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MEMORANDUM

Date: April 23, 2021

To: Dan Schluender, PE
City Engineer

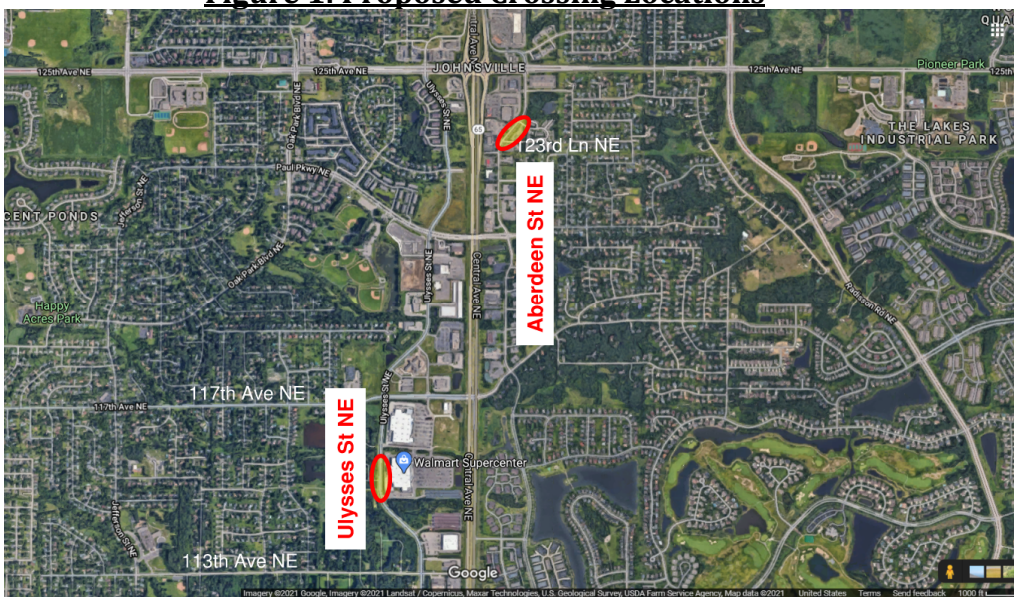
From: Jennifer McCoy, P.E., PTOE
Casey Kaucher, P.E.

Subject: Pedestrian Crossing Reviews
City of Blaine, MN

Introduction

At request of the City of Blaine, a high-level traffic review was conducted for two pedestrian crossing locations, Ulysses Street NE, south of 116th Avenue NE adjacent to Wal-Mart Entrance and Aberdeen Street NE in the area of 123rd Lane NE (**Figure 1**). This review analyzed the existing conditions including traffic control, traffic volume, geometrics, sight distance, speed limits, crash history and pedestrian origin-destination demand to determine the appropriate crosswalk locations and treatments. Field inspections were not part of this review. Data was collected using Google Street View and the latest available information from MnDOT. The City of Blaine provided daily traffic volumes and speed data. Per the City there are no infrastructure improvements scheduled at either location. The Data Collection Worksheets used to evaluate each proposed crossing location are provided in the **Appendix**. Sight distances were calculated per the AASHTO, *A Policy of Geometric Design of Highways and Streets* manual with an assumed pedestrian speed of 3.5 ft/sec. Each proposed pedestrian crossing location has its own unique configurations. Following is a review and recommendation for both crossing locations. Cost estimates for the recommended crossing treatments are provided in the **Appendix**.

Figure 1: Proposed Crossing Locations



Review

Ulysses Street NE

Ulysses Street NE between 117th Avenue NE and 113th Avenue NE is classified as a major collector roadway. The typical street section is 40-foot wide and consist of three lanes, one in each direction and a center two-way left turn lane. The posted speed limit is 40 miles per hour. Curb, gutter, and sidewalk are present along both sides and on-street parking is restricted. There are no streetlights installed along this section of roadway. The adjacent intersections with 117th Avenue NE and 113th Avenue NE are multiway stop controlled. Residential land uses are located on the west side of Ulysses Street NE and commercial land uses are located on the east side. Review of the collision history from the MnDOT database indicates four collisions over the past 3 years, no serious or fatal injuries occurred and there have been no bike or pedestrian collisions.

Aberdeen Street NE

Aberdeen Street NE between 123rd Lane NE and 124th Lane NE is classified as a major collector roadway. The typical street section is 40-foot and consist of three lanes, one in each direction and a center two-way left turn lane. Curb and gutter are present along both sides of the roadway and sidewalk is located along the east side. The posted speed limit is 35 miles per hour. A crosswalk was marked across Aberdeen St NE on the south side of 124th Avenue NE intersection. Due to safety concerns the markings were not replaced with the recent repaving project. There is one streetlight installed at this former crosswalk location. Residential land uses are located on the east side of Aberdeen Street NE and commercial land uses are located on the west side. Review of the collision history from the MnDOT database indicates two collisions over the past 3 years, no serious or fatal injuries occurred and there have been no bike or pedestrian collisions.

Traffic Data Collection

The City of Blaine collected traffic data in February 2021 during the COVID 19 pandemic. The collected 2021 daily traffic volumes were compared with historical traffic data from the Minnesota Department of Transportation, **Table 1**. To account for the atypical traffic patterns associated with COVID 19, the 2019 MnDOT traffic volumes were assumed for this traffic review.

Table 1: Daily Traffic Volumes

	2015	2017	2019	2021
Ulysses Street NE	6400	6300	**6400**	5066
Aberdeen Street NE	7100	7500	**7100**	5790

Recommendation

A report published by the Federal Highway Administration (FHWA) in July 2018 titled "*Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations"* was produced as part of the Safe Transportation for Every Pedestrian (STEP) program. STEP's purpose is to help transportation agencies address crashes by promoting countermeasures with known safety benefits at uncontrolled crossing locations. *Table 1: Application of pedestrian crash countermeasures by roadway feature* (see **Appendix**) found in the FHWA report provides suggested crossing improvements based on roadway speed, daily traffic volume, and number of lanes. The report states that treatment suggestions provided in *Table 1* should always be considered at a marked uncontrolled crossing

location, but are not mandated or required, and exceptions may be considered following engineering judgment. (FHWA, 2018, p. 16).

Ulysses Street NE

The purpose of the Ulysses Street NE crosswalk is to connect the residential and commercial land uses. The 2021 speed data provided by the City of Blaine shows the 85th percentile speed along this section of roadway is 41 miles per hour. The calculated stopping sight distance is 312 feet. To meet this the crossing should be located approximately 80 feet north of the Walmart entrance, **Figure 2**. Vegetation on the south side of the Walmart entrance will need to be cleared and maintained to a maximum 18-inch height. Curb ramps will need to be constructed to connect to the existing sidewalk facilities.

Figure 2: Ulysses Street NE

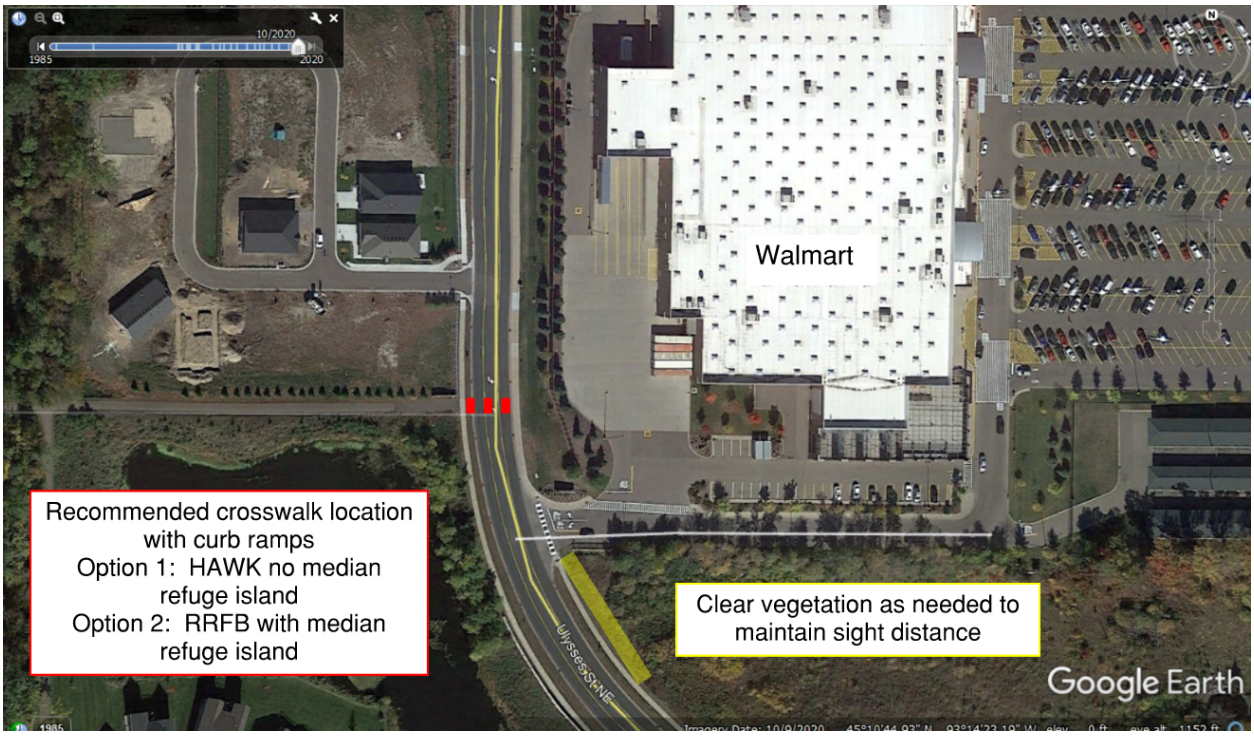


Table 1: Application of pedestrian crash countermeasures by roadway feature when applied to Ulysses Street's three lane, 41 mile per hour, 6,400 daily traffic volume would indicate that signing and markings alone are generally not an appropriate crossing treatment. The installation of either a Rectangular Rapid Flashing Beacon (RRFB), **Figure 4** or a Pedestrian Hybrid Beacon (HAWK), **Figure 6** would be appropriate. The RRFB would need to be combined with a refuge island to decrease the pedestrian crossing distance. Lighting, high-visibility ladder style crosswalk markings, pedestrian crossing warning signs with downward arrow plaque (MUTCD W11-2 and W16-7P) and advanced pedestrian crossing warning signs with ahead plaque (MUTCD Wll-2 and W16-9P) located 175 feet prior to crosswalk should be installed on each approach to the crossing. Refer to **Figure 3** and **Figure 5** for a concept level sketch of the recommended crosswalk options.

Figure 3: Rectangular Rapid Flashing Beacon Crossing

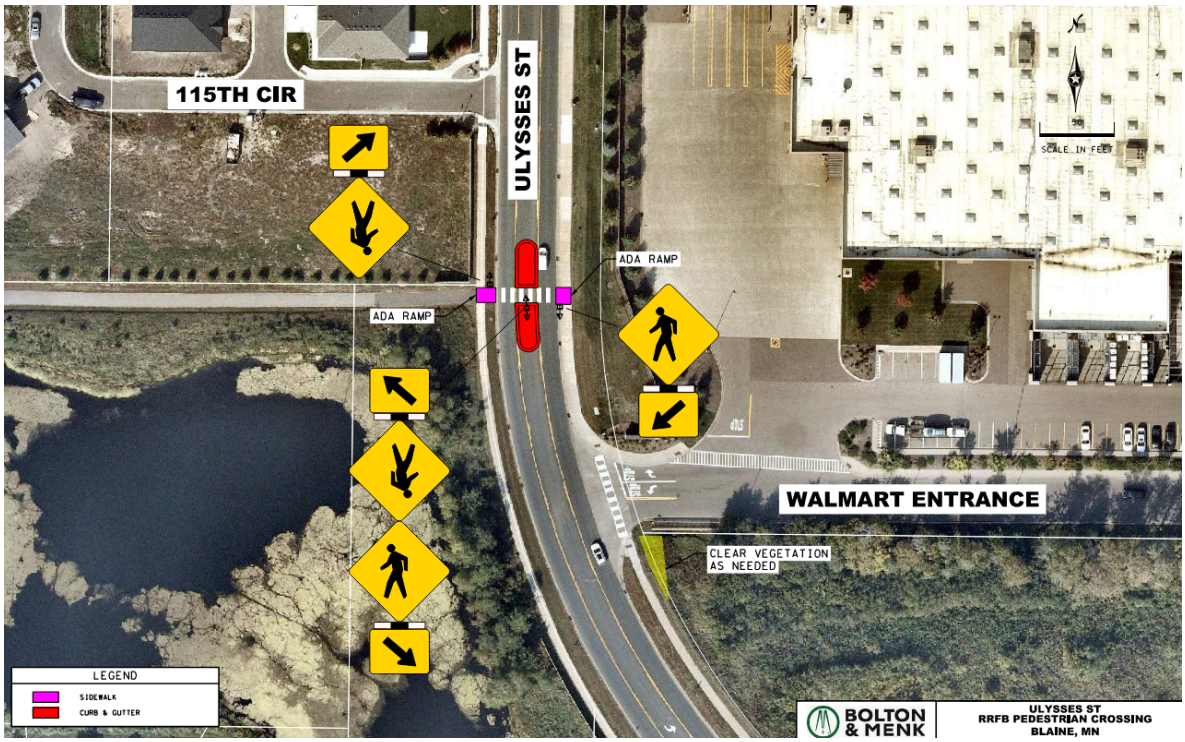


Figure 4: Rectangular Rapid Flashing Beacon

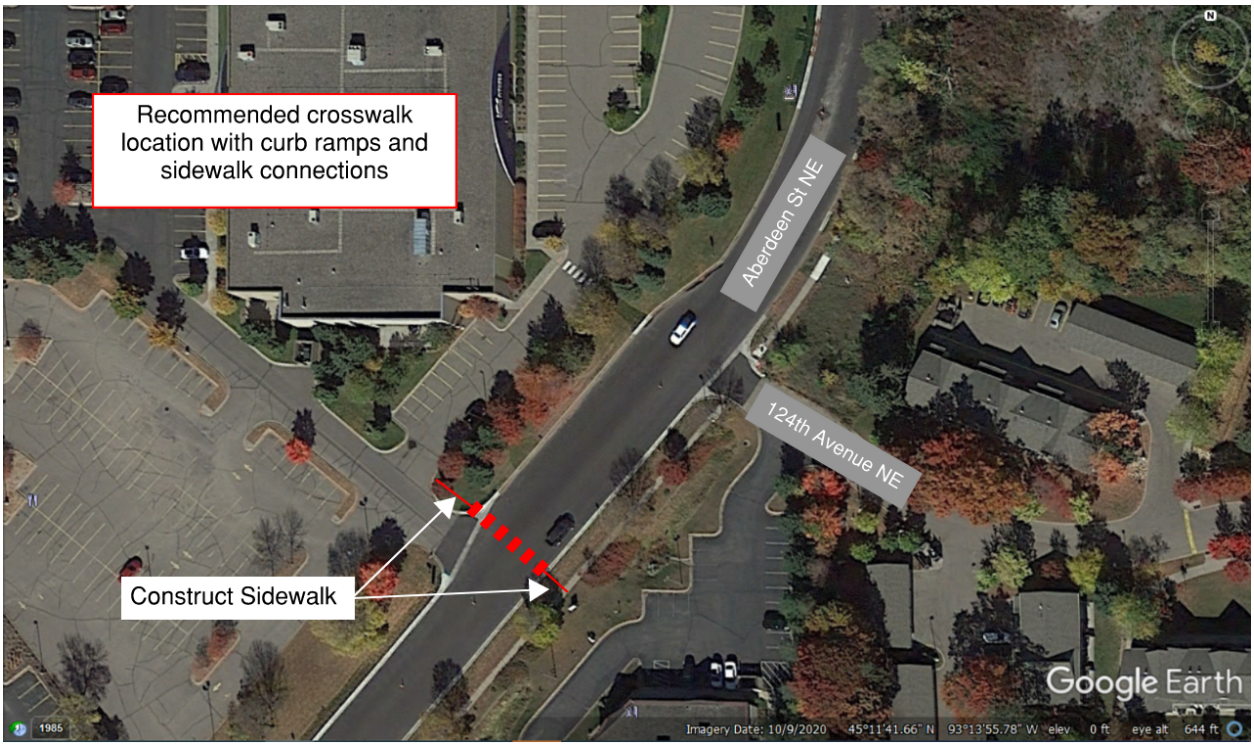
Figure 5: Pedestrian Hybrid Beacon (HAWK)

Figure 6: Pedestrian Hybrid Beacon (HAWK)

Aberdeen Street NE

The purpose of the Aberdeen Street crosswalk is to connect the residential and commercial land uses. The 2021 speed data provided by the City of Blaine shows the 85th percentile speed along this section of roadway is 34 miles per hour. The calculated stopping sight distance is 236 feet. To meet this the crossing should be located on Aberdeen Street NE approximately 140 feet south of the 124th Ave NE intersection, **Figure 7**. Curb ramps and sidewalk connections will need to be constructed on both sides of the crosswalk.

Figure 7: Aberdeen Street NE



The Aberdeen Street NE street section has a southbound right turn lane present at the proposed crossing location. This creates a total of 50 feet of pavement width. *Table 1: Application of pedestrian crash countermeasures by roadway feature* when applied to Aberdeen Street's four lane, 34 mile per hour, 7,100 daily traffic volume would indicate that signing and markings alone are generally not an appropriate crossing treatment. It is recommended that the pedestrian crossing treatment consist of a median refuge island (**Figure 9**) along with lighting, signs, and markings. High-visibility ladder style crosswalk markings, pedestrian crossing warning signs with downward arrow plaque (MUTCD W11-2 and W16-7P) and advanced pedestrian crossing warning signs with ahead plaque (MUTCD W11-2 and W16-9P) located 100 feet prior to crosswalk should be installed on each approach to the crosswalk and in median. **Figure 8** below shows a concept level sketch of the recommended crosswalk treatment.

Figure 8: Aberdeen Street Crosswalk Treatment

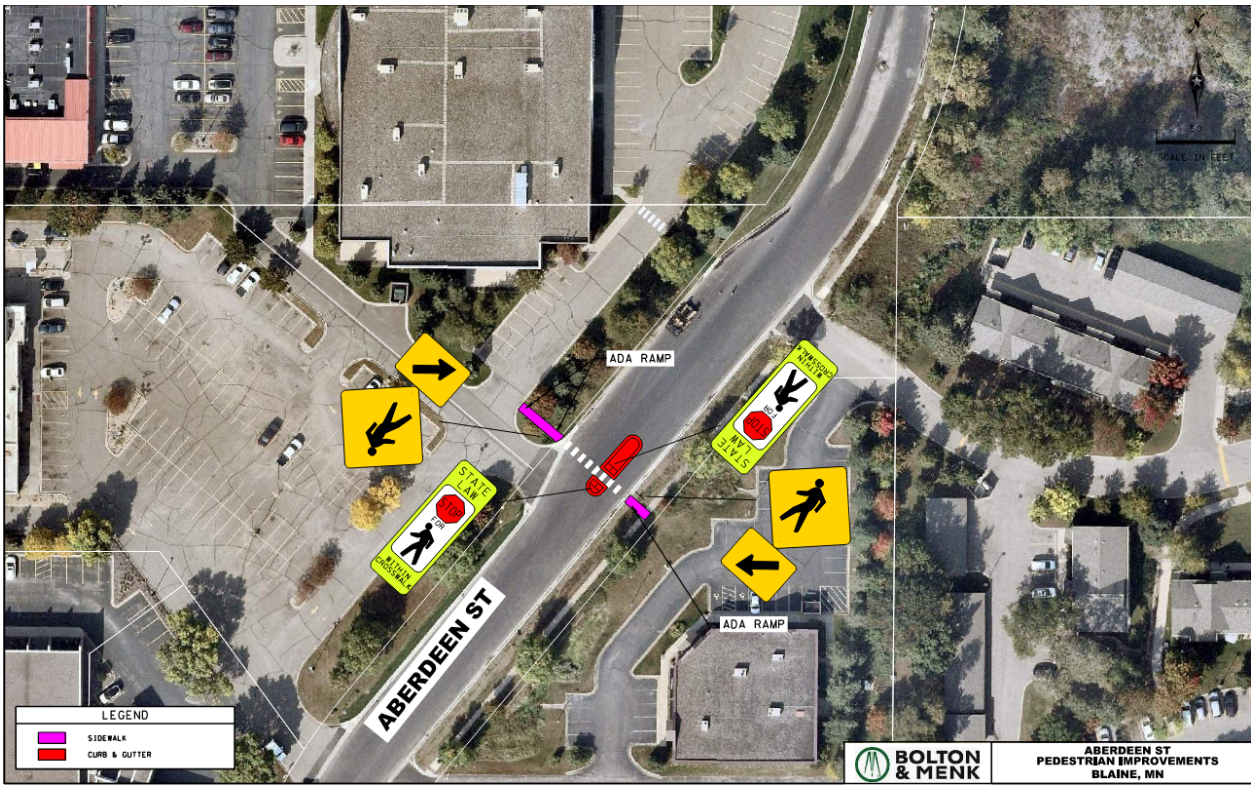
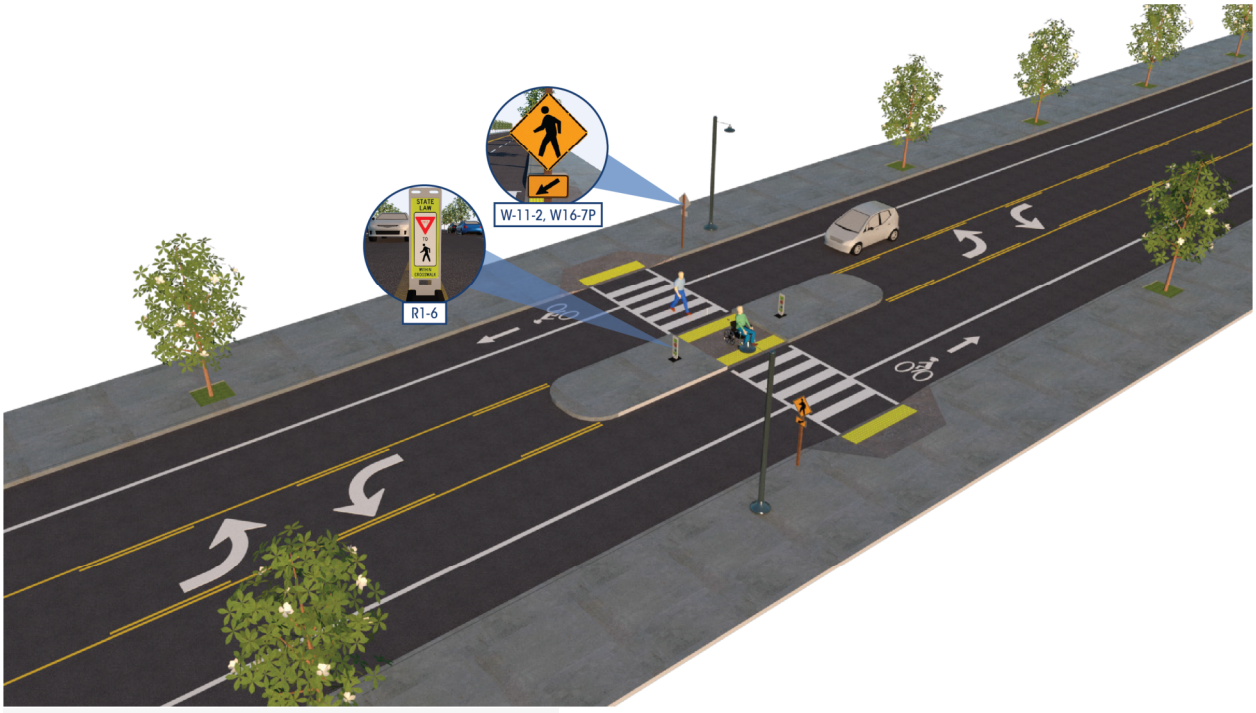


Figure 9: Crosswalk Refuge Island Signs and Markings



Source: Federal Highway Administration.

Appendix
City of Blaine, MN
Pedestrian Crossing Review

Appendix A

Data Collection Worksheets

Uncontrolled Pedestrian Crossing
Data Collection Worksheet

Location:	Aberdeen St NE at 123rd Ave NE	Date:	3-Mar-21
City, State:	Blaine, Minnesota	Scenario:	Pedestrian Crossing Analysis
Reviewer(s):	Chris Loyd	Agency:	BMI
Project #:	0T4.123835	ID #:	

The first step in understanding the pedestrian needs at a potential crossing location is completing a review of the location and adjacent facilities.

Geometrics

Crossing Length: Measure the crossing distance from curb to curb. Fill in Crossing 1 distance if there is no median. If there is a median at the crossing location, fill in Crossing 1 and 2 distances.

Crossing 1	50	ft.
Crossing 2		ft.

Median: width of median at crossing location	0	ft.
Crossing Width: effective crossswalk width	6	ft.

Raised Median Available?	☐ Yes	☑ No
ADA Compliant Median Available (minimum 4' x 4' landing)?	☐ Yes	☐ No
Curb Ramps Available?	☑ Yes	☐ No
ADA Compliant Curb Ramp Available (width, grades, truncated domes)?	☑ Yes	☐ No

Speed:	Posted or 85th percentile speed	34	mph
Roadway Curvature and Sight Distances:	Average walking speed	3.5	ft/s

Is the crossing location within a horizontal or vertical curve? ☐ Yes ☑ No

Equations to calculate the following are located on the next page

Direction 1:	Stopping Sight Distance (SSD)	236	ft.	provided?	☐ Yes ☐ No
Direction 2:	Stopping Sight Distance (SSD)		ft.	provided?	☐ Yes ☐ No
Direction 1:	Pedestrian Sight Distance (PedSD)	864	ft.	provided?	☐ Yes ☐ No
Direction 2:	Pedestrian Sight Distance (PedSD)		ft.	provided?	☐ Yes ☐ No

Traffic and Pedestrian Data

Measure traffic and pedestrian volume in 15-minute increments on the roadway to be crossed.

Attach Counts	**vehicles:**				**pedestrians:**			
	Daily	7100			Daily			
AM Peak	Hourly	517	Pk 15-min		Hourly		Pk 15-min	
PM Peak	Hourly	797	Pk 15-min		Hourly		Pk 15-min	

Additional Site Characteristics

Lighting:

Is street lighting present and does it light the crosswalk location? ☑ Yes ☐ No

Crosswalk Pavement Markings: Is the pedestrian crossing currently marked? ☐ Yes ☑ No

What is the condition of the markings? ☐ Excellent ☐ Good ☐ Fair ☐ Poor

Are the markings easily defined? ☐ Yes ☐ No

Do they need replacement? ☐ Yes ☐ No

What is the crosswalk marking pattern? Crosswalk Blocks

Signing: Currently signed at crosswalk? ☐ Yes ☐ No

Currently signed in advance of crosswalk? ☐ Yes ☐ No

Distances? direction 1: N/A ft. direction 2: N/A ft.

Enhancements: What enhancements are currently at the crossing location? None

Adjacent Facilities: Distance to nearest marked crosswalk? 760 ft.

What pedestrian control devices are present at the nearest adjacent marked crosswalk? Crosswalk Markings and Pedestrian Signals (push button activated)

Distance to nearest all-way stop, roundabout or signalized intersection 760 ft.

Could another location serve the same pedestrian crossing movement? ☑ Yes ☐ No

Could another location serve the the movement more effectively? ☑ Yes ☐ No

Uncontrolled Pedestrian Crossing
Data Collection Worksheet

Mark the following: site distances and potential conflicts, pavement markings (crosswalk, edge lines, center lines, lane lines, stop lines, and any other markings), signing, location of lighting units, curb ramps, truncated domes, presence of any other crosswalks or crossing locations parallel to and nearby the location being studied, adjacent intersection traffic control, parking, intersection width, lane lengths, shoulder widths, sign placement, and nearby orgins and destinations .

draw or insert map of location being studied

Notes:

Sight Distance Calculations:

Stopping sight distance (SSD), ft = $1.47St + 1.075S^2/a$

Pedestrian sight distance (PedSD), ft = $1.47S(L / S_p + t_s)$

where: S = design speed, mph

L = length of crossing, ft

where:

	defaults:
t = brake reaction time, s	2.5
a = deceleration rate, ft/s^2	11.2
S_p = average pedestrian walking speed, ft/s	3.5
t_s = pedestrian start-up and end clearance time, s	3.0

2010 Highway Capacity Manual (HCM)

Pedestrian Level of Service (LOS) at Uncontrolled Crossing Locations

Intersection and Mid-Block Crossings

Crossing Location:	Aberdeen St NE at 123rd Ln NE	Date:	3/3/2021
City, State:	Blaine, MN	Scenario:	Median Refuge Island
Reviewer(s):	Casey Kaucher	Agency:	
Project Number:		ID #:	

The following is the base information needed to complete the analysis.
If this is a one-stage crossing, use only Crossing 1.
If this is a two-stage crossing, each stage must be evaluated separately using Crossing 1 and Crossing 2.

Crossing 1:

Evaluation Inputs:

L = crosswalk length (ft)
S_p = average pedestrian walking speed (ft/s)
t_s = pedestrian start-up and end clearance time (s)
V = vehicular hourly volume (veh/hr)
v_p = pedestrian flow rate (ped/s)
v = vehicular flow rate (veh/s) = V/3600
W_c = crosswalk width (ft)
N = number of through lanes crossed (Integer)

defaults:		Input Table:	
		L =	13
S_p =	3.5	S_p =	3.5
t_s =	3.0	t_s =	3
		V =	355
v_p =	0*	v_p =	0.00
v =	V/3600	v =	0.099
W_c =	8.0	W_c =	6.0
N =	INT(L/11)	N =	1

*no platooning observed

Crossing 2:

(only used for two-stage crossings)

Evaluation Inputs:

L = crosswalk length (ft)
S_p = average pedestrian walking speed (ft/s)
t_s = pedestrian start-up and end clearance time (s)
V = vehicular hourly volume (veh/hr)
v_p = pedestrian flow rate (ped/s)
v = vehicular flow rate (veh/s) = V/3600
W_c = crosswalk width (ft)
N = number of through lanes crossed (Integer)

defaults:		Input Table:	
		L =	26
S_p =	3.5	S_p =	3.5
t_s =	3.0	t_s =	3
		V =	355
v_p =	0*	v_p =	0.00
v =	V/3600	v =	0.099
W_c =	8.0	W_c =	6.0
N =	INT(L/11)	N =	2

*no platooning observed

Crossing Treatment Yield Rate

M_y = motorist yield rate (decimal)

Input Table:	
M_y =	29%

Entering data into the tables above will populate the evaluation tables in Microsoft Excel.

Results:

Average Delay	**10.2**	**sec/ped**
LOS	**C**	

Uncontrolled Pedestrian Crossing
Data Collection Worksheet

Location:	Ulysses St NE at Walmart Entrance	Date:	3-Mar-21
City, State:	Blaine, Minnesota	Scenario:	Pedestrian Crossing Analysis
Reviewer(s):	Chris Loyd	Agency:	BMI
Project #:	0T4.123835	ID #:	

The first step in understanding the pedestrian needs at a potential crossing location is completing a review of the location and adjacent facilities.

Geometrics

Crossing Length: Measure the crossing distance from curb to curb. Fill in Crossing 1 distance if there is no median. If there is a median at the crossing location, fill in Crossing 1 and 2 distances.

Crossing 1	40	ft.
Crossing 2		ft.

Median: width of median at crossing location	0	ft.
Crossing Width: effective crosswalk width	6	ft.

Raised Median Available?	☐ Yes	☑ No
ADA Compliant Median Available (minimum 4' x 4' landing)?	☐ Yes	☑ No
Curb Ramps Available?	☐ Yes	☑ No
ADA Compliant Curb Ramp Available (width, grades, truncated domes)?	☐ Yes	☑ No

Speed:	Posted or 85th percentile speed	41	mph
Roadway Curvature and Sight Distances:	Average walking speed	3.5	ft/s

Is the crossing location within a horizontal or vertical curve? ☑ Yes ☐ No

Equations to calculate the following are located on the next page

Direction 1:	Stopping Sight Distance (SSD)	312	ft.	provided?	☐ Yes ☑ No
Direction 2:	Stopping Sight Distance (SSD)		ft.	provided?	☐ Yes ☐ No
Direction 1:	Pedestrian Sight Distance (PedSD)	870	ft.	provided?	☐ Yes ☑ No
Direction 2:	Pedestrian Sight Distance (PedSD)		ft.	provided?	☐ Yes ☐ No

Traffic and Pedestrian Data

Measure traffic and pedestrian volume in 15-minute increments on the roadway to be crossed.

Attach Counts		**vehicles:**			**pedestrians:**		
	Daily	6400			Daily		
AM Peak	Hourly	483	Pk 15-min		Hourly		Pk 15-min	
PM Peak	Hourly	634	Pk 15-min		Hourly		Pk 15-min	

Additional Site Characteristics

Lighting:

Is street lighting present and does it light the crosswalk location? ☐ Yes ☑ No

Crosswalk Pavement Markings: Is the pedestrian crossing currently marked? ☐ Yes ☑ No

What is the condition of the markings? ☐ Excellent ☐ Good ☐ Fair ☐ Poor

Are the markings easily defined? ☐ Yes ☐ No

Do they need replacement? ☐ Yes ☐ No

What is the crosswalk marking pattern? Crosswalk Blocks

Signing: Currently signed at crosswalk? ☐ Yes ☑ No

Currently signed in advance of crosswalk? ☐ Yes ☑ No

Distances? direction 1: N/A ft. direction 2: N/A ft.

Enhancements: What enhancements are currently at the crossing location? None

Adjacent Facilities: Distance to nearest marked crosswalk? 1400 ft.

What pedestrian control devices are present at the nearest adjacent marked crosswalk? Crosswalk Markings and Pedestrian Signals (push button activated)

Distance to nearest all-way stop, roundabout or signalized intersection 1400 ft.

Could another location serve the same pedestrian crossing movement? ☑ Yes ☐ No

Could another location serve the the movement more effectively? ☑ Yes ☐ No

Uncontrolled Pedestrian Crossing
Data Collection Worksheet

Mark the following: site distances and potential conflicts, pavement markings (crosswalk, edge lines, center lines, lane lines, stop lines, and any other markings), signing, location of lighting units, curb ramps, truncated domes, presence of any other crosswalks or crossing locations parallel to and nearby the location being studied, adjacent intersection traffic control, parking, intersection width, lane lengths, shoulder widths, sign placement, and nearby orgins and destinations .

draw or insert map of location being studied

Notes: Pedestrian sight distance southward along the road is much shorter than calculated, approx. 400 ft.

Sight Distance Calculations:

Stopping sight distance (SSD), ft = $1.47St + 1.075S^2/a$

Pedestrian sight distance (PedSD), ft = $1.47S(L / S_p + t_s)$

where: S = design speed, mph

L = length of crossing, ft

where:

	defaults:
t = brake reaction time, s	2.5
a = deceleration rate, ft/s^2	11.2
S_p = average pedestrian walking speed, ft/s	3.5
t_s = pedestrian start-up and end clearance time, s	3.0

2010 Highway Capacity Manual (HCM)

Pedestrian Level of Service (LOS) at Uncontrolled Crossing Locations

Intersection and Mid-Block Crossings

Crossing Location:	Ulysses St NE by Walmart Entrance	Date:	3/3/2021
City, State:	Blaine, MN	Scenario:	RRFB
Reviewer(s):	Casey Kaucher	Agency:	BMI
Project Number:		ID #:	

The following is the base information needed to complete the analysis.
If this is a one-stage crossing, use only Crossing 1.
If this is a two-stage crossing, each stage must be evaluated separately using Crossing 1 and Crossing 2.

Crossing 1:

Evaluation Inputs:

	defaults:		Input Table:	
L = crosswalk length (ft)			L =	15
S_p = average pedestrian walking speed (ft/s)	S_p =	3.5	S_p =	3.5
t_s = pedestrian start-up and end clearance time (s)	t_s =	3.0	t_s =	3
V = vehicular hourly volume (veh/hr)			V =	320
v_p = pedestrian flow rate (ped/s)	v_p =	0*	v_p =	0.00
v = vehicular flow rate (veh/s) = V/3600	v =	V/3600	v =	0.089
W_c = crosswalk width (ft)	W_c =	8.0	W_c =	6.0
N = number of through lanes crossed (Integer)	N =	INT(L/11)	N =	1

*no platooning observed

Crossing 2:

(only used for two-stage crossings)

Evaluation Inputs:

	defaults:		Input Table:	
L = crosswalk length (ft)			L =	15
S_p = average pedestrian walking speed (ft/s)	S_p =	3.5	S_p =	4
t_s = pedestrian start-up and end clearance time (s)	t_s =	3.0	t_s =	3
V = vehicular hourly volume (veh/hr)			V =	320
v_p = pedestrian flow rate (ped/s)	v_p =	0*	v_p =	0.00
v = vehicular flow rate (veh/s) = V/3600	v =	V/3600	v =	0.089
W_c = crosswalk width (ft)	W_c =	8.0	W_c =	6.0
N = number of through lanes crossed (Integer)	N =	INT(L/11)	N =	1

*no platooning observed

Crossing Treatment Yield Rate

	Input Table:	
M_y = motorist yield rate (decimal)	M_y =	81%

Entering data into the tables above will populate the evaluation tables in Microsoft Excel.

Results:

Average Delay	**5.5**	**sec/ped**
LOS	**B**	

2010 Highway Capacity Manual (HCM)

Pedestrian Level of Service (LOS) at Uncontrolled Crossing Locations

Intersection and Mid-Block Crossings

Crossing Location:	Ulysses St NE by Walmart Entrance	Date:	3/3/2021
City, State:	Blaine, MN	Scenario:	HAWK
Reviewer(s):	Casey Kaucher	Agency:	BMI
Project Number:		ID #:	

The following is the base information needed to complete the analysis.
If this is a one-stage crossing, use only Crossing 1.
If this is a two-stage crossing, each stage must be evaluated separately using Crossing 1 and Crossing 2.

Crossing 1:

Evaluation Inputs:

	defaults:		Input Table:	
L = crosswalk length (ft)			L =	40
S_p = average pedestrian walking speed (ft/s)	S_p =	3.5	S_p =	3.5
t_s = pedestrian start-up and end clearance time (s)	t_s =	3.0	t_s =	3
V = vehicular hourly volume (veh/hr)			V =	640
v_p = pedestrian flow rate (ped/s)	v_p =	0*	v_p =	0.00
v = vehicular flow rate (veh/s) = V/3600	v =	V/3600	v =	0.178
W_c = crosswalk width (ft)	W_c =	8.0	W_c =	6.0
N = number of through lanes crossed (Integer)	N =	INT(L/11)	N =	1

*no platooning observed

Crossing 2:

(only used for two-stage crossings)

Evaluation Inputs:

	defaults:		Input Table:	
L = crosswalk length (ft)			L =	
S_p = average pedestrian walking speed (ft/s)	S_p =	3.5	S_p =	
t_s = pedestrian start-up and end clearance time (s)	t_s =	3.0	t_s =	
V = vehicular hourly volume (veh/hr)			V =	
v_p = pedestrian flow rate (ped/s)	v_p =	0*	v_p =	0.00
v = vehicular flow rate (veh/s) = V/3600	v =	V/3600	v =	0.000
W_c = crosswalk width (ft)	W_c =	8.0	W_c =	
N = number of through lanes crossed (Integer)	N =	INT(L/11)	N =	

*no platooning observed

Crossing Treatment Yield Rate

	Input Table:	
M_y = motorist yield rate (decimal)	M_y =	97%

Entering data into the tables above will populate the evaluation tables in Microsoft Excel.

Results:

Average Delay	**2.8**	**sec/ped**
LOS	**A**	

Appendix B

Table 1: Application of pedestrian crash countermeasures by roadway feature

Table 1 provides initial countermeasure options for various roadway conditions. Each matrix cell indicates possibilities that may be appropriate for designated pedestrian crossings. Not all of the countermeasures listed in the matrix cell should necessarily be installed at a crossing.

For multi-lane roadway crossings with vehicle AADTs exceeding 10,000, a marked crosswalk alone is typically insufficient (Zegeer, 2005). Under such conditions, more substantial crossing improvements (such as the refuge island, PHB, and RRFB) are also needed to prevent an increase in pedestrian crash potential.

Table 1. Application of pedestrian crash countermeasures by roadway feature.

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5 7 9	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 9	① ❸ 5 8 ❾	① ❸ 5 ❼ 8 9	① ❸ 5 8 ❾	① ❸ 5 8 ❾
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ ❼ 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 8 ❾

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)**

Refer to Chapter 4, 'Using Table 1 and Table 2 to Select Countermeasures,' for more information about using multiple countermeasures.

***It should be noted that the PHB and RRFB are not both installed at the same crossing location.*

This table was developed using information from: Zegeer, C.V., J.R. Stewart, H.H. Huang, P.A. Lagerwey, J. Feaganes, and B.J. Campbell. (2005). Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines. FHWA, No. FHWA-HRT-04-100, Washington, D.C.; FHWA. Manual on Uniform Traffic Control Devices, 2009 Edition. (revised 2012). Chapter 4F, Pedestrian Hybrid Beacons. FHWA, Washington, D.C.; FHWA. Crash Modification Factors (CMF) Clearinghouse. http://www.cmfclearinghouse.org/; FHWA. Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE). http://www.pedbikesafe.org/PEDSAFE/; Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.; Thomas, Thirsk, and Zegeer. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington, D.C.; and personal interviews with selected pedestrian safety practitioners.

Appendix C

Cost Estimates

Opinion of Probable Cost - Preliminary Cost Estimate

Aberdeen St Pedestrian Crossing

Blaine, MN

4/23/2021

BOLTON & MENK
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Item		Unit	Total Qty	Unit Price	Total Cost
MAJOR ROADWAY ITEMS					
	REMOVE BITUMINOUS PAVEMENT	SY	60	$ 12.00	$ 800
	REMOVE CONCRETE WALK	SF	40	$ 2.00	$ 100
	REMOVE CURB AND GUTTER	LF	60	$ 5.00	$ 300
	AGGREGATE BASE (CV) CLASS 5	CY	15	$ 22.00	$ 400
	SELECT GRANULAR EMBANKMENT (CV)	CY	15	$ 19.00	$ 300
	CURB AND GUTTER B618	LF	100	$ 25.00	$ 2,500
	4" CONCRETE WALK	SF	590	$ 17.00	$ 10,100
	CONCRETE PEDESTRIAN RAMP	EACH	3	$ 1,500.00	$ 4,500
	MOBILIZATION	LS	1	$ 5,000.00	$ 5,000
	TRAFFIC CONTROL	LS	1	$ 5,000.00	$ 5,000
	SIGNING	EACH	8	$ 350.00	$ 2,800
	CROSSWALK STRIPING	SF	144	$ 7.00	$ 1,100
	Subtotal				**$ 33,000**
	All Roadway Construction Subtotal				**$ 33,000**
PRECENTAGE ITEMS					
	MISC REMOVALS (CURB, SIGNS, TREES, ETC.)	5%		of all roadway	$ 1,700
	TURF ESTABLISHMENT AND EROSION CONTROL	5%		of all roadway	$ 1,700
	CONTINGENCY FOR MISSING ITEMS	15%		of all roadway	$ 5,000
	Subtotal				**$ 8,000**
				Construction Cost (2021 Dollars)	$ 41,000
				Engineering Cost (2021 Dollars)	$ 14,350
				Total Construction Cost (2021 Dollars)	**$ 55,350**

Opinion of Probable Cost - Preliminary Cost Estimate

Ulysses St Pedestrian Crossing: RRFB Option

Blaine, MN

4/23/2021

BOLTON & MENK
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	Item	Unit	Total Qty	Unit Price	Total Cost
MAJOR ROADWAY ITEMS					
	REMOVE BITUMINOUS PAVEMENT	SY	120	$ 12.00	$ 1,500
	REMOVE CONCRETE WALK	SF	560	$ 2.00	$ 1,200
	REMOVE CURB AND GUTTER	LF	40	$ 5.00	$ 200
	COMMON EMBANKMENT (CV)	CY	40	$ 17.00	$ 700
	AGGREGATE BASE (CV) CLASS 5Q	CY	30	$ 22.00	$ 700
	SELECT GRANULAR EMBANKMENT (CV)	CY	40	$ 19.00	$ 800
	CURB AND GUTTER B424	LF	705	$ 25.00	$ 17,700
	4" CONCRETE WALK	SF	1,480	$ 17.00	$ 25,200
	CONCRETE PEDESTRIAN RAMP	EACH	2	$ 1,500.00	$ 3,000
	PATCH BITUMINOUS TRAIL	SF	150	$ 5.00	$ 800
	MOBILIZATION	LS	1	$ 5,000.00	$ 5,000
	TRAFFIC CONTROL	LS	1	$ 7,500.00	$ 7,500
	SIGNING	EACH	10	$ 350.00	$ 3,500
	CROSSWALK STRIPING	SF	144	$ 7.00	$ 1,100
	Subtotal				$ 69,000
	All Roadway Construction Subtotal				**$ 69,000**
SPECIAL LUMP SUM CONSTRUCTION ITEMS					
	RRFB	LS	1	$ 40,000.00	$ 40,000
	Subtotal				**$ 40,000**
PRECENTAGE ITEMS					
	MISC REMOVALS (CURB, SIGNS, TREES, ETC.)	2%		of all roadway	$ 1,100
	TURF ESTABLISHMENT AND EROSION CONTROL	5%		of all roadway	$ 3,500
	CONTINGENCY FOR MISSING ITEMS	15%		of all roadway	$ 10,400
	Subtotal				**$ 15,000**
				Construction Cost (2021 Dollars)	$ 124,000
				Engineering Cost (2021 Dollars)	$ 37,200
				Total Cost (2021 Dollars)	**$ 161,200**

Opinion of Probable Cost - Preliminary Cost Estimate

Ulysses St Pedestrian Crossing: HAWK Option

Blaine, MN

4/23/2021

BOLTON & MENK
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	Item	Unit	Total Qty	Unit Price	Total Cost
MAJOR ROADWAY ITEMS					
	REMOVE CONCRETE WALK	SF	560	$ 2.00	$ 1,200
	REMOVE CURB AND GUTTER	LF	40	$ 5.00	$ 200
	COMMON EMBANKMENT (CV)	CY	43	$ 17.00	$ 800
	AGGREGATE BASE (CV) CLASS 5Q	CY	3	$ 22.00	$ 100
	CURB AND GUTTER B424	LF	40	$ 25.00	$ 1,000
	4" CONCRETE WALK	SF	620	$ 17.00	$ 10,600
	CONCRETE PEDESTRIAN RAMP	EACH	2	$ 1,500.00	$ 3,000
	PATCH BITUMINOUS TRAIL	SF	150	$ 5.00	$ 800
	MOBILIZATION	LS	1	$ 5,000.00	$ 5,000
	TRAFFIC CONTROL	LS	1	$ 2,500.00	$ 2,500
	SIGNING	EACH	2	$ 350.00	$ 700
	CROSSWALK STRIPING	SF	144	$ 7.00	$ 1,100
	Subtotal				**$ 27,000**
	All Roadway Construction Subtotal				**$ 27,000**
SPECIAL LUMP SUM CONSTRUCTION ITEMS					
	HAWK SIGNAL SYSTEM	LS	1	$ 150,000.00	$ 150,000
	Subtotal				**$ 150,000**
PRECENTAGE ITEMS					
	MISC REMOVALS (CURB, SIGNS, TREES, ETC.)	2%		of all roadway	$ 500
	TURF ESTABLISHMENT AND EROSION CONTROL	5%		of all roadway	$ 1,400
	LANDSCAPING/STREETSCAPE	5%		of all roadway	$ 1,400
	CONTINGENCY FOR MISSING ITEMS	20%		of all roadway	$ 5,400
	Subtotal				**$ 9,000**
				Construction Cost (2021 Dollars)	$ 186,000
				Engineering Cost (2021 Dollars)	$ 37,200
				Total Cost (2021 Dollars)	**$ 223,200**