THE UNIVERSITY OF IOWA
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FOR SUSTAINABLE COMMUNITIES

Pennsylvania Avenue Complete Streets Design Alternatives, Mason City IA

Completed by: Tony Hemann, Jake Cooke, Jeff Crone
May 2018

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Course Name: Project Design & Management
Department of Civil & Environmental Engineering

In partnership with
The City of Mason City

City of MASON CITY IOWA

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MASON CITY COMPLETE STREETS DESIGN

Hawkeye Design

The University of Iowa

Final Submission – May 8, 2018

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I – Executive Summary

Hawkeye Design is pleased to submit this report detailing design options for a Complete Street Corridor Redesign of Pennsylvania Avenue in Mason City, Iowa. Hawkeye Design, located in Iowa City, Iowa, includes three senior transportation engineering students at the University of Iowa. Each having a unique background of both internship and classroom experience, these students bring to this design extensive background information and design expertise.

The project area includes seven blocks of Pennsylvania Avenue, from Willow Creek to the south to 4th Street NE to the north. By incorporating multi-modal Complete Street features, such as dedicated bike lanes, improved pedestrian crossings, and traffic calming measures, Pennsylvania Avenue will become more accessible for all citizens. Mason City has already committed to multi-modal transportation methods by establishing numerous bicycle routes throughout the city; a Complete Street design of Pennsylvania Avenue only compliments that commitment.

Hawkeye Design is presenting in this report three Design Alternatives. All alternatives incorporate several design features, such as replacement of the existing pavement surface, replacement of aged street light luminaires, and removal of the traffic signal at the East State Street intersection. Alternative One, the *Economical Street*, is a simplified Complete Street design, not modifying any curb lines or street widths. High visibility pedestrian crosswalks at each intersection, as well as shared bike lane signs and street markings are integral items in Alternative One.

Alternative Two, the *Charming Street*, incorporates the high visibility pedestrian crossings and shared bike lane markings of Alternative One but modifies each intersection throughout the project area using a modified bioswale bump-out. These bump-outs extend the sidewalk into the street, reducing the pedestrian crossing distance. These bump-outs also reduce vehicle speed throughout the corridor, further increasing pedestrian safety.

Alternative Three, the *Complete Street*, incorporates the high visibility pedestrian crossings and bump-outs from Alternative Two but includes a dedicated bike lane in each direction. Removing bicyclists from the vehicular travel lane not only reduces congestion and traffic for motorists, but promotes bicycle ridership along the corridor. Studies show that amateur riders prefer separated bike lanes when utilizing on-street facilities ("Commuting by Bicycle: An Overview of the Literature"). As the Mason City bike routes that run along Pennsylvania Avenue are centered more for pleasure rides than commuting rides, enticing amateur riders to utilize the corridor is a definite advantage to installing dedicated bike lanes.

While Mason City provided a budget of $950,000 for this project, all alternatives fall well below the target. Alternative One, the *Economical Street*, is the least expensive with a total at $437,000. Alternative Two, the *Charming Street* with the addition of bump-outs, is the most expensive, with a total at $636,700. Alternative Three, the *Complete Street* with the dedicated bike lanes, has a total at $620,000.

While all three alternatives are fully designed for Mason City's discretion, Hawkeye Design suggests completion of Alternative Three, the Complete Street. This Alternative best utilizes existing space to promote multi-modal usage and support the existing bicycle trail network. It also enhances pedestrian safety by reducing the crossing distances at each intersection and decreasing vehicular speed throughout the corridor. On-street parking is reduced in the Complete Street alternative, but the effects of this reduction will be minimal. While each alternative is a complete design, only Alternative Three represents a Complete Street.

II – Organization Qualifications and Experience

Name of Organization: Hawkeye Design
Organization Location: 103 S. Capitol St., Iowa City, IA 52242

Contact Information:
Project Manager (PM): Tony Hemann
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Organization and Design Team Description, and Previous Experience

The Hawkeye Design team consists of three civil engineering students in the capstone design class at the University of Iowa. All three students are specializing in transportation engineering. The Complete Streets design of Pennsylvania Ave. in Mason City was a cross-disciplinary effort, requiring analysis from numerous areas of civil engineering and urban design. Each team member has a unique course and internship background that provides a comprehensive overview of the project components.

Tony Hemann is a senior transportation engineering student from Charles City, Iowa. Using knowledge from his past internship experience at Heartland Asphalt in Mason City, Tony was responsible for materials selection and pricing, quantity estimation, and construction phasing. Tony evaluated the intersection of Pennsylvania Ave. and E. State St. and conducted a warrant analysis to determine if a traffic signal is still required. Tony also performed a storm water runoff analysis of the entire project to determine anticipated runoff capacity needs in the storm sewer system.

Jake Cooke is a senior transportation engineering student from Tinley Park, Illinois. Using experience from his past internships, Jake was the primary draftsman for this project. He first drafted the existing conditions from hand sketches and maps provided by Mason City. He then performed GIS analysis using ESRI ArcGIS to produce an elevation surface as the basis for our Civil 3D model, before drafting the proposed alternatives and improvements into the final drawing sets.

Jeff Crone is a senior transportation engineering student originally from rural Washington, Iowa. While in school he completed an urban planning class called Transportation and Land Use Planning, which discussed urban design and complete streets amongst other topics. Using this information, Jeff was responsible for designing the street usage alternatives and drafted the layout of proposed bicycle and pedestrian facilities improvements. Jeff was also the report editor and designed the 3D renderings included in this report and accompanying poster and presentation.

III – Proposed Services

The proposed project area is seven blocks of Pennsylvania Ave. between Willow Creek to the south and 4th St. NE to the north in Mason City, Iowa. The southern and northernmost blocks are zoned General Urban district currently with residential structures. The middle three blocks are zoned Central Business District currently with main-street businesses and churches. Pennsylvania Ave. is a traditional urban street that is a variable width between 38 and 52 feet and includes two through-lanes and parallel parking in each direction. Current traffic control includes a signalized intersection at E. State St. and a four way stop at 1st St. NE, 2nd St. NE, 3rd St. NE, and 4th St. NE. As of 2013, there is an average of 3,587 vehicles on the route per day with weekly half-hour bus service. There are also three bike routes that utilize at least part of the corridor. Bicycles currently share the roadway with vehicular traffic.

Physically Pennsylvania Ave. has an aged Hot Mix Asphalt (HMA) layer overlaying the original PCC pavement. Street widths and curb lines vary throughout the project, suggesting a patchwork method of street expansion throughout the last 80 years. Some areas of Pennsylvania Ave. are 39 feet wide, while conversely one block is in excess of 55 feet in width. Many intersections exhibit a form of bump-out, featuring non-conforming curve radii and ineffective pedestrian shelters for crossing. The street lights along the corridor appear aged and in poor repair. From information from Mason City, all street lights originally were powered from underground cabling. However over time these cables and conduits have ceased functioning, requiring a scattered number of streetlight to be powered by unsightly above-ground electrical cables. The only traffic signal at the E. State St. intersection is a timed two-cycle signal with an obsolete corner post design.

The City of Mason City is interested in a rejuvenation and redesign of Pennsylvania Ave. incorporating Complete Streets design criteria. Improving access for non-vehicular uses, including bicycles and pedestrians, is a cornerstone of any Complete Streets design. With the Mason City Public Library and Music Man Square located at the southern end of the project area, Main Street business in the central area of the project, and churches and other community centers at the northern end, there is a clear reason to increase the pedestrian vitality of the street. With the incorporation of new bike routes throughout the city Mason City has committed to alternate forms of transportation. The Complete Street redesign of Pennsylvania Ave. is another component in that commitment.

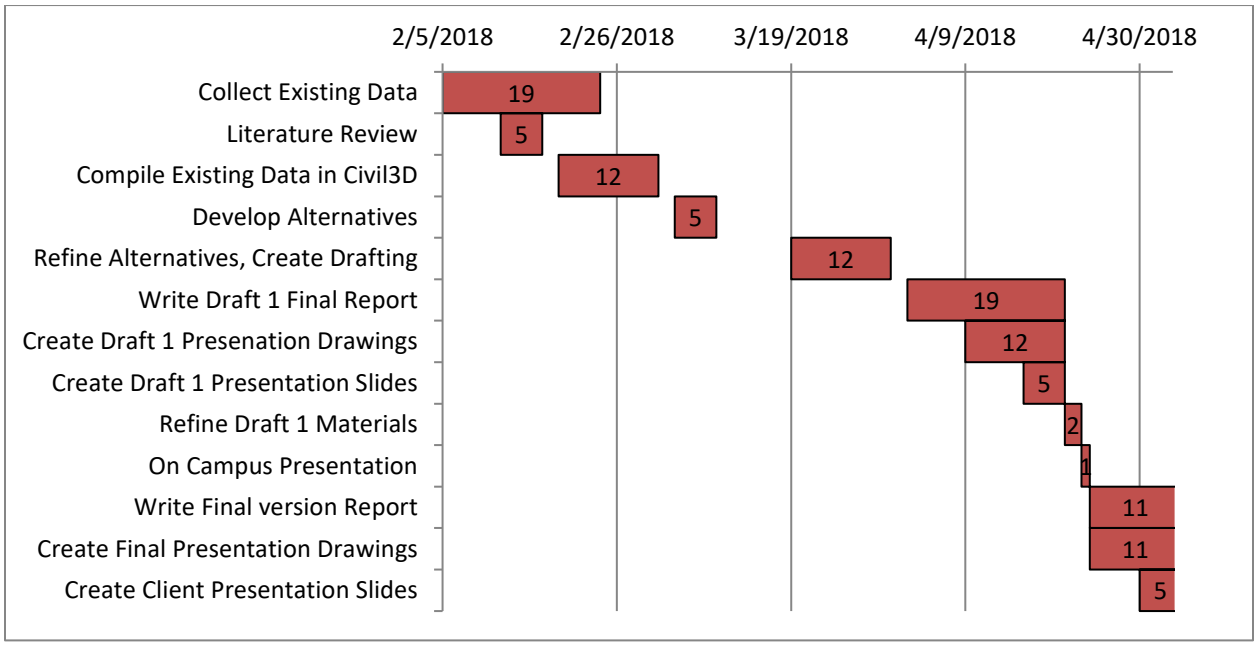
Hawkeye Design is providing the City of Mason City a complete redesign of Pennsylvania Ave. throughout the study area, including:

- Design inclusive of multi-modal use
- Design plan view and cross-sections
- Resurfacing and pavement marking design
- Surface runoff computation
- Construction phasing
- Pedestrian safety enhancements, including sidewalk repair information
- Improved bicycle facilities
- Traffic control evaluation of existing traffic signal at E. State St. intersection
- Traffic control evaluation of 2nd St. SE intersection
- Construction cost estimate
- Presentation renderings and materials for Mason City usage

Work Plan

Work began upon acceptance of the RFP on February 5th, 2018, and was completed on May 7th, 2018. The significant design tasks, duration, and project member responsible for each task is listed below. Also displayed is a graphical representation of these tasks.

Date	**Dur** (days)	**Task**	**Task Lead**
2/5/18	1	Begin Design	
2/5/18 – 2/23/18	19	Collect Existing Data	All
2/13/18	**1**	**Site Meeting in Mason City**	All
2/12/18 – 2/16/18	5	Literature and Design Standard Review	Jeff
2/19/18 – 3/2/18	12	Compile Existing Data into Civil3D	Jake
3/5/18 – 3/9/18	5	Develop Alternatives	All
3/19/18 – 3/30/18	12	Refine Alternatives, Create Drafting	Tony, Jake
4/2/18 – 4/20/18	19	Report and Plan Drawing Production	All
4/21/18 – 4/26/18	6	Refine Draft Materials	All
4/26/18	**1**	**On Campus Presentation**	All
4/27/18 – 5/7/18	11	Revise Report and Plan Drawing Materials	All
5/7/18	**1**	**Final Client Presentation**	All



IV – Constraints, Challenges, and Impacts

Constraints

The constraints encountered during this project include the budget, street width, and needs of the client. Mason City provided Hawkeye Design with a budget of $950,000 to complete this project. However, upon completing the alternative designs, no alternative exceeds this budget figure. In fact, all three estimates are significantly less than budgeted.

The width of Pennsylvania Ave. varies throughout the project. To limit costs and impacts on neighboring businesses and residences, no street widths were increased. This constrained the amount of space available for bike lanes and on-street parking. Emphasized early in the project was the need to maintain as much on-street parking capacity as possible. Where space was available, parallel on-street parking was maintained with new bike facilities. Where space was not available, the eastern side of parallel parking was removed to allow for new dedicated bike lanes. The effects of parking removal are described in Appendix D.

Requests from Mason City were a final constraint on the project. Resurfacing the existing roadway was important to include in this project. Elderly citizens utilize the pedestrian facilities toward the northern end of the project area, so inclusion of safe crossings for slower walkers was also required. Finally, Mason City requested a warrant analysis of the traffic signal currently at the State St. and Pennsylvania Ave. intersection to determine if a signalized intersection was still necessary.

Challenges

The primary challenge facing this project is the curb-to-curb width of the existing right-of-way. Including a dedicated bike lane along the entire length of Pennsylvania Ave. will eliminate one direction of on-street parking on several blocks, conflicting with client desires. With this in mind, the three Alternatives present a variety of design options so the client can decide which direction is most appropriate.

Another challenge that faces this project are the proposed pedestrian bump-outs at each intersection in two of the alternatives. The bump-outs are new curb lines that extend the sidewalk into the street at each intersection, decreasing the length of exposed pedestrian crossing. Throughout the project area, storm-water inlets consistently exist on the corners of the intersections, either as curb inlets or grated inlets a few feet from the curb. A solid concrete bump-out design would directly conflict with these storm-water inlets. With no budget available for storm-sewer relocation, a traditional bump-out design would cause Pennsylvania Ave. to become an expensive and bike-friendly river at the first major storm. A detailed design description and images of the bump-outs and storm sewer inlets are included in Appendix C.

A final design challenge is construction phasing and maintaining access to residents and businesses along Pennsylvania Ave. during construction. All design alternatives limit the amount of phasing to keep construction costs low; however, due to limited access to homes, businesses, and the Music Man Square, the portion of Pennsylvania Ave. south of 2nd St. SE must be completed first before proceeding north to the rest of the project. A detailed construction phasing discussion is included in Appendix H.

Societal Impact

The Pennsylvania Ave. corridor includes diverse commercial and residential uses, with improvement to the street impacting each usage differently. By proposing an Alternative that reduces available on-street parking for certain blocks, some business, funeral homes, and churches may be negatively impacted. It is unlikely that residents along Pennsylvania Ave. will be negatively impacted by parking reduction. Conversely, the addition of a dedicated bike lane may increase bicycle ridership along the corridor, improving bike access for residents of Mason City.

A significant positive impact is increased pedestrian safety. All design alternatives have measures to increase pedestrian crossing safety, from highly visible pedestrian crossing paint to bump-outs. With an elderly care facility close to the north end of the project area, increasing pedestrian safety for slower elderly walkers will positively impact residents utilizing Pennsylvania Ave.

V – Proffer of Alternative Design Options

Hawkeye Design fully designed and engineered three Alternatives. These Alternatives are described in detail in the design details section. A general description and comparison of all alternatives is included in this section.

Design Criteria Included in all Alternatives

All Alternatives include improvements to the Pennsylvania Ave. corridor, including:

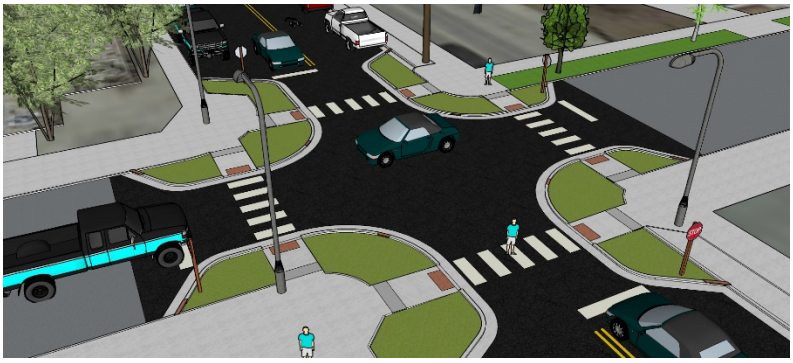
- Complete resurfacing of Pennsylvania Ave. in the project area.
- Removal of the traffic signal at the E. State St. intersection with a four-way stop as a replacement. See Appendix B for a full traffic report.
- Additional stop signs at the 2nd St. SE intersection on Pennsylvania Ave., making the intersection a four-way stop. See Appendix B for a full traffic report.
- Removal and replacement of new street lights.
- Replacement of underground wiring for street lights.
- Sidewalk repairs throughout the project area. See Appendix F.
- Pedestrian deterrent across from the Music Man Square entrance by the Mason City Public Library.

Alternative One – ***Economical Street***

Alternative One is the most basic model of a Complete Street design, adding value in street condition and function for various uses. No street widths are altered, and all parallel parking remains on every block. This alternative includes new pavement markings and signage for shared bicycle usage of the vehicle lanes, and improved pedestrian crossing safety features at every intersection in the project area.

Alternative One is the least expensive of the three alternatives, making it an attractive selection for the budget conscious. This Alternative also maintains on-street parking along all blocks of Pennsylvania Ave., a feature Mason City strongly desired to be maintained. However, while this alternative has new signage and shared bike lane paint markings, it lacks a dedicated bike lane. While new high visibility paint treatments demarcate pedestrian crossings at each intersection, all intersections still maintain long, exposed pedestrian crossing paths.

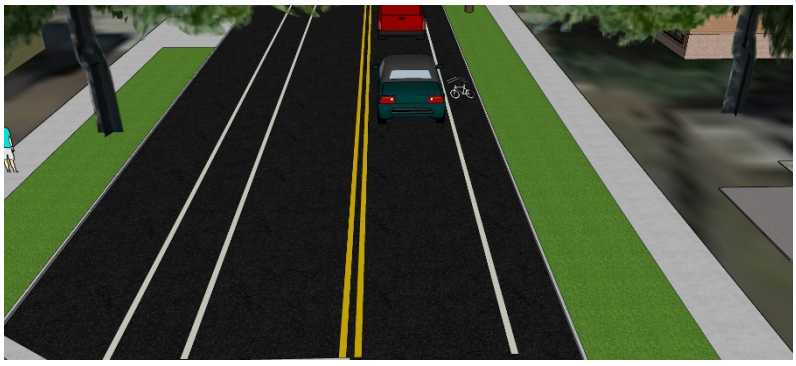
Alternative Two – ***Charming Street***



Alternative Two adds more Complete Street concepts by reducing the pedestrian crossing distance at all intersections in the project area. By utilizing the modified pedestrian bump-outs, crossing distances at each intersection will decrease from a variable width to a standardized 22 feet. Streets that had excess width are reduced to match streets elsewhere in the project. The crosswalks are painted with high visibility paint, and new signage and pavement markings for shared bicycle usage of the vehicle lanes promote alternative transportation methods.

Alternative Two enhances pedestrian safety at all intersections throughout the corridor. The physical change in the curb also promotes slower speeds and increases visibility of intersections to drivers. This Alternative also maintains all on-street parking along the corridor. This Alternative, however, is the most expensive and as in Alternative One, this Alternative has no dedicated bike lane, instead sharing bicycle and vehicle facilities in the same travel lane.

Alternative Three – ***Complete Street***



Alternative Three adds Complete Street design concepts across multi-modal transportation methods along the entire corridor. Utilizing the modified pedestrian bump-outs as in Alternative Two, the pedestrian crossing distances have decreased from a variable width to a standardized 32 feet across Pennsylvania Ave. and 22 feet across side streets. Streets that had excess width area reduced to match streets elsewhere in the project. The crosswalks are painted with high visibility paint for increased pedestrian visibility. This Alternative removes the east side of on-street parking along specific blocks for the addition of a dedicated bike lane in each direction. Parallel parking in both directions is maintained where space allows.

Alternative Three increases pedestrian safety by decreasing intersection crossing lengths. The Alternative increases bicycle safety by incorporating a dedicated bike lane in each direction along the entire length of the corridor. By removing bike traffic from the automobile travel lane,

both bicyclists and motorists will experience less conflict as they travel along Pennsylvania Ave. The major drawback to this Alternative is removal of parking. Removing parking is in conflict to directives provided by Mason City; with this in mind, a hybrid bike lane along one block is proposed. Details of this hybrid bike lane are discussed in the final design details section of this report.

Alternative Three is the recommended choice as it includes the most comprehensive Complete Street design. While the reduction in on-street parking certainly is a detriment, the mitigation efforts to reduce the negative impact during busy parking times should negate the drawback from having dedicated bike lanes along the corridor.

VI – Final Design Details

Design Criteria Included in all Alternatives

Complete Resurfacing of Pennsylvania Ave.

Pennsylvania Ave. consists of PCC Pavement with an HMA overlay. See Figure A1 in Appendix A for a cross-section of the current street. The HMA overlay is over 25 years old and in poor shape. Numerous utility projects since the last overlay has resulted in a mixture of surface pavements in varying conditions. Pavement rejuvenation was requested by Mason City and is an obvious component in this design.

Figure 1. Existing HMA pavement in poor condition

Figure 2. PCC pavements from utility work in poor condition

The HMA overlay will be removed to the original PCC pavement underneath, with an average 1.5 inch HMA overlay replacement. In areas where PCC is at surface elevation, two inches will be ground off to provide a consistent surface for the new HMA overlay. For calculation details regarding pavement scarification and new HMA and binder tonnage, see Table A1 of Appendix A.

Removal of Traffic Signal at East State Street

Traffic signals at E. State St. are aged and are no longer required with current traffic volumes. The traffic signals will be replaced by a four-way stop. A detailed traffic control report is included in Appendix B.

Additional Stop Signs at 2nd Street SE

Currently, the 2nd Street SE intersection is a two-way stop, with the minor street yielding to Pennsylvania Ave. While traffic volumes do not warrant the installation of a four-way stop, incorporating a stop for Pennsylvania Ave. traffic at this intersection will create a safer pedestrian crossing option. Details of this new stop control are included in the traffic control report in Appendix B.

Traffic Behavior Effects

The seven-block stretch of Pennsylvania Ave. was modeled using Trafficware Synchro software. The current delay per vehicle in the project area along Pennsylvania Ave. is 7.7 seconds. By removing the traffic signal at E. State St., per vehicle delay will decrease by 0.5 seconds to 7.2 seconds. With the addition of a new four-way stop at the 2nd St. SE intersection, per vehicle delay will increase to 7.9 seconds, only 0.2 seconds more than the delay under current conditions. As vehicular lane widths in all alternatives will be at minimum 11 feet, it is unlikely that vehicular users will experience any noticeable change in delay when utilizing Pennsylvania Ave. See Appendix B for a full traffic report.

Removal and Replacement of Street Lights

Street luminaires are aged and in poor quality, shown in Figure 3 on the following page. All street luminaires will be replaced with new, high-efficiency fixtures that aesthetically match fixtures found a block west on Delaware Street, shown in Figure 4 on the following page. The underground wiring conduits between fixtures require replacement and are included in the cost estimations.

Figure 3. Existing street light along Pennsylvania Ave. showing above ground wiring


Figure 4. Street light on Delaware Ave. as a template for new fixtures on Pennsylvania Ave.

Sidewalk Repairs

The sidewalks along Pennsylvania Avenue are generally in acceptable to good quality. Typical problems include misaligned joints and occasional cracking near driveways. A full sidewalk repair schedule is included in Appendix F.

Figure 5. Image of sidewalk requiring replacement.

Pedestrian Deterrent near Music Man Square

Mason City officials discussed a common problem towards the southern end of the project. The Music Man Square, a community center with events and daily children's music lessons, has no parking facilities of its own. Users of the facility typically park at the Mason City Public Library parking lot on the east side of Pennsylvania Ave. and cross midblock to the Music Man Square. This crossing poses a hazard as the available sight distances from northbound traffic prohibit a safe stopping distance at this crossing. Each design includes a decorative chain fence on the east side of Pennsylvania Ave. that extends south of the library entrance drive to the 2nd St. SE intersection to the north. The intent with this chain fence is to direct pedestrians north to the 2nd St. SE intersection for all crossings and forgo the convenient and typical midblock crossing. Details regarding this fence are included in Figure A2 in Appendix A. An image showing the fence location, as well as a rendering of the fence, are in Figures 6 and 7 on the following page.

Figure 6. Location of the pedestrian deterrent fence. The shoveled area in the grass shows how common it is for pedestrians to jaywalk.

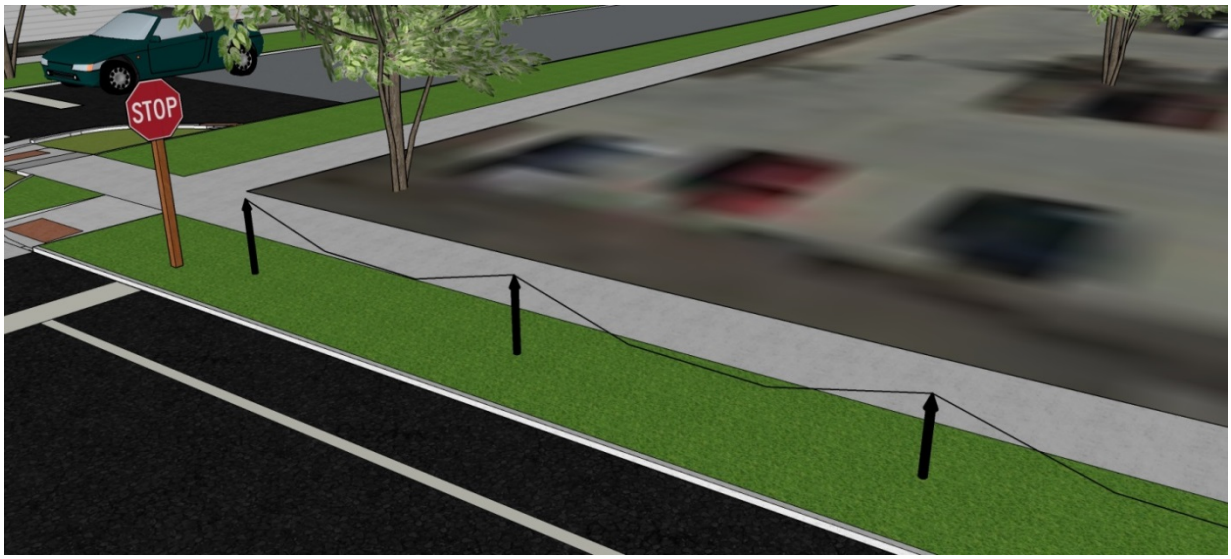


Figure 7. Rendering showing new pedestrian deterrent fence.

Enhanced Pedestrian Crossings

Crosswalks along Pennsylvania Ave. are currently demarked by two white lines that span the width of the street. While this type of demarcation is allowed by the Iowa SUDAS standards, their visibility to motorists is limited. In this Alternative, all pedestrian crossings will be painted with high visibility markings. Details on pedestrian crossings are found in Figure A3 in Appendix A.

Figure 8. Pedestrian crossings are difficult to see, especially in the winter.

Figure 9. Rendering of redesigned E. State St. intersection high visibility pedestrian crosswalks.

New Pavement Markings and Signage for Shared Bicycle Facilities

While this Alternative does not include a dedicated bike lane, new markings and signage showing that bicycles and automobiles must share the road are included and are an improvement to bicycle safety.

Figure 10. Rendering of Pennsylvania Ave. with new bicycle sharing paint symbols.

Figure 11. Share the road sign to be installed along Pennsylvania Ave.

Alternative Two Specific Criteria

Alternative Two incorporates specific criteria, as well as high visibility pedestrian crossing paint and bicycle share-the-road paint and signage from Alternative One.

Pedestrian Bump-out

Alternative Two reduces the intersection crossing distances by utilizing bump-outs at each corner of the intersections. The bump-outs constrict the available width to 22 feet in each direction for motorists and bicyclists. Pedestrian crossing distances significantly decrease by utilizing these bump-outs.

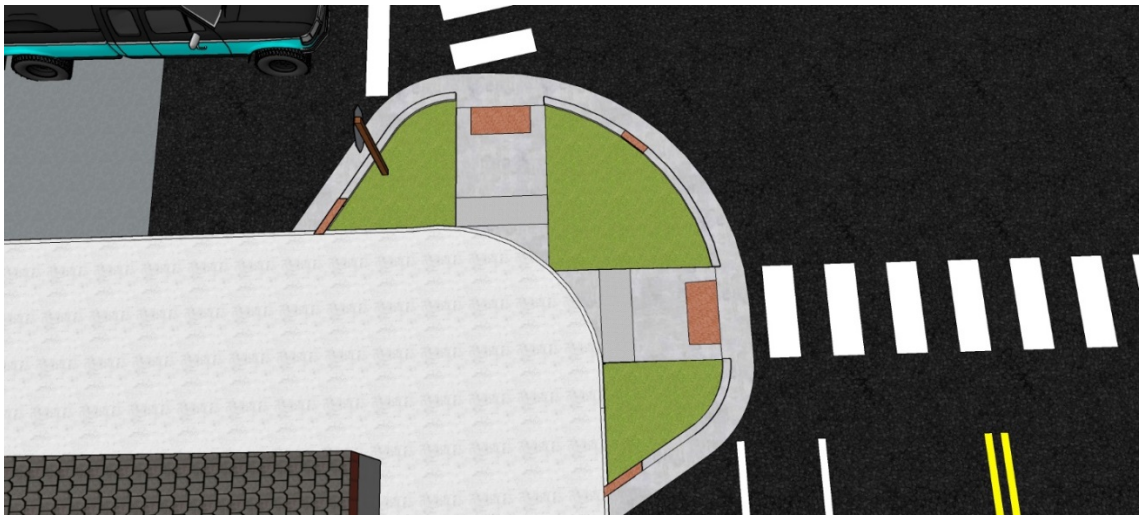


Figure 12. Rendering of a typical bump-out in Alternatives Two and Three. The curb is brought into the street to restrict the distance for motorists, sheltering pedestrians.

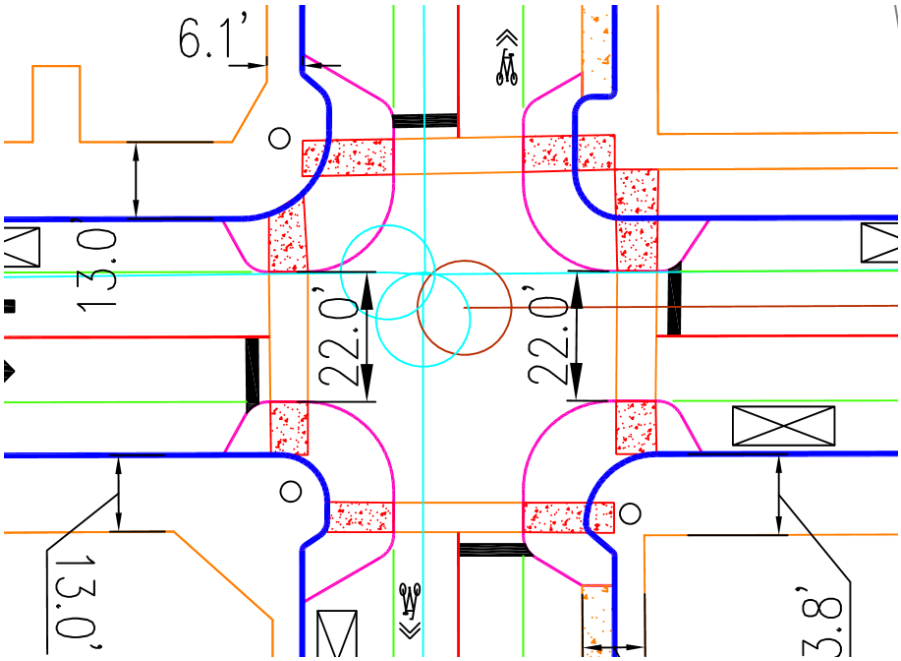


Figure 13. Plan drawing of the Pennsylvania Ave./E. State St. intersection with incorporation of the new pedestrian bump-outs. 11 foot lane widths are maintained throughout the intersection.

As briefly discussed in the challenges section of this report, at typical bump-out is a solid concrete extension of the sidewalk into the street at intersections. Along Pennsylvania Ave. storm water curb and street grating inlets are typically found in the corners of the intersections. As it is outside the scope of this design to relocate storm water facilities, the bump-outs have been modified to not impede storm water.

Figure 14. Typical location of storm water inlets are at corners of intersections. A traditional bump-out would impede these inlets.

A modified bioswale will be used in place of a solid bump-out design. A bioswale collects storm water for retention and filtration instead of allowing storm runoff to flow directly into the storm sewer. Typically bioswales have specific structures to drain excess storm water into the storm sewer system. See Appendix C for a typical bioswale cross section.

In Mason City, storm sewer inlets are not located on every corner, so there is not available drainage for every bump-out. With this consideration, a modified bioswaile will instead be used for these bump-outs. All bump-out areas will have existing pavements removed and excavated to subgrade elevations. A layer of geotextile fabric will be placed above the subgrade and against the existing pavement to prevent moisture from flowing from the new bioswale into the existing ground. Topsoil will be placed above the existing topsoil to street or inlet elevation, where grass and other plants will provide an added aesthetic. See Appendix C for modified Bioswale cross section and details.

The final bioswale bump-out will consist of a curb and gutter surrounding the outer perimeter, with grass and plantings filling the interior. Sidewalk crossing extension will extend through the bump-out where necessary. To not impede any street flows, curb cuts along the existing curb and towards the center of the street will allow water to flow through the bump-out. The result of the bump-out design is a structure that adds pedestrian protection without inhibiting any flow of storm water. See Appendix C for more details.

These bump-outs reduce unsheltered pedestrian crossing distances, providing easier crossings, especially for elderly, slower-moving residents. An elderly pedestrian currently takes 17 seconds to cross Pennsylvania Ave. at the State St. intersection; after the implementation of the bump-outs, an elderly pedestrian will need only eight seconds to cross, shown in Figure 16 on the following page. The bump-outs also, by narrowing the intersection geometry, slow traffic along the corridor increasing safety for all users. Narrow lane widths typically decrease traffic speeds and increase pedestrian safety ("Narrower Lanes, Safer Streets").

Figure 15. E. State St. Intersection from Alternative One with existing crossing and lane widths. The pedestrian crossing distance across Pennsylvania Avenue is in excess of 45 feet.

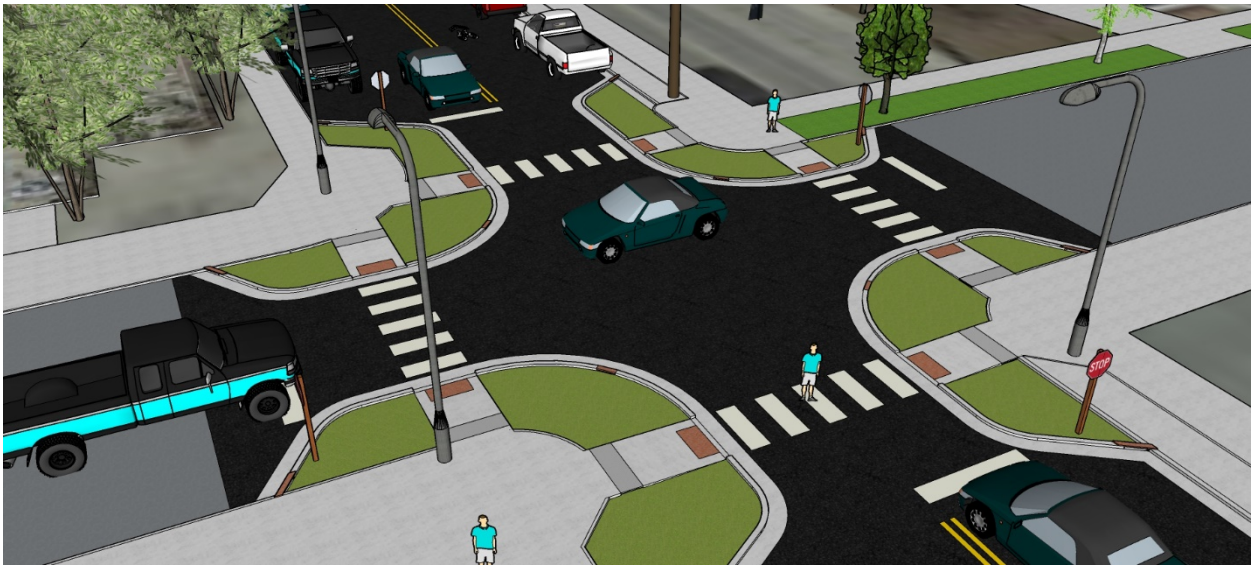


Figure 16. E. State St. Intersection in Alternative Two. Notice the reduced pedestrian crossing distances and reduced lane widths throughout the intersection. All pedestrian crossing distances have been reduced to 22 feet.

Decreasing Street Width

Pennsylvania Ave. from half a block south of E. State St. to 1st Street NE has excess width and is paved around utility poles. As these utility poles represent a hazard to motorists and are likely in violation of Iowa SUDAS Clear Zone standards, Alternative Two extends the curb away from the current sidewalk.

Figure 17. Curb not filled in along Pennsylvania Avenue, showing the potential hazard of the utility poles in the parking lane.

Figure 18. Curb filled in along Pennsylvania Avenue south of East State Street showing a new sidewalk surrounding the utility poles.

Alternative Three Specific Criteria

Alternative Three uses previously discussed designs including high visibility pedestrian crossings and pedestrian bump-outs. The bump-out dimensions in Alternative Three are slightly different than Alternative Two and are described in this section.

Dedicated Bike Lanes

Streets with traffic volumes higher than 3,000 ADT should incorporate dedicated bike lanes if bicycles are allowed on the street (Iowa SUDAS Section 5M-1, Complete Streets). Pennsylvania Ave. currently has over 3,500 ADT, allowing Alternative Three to include a dedicated bike lane. As Pennsylvania Ave. has varying widths throughout the seven block corridor, some blocks will experience impacts to on-street parking. From the southern end of the project to 1st St. SE, the east side of parallel parking is eliminated. From 1st St SE to 1st St NE, both sides of parallel parking are maintained. From 1st St NE to 2nd St. NE, a modified bike/parking lane is used, while north of 2nd St. NE the eastern side of parallel parking is again eliminated. Specific details regarding the anticipated impacts and mitigation efforts of parking removal is included in Appendix D. All blocks maintain one 11 foot travel lane in each direction and at least one 8 foot parking lane.

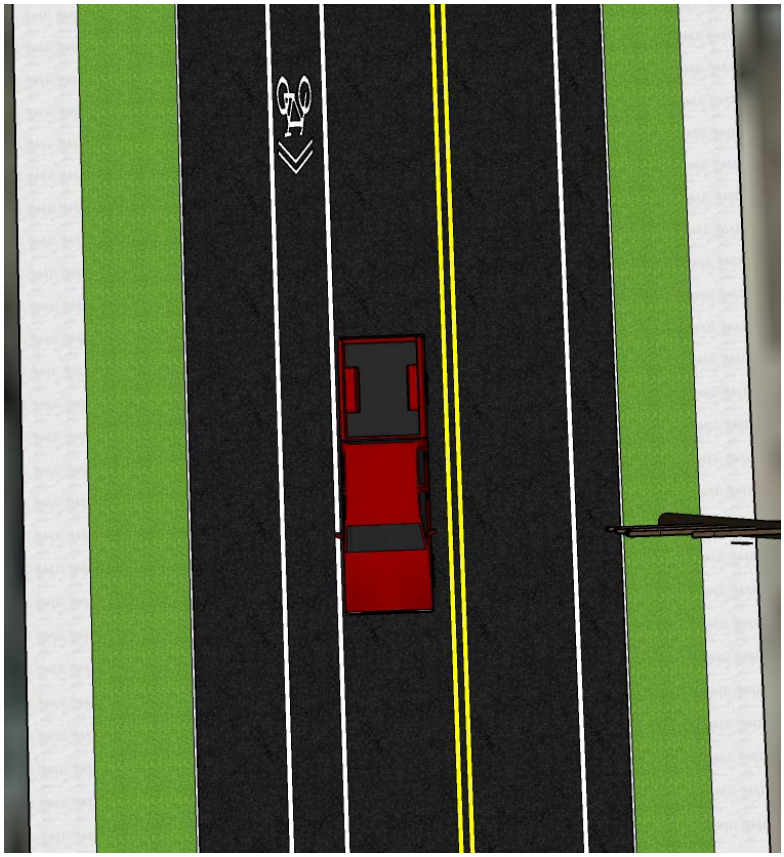


Figure 19. Rendering showing alignment with the eastern parking lane removed. Parking is maintained on the west side of the street, with a travel and bike lane in each direction.

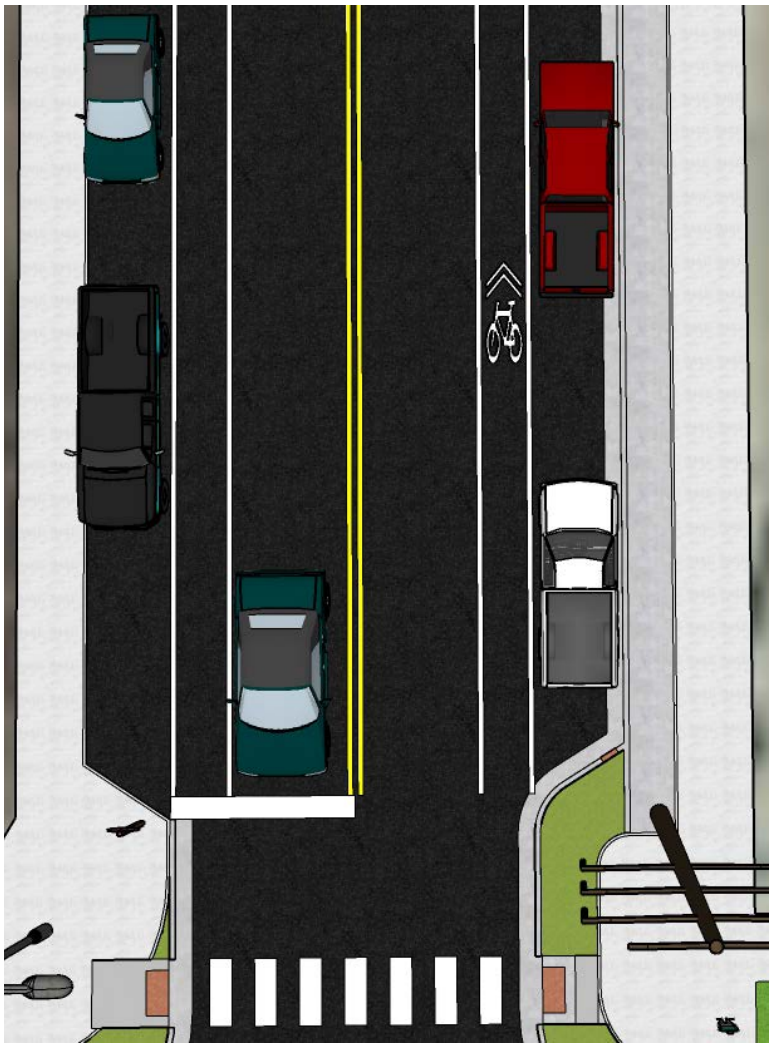


Figure 20. Rendering showing parking on both sides of the street with a travel and bike lane in each direction.

The block of Pennsylvania Ave. between 1st Ave. NE and 2nd Ave. NE will have a unique parking situation. The width of the street does not allow the full two lanes of parking along with bike and travel lanes. However, the northbound bike lane is wider than all other blocks, allowing vehicles to park in the lane during designated times. As the usage along that block is a church to the west and a funeral home to the east, permitted parking times are Sunday mornings and during funerals. This mitigates the loss of parking to these two organizations during their peak times of demand, and maintains the bike corridor throughout the rest of the week.

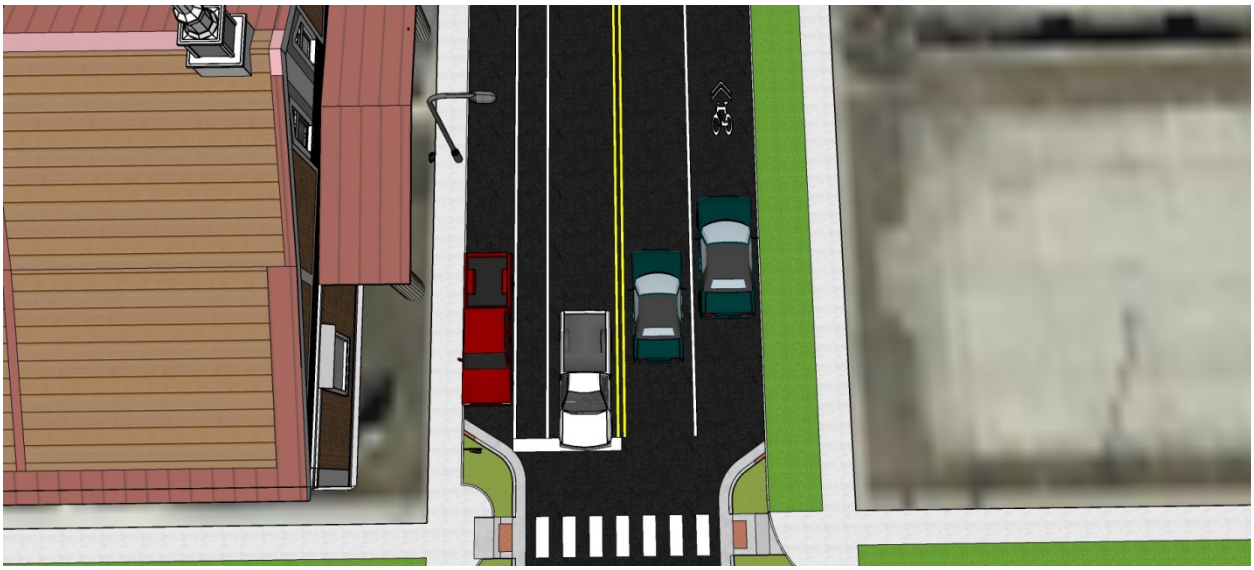


Figure 21. Rendering showing permitted parking in wide bike lane during designated times.

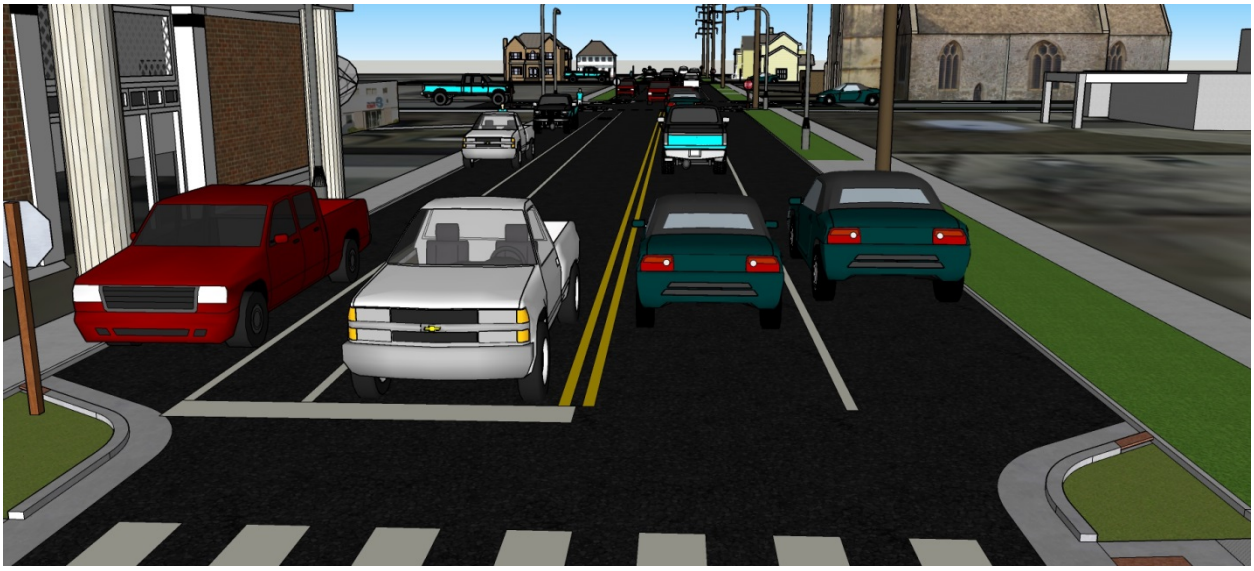


Figure 22. Rendering showing driver's viewpoint of wide bike lane with permitted parking during designated times.

Figure 23. Sunday only parking signs to be installed between 1st Ave. and 2nd Ave. NE.

Section VII – Engineer's Cost Estimate

This section contains estimated construction costs for each Alternative. For a detailed breakdown of each figure and price source information, see Appendix E.

Alternative One

Total: $437,000

PAY_ITEM	ITEM_DESCRIPTION	Unit	Unit Price	Quantity	Total Cost
2214-5145150	PAVEMENT SCARIFICATION	SY	$ 1.78	4960	$ 8,828.80
2303-1033500	HOT MIX ASPHALT STANDARD TRAFFIC, SURFACE COURSE, 1/2 IN. MIX, NO SPECIAL FRICTION REQUIREMENT	TN	$ 35.00	1171	$ 40,985.00
2303-1258344	ASPHALT BINDER, PG 58-34H, STANDARD TRAFFIC	TN	$ 475.00	70.26	$ 33,373.50
2525-0000120	REMOVAL OF TRAFFIC SIGNALIZATION	LS	$ 9,800.00	1	$ 9,800.00
2401-6745765	REMOVAL AND REINSTALL OF LIGHT POLE AND LUMINAIRE	EA	$ 6,000.00	17	$ 102,000.00
2511-6745900	REMOVAL SIDEWALK	SY	$ 8.95	720	$ 6,444.00
2511-7526006	SIDEWALK, P.C. CONCRETE, 6 IN	SY	$ 48.00	720	$ 34,560.00
2511-7526007	SIDEWALK, P.C. CONCRETE, PANELS	EA	$ 135.00	148	$ 19,980.00
2527-9263109	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CENTERLINE	LF	$ 0.34	4530	$ 1,540.20
2527-9263111	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, STOP BAR	LF	$ 2.80	601	$ 1,682.80
2527-9263112	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CROSS WALK	LF	$ 7.00	576.5	$ 4,035.50
2527-9263137	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 101.00	17	$ 1,717.00
2537-9374810	STREET LIGHT WIRING REPLACEMENT	LF	$ 11.90	1295	$ 15,410.50
2533-4980005	MOBILIZATION	LS	$ 25,500.00	1	$ 25,500.00
2526-8285000	CONSTRUCTION SURVEY	LS	$ 17,800.00	1	$ 17,800.00
	CONSTRUCTION SUBTOTAL				$ 323,657.30
	15% CONTINGENCY				$ 48,548.60
	20% ENGINEERING AND ADMINISTRATION				$ 64,731.46
				Grand Total	**$ 436,937.36**

Alternative Two

Total: $636,700

PAY_ITEM	ITEM_DESCRIPTION	Unit	Unit Price	Quantity	Total Cost
2102-2713090	EXCAVATION, CLASS 13, WASTE	CY	$ 8.00	400	$ 3,200.00
2105-8425005	TOPSOIL, FURNISH AND SPREAD	CY	$ 20.70	400	$ 8,280.00
2310-8300550	GEOTEXTILE FABRIC	SY	$ 2.16	1320	$ 2,851.20
2214-5145150	PAVEMENT SCARIFICATION	SY	$ 1.78	4960	$ 8,828.80
2303-1033500	HOT MIX ASPHALT STANDARD TRAFFIC, SURFACE COURSE, 1/2 IN. MIX, NO SPECIAL FRICTION REQUIREMENT	TN	$ 35.00	1083	$ 37,905.00
2303-1258344	ASPHALT BINDER, PG 58-34H, STANDARD TRAFFIC	TN	$ 475.00	64.98	$ 30,865.50
2525-0000120	REMOVAL OF TRAFFIC SIGNALIZATION	LS	$ 9,800.00	1	$ 9,800.00
2401-6745765	REMOVAL AND REINSTALL OF LIGHT POLE AND LUMINAIRE	EA	$ 6,000.00	17	$ 102,000.00
2511-6745900	REMOVAL SIDEWALK	SY	$ 8.95	720	$ 6,444.00
2511-7526006	SIDEWALK, P.C. CONCRETE, 6 IN	SY	$ 48.00	1425	$ 68,400.00
2511-7526007	SIDEWALK, P.C. CONCRETE, PANELS	EA	$ 135.00	78	$ 10,530.00
2512-1725156	CURB AND GUTTER, P.C. CONCRETE, 1.5 FT	LF	$ 23.00	1704	$ 39,192.00
2527-9263109	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CENTERLINE	LF	$ 0.34	4530	$ 1,540.20
2527-9263111	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, STOP BAR	LF	$ 7.00	345	$ 2,415.00
2527-9263112	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CROSS WALK	LF	$ 7.00	346.25	$ 2,423.75
2527-9263137	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 101.00	17	$ 1,717.00
2537-9374810	STREET LIGHT WIRING REPLACEMENT	LF	$ 11.90	1295	$ 15,410.50
2533-4980005	MOBILIZATION	LS	$ 102,000.00	1	$ 102,000.00
2526-8285000	CONSTRUCTION SURVEY	LS	$ 17,800.00	1	$ 17,800.00
	CONSTRUCTION Subtotal				$ 471,602.95
	15% CONTINGENCY				$ 70,740.44
	20% ENGINEERING AND ADMINISTRATION				$ 94,320.59
				Grand Total	**$ 636,663.98**

Alternative Three
Total: $620,000

PAY_ITEM	ITEM_DESCRIPTION	Unit	Unit Price	Quantity	Total Cost
2102-2713090	EXCAVATION, CLASS 13, WASTE	CY	$ 8.00	262	$ 2,096.00
2105-8425005	TOPSOIL, FURNISH AND SPREAD	CY	$ 20.70	262	$ 5,423.40
2310-8300550	GEOTEXTILE FABRIC	SY	$ 2.16	864.6	$ 1,867.54
2214-5145150	PAVEMENT SCARIFICATION	SY	$ 1.78	4960	$ 8,828.80
2303-1033500	HOT MIX ASPHALT STANDARD TRAFFIC, SURFACE COURSE, 1/2 IN. MIX, NO SPECIAL FRICTION REQUIREMENT	TN	$ 35.00	1109	$ 38,815.00
2303-1258344	ASPHALT BINDER, PG 58-34H, STANDARD TRAFFIC	TN	$ 475.00	67	$ 31,825.00
2401-6745765	REMOVAL AND REINSTALL OF LIGHT POLE AND LUMINAIRE	EA	$ 6,000.00	17	$ 102,000.00
2525-0000120	REMOVAL OF TRAFFIC SIGNALIZATION	LS	$ 9,800.00	1	$ 9,800.00
2511-6745900	REMOVAL SIDEWALK	SY	$ 8.95	720	$ 6,444.00
2511-7526006	SIDEWALK, P.C. CONCRETE, 6 IN	SY	$ 48.00	1359	$ 65,232.00
2511-7526007	SIDEWALK, P.C. CONCRETE, PANELS	EA	$ 135.00	78	$ 10,530.00
2512-1725156	CURB AND GUTTER, P.C. CONCRETE, 1.5 FT	LF	$ 23.00	1396	$ 32,108.00
2527-9263109	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CENTERLINE	LF	$ 0.34	4530	$ 1,540.20
2527-9263110	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, BIKE LANE EDGE MARKING	LF	$ 0.34	4530	$ 1,540.20
2527-9263111	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, STOP BAR	LF	$ 2.80	419	$ 1,173.20
2527-9263112	PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CROSS WALK	LF	$ 7.00	433	$ 3,031.00
2527-9263137	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 101.00	17	$ 1,717.00
2537-9374810	STREET LIGHT WIRING REPLACEMENT	LF	$ 11.90	1295	$ 15,410.50
2533-4980005	MOBILIZATION	LS	$ 102,000.00	1	$ 102,000.00
2526-8285000	CONSTRUCTION SURVEY	LS	$ 17,800.00	1	$ 17,800.00
	CONSTRUCTION SUBTOTAL				$ 459,181.84
	15% CONTINGENCY				$ 68,877.28
	20% ENGINEERING AND ADMINISTRATION				$ 91,836.37
				Grand Total	**$ 619,895.48**

Appendix A Materials

Existing Street Cross Section

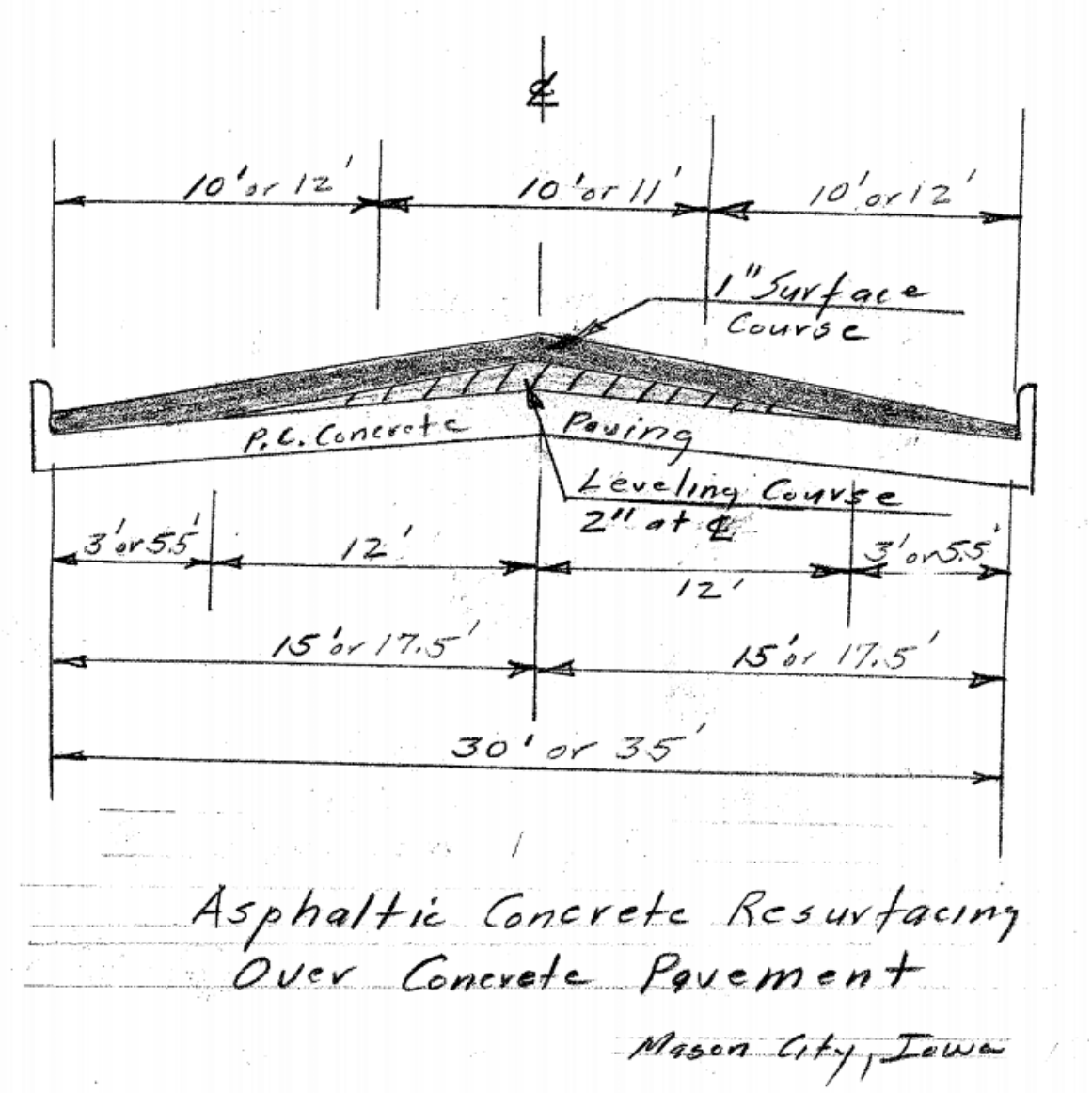


Figure A1. Existing pavement cross section for Pennsylvania Avenue

Asphalt Tonnage

The total area of new pavement of 133,839 square feet was calculated using Civil3D. See the SITE AERIAL on Sheet CS of the design packet for a visual representation of the area.

Area (ft^2)	Depth (ft)	Volume (ft^3)	Lbs / Ft^3	Total Tons
133,893	0.125	16,737	140	1,171

Table A1. Asphalt Tonnage Calculation

Asphalt weight source: "AASHTO Geometric Design of Streets and Highways" Table 3.5.1-1

Pedestrian Deterrent Fence

A decorative chain fence separating the sidewalk from the street will be installed by the Mason City Public Library. See DET3 of the design packet for the specific fence location and typical dimensions.

Figure A2. Decorative chain fence by the Music Man Square

Pedestrian Crossings

Crosswalks must be a minimum six feet wide and can be demarcated with lines parallel to traffic flow (Iowa SUDAS 3B-1 Pavement Marking Standards). The pavement markings in the Complete Street design are 6 feet long and 2 foot wide, alternating every other two feet, making a pattern as seen on the left side of Figure A3.

High visibility crosswalks have two potential drawbacks, the first being materials costs. To maintain the existing two-line crosswalk marking on the existing street widths requires $800 in materials. To upgrade the crosswalks to the suggested high-visibility pattern will require an additional $3,235 in materials. The second is the likely annual maintenance each spring. Snow plows will likely mar and remove the crosswalks, which will require repainting in the spring

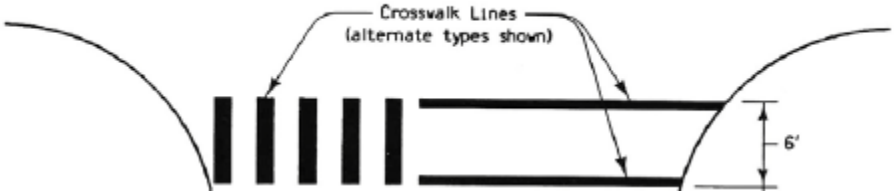


Figure A3. All high visibility crosswalk paint markings are similar in style to those seen on the left side of this example intersection.

Appendix B Traffic Report

Mason City, Iowa, is a moderately sized city in north central Iowa. In the eastern downtown district is Pennsylvania Ave., a north-south corridor that serves commercial, residential, and community uses within the downtown area. State St., and east-west street, bisects the downtown district and carries traffic from central downtown to Pennsylvania Ave. to the east. Currently the intersection of Pennsylvania Ave. and E. State St. utilizes a pre-timed, two-cycle traffic signal including pedestrian walk lights. The specific cycle timings are found in Table 1.

	Pennsylvania Ave. Green (sec)	State St. Green (sec)
Min Green	5	5
Max Green	10	15
Yellow	3.5	3.5
All Red	1.0	1.0
Walk	7	5
Ped Clearance	10	15
Split	27	33

Table B1. Current times at Pennsylvania Ave. / State St. intersection.

A warrant analysis was preformed using HCS 2010 software, finding that current traffic volumes no longer warrant a traffic signal. A full signal warrant report is included at the end of this Appendix. With a traffic signal no longer required, effects of a two and four way stop control at the E. State St. intersection were modeled on the entire Pennsylvania Ave. corridor using Trafficware Synchro software. With the difference in delay less than one second between the two control options, a four-way stop control will replace the traffic signal at E. State Street. This choice is for two reasons: maintain continuity with four-way stops at intersections to the north, and enhance pedestrian crossing safety at E. State St.

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.2
Total Delay (hr)	2.0
Total Del/Veh (s)	7.7
Stop Delay (hr)	1.1
Stop Del/Veh (s)	4.3

Figure B1. Current delay conditions in the project area along Pennsylvania Ave.

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.2
Total Delay (hr)	2.0
Total Del/Veh (s)	7.7
Stop Delay (hr)	1.1
Stop Del/Veh (s)	4.3

Figure B2. Option One: Pennsylvania Ave. performance two-way stop at E. State St. Total delay per vehicle is maintained at 7.7 seconds.

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.2
Total Delay (hr)	1.9
Total Del/Veh (s)	7.2
Stop Delay (hr)	0.8
Stop Del/Veh (s)	3.2

Figure B3. Option Two: Pennsylvania Ave. performance with four-way stop at E. State St. Total delay per vehicle is 7.2 seconds.

The intersection at 2nd St. SE is currently a two-way stop on the minor street. A warrant analysis was performed on that intersection with current traffic loads to determine if a four-way stop is warranted. A full warrant report is available at the end of this Appendix.

While the warrant analysis did not show need for a four-way stop at this intersection, Hawkeye Design recommends that it still be changed to a four-way stop, allowing for safer pedestrian crossings from the Mason City Public Library parking lot to destination on the east side of the street. By deterring pedestrian midblock jaywalking with a chain fence, making the 2nd St SE intersection more attractive to pedestrians will strengthen the change in pedestrian behavior.

Figure B4. Rendering showing new four-way stop control at the 2nd St. SE intersection

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.1
Total Delay (hr)	2.2
Total Del/Veh (s)	7.9
Stop Delay (hr)	1.0
Stop Del/Veh (s)	3.5

Figure B5. Pennsylvania Ave. performance with four-way stop at E. State St. and 2nd St. SE intersections. The total corridor delay per vehicle increases by 0.2 seconds per vehicle with the additional four-way stop at 2nd St. SE.

Warrants Summary

Information			
Analyst	Tony	Intersection	Penn & State
Agency/Co		Jurisdiction	
Date Performed	3/7/2018	Units	U.S. Customary
Project ID		Time Period Analyzed	
East/West Street	State Street	North/South Street	Pennsylvania Avenue
File Name	Warrants1.xhy	Major Street	East-West
Project Description			

General				Roadway Network	
Major Street Speed (mph)	25	☐	Population < 10,000	Two Major Routes	☐
Nearest Signal (ft)	0	☐	Coordinated Signal System	Weekend Count	☐
Crashes (per year)	0	☐	Adequate Trials of Alternatives	5-yr Growth Factor	0

Geometry and Traffic	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane usage		LTR			LTR			LTR			LTR	
Vehicle Volume Averages (vph)	0	132	0	0	132	0	0	98	0	0	148	0
Peds (ped/h) / Gaps (gaps/h)	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--
Delay (s/veh) / (veh-hr)	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--

Warrant 1: Eight-Hour Vehicular Volume	☐
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	☐
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	☐
1 (80%) Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 2: Four-Hour Vehicular Volume	☐
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 3: Peak Hour	☐
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--	☐
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 4: Pedestrian Volume	☐
4 A. Four Hour Volumes --or--	☐
4 B. One-Hour Volumes	☐
Warrant 5: School Crossing	☐
5. Student Volumes --and--	☐
5. Gaps Same Period	☐
Warrant 6: Coordinated Signal System	☐
6. Degree of Platooning (Predominant direction or both directions)	☐
Warrant 7: Crash Experience	☐
7 A. Adequate trials of alternatives, observance and enforcement failed --and--	☐
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--	☐
7 C. (80%) Volumes for Warrants 1A, 1B --or-- 4 are satisfied	☐

Warrant 8: Roadway Network	☐
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--	☐
8 B. Weekend Volume (Five hours total)	☐
Warrant 9: Grade Crossing	☐
9 A. Grade Crossing within 140 ft --and--	☐
9 B. Peak-Hour Vehicular Volumes	☐

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Warrants Summary

Information			
Analyst	Tony	Intersection	Penn & State
Agency/Co		Jurisdiction	
Date Performed	3/7/2018	Units	U.S. Customary
Project ID		Time Period Analyzed	
East/West Street	State Street	North/South Street	Pennsylvania Avenue
File Name	Warrants1 (2).xhy	Major Street	North-South

Project Description

General				Roadway Network	
Major Street Speed (mph)	25	☐	Population < 10,000	Two Major Routes	☐
Nearest Signal (ft)	0	☐	Coordinated Signal System	Weekend Count	☐
Crashes (per year)	0	☐	Adequate Trials of Alternatives	5-yr Growth Factor	0

Geometry and Traffic	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane usage		LTR			LTR			LTR			LTR	
Vehicle Volume Averages (vph)	0	64	0	0	64	0	0	115	0	0	171	0
Peds (ped/h) / Gaps (gaps/h)	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--
Delay (s/veh) / (veh-hr)	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--

Warrant 1: Eight-Hour Vehicular Volume	☐
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	☐
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	☐
1 (80%) Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 2: Four-Hour Vehicular Volume	☐
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 3: Peak Hour	☐
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--	☐
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	☐
Warrant 4: Pedestrian Volume	☐
4 A. Four Hour Volumes --or--	☐
4 B. One-Hour Volumes	☐
Warrant 5: School Crossing	☐
5. Student Volumes --and--	☐
5. Gaps Same Period	☐
Warrant 6: Coordinated Signal System	☐
6. Degree of Platooning (Predominant direction or both directions)	☐
Warrant 7: Crash Experience	☐
7 A. Adequate trials of alternatives, observance and enforcement failed --and--	☐
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--	☐
7 C. (80%) Volumes for Warrants 1A, 1B --or-- 4 are satisfied	☐

2nd St. SE Four Way Stop Warrant P. 1

Warrant 8: Roadway Network	☐
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--	☐
8 B. Weekend Volume (Five hours total)	☐
Warrant 9: Grade Crossing	☐
9 A. Grade Crossing within 140 ft --and--	☐
9 B. Peak-Hour Vehicular Volumes	☐

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Appendix C Bump-outs

Traditional Bioswale Cross Section

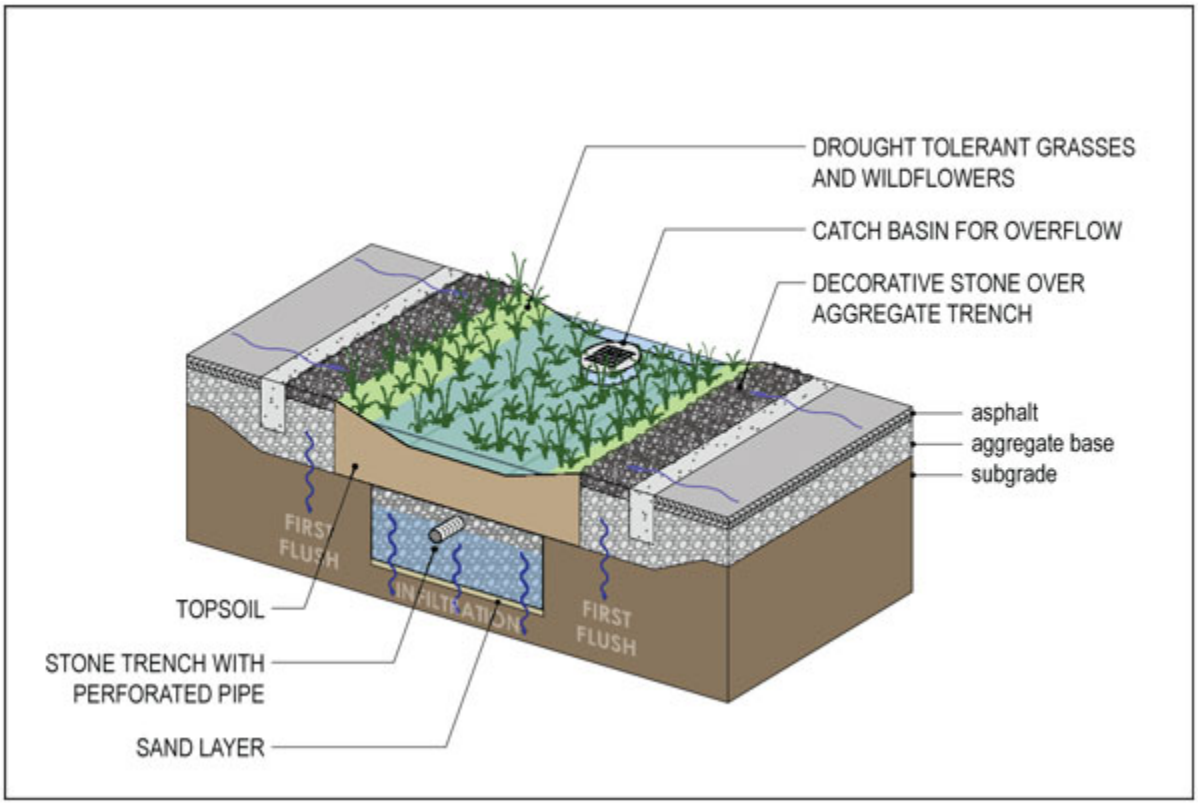

Figure C1. A cross section of a traditional bioswale. A subdrain is included under the topsoil layer to drain excess runoff into a storm sewer system.

As shown in Figure C1, traditional bioswales have under-surface drainage structures to drain excess water that percolates through the upper soil layers. While one corner of each intersection along Pennsylvania Ave. typically has a storm sewer inlet, drainage is not available for all four corners of any intersection. A modified bioswale design allows for storm water infiltration, but the layer of Geotextile Fabric between the topsoil and existing subgrade creates a "bathtub" and does not allow water to leave the top soil layer. This keeps water from flowing under the current roadway, destabilizing the existing subgrade. See the Typical Bumpout Cross Section on the DET1 sheet in the drawing package for more information.

Modified Bioswale Bump-out Design

The bump-outs along Pennsylvania Ave. must allow stormwater to pass in and through each bump-out. Each bump-out has curb cuts along the existing curb and towards the center of the intersection allowing water to flow in the bump-out. All sidewalks passing through the bump-out are elevated to allow water to pass underneath. For a typical plan of a bump-out, see the Typical Bumpout drawing on the DET1 page in the drawing set.

Figure C2. Example bump-out with curb cut to allow water to flow into the bump-out but still restricts vehicular and bicycle traffic.

Figure C3. Example bump-out with curb cut in middle of bump-out allowing water to flow from street

Figure C4. Steel plate in bump-out sidewalk allowing water to flow under the sidewalk.

Utilizing design concepts shown in Figures C2 – C4, the Pennsylvania Ave. bump-outs have consistent design elements across the project. At this point it is prudent to note that Hawkeye Design did not have any survey data, so slopes and elevations are approximated. The bump-outs may have a different design depending on the specific elevations at each intersection.

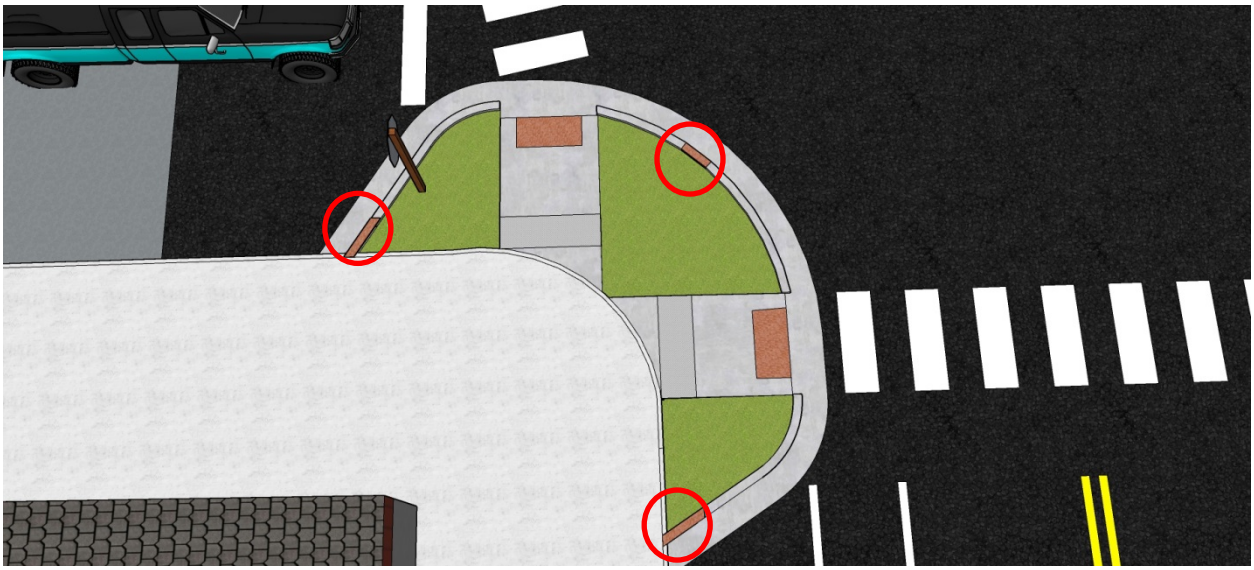

Figure C5. Top view of a typical bump-out along Pennsylvania Ave. Circled are curb cuts.

Figure C6. Side view of a typical bump-out showing relative elevations to the existing sidewalk and street.

Figure C7. Rendering of steel plate over curb cut, which allows water to flow into the bump-out but keeps vehicles and bicycles from entering.

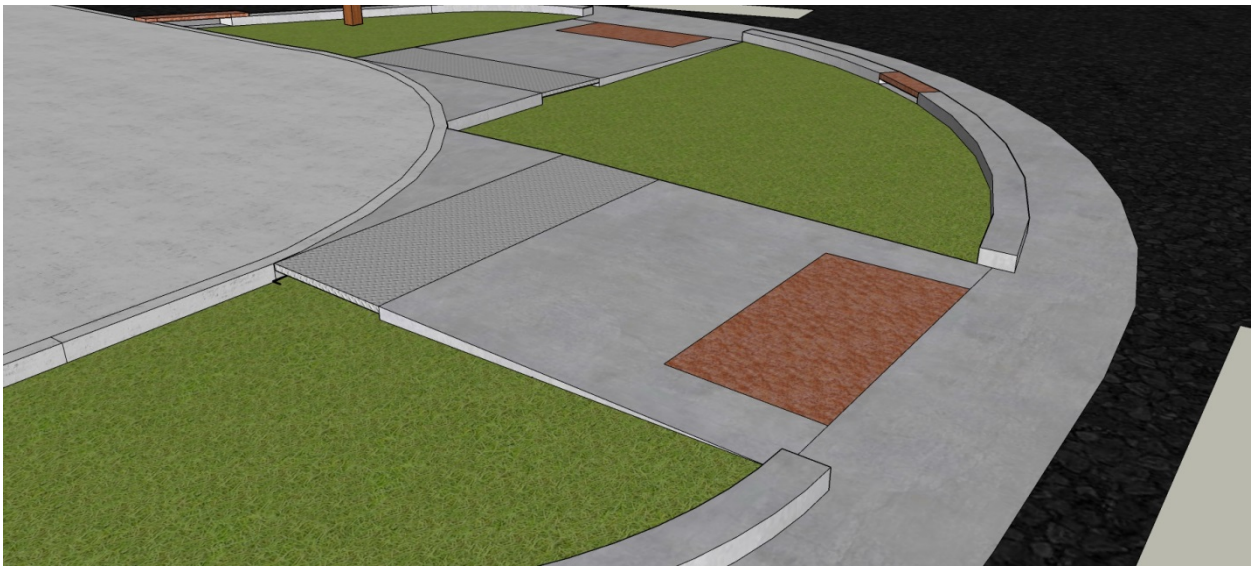

Figure C8. Typical sidewalk layout in the bump-out. Connecting with the existing sidewalk and extending to the street, the sidewalk is elevated above the bump-out elevation, keeping users' feet dry.

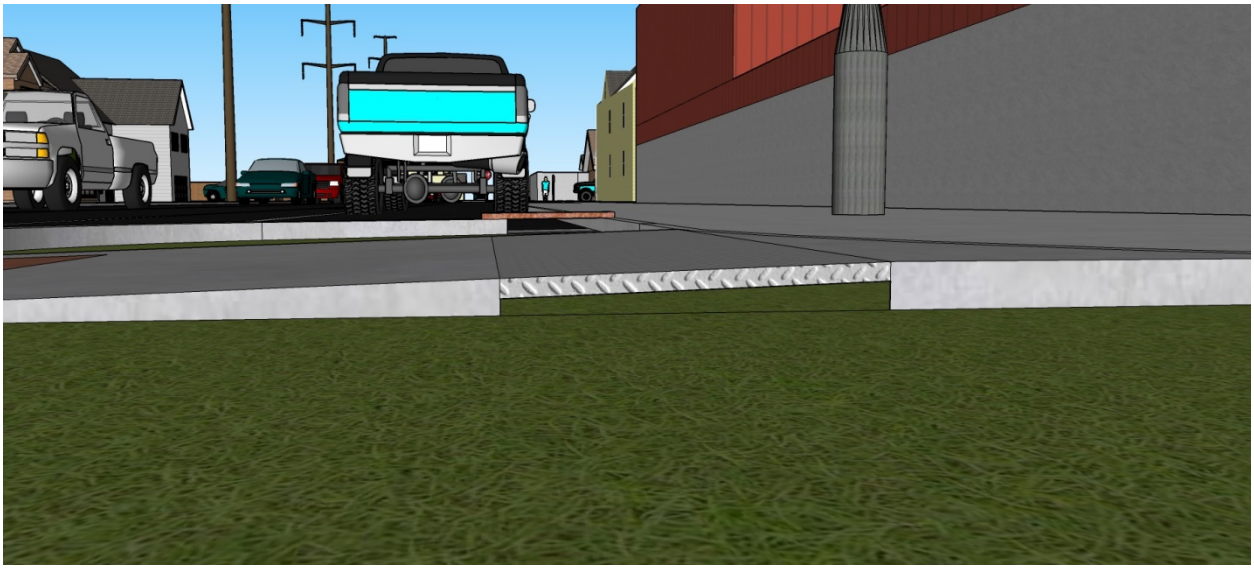

Figure C9. Typical grating in bump-out sidewalk, allowing water to flow freely through the bump-out. The exact elevation of the sidewalk is not known as there was no survey information available.

Appendix D Dedicated Bike Lanes

Parking Effects from Dedicated Bike Lane

During the initial project meeting with Mason City, maintaining existing on-street capacity along Pennsylvania Ave. was explicitly emphasized. Alternatives One and Two have no effect on the existing parking facilities, but Alternative Three, with the incorporation of a dedicated bike lane, reduces on-street parking capacity for some blocks.

South of 2nd Ave SE

From Willow Creek to 2nd Ave. SE, Pennsylvania Ave. has a width of 39 to 40 feet, and provides primary access to numerous homes, apartment buildings, the Fullterton Funeral Home, and the Music Man Square. Alternative Three eliminates on-street parking on the east side of the street. With the Mason City Public Library parking lot in close proximity to the Fullerton Funeral Home and Music Man Squarre for users and events, reduced on-street parking should have minimal effect on this block.

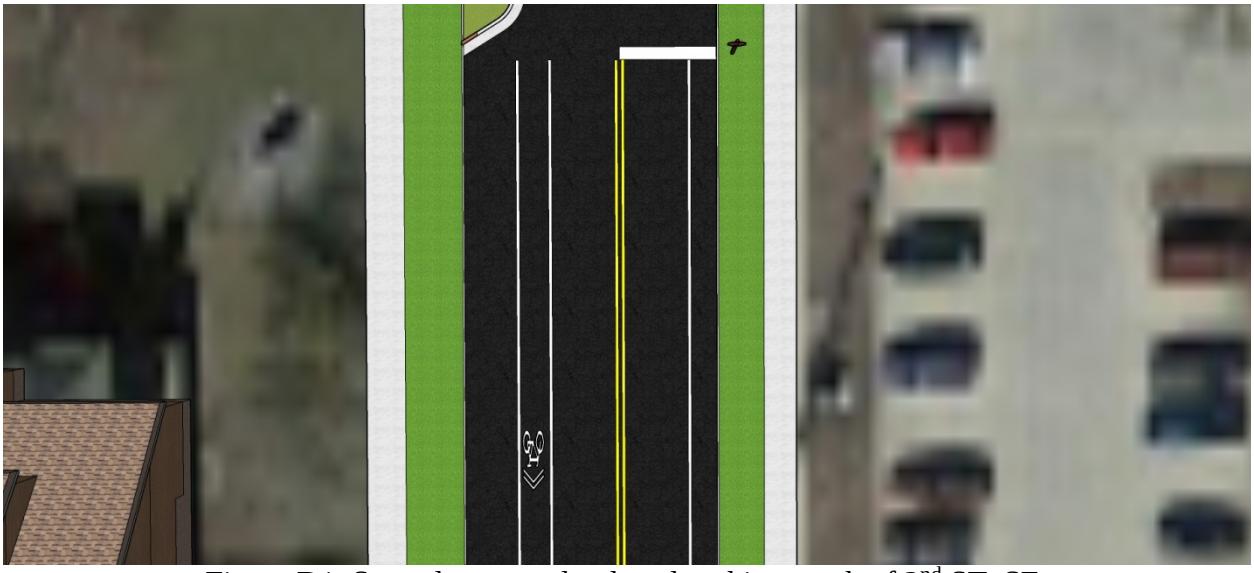

Figure D1. Street layout and reduced parking south of 2nd ST. SE.

2nd St SE to 1st St SE

This block has a width of 39 feet and includes residences to the southern end, with a former restaurant on the northwest end, and an auto repair shop on the northeast end. Alternative Three removes the on-street parking on the east side of the street. As the auto repair shop has a wide driveway, the northern half of the eastern on-street parking was unusable. This Alternative effectively removes only four spot of on-street parking, minimally impacting the largely residential uses of this street.

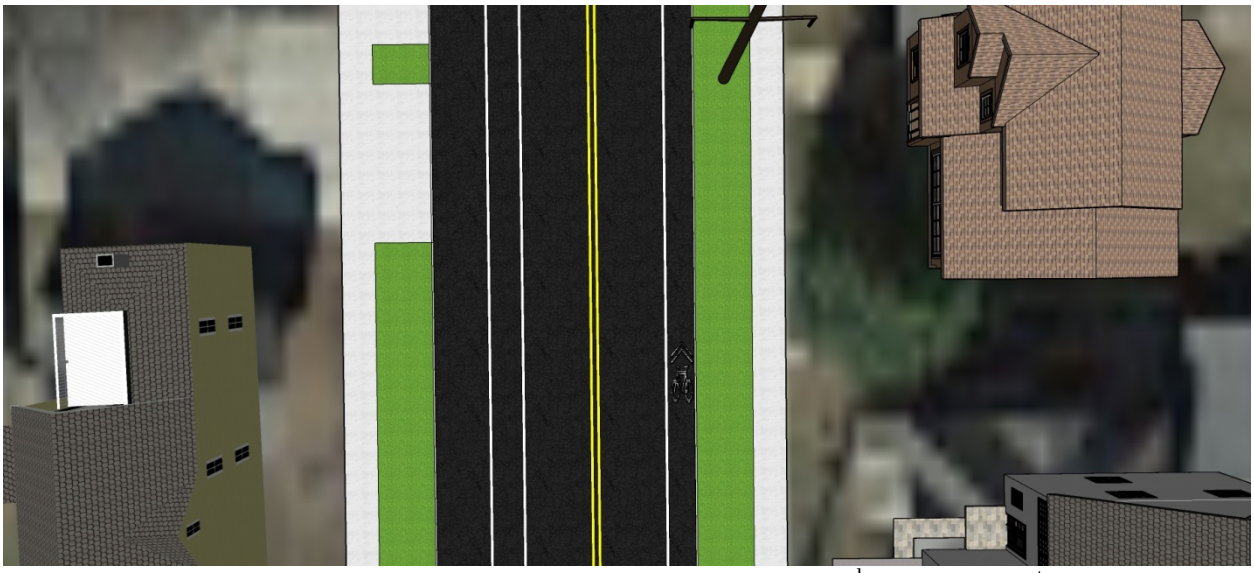

Figure D2. Street layout and reduced parking between 2nd St. SE and 1st St SE.

1st St. SE to E. State St.

The block directly south of E. State St. is 48 feet wide, with businesses along the block, and a church at the southwest corner of the E. State St. intersection. With the available street width, parking is maintained on both sides of the street in Alternative Three.

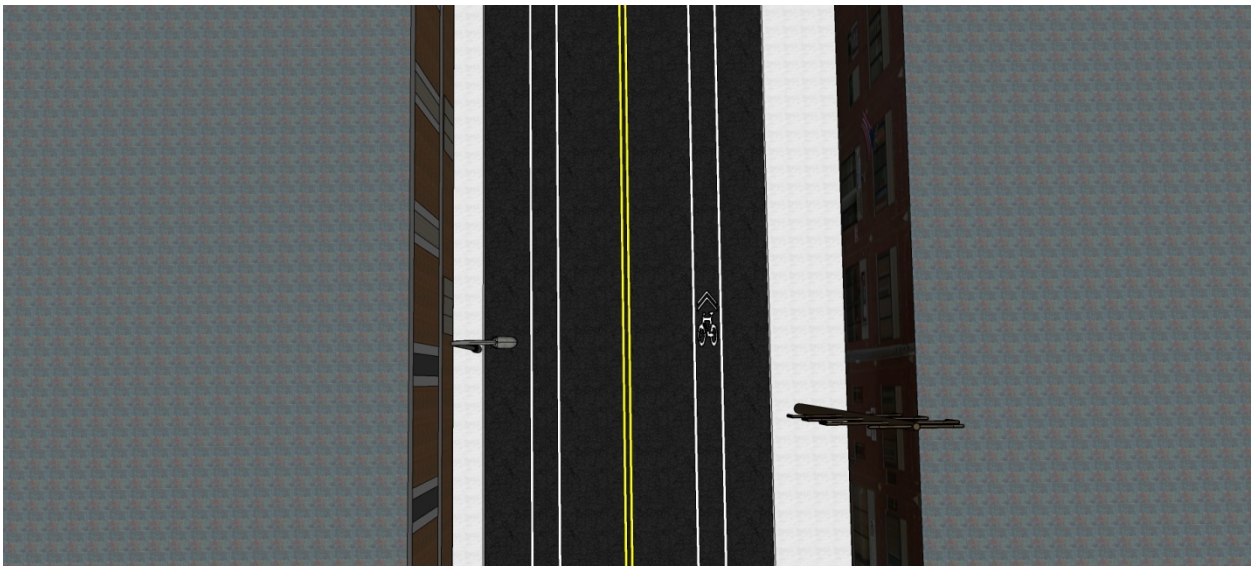

Figure D3. Street layout with all parking maintained between 1st ST. SE and E. State St.

1st St. NE to E. State St.

The block directly north of E. State St. is 48 feet wide as well, with a city parking lot on the west side of the street and businesses and residences on the east side. With the available street width, parking is maintained on both sides of the street in Alternative Three.

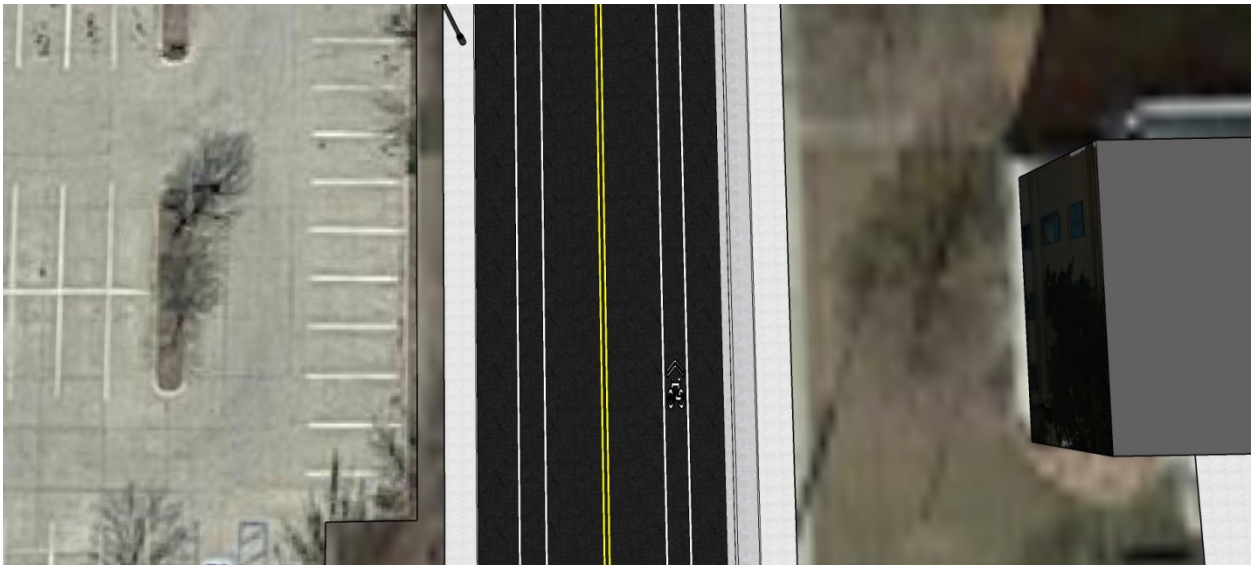

Figure D4. Street layout with all parking maintained between 1st St. NE and E. State St.

2nd St. NE to 1st St. NE

This block is roughly 45 feet wide and has a church and television station on the west side of the street, with a funeral home on the east side. Alternative Three removes parking from the eastern side of the street for an extra wide bike lane. As heavy parking usage will typically only happen during church services and funerals, the eastern bike lane will have parking allowed during Sunday mornings and funerals. Throughout the rest of the week parking is not allowed and the bike lane is maintained.

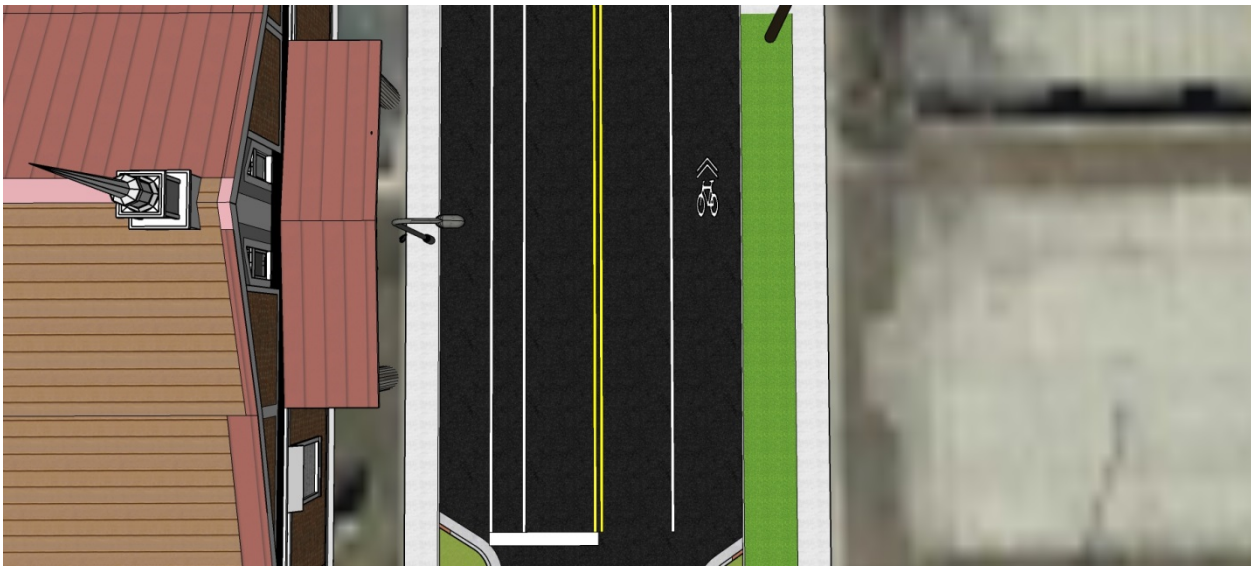

Figure D5. Street layout with wide bike lane and Sunday morning and funeral parking

3rd St. NE to 2nd St. NE

This block is roughly 40 feet wide and has a city parking lot on the east side and a church on the west side of the street. Alternative Three removes parking from the eastern side of the street for a standard width bike lane. No Sunday morning parking will be allowed on this block as parked cars would inhibit free flow in the northbound travel lane. While removing on-street parking in front of the church likely will inconvenience parishioners, the availability of the city parking lot across the street will mitigate any loss in parking on Sunday morning.

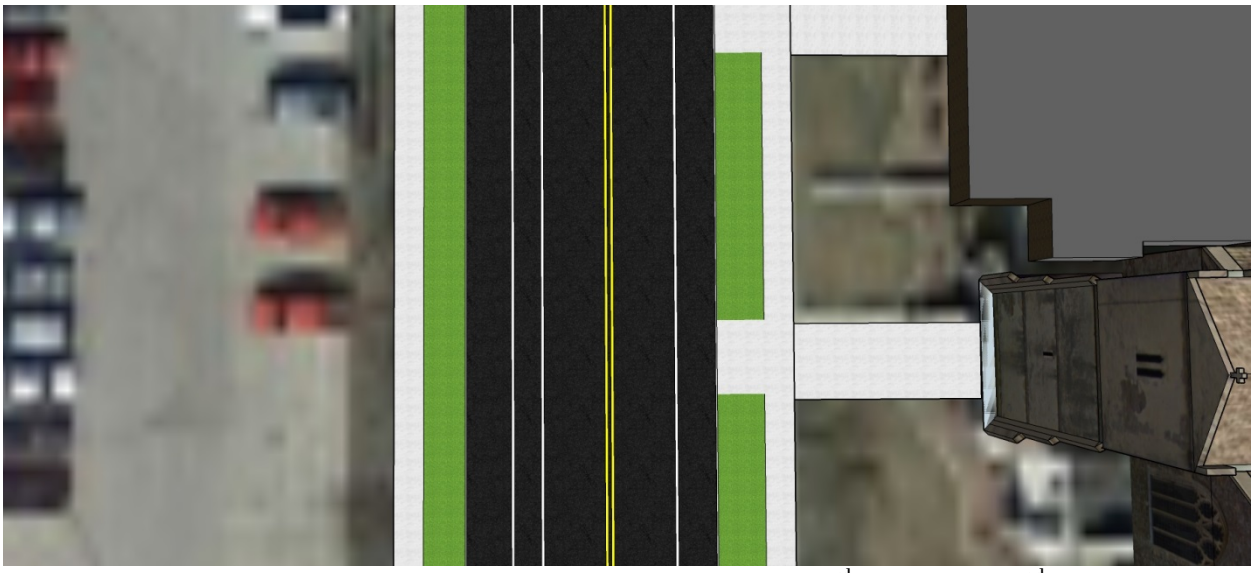

Figure D5. Street layout and reduced parking between 3rd St. NE and 2nd St. NE

4th St. NE to 3rd St. NE

The final block of Pennsylvania Ave. is 40 feet wide and has residences on the east side with a funeral home on the west side of the street. Alternative Three removes on-street parking on the east side of the street. The funeral home currently has a large parking lot north of the building, and with access to a city lot across the street to the south, negative effects from reducing on-street parking along this block should be minimal.

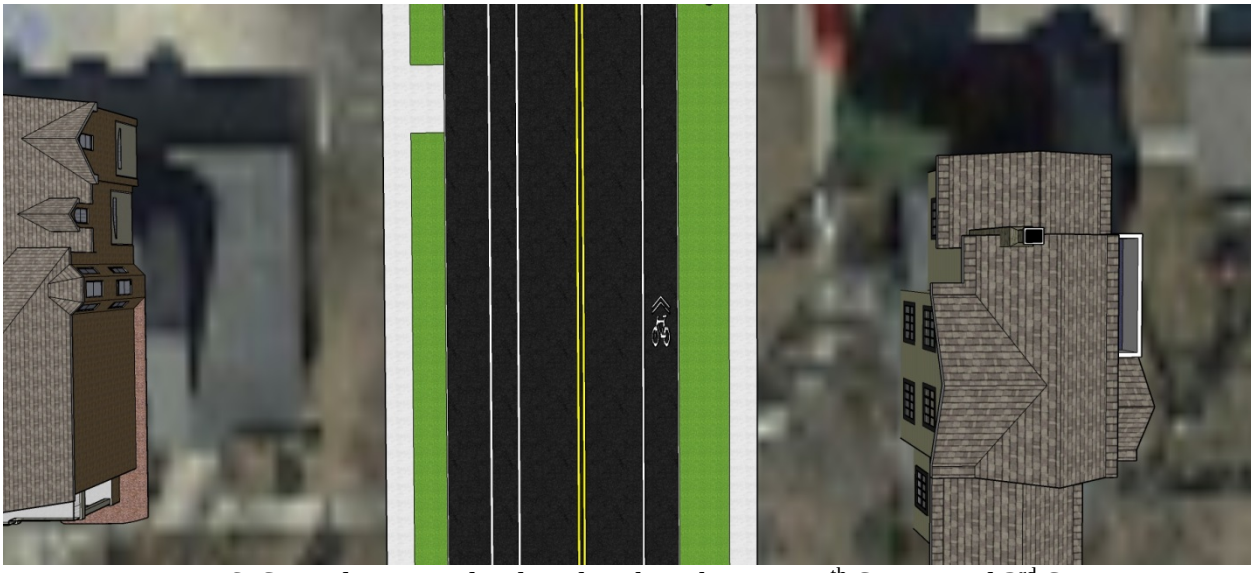

Figure D6. Street layout and reduced parking between 4th St. NE and 3rd ST. NE

Appendix E Pricing Information

Sources for Pricing Estimation

ITEM_DESCRIPTION	Cost Source
EXCAVATION, CLASS 13, WASTE	Iowa DOT Bids Average Price (04-17 to 03-18)
TOPSOIL, FURNISH AND SPREAD	Iowa DOT Bids Average Price (04-17 to 03-18)
GEOTEXTILE FABRIC	Iowa DOT Bids Average Price (04-17 to 03-18)
PAVEMENT SCARIFICATION	Iowa DOT Bids Average Price (04-17 to 03-18)
HOT MIX ASPHALT STANDARD TRAFFIC, SURFACE COURSE, 1/2 IN. MIX, NO SPECIAL FRICTION REQUIREMENT	Iowa DOT Bids Average Price (04-17 to 03-18)
ASPHALT BINDER, PG 58-34H, STANDARD TRAFFIC	Iowa DOT Bids Average Price (04-17 to 03-18)
REMOVAL AND REINSTALL OF LIGHT POLE AND LUMINAIRE	Iowa DOT Bids Average Price (04-17 to 03-18)
REMOVAL OF TRAFFIC SIGNALIZATION	Iowa DOT Bids Average Price (04-17 to 03-18)
REMOVAL SIDEWALK	Iowa DOT Bids Average Price (04-17 to 03-18)
SIDEWALK, P.C. CONCRETE, 6 IN	Iowa DOT Bids Average Price (04-17 to 03-18)
SIDEWALK, P.C. CONCRETE, PANELS	Iowa DOT Bids Average Price (04-17 to 03-18)
CURB AND GUTTER, P.C. CONCRETE, 1.5 FT	Iowa DOT Bids Average Price (04-17 to 03-18)
PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CENTERLINE	RS Means Heavy Construction
PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, BIKE LANE EDGE MARKING	RS Means Heavy Construction
PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, STOP BAR	RS Means Heavy Construction
PAINTED PAVEMENT MARKING, WATEBORNE OR SOLVENT-BASED, CROSS WALK	RS Means Heavy Construction
PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	RS Means Heavy Construction
STREET LIGHT WIRING REPLACEMENT	RS Means Site Work
MOBILIZATION	Iowa DOT Bids Average Price (04-17 to 03-18)
CONSTRUCTION SURVEY	Iowa DOT Bids Average Price (04-17 to 03-18)

Description of Items

Excavation, Class 13, Waste: Removal of existing pavements for bump-outs in Alternatives Two and Three
Topsoil, Furnish and Spread: Topsoil backfill for bump-outs in Alternatives Two and Three
Geotextile Fabric: Layer under topsoil in Alternative Two and Three bump-outs
Pavement Scarification: Removal of existing HMA overlay on Pennsylvania Ave.
HMA Standard Traffic: New HMA overlay.
Asphalt Binder PG58-34H, Standard Traffic: Binder for new HMA overlay. Binder chosen from "2016 Asphalt Binder and Mix Specification Guide" from the Asphalt Paving Association of Iowa
Removal and Reinstall Light Pole: Removal of old street lights and replacement with new fixtures.
Removal of Traffic Signalization: Removal of traffic signal at E. State St. intersection
Removal of Sidewalk: Removal of sidewalk for buried street light wire replacement
Sidewalk, PCC 6in: Area quantity for sidewalk replacement after wire replacement
Sidewalk, PCC, Panels: Sidewalk repair per panel
Curb and Gutter, PCC, 1.5 Ft: New curb and gutter for bump-outs and sidewalk extensions
Painted Pavement Marking: All pavement markings by type in the project.
Street Light Wiring Replacement: Wiring and conduit for buried street light wiring.
Mobilization: Cost to bring construction equipment on site. NOTE: Alternatives Two and Three share mobilization costs, while Alternative One has only ¼ the estimated mobilization cost as the lack of bump-outs will likely decrease the amount of equipment required on the job site.
Construction Survey: There was no survey data available for this design, so any construction project will need surveying information first.

Appendix F Sidewalk Repair Schedule

Address	Location	Panels	Action
322 N. Penn Ave		9	Replace
321 N. Penn Ave		1	Replace
316 N. Penn Ave		1	Grind joint
316 N. Penn Ave		6	Replace
315 N. Penn Ave		4	Replace
300 N. Penn Ave		1	Grind joint
N. Penn Ave and 3rd St.	South side of intersection	4	ADA Upgrade
213 N. Penn Ave		1	Grind joint
213 N. Penn Ave		1	Replace
N. Penn Ave and 2nd St.	All corners	8	ADA Upgrade
112 N. Penn Ave		14	Replace
111 N. Penn Ave		9	Replace
111 N. Penn Ave		2	Grind joint
103 N. Penn Ave (west)		14	Replace
103 N. Penn Ave		5	Grind joint
N. Penn Ave and 1st St.	South side and northeast corner	5	ADA Upgrade
N. Penn Ave and State St.	All corners	8	ADA Upgrade
5 S. Penn Ave		8	Replace
5 S. Penn Ave (west)			Trim or remove trees
103 S. Penn Ave		1	Replace
110 S. Penn Ave		8	Replace
132 2nd St. SE		15	Replace
300 S. Penn Ave		2	Grind joint
300 S. Penn Ave (east)		2	Grind joint
308 S. Penn Ave		1	Replace
Mason City Library		1	Grind joint
314 S. PennAve		4	Replace
Music Man Square Access Drive		3	Replace
320 S. Penn Ave		1	Grind joint
325 S. Penn Ave		3	Replace
330 S. Penn Ave		1	Grind joint
332 S. Penn Ave		1	Grind Joint
361 S. Penn Ave		4	Replace

Appendix G Storm Water Report

Mason City stated at the initial meeting of the project that there were no problems with the existing storm water collection system. With this it was concluded that there was no need for intake or storm water pipe replacement. However, a check was still performed to see if the current capacity of the pipe network was sufficient for storm water after the installation of new features. Using the equation below for the rational method, the peak flow for the post-development site block by block could be found.

$$Q_T = Ci_TA$$ **Equation 2B-4.01**

where:

Q_T = estimate of the peak rate of runoff (cfs) for some recurrence interval, T
C = runoff coefficient; fraction of runoff, expressed as a dimensionless decimal fraction, that appears as surface runoff from the contributing drainage area.
i_T = average rainfall intensity (in/hr) for some recurrence interval, T, during that period of time equal to the T_c.
A = the contributing drainage area (acres) to the point of design that produces the maximum peak rate of runoff.
T_c = Time of concentration, minutes.

North Street	Peak Flow (ft3/s)
SE 2nd St	1.99
SE 1st St	1.04
State St	1.11
NE 1st St	1.11
NE 2nd St	1.09
NE 3rd St	1.06
NE 4th St	1.15

Table G1: Summary of Peak Flows by Block

The analysis used two different C-values, one being 0.98 for the impervious area with the other being 0.8 for the industrial area. The design storm was a 100-year, twelve-hour storm with a rainfall intensity of 0.58 inches per hour. Utilizing the Manning's Equation, shown below, with a Manning's number of 0.013 for the concrete pipe and a slope of 2%, the max flow rate is 2.9 ft^3/s. All pipe flows are well under the maximum flow rate, confirming the existing storm water system is sufficient.

$$V = \frac{Q}{A} = \frac{1.486}{n} r^{2/3} s^{1/2}$$ **Equation 2D-2.01**

where:

V = Average velocity, ft/s
Q = Discharge, cfs
A = Cross-sectional area of flow, ft^2
n = Manning's roughness coefficient
r = hydraulic radius, ft
= A/p (note: for circular pipes flowing full, r=D/4)
p = wetted perimeter, ft
s = slope of hydraulic grade line (pipe/channel slope), ft/ft

Appendix H Construction Phasing

The project will need to be split into two construction phases. The first construction phase will be the entire completion of the project from the Willow Creek to the north side of the 2nd Street SE intersection. 2nd Street SE will remain open on both sides of Pennsylvania Avenue up to the intersection where it will be closed. The intersection of 1st Street SE will be closed in the south bound direction and the intersection of 5th Street SE will be closed in the north bound direction. All traffic during Phase 1 will be directed to use Highway 65 as indicated below. Phase 1 is being completed first to minimize impacts to residential homes along Pennsylvania Ave. to the south of 1st Street SE. To accommodate these homes the Public Library parking lot will be available for residents to park and walk to their homes. The most impactful elements of this phase are expected to last no more than 1-2 working days.

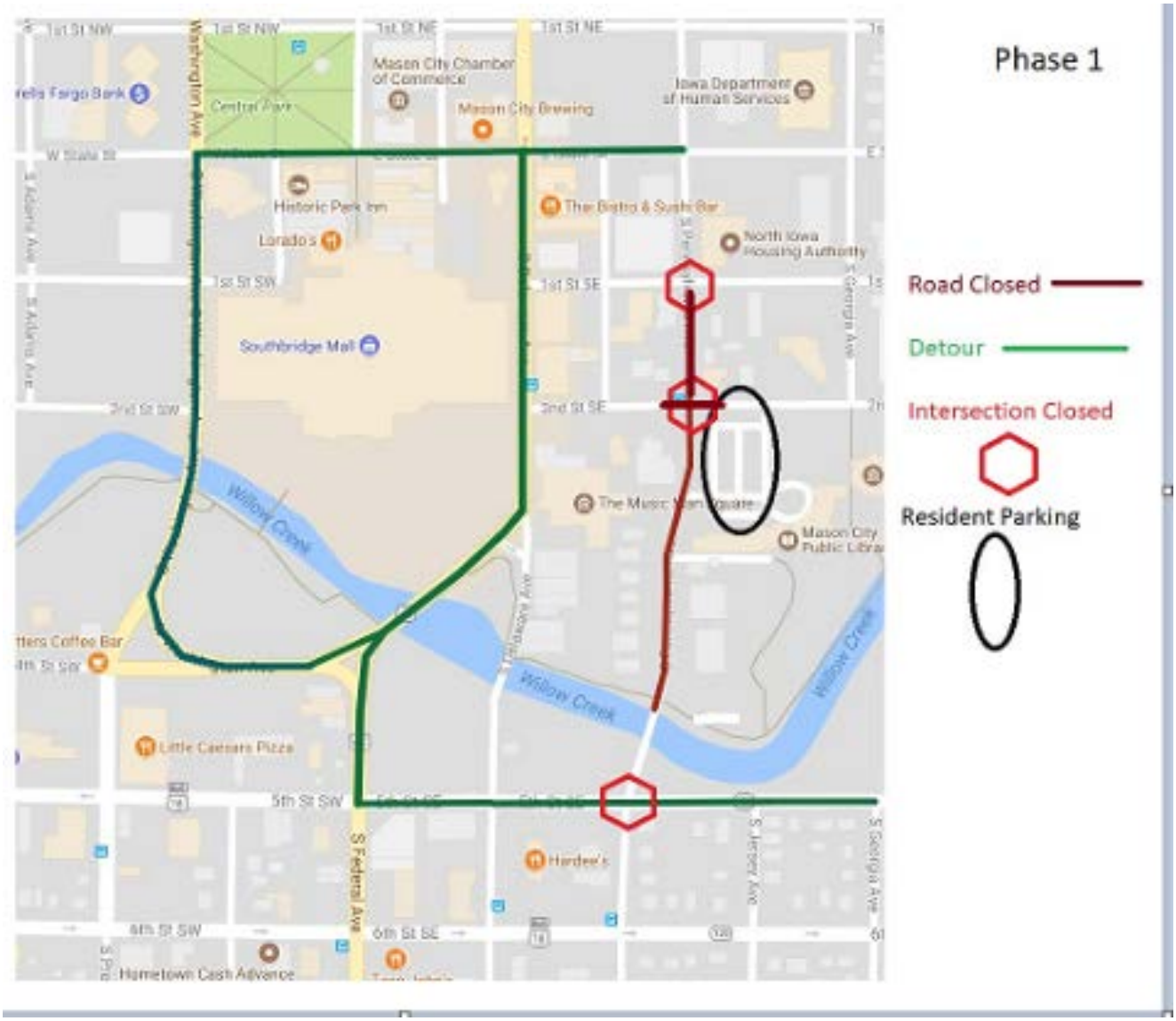

Figure H1. Phase 1 Traffic Map

Phase 2 of this project will be the remainder of the project from the 2nd Street SE intersection to the north side of the 4th Street NE intersection. All traffic will again be rerouted to Highway 65 using either 1st Street SE or 6th Street SE. The intersection of 5th Street NE will be closed in the south bound direction and the intersection of 2nd Street SE will be closed in the north bound direction. This phase is expected to last no more than 7-8 working days.

Figure H2. Phase 2 Traffic Map

Design References

1. Iowa SUDAS 2B-4: *Runoff and Peak Flow*. Used for storm water runoff calculations.
2. Iowa SUDAS 2D-1: *General Information for Storm Sewer Design*. Used for storm water runoff calculations.
3. Iowa SUDAS 5C-1: *Geometric Design Tables*. Used for bump-out and intersection redesign.
4. Iowa SUDAS 5C-2: *Geometric Design Elements*. Used for bump-out and intersection redesign.
5. Iowa SUDAS 5M: *Complete Streets.* Used as general design template for Complete Street design.
6. Iowa SUDAS 12A-1: *General Sidewalk Requirements.* Used for design of sidewalk improvements.
7. Iowa SUDAS 12A-2: *Accessible Sidewalk Requirements*. Used for design of sidewalk improvements.
8. Iowa SUDAS 12B-1: *Bicycle and Pedestrian Facilities.* Used for design of bicycle facility improvements.
9. Iowa SUDAS 12B-3: *On-Street Bicycle Facilities.* Used for design of bicycle facility improvements.
10. Iowa DOT Design Manual 6C-8: *Parking on Urban Primary Highways.* Used to design integration of on-street parking with bump-outs.
11. Iowa DOT Design Manual 3B-1: *Pavement Marking Standards.* Used to design new centerline, bike lane, and stop bar paint markings.
12. Iowa DOT Design Manual 3B-2: *Typical Pavement Markings Layouts.* Used to design high-visibility crosswalks and shared and dedicated bike lane symbols.
13. Asphalt Paving Association of Iowa: *2016 Asphalt Binder and Mix Specification Update Reference Guide.* Used to select asphalt binder for new HMA overlay.
14. Masud Karim, Dewan, P.Eng., PTOE. "Narrower Lanes, Safer Streets." Senior Transportation Planner, City of Toronto
15. "Commuting by Bicycle: An Overview of the Literature." By Eva Heinen, Bert Van Wee, Kees Maat. Published in Transport Reviews, January 2010.