Project: Agency Street Trail Project

Client: City of West Burlington

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Section I Executive Summary

The Agency Street Trail Project represents a step forward in enhancing pedestrian and bicycle infrastructure in West Burlington, Iowa. This project focuses on improving connectivity and safety while promoting healthier, sustainable transportation options for residents and visitors. The centerpiece of the project is a 10-foot-wide trail along the north side of Agency Street, connecting West Burlington Avenue to Gear Avenue. This trail will integrate with the future Broadway Street Trail and the existing Gear Avenue Trail, creating a cohesive network that links residential neighborhoods, commercial areas, Southeastern Community College, the Southeasst Iowa Regional Medical Center, and the RecPlex. Additionally, a connecting trail along Broadway Street will bridge gaps in the existing infrastructure, ensuring seamless access to important community destinations.

In addition to the trail construction, significant intersection improvements are planned to enhance pedestrian safety and traffic flow. These upgrades include highly visible longitudinal crosswalk markings, stand-alone pedestrian push-button systems for better accessibility, and optimized signal timings. These features will facilitate safer crossings at busy intersections like Gear Avenue, Broadway Street, West Burlington Avenue, and near the mall--all critical access points for schools, shopping, and recreation. The design team has prioritized safety and compliance with ADA standards throughout the project, ensuring accessibility for vulnerable populations such as seniors, individuals with disabilities, and those who rely on non-motorized transportation.

The project offers broad community benefits, including enhanced safety, improved quality of life, and economic growth. By providing a dedicated, safe space for walking and biking, the trail will reduce the risks posed by high-traffic roads. This infrastructure will also support local businesses by increasing foot and bicycle traffic to nearby establishments, potentially boosting sales and generating additional sales tax revenue.

Despite its advantages, the project presents challenges, including maintaining the required trail width within existing rights-of-way, addressing drainage issues along Agency Street, and avoiding utility conflicts. The design team has worked to overcome these obstacles by using advanced tools such as AutoCAD Civil 3D and ArcGIS Pro to plan precise alignments and mitigate disruptions. Concrete was selected as the preferred material for the trail due to its durability and low maintenance requirements, though its higher upfront cost was carefully weighed against longterm benefits.

The project is estimated to cost $746,200, which includes construction, contingencies, engineering, and administration expenses. The Agency Street Trail budget is $358,500. The extent of the new Agency Street Trail includes 4,800 linear feet of 10-foot-wide trail and 50 feet of 5-foot-wide trails connecting businesses that consists of 6-inch PCC pavement and a 6-inch-deep base layer. This trail crosses three major intersections, five driveways where crosswalks are necessary, and six driveways where a crosswalk is not necessary. An estimated budget of $202,500 for the Broadway Street Trail includes 2,600 linear feet of 10-foot-wide trail and 450 feet of 5-foot-wide trail that consists of 6-inch-deep PCC pavement and a 6-inch-deep base layer. The Broadway Street Trail crosses only one signalized intersection and has two crossings at the Division Street and Broadway Street four-way stop intersection. It also crosses one driveway where a crosswalk is necessary and nine driveways where a crosswalk will not be necessary. This includes all pavement markings, pavement marking removals, pedestrian pushbuttons, and pedestrian signal heads at all intersections. $13,000 is the estimated budget for the Mall Trail.

This estimate includes 360 feet of five-foot-wide trail that consists of 6-inch PCC pavement and a 6-inch base layer. These estimates were developed using Iowa Public Works Service Bureau Bid Tabulation Reports, *2024 RS Means Heavy Construction Costs*, comparisons with similar local projects, and detailed cost analyses. To ensure financial flexibility, the project is designed with the option to be implemented in phases, allowing for adjustments based on available resources. The total project cost then had 10% ($57,400) added for contingencies and 20% ($114,800) added for engineering and administration. Below are photos of the extent of the entire project. Figure 1 shows the extent of the trail construction including PCC pavement, base layer, and daylighting. Figure 2 demonstrates the extent of the new intersection designs including new pavement markings, stand-alone pedestrian pushbuttons, pavement marking removals, and pedestrian signals.

Figure 1: Appendix C

Figure 2: Appendix C

Moving forward, the project requires final design approvals, securing permits and funding, and coordination with contractors for phased construction. Once completed, the Agency Street Trail Project will help transform West Burlington into a more connected, pedestrian-friendly city, fostering community well-being, economic vitality, and environmental sustainability. This initiative aligns with the city's long-term vision of creating a safe, accessible, and vibrant community for all.

Section II Organization Qualifications and Experience

Team Project Manager: Emma Oelmann

Team Member: Blake Misfeldt

Organization and Design Team Description: We are a team of two students enrolled in the University of Iowa's Civil and Environmental Engineering program. This project was completed for our capstone senior design class. Emma Oelmann and Blake Misfeldt,collaborated on the Agency Street Trail project. Both team members are equipped with classroom experience in trail design and traffic engineering. Blake specializes in business management and Emma specializes in transportation.

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Section III Design Services

Project Scope: The scope of the Agency Street Trail project includes a 10-foot-wide trail along the north side of Agency Street. This trail will extend from West Burlington Avenue to Gear Avenue connecting to the planned Broadway Street Trail and the existing Gear Avenue Trail. This new trail will connect key commercial areas that include Walmart, Target, Farm King, shopping centers, multiple gas stations, and Kohl's, as well as residential areas, Southeastern Community College, and the Southeast Iowa Regional Medical Center. The trail will also include pedestrian access to Walmart and Dunkin' Donuts along Agency Street. Further, the project includes a trail connecting the end of the sidewalk on Broadway Street. This trail will extend south and connect with the already existing Broadway Street Trail along Division Street. The trail will be 5-feet wide between the start of the existing sidewalk to Agency Street. This project also includes intersection improvements for safer pedestrian crossings for the Gear/Agency intersection and the Broadway/Agency intersection. Improved and safe pedestrian crossings are also planned to connect the mall, the new Gear Avenue Trail, the high school, the middle school, and a new development. For this project, the design team collaborated with West Burlington officials to conduct an initial site visit, gathered on-site elevation data, and developed a comprehensive design that included horizontal and vertical alignments, trail cross-sections, pedestrian crosswalk layout, adjustments to traffic light timing, material quantities, and cost estimates. All project deliverables were prepared by the design team and presented to the client.

Work Plan: A Gantt chart work plan can be found in Appendix G.

Section IV Constraints, Challenges and Impacts

Constraints: A 10-foot width is a requirement for West Burlington to receive the proper funding for this project. The pavement's edge must be outside of the 10-foot clear zone along the road. Designing for outside of the clear zone is a major safety factor for users of both the roadway and the new trail because it will mitigate the probability of vehicle crashes with pedestrians due to Agency Street's high daily traffic volumes, including a high number of vehicles traveling above the speed limit. The trail must also avoid any existing obstructions such as drainage culverts and manholes. Sections of Agency Street do not have curb and gutter; retaining existing culverts is important to the drainage of the street and trail.

Challenges: To keep within the 10-foot-wide constraint as well as the 10-foot clear zone, we face the challenge of keeping the trail within the existing right-of-way. Although it is preferred that the proposed trail stay within the right-of-way, it is possible to move sections of the trail past commercial area property lines if special permission is granted. Sections of Agency Street have no existing curb and gutter, thus creating a drainage challenge for the new trail. The trail is designed to have water flowing toward the roadway where there is curb and gutter, and to have water flow towards the drainage ditches where there is no cub and gutter. There are many obstacles such as trees and utilities that need to be moved or removed to fit the 10-foot trail with clear space.

Societal Impact within the Community: The construction of a pedestrian trail that will connect nearby businesses will have significant positive impacts on the community's populace, economy, and public revenues.

Populace: The trail will enhance the safety and accessibility of the community, particularly for vulnerable populations such as the elderly, disabled individuals, and those without access to motorized transportation. Redesigned intersections will allow safer travel for pedestrians crossing the street and lower the likelihood of accidents. The path will also encourage healthier lifestyles by promoting walking and cycling as viable alternatives to driving, which can improve overall well-being.

Economy: The trails and redesigned intersections will stimulate local economic growth by increasing foot and bike traffic to nearby businesses, making it easier for students and residents to access essential services like grocery stores. This will likely result in higher sales for local businesses, particularly those that rely on nearby consumers who may not have frequent access to transportation.

Public Revenues: Increased business activity will contribute to higher sales tax revenues for the local government. Additionally, the pedestrian trail may attract more students and residents to the area, potentially increasing property values and expanding the tax base. Savings to public money could be made by minimizing wear and tear to the roadway and decreasing traffic accidents.

Section V Alternative Solutions Considered

Concrete Trail: Portland cement concrete has been identified as the preferred alternative by West Burlington officials due to its superior durability and longer lifespan as compared to asphalt. Concrete provides a stable, even surface that is highly beneficial for wheelchairs, strollers, and cyclists. It is low maintenance, which contributes to its long-term cost-effectiveness. Nevertheless, concrete trails involve higher initial costs and longer installation times as compared to asphalt. The hard surface can be more challenging on the joints of joggers, potentially leading to discomfort during extended use.

Placement of the Broadway Street Trail: Initially, West Burlington preferred placing the trail on the west side of Broadway Street for the section running from Agency Street to Division Street, due to perceived utility conflicts on the east side. However, a more detailed assessment revealed that there were minimal utilities on the east side, where there was also ample right-of-way. The west side has limited right-of-way for trail placement. However, an additional crosswalk will be needed at the east leg of the Broadway and Agency Streets intersection. Given these findings, we proposed shifting the trail to the east side of Broadway Street, prioritizing accessibility and clear space, a modification that was approved by West Burlington. While the majority of the trail is within West Burlington's city limits, small portions of the daylighting close to the intersection north of Division Street extends into the Burlington city limits. Thus, West Burlington may need to make an agreement with the City of Burlington.

Stand-Alone Push Buttons for Pedestrian Crossings: For pedestrian crossings at certain intersections, the placement of stoplights presented a challenge, as some were located too far from the crosswalks, making it inconvenient for pedestrians to reach the signal buttons. Two alternatives were considered:

integrating crosswalk signal activation with existing stoplights or installing stand-alone push buttons near the crosswalks. While the first option might reduce initial costs, it was ultimately rejected due to accessibility concerns and avoiding utilities along the edge of pavement. The stand-alone push buttons offered greater convenience and safety by bringing pedestrian controls closer to the intersections, a solution that West Burlington approved.

Walmart Driveway: An area of concern to West Burlington is the Walmart driveway on Agency Street nearest to Broadway Street. This location is associated with a high frequency of vehicle crashes, particularly with left-turning vehicles. We evaluated two options: leaving the driveway as is or introducing a median to restrict left turns. The preferred alternative was to install a median, that would prevent left turns out of the Walmart driveway onto Agency Street, thereby reducing collision risks and improving overall traffic flow. This modification was selected based on its potential to enhance safety and decrease accident rates, aligning with the City's priorities for safer roadway access.

Access to Local Businesses: A trail that connects residential areas, a local college, and nearby businesses will promote non-motorized transportation, increase foot traffic to businesses, and enhance accessibility for wheelchairs, strollers, and electric mobility devices. Access to businesses would potentially eliminate safety concerns at intersections and parking lot entrances, while encouraging walking and biking, reduce car dependency, alleviate traffic congestion and parking demand, and contribute to sustainability by lowering emissions. Drawbacks include initial costs for businesses to adjust like adding bike racks or signage, and the need for ongoing maintenance.

Section VI Final Design Details

Trail Design

Design Process:

The trail was designed using AutoCAD Civil 3D Software. Setting the new drawing to the correct coordinates of Iowa State Plane South, we turned on a BING aerial map of West Burlington to reference the project location. During our first site visit, we shot the locations of potential obstacles, (e.g., rees, storm intakes, road signs, water valves, electrical meters) that are alongside Agency Street with a handheld camera. These points were brought into the AutoCAD Civil 3D drawing to layout obstacles to avoid. We used Iowa DNR's Geospatial Data Clearinghouse online to download a 2-foot contour shapefile of Des Moines County. We used ArcGIS Pro to crop the size of the map to area of the project location, and it was used to create a surface in AutoCAD Civil 3D as existing ground. We obtained GIS files from the city, which included right of ways, storm and water structures, natural gas lines, parcels, and corporate limits. After exporting these GIS files into AutoCAD Civil 3D, using Polylines, the location of the trail was rough drafted with the correct 10-foot width, acceptable clear space, and avoidance of utilities. Once we were satisfied with the rough draft, we began creating a horizontal alignment for each section of the trail. Then we created the corresponding vertical alignment. Using the existing ground surface from Iowa DNR, we created a ground surface profile and created a vertical alignment along the profile. Next, we created a corridor that included assemblies of the trail cross sections and its various cross slopes and daylighting requirements.

We returned to West Burlington to survey the existing ground of the project location to provide a more precise ground profile. We exported the surveyed points into ArcGIS Pro to create a shapefile and add them to the existing surface in AutoCAD Civil 3D. From here we created an accurate corridor to tie into the existing conditions. Using the corresponding horizontal alignments, vertical alignments, and assemblies, we successfully created the corridor for the trail. Regions were created for different assemblies as necessary. To finalize the corridor and the design process, a new surface was created on the corridor to add sample lines and begin quantity estimations.

Design Details

Width of the Trail: The trail is specified as being 10 feet wide along the north side of Agency Street from Gear Avenue to West Burlington Avenue as well as along the east side Broadway Street from Agency Street to Division Street. The 10-foot-wide trail was requested from the client in order to qualify for state funding. The trail runs 5-feet wide along the West side of Broadway Street from Agency Street to the Walmart driveway in order to match the width of the existing sidewalk North of the Walmart Driveway. Figure 1 is a typical cross section for all 5’ portions of the trail network and Figure 2 shows typical cross sections for all 10’ portions of the trial network.

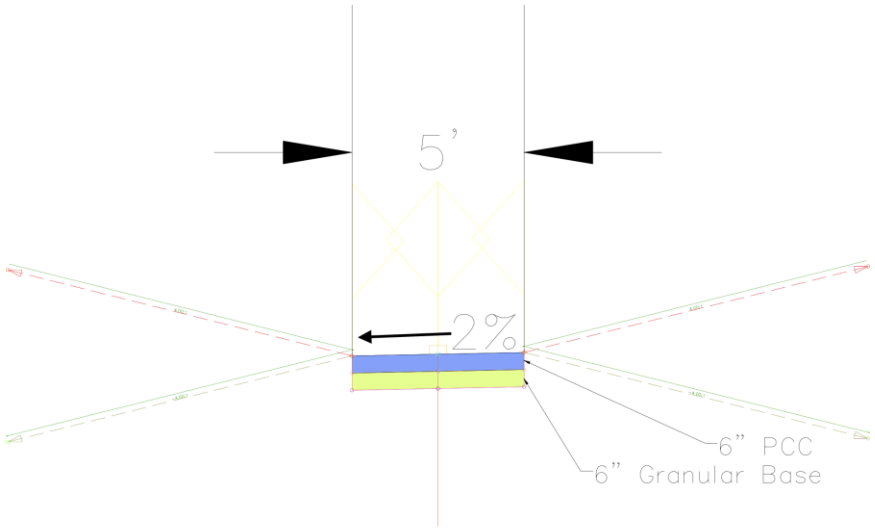


Figure 3: Appendix C

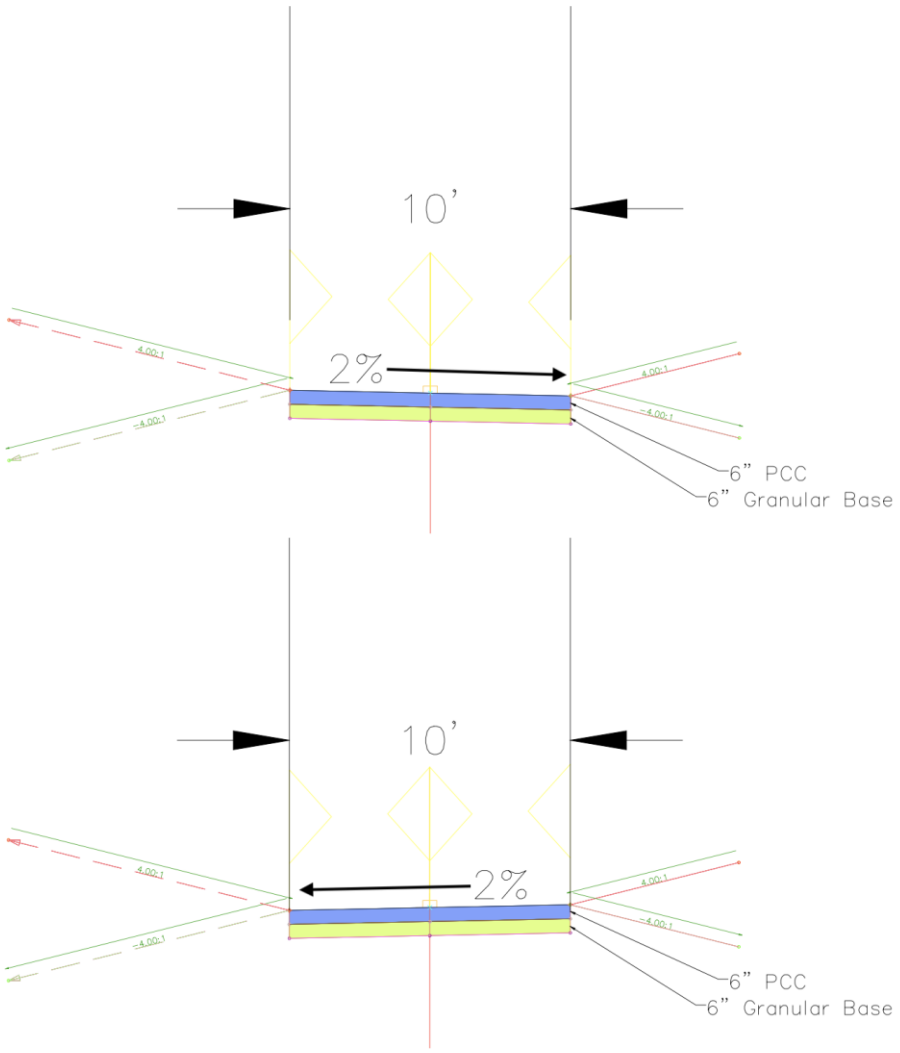


Figure 4: Appendix C

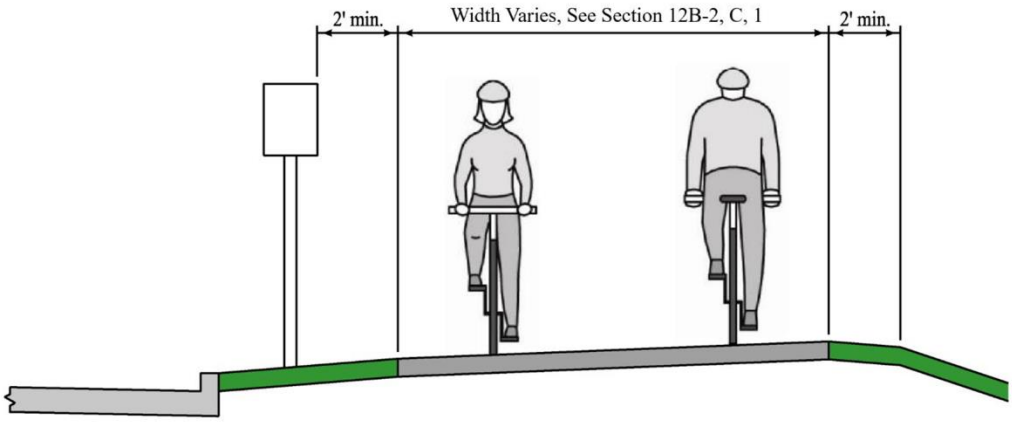
Pavement Thickness: The Iowa DOT Section 12B-2 – Shared Use Path Design C2 states that the minimum pavement thickness for PCC is 4 inches, but 5 inches is recommended. Due to the size of West Burlington's snow removal equipment, the trail is designed with a 6 in thickness.

Depth of Base: The entirety of the trial is designed with a 6-inch base of granular material. This is in compliance with Iowa DOT Section 12B-2 – Shared Path Design. Like the added thickness of the pavement, the depth of the base is above the recommended depth due to the size of West Burlington's snow removal equipment.

Cross Slope: A minimum of 1% cross slope is recommended and should drain towards the adjacent roadway according to Iowa DOT Section 12B-2 – Shared Use Path Design H1. The entirety of this project has a 2% cross slope that slopes towards the adjacent roadway where there is curb and gutter and away from the adjacent roadway where there is no curb and gutter.

Daylighting: This design has a consistent 4:1 daylighting slope throughout the project. According to Iowa DOT Section 12B-2 – Shared Use Path Design C6, the minimum graded shoulder width is 2 feet. The maximum shoulder area cross slope is 6:1.

Figure 12B-2.01: Typical Cross-Section of Two-Way Shared Use Path on Independent Right-of-Way



Source: Adapted from AASHTO *Bicycle Guide* Exhibit 5.1

Figure 5: Appendix C

Clear Space: According to the Iowa DOT Design Manual, Chapter 8 Section 8A-2, a clear zone between the edge of pavement of the trail to the edge of pavement of the roadway is required. AASHTO Roadside Design Guide defines the clear zone as "the total roadside border area, starting at the edge of the travelled way, available for safe use by errant vehicles." SUDAS Section 5C-2 states that the clear zone must be kept free of objects including light poles, culverts, sign supports, and any other fixed objects that can damage an out-of-control vehicle that could injure a pedestrian. Also stated in Iowa DOT Section 8A-2, for urban roadways with a posted speed limit of 35 mph it is preferred to have a clear zone of 10-feet. However, a clear zone of 8-feet is acceptable depending on a case-by-case basis. The team's goal was to stay within the city's right of way to the best of our ability, so the trail was designed with an 8-foot clear zone. With this clear zone, it still brings the edge of the trail outside the right of way, but we do not recommend going any less than 8-feet due to safety concerns. Agency Street has heavy traffic volumes of 8,000 vehicles per day and higher, and a significant amount of traffic travels above the posted speed limit about 10 mph over. Therefore, 8 feet should be the minimum clear space for this trail and some sections are less only due to avoiding any utilities. The 10-foot trail running along Broadway Street south of the Agency Street intersection towards the RecPlex is designed with a 6-foot clear zone. To stay consistent with the 10-feet of pavement requirement and to avoid building into drainage intakes and culverts, we recommend only a 6-foot clear zone because traffic volumes are significantly smaller. On the north side of Agency Street intersection, along Broadway Street the 5-foot trail is designed with a clear zone of 6 feet as well. According to the Iowa DOT, Chapter 8 Section 8A-2, an urban street with a posted speed limit of 25 mph, it is preferred to have a clear zone of 8 feet, but 6 feet will be accepted. Due to restricted right of

way space and existing business, we recommend building this section of the trail with a 6-foot clear space. Figure 5 visually shows the clear space required for this entirety of the project.

Table 1: Appendix B

Right-of-Way Purchase Needed			
Alignment	**Leaves ROW (STA)**	**Returns to ROW (STA)**	**Length of ROW Needed (LF)**
Gear Ave. to W Walmart Driveway	6+37	34+00	2763
W Walmart Driveway to Broadway St.	0+00	2+25	225
Broadway St. to W Burlington Ave.	0+13	5+50	537
Broadway St. to W Burlington Ave.	7+41	12+22	481
Broadway St. to W Burlington Ave.	12+75	15+69	294
Broadway St. North of Agency St.	0+00	4+94	494
Broadway St. South to Rec Plex	0+95	1+48	53
Broadway St. South to Rec Plex	9+63	10+16	53
Broadway St. South to Rec Plex	24+74	24+93	19
Broadway St. South to Rec Plex	27+50	28+66	116
Extra Trail by Rec Plex Heading South	0+10	2+43	233
Mall Intersection Trail	0+00	3+61	361
		Agency St. Trail Total	**4794**
		Broadway St. Trail Total	**474**
		Mall Intersection Trail Total	**361**
		Total Project	**5629**

Right-of Way: A goal when designing the horizontal alignment was to maximize pedestrian safety with clear space while minimizing the amount of right-of-way that needs to be purchased. Table 1 shows where the trail veers outside of the right-of-way and comes back into the right of way. Approximately 5,629-linear feet of right-of-way must be purchased for this project. Generally speaking, in the areas inn which the trail goes outside of the right-of-way, less than a 3-foot width of right-of-way must be purchased. However, in some areas, such as around driveways, a larger width of right-of-way purchase may be necessary. The right-of-way boundary is also marked on all the plan view pages on the drawing set.

Vertical Alignment: The vertical alignment for the trail was designed to minimize cut and fill, as well as making sure the surface meets the existing surface of driveways and roadways. Minimizing cut and fill was an easy task because the existing surfaces along Agency Street and Broadway Street are relatively flat. With this flat trail, it is also easy to stay within ADA compliance of a maximum vertical slope of 5%. All slopes of the vertical curves of this trail are no steeper than 4%.

Benches: The city expressed safety concerns for the senior population what walk along Agency Street to get to the Southeast Iowa Regional Medical Center. At least two park benches should be placed along the new Agency Street Trail to allow for this population to rest. We recommend using Pilot Rock recycled plastic park benches on concrete pads. Figure 6 below is an AI generated image of what it should look like.

Figure 6: Appendix C

Quantity Estimate: All quantities were estimated using AutoCAD Civil 3D.

Pedestrian Crossings

Design Process

The design of the intersections was completed in AutoCAD Civil 3D. Using the same aerial map of West Burlington, simple polyline work was done to create the crosswalks and new pavement markings like stop bars. The lines were filled with the hatching tool. Polylines were used to measure the placement of new pedestrian pushbuttons. After new intersection markings and crosswalks were designed, we began the traffic impact study.

Design Standards

Pavement Markings: The implementation of the new trail requires crosswalks since it will cross multiple prominent intersections. The crosswalks will be marked as longitudinal lines painted with waterborne paint. The Manual of Uniform Traffic Control Devices (MUTCD) Section 3B.18, recommends the longitudinal markings parallel to traffic flow for locations that have a substantial number of pedestrian crossings for added visibility. The visual from Figure 3B-19 from MUTCD demonstrates the recommended longitudinal markings.

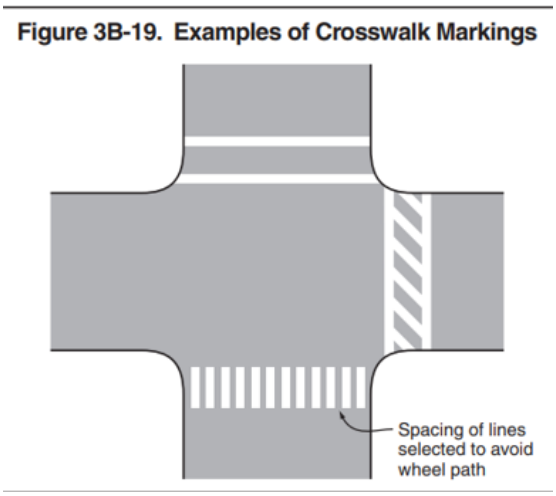


Figure 7: Appendix C

Since Agency Street currently has a considerable number of pedestrians, that number can be expected to increase if the trail is constructed; hence, we recommend longitudinal lines rather than transverse lines for a crosswalk. Stated in Iowa DOT Design Manual Chapter 3 Section 3B-1, the lines must be solid white and the spacing should avoid wheel paths and extend the entire width of the pavement. Also stated is that marked crosswalks should be no less than 6 feet in width. The Agency Street trail is designed with 10-foot-wide crosswalks to match the trail width. MUTCD Section 3B.18 also specifies that the line should be 12 to 24 inches in width and spaced by gaps of 12 to 60 inches. The proposed Agency Street crosswalks are designed with 24-inch-wide lines with 36-inch-wide gaps in between. This spacing gives the crosswalk a uniform look and the 36-inch gaps provide more buffer to avoid the wheel path. Longitudinal crosswalks are used at every intersection and driveway the new trail crosses. However, it is not necessary to implement a crosswalk at every driveway. We only recommend a crosswalk at the Menards, Walmart, and gas station driveways due to their higher traffic volumes.

With the new implementation of crosswalks, a stop line is recommended to indicate the point behind which vehicles are required to stop in compliance with a traffic control signal. The idea behind implementing this stop line is to prevent vehicles from stopping on the crosswalk. MUTCD Section 3B.16 specifies that stop lines should be 12 to 24 inches wide and placed at a minimum of 4 feet in advance of the nearest crosswalk line at controlled intersections. We designed the stop lines 24 inches wide and placed 4 feet in advance of the crosswalk.

Signage and Stand-Alone Pedestrian Pushbuttons: According to MUTCD Section 2B.11, an R1-5 sign should be mounted at each driveway that has a crosswalk. Below is a photo of an R1-5 from MUTCD.

Figure 8: Appendix C

In our plans, we designed a crosswalk for every driveway minus the homeowner's driveway on Agency Street. R1-5 signs are not necessary at signalized intersections nor at the driveways recommended for a crosswalk (see Pavement Markings section) because those driveways already have stop signs. If the city decides to implement additional crosswalks outside of the driveways mentioned, then an R1-5 sign is necessary for pedestrian protection. We also recommend using an R9-3 sign at the end of the existing sidewalk along West Houston Drive that meets with the new sidewalk leading to the mall intersection. According to Iowa DOT Design Manual Chapter 12, "Pedestrians will generally not travel out of direction and will cross at the most convenient location." We mplemented an R1-3 sign to prevent pedestrians from crossing Gear Avenue at the end of the existing sidewalk and reroute pedestrians to cross at the intersection where there is more protection. Below is a photo of an R1-3 sign from MUTCD.

Figure 9: Appendix C

With the new intersection design, we recommend using pedestrian pushbuttons for a pedestrian signal. The existing traffic signal poles have pushbuttons but it is challenging to access them due utility structures. MUTCD Section 4E.08 states that it must be obvious which pushbutton is associated with each crosswalk and conveniently located. Figure 4E-3 from MUTCD demonstrates the minimum and maximum placement of the pushbuttons.

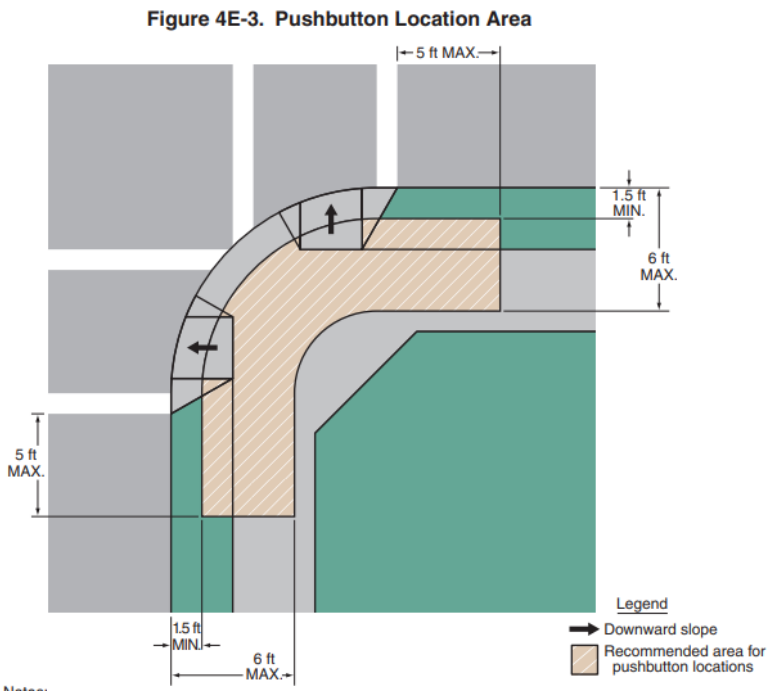


Figure 10: Appendix C

Our design has pushbuttons placed 5-feet away from the edge of the crosswalk and 1-foot offset from the edge of the trail on a concrete pad. MUTCD Section 4E-3 also requires the button to be mounted no higher than 4 feet above the sidewalk and should be at a height of approximately 3.5 feet. For this design we propose 3.5 feet for easiest accessibility. SUDAS section 8010.106 drawing depicts what should be used:

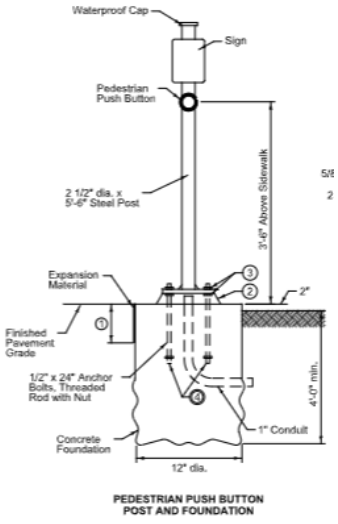


Figure 11: Appendix C

In addition, an R10-3e (MUTCD Figure 2B-26) sign shown below should be mounted above the pushbutton.

Figure 12: Appendix C

ADA Ramps: For accessibility, we recommend implementing standard curb ramps at every intersection and driveway. During our initial site visit, we were told that people in wheelchairs are frequently seen using the roadway. We believe it is very important to make this new trail accessible to everyone. SUDAS figure 7030.204 demonstrates the design requirements needed for the new curb ramps below:

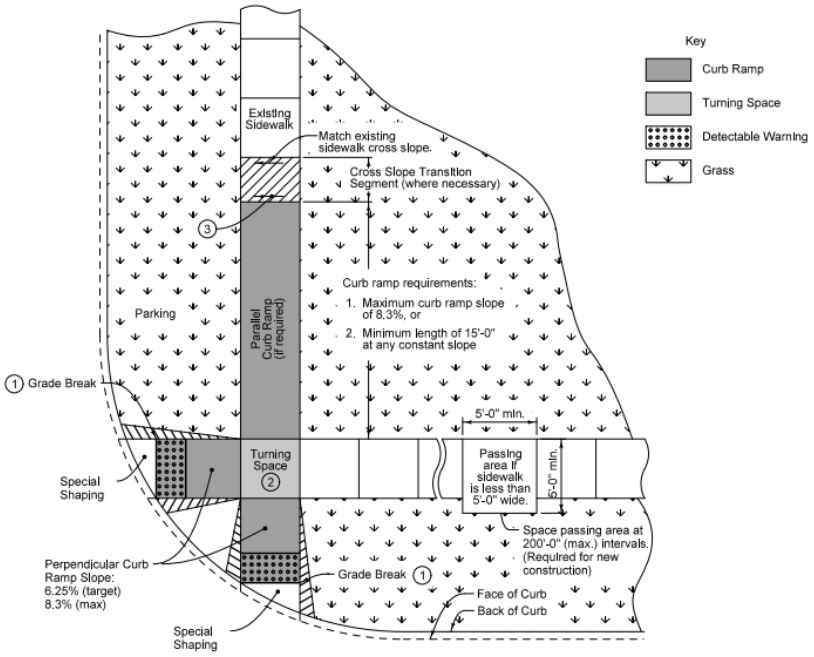


Figure 13: Appendix C

MUTCD Section 3B.18 specifies that detectable warning surfaces are required by the ADA to mark the boundary between pedestrian and vehicular ways.

Pedestrian Traffic Signals: Pedestrian signal indications will need to be installed at each intersection. We recommend using one with the countdown displayed. MUTCD Section 4E.04 Figure 4E-1 is what should be used:

Figure 14: Appendix C

During the yellow light change interval, an upraised hand signal (symbolizing DON'T WALK) should be displayed as a flashing indication for the initial portion of the yellow change, and a steady indication should be displayed during conflicting vehicle movement. The walking person (symbolizing WALK) should be displayed when pedestrians are permitted to cross. Signals must be mounted between 7- and 10-feet above sidewalk level.

Traffic Detectors: The intersections of Broadway Street/Agency Street, West Burlington Street/ Agency Strreet, and the mall driveway have traffic detectors in the pavement for actuated traffic signals. With the implementation of new crosswalks at select legs of these intersections, these detectors must be moved in compliance with FHWA. For example, the new stop line is 6 -eet back from the existing stop line at the Broadway Street/Agency Street intersection, so each of the existing detectors will need to be moved 6-feet now that traffic is stopping 6-feet further back. This applies to each intersection with detectors in the pavement. Below is a photo of the existing detector locations and where the new locations will be on Broadway Street. The red roughly depicts the existing location of the detectors, and the blue is the new placement.

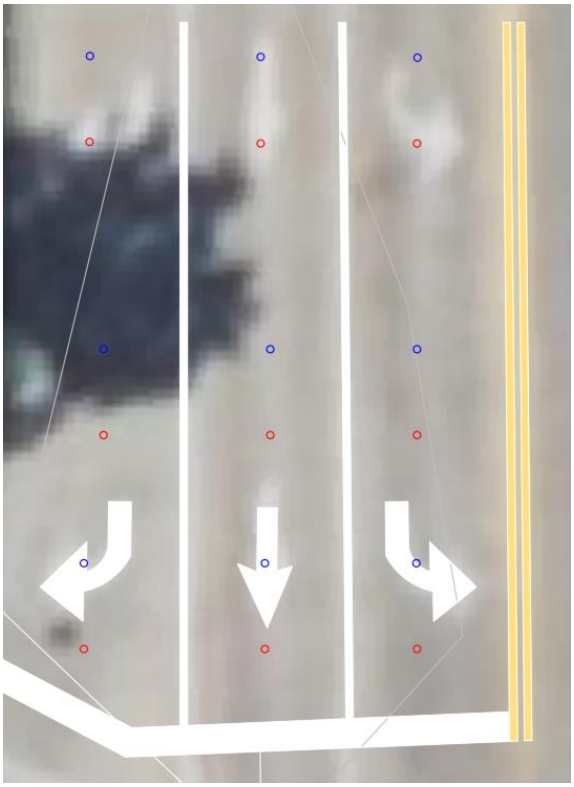


Figure 15: Appendix C

Intersection Evaluations

Evaluation Process

Using Iowa DOT's open data, we obtained AADT for each leg of each intersection. Turning movements were calculated using Mark C. Schaefer's Estimation of Intersection Turning Movements from Approach Counts as a numerical technique to convert approach volumes to turning movements. The evaluation is based off a five-year exponential growth projection, using a growth rate of 1.5%. A 50% split was assumed to determine intersection incoming and outgoing traffic. This analysis is based on the evening peak rush traffic with the assumption that this will be the busiest condition of the day. Using the Hourly Distribution of Daily Traffic 2021 Municipal Streets from Iowa DOT, we found an 8.63% increase of daily trips during the peak from 5pm to 6 pm. A traffic signal timing and phasing plan was created based off an actuated signal analysis. Assuming a start-up lost time of 3 seconds, the minimum green time used in this analysis is 9 seconds. Passage time is also needed to run the analysis assuming the maximum allowable headway as 4 seconds, the time to pass through the intersection is 2.5 seconds for the sake of analysis. Finally, the yellow time is needed.Assuming a driver's reaction time is 1 second and a grade of 0%, the yellow time is calculated as 4 seconds. The timing, phasing, and turning movements were put into Highway Capacity Software to analyze the impact a crosswalk will have on the existing intersections. A streets analysis was run for the mall, Agency/Gear, Agency/Broadway, and Agency/West Burlington intersections, and an AWSC analysis was run on the Broadway/Division intersection. The Streets

analysis was run with projected conditions only, and then with scenarios of 10 pedestrians/hour, 20 pedestrians/hour, 30 pedestrians/hour, 40 pedestrians/hour, and 50 pedestrians/hour in each direction. Using a generous pedestrian speed of 3.5 ft/second, the time it takes to cross can be used in HCS.

Intersection Evaluation Results

Mall/Target Intersection: The new crosswalk will be placed on the north leg of the intersection crossing Gear Avenue, as well as a new stop line using the design described in the Design Standards section above. The crosswalk is 6 -eet wide to match the new 5-foot sidewalk. The existing stop line will need to be removed, and the centerlines will need to be removed up to the new stop line. Below is an aerial photo of the intersection with the new crosswalk design.

Figure 16: Appendix C

With the new crosswalks, the traffic detector pods will need to be moved. The final pod (closest to the stop bar) should be no more than 10-feet away from the stop line. This is so a vehicle would not be trapped in between the stop line and the pod, and the signal will not detect the vehicle. The new stop line will be placed 7.5-feet back from the existing stop line; we recommend each of the pods be moved back 7.5 feet. During our initial site visit, the issue of pedestrians crossing Gear Avenue a short distance north of the unprotected Target/mall intersection was discussed. A safe and protected crosswalk at the intersection was recommended by the city. We decided pedestrians should cross at the intersection. We initially decided to design the crosswalk north of the intersection where pedestrians are already crossing. After further research, we decided that having the crosswalk protected at the intersection would be the safest option. According to the Manual of Uniform Traffic Control Devices. Page 384 under section 3B.18, a crosswalk without enhanced warning to oncoming traffic should not be placed if the roadway is more than 4 lanes of travel and the speed limit is 40 mph or more. Although the speed limit on S Gear Avenue is 35 mph, many vehicles go much faster.

It would be safer for pedestrians to cross with protection at the light. At the end of the existing sidewalk along West Houston Drive, the R9-3 sign shown above under Signage & Stand-Alone Pedestrian Pushbuttons, should be implemented to prevent pedestrians from crossing the street and rerouting them to the new crosswalk. Stand-alone pushbuttons installment would not be necessary since there is good access to the pushbuttons on the traffic light poles. Curb ramps will also not be necessary since they are already implemented. However, it is recommended detectable surfaces be implemented for ADA safety. No pedestrian signal indications will be necessary as they are already installed.

The pedestrian signal must allow at a minimum of 22 seconds for pedestrians to cross the street safely, plus an additional 3 seconds of flashing hand as a warning during the 4 seconds of yellow time. Pedestrians will be permitted to cross during the westbound protected left/thru/right phase and during the eastbound and westbound left turn permitted phases. Based on the timing and phasing we calculated for demonstration; this intersection allows for this new crosswalk and pedestrian phase running at a level of service D, which is the minimum accepted for urban intersections. The delay and level of service for each scenario is shown in the table below.

	Intersection LOS	**Intersection Delay**	**Multimodal LOS**		**Multimodal Delay**	
0 pedestrians/hr	D	51.8 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	D	52.4 seconds	B	B	2.48 seconds	2.33 seconds
20 pedestrians/hr	D	53 seconds	B	B	2.48 seconds	2.33 seconds
30 pedestrians/hr	D	53.6 seconds	B	B	2.48 seconds	2.33 seconds
40 pedestrians/hr	D	54.2 seconds	B	B	2.48 seconds	2.33 seconds
50 pedestrians/hr	D	54.9 seconds	B	B	2.48 seconds	2.33 seconds

Table 2: Appendix B

Agency Street/Gear Avenue: The new crosswalk will be placed on the north leg of the intersection crossing Gear Avenue as well as a new stop line using the design described in the Design Standards section above. The existing stop line will need to be removed and the right turn arrow and the west through lane arrow will also need to be removed. The two arrows will need to be repainted in white waterborne paint using the following dimensions from MUTCD Figure 3B-24:

Figure 3B-24. Examples of Standard Arrows for Pavement Markings

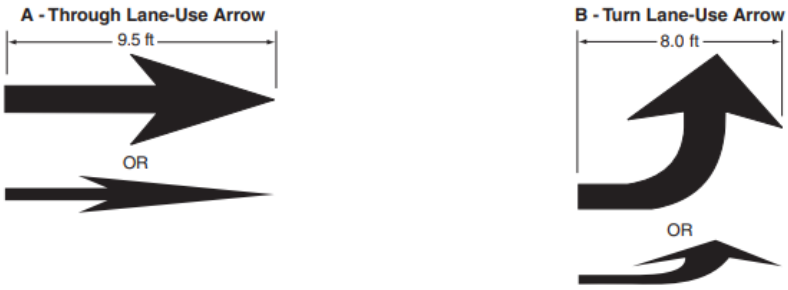


Figure 17: Appendix C

Pushbuttons will be placed at each end of the crossing as described in the Design Standards section above. Standard ADA curb ramps with detectable warning surfaces shall be implemented at each end of the crossing to meet the existing pavement. Pedestrian signal indicators do not need to be installed because they are implemented already. Below is an aerial photo of the new design on the intersection.

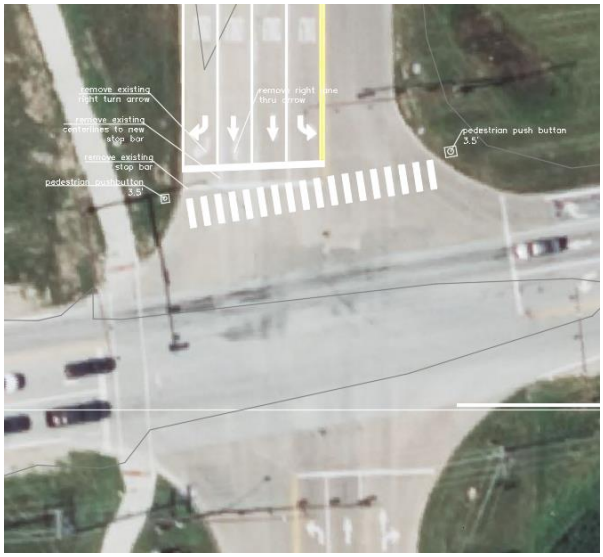


Figure 18: Appendix C

The pedestrian signal must allow a minimum of 33 seconds for pedestrians to cross the street, plus an additional three seconds of flashing hand as a warning during the four seconds of yellow time. Pedestrians will be permitted to cross during the westbound and eastbound thru/right traffic phase and during the westbound protected left/thru/right turn traffic phase. Based on the timing and phasing we calculated for demonstration; this intersection allows for this new crosswalk only if the westbound through traffic and eastbound through traffic phase green times are increased to a minimum of 35 seconds to permit adequate time to cross the intersection safely. With this optimization with the new crosswalk and pedestrian phase, this

intersection runs at a level of service of C, which is acceptable. The delay and level of service for each pedestrian scenario is shown in the table below.

	Intersection LOS	Intersection Delay	Multimodal LOS		Multimodal Delay	
0 pedestrians/hr	C	23.4 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	C	26.2 seconds	B	B	2.29 seconds	2.44 seconds
20 pedestrians/hr	C	28.8 seconds	B	B	2.30 seconds	2.45 seconds
30 pedestrians/hr	C	30.7 seconds	B	B	2.30 seconds	2.45 seconds
40 pedestrians/hr	C	32 seconds	B	B	2.30 seconds	2.45 seconds
50 pedestrians/hr	C	32.7 seconds	B	B	2.30 seconds	2.45 seconds

Table 3: Appendix B

Agency Street/Broadway Street: The new crosswalk will be placed on the north leg of the intersection crossing Broadway Street and another one on the east leg of the intersection crossing Agency Street to the new Broadway Street trail towards RecPlex. The crosswalk is designed using the same standards described above as well as the added stop line. Stand-alone pushbuttons are placed on each end of each crosswalk. The existing stop lines will need to be removed and the existing centerlines to meet the new stop lines. All three lane indicator arrows on the east leg of the intersection need to be removed and repainted behind the new stop line using the dimensions in Figure 3B-24 above. Standard ADA curb ramps with detectable warning surfaces will be implemented at each end of each crossing to meet the existing pavement. With the new crosswalks, the traffic detector pods will need to be moved. The final pod (closest to the stop bar) should be no more than 10 feet away from the stop line. This is so a vehicle would not be trapped in between the stop line and the pod, and the signal won't detect the vehicle. The new stop line will be placed 6 feet back from the existing stop line, and with that, we recommend each of the pods be moved back 6 feet as well for the East-West crosswalk. For the North-South crosswalk, the new stop line is 24 feet behind the existing stop line, so the pods must be pushed back 24 feet each. Pedestrian signal indicators described under the Design Standards section above will be mounted at each end of both crosswalks. Below is an aerial photo of the intersection with the new design:

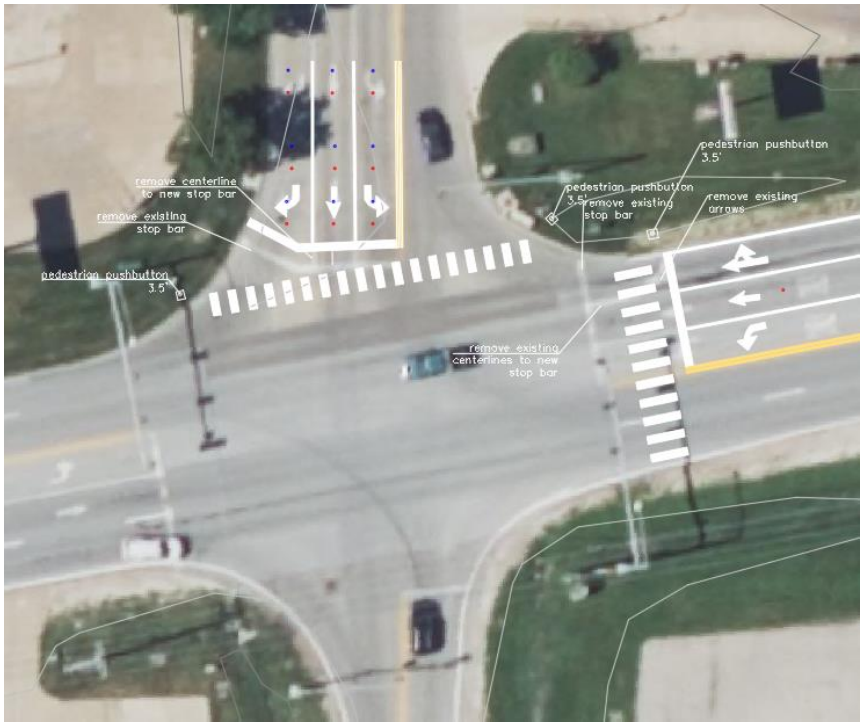


Figure 19: Appendix C

The East-West crosswalk crossing Broadway Street pedestrian signal must be timed to allow for 25 seconds for pedestrians to safely cross. There must also be an additional three seconds of flashing hand as a warning during the four seconds of yellow time. Pedestrians will be permitted to cross during the eastbound protected left/thru/right turn phase and the eastbound and westbound thru/right turn traffic phases. Based on the phasing calculated for simulation, the intersection permits the new crosswalk because the calculated eastbound and westbound green times allow for adequate timing (greater than 25 seconds) for pedestrians to cross the street. After this optimization, the intersection runs at a level of service C, which is good. he delay and level of service for the East-West crosswalk are shown in the table below.

	Intersection LOS	**Intersection Delay**	**Multimodal LOS**		**Multimodal Delay**	
0 pedestrians/hr	C	26.7 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	C	27.2 seconds	B	B	1.72 seconds	2.13 seconds
20 pedestrians/hr	C	27.8 seconds	B	B	1.72 seconds	2.14 seconds
30 pedestrians/hr	C	28.2 seconds	B	B	1.72 seconds	2.14 seconds
40 pedestrians/hr	C	28.5 seconds	B	B	1.72 seconds	2.14 seconds
50 pedestrians/hr	C	28.7 seconds	B	B	1.72 seconds	2.14 seconds

Table 4: Appendix B

Agency Street's North-South crosswalk pedestrian signal must be timed to allow for 18 seconds for pedestrians to safely cross. There must also be an additional three seconds of flashing hand as a warning during the four seconds of yellow time. Pedestrians will be permitted to cross during the southbound protected left/thru/right turn phase and the southbound and northbound permitted left/thru/right turn traffic phases.

Based on the phasing calculated for simulation, the intersection permits this East-West crosswalk only if the southbound through traffic phase is increased to a minimum of 18 seconds to allow for enough times for pedestrians to cross safely. After optimization, the intersection runs at a level of service C, which is good. The delay and level of service for the North-South crosswalk are shown in the table below.

	Intersection LOS	**Intersection Delay**	**Multimodal LOS**		**Multimodal Delay**	
0 pedestrians/hr	C	26.7 seconds	**NB**	**SB**	**NB**	**SB**
10 pedestrians/hr	C	27.2 seconds	B	B	2.30 seconds	2.30 seconds
20 pedestrians/hr	C	27.8 seconds	B	B	2.30 seconds	2.30 seconds
30 pedestrians/hr	C	28.2 seconds	B	B	2.31 seconds	2.31 seconds
40 pedestrians/hr	C	28.5 seconds	B	B	2.31 seconds	2.31 seconds
50 pedestrians/hr	C	28.7 seconds	B	B	2.31 seconds	2.31 seconds

Table 5: Appendix B

Agency Street/West Burlington Street: The new crosswalk will be placed on the north leg of the intersection crossing West Burlington Avenue as well as a new stop line using the design described in the Design Standards section above. The existing stop line will need to be removed as well as both the through lane and left turn arrows. The lane indication arrows must be repainted using the measurements shown in Figure 3B-24 above. The centerlines will need to be removed up to the new stop line. Stand-alone pedestrian pushbuttons should be placed on each end of the crosswalk. Standard ADA curb ramps with detectable warning surfaces will be implemented at each end of the crossing to meet the existing pavement. With the new crosswalks, the traffic detector pods will need to be moved. The final pod (closest to the stop bar) should be no more than 10-feet away from the stop line. This is so a vehicle would not be trapped in between the stop line and the pod, and the signal won't detect the vehicle. The new stop line will be placed 31.5 feet back from the existing stop line, and with that, we recommend the each of the pods be moved back 31.5 feet as well. Pedestrian signal indicators described under the Design Standards section above will be mounted at each end of both crosswalks. Below is an aerial photo of the intersection with the new crosswalk design:

Figure 20: Appendix C

The pedestrian signal must allow at a minimum of 13 seconds to allow pedestrians to cross the street safely. In addition, three seconds of flashing hand as a warning during the four seconds of yellow time. Pedestrians will be permitted to cross during the eastbound protected left/thru/right turn traffic phase and during the westbound and eastbound thru/right turn traffic phase. Based on the timing and phasing calculated for demonstration, this intersection allows for this new crosswalk because the eastbound and westbound phase green times are long enough to allow adequate time for a pedestrian to safely cross the street. With the new crosswalk and pedestrian phase, this intersection runs at a level of service of C which is acceptable. The delay and level of service for each pedestrian scenario is shown in the table below.

	Intersection LOS	**Intersection Delay**	**Multimodal LOS**		**Multimodal Delay**	
0 pedestrians/hr	C	20.9 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	C	21 seconds	B	B	2.11 seconds	1.92 seconds
20 pedestrians/hr	C	21.2 seconds	B	B	2.11 seconds	1.92 seconds
30 pedestrians/hr	C	21.2 seconds	B	B	2.11 seconds	1.92 seconds
40 pedestrians/hr	C	21.3 seconds	B	B	2.11 seconds	1.92 seconds
50 pedestrians/hr	C	21.4 seconds	B	B	2.11 seconds	1.92 seconds

Table 6: Appendix B

Broadway Street/Division Street: The new crosswalks will be placed on the north leg of the intersection crossing Broadway Street and another one on the west leg of the intersection crossing Division Street by the RecPlex. The crosswalk is designed using the same standards described above as well as the added stop line. Stand-alone pushbuttons are unnecessary because this is a

four-way stop intersection. With the new stop line and crosswalks, the existing stop signs will need to be moved. Stop signs need to be placed at a minimum of 2-feet from the edge of pavement and mounted at a minimum of 7-feet tall. The visual below demonstrates how the stop signs are placed:

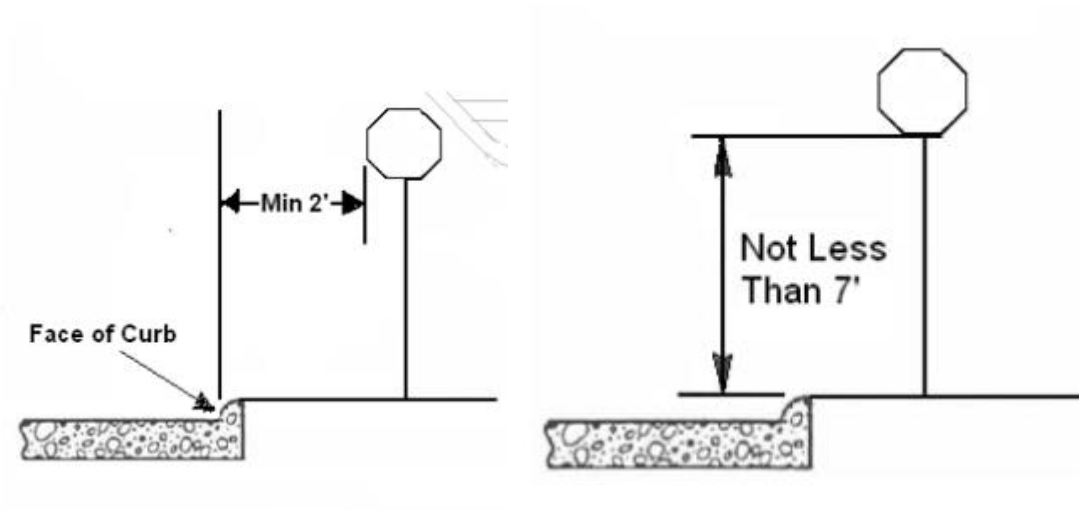


Figure 21: Appendix C

Standard ADA curb ramps with detectable warning surfaces will be implemented at each end of each crossing to meet the existing pavement. No pedestrian signal indicators are needed with stop signs. Below is an aerial photo of the intersection with the new design:

Figure 22: Appendix C

This intersection permits the new crosswalks. This all-way stop intersection operates at a level of service A and a delay of 9.9 seconds.

West Walmart Driveway: During the initial site visit and client call, concern was expressed regardomg the number of crashes at the west Walmart driveway. Two alternatives were discussed to mitigate the number of accidents. The first is to shut down the driveway entirely. This may inconvenience quite a few people, so a second alternative is to implement a no-left-turn median. Unprotected left turns on a street as busy as Agency Street are dangerous and are at a high risk for accidents. The drafted median only allows for right turns into the driveway and right turns leaving the driveway. Vehicles leaving the driveway would be have to yield to less oncoming traffic, therefore reducing the risk of accidents.

Section VII Engineer's Cost Estimate

To prepare a comprehensive cost estimation report for the preliminary design of a pedestrian path, several key components were considered, including material cost, labor, equipment, overhead, profit, contingency, final design, inspection, and administrative costs. All quantities were estimated using AutoCAD Civil 3D. Three resources were used to ensure the most accurate cost estimate: the *2024 RSMeans Heavy Construction Costs* Reference book, the Iowa Public Works Service Bureau Bid Tabulation Report, and comparing to the recently constructed Gear Ave. trail construction cost. All unit prices from the Iowa Public Works Service Bureau were determined by the weighted-average cost throughout the state in 2024 USD. The cost estimation does not include property acquisition, but the amount of right-of-way needed is outlined in this report. The total cost for each entity was then given a 10% markup for contingencies and a 20% markup for engineering and administration expenses.

The cost estimation is broken down into three different phases: Agency Street Trail, Broadway Street Trail, and the Mall Intersection Trail. Each phase includes the construction of its respective trail as well as the implementation of the intersection design on any intersections the trail crosses. Having this breakdown allows for the project to be divided into phases. It is recommended that the Agency Street Trail is constructed before the Broadway Street Trail for three reasons: 1) There are currently many pedestrians walking on Agency Street ,and it is a priority to get these pedestrians off the road and on a safe walking route. Comparatively, Broadway Street has significantly less vehicle traffic and the posted speed limit is lower, so it does not pose as much of a threat to pedestrians; 2) the Agency Street Trail would give pedestrians safe access to essential shopping, including grocery stores; 3) much of the Broadway Street Trail pedestrian traffic is expected to stem from the Agency Street Trail as students from the community college frequently travel to the RecPlex. The Mall Intersection Trail can be completed first, middle, or last since its cost is significantly lower than the other phases. Tables 7, 8, and 9 show the itemized cost estimates for each phase. The engineering and administration markup of 20% encompasses a range of essential activities, including detailed final design work, project management, permitting, inspections, and general oversight required to ensure the project's successful execution. The 10% contingency markup accounts for unforeseen circumstances such as minor design changes, unexpected site conditions, or cost fluctuations in materials and labor. While the estimate is comprehensive, it does not include costs for construction mobilization, which would increase significantly if the project were

done in phases compared to doing it at once. These costs, though critical, are variable and could be accounted for by adding an explicit allowance to the total project cost to provide a more complete financial projection. Acknowledging these exclusions ensures transparency and highlights areas where additional funding might be necessary. Table 10 has 10% added to the construction subtotal for contingencies and 20% added for engineering and administration, making the total project cost $746,200.

Table 7: Appendix B

Agency St. Trail

Reference	Item Code	Bid Item Description	Unit	Unit Price	Quantity	Cost
Iowa Public Works Service Bureau Bid Tabulation Report	2010-B	CLEARING AND GRUBBING	Acre	$ 7,102.73	1.405	$ 9,976.74
Iowa Public Works Service Bureau Bid Tabulation Report	1020-E	EXCAVATION, CLASS 10, CLASS 12, OR CLASS 13	CY	$ 8.12	216.12	$ 1,754.89
RS Means Heavy Construction Costs	G1030 115 1000	CUT & FILL COMMON EARTH	CY	$ 10.56	202.39	$ 2,137.24
Iowa Public Works Service Bureau Bid Tabulation Report	7030-C	SHARED USE PATH, PCC, 6"	SY	$ 48.20	5354.04	$ 258,064.73
Iowa Public Works Service Bureau Bid Tabulation Report	1020-J	SUBBASE, GRANULAR, 6"	SY	$ 10.75	5354.04	$ 57,555.93
Iowa Public Works Service Bureau Bid Tabulation Report	9010-A	CONVENTIONAL SEEDING, SEEDING, FERTILIZING, AND MULCHING. 1	Acre	$ 2,451.62	1.405	$ 3,443.63
Pilot Rock RJ Thomas Mfg. Co.	N/a	*100% RECYCLED PLASTIC BENCH - WITH BACKREST. RBB SERIES. (FULLY INSTALLED)	EA	$ 1,000.00	2	$ 2,000.00
RS Means Heavy Construction Costs	32 17 23.13 0604	ACRYLIC WATERBORNE, WHITE, 12" WIDE, LESS THAN 3,000-16,000 LF	LF	$ 1.60	2886	$ 4,617.60
Iowa Public Works Service Bureau Bid Tabulation Report	8020-K	PAVEMENT MARKINGS REMOVED	STA	$ 10.78	3.62	$ 39.02
Iowa Public Works Service Bureau Bid Tabulation Report	8020-G	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 102.40	4	$ 409.60
Iowa Public Works Service Bureau Bid Tabulation Report	8020-L	SYMBOLS AND LEGENDS REMOVED	EA	$ 88.33	4	$ 353.32
Traffic Safety Corp	N/a	**BULLDOG III PUSH-BUTTON STATIONS	EA	$ 3,000.00	6	$ 18,000.00
Total						$ 358,352.71

Footnote:

*Unit Price for 100% Recycled Plastic Bench – with Backrest. RBB Series. (Fully Installed) includes excavation costing $4.06, 6' x 4' - 6" PCC pad costing $128.53, 6' x 4' - 6" granular subbase costing $28.67, and 100% Recycled Plastic Bench – with Backrest. RBB Series. costing $667 with an approximate $175 installation fee, making the total unit cost in the bid item cost breakdown approximately $1,000

** the Bulldog III Push-Button Stations were a reasonable estimate of the cost compared to vendors such as Traffic Safety Corp with an added installation fee

Table 8: Appendix B

Broadway St. Trail

Reference	Item Code	Bid Item Description	Unit	Unit Price	Quantity	Cost
Iowa Public Works Service Bureau Bid Tabulation Report	2010-B	CLEARING AND GRUBBING	Acre	$ 7,102.73	0.727	$ 5,160.17
Iowa Public Works Service Bureau Bid Tabulation Report	1020-E	EXCAVATION, CLASS 10, CLASS 12, OR CLASS 13	CY	$ 8.12	83.23	$ 675.83
RS Means Heavy Construction Costs	G1030 115 1000	CUT & FILL COMMON EARTH	CY	$ 10.56	55.61	$ 587.24
Iowa Public Works Service Bureau Bid Tabulation Report	7030-C	SHARED USE PATH, PCC, 6"	SY	$ 48.20	3189.54	$ 153,735.83
Iowa Public Works Service Bureau Bid Tabulation Report	1020-J	SUBBASE, GRANULAR, 6"	SY	$ 10.75	3189.54	$ 34,287.56
Iowa Public Works Service Bureau Bid Tabulation Report	9010-A	CONVENTIONAL SEEDING, SEEDING, FERTILIZING, AND MULCHING. 1	Acre	$ 2,451.62	0.727	$ 1,781.11
Pilot Rock RJ Thomas Mfg. Co.	N/a	*100% RECYCLED PLASTIC BENCH - WITH BACKREST. RBB SERIES. (FULLY INSTALLED)	EA	$ 1,000.00	0	$ -
RS Means Heavy Construction Costs	32 17 23.13 0604	ACRYLIC WATERBORNE, WHITE, 12" WIDE, LESS THAN 3,000-16,000 LF	LF	$ 1.60	1768	$ 2,828.80
Iowa Public Works Service Bureau Bid Tabulation Report	8020-K	PAVEMENT MARKINGS REMOVED	STA	$ 10.78	0.84	$ 9.06
Iowa Public Works Service Bureau Bid Tabulation Report	8020-G	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 102.40	3	$ 307.20
Iowa Public Works Service Bureau Bid Tabulation Report	8020-L	SYMBOLS AND LEGENDS REMOVED	EA	$ 88.33	3	$ 264.99
Traffic Safety Corp	N/a	**BULLDOG III PUSH-BUTTON STATIONS	EA	$ 3,000.00	1	$ 3,000.00
Total						$ 202,637.78

Footnote:

*Unit Price for 100% Recycled Plastic Bench – with Backrest. RBB Series. (Fully Installed) includes excavation costing $4.06, 6' x 4' - 6" PCC pad costing $128.53, 6' x 4' - 6" granular subbase costing $28.67, and 100% Recycled Plastic Bench – with Backrest. RBB Series. costing $667 with an approximate $175 installation fee, making the total unit cost in the bid item cost breakdown approximately $1,000

** the Bulldog III Push-Button Stations were a reasonable estimate of the cost compared to vendors such as Traffic Safety Corp with an added installation fee

Table 9: Appendix B

Mall Trail

Reference	Item Code	Bid Item Description	Unit	Unit Price	Quantity	Cost
Iowa Public Works Service Bureau Bid Tabulation Report	2010-B	CLEARING AND GRUBBING	Acre	$ 7,102.73	0.058	$ 413.67
Iowa Public Works Service Bureau Bid Tabulation Report	1020-E	EXCAVATION, CLASS 10, CLASS 12, OR CLASS 13	CY	$ 8.12	6.28	$ 50.99
RS Means Heavy Construction Costs	G1030 115 1000	CUT & FILL COMMON EARTH	CY	$ 10.56	5.19	$ 54.81
Iowa Public Works Service Bureau Bid Tabulation Report	7030-C	SHARED USE PATH, PCC, 6"	SY	$ 48.20	200.58	$ 9,667.96
Iowa Public Works Service Bureau Bid Tabulation Report	1020-J	SUBBASE, GRANULAR, 6"	SY	$ 10.75	200.58	$ 2,156.24
Iowa Public Works Service Bureau Bid Tabulation Report	9010-A	CONVENTIONAL SEEDING, SEEDING, FERTILIZING, AND MULCHING. 1	Acre	$ 2,451.62	0.058	$ 142.78
Pilot Rock RJ Thomas Mfg. Co.	N/a	*100% RECYCLED PLASTIC BENCH - WITH BACKREST. RBB SERIES. (FULLY INSTALLED)	EA	$ 1,000.00	0	$ -
RS Means Heavy Construction Costs	32 17 23.13 0604	ACRYLIC WATERBORNE, WHITE, 12" WIDE, LESS THAN 3,000-16,000 LF	LF	$ 1.60	248	$ 396.80
Iowa Public Works Service Bureau Bid Tabulation Report	8020-K	PAVEMENT MARKINGS REMOVED	STA	$ 10.78	0.84	$ 9.06
Iowa Public Works Service Bureau Bid Tabulation Report	8020-G	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 102.40	0	$ -
Iowa Public Works Service Bureau Bid Tabulation Report	8020-L	SYMBOLS AND LEGENDS REMOVED	EA	$ 88.33	0	$ -
Traffic Safety Corp	N/a	**BULLDOG III PUSH-BUTTON STATIONS	EA	$ 3,000.00	0	$ -
Total						$ 12,892.30

Footnote:

*Unit Price for 100% Recycled Plastic Bench – with Backrest. RBB Series. (Fully Installed) includes excavation costing $4.06, 6' x 4' - 6" PCC pad costing $128.53, 6' x 4' - 6" granular subbase costing $28.67, and 100% Recycled Plastic Bench – with Backrest. RBB Series. costing $667 with an approximate $175 installation fee, making the total unit cost in the bid item cost breakdown approximately $1,000

** the Bulldog III Push-Button Stations were a reasonable estimate of the cost compared to vendors such as Traffic Safety Corp with an added installation fee

Table 10: Appendix B

Total Costs		
Entity		**Cost**
Agency St. Trail	$	358,500
Broadway St. Trail	$	202,500
Mall Trail	$	13,000
Construction Subtotal	**$**	**574,000.00**
Easements & Property Acquisition		TBD
10% Contingencies	$	57,400.00
20% Engineering & Administration	$	114,800.00
Total Project Cost	**$**	**746,200.00**

To summarize, this cost estimation report outlines the projected expenses for the proposed pedestrian path project in three phases: Agency St. Trail, Broadway St. Trail, and Mall Intersection Trail. Each phase incorporates construction, design, and safety measures specific to its location while allowing for phased implementation based on funding availability. The total project cost, including contingencies and administrative expenses, is estimated at $746,200. This phased approach prioritizes safety and accessibility, beginning with the Agency St. Trail, which addresses urgent pedestrian needs and provides access to essential services. This comprehensive breakdown ensures flexibility and transparency, paving the way for a safer and more connected community.

Appendices

Appendix A – References

Pavement Thickness - Iowa DOT Design Manual Section 12B-2

Cross Slopes - Iowa DOT Design Manual Section 12B-2

Clear Zones - Iowa DOT Design Manual, Chapter 8 Section 8A-2

- AASHTO Roadside Design Guide

- SUDAS Section 5C-2

Benches – Microsoft Copilot

Crosswalks - Manual of Uniform Traffic Control Devices Section 3B.18

- Manual of Uniform Traffic Control Devices Figure 3B-19

- Iowa DOT Design Manual Chapter 3 Section 3B-1

Stop Lines – Manual of Uniform Traffic Control Devices Section 3B.16

Stand-alone Pedestrian Pushbuttons – Manual of Uniform Traffic Control Devices Section 4E.08

- Manual of Uniform Traffic Control Devices Figure 4E-3

- Manual of Uniform Traffic Control Devices Section 4E-3

- Manual of Uniform Traffic Control Devices Figure 2B-26

- SUDAS 1080.106

ADA Ramps - SUDAS figure 7030.204

Detectable Surfaces – Manual of Uniform Traffic Control Devices Section 3B.18

Pedestrian Signal Indicators – Manual of Uniform Traffic Control Devices Section 4E.04 Figure 4E-1

Stop Signs – Iowa DOT Design Manual

Signage – Manual of Uniform Traffic Control Devices Section 2B.11 Figure 2B-2

Intersection Evaluations

- AADT – Iowa DOT Open Data
- Evening Peak Percent Increase – Iowa DOT Traffic Distribution by Hour
- Turning Movements – Estimation of Intersection Turning Movements from Approach Counts

Appendix B – Summary Tables

Table 1

Right-of-Way Purchase Needed			
Alignment	**Leaves ROW (STA)**	**Returns to ROW (STA)**	**Length of ROW Needed (LF)**
Gear Ave. to W Walmart Driveway	6+37	34+00	2763
W Walmart Driveway to Broadway St.	0+00	2+25	225
Broadway St. to W Burlington Ave.	0+13	5+50	537
Broadway St. to W Burlington Ave.	7+41	12+22	481
Broadway St. to W Burlington Ave.	12+75	15+69	294
Broadway St. North of Agency St.	0+00	4+94	494
Broadway St. South to Rec Plex	0+95	1+48	53
Broadway St. South to Rec Plex	9+63	10+16	53
Broadway St. South to Rec Plex	24+74	24+93	19
Broadway St. South to Rec Plex	27+50	28+66	116
Extra Trail by Rec Plex Heading South	0+10	2+43	233
Mall Intersection Trail	0+00	3+61	361
		Agency St. Trail Total	**4794**
		Broadway St. Trail Total	**474**
		Mall Intersection Trail Total	**361**
		Total Project	**5629**

Table 2

	Intersection LOS	**Intersection Delay**	**Multimodal LOS**		**Multimodal Delay**	
0 pedestrians/hr	D	51.8 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	D	52.4 seconds	B	B	2.48 seconds	2.33 seconds
20 pedestrians/hr	D	53 seconds	B	B	2.48 seconds	2.33 seconds
30 pedestrians/hr	D	53.6 seconds	B	B	2.48 seconds	2.33 seconds
40 pedestrians/hr	D	54.2 seconds	B	B	2.48 seconds	2.33 seconds
50 pedestrians/hr	D	54.9 seconds	B	B	2.48 seconds	2.33 seconds

Table 3

	Intersection LOS	**Intersection Delay**	**Multimodal LOS**		**Multimodal Delay**	
0 pedestrians/hr	C	23.4 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	C	26.2 seconds	B	B	2.29 seconds	2.44 seconds
20 pedestrians/hr	C	28.8 seconds	B	B	2.30 seconds	2.45 seconds
30 pedestrians/hr	C	30.7 seconds	B	B	2.30 seconds	2.45 seconds
40 pedestrians/hr	C	32 seconds	B	B	2.30 seconds	2.45 seconds
50 pedestrians/hr	C	32.7 seconds	B	B	2.30 seconds	2.45 seconds

Table 4

	Intersection LOS	Intersection Delay	Multimodal LOS		Multimodal Delay	
0 pedestrians/hr	C	26.7 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	C	27.2 seconds	B	B	1.72 seconds	2.13 seconds
20 pedestrians/hr	C	27.8 seconds	B	B	1.72 seconds	2.14 seconds
30 pedestrians/hr	C	28.2 seconds	B	B	1.72 seconds	2.14 seconds
40 pedestrians/hr	C	28.5 seconds	B	B	1.72 seconds	2.14 seconds
50 pedestrians/hr	C	28.7 seconds	B	B	1.72 seconds	2.14 seconds

Table 5

	Intersection LOS	Intersection Delay	Multimodal LOS		Multimodal Delay	
0 pedestrians/hr	C	26.7 seconds	**NB**	**SB**	**NB**	**SB**
10 pedestrians/hr	C	27.2 seconds	B	B	2.30 seconds	2.30 seconds
20 pedestrians/hr	C	27.8 seconds	B	B	2.30 seconds	2.30 seconds
30 pedestrians/hr	C	28.2 seconds	B	B	2.31 seconds	2.31 seconds
40 pedestrians/hr	C	28.5 seconds	B	B	2.31 seconds	2.31 seconds
50 pedestrians/hr	C	28.7 seconds	B	B	2.31 seconds	2.31 seconds

Table 6

	Intersection LOS	Intersection Delay	Multimodal LOS		Multimodal Delay	
0 pedestrians/hr	C	20.9 seconds	**EB**	**WB**	**EB**	**WB**
10 pedestrians/hr	C	21 seconds	B	B	2.11 seconds	1.92 seconds
20 pedestrians/hr	C	21.2 seconds	B	B	2.11 seconds	1.92 seconds
30 pedestrians/hr	C	21.2 seconds	B	B	2.11 seconds	1.92 seconds
40 pedestrians/hr	C	21.3 seconds	B	B	2.11 seconds	1.92 seconds
50 pedestrians/hr	C	21.4 seconds	B	B	2.11 seconds	1.92 seconds

Table 7

Agency St. Trail						
Reference	**Item Code**	**Bid Item Description**	**Unit**	**Unit Price**	**Quantity**	**Cost**
Iowa Public Works Service Bureau Bid Tabulation Report	2010-B	CLEARING AND GRUBBING	Acre	$ 7,102.73	1.405	$ 9,976.74
Iowa Public Works Service Bureau Bid Tabulation Report	1020-E	EXCAVATION, CLASS 10, CLASS 12, OR CLASS 13	CY	$ 8.12	216.12	$ 1,754.89
RS Means Heavy Construction Costs	G1030 115 1000	CUT & FILL COMMON EARTH	CY	$ 10.56	202.39	$ 2,137.24
Iowa Public Works Service Bureau Bid Tabulation Report	7030-C	SHARED USE PATH, PCC, 6"	SY	$ 48.20	5354.04	$ 258,064.73

Iowa Public Works Service Bureau Bid Tabulation Report	1020-J	SUBBASE, GRANULAR, 6"	SY	$ 10.75	5354.04	$ 57,555.93
Iowa Public Works Service Bureau Bid Tabulation Report	9010-A	CONVENTIONAL SEEDING, SEEDING, FERTILIZING, AND MULCHING. 1	Acre	$ 2,451.62	1.405	$ 3,443.63
Pilot Rock RJ Thomas Mfg. Co.	N/a	*100% RECYCLED PLASTIC BENCH - WITH BACKREST. RBB SERIES. (FULLY INSTALLED)	EA	$ 1,000.00	2	$ 2,000.00
RS Means Heavy Construction Costs	32 17 23.13 0604	ACRYLIC WATERBORNE, WHITE, 12" WIDE, LESS THAN 3,000-16,000 LF	LF	$ 1.60	2886	$ 4,617.60
Iowa Public Works Service Bureau Bid Tabulation Report	8020-K	PAVEMENT MARKINGS REMOVED	STA	$ 10.78	3.62	$ 39.02
Iowa Public Works Service Bureau Bid Tabulation Report	8020-G	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 102.40	4	$ 409.60
Iowa Public Works Service Bureau Bid Tabulation Report	8020-L	SYMBOLS AND LEGENDS REMOVED	EA	$ 88.33	4	$ 353.32
Traffic Safety Corp	N/a	**BULLDOG III PUSH-BUTTON STATIONS	EA	$ 3,000.00	6	$ 18,000.00
Total						$ 358,352.71

Footnote:

*Unit Price for 100% Recycled Plastic Bench – with Backrest. RBB Series. (Fully Installed) includes excavation costing $4.06, 6' x 4' - 6" PCC pad costing $128.53, 6' x 4' - 6" granular subbase costing $28.67, and 100% Recycled Plastic Bench – with Backrest. RBB Series. costing $667 with an approximate $175 installation fee, making the total unit cost in the bid item cost breakdown approximately $1,000

** the Bulldog III Push-Button Stations were a reasonable estimate of the cost compared to vendors such as Traffic Safety Corp with an added installation fee

Table 8

Broadway St. Trail						
Reference	**Item Code**	**Bid Item Description**	**Unit**	**Unit Price**	**Quantity**	**Cost**
Iowa Public Works Service Bureau Bid Tabulation Report	2010-B	CLEARING AND GRUBBING	Acre	$ 7,102.73	0.727	$ 5,160.17
Iowa Public Works Service Bureau Bid Tabulation Report	1020-E	EXCAVATION, CLASS 10, CLASS 12, OR CLASS 13	CY	$ 8.12	83.23	$ 675.83
RS Means Heavy Construction Costs	G1030 115 1000	CUT & FILL COMMON EARTH	CY	$ 10.56	55.61	$ 587.24
Iowa Public Works Service Bureau Bid Tabulation Report	7030-C	SHARED USE PATH, PCC, 6"	SY	$ 48.20	3189.54	$ 153,735.83
Iowa Public Works Service Bureau Bid Tabulation Report	1020-J	SUBBASE, GRANULAR, 6"	SY	$ 10.75	3189.54	$ 34,287.56

Iowa Public Works Service Bureau Bid Tabulation Report	9010-A	CONVENTIONAL SEEDING, SEEDING, FERTILIZING, AND MULCHING. 1	Acre	$ 2,451.62	0.727	$ 1,781.11
Pilot Rock RJ Thomas Mfg. Co.	N/a	*100% RECYCLED PLASTIC BENCH - WITH BACKREST. RBB SERIES. (FULLY INSTALLED)	EA	$ 1,000.00	0	$ -
RS Means Heavy Construction Costs	32 17 23.13 0604	ACRYLIC WATERBORNE, WHITE, 12" WIDE, LESS THAN 3,000-16,000 LF	LF	$ 1.60	1768	$ 2,828.80
Iowa Public Works Service Bureau Bid Tabulation Report	8020-K	PAVEMENT MARKINGS REMOVED	STA	$ 10.78	0.84	$ 9.06
Iowa Public Works Service Bureau Bid Tabulation Report	8020-G	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 102.40	3	$ 307.20
Iowa Public Works Service Bureau Bid Tabulation Report	8020-L	SYMBOLS AND LEGENDS REMOVED	EA	$ 88.33	3	$ 264.99
Traffic Safety Corp	N/a	**BULLDOG III PUSH-BUTTON STATIONS	EA	$ 3,000.00	1	$ 3,000.00
Total						$ 202,637.78

Footnote:

*Unit Price for 100% Recycled Plastic Bench – with Backrest. RBB Series. (Fully Installed) includes excavation costing $4.06, 6' x 4' - 6" PCC pad costing $128.53, 6' x 4' - 6" granular subbase costing $28.67, and 100% Recycled Plastic Bench – with Backrest. RBB Series. costing $667 with an approximate $175 installation fee, making the total unit cost in the bid item cost breakdown approximately $1,000

** the Bulldog III Push-Button Stations were a reasonable estimate of the cost compared to vendors such as Traffic Safety Corp with an added installation fee

Table 9

Mall Trail

Reference	Item Code	Bid Item Description	Unit	Unit Price	Quantity	Cost
Iowa Public Works Service Bureau Bid Tabulation Report	2010-B	CLEARING AND GRUBBING	Acre	$ 7,102.73	0.058	$ 413.67
Iowa Public Works Service Bureau Bid Tabulation Report	1020-E	EXCAVATION, CLASS 10, CLASS 12, OR CLASS 13	CY	$ 8.12	6.28	$ 50.99
RS Means Heavy Construction Costs	G1030 115 1000	CUT & FILL COMMON EARTH	CY	$ 10.56	5.19	$ 54.81
Iowa Public Works Service Bureau Bid Tabulation Report	7030-C	SHARED USE PATH, PCC, 6"	SY	$ 48.20	200.58	$ 9,667.96
Iowa Public Works Service Bureau Bid Tabulation Report	1020-J	SUBBASE, GRANULAR, 6"	SY	$ 10.75	200.58	$ 2,156.24
Iowa Public Works Service Bureau Bid Tabulation Report	9010-A	CONVENTIONAL SEEDING, SEEDING, FERTILIZING, AND MULCHING. 1	Acre	$ 2,451.62	0.058	$ 142.78

Pilot Rock RJ Thomas Mfg. Co.	N/a	*100% RECYCLED PLASTIC BENCH - WITH BACKREST. RBB SERIES. (FULLY INSTALLED)	EA	$ 1,000.00	0	$ -
RS Means Heavy Construction Costs	32 17 23.13 0604	ACRYLIC WATERBORNE, WHITE, 12" WIDE, LESS THAN 3,000-16,000 LF	LF	$ 1.60	248	$ 396.80
Iowa Public Works Service Bureau Bid Tabulation Report	8020-K	PAVEMENT MARKINGS REMOVED	STA	$ 10.78	0.84	$ 9.06
Iowa Public Works Service Bureau Bid Tabulation Report	8020-G	PAINTED SYMBOLS AND LEGENDS, WATERBORNE OR SOLVENT-BASED	EA	$ 102.40	0	$ -
Iowa Public Works Service Bureau Bid Tabulation Report	8020-L	SYMBOLS AND LEGENDS REMOVED	EA	$ 88.33	0	$ -
Traffic Safety Corp	N/a	**BULLDOG III PUSH-BUTTON STATIONS	EA	$ 3,000.00	0	$ -
Total						$ 12,892.30

Footnote:

*Unit Price for 100% Recycled Plastic Bench – with Backrest. RBB Series. (Fully Installed) includes excavation costing $4.06, 6' x 4' - 6" PCC pad costing $128.53, 6' x 4' - 6" granular subbase costing $28.67, and 100% Recycled Plastic Bench – with Backrest. RBB Series. costing $667 with an approximate $175 installation fee, making the total unit cost in the bid item cost breakdown approximately $1,000

** the Bulldog III Push-Button Stations were a reasonable estimate of the cost compared to vendors such as Traffic Safety Corp with an added installation fee

Table 10

Total Costs

Entity		Cost
Agency St. Trail	$	358,500
Broadway St. Trail	$	202,500
Mall Trail	$	13,000
Construction Subtotal	**$**	**574,000.00**
Easements & Property Acquisition		TBD
10% Contingencies	$	57,400.00
20% Engineering & Administration	$	114,800.00
Total Project Cost	**$**	**746,200.00**

Appendix C – Visuals

Figure 1

Figure 2

Figure 3

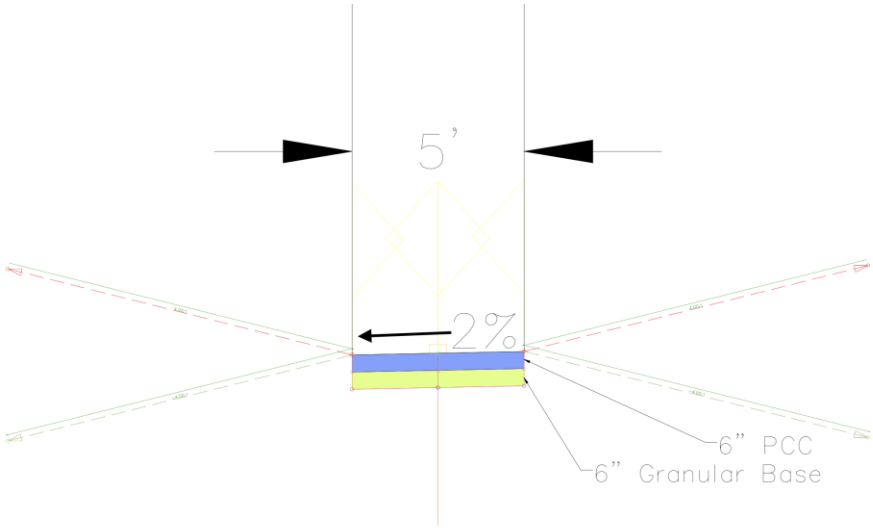


Figure 4

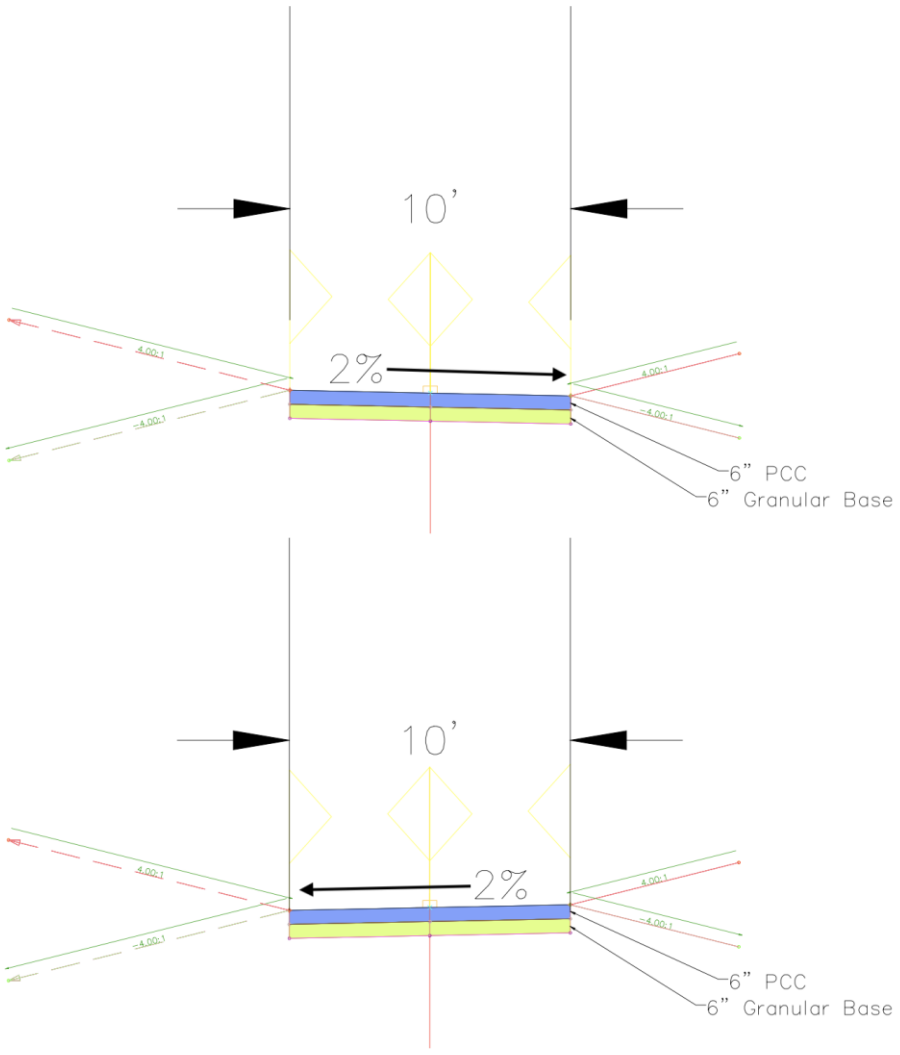
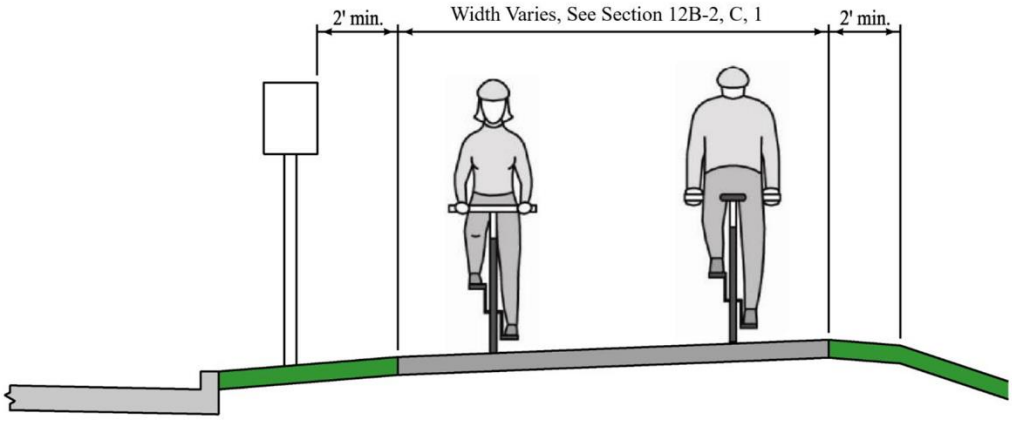


Figure 5

Figure 12B-2.01: Typical Cross-Section of Two-Way Shared Use Path on Independent Right-of-Way



Source: Adapted from AASHTO *Bicycle Guide* Exhibit 5.1

Figure 6

Figure 7

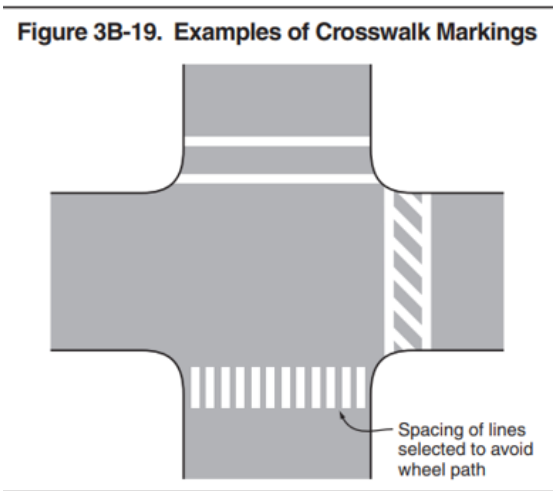


Figure 8

Figure 9

Figure 10

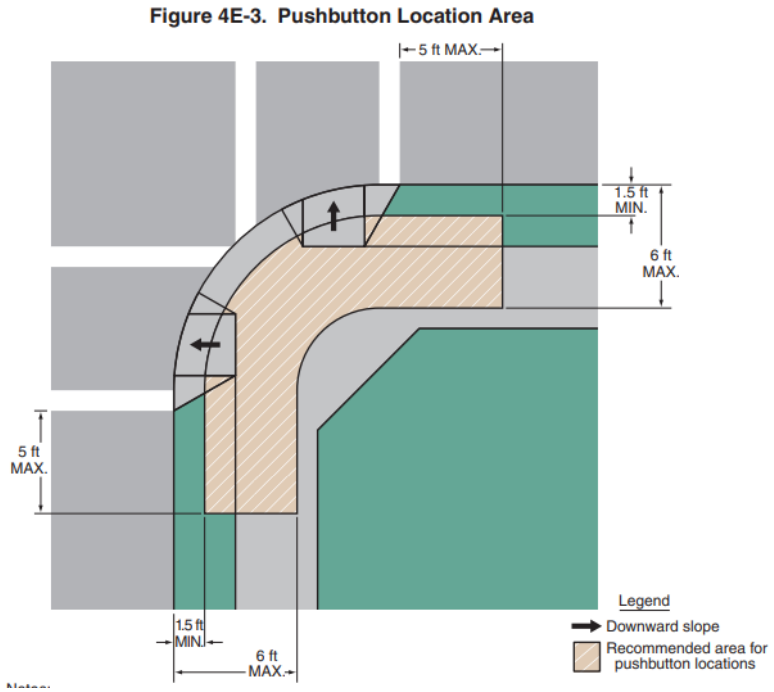


Figure 11

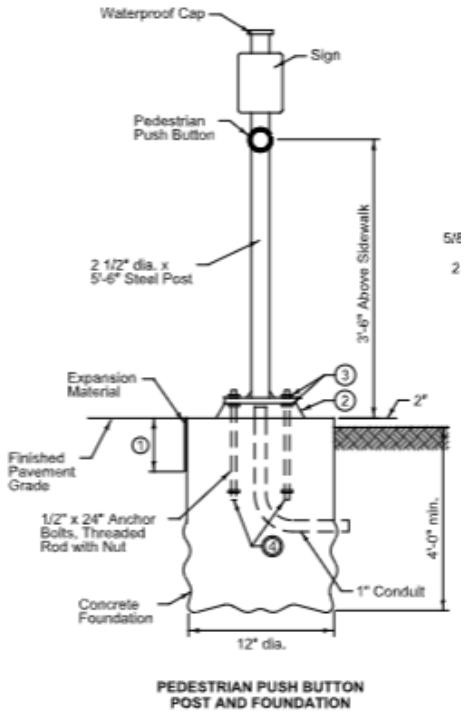


Figure 12

R10-3e

Figure 13

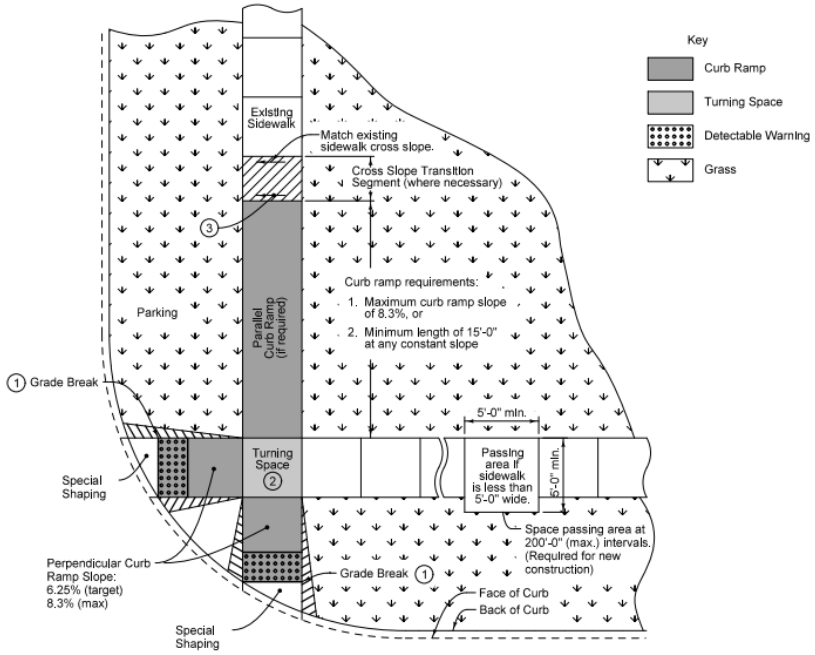


Figure 14

Figure 15

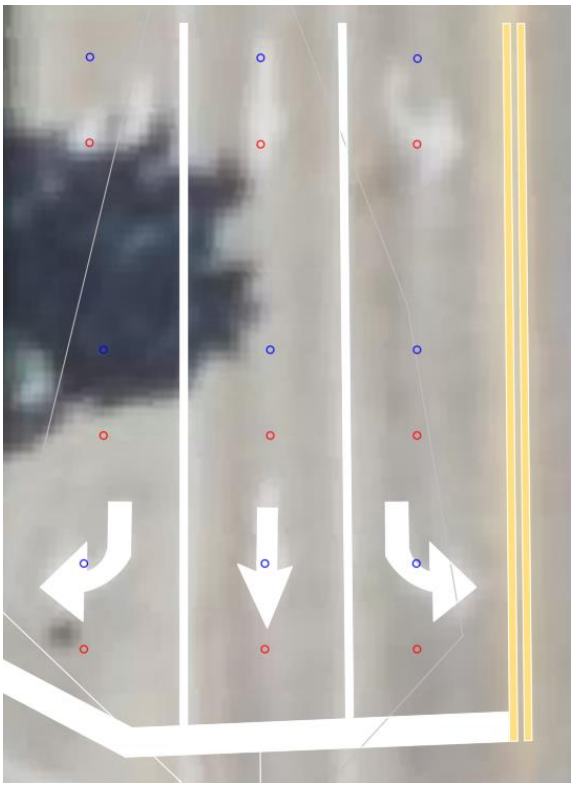


Figure 16

Figure 17

Figure 3B-24. Examples of Standard Arrows for Pavement Markings

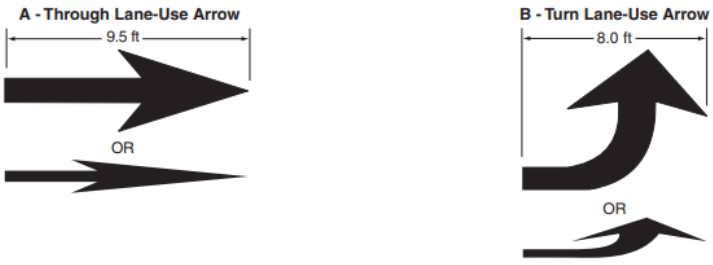


Figure 18

Figure 19

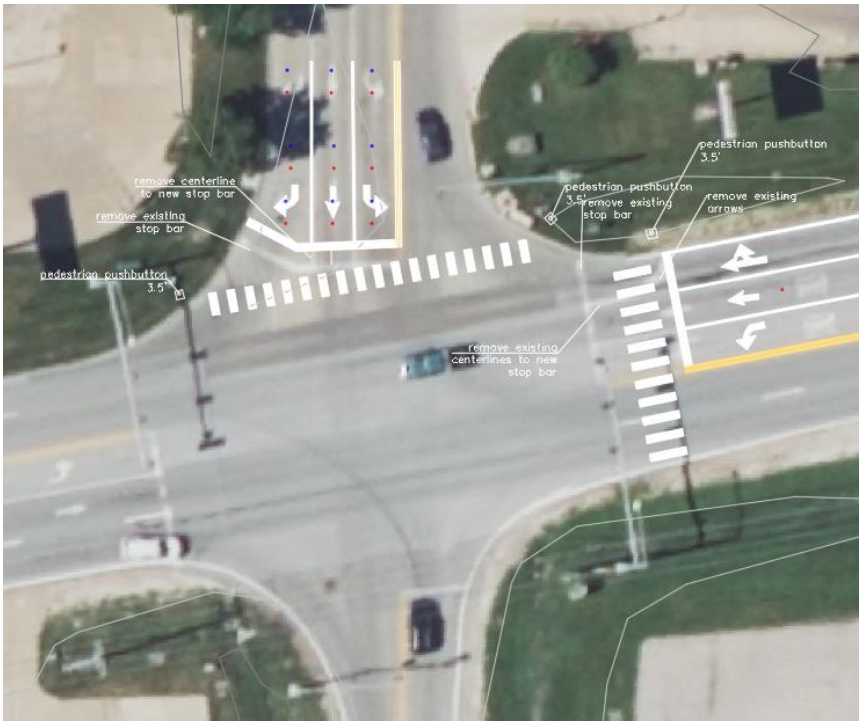


Figure 20

Figure 21

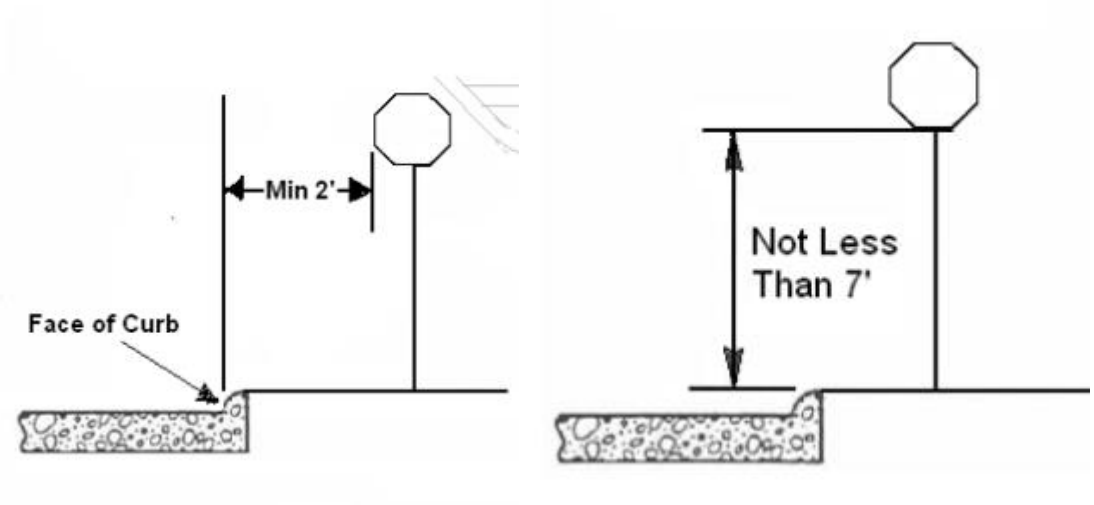


Figure 22

Appendix D – Calculations

Mall Intersection Turning Movement Calculations

Mall Intersection

Current AADT				assume 50% split:
North leg:	8800	veh/day	arterial	
East Leg:	1000	veh/day	collector	
South leg:	8800	veh/day	arterial	
West leg:	3820	veh/day	collector	

Projected AADT		T=T(1+r)^n	n=	5
North leg:	9480	veh/day	growth=	1.5
East Leg:	1077	veh/day		
South leg:	9480	veh/day		
West leg:	4115	veh/day		

Intersection Geometries

Current AADT

North Leg:			
	4400	veh/day	northbound
	4400	veh/day	southbound
South leg:			
	4400	veh/day	northbound
	4400	veh/day	southbound
East leg:			
West leg:			
	1910	veh/day	westbound
	1910	veh/day	eastbound

Projected AADT

North Leg:		
4740	veh/day	northbound
4740	veh/day	southbound
south leg:		
4740	veh/day	northbound
4740	veh/day	southbound
East leg:		
539	veh/day	eastbound
539	veh/day	westbound
west leg:		
2058	veh/day	eastbound
2058	veh/day	westbound

AADT Hourly Count - Evening Pea

Evening Peak: 5p-6p	8.74
	8.59
	8.57
average:	8.633333
hourly percentage:	0.08633

Projected North Leg Hourly:	409	veh/hour	northbound
	409	veh/hour	southbound
Projected South Leg Hourly:	409	veh/hour	northbound
	409	veh/hour	southbound
Projected East Leg Hourly:	47	veh/hour	eastbound
	47	veh/hour	westbound
Projected West Leg Hourly:	178	veh/hour	eastbound
	178	veh/hour	westbound

Type of Approach	Proportion Left	Through	Right
Central business district	0.10	0.78	0.12
Arterial to arterial	0.12	0.76	0.12
Arterial to collector	0.04	0.91	0.05
Collector to arterial	0.30	0.38	0.32
Collector to collector	0.10	0.70	0.20

Source: Cited reference 2.

Turning Movements

	From				
To	N	E	S	W	Oi
N	0	0.32	0.76	0.3	409
E	0.04	0	0.05	0.7	47
S	0.76	0.3	0	0.32	409
W	0.05	0.7	0.04	0	178
Dj	409	47	409	178	1043

Ai=Oi/sqrt(S)

	i	Ai
N	1	12.58
E	2	1.19
S	3	12.70
W	4	6.28

Bj=Dj/sum of Ai*Pij

	j	Bj
N	1	40.86
E	2	3.84
S	3	41.42
W	4	20.53

Ai=Oi/sum of Bj*Pij

	i	Ai
N	1	12.52
E	2	1.18
S	3	12.76
W	4	6.31

RMSE: 0.00436 <0.01

Tij=Pij*Ai*Bj

j		from	i			
to	from/to	N	E	S	W	Oi
	N	0	15	396	77	489
	E	2	0	2	17	21
	S	394	15	0	84	493
	W	13	17	10	0	40
	Dj	409	47	409	178	
		left	thru	right		
	eastbound	77	17	84		
	westbound	15	17	15		
	northbound	10	396	2		
	southbound	2	394	13		

Broadway St/Division St Turning Movements Calculations

Broadway St & Division St						**Current AADT**			**Prjected AADT**	
Current AADT				assume 50% split:		North Leg:			North leg:	
North leg:	3370 veh/day		collector			1685	veh/day	northbound	1815	northbound
East Leg:	4850 veh/day		collector			1685	veh/day	southbound	1815	southbound
South leg:	590 veh/day		collector			South leg:			South leg:	
West leg:	4850 veh/day		collector			295	veh/day	northbound	318	northbound
Projected AADT		T=T(1+r)^n	n=	5		295	veh/day	southbounf	318	southbound
North leg:	3630	veh/day	growth=	1.5	0.015	East leg:			East leg:	
East Leg:	5225	veh/day				2425	veh/day	eastbound	2612	eastbound
South leg:	636	veh/day				2425	veh/day	westbound	2612	westbound
West leg:	5225	veh/day				West leg:			West leg:	
						2425	veh/day	eastbound	2612	eastbound
Intersection Geometries						2425	veh/day	westbound	2612	westbound

AADT Hourly Count - Evening Peak											
Evening Peak: 5p-6p	8.74										
	8.59										
	8.57										
Average:	8.63										
Hourly Percentage:	0.0863										
Projected North Leg Hourly:		157	veh/hour	northbound							
		157	veh/hour	southbound							
Projected South Leg Hourly:		27	veh/hour	northbound							
		27	veh/hour	southbound							
Projected East Leg Hourly:		225	veh/hour	eastbound							
		225	veh/hour	westbound							
Projected West Leg Hourly:		225	veh/hour	eastbound							
		225	veh/hour	westbound							

Arterial to arterial	0.12	0.76	0.12
Arterial to collector	0.04	0.91	0.05
Collector to arterial	0.30	0.38	0.32
Collector to collector	0.10	0.70	0.20

Source: Cited reference 2.

Turning Movements - Projected Only

	From				
To	**N**	**E**	**S**	**W**	**Oi**
N	0	0.1	0.7	0.1	157
E	0.1	0	0.2	0.7	225
S	0.7	0.2	0	0.2	27
W	0.2	0.7	0.1	0	225
Dj	157	225	27	225	635

Ai=Oi/sqrt(S)		
	i	**Ai**
North	**1**	14.237
East	2	8.050
South	3	0.569
West	4	8.050
Bj=Dj/sum of Pij*Ai		
	i	**Bj**
North	**1**	55.6818
East	2	31.4315
South	3	2.21519
West	4	31.4315
Ai=Oi/Sum of Bj*Pij		
	i	**Ai**
North	**1**	14.2671
East	2	8.04803
South	3	0.56658
West	4	8.04803
RMSE=	0.0057788	<0.01

Tij=Pij*Ai*Bj					
	from	i			
to	N	**E**	**S**	**W**	**Oi**
N	0	45	22	45	**112**
E	45	0	4	177	225
S	22	4	0	4	29
W	90	177	2	0	269
Dj	157	225	27	225	
		left	**thru**	**right**	
	eastbound	45	177	4	
	westbound	4	177	45	
	northbound	4	22	2	
	southbound	90	22	45	

West Burlington Ave/Agency St Turning Movement Calculations

W. Burlington Avenue & Agency Street							Current AADT			Prjected AADT		
Current AADT					assume 50% split:		North Leg:			North leg:		
North leg:	4190 veh/day		arterial				2095	veh/day	northbound	2257	veh/day	northbound
East Leg:	10900 veh/day		arterial				2095	veh/day	southbound	2257	veh/day	southbound
South leg:	3980 veh/day		arterial				South leg:			South leg:		
West leg:	10000 veh/day		arterial				1990	veh/day	northbound	2144	veh/day	northbound
Projected AADT		T=T(1+r)^n	n=	5			1990	veh/day	southbounf	2144	veh/day	southbound
North leg:	4514	veh/day	growth=	1.5	0.015		East leg:			East leg:		
East Leg:	11742	veh/day					5450	veh/day	eastbound	5871	veh/day	eastbound
South leg:	4288	veh/day					5450	veh/day	westbound	5871	veh/day	westbound
West leg:	10773	veh/day					West leg:			West leg:		
							5000	veh/day	eastbound	5386	veh/day	eastbound
Intersection Geometries							5000	veh/day	westbound	5386	veh/day	westbound

AADT Hourly Count - Evening Peak					
Evening Peak: 5p-6p	8.74				
	8.59				
	8.57				
Average=	8.633333				
Hourly Percentage=	0.08633				
Projected North Leg Hourly:		195	veh/hour	northbound	
		195	veh/hour	southbound	
Projected South Leg Hourly:		185	veh/hour	northbound	
		185	veh/hour	southbound	
Projected East Leg Hourly:		507	veh/hour	eastbound	
		507	veh/hour	westbound	
Projected West Leg Hourly:		465	veh/hour	eastbound	
		465	veh/hour	westbound	

Type of Approach	Proportion Left	Through	Right
Central business district	0.10	0.78	0.12
Arterial to arterial	0.12	0.76	0.12
Arterial to collector	0.04	0.91	0.05
Collector to arterial	0.30	0.38	0.32
Collector to collector	0.10	0.70	0.20

Source: Cited reference 2.

Turning Movements - Projected Only

j		From	i			
To	From/to	N	E	S	W	Oi
	N	0	0.12	0.76	0.12	195
	E	0.12	0	0.12	0.76	507
	S	0.76	0.12	0	0.12	185
	W	0.12	0.76	0.12	0	465
	Dj	195	507	185	465	1352

Ai=Oi/sqrt(S)		
	i	Ai
N	1	6.932
E	2	15.998
S	3	6.035
W	4	9.198
Bj=Dj/sum of Ai*Pij		
	i	Bj
N	1	25.623
E	2	59.321
S	3	22.311
W	4	33.906
Ai=Oi/sum of Bj*Pij		
	i	Ai
N	1	6.929
E	2	16.085
S	3	6.034
W	4	9.147
RMSE=	0.00774	<0.01

Tij=Pij*Ai*Bj							
		From	i				
		N	E	S	W	Oi	
j	N	0	49	117	28	195	
to	E	49	0	43	412	505	
	S	117	43	0	24	185	
	W	28	414	25	0	467	
	Dj	195	507	185	465		
			left	thru	right		
		eastbound	28	412	24		
		westbound	43	414	49		

Broadway St/Agency St Turning Movement Calculations

Broadway Street & Agency Street						Current AADT			Prjected AADT		
Current AADT				assume 50% split:		North Leg:			North leg:		
North leg:	5800 veh/day	arterial				2900	veh/day	northbound	3124	veh/day	northbound
East Leg:	10000 veh/day	arterial				2900	veh/day	southbound	3124	veh/day	southbound
South leg:	3370 veh/day	collector				South leg:			South leg:		
West leg:	8000 veh/day	arterial				1685	veh/day	northbound	1815	veh/day	northbound
Projected AADT	T=T(1+r)^n	n=	5			1685	veh/day	southbounf	1815	veh/day	southbound
North leg:	6248 veh/day	growth=	1.5	0.015		East leg:			East leg:		
East Leg:	10773 veh/day					5000	veh/day	eastbound	5386	veh/day	eastbound
South leg:	3630 veh/day					5000	veh/day	westbound	5386	veh/day	westbound
West leg:	8618 veh/day					West leg:			West leg:		
						4000	veh/day	eastbound	4309	veh/day	eastbound
Intersection Geometries						4000	veh/day	westbound	4309	veh/day	westbound

AADT Hourly Count - Evening Peak				
Evening Peak: 5p-6p	8.74			
	8.59			
	8.57			
Average=	8.633333			
Hourly Percentage=	0.08633			
Projected North Leg Hourly:	270	veh/hour	northbound	
	270	veh/hour	southbound	
Projected South Leg Hourly:	157	veh/hour	northbound	
	157	veh/hour	southbound	
Projected East Leg Hourly:	465	veh/hour	eastbound	
	465	veh/hour	westbound	
Projected West Leg Hourly:	372	veh/hour	eastbound	
	372	veh/hour	westbound	

Type of Approach	Proportion Left	Through	Right
Central business district	0.10	0.78	0.12
Arterial to arterial	0.12	0.76	0.12
Arterial to collector	0.04	0.91	0.05
Collector to arterial	0.30	0.38	0.32
Collector to collector	0.10	0.70	0.20

Source: Cited reference 2.

north leg	arterial
east leg	arterial
south leg	collector
west leg	arterial

Turning Movements - Projected Only

j		from	i			
to	from/to	N	E	S	W	Oi
	N	0	0.12	0.38	0.12	270
	E	0.12	0	0.32	0.76	465
	S	0.91	0.04	0	0.05	157
	W	0.12	0.76	0.3	0	372
	Dj	270	465	157	372	1264

Ai=Oi/sqrt(S)		
	i	Ai
N	1	11.69
E	2	21.77
S	3	3.24
W	4	5.55
Bj=Dj/sum of Ai*Pij		
	i	Bj
N	1	43.367
E	2	80.902
S	3	12.008
W	4	20.538
Ai=Oi/sum of Bj*Pij		
	i	Ai
N	1	11.688
E	2	21.838
S	3	3.235
W	4	5.528
RMSE:	0.00965	<0.01
Tij=Pij*Ai*Bj		

		From	i			
j		N	E	S	W	Oi
to	N	0	114	53	29	196
	E	113	0	84	340	537
	S	128	10	0	3	142
	W	29	341	20	0	390
	Dj	270	465	157	372	

	Left	Thru	Right
eastbound	29	340	3
westbound	10	341	114
northbound	20	53	84
southbound	113	128	29

Gear Ave/Agency St Turning Movement Calculations

Gear Avenue & Agency Street						Current AADT			Prjected AADT		
Current AADT					assume 50% split:	North Leg:			North leg:		
North leg:	10200 veh/day		arterial			5100	veh/day	northbound	5494	veh/day	northbound
East Leg:	8000 veh/day		arterial			5100	veh/day	southbound	5494	veh/day	southbound
South leg:	7200 veh/day		arterial			South leg:			South leg:		
West leg:	5700 veh/day		arterial			3600	veh/day	northbound	3878	veh/day	northbound
Projected AADT		T=T(1+r)^n	n=	5		3600	veh/day	southbounf	3878	veh/day	southbound
North leg:	10988	veh/day	growth=	1.5		East leg:			East leg:		
East Leg:	8618	veh/day				4000	veh/day	eastbound	4309	veh/day	eatbound
South leg:	7756	veh/day				4000	veh/day	westbound	4309	veh/day	westbound
West leg:	6141	veh/day				West leg:			West leg:		
						2850	veh/day	eastbound	3070	veh/day	eastbound
Intersection Geometries						2850	veh/day	westbound	3070	veh/day	westbound

AADT Hourly Count - Evening Peak				
Evening Peak: 5p-6p	8.74			
	8.59			
	8.57			
Average:	8.633333			
Hourly Percentage:	0.08633			
Projected North Leg Hourly:	474	veh/hour	northbound	
	474	veh/hour	southbound	
Projected South Leg Hourly:	335	veh/hour	northbound	
	335	veh/hour	southbound	
Projected East Leg Hourly:	372	veh/hour	eastbound	
	372	veh/hour	westbound	
Projected West Leg Hourly:	265	veh/hour	eastbound	
	265	veh/hour	westbound	

Type of Approach	Left	Through	Right
Central business district	0.10	0.78	0.12
Arterial to arterial	0.12	0.76	0.12
Arterial to collector	0.04	0.91	0.05
Collector to arterial	0.30	0.38	0.32
Collector to collector	0.10	0.70	0.20

Source: Cited reference 2.

Turning Movements - Projected Only

j		from	i			
to	from/to	N	E	S	W	Oi
	N	0	0.12	0.76	0.12	474
	E	0.12	0	0.12	0.76	372
	S	0.76	0.12	0	0.12	335
	W	0.12	0.76	0.12	0	265
	Di	474	372	335	265	1446

Ai=Oi/sqrt(S)		
	i	Ai
N	1	19.90
E	2	13.87
S	3	4.79
W	4	4.86
Bj=Dj/sum of Ai*Pij		
	i	Bj
N	1	80.48
E	2	55.87
S	3	19.28
W	4	19.63
Ai=Oi/sum of Bj*Pij		
	i	Ai
N	1	19.99
E	2	13.83
S	3	4.77
W	4	4.87
RMSE:	0.00964	<0.01

Tij=Pij*Ai*Bj

		from	i			
j		N	E	S	W	Oi
to	N	0	134	292	47	472
	E	134	0	32	207	373
	S	293	32	0	11	336
	W	47	206	11	0	265
	Dj	474	372	335	265	

	left	thru	right
eastbound	47	207	11
westbound	134	206	32
northbound	11	292	32
southbound	134	293	47

Actuated Signal Timing and Phasing Calculations

Step 1: Minimum Green Time

$$G_{min} = l_1 + 2.0 * Int\left(\frac{d}{25}\right)$$

Gmin= 3 seconds

l_1 =	start-up lost time, s (use 3 s)	3	seconds
d =	distance between detector and STOP line, ft	11	feet
25 =	assumed head-to-head spacing between vehicles in queue, ft		

Assume detector distance behind stop line

point detectors need to be located so no vehicle can enter lane between the detector and the stop line

Step 2: Passage Time

point detector

$$PT = MAH$$

MAH = Maximum allowable headway, s (use 3 to 4 s) — max headway: 4 seconds

$$PT_{min} = \frac{d}{1.47S_{15}}$$

PT min= 0.249433 round to: 1 second

d =	distance between detector and STOP line, ft		
S_{15} =	15th percentile approach speed (speed limit - 5 mph)	posted speed limit:	35 mph
		15th percentile speed	30 mph

Verify that the minimum passage time is less than the calculated passage time

Presence Detector

$$G_{min} = l_1 + 2n$$

9

l_1 =	start-up lost time, s (use 3 s)		
n =	number of vehicles stored in the detection area	3	cars
	If front edge of detector is < 2 feet from the stop line		
	(n = distance between front edge of detector and stop line / 25)		

Presence Detector

$$PT = MAH - \frac{L_v + L_d}{1.47S_a}$$

PT= 2.445092 seconds

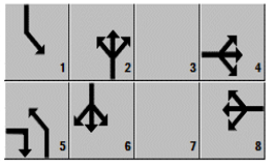
MAH =	Maximum allowable headway, s (use 3 to 4 s)	4	seconds
Lv =	Length of vehicle, ft (use 20 ft)	20	feet
Ld =	Length of detection zone, ft	60	feet
Sa =	average approach speed, mi/h (use post speed limit)	35	mph

$$PT_{min} = \frac{d}{1.47S_{15}}$$

PT min= 0.249433 seconds

d =	distance between detector and STOP line, ft	11	feet
S_{15} =	15th percentile approach speed (speed limit - 5 mph)	30	mph

Step 5: Determine Phasing for the Intersection



only for reference

Step 6: Yellow Time

$$y = t + \frac{1.47 * S_{85}}{2a + 64.4 * 0.01G}$$

3.94 seconds

t =	driver reaction time, s (use 1 s)	1	second	
S_{85} =	85th percentile speed (use posted speed limit +5)	85th percentile speed	40	mph
a =	deceleration rate (use 10 ft/s^2)	10	ft/s^2	
G =	grade, %	assuming 0%		

Step 7: All-Red Times: Lost Time per Cycle

$$ar = \frac{w + L}{1.47 * S_{15}} \; or \; \frac{P + L}{1.47 S_{15}}$$

S_{85} =	85th percentile speed (use posted speed limit +5)	40	mph
w =	width of street(s) being crossed, ft		
P =	distance brom near curb to far side of far crosswalk, ft		
L =	length of standard vehicle, ft (use 20 ft)	20	feet

Mall

ar: 1.683673 seconds

Gear

ar: 1.904762 seconds

Broadway

ar: 1.683673 seconds

Burlington

ar: 1.802721 seconds

Pedestrian Crossings

crossing time: 3.5 ft/s

Scemarios

10 ped/hour	20 ped/hour	30 ped/hour

Gear.Agency

33 seconds

Mall

21.7142857 seconds 76 ft

Broadway.Agency

EW-	25.71429 seconds	90 ft	
NS-	18 seconds	63 ft	

Burlington.Agency

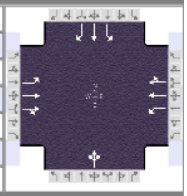
12.8571429 seconds 45 ft

Appendix E – Highway Capacity Software Generated Reports

Broadway Street & Agency Street Intersection

HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	11/9/2024	Area Type	Other
Jurisdiction		Time Period		PHF	0.92
Urban Street	Agency Street	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Agency/Broadway	File Name	Broadway.Agency.xus		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	29	340	3	10	341	114	20	53	84	113	128	29

Signal Information			
Cycle, s	83.7	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.0	2.7	14.6	6.0	2.5	32.0	
Yellow	4.0	0.0	4.0	4.0	0.0	4.0	
Red	2.0	0.0	2.0	2.0	0.0	2.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	2.0	4.0	9.0	14.0	1.1	3.0
Phase Duration, s	10.7	23.3	8.0	20.6	12.0	38.0	14.5	40.5
Change Period, ($Y+R_c$), s	6.0	6.0	6.0	6.0	6.0	8.0	6.0	8.0
Max Allow Headway (*MAH*), s	3.3	3.3	3.3	3.3	0.0	3.4	3.3	3.4
Queue Clearance Time (g_s), s	3.4	9.0	2.5	12.7		32.0	5.3	7.0
Green Extension Time (g_e), s	0.0	1.8	0.0	1.9	0.0	0.0	0.1	0.6
Phase Call Probability	0.52	1.00	0.22	1.00		1.00	0.94	1.00
Max Out Probability	0.00	0.00	0.00	0.00		1.00	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	32	187	186	11	256	239		171		123	139	32
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1864	1781	1870	1711		940		1781	1870	1585
Queue Service Time (g_s), s	1.4	7.0	7.0	0.5	10.4	10.7		6.0		3.3	5.0	1.3
Cycle Queue Clearance Time (g_c), s	1.4	7.0	7.0	0.5	10.4	10.7		30.0		3.3	5.0	1.3
Green Ratio (*g/C*)	0.56	0.21	0.21	0.53	0.17	0.17		0.36		0.46	0.39	0.39
Capacity (*c*), veh/h	99	385	384	43	326	298		406		267	725	615
Volume-to-Capacity Ratio (*X*)	0.317	0.484	0.485	0.254	0.785	0.801		0.420		0.460	0.192	0.051
Back of Queue (*Q*), ft/ln (50 th percentile)	15	73	72	5	100	93		78		31	53	11
Back of Queue (*Q*), veh/ln (50 th percentile)	0.6	2.9	2.9	0.2	4.0	3.7		3.1		1.2	2.1	0.4
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.06	0.00	0.00		0.00		0.44	0.75	0.16
Uniform Delay (d_1), s/veh	37.0	26.8	26.8	36.2	27.5	27.6		26.9		18.1	21.4	20.0
Incremental Delay (d_2), s/veh	0.7	0.4	0.4	1.1	1.6	1.9		0.3		0.5	0.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	37.7	27.2	27.2	37.3	29.0	29.5		27.2		18.6	21.4	20.0
Level of Service (LOS)	D	C	C	D	C	C		C		B	C	B
Approach Delay, s/veh / LOS	28.0	C		29.4	C		27.2	C		20.1	C	
Intersection Delay, s/veh / LOS	26.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.71	B	2.13	B	2.30	B	2.30	B
Bicycle LOS Score / LOS	0.82	A	0.90	A	0.77	A	0.97	A

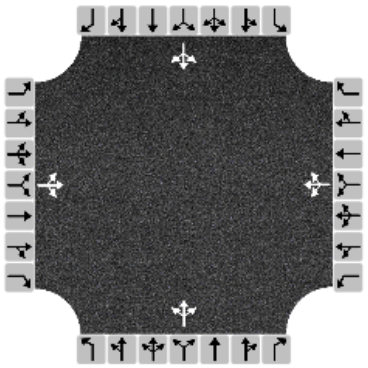
Broadway Street & Division Street Intersection

HCS All-Way Stop Control Report

General and Site Information

Analyst	Emma
Agency/Co.	Univeristy of Iowa
Date Performed	11/9/2024
Analysis Year	2024
Analysis Time Period (hrs)	0.25
Time Analyzed	
Project Description	Senior Design
Intersection	Broadway/Division
Jurisdiction	West Burlington
East/West Street	Division Street
North/South Street	Broadway Street
Peak Hour Factor	0.92

Lanes



Turning Movement Demand Volumes

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume (veh/h)	45	177	4	4	177	45	4	22	2	90	22	45
% Thrus in Shared Lane												

Lane Flow Rate and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	246			246			30			171		
Percent Heavy Vehicles	2			2			2			2		
Initial Departure Headway, h_d (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.218			0.218			0.027			0.152		
Final Departure Headway, h_d (s)	4.81			4.67			5.38			5.10		
Final Degree of Utilization, x	0.328			0.319			0.045			0.242		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, t_s (s)	2.81			2.67			3.38			3.10		

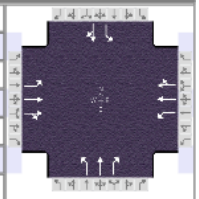
Capacity, Delay and Level of Service

Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	246			246			30			171		
Capacity (veh/h)	749			770			669			706		
95% Queue Length, Q_{95} (veh)	1.4			1.4			0.1			0.9		
95% Queue Length, Q_{95} (ft)	28.7			28.7			2.1			18.5		
Control Delay (s/veh)	10.1			9.8			8.6			9.7		
Level of Service, LOS	B			A			A			A		
Approach Delay (s/veh) | LOS	10.1	B		9.8	A		8.6	A		9.7	A	
Intersection Delay (s/veh) | LOS	9.9						A					

West Burlington Avenue & Agency Street Intersection

HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	11/9/2024	Area Type	Other
Jurisdiction		Time Period		PHF	0.92
Urban Street	Agency Street	Analysis Year	2024	Analysis Period	1> 7:00
Intersection		File Name	Streets4.xus		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	28	412	24	43	414	49	25	117	43	28	117	49

Signal Information												
Cycle, s	120.0	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On	Green	13.0	43.0	13.0	23.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	0.0	0.0		
				Red	3.0	3.0	3.0	3.0	0.0	0.0		

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	7	4	3	8
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	4.0
Phase Duration, s	20.0	50.0	20.0	50.0	20.0	30.0	20.0	30.0
Change Period, ($Y+R_c$), s	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Max Allow Headway (*MAH*), s	4.3	0.0	4.3	0.0	4.3	4.3	4.3	4.3
Queue Clearance Time (g_s), s	3.0		3.6		3.2	8.3	3.4	12.0
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0	0.0	1.2	0.0	1.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.00		0.00	0.01	0.00	0.04

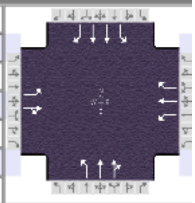
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	7	4	14	3	8	18
Adjusted Flow Rate (*v*), veh/h	30	239	235	47	255	248	27	127	47	30	180	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1834	1781	1870	1801	1781	1870	1585	1781	1776	
Queue Service Time (g_s), s	1.0	7.8	7.9	1.6	8.5	8.6	1.2	6.3	2.5	1.4	10.0	
Cycle Queue Clearance Time (g_c), s	1.0	7.8	7.9	1.6	8.5	8.6	1.2	6.3	2.5	1.4	10.0	
Green Ratio (*g/C*)	0.47	0.36	0.36	0.47	0.36	0.36	0.30	0.19	0.19	0.30	0.19	
Capacity (*c*), veh/h	494	670	657	507	670	645	363	358	304	408	340	
Volume-to-Capacity Ratio (*X*)	0.062	0.356	0.358	0.092	0.381	0.384	0.075	0.355	0.154	0.075	0.530	
Back of Queue (*Q*), ft/ln (95 th percentile)	20	149	144	32	160	154	25	136	48	28	203	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	5.9	5.8	1.2	6.3	6.2	1.0	5.4	1.9	1.1	8.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.17	0.00	0.00	0.21	0.00	0.00	0.20	0.00	0.34	0.19	0.00	
Uniform Delay (d_1), s/veh	16.4	17.1	17.1	16.5	17.2	17.2	28.0	35.1	33.9	27.7	36.4	
Incremental Delay (d_2), s/veh	0.2	1.5	1.5	0.4	1.6	1.7	0.4	2.7	1.1	0.4	5.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	16.6	18.6	18.6	16.8	18.9	19.0	28.4	37.9	34.9	28.1	42.2	
Level of Service (LOS)	B	B	B	B	B	B	C	D	C	C	D	
Approach Delay, s/veh / LOS	18.5	B		18.7	B		35.9	D		40.2	D	
Intersection Delay, s/veh / LOS	24.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.12	B	1.93	B	2.30	B	2.30	B
Bicycle LOS Score / LOS	0.90	A	0.94	A	0.82	A	0.84	A

Gear Avenue & Agency Street

HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	11/9/2024	Area Type	Other
Jurisdiction		Time Period		PHF	0.92
Urban Street	Agency Street	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Agency/Gear	File Name	Gear.Agency.Existing.xus		
Project Description	No pedestrians				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	47	207	11	134	206	32	11	292	32	134	293	47

Signal Information					EB			WB			NB		
Cycle, s	61.5	Reference Phase	2										
Offset, s	0	Reference Point	End										
Uncoordinated	Yes	Simult. Gap E/W	On	Green	5.2	3.0		11.0	1.7	0.6	10.0		
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	0.0		4.0	4.0	4.0	4.0		
				Red	2.0	0.0		2.0	2.0	2.0	2.0		

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2	3	8	7	4
Case Number	2.0	4.0	2.0	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	11.2	17.0	14.3	20.0	7.7	16.0	14.3	22.6
Change Period, ($Y+R_c$), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.3	4.2	4.3	4.2	4.3	4.2	4.3	4.2
Queue Clearance Time (g_s), s	3.7	9.1	6.8	8.1	2.4	7.5	6.8	6.5
Green Extension Time (g_e), s	0.1	1.9	0.4	2.0	0.0	2.4	0.3	2.2
Phase Call Probability	0.58	1.00	0.92	1.00	0.18	1.00	0.92	1.00
Max Out Probability	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.23

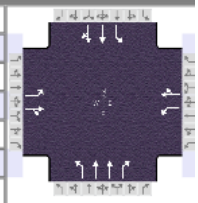
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	1	6	16	5	2	12	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	51	237		146	224	35	12	178	174	146	318	51
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1854		1781	1870	1585	1781	1870	1805	1781	1781	1585
Queue Service Time (g_s), s	1.7	7.1		4.8	6.1	1.0	0.4	5.5	5.5	4.8	4.5	1.6
Cycle Queue Clearance Time (g_c), s	1.7	7.1		4.8	6.1	1.0	0.4	5.5	5.5	4.8	4.5	1.6
Green Ratio (*g/C*)	0.80	0.18		0.85	0.23	0.23	0.42	0.16	0.16	0.52	0.27	0.27
Capacity (*c*), veh/h	152	332		239	427	362	48	303	293	239	958	427
Volume-to-Capacity Ratio (*X*)	0.336	0.713		0.609	0.525	0.096	0.247	0.587	0.596	0.609	0.332	0.120
Back of Queue (*Q*), ft/ln (95 th percentile)	33	131		94	109	15	9	109	106	94	80	24
Back of Queue (*Q*), veh/ln (95 th percentile)	1.3	5.1		3.7	4.3	0.6	0.4	4.3	4.2	3.7	3.1	1.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.16	0.62		0.52	0.36	0.05	0.06	0.73	0.72	0.39	0.33	0.11
Uniform Delay (d_1), s/veh	26.7	21.0		25.5	18.5	16.7	29.3	24.2	24.3	25.5	18.8	17.7
Incremental Delay (d_2), s/veh	1.3	2.8		2.5	1.0	0.1	2.6	1.8	1.9	2.5	0.2	0.1
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	27.9	23.9		28.0	19.5	16.8	31.9	26.0	26.2	28.0	19.0	17.8
Level of Service (LOS)	C	C		C	B	B	C	C	C	C	B	B
Approach Delay, s/veh / LOS	24.6	C		22.3	C		26.3	C		21.4	C	
Intersection Delay, s/veh / LOS	23.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.28	B	2.44	B	2.15	B	1.97	B
Bicycle LOS Score / LOS	0.96	A	1.15	A	0.79	A	0.91	A

Mall Intersection

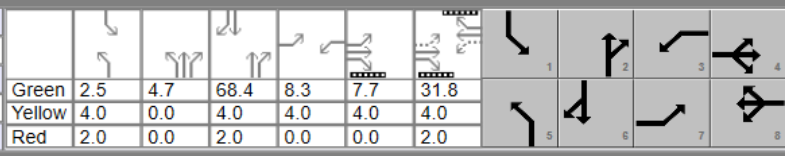
HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	11/9/2024	Area Type	Other
Jurisdiction		Time Period		PHF	1.00
Urban Street	Gear Ave	Analysis Year	2024	Analysis Period	1> 7:00
Intersection	Mall	File Name	Mall.0pedestrians.xus		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	308	68	336	60	68	60	40	1584	8	8	1576	52

Signal Information			
Cycle, s	149.5	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.5	4.7		68.4	8.3	7.7	31.8					
Yellow	4.0	0.0		4.0	4.0	4.0	4.0					
Red	2.0	0.0		2.0	0.0	0.0	2.0					

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	24.0	49.5	12.3	37.8	13.3	79.1	8.5	74.4
Change Period, (*Y+R c*), s	4.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.3	4.5	4.3	4.5	4.3	4.2	4.3	4.2
Queue Clearance Time (*g s*), s	22.0	42.4	5.8	11.4	5.3	63.2	2.7	63.7
Green Extension Time (*g e*), s	0.0	1.2	0.1	2.2	0.1	7.1	0.0	4.7
Phase Call Probability	1.00	1.00	0.92	1.00	0.81	1.00	0.28	1.00
Max Out Probability	1.00	0.37	0.00	0.01	0.00	0.95	0.00	0.96

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	308	404		60	128		40	1584	8	8	817	811
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1464		1781	1725		1781	1781	1585	1781	1900	1878
Queue Service Time (*g s*), s	20.0	40.4		3.8	9.4		3.3	61.2	0.4	0.7	61.1	61.7
Cycle Queue Clearance Time (*g c*), s	20.0	40.4		3.8	9.4		3.3	61.2	0.4	0.7	61.1	61.7
Green Ratio (*g/C*)	0.36	0.29		0.27	0.21		0.35	0.49	0.49	0.32	0.46	0.46
Capacity (*c*), veh/h	476	427		155	367		87	1742	775	30	869	859
Volume-to-Capacity Ratio (*X*)	0.647	0.947		0.388	0.349		0.460	0.909	0.010	0.263	0.939	0.944
Back of Queue (*Q*), ft/ln (50 th percentile)	232	452		45	105		40	702	4	9	798	801
Back of Queue (*Q*), veh/ln (50 th percentile)	9.1	17.8		1.8	4.2		1.6	27.6	0.1	0.3	31.9	32.0
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (*d 1*), s/veh	37.8	51.9		44.8	50.0		69.2	35.1	19.6	72.6	38.6	38.7
Incremental Delay (*d 2*), s/veh	3.0	26.1		1.6	0.6		3.8	7.5	0.0	4.5	16.9	17.8
Initial Queue Delay (*d 3*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	40.8	78.0		46.3	50.6		73.0	42.6	19.6	77.1	55.5	56.6
Level of Service (LOS)	D	E		D	D		E	D	B	E	E	E
Approach Delay, s/veh / LOS	61.9	E		49.2	D		43.3	D		56.1	E	
Intersection Delay, s/veh / LOS	51.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.48	B	2.33	B	2.00	B	2.00	B
Bicycle LOS Score / LOS	1.66	B	0.80	A	1.83	B	1.84	B

Appendix F – Quantity Tables

Intersections & Crosswalks Quantities

Intersections & Crosswalks			
	Agency St. Trail	Broadway St. Trail	Mall Sidewalk
Number of 10' x 2' Markings (unit)	115	82	0
Number of 6' x 2' Markings (unit)	26	0	14
Stop Bars (LF with 2' Width)	137	64	40
Pavement Markings (LF with 1' width)	2886	1768	248
Pavement Markings Removed (LF)	362	92	84
Number of Stand-Alone Push Buttons (unit)	6	1	0
Symbols Removed (unit)	4	3	0
Symbols Added (unit)	4	3	0

Agency St. Trail Quantities

Agency St. Trail						
	Agency St. Trail From Gear Ave. to W Walmart Driveway	Gas Station Sidewalk	Walmart Sidewalk	Agency St. Trail From W Walmart Driveway to Broadway St.	Agency St. Trail From Broadway St. to West Burlington Ave.	Total
Cut (CY)	133.90	0.34	0.61	3.67	77.60	216.12
Fill (CY)	321.30	0.46	0.01	1.53	95.21	418.51
PCC (CY)	571.76	2.31	2.31	57.87	258.09	892.34
Base (CY)	571.76	2.31	2.31	57.87	258.09	892.34
6" PCC (SF)	30875.04	124.74	124.74	3124.98	13936.86	48186.36
6" Base (SF)	30875.04	124.74	124.74	3124.98	13936.86	48186.36
Sidewalk Linear Feet (10' Wide)	3087.50	0.00	0.00	312.50	1393.69	4793.69
Sidewalk Linear Feet (5' Wide)	0.00	24.95	24.95	0.00	0.00	49.90
Corridor Surface Area (SF)	40046.72	221.09	183.75	3395.05	17339.29	61185.90
Corridor Surface Area (Acres)	0.919	0.005	0.004	0.078	0.398	1.405

Fill Needed
202.39

Broadway St. Trail Quantities

Broadway St. Trail						
	Broadway St. Trail From Agency St. to E Walmart Driveway	Broadway St. Trail From Agency St. to Division St.	Broadway/Division Intersection	Rec Plex Trail Heading West	Rec Plex Trail Heading South	Total
Cut (CY)	7.52	56.54	1.37	8.99	8.81	83.23
Fill (CY)	5.34	126.38	0.25	4.55	2.32	138.84
PCC (CY)	41.56	375.00	9.26	60.77	45.00	531.59
Base (CY)	41.56	375.00	9.26	60.77	45.00	531.59
6" PCC (SF)	2244.24	20250	500.04	3281.58	2430	28705.86
6" Base (SF)	2244.24	20250.00	500.04	3281.58	2430.00	28705.86
Sidewalk Linear Feet (10' Wide)	0.00	2025.00	50.00	328.16	243.00	2646.16
Sidewalk Linear Feet (5' Wide)	448.85	0.00	0.00	0.00	0.00	448.85
Corridor Surface Area (SF)	2954.65	21808.43	484.20	3586.34	2812.95	31646.57
Corridor Surface Area (Acres)	0.068	0.501	0.011	0.082	0.065	0.727

Fill Needed
55.61

Mall Sidewalk Quantities

Mall Sidewalk		
	Mall Intersection Sidewalk	Total
Cut (CY)	11.47	11.47
Fill (CY)	6.28	6.28
PCC (CY)	33.43	33.43
Base (CY)	33.43	33.43
6" PCC (SF)	1805.22	1805.22
6" Base (SF)	1805.22	1805.22
Sidewalk Linear Feet (10' Wide)	0.00	0.00
Sidewalk Linear Feet (5' Wide)	361.04	361.04
Corridor Surface Area (SF)	2536.98	2536.98
Corridor Surface Area (Acres)	0.058	0.058

Cut Removed
5.19

Appendix G – Work Plan

Work Plan Gantt Chart:

https://iowa.sharepoint.com/:x:/r/sites/AgencyStreet/Shared%20Documents/General/Projects%20Deliverables/Work%20Plan.xlsx?d=w96eaa79d584d46dfbda54c066e1fb7e7&csf=1&web=1&e=znJgWb

Appendix H – Bibliography

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