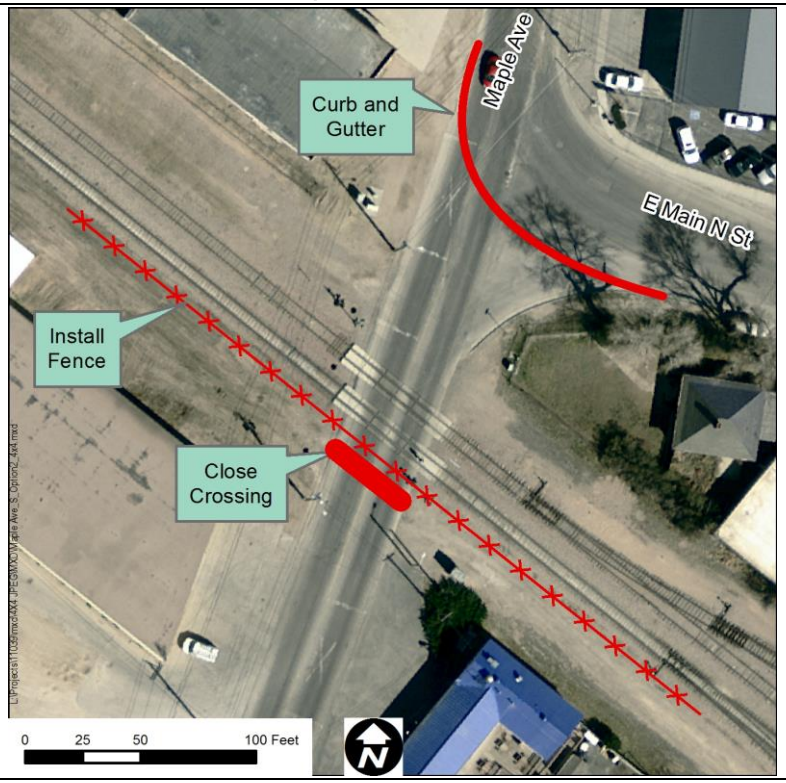
Option 1: Wayside Horns



Risk Reduction:	n/a
Signal Costs:	$280,000
Roadway Costs:	$14,256
Total Cost:	**$294,256**
	(+$5,000 Ann. Maint.)

Notes: The diagnostic team discussed the use of wayside horns as a potential option at this crossing.

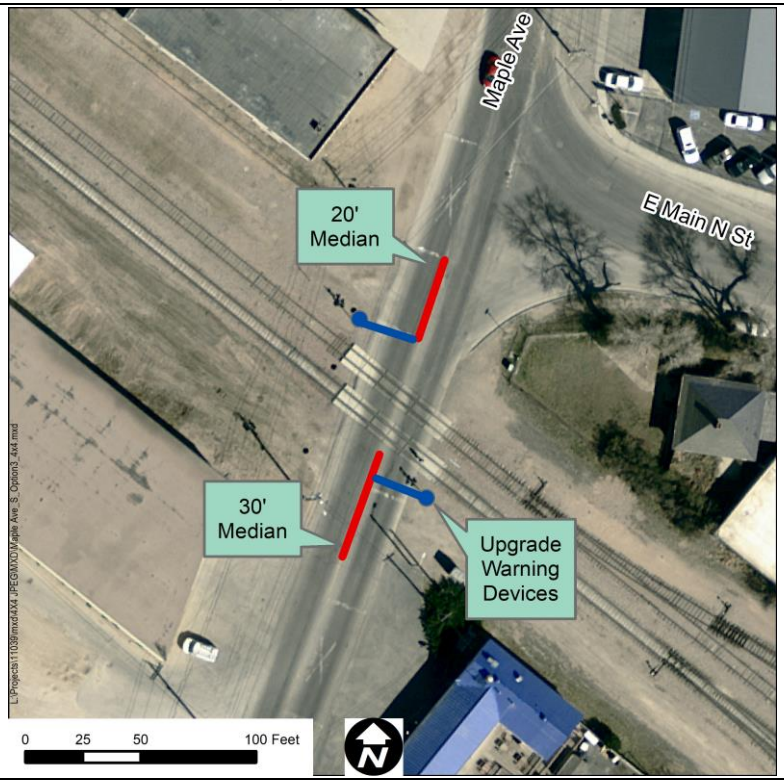
Option 2: Closure



Risk Reduction:	7,084 → 0 (100%)
Signal Costs:	$0
Roadway Costs:	$65,543
Total Cost:	**$65,543**

Notes: As proposed, this closure option removes the intersection of Maple Avenue and E Main Street. The addition of fencing prohibits pedestrian access.

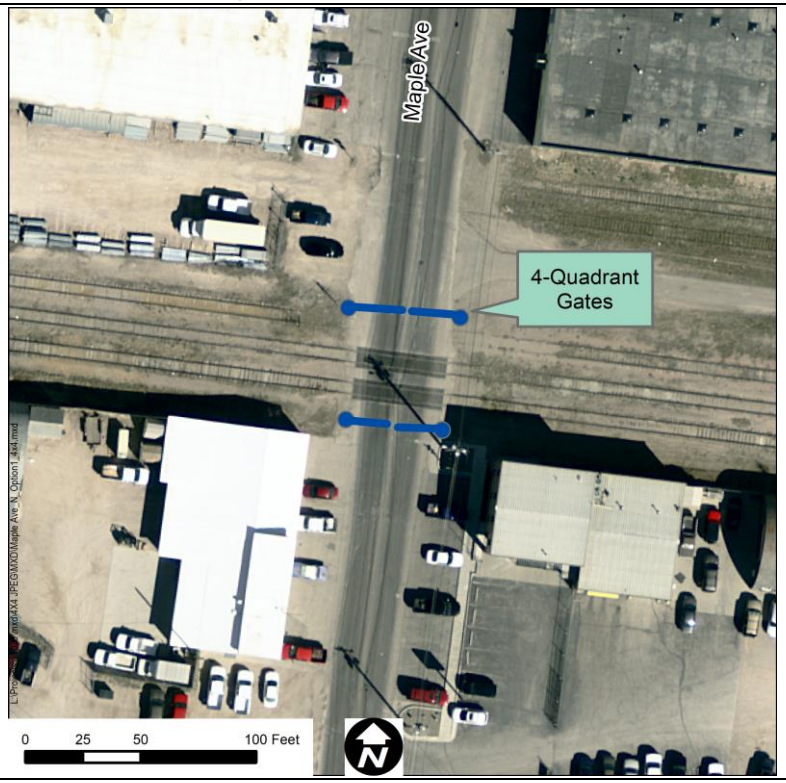
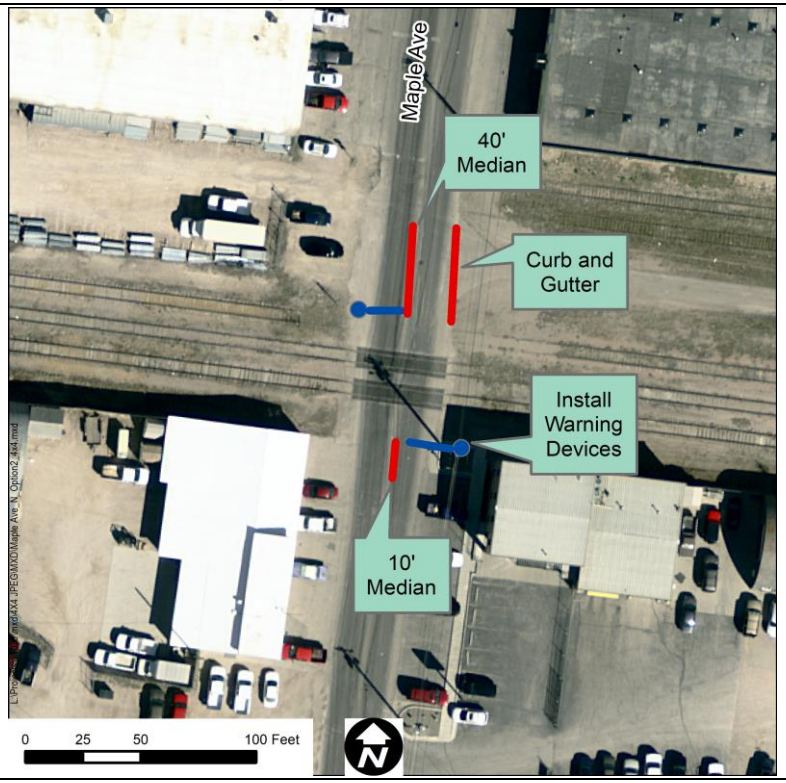
Option 3: ASM Medians



Risk Reduction:	7,084 → 4,723 (33%)
Signal Costs:	$250,000
Roadway Costs:	$35,165
Total Cost:	**$285,165**

Notes: The median lengths at this crossing are limited by the proximity of the intersection with E Main Street and the commercial accesses south of the crossing.

Maple Avenue (North) (190262D)

Option 1: Four-Quadrant Gates	Option 2: ASM Medians
	
Risk Reduction: 7,239 → 1,665 (77%) Signal Costs: $350,000 Roadway Costs: $14,256 **Total Cost: $364,256** **(+$5,000 Ann. Maint.)**	Risk Reduction: 7,239 → 5,574 (33%) Signal Costs: $250,000 Roadway Costs: $38,966 **Total Cost: $288,966**
Notes: Four-quadrant gates may be the most feasible option at this crossing due to the proximity of multiple commercial accesses.	**Notes:** The median lengths at this crossing are limited by the proximity of multiple commercial accesses to the north and south of the crossing.

Omaha Avenue Crossings

Omaha Avenue (West) (190148D)	Omaha Avenue (East) (190267M)
	
Notes: Upgrading this crossing with the minimum signal requirements would be very difficult given the existing roadway configuration. Median gates would be needed on each approach due to the number of lanes. RCPE noted that under standard operations, trains use this crossing in reverse. Therefore, horns do not sound, and the crossing movement is protected using flaggers. Due to the difficulty of improvement installation and the limited existing train horn impacts, this crossing was eliminated from consideration for quiet zone implementation.	**Notes:** Like the other Omaha Avenue crossing, this crossing would be very difficult to upgrade with the minimum requirements. Median gates would be need on each approach due to the number of lanes. Additionally, the intersection with 3rd Street would likely need to be closed in order to install entry gates on the eastbound approach. Due to the difficulty of improvement installation, this crossing was eliminated from consideration for quiet zone implementation.

Crossing Improvement Scenarios

Multiple crossing improvement scenarios are available which would allow for the implementation of one or more quiet zones in Rapid City. Each scenario below was developed by selecting the various individual crossing improvement options described in the previous section. The options were selected to achieve a specific goal for each scenario such as selecting options that result in the highest levels of safety or selecting only the most cost-effective scenarios while leaving others with only the minimum crossing signal upgrades. Documentation of the quiet zone risk calculations is included in Appendix C.

Mainline Improvement Scenarios

This quiet zone corridor would extend from 11th Street to Maple Avenue (South). Rapid City crossings not included in this corridor are the two crossings at Omaha Avenue, and the Maple Avenue (North) crossing. Each of the scenarios below is compared in terms of total implementation cost, overall safety benefits, and other potential impacts to property access and traffic circulation. The relative risk levels are discussed in terms of Quiet Zone Risk Index (QZRI), Risk Index With Horns (RIWH), and Nationwide Significant Risk Threshold (NSRT). These concepts are discussed in more detail in the Introduction. A summary of the proposed scenarios is included in Table 4. Note that these sample represent only a small portion of the potential implementation options.

Baseline Scenario

The baseline scenario assumes that all the crossings in the corridor have been upgraded to meet the minimum warning device requirements but with no additional crossing improvements. The cost for these minimum upgrades is estimated at $3,300,000. The final QZRI is 10,137 compared to a RIWH of 6,077 and an NSRT of 14,723. Since the QZRI is less than the NSRT, the City has the option to implement a quiet zone using only these minimum upgrades. However, if the quiet zone is implemented under this standard, it will be subject to an annual risk review by the FRA. The QZRI may increase if a crash occurs at a crossing or if train or traffic volumes increase. If an annual review finds that the QZRI is no longer below the NSRT, the City will be required to implement additional safety improvements.

Scenario 1: High Safety

The goal of this scenario is to select the improvement options that have the greatest impact on risk reduction, regardless of cost. As each crossing, the option with the highest risk reduction score was selected. This includes the use of a wayside horn system at 2nd Street, where no alternate options are available that did not include closure of the crossing. The result is a QZRI of 3,293 compared to a RIWH of 6,449. The estimated cost of this scenario is $4,403,578.

Scenario 2: Cost Effective (Without Closures)

The combination of cost, risk reduction, and starting QZRI level result in varying levels of cost-effectiveness. Since the risk is calculated for the quiet zone as a single corridor, it is helpful and instructive to review the individual cost effectiveness of each improvement option. This will allow us to identify the options that have the greatest impact on corridor risk levels while minimizing overall costs. Table 3 summarizes the dollars per point of risk reduction for each option. The cost-effectiveness ratings range from $9.25 per risk point for the closure of Maple Avenue (South) to $224.48 per risk point for the installation of medians at 1st Street. The four closure options rank the highest due to their complete elimination of risk at the crossing. The costs for these improvements are also low since there is no need for crossing signal upgrades. Note that the wayside horn options are not included in this table. Wayside horns function as a one-for-one replacement of the train horn, and the crossing is excluded from risk calculations.

Using this ranking as a guide, this scenario proposes improvements at only four crossings: 1) Extending the existing medians at West Boulevard, 2) Three-quadrant gates at Mt. Rushmore Road, 3) Four-quadrant gates at 6th Street, and 4) Medians at East Boulevard. This scenario specifically avoids the use of closures due to their impact on access and traffic circulation. Improvements were added until the QZRI was less than the RIWH. The result is a QZRI of 5,749 compared to a RIWH of 6,077. The estimated cost of this scenario is $3,763,910.

Scenario 3: Cost Effective (With Closures)

Using the same approach as Scenario 2, this scenario selects the most cost-effective improvement options first, but also includes the closure/pedestrian conversion of the 6th Street crossing. This scenario proposes improvements at four crossings: 1) Extending the existing medians at West Boulevard, 2) Three-quadrant gates at Mt. Rushmore Road, 3) Conversion of 6th Street to a pedestrian-only crossing, and 4) Medians at East Boulevard. The result is a QZRI of 5,614 compared to a RIWH of 6,077. The estimated cost of this scenario is $3,457,630.

Table 3. Cost-Effectiveness of Proposed Improvements

Crossing Name	Improvement Option		Risk Reduction	QZRI	QZRI Reduction	Improvement Cost	Dollars / QZRI Reduction
Maple Avenue (south)	2	Closure	100%	7,084	7,084	$65,542	9.25
6th Street	2	Closure/Ped. Conversion	100%	6,448	6,448	$82,606	12.81
2nd Street	2	Closure	100%	3,945	3,945	$59,541	15.09
1st Street	1	Closure	100%	3,312	3,312	$55,845	16.86
Mt Rushmore Road	2	3-Quad Gates	79%	20,484	16,080	$365,305	22.72
Mt Rushmore Road	1	4-Quad Gates	77%	20,484	15,773	$380,715	24.14
West Boulevard	2	ASM Medians (Extend Existing)	80%	18,233	14,587	$357,820	24.53
East Boulevard	1	ASM Medians	80%	15,797	12,638	$351,900	27.85
Mt Rushmore Road	3	ASM Medians	40%	20,484	8,194	$315,305	38.48
West Boulevard	1	ASM Medians (Existing)	23%	18,233	4,254	$325,978	76.62
6th Street	1	4-Quad Gates	77%	6,448	4,965	$388,886	78.33
11th Street	1	4-Quad Gates	77%	5,954	4,584	$364,256	79.46
5th Street	2	ASM Medians	50%	19,263	9,631	$861,804	89.48
11th Street	2	ASM Medians	67%	4,982	3,321	$314,056	94.56
11th Street	1	4-Quad Gates	77%	4,982	3,836	$364,256	94.96
7th Street	1	4-Quad Gates	77%	6,007	4,625	$448,208	96.91
Maple Avenue (south)	3	ASM Medians	33%	7,084	2,361	$285,164	120.77
6th Street	3	ASM Medians	37%	6,448	2,364	$293,256	124.04
1st Street	2	ASM Medians	40%	3,312	1,325	$297,365	224.48

Scenario 4: Include Only Core Downtown Crossings

As noted earlier, the City will not need to include all crossings within the City. The quiet zone must only meet the half-mile length requirement to qualify. The City may choose to focus efforts only on those crossings with the high potential for noise impact. This scenario proposes including only the four crossings from Mt. Rushmore Road to 5th Street. This scenario also proposes improvements at only two crossings: 1) Three quadrant gates at Mt. Rushmore Road and 2) Medians at 5th Street. The result is a QZRI of 6,623 compared to a RIWH of 7,824. The estimated cost of this scenario is $1,727,109. Nearly half of this proposed cost is the minimum signal upgrades required at the 5th Street crossing.

Scenario 5: Phased Implementation

One option for the City to consider is a phased implementation of the quiet zone. For example, if the City pursues Scenario 4, quiet zones could be implemented at the other crossings at a later date. Using this approach, each quiet zone would need to qualify independently. The scenario proposes the implementation of quiet zones at three independent groupings of contiguous crossings:

- **West:** This grouping would consist of the crossings at 11th Street and West Boulevard. Improvements would include only extending the medians at West Boulevard. The result is a QZRI of 4,315 compared to a RIWH of 6,959. The estimated cost of this phase is $607,820.
- **Downtown:** This grouping and proposed improvements matches those proposed in Scenario 4. The result is a QZRI of 6,623 compared to a RIWH of 7,824. The estimated cost of this phase is $1,727,109.
- **East:** This grouping includes the remaining crossings between 3rd Street and Maple Avenue (South). The proposed improvements include: 1) Four-quadrant gates at 3rd Street, 2) Medians at East Boulevard, and 3) Medians at Maple Avenue (South). The result is a QZRI of 3,302 compared to a RIWH of 4,327. The estimated cost of this phase is $1,501,321.

The combined cost of implementing all three phases is $3,836,249.

Additional Crossings

As noted during the diagnostic team meeting, the two crossings at Omaha Avenue have unique geometric configurations that make the installation of even the minimum signal upgrades either extremely costly, or physically impossible without major modification to the surrounding roadway infrastructure. Due to these difficulties, and the limited train horn noise impact experienced at these crossings, they were eliminated from further consideration of quiet zone implementation.

Likewise, the State-owned crossing at Maple Avenue (North) experiences very few trains—typically only a few per year. Therefore, this from was also eliminated from further consideration for quiet zone implementation.

Table 4. Improvement Scenario Summary

Crossing Name	Baseline	Scenario 1: High Safety	Scenario 2: Cost-Effective (Without Closures)	Scenario 3: Cost-Effective (With Closures)	Scenario 4: Core Downtown Crossings Only
11th Street	Signals Only	4-Quad Gates	Signals Only	Signals Only	Excluded
West Boulevard	Signals Only	ASM Medians (Ext. Existing)	ASM Medians (Ext. Existing)	ASM Medians (Ext. Existing)	
Mt Rushmore Road	Signals Only	3-Quad Gates	3-Quad Gates	3-Quad Gates	3-Quad Gates
7th Street	Signals Only	4-Quad Gates	Signals Only	Signals Only	Signals Only
6th Street	Signals Only	4-Quad Gates	4-Quad Gates	Closure / Ped-Only	Signals Only
5th Street	Signals Only	ASM Medians	Signals Only	Signals Only	ASM Medians
3rd Street	Signals Only	4-Quad Gates	Signals Only	Signals Only	Excluded
2nd Street	Signals Only	Wayside Horns	Signals Only	Signals Only	
1st Street	Signals Only	ASM Medians	Signals Only	Signals Only	
East Boulevard	Signals Only	ASM Medians	ASM Medians	ASM Medians	
Maple Avenue (south)	Signals Only	ASM Medians	Signals Only	Signals Only	
Estimated Cost	$3,300,000	$4,403,578	$3,763,910	$3,457,630	$1,727,109
NSRT	14,723	14,723	14,723	14,723	14,723
RIWH	6,077	6,449	6,077	6,077	7,824
QZRI	10,137	3,293	5,749	5,614	6,623

Note: Quiet Zone Risk Index (QZRI) must be below either Nationwide Significant Risk Threshold (NSRT) or Risk Index With Horns (RIWH) to qualify for quiet zone implementation.

Next Steps and Implementation Timeline

The next step for the City is to determine the preferred crossing improvement scenario. All the proposed scenarios will qualify for quiet zone implementation. The City will need to determine which scenario provides the best balance between cost, safety, and property access and traffic circulation impacts. Once the appropriate crossing improvement options have been selected, there are several steps necessary to implement a quiet zone.

1. **Notice of Intent:** The first step in the quiet zone implementation process is the submittal of a Quiet Zone Notice of Intent (NOI) to the FRA, RCPE, SDDOT, and any other applicable stakeholders. The NOI outlines the proposed crossing improvements the City intends to use to qualify for quiet zone implementation. All recipients of the NOI are allowed 60 days to provide comment.

2. **Quiet Zone Application:** Many of the proposed improvements described in this report include the use of Alternative Safety Measure (ASM) improvements. When ASM improvements are used, a Quiet Zone Application must be submitted to the FRA following the NOI 60-day comment period. The Application is subject to a minimum 60-day comment period for all stakeholders and must then be approved by the FRA. It is estimated that this process will take nine to twelve months to complete.

3. **Construct Improvements:** Once the Quiet Zone Application has been approved, the City may begin construction of the proposed crossing improvements. The City must also install advance warning signs and pavement markings conforming to the MUTCD standards, including the installation of "No Train Horn" signs to notify the public that train horns will no longer routinely sound at these crossings.

4. **Notice of Establishment:** Once the proposed improvements have been constructed, the City must then submit a Quiet Zone Notice of Establishment (NOE) to the FRA and all applicable stakeholders. The railroad must cease the routine sounding of horns 21 days after the submittal of this final notice.

After the quiet zone is implemented, the City will be required to provide updates to the FRA on a routine basis confirming that the improvements used to qualify for the quiet zone are still in place. If the quiet zone is established by installing SSMs at every crossing, the FRA requires a letter every five years confirming the continued presence of the SSM improvements. If the quiet zone is established without SSMs at every crossing a similar letter must be submitted to the FRA every three years. If the quiet zone is established by meeting only the NSRT threshold (Baseline Scenario), FRA staff will complete an annual risk assessment to confirm that the quiet zone is still within the NSRT threshold and will notify the City of the results. If the NSRT threshold is no longer met, the City will have six months to develop an action plan for adding additional improvements to bring the quiet zone under the NSRT threshold and three years to install these improvements before the quiet zone is terminated.

Appendix A: Diagnostic Meeting Minutes

SRF No. 11039.00

RAPID CITY, SD

PRELIMINARY QUIET ZONE DIAGNOSTIC MEETING

MEETING MINUTES
9:00 A.M. March 7th, 2017

ATTENDEES:

Kip Harrington, Rapid City
Steve Frooman, Rapid City
Ritchie Nordstrom, Rapid City
Lindsey Seachris, Rapid City
Eric Braun, Rapid City
Dan Senftner, Destination Rapid City
Gary Bate, RCPE
Jim Nemec, RCPE
Shawn Engel, RCPE
Karim M, Rushmore Hotel & Suites
Cheri Bonebrake, FRA (on the phone)
Jason Hanson, Brosz Engineering
Chris Ryan, SRF Consulting Group
Eric Hodgson, SRF Consulting Group

The diagnostic meeting participants, including representatives from The City of Rapid City (the City), the Rapid City Pierre & Eastern (RCPE) Railroad, the Federal Railroad Administration (FRA), the Rushmore & Suites Hotel, Brosz Engineering, and SRF Consulting Group. The participants met at the Rapid City Public Administration building to discuss the steps necessary to implement a quiet zone in the Rapid City under the FRA's Train Horn Rule. A copy of the sign-in sheet with contact information is provided as an attachment.

The meeting began with introductions and a brief project overview. The purpose of the meeting was to investigate and gather input on the various Supplemental Safety Measure (SSM) and Alternative Safety Measure (ASM) options available at each crossing in the proposed quiet zone. The quiet zone diagnostic meeting is also an opportunity to identify other concerns or issues related to the crossing such as safety, traffic operations, construction needs, etc.

The review included fourteen public vehicular crossings:

- Eleven crossings are on the RCPE main line from Colony to Dakota Junction: 11th Street, West Boulevard, Mt. Rushmore Road, 7th Street, 6th Street, 5th Street, 3rd Street, 2nd Street, 1st Street, East Boulevard, and Maple Avenue (south)
- One crossing is on the RCPE main line from Rapid City to Pierre: Omaha street (east)
- One crossing is on spur/industry tracks serving the Dakota Mill and Grain site
- One crossing is on the State-owned Kadoka to Rapid City line: Maple Avenue (north)

Informational packets distributed to the group at the meeting included the following materials:

1. 8.5x11 aerial map showing the layout of each crossing.
2. 2-page glossary of Quiet Zone terminology and improvement option examples.
3. A blank evaluation sheet for the diagnostic team members to document the preferred SSM/ASM improvement options and other field notes.

Additional information was provided to the group via email. This included:

1. United States Department of Transportation (USDOT) grade crossing inventory forms for each of the crossings.
2. Accident/Incident Reports (No crashes have been recorded at any crossing within the past five years)
3. Preliminary Quiet Zone Risk Calculations.

Chris Ryan (SRF Consulting Group) provided an overview of the quiet zone review and implementation process. A quiet zone prevents the *routine* sounding of horns, but horns may still be sounded in cases of emergency (vehicle, pedestrian, or animal on the tracks), in cases where construction or maintenance personnel are near the track, or if the crossing warning devices are not functioning correctly.

To be eligible for quiet zone implementation, each crossing in the quiet zone must be equipped with the minimum warning device requirements of gates, flashing lights, power out indicators, and Constant Warning Time (CWT) detectors where reasonably practical. Currently, none of the crossings in the corridor are equipped with all the minimum warning devices.

Gary Bate (RCPE) expressed his concern with being able to implement Constant Warning Time (CWT) at all the crossings. At some crossings in the City where CWT was implemented, the high salt water content in the rail ballast created from salting the roads in winter caused the warning devices to activate with false positives. RCPE has since disconnected the CWT detectors and uses the grade crossing island circuits to activate the warning devices. As an alternative to CWT, the railroad would prefer to implement a Phase Shift Overlay (PSO) system if the quiet zone is implemented. RCPE believes this train detection system would be more reliable than a CWT system based on the current conditions in the corridor. While the Train Horn Rule requires the use of CWT "where reasonably practical," this may be a situation where the requirement can be waived in favor of the PSO system. This waiver would require a special request and exemption authorized by the FRA. SRF will coordinate further with FRA on the potential for a waiver of the CWT requirement in this corridor.

The cost of upgrading the warning devices is determined by the railroad but these costs will be the responsibility of the City. For high-level planning purposes, the following general cost estimates will be assumed for the project:

- 2-Quadrant Gate System with CWT Upgrade: $250,000
- 4-Quadrant Gate System with CWT Upgrade: $350,000
- It is assumed that the implementation of PSO instead of CWT will increase the above cost estimates by $50,000.

The FRA's risk calculations assume that the implementation of a quiet zone will increase the risk at each crossing. The City must then implement additional safety improvements (SSMs and/or ASMs) sufficient to bring the Quiet Zone Risk Index (QZRI) below either the Risk Index with Horns (RIWH) or the Nationwide Significant Risk Threshold (NSRT). Preliminary risk calculations show that the current risk levels are as follows:

- RIWH (existing risk levels) = 12,671
- QZRI (with no additional safety improvements) = 21,136
- NSRT = 14,723

The group discussed the various SSM and ASM improvements options available. Conversation during the diagnostic meeting focused on the following improvement options:

- **4-Quadrant Gates:** This combination of entry and exit gates fully blocks access to the crossing. It is a very effective improvement (reducing risk by 77-82 percent) and has little to no impact on adjacent accesses but is more expensive than other options.
- **Non-Traversable Medians/Channelization Devices:** These improvements prevent vehicles from circumventing the gates when they are in the down position and have an effectiveness of 75-80 percent. Per the FRA Train Horn Rule, these improvements should be 100 feet long where possible. Medians/channelization devices shorter than 60 feet, or which have commercial accesses located within 60 feet of the gate arm are considered ASMs, have a more limited risk reduction effectiveness, and require the submittal of a Quiet Zone Application to the FRA.
- **Crossing Closure:** Crossing closures effectively eliminate all crossing risk, but may have a significant impact on traffic circulation.
- **Wayside Horns:** These improvements replace the train horn with a horn at the crossing which focuses the horn sound at the roadway for a more limited horn impact. This cost of wayside horns was estimated at $30,000, but their use still requires an upgrade to a 2-quadrant gate system.

Following the diagnostic meeting, the City will work to identify the appropriate crossing improvements at each crossing necessary to qualify for a quiet zone. If the quiet zone moves forward, a Notice of Intent will be submitted to all stakeholders providing an overview of the proposed improvements. This notice is subject to a 60-day stakeholder comment period. If ASM crossing improvements are used, the FRA will require the submittal of a Quiet Zone Application. This application must be reviewed by the FRA's Railroad Safety Board and the processing time is currently estimated at six to nine months, but can sometime take up to a year. Construction of the improvements typically occurs following FRA approval of this application. Construction may occur prior to approval, but any modifications required by the FRA would need to be incorporated. Once the Quiet Zone Application is approved and the crossing improvements are installed, a Notice of Quiet Zone Establishment will be submitted to all stakeholders. The quiet zone will go into effect 21 days after this Notice.

Cheri Bonebrake (FRA) discussed the FRA's periodic recertification process wherein the City must document that the crossings still comply with the Train Horn Rule requirements. This process occurs once every one to five years depending on how the quiet zone is established.

RCPE then gave a general safety briefing and code of conduct for crossing site visits. Attendees then headed to the field to visit the crossings and to conduct a diagnostic review and to discuss potential safety measure updates for the crossings in the proposed quiet zone. A summary of the notes, discussion items, and recommended improvements for each crossing is provided in the tables on the following pages.

General comments relevant to all crossings include:

- All crossings will need to be equipped with "No Train Horn" signs if a quiet zone is implemented. Additional advance warning signage and pavement markings may be necessary to be consistent with the guidance in the Manual on Uniform Traffic Control Devices (MUTCD).
- RCPE confirmed that current train volumes at the mainline crossings are two through trains and two switching trains per day. Exceptions to these counts are noted individually below.
- RCPE also confirmed that the maximum timetable speed is 25 MPH at 11th Street, and 10 MPH at all other RCPE mainline crossings.
- In general, 4-quadrant gates and the "no treatment" options (minimum warning device upgrades only) could be used at any crossing. More detail is provided in the following sections regarding other potential improvements such as medians, channelization devices, wayside horns, and closures.
- The City may propose a quiet zone that does not include all of the crossings included in this review. The potential start and end points of the quiet zone will be reviewed to identify logical breakpoints.
- The City is not required to install additional improvements (beyond the minimum warning devices requirements) at all crossings to qualify for the quiet zone. Some crossings may be proposed to have no additional improvements installed.

11th Street

FRA Crossing ID: **190273R**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	_X_ 4-Quadrant Gate		___ 3-Quadrant Gate	
	___ Non-Traversable Medians		_X_ Reduced Length Non-Traversable Medians	
	___ Channelized Delineators		___ Reduced Length Channelized Delineators	
	_X_ Wayside Horns		___ Other (Describe):	_X_ No Treatment
	___ Closure			
	___ One-Way Streets			

Notes:

The roadway width at this crossing is 32', measured edge to edge of travel lane. North of the crossing, commercial accesses are immediately adjacent to the crossing on both sides of the road. South of the crossing, commercial accesses are located approximately 15' from the crossing on the east side of the road and 80' from the crossing on the west side of the road.

Reduced Length Medians are an option at this crossing but would be limited to approximately 40' to the north (approximately 60' if the east commercial access is closed) and approximately 80' to the south.

Wayside horns were discussed as a potential option at this crossing given the distance from hotels, restaurants, and other noise-sensitive land uses.

West Boulevard

FRA Crossing ID: **190272J**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	___ 4-Quadrant Gate		___ 3-Quadrant Gate	
	___ Non-Traversable Medians		_X_ Reduced Length Non-Traversable Medians	
	___ Channelized Delineators		___ Reduced Length Channelized Delineators	
	___ Wayside Horns		___ Other (Describe):	___ No Treatment
	___ Closure			
	___ One-Way Streets			

Notes:

The roadway widths at this crossing measured edge to edge of travel lane are 24' in the NB direction and 34' in the SB direction with a 13' median in the center, measured from back of curb. An existing median at the crossing extends approximately 5' to the north and 30' to the south. North of the crossing, commercial accesses are immediately adjacent to the crossing on both sides of the road. South of the crossing, commercial accesses are located approximately 35' from the crossing on the east side of the road and 115' from the crossing on the west side of the road.

The southbound roadway approach consists of three travel lanes. The maximum gate length allowable is 32', sufficient to cover two travel lanes and the necessary clearance distance to the gate mast. Therefore, under the current lane configuration, a median gate will also be required for the southbound approach. RCPE requires a minimum median width of 9' to accommodate the median gate. The extra gate will bring the estimated cost of minimum improvements at this crossing to $350,000.

Reduced Length Medians are an excellent option at this crossing given the existing median segments. The median north of the crossing could be extended to approximately 80'. The access to Kreisers Inc on the west side of the roadway would be limited to right-in/right-out (RIRO) access. Access to the property may be improved by creating an access to the north off Rapid Street. The current access would also likely need to be relocated to the north to allow sufficient clearance for the southbound gate arm. If the north median is left in its current configuration, only minimal risk reduction could be claimed.

The median south of the crossing results in approximately 30-35' of median length. Additional median length may be gained by extending the south median and limiting the commercial access on the east side of the road to RIRO access.

Mt. Rushmore Road

FRA Crossing ID: **190271C**

Crossing Improvement Options (Rank Top 3):

SSMs:	__X__ 4-Quadrant Gate ____ Non-Traversable Medians ____ Channelized Delineators ____ Wayside Horns ____ Closure ____ One-Way Streets	**ASMs:**	__X__ 3-Quadrant Gate __X__ Reduced Length Non-Traversable Medians ____ Reduced Length Channelized Delineators ____ Other (Describe):	__X__ No Treatment

Notes:

The roadway width at this crossing is 64', measured edge to edge of travel lane. North of the crossing, an intersection with Apolda Street is immediately adjacent to the crossing on both sides of the road. South of the crossing, commercial accesses are located approximately 12' from the crossing on the east side of the road.

Due to the proximity of intersecting roadways and commercial accesses, median or channelization devices will only be feasible south of the crossing. A 100' median could be installed to the south, assuming it is acceptable for the commercial access on the east side of the road to be limited to RIRO access.

A 3-quadrant gate (medians to the south with entry/exit gates to the north) was also discussed as a feasible option at this crossing.

Due to higher pedestrian traffic at this crossing, additional improvements such as pedestrian mazes or gates were discussed for potential implementation at this crossing.

7th Street

FRA Crossing ID: **190270V**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	_X_ 4-Quadrant Gate		___ 3-Quadrant Gate	
	___ Non-Traversable Medians		___ Reduced Length Non-Traversable Medians	
	___ Channelized Delineators		___ Reduced Length Channelized Delineators	
	___ Wayside Horns		___ Other (Describe):	_X_ No Treatment
	___ Closure			
	___ One-Way Streets			

Notes:

The roadway width at this crossing is 32', measured edge to edge of travel lane. North of the crossing, an intersection with Apolda Street is immediately adjacent to the crossing on both sides of the road. South of the crossing, commercial accesses are located immediately adjacent to the crossing on the west side of the road and approximately 130' from the crossing on the east side of the road.

Due to the proximity of intersecting roadways and commercial accesses, 4-quadrant gates are the only feasible improvement option at this crossing. However, RCPE expressed concern that the southbound exit gate may be an obstacle for trucks accessing the commercial access on the west side of the street. Physical protection of this gate (bollards, etc.) is recommended.

Grade issues at this crossing surface contribute to ponding issues. RCPE recommended that the crossing surface be reconstructed as part of any crossing improvement plan.

6th Street

FRA Crossing ID: **190269B**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	_X_ 4-Quadrant Gate		___ 3-Quadrant Gate	
	___ Non-Traversable Medians		_X_ Reduced Length Non-Traversable Medians	
	___ Channelized Delineators		___ Reduced Length Channelized Delineators	
	___ Wayside Horns		___ Other (Describe):	_X_ No Treatment
	_X_ Closure			
	___ One-Way Streets			

Notes:

The roadway width at this crossing is 30', measured edge to edge of travel lane. North of the crossing, an intersection with Apolda Street is immediately adjacent to the crossing on the west side of the road. South of the crossing, commercial accesses are located immediately adjacent to the crossing on the west side of the road and approximately 28' from the crossing on the east side of the road.

The truck turning movements required to access the commercial property in the southwest quadrant of the crossing prevent the installation of median to the south. A 50-60' median could be installed to the north, but this would limit the intersection with Apolda Street to RIRO turning movements.

The conversion of this crossing to pedestrian-only access was discussed as an option. The standard crossing closure incentive payments ($7,500 from SDDOT with a $7,500 match from RCPE) would not apply unless the crossing was closed to pedestrians also. The FRA noted that this conversion would not apply as a closure for risk calculation purposes but should instead be excluded from the risk calculations. It was recommended that pedestrian mazes be installed as part of this conversion effort.

5th Street

FRA Crossing ID: **190268U**

Crossing Improvement Options (Rank Top 3):

SSMs:	___ 4-Quadrant Gate ___ Non-Traversable Medians ___ Channelized Delineators __X__ Wayside Horns ___ Closure ___ One-Way Streets	ASMs:	___ 3-Quadrant Gate __X__ Reduced Length Non-Traversable Medians __X__ Reduced Length Channelized Delineators ___ Other (Describe):	__X__ No Treatment

Notes:

The roadway widths at this crossing measured edge to edge of travel lane are 56’ on the south side of the main line tracks and 64’ on the north side of the industry tracks. North of the crossing, commercial accesses are located approximately 51’ from the crossing on the west side of the road and 100’ from the crossing on the east side of the road. South of the crossing, commercial accesses are located approximately 40’ from the crossing on the east side of the road and 98’ from the crossing on the west side of the road. At this crossing, the rail spur serving the Dakota Mill and Grain site branches off the mainline. An intersection with Rapid Street is located on the east side of the roadway between the spur and mainline tracks. To meet the minimum warning device requirements, this approach will also need to be equipped with gates and flashing lights. Due to the need for additional gates and the complex track configuration, RCPE estimated the cost to upgrade the crossing with the minimum warning device requirements at $800,000.

Reduced length medians could be installed at this crossing with approximately 40-50’ of median to the north and 30-40’ of median to the south. Longer medians may be possible but would limit commercial accesses to RIRO access on either side of the crossing. The median to the north of the crossing may also interfere with vehicle storage for the northbound left-turn lane. A median could also be installed on the westbound approach from Rapid Street. Channelization devices may be used in lieu of median to have less impact on the current lane configuration.

Wayside horns were discussed as a potential option at this crossing given the current ambient noise levels at the crossings due to high traffic volumes.

3rd Street

FRA Crossing ID: **190266F**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	_X_ 4-Quadrant Gate		___ 3-Quadrant Gate	
	___ Non-Traversable Medians		___ Reduced Length Non-Traversable Medians	
	___ Channelized Delineators		___ Reduced Length Channelized Delineators	
	_X_ Wayside Horns		___ Other (Describe):	_X_ No Treatment
	___ Closure			
	___ One-Way Streets			

Notes:

The roadway width at this crossing is 42', measured edge to edge of travel lane. North of the crossing, an intersection with Rapid Street is immediately adjacent to the crossing on the west side of the road and a commercial access is immediately adjacent to the crossing on the east side of the road. South of the crossing, a commercial access is located immediately adjacent to the crossing on the east side of the road. The railroad access on the west side of the road also appears to be used to access the commercial property.

Due to the proximity of Rapid Street and multiple commercial access, medians are not a feasible option at this crossing.

Wayside horns were discussed as a potential option at this crossing given the distance from hotels, restaurants, and other noise-sensitive land uses.

2nd Street

FRA Crossing ID: **190265Y**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	___ 4-Quadrant Gate		___ 3-Quadrant Gate	
	___ Non-Traversable Medians		___ Reduced Length Non-Traversable Medians	
	___ Channelized Delineators		___ Reduced Length Channelized Delineators	
	_X_ Wayside Horns		___ Other (Describe):	_X_ No Treatment
	_X_ Closure			
	___ One-Way Streets			

Notes:

The roadway width at this crossing is 36', measured edge to edge of travel lane. North of the crossing, commercial accesses are located immediately adjacent to the crossing on both sides of the road. South of the crossing, commercial accesses are located immediately adjacent to the crossing on both sides. At this crossing, the RCPE Rapid City to Pierre line branches off from the mainline. An access to a commercial property (Good Year) is located on the west side of the roadway between the two rail lines and between the warning devices. The FRA will likely require this access to be closed if a quiet zone is implemented at this crossing. The primary access to the property is via 3rd Street.

Due to low traffic volumes, this crossing is a suitable candidate for closure. This crossing has the lowest estimated risk level in the corridor. Wayside horns were discussed as a potential option at this crossing given the distance from hotels, restaurants, and other noise-sensitive land uses.

1st Street

FRA Crossing ID: **190264S**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	___ 4-Quadrant Gate		___ 3-Quadrant Gate	
	___ Non-Traversable Medians		_X_ Reduced Length Non-Traversable Medians	
	___ Channelized Delineators		___ Reduced Length Channelized Delineators	
	___ Wayside Horns		___ Other (Describe):	
	_X_ Closure			
	___ One-Way Streets			
				_X_ No Treatment

Notes:

The roadway width at this crossing is 36', measured edge to edge of the travel lane. North of the crossing, a commercial access is located approximately 21' from the crossing on the west side of the road. An additional access to an auto garage is located approximately 60' from the crossing on the west side of the road. South of the crossing, commercial accesses are located approximately 25' from the crossing on the west side of the road and 81' from the crossing on the east side of the road.

Due to the truck movements required to access the commercial property in the southwest quadrant, no median is feasible south of the crossing. A 60-100' median could be installed north of the crossing. This would restrict the commercial access in the northwest quadrant to RIRO access.

Due to low traffic volumes, this crossing is a suitable candidate for closure. This crossing has the second lowest estimated risk level in the corridor.

The City noted the presence of the Corner Stone Rescue Mission and a Rapid City Fire Station There is a need to try to limit train noise at this location due to the Mission and Fire Station Buildings in the area, which both house people.

East Boulevard

FRA Crossing ID: **190263K**

Crossing Improvement Options (Rank Top 3):

SSMs:	ASMs:	
___ 4-Quadrant Gate __X__ Non-Traversable Medians ___ Channelized Delineators ___ Wayside Horns ___ Closure ___ One-Way Streets	___ 3-Quadrant Gate ___ Reduced Length Non-Traversable Medians ___ Reduced Length Channelized Delineators ___ Other (Describe):	__X__ No Treatment

Notes:

The roadway width at this crossing is 65', measured edge to edge of travel lane. North of the crossing, commercial accesses are located approximately 15 and 165' from the crossing on the west side of the road and 10-15' from the crossing on the east side of the road. South of the crossing, commercial accesses are located approximately 103' from the crossing on the west side of the road and 32' from the crossing on the east side of the road.

The current lane configuration at this crossing includes a striped center divider lane. 100' medians could be installed in the lane on each side of the roadway. The commercial access in the northeast quadrant would need to be closed by installing curb and gutter along the roadway edge. The first commercial access in the northwest quadrant would be limited to RIRO access. Additional access to this property is available approximately 165' north of this access. The access to the vacant property in the southeast quadrant would be limited to RIRO access.

Maple Ave (north)

FRA Crossing ID: **190262D**

Crossing Improvement Options (Rank Top 3):

SSMs:	ASMs:	
__X__ 4-Quadrant Gate ___ Non-Traversable Medians ___ Channelized Delineators ___ Wayside Horns ___ Closure ___ One-Way Streets	___ 3-Quadrant Gate __X__ Reduced Length Non-Traversable Medians ___ Reduced Length Channelized Delineators ___ Other (Describe):	__X__ No Treatment

Notes:

The roadway width at this crossing is 33', measured from edge to edge of travel lane. North of the crossing, commercial accesses are located approximately 45' from the crossing on the west side of the road and immediately from the crossing on the east side of the road. South of the crossing, commercial accesses are immediately adjacent to the crossing on both sides of the road.

This crossing is part of a state-owned rail line and would be considered a separate quiet zone if implemented. Rail volumes at this crossing vary seasonally but are estimated at fewer than one train per day.

Reduced length medians may be feasible but would be limited to approximately 10-40' in length by the proximity of the commercial accesses on each side of the crossing.

Maple Ave (south)

FRA Crossing ID: **190261W**

Crossing Improvement Options (Rank Top 3):

SSMs:	ASMs:	
___ 4-Quadrant Gate ___ Non-Traversable Medians ___ Channelized Delineators _X_ Wayside Horns _X_ Closure ___ One-Way Streets	___ 3-Quadrant Gate _X_ Reduced Length Non-Traversable Medians ___ Reduced Length Channelized Delineators ___ Other (Describe):	_X_ No Treatment

Notes:

The roadway width at this crossing is 36', measured edge to edge of travel line. North of the crossing, an intersection with Main Street is located 10-15' from the crossing on the east side of the road. South of the crossing, commercial accesses are located approximately 59' from the crossing on the west side of the road and 29' from the crossing on the east side of the road.

Reduced length medians may be feasible at this crossing. Approximately 15-20' of median could be installed to the north and approximately 25-30' of median could be installed to the south. Longer medians are not possible due to the proximity of roadway intersections and commercial accesses.

Wayside horns were discussed as a potential option at this crossing given the distance from hotels, restaurants, and other noise-sensitive land uses.

RCPE noted that this crossing sees two additional switching trains (for a total of 6 trains per day) because of the siding tracks located to the east of the crossing.

Omaha Ave (west)

FRA Crossing ID: **190148D**

Crossing Improvement Options (Rank Top 3):

SSMs:	ASMs:	
___ 4-Quadrant Gate ___ Non-Traversable Medians ___ Channelized Delineators ___ Wayside Horns ___ Closure ___ One-Way Streets	___ 3-Quadrant Gate ___ Reduced Length Non-Traversable Medians ___ Reduced Length Channelized Delineators _X_ Other (Describe): Exclude from QZ	___ No Treatment

Notes:

The roadway configuration at this crossing consists of three travel lanes in the eastbound direction and four travel lanes in the westbound direction. This configuration would require the use of median gates to meet the minimum warning device requirements. The roadway configuration prevents the use of a 4-quadrant gate system and the proximity of commercial accesses make medians unfeasible. RCPE noted that push operation into this facility is standard. Under this operation, the horn is not sounded and the move is protected by flagmen. Due to the low train volumes at the crossing, the difficulty of treatment, and the limited use of the horn at this crossing, it was determined that this crossing should be excluded from further consideration in the quiet zone study.

Omaha Ave (east)

FRA Crossing ID: **190267M**

Crossing Improvement Options (Rank Top 3):

SSMs:		ASMs:		
	___ 4-Quadrant Gate ___ Non-Traversable Medians ___ Channelized Delineators ___ Wayside Horns ___ Closure ___ One-Way Streets		___ 3-Quadrant Gate ___ Reduced Length Non-Traversable Medians ___ Reduced Length Channelized Delineators __X__ Other (Describe): Exclude from QZ	___ No Treatment

Notes:

The roadway configuration at this crossing consists of three travel lanes in the eastbound direction and four travel lanes in the westbound direction. This configuration would require the use of median gates to meet the minimum warning device requirements. A gate for the eastbound direction would only be feasible if the intersection with 3rd Street on the south side of the road were closed. Due to the low train volumes at the crossing and the difficulty of treatment, it was determined that this crossing should be excluded from further consideration in the quiet zone study.

Appendix B: Preliminary Construction Cost Estimates

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	11th Street					
			Option 1 Quad Gates		Option 2 ASM/SSM Medians		Option 3 Wayside Horns	
			Quantity	Cost	Quantity	Cost	Quantity	Cost
Roadway Costs								
Mobilization (10% of Roadway Costs)	LS	Varies	1	$900.00	1	$4,043.94	1	$900.00
Saw Pavement	LF	$9.00	0	$0.00	312	$140.00	0	$0.00
Removal of Concrete	SY	$15.00	0	$0.00	0	$0.00	0	$0.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	249	$2,115.56	0	$0.00
Removal of Curb & Gutter	LF	$10.00	0	$0.00	70	$700.00	0	$0.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	19	$388.89	0	$0.00
Curb	LF	$50.00	0	$0.00	380	$19,000.00	0	$0.00
Concrete Median Pavement	SY	$65.00	0	$0.00	63	$4,095.00	0	$0.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	0	$0.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	0	$0.00	1	$5,000.00	0	$0.00
Crossing Signal Costs								
2 Quad Gate System with CWT	LS	$250,000.00	0	$0.00	1	$250,000.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	1	$350,000.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00	0	$0.00	1	$30,000.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$9,900		$44,483		$9,900
20% Contingency on Roadway Costs				$11,880		$53,380		$11,880
20% Engineering Cost on Roadway Costs				$14,256		$64,056		$14,256
Crossing Signal Costs				**$350,000**		**$250,000**		**$280,000**
Roadway Costs				**$14,256**		**$64,056**		**$14,256**
Total Cost:				**$364,256**		**$314,057**		**$294,256**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	West Boulevard Option 1 Ex. ASM Medians Quantity	Option 1 Ex. ASM Medians Cost	West Boulevard Option 2 ASM Medians Quantity	Option 2 ASM Medians Cost
Roadway Costs						
Mobilization (10% of Roadway Costs)	LS	Varies	1	$1,640.00	1	$3,650.22
Saw Pavement	LF	$9.00	0	$0.00	160	$1,440.00
Removal of Concrete	SY	$15.00	0	$0.00	160	$2,400.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	0	$0.00
Removal of Curb & Gutter	LF	$10.00	40	$400.00	40	$400.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	36	$722.22
Curb	LF	$50.00	40	$2,000.00	200	$10,000.00
Concrete Median Pavement	SY	$65.00	0	$0.00	116	$7,540.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Crossing Signal Costs						
2 Quad Gate System with CWT	LS	$250,000.00	1	$250,000.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	1	$50,000.00	1	$50,000.00
Subtotal Cost for Roadway Costs				$18,040		$40,152
20% Contingency on Roadway Costs				$21,648		$48,183
20% Engineering Cost on Roadway Costs				$25,978		$57,820
		Crossing Signal Costs		**$300,000**		**$300,000**
		Roadway Costs		**$25,978**		**$57,820**
		Total Cost:		**$325,978**		**$357,820**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	Mt. Rushmore Road – Option 1 Quad Gates Quantity	Option 1 Quad Gates Cost	Option 2 ASM/SSM Medians Quantity	Option 2 ASM/SSM Medians Cost	Option 3 ASM Median Quantity	Option 3 ASM Median Cost
Roadway Costs								
Mobilization (10% of Roadway Costs)	LS	Varies	1	$1,939.10	1	$4,122.77	1	$4,122.77
Saw Pavement	LF	$9.00	104	$936.00	284	$2,556.00	284	$2,556.00
Removal of Concrete	SY	$15.00	36	$533.33	213	$3,200.00	213	$3,200.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	0	$0.00	0	$0.00
Removal of Curb & Gutter	LF	$10.00	0	$0.00	0	$0.00	0	$0.00
Aggregate Base Course CL 5	Ton	$20.00	8	$166.67	46	$916.67	46	$916.67
Curb	LF	$50.00	40	$2,000.00	220	$11,000.00	220	$11,000.00
Concrete Median Pavement	SY	$65.00	27	$1,755.00	147	$9,555.00	147	$9,555.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	0	$0.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	1	$5,000.00	1	$5,000.00	1	$5,000.00
Crossing Signal Costs								
2 Quad Gate System with CWT	LS	$250,000.00	0	$0.00	1	$250,000.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	1	$350,000.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00	0	$0.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	1	$50,000.00	0	$0.00
Subtotal Cost for Roadway Costs				$21,330		$45,350		$45,350
20% Contingency on Roadway Costs				$25,596		$54,421		$54,421
20% Engineering Cost on Roadway Costs				$30,715		$65,305		$65,305
Crossing Signal Costs				**$350,000**		**$300,000**		**$250,000**
Roadway Costs				**$30,715**		**$65,305**		**$65,305**
Total Cost:				**$380,716**		**$365,305**		**$315,305**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	7th Street Option 1 Quad Gates Quantity	Cost
Roadway Costs				
Mobilization (10% of Roadway Costs)	LS	Varies	1	$6,200.00
Saw Pavement	LF	$9.00	0	$0.00
Removal of Concrete	SY	$15.00	0	$0.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00
Removal of Curb & Gutter	LF	$10.00	0	$0.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00
Curb	LF	$50.00	0	$0.00
Concrete Median Pavement	SY	$65.00	0	$0.00
Narrow Bituminous Median	SY	$175.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	20	$3,000.00
Jersey Barrier	LF	$250.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	25	$50,000.00
Railroad Protective Liability Insurance	LS	$5,000.00	0	$0.00
Crossing Signal Costs				
2 Quad Gate System with CWT	LS	$250,000.00	0	$0.00
4 Quad Gate System with CWT	LS	$350,000.00	1	$350,000.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00
Subtotal Cost for Roadway Costs				$68,200
20% Contingency on Roadway Costs				$81,840
20% Engineering Cost on Roadway Costs				$98,208
		Crossing Signal Costs		**$350,000**
		Roadway Costs		**$98,208**
		Total Cost:		**$448,208**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	6th Street					
			Option 1 Quad Gates		Option 2 Closure Conversion		Option 3 SSM Median	
			Quantity	Cost	Quantity	Cost	Quantity	Cost
Roadway Costs								
Mobilization (10% of Roadway Costs)	LS	Varies	1	$2,454.90	1	$5,215.00	1	$2,730.80
Saw Pavement	LF	$9.00	111	$999.00	0	$0.00	237	$2,133.00
Removal of Concrete	SY	$15.00	80	$1,200.00	167	$2,500.00	80	$1,200.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	0	$0.00	0	$0.00
Removal of Curb & Gutter	LF	$10.00	60	$600.00	65	$650.00	60	$600.00
Aggregate Base Course CL 5	Ton	$20.00	25	$500.00	0	$0.00	25	$500.00
Curb	LF	$50.00	65	$3,250.00	90	$4,500.00	65	$3,250.00
Concrete Median Pavement	SY	$65.00	0	$0.00	0	$0.00	25	$1,625.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	80	$4,000.00	0	$0.00	80	$4,000.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	40	$6,000.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	1	$2,500.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	400	$22,000.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	1	$5,000.00	1	$5,000.00	1	$5,000.00
Crossing Signal Costs								
2 Quad Gate System with CWT	LS	$250,000.00	0	$0.00	0	$0.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	1	$350,000.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00	0	$0.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$27,004		$57,365		$30,039
20% Contingency on Roadway Costs				$32,405		$68,838		$36,047
20% Engineering Cost on Roadway Costs				$38,886		$82,606		$43,256
Crossing Signal Costs				**$350,000**		**$0**		**$250,000**
Roadway Costs				**$38,886**		**$82,606**		**$43,256**
Total Cost:				**$388,886**		**$82,606**		**$293,256**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	5th Street Option 1 Wayside Horns Quantity	5th Street Option 1 Wayside Horns Cost	5th Street Option 2 ASM Median/Del. Quantity	5th Street Option 2 ASM Median/Del. Cost
Roadway Costs						
Mobilization (10% of Roadway Costs)	LS	Varies	1	$1,400.00	1	$3,901.77
Saw Pavement	LF	$9.00	0	$0.00	414	$3,726.00
Removal of Concrete	SY	$15.00	0	$0.00	160	$2,400.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	44	$377.78
Removal of Curb & Gutter	LF	$10.00	0	$0.00	0	$0.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	31	$625.00
Curb	LF	$50.00	0	$0.00	150	$7,500.00
Concrete Median Pavement	SY	$65.00	0	$0.00	100	$6,500.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	22	$3,888.89
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Crossing Signal Costs				Cost Provided by RCPE		
2 Quad Gate System with CWT	LS	$250,000.00	1	$800,000.00	1	$800,000.00
4 Quad Gate System with CWT	LS	$350,000.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	1.5	$45,000.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$15,400		$42,919
20% Contingency on Roadway Costs				$18,480		$51,503
20% Engineering Cost on Roadway Costs				$22,176		$61,804
Crossing Signal Costs				**$845,000**		**$800,000**
Roadway Costs				**$22,176**		**$61,804**
Total Cost:				**$867,176**		**$861,804**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	3rd Street Option 1 Quad Gates Quantity	3rd Street Option 1 Quad Gates Cost	3rd Street Option 2 Wayside Horns Quantity	3rd Street Option 2 Wayside Horns Cost
Roadway Costs						
Mobilization (10% of Roadway Costs)	LS	Varies	1	$900.00	1	$900.00
Saw Pavement	LF	$9.00	0	$0.00	0	$0.00
Removal of Concrete	SY	$15.00	0	$0.00	0	$0.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	0	$0.00
Removal of Curb & Gutter	LF	$10.00	0	$0.00	0	$0.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	0	$0.00
Curb	LF	$50.00	0	$0.00	0	$0.00
Concrete Median Pavement	SY	$65.00	0	$0.00	0	$0.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	0	$0.00	0	$0.00
Crossing Signal Costs						
2 Quad Gate System with CWT	LS	$250,000.00	0	$0.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	1	$350,000.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00	1	$30,000.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$9,900		$9,900
20% Contingency on Roadway Costs				$11,880		$11,880
20% Engineering Cost on Roadway Costs				$14,256		$14,256
Crossing Signal Costs				**$350,000**		**$280,000**
Roadway Costs				**$14,256**		**$14,256**
Total Cost:				**$364,256**		**$294,256**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	2nd Street Option 1 Wayside Horns Quantity	2nd Street Option 1 Wayside Horns Cost	2nd Street Option 2 Close Crossing Quantity	2nd Street Option 2 Close Crossing Cost
Roadway Costs						
Mobilization (10% of Roadway Costs)	LS	Varies	1	$2,437.78	1	$3,758.89
Saw Pavement	LF	$9.00	0	$0.00	0	$0.00
Removal of Concrete	SY	$15.00	0	$0.00	0	$0.00
Removal of Bituminous Pavement	SY	$8.50	44	$377.78	122	$1,038.89
Removal of Curb & Gutter	LF	$10.00	0	$0.00	0	$0.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	0	$0.00
Curb	LF	$50.00	0	$0.00	0	$0.00
Concrete Median Pavement	SY	$65.00	0	$0.00	0	$0.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	40	$10,000.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	410	$22,550.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Crossing Signal Costs						
2 Quad Gate System with CWT	LS	$250,000.00	1	$250,000.00	0	$0.00
4 Quad Gate System with CWT	LS	$350,000.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	1	$30,000.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$26,816		$41,348
20% Contingency on Roadway Costs				$32,179		$49,617
20% Engineering Cost on Roadway Costs				$38,614		$59,541
Crossing Signal Costs				**$280,000**		**$0**
Roadway Costs				**$38,614**		**$59,541**
Total Cost:				**$318,615**		**$59,541**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	1st Street Option 1 Close Crossing Quantity	1st Street Option 1 Close Crossing Cost	1st Street Option 2 ASM/SSM Median Quantity	1st Street Option 2 ASM/SSM Median Cost	East Boulevard Option 1 SSM Medians Quantity	East Boulevard Option 1 SSM Medians Cost
Roadway Costs								
Mobilization (10% of Roadway Costs)	LS	Varies	1	$3,525.56	1	$2,990.23	1	$6,433.10
Saw Pavement	LF	$9.00	0	$0.00	216	$1,944.00	464	$4,176.00
Removal of Concrete	SY	$15.00	0	$0.00	0	$0.00	356	$5,333.33
Removal of Bituminous Pavement	SY	$8.50	89	$755.56	89	$755.56	0	$0.00
Removal of Curb & Gutter	LF	$10.00	0	$0.00	0	$0.00	30	$300.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	14	$277.78	83	$1,666.67
Curb	LF	$50.00	80	$4,000.00	200	$10,000.00	430	$21,500.00
Concrete Median Pavement	SY	$65.00	0	$0.00	45	$2,925.00	267	$17,355.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	300	$16,500.00	0	$0.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	1	$5,000.00	1	$5,000.00	1	$5,000.00
Crossing Signal Costs								
2 Quad Gate System with CWT	LS	$250,000.00	0	$0.00	1	$250,000.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	0	$0.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00	0	$0.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$38,781		$32,893		$70,764
20% Contingency on Roadway Costs				$46,537		$39,471		$84,917
20% Engineering Cost on Roadway Costs				$55,845		$47,365		$101,900
Crossing Signal Costs				**$0**		**$250,000**		**$250,000**
Roadway Costs				**$55,845**		**$47,365**		**$101,900**
Total Cost:				**$55,845**		**$297,366**		**$351,901**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	Maple Ave (South) Option 1 Wayside Horns Quantity	Option 1 Wayside Horns Cost	Option 2 Close Crossing Quantity	Option 2 Close Crossing Cost	Option 3 ASM Medians Quantity	Option 3 ASM Medians Cost
Roadway Costs								
Mobilization (10% of Roadway Costs)	LS	Varies	1	$900.00	1	$4,137.78	1	$2,219.97
Saw Pavement	LF	$9.00	0	$0.00	0	$0.00	132	$1,188.00
Removal of Concrete	SY	$15.00	0	$0.00	0	$0.00	0	$0.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	444	$3,777.78	44	$377.78
Removal of Curb & Gutter	LF	$10.00	0	$0.00	60	$600.00	0	$0.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	0	$0.00	7	$138.89
Curb	LF	$50.00	0	$0.00	180	$9,000.00	100	$5,000.00
Concrete Median Pavement	SY	$65.00	0	$0.00	0	$0.00	23	$1,495.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	0	$0.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	1	$2,500.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	300	$16,500.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	0	$0.00	1	$5,000.00	1	$5,000.00
Crossing Signal Costs								
2 Quad Gate System with CWT	LS	$250,000.00	1	$250,000.00	0	$0.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	0	$0.00	0	$0.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	1	$30,000.00	0	$0.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$9,900		$45,516		$24,420
20% Contingency on Roadway Costs				$11,880		$54,619		$29,304
20% Engineering Cost on Roadway Costs				$14,256		$65,542		$35,164
Crossing Signal Costs				**$280,000**		**$0**		**$250,000**
Roadway Costs				**$14,256**		**$65,542**		**$35,164**
Total Cost:				**$294,256**		**$65,543**		**$285,165**

Rapid City Quiet Zone Study
Planning-Level Cost Estimates

Description	Unit	Unit Cost	Maple Ave (North) Option 1 Quad Gates Quantity	Option 1 Quad Gates Cost	Maple Ave (North) Option 2 ASM Median Quantity	Option 2 ASM Median Cost
Roadway Costs						
Mobilization (10% of Roadway Costs)	LS	Varies	1	$900.00	1	$2,459.97
Saw Pavement	LF	$9.00	0	$0.00	132	$1,188.00
Removal of Concrete	SY	$15.00	0	$0.00	0	$0.00
Removal of Bituminous Pavement	SY	$8.50	0	$0.00	44	$377.78
Removal of Curb & Gutter	LF	$10.00	0	$0.00	40	$400.00
Aggregate Base Course CL 5	Ton	$20.00	0	$0.00	7	$138.89
Curb	LF	$50.00	0	$0.00	140	$7,000.00
Concrete Median Pavement	SY	$65.00	0	$0.00	23	$1,495.00
Narrow Bituminous Median	SY	$175.00	0	$0.00	0	$0.00
Sidewalk Concrete 4 IN	SY	$50.00	0	$0.00	0	$0.00
Traffic Control	LS	$5,000.00	1	$5,000.00	1	$5,000.00
Ornamental Fence (Barrier)	LF	$150.00	0	$0.00	0	$0.00
Jersey Barrier	LF	$250.00	0	$0.00	0	$0.00
Landscaping	LS	$2,500.00	0	$0.00	0	$0.00
Signs and Striping	LS	$4,000.00	1	$4,000.00	1	$4,000.00
Chain Link Fence	LF	$55.00	0	$0.00	0	$0.00
Concrete Crossing Material	LF	$2,000.00	0	$0.00	0	$0.00
Railroad Protective Liability Insurance	LS	$5,000.00	0	$0.00	1	$5,000.00
Crossing Signal Costs						
2 Quad Gate System with CWT	LS	$250,000.00	0	$0.00	1	$250,000.00
4 Quad Gate System with CWT	LS	$350,000.00	1	$350,000.00	0	$0.00
Wayside Horns (2 Horns)	LS	$30,000.00	0	$0.00	0	$0.00
1 Extra Vehicle Gate	LS	$50,000.00	0	$0.00	0	$0.00
Subtotal Cost for Roadway Costs				$9,900		$27,060
20% Contingency on Roadway Costs				$11,880		$32,472
20% Engineering Cost on Roadway Costs				$14,256		$38,966
Crossing Signal Costs				**$350,000**		**$250,000**
Roadway Costs				**$14,256**		**$38,966**
Total Cost:				**$364,256**		**$288,966**

Appendix C: Quiet Zone Risk Calculations

190261W MAPLE ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 007891	2700
Total trains: 4	8
Day through trains : 1	1
Total Switching Trains : 2	4
Number of main tracks: 1	1
Number of other tracks: 1	1
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 20	10
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190262D MAPLE AVE

Crossing Updated!

Present warn device: Crossbucks	Gates
Number of highway vehicles per day: 007891	2700
Total trains: 2	4
Day through trains : 0	2
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 30	30
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190263K EAST BOULEVARD

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 016500	11659
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 1	1
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 20	10
Number of highway lanes: 4	4
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190264S FIRST ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 002521	516
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 20	10
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190265Y SECOND ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 002272	790
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 10	10
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190266F THIRD ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 002487	2153
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 10	10
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190268U FIFTH ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 005343	18365
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 3	3
Urban(U.)/Rural(R.): U.Minor Arterial	U.Minor Arterial
Highways paved: Yes	Yes
Maximum timetable speed mph: 20	10
Number of highway lanes: 5	5
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190269B SIXTH ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 007418	3200
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 1	1
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 20	10
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190270V SEVENTH ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 005178	2200
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 20	10
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190271C MT RUSHMORE/8TH

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 010474	11498
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 20	10
Number of highway lanes: 5	5
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190272J WEST BLVD

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 010050	13509
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Collector	U.Collector
Highways paved: Yes	Yes
Maximum timetable speed mph: 10	10
Number of highway lanes: 4	4
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

190273R 11TH ST

Crossing Updated!

Present warn device: Flashing Lights	Gates
Number of highway vehicles per day: 000863	1706
Total trains: 4	4
Day through trains : 1	1
Total Switching Trains : 2	2
Number of main tracks: 1	1
Number of other tracks: 0	0
Urban(U.)/Rural(R.): U.Local	U.Local
Highways paved: Yes	Yes
Maximum timetable speed mph: 25	25
Number of highway lanes: 2	2
Number of years accident data: 5	5
Number of accidents in accident data years: 0	0
Wayside horn:	No
Pre-Existing SSM:	No

Print This Page

Home | **Help** | **Contact** | **logoff** cryan@srfconsulting.com

Cancel | Change Scenario: RAPID CITY_53180 ▼ | Continue

Create New Zone

Manage Existing Zones

Log Off

Crossing	Street	Traffic	Warning Device	Pre-SSM	SSM	Risk	
190261W	**MAPLE ST**	**2700**	**Gates**	0	0	7,083.87	MODIFY
190262D	**MAPLE AVE**	**2700**	**Gates**	0	0	7,239.10	MODIFY
190263K	**EAST BOULEVARD**	**11659**	**Gates**	0	0	15,797.08	MODIFY
190264S	**FIRST ST**	**516**	**Gates**	0	0	3,311.72	MODIFY
190265Y	**SECOND ST**	**790**	**Gates**	0	0	3,944.57	MODIFY
190266F	**THIRD ST**	**2153**	**Gates**	0	0	5,953.53	MODIFY
190268U	**FIFTH ST**	**18365**	**Gates**	0	0	19,262.87	MODIFY
190269B	**SIXTH ST**	**3200**	**Gates**	0	0	6,447.90	MODIFY
190270V	**SEVENTH ST**	**2200**	**Gates**	0	0	6,006.56	MODIFY
190271C	**MT RUSHMORE/8TH**	**11498**	**Gates**	0	0	20,484.32	MODIFY
190272J	**WEST BLVD**	**13509**	**Gates**	0	0	18,233.14	MODIFY
190273R	**11TH ST**	**1706**	**Gates**	0	0	4,981.73	MODIFY

Step by Step Instructions:

Step 1: To specify New Warning Device (For Pre-Rule Quiet Zone Only) and/or SSM, click the MODIFY Button

Step 2: Select proposed warning device or SSM. Then click the UPDATE button.To generate a spreadsheet of the values on this page, click on ASM button—This spreadsheet can then be used for ASM calculations.

Step 3: Repeat Step (2) until the SELECT button is shown at the bottom right side of this page. Note that the SELECT button is shown ONLY when the Quiet Zone Risk Index falls below the NSRT or the Risk Index with Horn.

Step 4: To save the scenario and continue, click the SELECT button

* Only Public At Grade Crossings are listed.

Click for Supplementary Safety Measures [SSM]

Click for ASM spreadsheet: **ASM** * Note:The use of ASMs requires an application to and approval from the FRA.

Summary	
Proposed Quiet Zone:	RAPID CITY 2018-08-08
Type:	New 24-hour QZ
Scenario:	RAPID CITY_53180
Estimated Total Cost:	$0.00
Nationwide Significant Risk Threshold:	14723 .00
Risk Index with Horns:	5932.57
Quiet Zone Risk Index:	**9895.53**

Select

Baseline: Signal Upgrades Only

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI	Option	Improvement Summary	Signal Costs	Roadway Costs
190273R	11TH ST	4,982	2,987	0.000	4,982	0	Signals Only	$ 250,000	$ -
190272J	WEST BLVD	18,233	10,931	0.000	18,233	0	Signals Only	$ 250,000	$ -
190271C	MT RUSHMORE/8TH	20,484	12,281	0.000	20,484	0	Signals Only	$ 250,000	$ -
190270V	SEVENTH ST	6,007	3,601	0.000	6,007	0	Signals Only	$ 250,000	$ -
190269B	SIXTH ST	6,448	3,866	0.000	6,448	0	Signals Only	$ 250,000	$ -
190268U	FIFTH ST	19,263	11,548	0.000	19,263	0	Signals Only	$ 800,000	$ -
190266F	THIRD ST	5,954	3,569	0.000	5,954	0	Signals Only	$ 250,000	$ -
190265Y	SECOND ST	3,945	2,365	0.000	3,945	0	Signals Only	$ 250,000	$ -
190264S	FIRST ST	3,312	1,985	0.000	3,312	0	Signals Only	$ 250,000	$ -
190263K	EAST BOULEVARD	15,797	9,471	0.000	15,797	0	Signals Only	$ 250,000	$ -
190261W	MAPLE ST	7,084	4,247	0.000	7,084	0	Signals Only	$ 250,000	$ -
			6,077		**10,137**			**$ 3,300,000**	**$ -**
				NSRT	**14,723**				
				RIWH	**6,077**				
				QZRI	**10,137**	1.67 (QZRI / RIWH)	**TOTAL**	**$**	**3,300,000**

Scenario 1: High Safety

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI	Option	Improvement Summary	Signal Costs	Roadway Costs
190273R	11TH ST	4,982	2,987	0.770	1,146	1	4-Quad Gates	$ 350,000	$ 14,256
190272J	WEST BLVD	18,233	10,931	0.800	3,647	2	ASM Medians (Extend Existing)	$ 300,000	$ 57,820
190271C	MT RUSHMORE/8TH	20,484	12,281	0.785	4,404	2	3-Quad Gates	$ 300,000	$ 65,305
190270V	SEVENTH ST	6,007	3,601	0.770	1,382	1	4-Quad Gates	$ 350,000	$ 98,208
190269B	SIXTH ST	6,448	3,866	0.770	1,483	1	4-Quad Gates	$ 350,000	$ 38,886
190268U	FIFTH ST	19,263	11,548	0.500	9,631	2	ASM Medians	$ 800,000	$ 61,804
190266F	THIRD ST	5,954	3,569	0.770	1,369	1	4-Quad Gates	$ 350,000	$ 14,256
190265Y	SECOND ST					1	Wayside Horns	$ 280,000	$ 38,614
190264S	FIRST ST	3,312	1,985	0.400	1,987	2	ASM Medians	$ 250,000	$ 47,365
190263K	EAST BOULEVARD	15,797	9,471	0.800	3,159	1	ASM Medians	$ 250,000	$ 101,900
190261W	MAPLE ST	7,084	4,247	0.333	4,723	3	ASM Medians	$ 250,000	$ 35,164
			6,449		**3,293**			**$ 3,830,000**	**$ 573,578**
				NSRT	**14,723**				
				RIWH	**6,449**				
				QZRI	**3,293**	0.51 (QZRI / RIWH)	**TOTAL**	**$**	**4,403,578**

Scenario 2: Cost-Effective (Without Closures)

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI	Option	Improvement Summary	Signal Costs	Roadway Costs
190273R	11TH ST	4,982	2,987	0.000	4,982	0	Signals Only	$ 250,000	$ -
190272J	WEST BLVD	18,233	10,931	0.800	3,647	2	ASM Medians (Extend Existing)	$ 300,000	$ 57,820
190271C	MT RUSHMORE/8TH	20,484	12,281	0.785	4,404	2	3-Quad Gates	$ 300,000	$ 65,305
190270V	SEVENTH ST	6,007	3,601	0.000	6,007	0	Signals Only	$ 250,000	$ -
190269B	SIXTH ST	6,448	3,866	0.770	1,483	1	4-Quad Gates	$ 350,000	$ 38,886
190268U	FIFTH ST	19,263	11,548	0.000	19,263	0	Signals Only	$ 800,000	$ -
190266F	THIRD ST	5,954	3,569	0.000	5,954	0	Signals Only	$ 250,000	$ -
190265Y	SECOND ST	3,945	2,365	0.000	3,945	0	Signals Only	$ 250,000	$ -
190264S	FIRST ST	3,312	1,985	0.000	3,312	0	Signals Only	$ 250,000	$ -
190263K	EAST BOULEVARD	15,797	9,471	0.800	3,159	1	ASM Medians	$ 250,000	$ 101,900
190261W	MAPLE ST	7,084	4,247	0.000	7,084	0	Signals Only	$ 250,000	$ -
			6,077		**5,749**			**$ 3,500,000**	**$ 263,910**
				NSRT	**14,723**				
				RIWH	**6,077**				
				QZRI	**5,749**	0.95	(QZRI / RIWH)	**TOTAL**	**$ 3,763,910**

Scenario 3: Cost-Effective (With Closures)

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI	Option	Improvement Summary	Signal Costs	Roadway Costs
190273R	11TH ST	4,982	2,987	0.000	4,982	0	Signals Only	$ 250,000	$ -
190272J	WEST BLVD	18,233	10,931	0.800	3,647	2	ASM Medians (Extend Existing)	$ 300,000	$ 57,820
190271C	MT RUSHMORE/8TH	20,484	12,281	0.785	4,404	2	3-Quad Gates	$ 300,000	$ 65,305
190270V	SEVENTH ST	6,007	3,601	0.000	6,007	0	Signals Only	$ 250,000	$ -
190269B	SIXTH ST	6,448	3,866	1.000	-	2	Closure/Pedestrian Conversion	$ -	$ 82,606
190268U	FIFTH ST	19,263	11,548	0.000	19,263	0	Signals Only	$ 800,000	$ -
190266F	THIRD ST	5,954	3,569	0.000	5,954	0	Signals Only	$ 250,000	$ -
190265Y	SECOND ST	3,945	2,365	0.000	3,945	0	Signals Only	$ 250,000	$ -
190264S	FIRST ST	3,312	1,985	0.000	3,312	0	Signals Only	$ 250,000	$ -
190263K	EAST BOULEVARD	15,797	9,471	0.800	3,159	1	ASM Medians	$ 250,000	$ 101,900
190261W	MAPLE ST	7,084	4,247	0.000	7,084	0	Signals Only	$ 250,000	$ -
			6,077		**5,614**			**$ 3,150,000**	**$ 307,630**
				NSRT	**14,723**				
				RIWH	**6,077**				
				QZRI	**5,614**	0.92	(QZRI / RIWH)	**TOTAL**	**$ 3,457,630**

Scenario 4: Core Downtown Crossings Only

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI	Option	Improvement Summary	Signal Costs	Roadway Costs
190273R	11TH ST								
190272J	WEST BLVD								
190271C	MT RUSHMORE/8TH	20,484	12,281	0.785	4,404	2	3-Quad Gates	$ 300,000	$ 65,305
190270V	SEVENTH ST	6,007	3,601	0.000	6,007	0	Signals Only	$ 250,000	$ -
190269B	SIXTH ST	6,448	3,866	0.000	6,448	0	Signals Only	$ 250,000	$ -
190268U	FIFTH ST	19,263	11,548	0.500	9,631	2	ASM Medians	$ 800,000	$ 61,804
190266F	THIRD ST								
190265Y	SECOND ST								
190264S	FIRST ST								
190263K	EAST BOULEVARD								
190261W	MAPLE ST								
			7,824		**6,623**			**$ 1,600,000**	**$ 127,109**
				NSRT	**14,723**				
				RIWH	**7,824**				
				QZRI	**6,623**	0.85	(QZRI / RIWH)	**TOTAL**	**$ 1,727,109**

Scenario 5: Phased Implementation

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI		Option	Improvement Summary	Signal Costs	Roadway Costs
190273R	11TH ST	4,982	2,987	0.000	4,982		0	Signals Only	$ 250,000	$ -
190272J	WEST BLVD	18,233	10,931	0.800	3,647		2	ASM Medians (Extend Existing)	$ 300,000	$ 57,820
			6,959		**4,315**				**$ 550,000**	**$ 57,820**
				NSRT	**14,723**					
				RIWH	**6,959**					
				QZRI	**4,315**	0.62	(QZRI / RIWH)	**TOTAL**		**$ 607,820**

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI		Option	Improvement Summary	Signal Costs	Roadway Costs
190271C	MT RUSHMORE/8TH	20,484	12,281	0.785	4,404		2	3-Quad Gates	$ 300,000	$ 65,305
190270V	SEVENTH ST	6,007	3,601	0.000	6,007		0	Signals Only	$ 250,000	$ -
190269B	SIXTH ST	6,448	3,866	0.000	6,448		0	Signals Only	$ 250,000	$ -
190268U	FIFTH ST	19,263	11,548	0.500	9,631		2	ASM Medians	$ 800,000	$ 61,804
			7,824		**6,623**				**$ 1,600,000**	**$ 127,109**
				NSRT	**14,723**					
				RIWH	**7,824**					
				QZRI	**6,623**	0.85	(QZRI / RIWH)	**TOTAL**		**$ 1,727,109**

Crossing	Street	Baseline QZRI	RIWH	Eff. of New ASM	Final QZRI		Option	Improvement Summary	Signal Costs	Roadway Costs
190266F	THIRD ST	5,954	3,569	0.770	1,369		1	4-Quad Gates	$ 350,000	$ 14,256
190265Y	SECOND ST	3,945	2,365	0.000	3,945		0	Signals Only	$ 250,000	$ -
190264S	FIRST ST	3,312	1,985	0.000	3,312		0	Signals Only	$ 250,000	$ -
190263K	EAST BOULEVARD	15,797	9,471	0.800	3,159		1	ASM Medians	$ 250,000	$ 101,900
190261W	MAPLE ST	7,084	4,247	0.333	4,723		3	ASM Medians	$ 250,000	$ 35,164
			4,327		**3,302**				**$ 1,350,000**	**$ 151,321**
				NSRT	**14,723**					
				RIWH	**4,327**					
				QZRI	**3,302**	0.76	(QZRI / RIWH)	**TOTAL**		**$ 1,501,321**